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## **Vorwort**

Das zweite Alumni-Netzwerk-Treffen in Ägypten im Herbst 2000 fand in St. Katherine (Sinai) statt. Die Tagung verfolgte wie im vorangegangenen Jahr zwei Hauptziele:

Weiterführung des Gedankenaustausches zwischen deutschen und ägyptischen Wissenschaftler/Innen bzw. Vertretern aus der Region und Vertiefung derselben, auch auf der Ebene der Bildungsinstitutionen.

Aus- und Weiterbau des gemeinsamen Inter-Alumni-Netzwerks GEAR in Ägypten.

Das Thema des Symposiums :

Zukunft der Landwirtschaft in Ägypten: Herausforderungen der Wissenschaft, Wirtschaft und Gesellschaft

wurde nicht zuletzt auf der Basis der Erfahrungen und Wünsche der Teilnehmer/Innen des vorangegangenen Symposiums etwas breiter gefasst, um die Möglichkeit einer optimalen Beteiligung zu ermöglichen. So sind in diesem Band 25 Beiträge veröffentlicht in den Gruppen: Animal Production, Plant Production, Socio Economics, University Staff Development, Natural Resources, Veterinary Medicine und Soil Science.

Die Seminarsprachen waren Englisch, überwiegend Deutsch und gelegentlich Arabisch. Der bewährte Ablauf des Treffens wurde beibehalten, so wurden auch in St. Katherine im ersten Teil der Veranstaltung im Plenum und in Gruppen die wissenschaftlichen Beiträge der TeilnehmerInnen dargestellt und diskutiert. In der zweiten Hälfte der Tagung wurden Gruppen aus gemischten wissenschaftlichen Disziplinen gebildet, die den Ausbau und die Weiterführung des Netzwerks erörterten.

Die Ergebnisse des Netzwerk Workshops sind hier nicht dargelegt, sie sind größtenteils auf der Webseite des Gear Netzwerks, unter (<http://www.gear-network.de>) zu finden. Im Rahmen des GEAR Netzwerkprogrammes spielt das Internet eine zentrale Rolle im Informationsaustausch zwischen den Netzwerkmitgliedern. Um eine verstärkte Nutzung der internetbasierten Dienstleistungen innerhalb des Gear Netzwerks anzuregen, fand im Vorfeld des 2. Symposiums ein Kurs in den Räumen des Computerzentrums der Universität Cairo statt.

Der vorliegende Tagungsband, der in der Schriftenreihe „Beihefte zu Der Tropenlandwirt, Journal of Agriculture in the Tropics and Subtropics“ als Beiheft Nr. 71 erscheint, ist mit der finanziellen Unterstützung des Deutschen Akademischen Austauschdienst (DAAD) entstanden, wofür herzlich gedankt wird.

Besonderer Dank gebührt Frau Prof. Dr. Hala Aref und ihren ägyptischen Kolleginnen und Kollegen, die die Organisation des Symposiums in St. Katherine tatkräftig unterstützt haben.

Danken möchten wir den Autorinnen und Autoren für ihre Beiträge, die in diesem Band überwiegend in Englisch erscheinen.

Die gute Zusammenarbeit der Agrarfakultäten der Universitäten Cairo, Göttingen und Kassel bilden die Grundlage für die Kooperation mit den Universitäten im ägyptisch-arabischen Sprachraum. In St. Katherine haben nahezu 180 Ägypterinnen und Ägypter aus 12 Universitäten des Landes und ein Jordanier an dem Symposium cum Workshop teilgenommen.

Dieser Band wäre ohne die tatkräftige Unterstützung von Frau Judith Specht und Herrn Dr. Amini nicht erschienen.

Die Herausgeber  
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## ***Animal Production (Group Scarabaeus)***

### **Possibilities to Expand Sheep Production by Crossbreeding**

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#### ***Introduction and Background***

Population in the developing regions is expected to grow from about 4 billion at present to 7 billion by 2025 with the majority (4.4 billion) in Asia (United Nations, 1988). By 2025 the majority of people in the developing regions will be urban dwellers (Sub Sahara Africa 54%; Asia 56%; West Asia and North Africa 75%; Latin America and the Caribbean 84%). The projected average annual growth rate for per capital income in the developing countries is about 3.5%. Based on these projections for population, urbanisation and income, it has been predicted that in most developing countries, food consumption will increase and there will be a shift in diets from staple grain to livestock.

Small ruminants form an integral and important component of the pattern of animal production in many parts of the Tropics and Subtropics. Sheep are widespread and a characteristic feature of their production is that they are essentially reared in a complex of production systems on small farms.

In terms of food supply, many countries are very dependent on imports. The imbalance between demand and local supply is especially evident in parts of the livestock sector.

It is possible to increase local sheep production by

- a) increasing the size of the national flock,
- b) increasing productivity by crossing local sheep with imported breeds, especially for certain production systems,
- c) improving the feedstuff, and
- d) control of diseases.

The first part of the study consists of an overview of the world sheep population describing the development of the sheep population.

#### **World Sheep Population**

In the last forty years, as reported by FAO (2000) in Table 1, the sheep population in Africa has increased continuously from 135 million to 240 million and in Asia has from 232 million (1961) to 413 million (1999). In a comparison of Asia with Africa in the last twenty years, the sheep population in Africa increased by 31%, and in Asia by 25%. North America, South America and Oceania have had a negative development of sheep population over the last twenty years. Europe has had a slight increase by 12%.

**Table 1: Sheep stocks according to Continents and selected Countries  
(FAO 1961-2000)**

	1961	1981	1999	Development 1999:1961 %	% in World stocks in 1999 %
	in 1000 pces				
<b>World</b>	<b>994072</b>	<b>1110355</b>	<b>1068669</b>	<b>107,50</b>	<b>100</b>
<b>Africa</b>	<b>135126</b>	<b>183780</b>	<b>240342</b>	<b>177,87</b>	<b>22,49</b>
Egypt	1552	2100	4400	283,51	0,41
Jordan	528	1073	2000	378,79	0,19
Sudan	7848	18107	42500	541,54	3,98
Tanzania	2986	3772	4150	138,98	0,39
Tunisia	5116	4734	6600	129,01	0,62
<b>Asia</b>	<b>232092</b>	<b>329605</b>	<b>412608</b>	<b>177,78</b>	<b>38,61</b>
China	61640	106627	127163	206,30	11,90
India	40223	46420	57600	143,02	5,39
Syria	2901	10504	15000	517,06	1,40
Palestine: Gaza Strip & West Bank		248	376		0,04
<b>Europe</b>	<b>133973</b>	<b>137109</b>	<b>154256</b>	<b>115,40</b>	<b>14,43</b>
EU:15 Countries	90733	78420	115187	126,95	10,78
Germany	3052	3217	2298	75,29	0,22
Greece	9353	8048	9290	99,33	0,87
UK	29070	21604	44656	153,62	4,18
<b>North &amp; Central America</b>	<b>39335</b>	<b>20044</b>	<b>15150</b>	<b>38,52</b>	<b>1,42</b>
USA	32725	12947	7238	22,12	0,68
Mexico	5853	6567	5900	100,80	0,55
<b>South America</b>	<b>118441</b>	<b>105284</b>	<b>80594</b>	<b>68,05</b>	<b>7,54</b>
Argentina	50150	31418	14000	27,92	1,31
Brazil	14000	19054	18300	130,71	1,71
<b>Oceania</b>	<b>201150</b>	<b>204298</b>	<b>165718</b>	<b>82,39</b>	<b>15,51</b>
Australia	152678	134407	119600	78,33	11,19
New Zealand	48462	69884	46100	95,13	4,31

Table 1 shows that in 1999 high proportion of 38.61% of world sheep population is concentrated in Asia. The other continents are Africa 22.49%, Europe 12.52%, North & Central America 1.42%, South America 7.54% and Oceania 15.51%. The population of small ruminants in the developing countries accounts about 56% of the world total compared to about 38% in developed countries, again this implies the important role of small ruminants in developing countries.

### **Constraints to Small Ruminant Production**

Small ruminant production systems in the developing countries have not reached their full potential, therefore, there is a lot of opportunity for improvement of small ruminant production systems. The establishment of more intensive production systems can lead to increased production. However, before the systems are expanded, it is important to discuss the constraints, possibilities and implications.

Small ruminant production systems are complex. These systems are affected by inter-related biological and non-biological environment factors. The biological factors include genetic potential and resources, nutrition and animal health. Non-biological factors are:

- the economic factors of capital, price, labour, land tenure and demand,
- institutional factors such as education, research and extension services and
- social factors such as attitudes, beliefs and norms.

The relative importance of these constraints for small ruminant production systems varies. A full understanding of the complexity of small ruminant production systems is necessary in order to predict the consequences of change. Intensification with higher inputs is not always economical, if the small ruminants cannot respond with higher outputs. However, most small ruminants in developing countries survive in harsh climate, endemic diseases and poor feeding by a process of adaptation that combines tolerance with lower productivity.

The establishment of more intensive production systems needs to improve the genetic resources. There are three possible solutions to the problem of breeding small ruminants with improved genetic resources for productivity:

- selection of the most productive animals from indigenous animals,
- introduction of exotic breeds and
- cross breeding between indigenous and exotic breeds (up-grading).

In the following part examples of crossbreeding programmes for sheep for improving the genetic resources are introduced:

- crossbreeding object in Malaysia
- crossbreeding object in Germany
- possibilities for a crossbreeding programme for intensive production systems

### ***Crossbreeding Object in Malaysia<sup>1</sup>***

Many tropical countries have tried to import a large number of temperate sheep to crossbreed with their local breeds in order to increase the body size and possibly improve the reproductive capabilities.

Even in Malaysia, since 1955 genetic improvement by crossbreeding with more productive imported temperate and other tropical breeds has been attempted. Crossbreeding of local sheep with highly productive exotic breeds of temperate climates did not produce the initially expected high rates of productivity. The imported wool breeds has been hit by high rates of mortality and by low reproductive performance among the surviving adults. The poor adaptability of animals to the Tropics is due to the heat stress. Additionally, there is the typical low quality of the local forage resources and extreme levels of ecto- and endoparasitic burdens. Most of the local sheep breeds were originally not indigenous to the region and are characterised by a low level of productivity under the given conditions of breeding in the humid tropics.

Therefore, the University of Malaysia has imported hair sheep and also Thai Long-tail. As hair sheep are indigenous mainly to the humid tropics of West Africa since early domestication, they show high productive adaptability under the constraints of tropical animal breeding. Thai Long-tail is believed to originate from Myanmar, previously known as Burma (Mukherjee 1999). The Thai Long-tail is a large sheep with low incidence of twinning. This breed has been introduced into Malaysia and used for crossbreeding to increase body weight.

The Malaysia Peninsula stretches from NW to SE over 700km ranging from 6°30' N to 1°20'N and is 300 km at its widest. The core of the country is mountainous with steep, heavily forested slopes rising from very flat coastal and ravine lowlands. Two thirds of the land lie above 200m altitude with a maximum of 2,100m. Its typical hot and wet

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<sup>1</sup> Afewerki, A. 1999: The role of sheep keeping in Malaysia. Thesis, Dept. of International Animal Husbandry, University of Kassel

equatorial climate has an annual range of temperature that does not exceed 15°C with the diurnal ranges typically greater than that, i.e. the mean daily temperature variations are greater than the difference between the temperature means of the warmest and coolest months of the year. The mean daily range of temperature is less than 11°C and the absolute minimum and maximum temperatures observed are 17.8°C and 36.7°C respectively.

### **Breeding Object Cameroon with Thai Long-tail**

The aim of this investigation was to develop a synthetic hair sheep, which adapted well in the humid tropics, by crossbreeding imported hair sheep (Cameroon) and wool sheep (Thai Long-tail from Thailand):

#### **Hair sheep (Cameroon) x Thai long-tail sheep (Thailand)**

The breeding work carried out had two objectives:

- to introduce a nucleus flock of hair sheep crosses as a basis for the foundation of a synthetic breed
- The scheduled production of animals arranged in groups of genotypes differing in their hair sheep blood percentage as needed for the experiments of the various sub-projects.

The breeding plan was based on the assumption that the inheritance of the hair coat follows a dominant mode. The dominant mode is based on the effect of a major gene (N) whose expression is altered in the presence of modifying factors. As a result, the production of F<sub>1</sub> by crossing Thai Long-tail with Cameroon and their subsequent inter-mating was the premise for a large F<sub>2</sub> generation. The identification of the homozygotes and selection for growth performance above the average from the second generation onwards represented the initial steps for the foundation of the synthetic breed with combined improved growth performance and desirable coat characteristics.

As soon as the first male F<sub>1</sub> rams had reached breeding maturity, the University of Malaysia arranged for extension workers who gave the rams to the village farmers. In the district of Kuala Langat were those identified who were able to guarantee that the hair sheep crosses produced in their farms would be managed separately.

### **Results**

The hair sheep F<sub>1</sub>-crosses produced, as this project shows, terms of weight and body conformation which were comparable to that of wool breeds. Although this level of performance is partly due to hybrid effect, which will eventually be lost with further crossing, it can be assumed that such losses will be compensated by selection and other advantages which hair sheep crosses seem to possess (Mukherjee, 1994). All in all, the small body size Cameroon crosses show compact body conformation and hence possess meat type characteristics that are desirable for a meat sheep. Furthermore the small body size is produced by males and females which do not differ much in their performance and therefore masks an outstanding performance of crossbred females compared to pure-bred ewes. As the same time, the crosses show an advantage expressed in high daily weight gains if subjected to adverse environments such as grazing under tropical climate and forage conditions. Best performance under such conditions shows an improved productive adaptability of crosses compared to wool sheep.

The superior performance of the ewes was well recognised by local farmers who showed interest in purchasing crossbred ewes. Mating them to Dorset Malin or Long-

tail rams would produce back cross offspring forming a pool from which the farmers could select their replacement stock with combination of desired characteristics (Sivaraj, 1994).

Nutritional and parasitological studies imply that the performance of hair sheep crosses is based on the ability to produce better growth rates than wool sheep subjected to low quality forage, especially under grazing management. Secondly, the hair sheep crosses seem to show obvious lower infection rates than wool sheep under a given endoparasite burden as typical for the humid tropics (Pendey, 1993).

Therefore, the results of this study indicated that the attention that hair sheep have recently gained in breed evaluation programmes for the Tropics is fully justified. The genetic potential which hair sheep hold, has to be recognised and their importance for the improvement of sheep production and imminently for the protein supply of the increasing population has to be acknowledged.

## ***Crossbreeding Object for Hair Sheep in Germany***

### **Problems of the international wool market**

The number of sheep in the EU has remained the same since 1987. The number of sheep in Germany has declined for years, since 1995/96 annually up to 10%. Supply of mutton and lamb from home reserves has fallen accordingly from 77,1% in 1990 to 47.9% in 1999. The reasons for the decline in sheep keeping are the unsatisfactory price development (currently 6,50 - 7,00 DM/kg warm slaughter weight), especially (Fig. 1) due to the heavy fall in wool prices (0,50 DM/kg raw wool in 1998). During the same time the market inflection of the high grade, synthetic textiles are rising steadily. It is only fine wool (fibre <20 $\mu$ ) that can still be marketed. Wool of this quality cannot, however, be produced by the most sheep breeds for known reasons.

*Fig. 1: Wool price development in Germany<sup>2</sup>*

The majority of sheep keepers only produce crossbred wools of inferior quality or coarser wools which cannot be marketed. Wool has therefore now turned from being a desired by-product to being an unwanted waste product. The increasing expenses for care of wool, its shearing and the sale cause a considerable decrease in profit margin. On the basis of a long well known development there has been intensive research for other uses for wool such as insulation. However, the wool must be processed for this purpose with chemicals to hinder the natural process of rotting and especially as a protection against parasites (insects and mice), which is very costly. Scepticism is justified as far as costs are concerned when a comparison of insulating and sound-proofing materials is made with commonly used materials with regard to its durability and insulating efficiency.

### **Wool does not only give the sheep an advantage**

Shepherds in the past have known for a long time that the fleece only has two advantages; firstly this could be sold and secondly it protects the sheep against the extreme cold. These two advantages, the first of which has already disappeared over the last few years, face disadvantages. The change due to the selection of breeding in the natural conditions of the secondary to the primary hair follicles from 2:1 in the direction of 20:1 is unnatural and affects the welfare of the sheep, not only in hot summers. Ewes feel better without wool and move around more. Should the sheep be exposed

<sup>2</sup> The figure is only available in the print copy (Beihefte zu Der Tropenlandwirt Nr. 71)

to continual rain, the fleece soaks up the water and becomes full of algae. The consequences are pneumonia and parasites. The wet and cold fleece is often the reason for the ewes not becoming pregnant. This really points to wool being rather a hindrance to the sheep.

### **Efficient hair sheep can solve the problem**

Sheep breeders in Germany are to reach a decision in the coming years whether it should keep the dual-purpose type (meat and wool) or cross bred part of the simple and coarse wool sheep stocks (fibre thickness  $>25 \mu$ ) to the single-purpose sheep type (meat). Hair sheep serve the purpose of meat production only as compared to wool sheep. They do not grow a wool fleece, but show a short hair coverage like wild sheep with a ratio of secondary to primary follicles of 2:1 (wool sheep up to 25:1). Similar to wild sheep they carry a pelt in the summer of smooth upper hair and grow a winter pelt in late autumn with sufficient undergrowth wool. Hair sheep change their hair each spring. The costs for shearing and the expenses for the wool care are therefore nil.

The argument that the wool fleece puts the sheep into a position to be kept outdoors all the year with a minimum of indoor care, is to be invalidated in this connection because hair sheep grow a short thick fleece in cold winters as do primitive domesticated sheep and wild sheep. This coat is shed during the spring change of hair.

Today hair sheep number about 10% of the world sheep stocks; population is growing. Most hair sheep are in the Tropics but there are some hair sheep breeds in Europe and Euro-Asia which are adapted to moderate climate and local conditions. In the USA there have been, for a few years now, genetically consolidated and recognised hair sheep breeds.

### **The Nolana Sheep Breeding Project**

The project became realistic on a broad and solid basis in the Spring, 1998. In co-operation with the Department of International Animal Husbandry of the University of Kassel with the Faculty of Agriculture in Osnabrück, the Chamber of Agriculture in Hanover, the University of Göttingen, the College of Veterinary Science in Hanover, the Federal Institute for Agriculture in Köllitisch in Saxony and the State Education and Research Institute for Cattle Husbandry and Forage Farming Aulendorf as well as with many private sheep keepers, the building up of a nucleus herd of Nolana sheep has began. With the Nolana sheep, a sheep for meat production and landscape management as well as a sheep which is suitable, robust, efficient and fertile is to be bred. High grade material from the breeds Wiltshire Horn, Dorper, Barbados and other suitable hair sheep breeds are to be crossbred into wool sheep herds under a controlled method. The genetic variety in the sheep breeds will be used today in the best economic way with Nolana hair sheep for meat production and in landscape management. Due to the prices for meat and wool Nolana sheep extend the current breeding spectrum, offer sheep keepers an additional alternative and can give new impulses to sheep breeding in Germany and neighbouring countries.

The Department of International Animal Husbandry in Witzenhausen has already started co-operating with sheep keepers in the region on a crossbreeding programme. A hair buck of the robust Wiltshire Horn breed from England has been crossed with German Black Head herds (Schwarzkopf). The lambs of the first generation are under investigation for quality control.

## Wiltshire Horn (England) x Black Head (Germany)

### Summary of goals of the Nolana hair sheep project

- New positive impulses for improving the decline in sheep keeping in Germany
- Provision of breeding animals of the robust and fertile Nolana hair sheep breed for meat production and landscape management
- Extension of crossbreeding to the existing flocks of the interested sheep breeders
- Development of sheep breeding and keeping under economic viewpoints
- Conservation and promotion of sheep in landscape management and protection of the agro-ecological environment

Crossbreeding plan (Fig. 2 ):

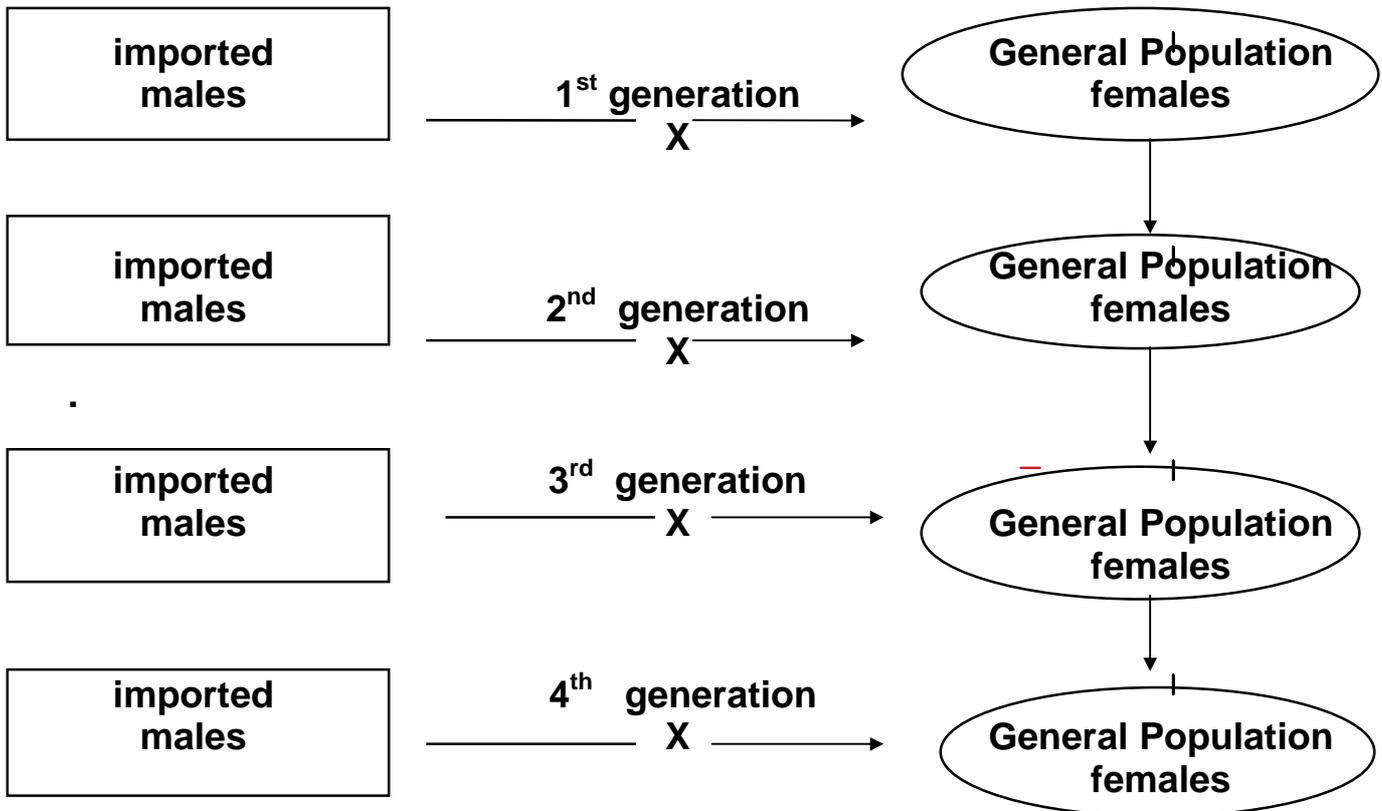
- Hair-meat-sheep breed as male line:  
Wiltshire Horn, Dorper, Barbados
- Wool-meat-sheep breed (local sheep) as female line:  
Black Head meat sheep, White Head sheep, Merino-sheep

**Table 2 : A comparison of wool and hair sheep (Minhorst, 1999)**

<b>Wool sheep</b>	<b>Hair sheep</b>
Wool fleece	Short hair cover, no wool
Shearing 1x/annually (Animal Protection Laws)	No shearing necessary for short hair, no woollen fleece
Very good meat production performance	Meat performance is lower
Satisfactory good meat quality	Very good meat quality, often dark meat with game character
Fat coverage mainly in acceptable areas	Only small, often no fat coverage
Good fertility	Very high fertility
Dark skin pigmentation only in certain breeds	Dark skin pigmentation in nearly all breeds
Very often foot problems	Few foot problems

Comparative performances of the wool and hair type sheep is shown in table 2.

Fig. 2: Crossbreeding Plan



### ***Possibilities for Crossbreeding Programmes for Intensive Sheep Systems***

In countries, where the sheep has significant value for meat production, such as the Near East, where the sheep are wool-type and fat tailed-type the questions are:

- What value has the wool production for the animal keeper and for the consumer?
- What value has the fat in the tail region of the animal and for the animal keeper and for the consumer?

For the small holder and direct live market to the consumer the wool sheep with the fat tail has traditional value. The existing husbandry management systems in many countries are normally the result of hundreds of years of traditional husbandry. On the large intensive farms near large cities, especially where the sale of meat is through the butcher, the above mentioned questions are very important. Sheep are intensively indoor-fed and the costs of feeding are significant factors for profitability of the production. Sheep production plays an important role as an income generating activity. The major local breeds in many parts in Africa and Asia are wool-fat-tail sheep, which are widely distributed in the Subtropics.

The following factors are prerequisite for economic improvement of sheep production systems:

- Increase in average production by improving the management systems so that the genetic potential of the animals may be expressed as fully as possible.
- Improve the genetic potential of the stock population by the introduction of new genotypes by crossbreeding.

Consequently, it will of a great interest in introduction of crossbreeding programme with new genotypes, for example

- meat hair sheep or
- meat sheep with thin tail or
- meat hair sheep with thin tail.

Such genetic improvement programmes must be based on crossbreeding between available local breeds as female breeding stock and imported breeds as the male breeding line. The introduction of specialised breeds with good production and reproduction performance with thin tail and also if needed, as hair sheep, may be a rapid solution for increasing the performance of the animals.

The most important factors responsible for economic return in performance include:

- litter size
- survival rate
- growth rate of lamb
- kidding interval.

It means that the selection programme need to be concentrated on the ability of ewe to produce meat per year under the local environment. These last points are to start the discussion in the group: "The Value of the wool and the fat tail for intensive sheep farm systems".

## Use of Biotechnology in Milk Production in Egypt

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Biotechnology applications in livestock production cover a wide range and vary in their nature and objectives. Biotechnology in its broad terms refers to the technology used to control or manipulate certain biological function(s) of animal as a whole or in part, applied either in vivo or in vitro. Recombinant bovine somatotropin (BST) is one of the modern technologies used to improve milk production. Bovine somatotropin, or BST, which is produced by the recombinant DNA biotechnology, has been recognized for its ability to increase milk production from dairy cows in many countries over the last decade. There is no question that BST use increase milk yield and production response, and the results obtained are varied widely.

In Egypt, some large dairy farms have used BST to increase milk yield as well as to increase their income. It is argued that large commercial dairy operations can begin using new technologies such as BST more easily, rapidly, and efficiently than smaller ones.

This brief paper addresses some of the issues that surround BST use in Egyptian dairy farms after its commercial availability. Specifically, the focus of our inquiry is on, has this technology been profitable and productive at the farm level? Is the BST an economically feasible technology?

**Keywords:** recombinant bovine somatotropin, adoption, profitability, economic feasibility, Egypt

Bovine somatotropin is a naturally occurring (protein) hormone produced in cattle and all species of animals, by the pituitary gland. This hormone is important for growth, development, and other body functions of animals ( Butler, 1999). In the 1930's, it was discovered that injecting extracted BST into lactating cows could increase milk production. In the late of 1970's, Bauman, successfully transferred the gene responsible for BST production to a bacterium. The resulting product was called recombinant bovine somatotropin, BST. Simple multiplication of the bacterium meant that BST could easily be produced in commercial quantities at reasonable cost Though BST is a peptide hormone and not a (much-maligned) steroid hormone (Butler, 1999). The basic findings of BST were as follows:

- Using recombinant bovine somatotropin, could cause a 10-20% increase in milk yield and accordingly increases milk efficiency. It also decreases the feed costs per unit of milk produced by reducing the needed maintenance feed ( Butler, 1999).
- Using recombinant bovine somatotropin, seems to be safe for both human milk consumption and cows because of its nature as a protein

It took until November of 1993 to gain Food and Drug Administration (FDA) approval, and it was not released commercially until February of 1994.

### ***Use of BST in Developing Countries:***

The first trial with BST in the tropics was carried out by Ludri and his colleagues in 1989 in India with milking Buffalo. In Africa, Phipps et al (1997) suggested that BST increased total milk production in Zimbabwe (Fig.1). Further trails have been carried in Gambia (Fig. 2) and Kenya (Fig. 3)<sup>3</sup>.

### ***Use of BST in Egypt:***

In Egypt, BST was approved in 1996 and was used commercially in two large private dairy farms at the end of the same year. Starting from the year of 1997, the number of dairy farms that adopted BST technology has linearly increased being nine dairy farms and accordingly the number of cows injected with BST which also increased to be 2000 lactating cows by the year 1998.

Thereafter, the treated cows with BST, in Egypt, has dramatically decreased reaching to the lowest number being 500 cows (Fig.4). Seven farms were stopped to use BST which may be due to the following reasons

- 57% of the dairy farms claims from its negative effect on reproduction, including increase of the days open, increase number of services per conception and lowering the conception rate.
- 29% suggested that there is no significant economical return with using BST as a result of low production response to the BST and low milk price.
- 14% observed that using BST did not increase milk production compared with the untreated cows.

*Figure 4: Number of BST treated cows from 1996 to 2000 in Egypt*

Nowadays, the controversy surrounding the use of BST in Egypt that has existed since 1996, health of animals treated with BST. Therefore, the researchers in Egypt, conducted the first trail about the using of BST in commercial herds under the Egyptian condition and its effects an milk yield, reproduction and animal health (El-Ghandour, 2000).

The main results of this study could be summarized as follows:

The overall average percentage increase in milk yield that resulted from BST treatment found in this study is in line with the average increase of 10-20 % reported in many trials such as the study conducted in Egypt by El-Harairy (2000) on Holstein cows. The magnitude of increase in milk yield in this study was, however, significantly larger in early treated (starting on day 65 postpartum) than in later treated cows (starting on day 105 postpartum). Such difference would be mainly a function of the length of time during which cows were subjected to treatment.

The finding that multiparous cows had significantly higher response to BST (percentage increase in milk yield) than primiparous cows is of great interest. Part of this difference may be related to the relatively limited udder capacity for milk synthesis in primiparous than multiparous cows. Primiparous cows also have less available nutrients for increased milk synthesis, with a significant part of the available nutrients being directed to continue growth, as compared to the situation in the more mature multiparous cows. This finding is of practical importance, as it may be recommended, accordingly, to limit the use of BST to multiparous cows in order to achieve higher economic efficiency of the treatment.

<sup>3</sup> The figures and tables are only available in the print copy (Beihefte zu Der Tropenlandwirt Nr. 71)

One of the most interesting results in the study conducted by El-Ghandour (2000) is the discrepancy in the response to BST treatment due to the level of milk yield, with the high yielders showing higher response to treatment, being almost three times higher than the response obtained in low producers (22 v. 6%). Such finding which, to our knowledge, has not been reported elsewhere, has serious practical impact, with the recommendation to limit the use of BST to high and medium-producing animals only, to achieve highest economic efficiency of the treatment. This was illustrated clearly in the economic analysis conducted (Table 1), where the treatment of low producing cows did not seem to be profitable, since the small increase in milk yield obtained did not cover the cost of treatment itself. This finding also raises an important question, whether BST treatment would be biologically and economically effective in other circumstances with low producing cattle genotypes of buffaloes? Such a question deserves an answer through future detailed studies on our local cattle breed and buffaloes.

Another interesting result that emerged from this study is the significantly higher response to BST in open cows than in those that conceived during the first eight months of lactation. This is likely to be due to the effect of gestation and the diversion of part of the available nutrients to meet the demands of the conceptus. This, however, opens the debate on "to what extent we can extend the calving interval to achieve maximum profitability in high yielding dairy cows". This question is of practical importance for commercial dairy herds. Its answer can only be achieved through future studies that should also take into account the changes in total production of a cow over its herd life time, both from milk and calves born, the possible implications of long lactation periods on cows body condition score (BCS) and health, and in turn its productivity in subsequent lactations (Aboul-Ela et al., 2000).

Unfortunately, the effect of BST on cows reproductive performance could not be studied thoroughly, mainly due to the rather poor reproductive management system applied in the herd, as indicated from the performance of all groups including the control, where about half of the cows did not get in calf for over eight months (El-Ghandour, 2000).

The lack of monensin (RM) effect on milk yield is consistent with the results of other investigations, as discussed by Aboul-Ela et al., (2000). This, however, should be taken care of in future studies to elucidate the mechanism through which RM treatment could alleviate the negative effect of BST treatment on BCS.

### ***Profitability of using BST in Egypt:***

There is no doubt that the major contributing factor for profitability with BST is the magnitude of response which is directly related to management, including cow health, feed quality and intake, water intake, cows comfort. Therefore, providing a high quality of management can optimize the profitability of BST. The other contributing factors to BST profitability are milk price, feed price, BST price, and labor costs. Since milk price is the most changeable factor, the profitability of BST was calculated as a function of milk price (ranging from 0.55 to 1.25 LE/kg) and the magnitude of response to BST. This index (Table 1) is suggested as a guide for profitability of BST under these conditions (El-Ghandour, 2000). Furthermore, milk price up to LE 0.65/kg makes it not profitable under similar conditions of response, feed, and labor costs. In addition, using BST was more profitable in high and medium producers compared with in low producers, which was not profitable.

As shown in Table 1, return on investment and, of course, profitability of BST is increased with increasing in milk price and the magnitude of lactation response to BST

treatment. Under the conditions of the study by El-Ghandour (2000), one may recommend the use of BST as a treatment to increase milk production in multiparous and in both high and medium producers cows, and to exclude primiparous and low producing cows from the treatment, in order to achieve maximum profitability. However, it should be stressed that an economic analysis should be made for each given condition, taken into account various aspects of the production process, particularly the level of milk production, the magnitude of milk yield response to treatment, and the milk price along with the cost of treatment.

*Table 1: Profitability\* of using BST as a function of milk response and price (El-Ghandour, 2000)*

## **Conclusion**

On the light of the results under Egyptian conditions, there are beneficial effects of using BST in improving milk production, however, these depend to large extent on the management system applied in the farms including nutrition, reproduction, and body condition score. Additionally, large commercial dairy operations can use modern technologies (BST) more easily, efficiently, and economically than smaller ones.

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## ***Plant Production (Group Lotus)***

### **Effect of Plant Density and Harvest Time on Cotton Seed Quality. Field Studies on Acid-delinted Cotton Seed**

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#### ***Introduction***

Acid-delinted cotton seed is the highest improved seed quality approaches introduced in Egypt. In 1998, an experiment was carried out on the cultivar Giza 87 to investigate the effect of acid-delinted seed on the plant population and their influence on the productivity of cotton at Sakha, Kafr El-Sheikh, Egypt. The results discovered that the plant population could be reduced to 30-40 thousand plants per fed. without negative effects on yield from unit area in comparison to the traditional growing pattern, that recommend  $60-70 \times 10^3$  plants per fed. Also, the yield of the first harvest was improved (Abdel-Hafez and Homeyer;1999). Moreover, further studies were carried out on the cultivar Giza 89 in another location (Abdel-Hafez;2000). The results showed that, there were not significant differences between 64,000 plants/fed and 40,000 plants/fed. So, growing 40,000 plants/fed is shown to be enough for getting the best yield/fed. This was achieved by 75 cm ridging distance and 25 cm among hills. This facilitates the culture practicing, save seed and reduce shading to encourage generative growth (fruiting) and reduce flower and capsule shedding. Also, it provides the best land use and input use efficiencies. Consequently increases seed cotton yield.

Such results are not strange, thus the breeding processes and plant improvement resulted in modern cultivars with different branching patterns and earliness. In other words the present varieties are different in one or another way from the old ones and need more suitable culture practices, e.g. in terms of planting patterns.

On the other hand, germination of cotton seed in the field and emergence of seedlings is very important factor, for encouraging the cotton growers. High quality certified cotton seed is the most important factor to reach excellent germination as well as seedling emergence, especially in the early sowing during March, under the Egyptian conditions. The quality of seed depends on several factors, e.g. seed maturity, seed purity, seed health and seed viability. Seed maturity and storage have effects on other important criterion, i.e. free fatty acid (FFA) content in its oil. The presence of high ratios of FFA in the oil of seeds adversely affects or inhibit the metabolism and germination of seed. Also, immature seeds have a much higher FFA content and the presence of immature seeds within the mature seeds could raise the FFA content.

Therefore, the present investigation was planned to study the effect of plant population and harvest time on seed quality. The obtained information will provide information to improve the quality of cottonseed in seed production process.

## **Material and Methods**

An experiment was carried out in 1999 season at El-Magd village, Rahmania, El-Behira Governorate. The soil structure is mostly silt and the soil is highly fertile. The preceding crop was Berseem (two cuts) as early winter crop. The soil was operated and  $P_2O_5$  fertilizer in form of monosuperphosphate 15.5% at the rate of 60 kg  $P_2O_5$ /fed incorporated in the soil before ridging and dividing. Also 50 kg Kalium sulfate (24 units and 18 units sulfur) was added. Three different ridge widths were used; 65 cm, 75 cm and 90 cm widths. Cotton was planted on one ridge-side in hills 20, 25 and 90 cm apart.

Planting date: April 1999:

Planting was done with special handy planter prepared for this experiment that allows only unique depth of 3 cm for the seeds.

The seeding rate:

3 different seed-numbers per hill were put. First, the control plots on ridges 65 cm wide had to ensure presence of  $64 \times 10^3$  plants per fed and therefore, four seeds were put per hill and the seedlings were thinned to leave two plants per each hill. Second, the hills were spaced 25 cm on the 75cm wide ridges and spaced 30 cm on the 90 cm wide ridges. The number of seeds in each hill in the last two planting patterns;  $75 \times 25$  cm and  $90 \times 30$  cm; differed, from the control ( $65 \times 20$  cm). Herein, only three seeds were planted in each hill and not more than two plants were left per hill after emergence. Theoretically, the number of plants per feddan within the three planting patterns was  $64 \times 10^5$  ( $60 \times 20$  cm  $\times$  2 plants),  $40 \times 10^3$  ( $75 \times 25$  cm  $\times$  1-2 plants) and  $30 \times 10^3$  ( $90 \times 30$  cm  $\times$  1-2 plants). The actual number of plants was almost 10% less than the former ones. The plants received the same normal growing culture practices.

Experimental design:

The treatments were arranged in a randomized complete block design (RCBD) with four replication. The plot size was  $7 \times 9m^2$  area in which the plot included the following number of ridges:

- 14 ridges for the planting pattern ( $65 \times 20$  cm),
- 12 ridges for the planting pattern ( $75 \times 25$  cm), and
- 10 ridges for the planting pattern ( $90 \times 30$  cm).

The two outer rows were left as guard rows and 12 central ridges were used for evaluation of the ( $65 \times 20$  cm) pattern, 3 replications were used for the determination of all the seed quality studies.

The following data were recorded on the seeds:

- 1- **Seed index first harvest:** Weight of 100 seeds in first harvest.
- 2- **Seed index second harvest:** Weight of 100 seeds in second harvest.
- 3- **Estimation of the mature/immature seed %:** An amount of 10 kg seeds from each population and harvest time were used to estimate the percentage of mature/immature seeds. The seeds were exposed to a seed blower. The airflow rate was adjusted to remove almost all the immature seeds and insect damaged seeds. However, some light mature seeds were also removed. The mature seeds were weighed

$$\text{Mature seed \%} = \frac{\text{Weight of mature seed g}}{\text{Weight of raw seed g}} \times 100$$

$$\text{Immature seed \%} = \frac{\text{Weight of immature seed g}}{\text{Weight of raw seed g}} \times 100$$

- 4- **Determination of free fatty acids (FAA) %:** The percent FFA was determined in the mature seeds after removing of the immature and insect damaged seeds obtained from the three plant populations and the two harvest times. The procedure of determination was carried out according to the quick method of the Association of official oil chemists as described by Dr. Bernhard Homeyer in the "Egyptian-German Acid Delinting for Cotton Seed Project". Bulletin. Three samples were taken from each oil stock to determine the FFA percent.
- 5- **Germination %:** Germination test of mature seeds was carried out in lab under controlled conditions. The germination test was carried out in sandy soil and in eight replications at 30°C. The seedlings were counted after five days were classified in normal seedlings and abnormal ones. Also, the not germinating seeds were assorted in dead/disease-infected seeds and not germinating seeds. Finally, the following traits were calculated.

$$\text{Germination \%} = \frac{\text{Mean No. of normal seedlings}}{\text{No. of sown seeds}} \times 100$$

$$\text{Abnormal seedling \%} = \frac{\text{Mean No. of abnormal seedlings}}{\text{No. of sown seeds}} \times 100$$

$$\text{Dead seed (infected)\%} = \frac{\text{Mean No. of dead seeds}}{\text{No. of sown seeds}} \times 100$$

$$\text{Not germinating seeds \%} = \frac{\text{Mean No. of not germinating seeds}}{\text{No. of sown seeds}} \times 100$$

Finally, the data were computed and the means were compared according to Duncan's Multiple Range Test. In some cases the data were transformed before subjecting it to statistical analyses.

## **Results**

### **1- Seed Index:**

The seed index data (Table1) showed that the plant populations used herein did not effect the seed index strongly. But, this trait was strongly affected by the harvest time. The seeds produced from the first harvest were higher in weight than that of the second harvest. This means, that second harvest produce low quality seeds, that are not suitable for cultivation. The differences in seed index between the two harvests were highly significant.

**Table (1): Mean seed index (g) of Giza 89 cotton planted with acid-delinted seed in 1999.**

Planting pattern cm	Plants/hill	Harvest (H)		Means (p)	Difference
		1 <sup>st</sup>	2 <sup>nd</sup>		
65/20 (control)	2	9.058 a	11.265 a	10.162 a	-2.208**
75/25	1-2	8.912 a	11.308 a	10.110 a	-2.396**
90/30	1-2	9.187 a	11.261 a	10.224 a	-2.074**
<b>Mean</b>		<b>9.052</b>	<b>11.278</b>	<b>10.165</b>	<b>-2.226**</b>

\*\* = Significant at 1% level.

ns = not significant.

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

Comparison	S.E.D.	LSD (5%)	LSD (1%)
2-H*P means	0.258	0.550	0.761
2-p means	0.149	0.318	0.439

## 2- Lint percentage:

The lint percentage of the first harvest was highly significantly lower than that of the second harvest (Table 2). This is mainly caused due to the high seed index in the first harvest compared to that of the second one. However, these differences were only significant in both 65/20 cm (the control treatment) and 75/25 cm plant population patterns. But, the difference was highly significant in the 90/30 cm plant population pattern that produced high seed index besides its higher yields than the control in the first harvest.

**Table (2): Mean lint percentage of Giza 89 cotton planted by acid-delinted seed in 1999.**

Planting pattern cm	Plants/hill	Harvest (H)		Means (p)	Difference
		1 <sup>st</sup>	2 <sup>nd</sup>		
65/20 (control)	2	0.362 a	0.396 a	0.379 a	-0.034 *
75/25	1-2	0.370 a	0.404 a	0.387 a	-0.034 *
90/30	1-2	0.358 a	0.399 a	0.378 a	-0.041 **
<b>Mean</b>		<b>0.363</b>	<b>0.400</b>	<b>0.381</b>	<b>-0.036 **</b>

\*\* = Significant at 1% level.

ns = not significant.

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

Comparison	S.E.D.	LSD (5%)	LSD (1%)
2-H*P means	0.013	0.029	0.039
2-H means	0.008	0.016	0.023

## 3- Mature seed %:

The mean percentage of mature seeds (Table 3) was less in the second harvest by 20.88% than that of the first harvest. Such reduction reached 25.06, 16.44 and 21.35% at the 65/20, 75/25 and 90/30 cm<sup>2</sup> plant population patterns, respectively. Also, the mature seed percentage was influenced with the plant population density/pattern x harvest time interaction. Thus the high population of 64,000 plant/fed produced the least percentage mature seeds in the second harvest. On the other hand, the 75/25 cm<sup>2</sup> planting pattern/population produced the highest mature seed percentage at each of first and second harvest compared with the other populations and their correspondent harvest time.

**Table (3): Mature seed percent as affected by the interaction of harvest time × plant population: means for mature seed % of Giza 89 cotton planted by acid-delinted seed in 1999.**

Planting pattern cm	Plants/hill	Harvest (H)		Means (p)	Difference
		1 <sup>st</sup>	2 <sup>nd</sup>		
65/20 (control)	2	77.917 c	58.394 c	68.155	19.524**
75/25	1-2	81.412 a	68.030 a	74.721	13.383**
90/30	1-2	80.357 b	63.204 b	71.781	17.153**
<b>Mean</b>		<b>79.896</b>	<b>63.209</b>	<b>71.552</b>	<b>16.686</b>

\*\* = Significant at 1% level.

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

#### 4- Immature seed %:

Opposite to the mature seed %, the immature seed percentage (Table 4) was higher by 80.67 in the seeds derived from the second harvest than that obtained in the first harvest. In respect to the plant population, different relative values of mature seeds and immature seeds were produced in the first and second harvests. The highest plant population (64,400 plants/ fed) produced the highest relative immature seeds compared to the 40,000 and 30,000 plants/fed. The lightest plant population of 30,000 plants/fed produced more immature than the intermediate plant population of 40,000 plants/fed.

**Table (4): Immature seed percent as affected by the interaction of harvest time × plant population: means for mature seed % of Giza 89 cotton planted by acid-delinted seed in 1999.**

Planting pattern cm	Plants/hill	Harvest (H)		Means (p)	Difference
		1 <sup>st</sup>	2 <sup>nd</sup>		
65/20 (control)	2	22.562 a	40.963 a	31.762	-18.402**
75/25	1-2	18.555 c	31.533 c	25.044	-12.977**
90/30	1-2	19.396 b	36.830 b	28.113	-17.434**
<b>Mean</b>		<b>20.171</b>	<b>36.442</b>	<b>28.306</b>	<b>-16.271</b>

\*\* = Significant at 1% level.

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

#### 5- Free fatty acids%:

The percentage of free fatty acids in cotton seed oil of Egyptian cotton *Gossypium barbadense* seemed to be higher than that in the upland cotton *Gossypium hirsutum*. It was ranged from 2.98 to 4.88% in our experiment Table 5. The percentage of free fatty acids differed in cottonseed oil, depending on the source of the seeds. It was higher in seeds of second harvest (second pick) than that derived from the first harvest. The difference was very high and reached 76.35% increase free fatty acids in the second harvest seed. Also, such increase was existent irrespective of the plant population density ("Pflanzendichte") in field; 70.54% at 65 × 20 cm<sup>2</sup>, 103.82% at 75 × 25cm<sup>2</sup> and 35.55 at 90 × 30 cm<sup>2</sup>.

**Table (5): Free fatty acid % in cotton seed oil as affected by interaction between harvest time and plant population: means for mature seed % of Giza 89 cotton planted by acid-delinted seed in 1999.**

Planting pattern cm	Plants/hill	Harvest (H)		Means (p)	Difference
		1 <sup>st</sup>	2 <sup>nd</sup>		
65/20 (control)	2	2.787 b	4.753 a	3.770 b	-1.966**
75/25	1-2	2.254 b	4.599 a	3.426 b	-2.345**
90/30	1-2	3.907 a	5.296 a	4.602 a	-1.389**
<b>Mean</b>		<b>2.983</b>	<b>4.883</b>	<b>3.933</b>	<b>-1.900**</b>

\*\* = Significant at 1% level.

In a column, means followed by a common letter are not significantly different at the 5% level by DMR

### 6- Germination %:

When the mature seeds produced from the first harvest were subjected to germination test, in comparison to the mature seeds produced from the second harvest, the data in table 6 showed highly significant differences among the means of the two seeds. Seeds from the first harvest which represent two thirds of the total seed yield, as presented in yield data, showed highly significantly higher germination percentage than that of the second harvest. The difference was 4.332% at 64,000 plants/fed 0.338% at 40,000 plants/fed and 13.705% at 30,000 plants/fed.

**Table (6): Germination % as affected by interaction of harvest time x Plant population: means for mature seed % of Giza 89 cotton planted by acid-delinted seed in 1999.**

Planting pattern cm	Plants/hill	Harvest (H)		Means (p)	Difference
		1 <sup>st</sup>	2 <sup>nd</sup>		
65/20 (control)	2	83.704 ab	79.373 a	81.538	4.332**
75/25	1-2	82.007 b	81.669 a	81.838	0.338 ns
90/30	1-2	85.373 a	71.668 b	78.520	13.705**
<b>Mean</b>		<b>83.695</b>	<b>77.570</b>	<b>80.632</b>	<b>6.135</b>

\*\* = significant at 1% level.

ns = not significant.

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

### 7- Number of abnormal seedlings % :

There was no significant difference. In other words, there were no significant effects for plant population or harvest time on the number of abnormal seedlings in germination tests (Table 7).

**Table (7): Abnormal seedlings % as affected by interaction of harvest time x plant population: means for mature seed % of Giza 89 cotton planted by acid-delinted seed in 1999.**

Planting pattern cm	Plants/hill	Harvest (H)		Means (p)	Difference
		1 <sup>st</sup>	2 <sup>nd</sup>		
65/20 (control)	2	5.9 a	4.2 b	5.0 a	1.7 ns
75/25	1-2	7.0 a	5.7 ab	6.3 a	1.3 ns
90/30	1-2	5.3 a	7.7 a	6.5 a	-2.3 ns
<b>Mean</b>		<b>6.1</b>	<b>5.8</b>	<b>5.9</b>	<b>0.2 ns</b>

Ns = not significant.

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

### 8- Dead seeds % and No. of non-germinating seeds:

Dead seeds exhibited disease infection instead of germinating. The mean number of dead seeds was not significantly effected by plant population. However, it was shown significantly influenced (increased) in seeds derived from the second harvest compared to the first one. Also, it was influenced by the interaction between plant population density and harvest time. Yet, the first harvest at 64,000 and 40,000 plants population densities obtained relatively significant higher relative dead seeds than the second harvest, but the opposite was obtained at the 30,000 plant population density. Moreover, the second harvest seeds showed highly significantly higher relative dead seeds than that of the first harvest (Table 8).

**Table (8): Dead seeds % as affected by interaction of harvest time × plant population: means for mature seed % of Giza 89 cotton planted by acid-delinted seed in 1999.**

Planting pattern cm	Plants/hill	Harvest (H)		Means (p)	Difference
		1 <sup>st</sup>	2 <sup>nd</sup>		
65/20 (control)	2	4.655 ab	6.610 ab	5.632	-1.955 ns
75/25	1-2	6.667 a	4.580 b	5.624	2.086 ns
90/30	1-2	2.645 b	8.292 a	5.468	-5.647**
<b>Mean</b>		<b>4.655</b>	<b>6.494</b>	<b>5.575</b>	<b>-1.839</b>

\*\* = significant at 1% level.

Ns = not significant.

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

Also, data in Table 9 show that the relative number of non-germinating seeds was significantly or highly significantly higher for seeds derived from second harvest that derived from first harvest.

**Table (9): Non-germinating seeds % as affected by interaction of harvest time × plant population: means for mature seed % of Giza 89 cotton planted by acid-delinted seed in 1999.**

Planting pattern cm	Plants/hill	Harvest (H)		Means (p)	Difference
		1 <sup>st</sup>	2 <sup>nd</sup>		
65/20 (control)	2	4.624 a	7.327 a	5.975 a	-2.703*
75/25	1-2	4.250 a	7.584 a	5.917 a	-3.334*
90/30	1-2	2.645 a	8.625 a	5.635 a	-5.980**
<b>Mean</b>		<b>3.839</b>	<b>7.845</b>	<b>5.842</b>	<b>-4.005**</b>

\*\* = significant at 1% level.

\* = significant at 5% level.

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

## Discussion

In comparison between seeds produced from the first and the second pick ("Pflücken"), seed index of seeds from the first pick was higher than that derived from the second pick. This means that seeds of the first pick are vigorous than these of the second one. Such difference was increased as the plant population was reduced. Consequently, the seeds from the first pick especially, that produced under lower plant population should be preferred for planting.

The percent of mature seed was strongly higher in seeds of first pick compared to the second one. This findings, demonstrates the importance of reserving the seeds of the

first pick for seed production as they are the better quality seeds. Also, this idea can save a lot of time and costs in seed processing to separate the immature seeds from the raw seeds. On the other side, the second pick produces higher percentages of immature seeds than the first pick, and needs more time and costs in seed processing, transportation, packages, handling, storage etc., and lastly produce less amount of mature seeds for certification. Furthermore, seeds of the second pick proved to contain higher amounts of free fatty acids in their oil, compared to the seeds derived from the first pick.

The seeds of the second pick contained 76.35% more FFA in cotton seed oil, than that oil from the seed derived from the first pick. The presence of such sizeable increase in FFA is very effective in deterioration of the viability of the seed obtained from the second pick.

Therefore, it is wise to use seeds derived from the first pick alone to be processed and certified to grow cotton. This findings is strongly supported by the fact that our results clearly demonstrated that the germination percent of seeds from the first pick was highly significantly higher than that of seeds derived from the second pick. Moreover, the last seeds derived from the second pick contained more dead and disease infected seeds as well as non-germinating seeds than the that from the first pick. Finally, it will be possible to cultivate the unit area *feddan* with *less than twenty kg* of the acid-delinted seed of first pick.

## **Conclusion**

Seeds produced from the first harvest have less content of free fatty acids and can have longer viability life in storage.

Seeds produced from first harvest have higher seed index, better germination ratios and are preferred to produce better quality seed with less total costs.

On the other hand, seeds from second harvest have less germination percentage, contain higher free fatty acids and could hardly keep good viability during storage. Therefore, it should be avoided as source of seed.

Seeds derived from the first pick are representing up to 2/3 of the seed yield per unit area and would be enough to produce high quality seed. Some financial promotion, for seed producing cotton growers could encourage them pick the fast yield at proper time.

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## Response of *Datura innoxia* Mill Plants to Jasmonic Acid Application

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### **Abstract**

Two experiments were carried out during the seasons of 1994/1995 and 1995/1996 to study the effect of Jasmonic acid\* at three concentrations; i.e., 200, 400 and 800 ppm, besides the distilled water as a control on the growth, chlorophyll content, the levels of endogenous hormones and alkaloid contents as well as yield of *Datura innoxia* Mill plants. The obtained results indicated that JA application at different concentrations significantly decreased plant heights and increased the number of both leaves and branches as well as dry weights of the different organs of *Datura* plants. Plants treated with JA showed a decrease in transpiration rate and total Chl a + b, with an increment of the JA concentration.

Results also showed that alkaloid content of the seeds was higher than that the different organs of *Datura innoxia*. Seeds yield and alkaloids as well as oil content in the seeds were significantly increased by JA treatments. The effect was more pronounced by JA at 800 ppm during the two seasons. On the other hand, JA treatments decreased growth promoters and increased growth inhibitors with raising of JA concentration.

### **Introduction**

*Datura innoxia* Mill is one of the most important solanaceous plants, which is considered as a main source for producing tropane alkaloids needed for the pharmaceutical industries. In the last few years, great attention was drawn to improve the yield and its quality of *Datura*. Application of wide variety of both naturally occurring and synthetic chemical growth regulators have been extensively used in order to ascertain their beneficial effects upon the growth and development of plants. A number of synthetic growth retardants have been discovered and proved to be of considerable importance in agriculture (Yamane *et al.*, 1990; Yamane *et al.*, 1981; Sembdner and Klose, 1985; Vick and Zimmermann, 1986).

Jasmonic acid (JA) and its methyl ester (JA-Me) are endogenous physiologically active compounds with a phytohormone-like action and they are widely distributed in higher plants (Ueda *et al.*, 1981; Sembdner and Klose, 1985 and Parthier, 1990). They cause growth inhibition (Miersch *et al.*, 1986 and Popova *et al.*, 1988).

According to these contradictory opinions, we have carried out this investigation in order to determine the optimum JA levels, which may realize an increment in the obtained drug and alkaloid yield from *Datura innoxia* Mill plants, under our experimental and environmental conditions.

## **Materials and Methods**

Two field experiments were carried out at the Experimental Farm of the Faculty of Agriculture at Shibin El-Kom, Minufiya University during two successive seasons of 1994/1995 and 1995/1996 for studying the effect of Jasmonic acid (JA) on the growth, photosynthetic pigments, photohormone concentrations drug yield, and alkaloids content of the different plant organs of *Datura innoxia* Mill plants.

The seeds from the local plants were planted in seed pans at the 1<sup>st</sup> of October 1994 and 1995 in the nursery. The seedlings of 2-3 pair of leaves were transplanted at the mid of December in the seasons of 1994/1995 and 1995/1996 in plots of 2 x 4 m at 40 cms. apart between the plants. During the soil preparation, chemical fertilizers as calcium superphosphate (15% P<sub>2</sub>O<sub>5</sub>) and potassium sulphate (50% K<sub>2</sub>O) were added to the soil at rates of 130 and 85 Kg/fed. respectively. Concerning, the nitrogen fertilizer, the plants received urea (46% N) at rate of 85 Kg/fed. in three equal side dressings on 10<sup>th</sup> of January, February and March in the two seasons. All other cultural practices were performed as usual. The study was conducted in a randomized complete block design with three replicates.

Jasmonic acid (JA) was applied as a foliar application at the rates of 200, 400 and 800 ppm. Distilled water was used as a control plants. Plants were sprayed twice, at 35 days from transplanting and 7 days later by means of a hand atomizer until run-off. Tween 20 was used a wetting agent at a concentration of 0.5%.

At the full flowering stage, plant height, number of both leaves and branches and dry weights of leaves, stems, flowers and roots were measured. The different plant organs were dried at 70°C and grinded as a preparation of chemical analysis. The chlorophyll, and transpiration rate were taken, at the full flowering stage.

- 1) Chlorophyll a, Chl b and carotenoids were determined spectrophotometrically as described by Wettstein (1957).
- 2) The transpiration rate (g water/cm<sup>2</sup>/h) was determined according to Kreeb (1990).
- 3) The total alkaloid percentage in the dried different plant organs was determined according to the method described by Karawya *et al.* (1975).

### **Determination of endogenous growth hormones:**

Extraction of endogenous growth hormones was carried out according to method of Shindy and Smith (1975), 30 grams fresh weight of the leaves at full flowering stage were used for the determination of auxin and their inhibitors, gibberellins and cytokinins. Plant material was extracted three times with 80% cold methanol. The combined alcohol extracts were evaporated under reduced pressure and the aqueous residue was partially purified by partition with ethyl acetate. The acidic ethyl acetate fraction was then collected and dried under vacuum at 37°C to dryness to determine auxin and their inhibitors and gibberellins whereas, the alkaline fraction was used to determine cytokinins. Separation was carried out by paper chromatography using a solvent composed of isopropanol : ammonia : water (10:1:1). Bioassay techniques were followed using wheat coleoptile straight assay (Bently and Housley, 1954) for auxins and their inhibitors, lettuce hypocotyl assay (Frankland and Wareing, 1960) for gibberellins and cucumb cotyledons assay (Fletcher *et al.*, 1982) for cytokinins. The results of phytohormones were statistically analyzed according to Tukey (1953).

At harvest, the seed yield, oil and alkaloid yield were recorded. The oil percentage in *Datura* seed was determined using Soxhlet continuous extraction apparatus according to A.O.A.C (1980). All data were subjected to statistical analysis of variance (Snedecor and Cochran, 1969).

## Results and Discussion

### 1 - Growth analysis:

Data in Table (1) indicated clearly that, plant heights significantly decreased with increasing Jasmonic acid concentrations. The highest value in this respect was obtained by 800 ppm at which plant heights were decreased by about 13% and 15% in the first and second seasons, respectively, as compared with untreated plants. It was clear from the same Table that, all levels of JA caused a significant increase in the number of both leaves and branches per plant, drug weights of different parts of *Datura innoxia* Mill plants (Table 2). The highest value in this respect was obtained by 800 ppm of JA. These results were true in both 1994/1995 and 1995/1996 seasons.

The dwarfing effect of Jasmonic acid may be due to the influences of JA on preventing cell elongation and/or stopping cell division, act as antigibberellin (Fig. 2). In this regard, several investigators reported that JA shortened the heights of many plants species (Dathe *et al.*, 1981; Sembdner and Gross, 1986; Parthier 1990; Gendy and Schilling, 1990; Gendy and Selim, 1994)

**Table (1): Effect of Jasmonic acid on growth parameters of *Datura* plants during 1994/95 and 1995/96 seasons.**

JA levels (ppm)	Plant height cm/plant	No. of leaves/plant	No. of branches/plant
<b>1994/95 season</b>			
Control	90.2	89.2	15.2
200	87.4	95.4	17.6
400	80.6	96.8	18.3
800	78.4	80.2	15.0
L.S.D 5%	5.2	18.1	4.2
<b>1995/96 season</b>			
Control	86.4	84.8	14.2
200	82.1	89.9	16.3
400	80.2	92.4	19.4
800	73.4	81.4	14.8
L.S.D 5%	4.8	16.4	3.4

**Table (2): Effect of Jasmonic acid on the drug yield in gms/plant of *Datura innoxia* Mill plants during the seasons of 1994/95 and 1995/96.**

JA levels (ppm)	Leaves	Stems	Flowers	Total herb	Roots
<b>1994/85 season</b>					
Control	80.2	45.5	9.4	135.1	15.8
200	82.4	48.2	9.8	140.4	18.2
400	86.9	50.4	10.2	147.5	19.6
800	88.1	52.8	10.3	151.2	19.8
L.S.D 5%	4.2	4.2	0.8	7.8	2.4
<b>1995/96 season</b>					
Control	79.2	46.2	9.2	134.6	14.2
200	80.4	49.4	9.6	139.4	15.4
400	83.2	50.8	10.0	144.0	18.4
800	84.6	53.7	10.2	148.5	19.6
L.S.D 5%	3.1	4.6	0.6	6.6	2.6

The increase in drug weights of treated plants (Table 2) might be attributed to the positive effect of JA on number of both leaves and branches and dry matter deposition. This increase also might be due to the enhancement at JA on CO<sub>2</sub> fixation and/or the increase in the anabolic metabolism (Sembdner and Parthier, 1993).

## **2 - Transpiration rate:**

Data recorded in Table (3) showed clearly that all levels of JA caused a significant decrease in the transpiration rate. The most effective treatments to decrease the transpiration rate was at the highest levels of JA. This decrease may be attributed to the stomata closure by JA (Satler and Thimann, 1981; Horton, 1991; Gendy and Selim, 1994). Jasmonic acid activities seem to be similar to abscisic acid on this character (Sembdner and Parthier, 1993).

## **3 - Photosynthetic pigments:**

Data in Table (3) indicated clearly that all JA levels decreased Chl a, Chl b and total Chl (a+b) as well as carotenoids in both seasons. On the contrary, the carotenoids significantly increased with raising the JA levels. The lowest value of total Chl a+b resulted from plants sprayed at the highest levels of JA.

The decrease in photosynthetic pigments as a result of JA treatments was reported in other investigations by Parthier *et al.* (1987a), Ueda and Kato (1982), Parthier (1990), Gendy and Schilling (1990), Gendy and Selim (1994). The role of JA to inhibition the chlorophyll content was attributed to the capability of JA to reduce of chloroplast development during leaf growth and to promote the rate of leaf senescence as well as to stimulate the degradation of chlorophyll (Sembdner and Parthier, 1993). The reduction in Chl content may be due to several factors: 1) inhibition of endogenous hormonal activity, 2) suppression of rRNA incorporation into plastid nucleic acid and its synthesis, 3) inhibition of GA-dependent DNA biosynthesis which decrease protein content necessary for Chl biosynthesis, and/or 4) increasing chlorophyllase synthesis (Parthier, 1991).

## **4 - Phytohormones concentration:**

Data presented in Table (4) exhibit a marked decrease in IAA, GA and Cytokinin concentration of treated leaves at all JA levels as compared with untreated leaves. On the contrary, the ABA concentration was insignificantly increased. Similar findings were reported by Ueda *et al.* (1981), Ueda and Kato (1982), who found that the application of JA decreased the cytokinin concentration. In this connection, Gendy and Selim (1994) reported that the gibberellin concentration in faba bean was decreased after leaf treatment with JA.

**Table (3): Effect of Jasmonic acid on chlorophyll concentration and transpiration rate in leaves of *Datura* plants (1994/1995 and 1995/1996 season).**

JA levels (ppm)	Chlorophyll concentration (mg/g.f.wt)			Transpiration rate	
	Chl a (mg/cm <sup>2</sup> /h)	Chl b	Chl a + b	Carotenoid	
<b>1994/1995 season</b>					
Control	6.32	2.18	8.50	2.77	5.8
200	6.12	2.12	8.24	2.80	5.0
400	5.80	2.08	7.88	2.90	4.2
800	5.42	2.00	7.42	2.98	3.2
L.S.D 5%	0.85	0.12	0.89	0.21	1.0
<b>1995/1996 season</b>					
Control	5.12	2.00	7.12	2.30	4.9
200	5.00	1.90	6.90	2.45	4.6
400	4.82	1.82	6.64	2.54	3.9
800	4.34	1.68	6.02	2.62	3.2
L.S.D 5%	0.67	0.16	0.94	0.32	1.2

**Table (4): Effect of JA on endogenous phytohormones concentration (ng/g/fwt) of *datura* leaves.**

JA levels (ppm)	IAA	GA	Cytokin	ABA
<b>1994/95 season</b>				
Control	58.0	25.0	95.0	72.0
200	50.0	20.0	90.0	72.5
400	48.0	17.0	84.0	72.8
800	45.0	14.0	80.0	73.0
L.S.D 5%	6.2	4.5	4.8	NS
<b>1995/96 season</b>				
Control	59.0	28.0	96.0	74.0
200	51.0	22.0	91.0	74.6
400	49.0	19.0	83.0	74.8
800	46.0	15.0	80.0	75.0
L.S.D 5%	7.1	5.6	4.9	NS

## 5 - Total alkaloids:

### a) alkaloid percentage:

The reported data in Table (5) show clearly that JA application on *Datura innoxia* Mill plants caused a slightly decrease in the alkaloid concentration in the dried leaves, stems, and roots than the untreated plants, whereas, the total alkaloid percentage in the flowers showed an increase tendency than untreated plants in both seasons.

The decrease in the alkaloid percentages as a result of JA application in the leaves, stems and roots of *Datura innoxia* Mill plants could be due to the dilution effect of alkaloid concentrations in previous mentioned organs as a result of the increment of drug yield. Similar results were obtained by Mostafa *et al.* (1984) on *Datura* plants.

## b) alkaloid content:

The presented data in Table (5) indicate that JA application on *Datura innoxia* Mill plants at its different concentrations increased the alkaloid yield/plant in flowers than the control plants. The best results in this respect was obtained by spraying the plants with 400 and 800 ppm of JA in the two experimental seasons.

It seems from these results (Tables 3 and 5) that JA application was more effective in increasing alkaloids yield of *Datura* flowers as compared to untreated plants. These results are in agreement with the findings of Parthier (1991).

The beneficial effects of growth regulators on the biosynthesis of alkaloids and other secondary metabolites in many medicinal plants were also reported by Moskova-Simenova *et al.* (1987); Moftah and Attia (1992). The increase in N uptake and amino nitrogen content resulted from these growth regulators and reported by Abdou (1987) might be reasons for stimulating alkaloid biosynthesis.

**6 - The yield:**

As shown in Table (6) seeds yield was affected positively and significantly by Jasmonic acid application. The highest seed yield was obtained at the moderate rate of JA. The highest increase in seed yield over the control reached about 63% and 56% in the first and second seasons, respectively.

It can be also noticed from Table (6) that foliar spray of JA to *Datura* plants leads generally to an increase in oil and alkaloid percentages and yields in the seeds as compared with untreated plants. Seed content of alkaloid reached the maximum value when plants sprayed at 400 ppm of JA.

From the aforementioned discussion it could be concluded that JA application modify *Datura* plants growth. The modifications are characterized by significantly shorter plants. Moreover, the seed yield and alkaloid yield were increased.

**Table (5): Effect of Jasmonic acid on the alkaloids content of the different *Datura* plant organs during the seasons of 1994/95 and 1995/96.**

JA levels (ppm)	Leaves		Stems		Flowers		Total herb		Roots	
	%	g/plant	%	g/plant	%	g/plant	%	g/plant	%	g/plant
<b>1994/95 season</b>										
Control	0.86	0.69	0.56	0.25	0.89	0.08	0.79	0.59	0.40	0.06
200	0.74	0.61	0.52	0.25	0.96	0.09	0.70	0.56	0.31	0.06
400	0.72	0.63	0.45	0.23	1.20	0.12	0.62	0.57	0.24	0.05
800	0.70	0.62	0.36	0.19	1.42	0.15	0.60	0.42	0.20	0.04
L.S.D5%	-	0.06	-	0.02	-	0.02	-	0.08	-	0.02
<b>1995/96 season</b>										
Control	0.58	0.54	0.48	0.22	0.72	0.07	0.61	0.43	0.31	0.04
200	0.60	0.48	0.40	0.20	0.84	0.08	0.58	0.49	0.28	0.04
400	0.52	0.43	0.36	0.18	0.99	0.10	0.50	0.47	0.21	0.04
800	0.48	0.41	0.30	0.16	1.20	0.12	0.48	0.33	0.18	0.04
L.S.D5%	-	0.09	-	0.04	-	0.04	-	0.09	-	N.S.

**Table (6): Effect of Jasmonic acid on seed yield, seed oil and seed alkaloids yields of *Datura* plants.**

JA levels (ppm)	Seed yield		Seed oil		Seed alkaloid
	g/plant	%	g/plant	%	g/plant
<b>1994/95 season</b>					
Control	50.1	14.6	7.31	1.40	0.70
200	55.3	15.2	8.41	2.10	1.16
400	64.2	16.8	10.79	3.30	2.12
800	60.4	16.0	9.66	2.80	1.69
L.S.D 5%	2.5	1.2	1.45	1.12	0.62
<b>1995/96 season</b>					
Control	48.2	14.2	6.84	1.30	0.63
200	52.4	15.0	7.86	2.20	1.15
400	66.8	16.2	10.82	3.28	2.19
800	61.6	15.8	9.73	2.60	1.60
L.S.D 5%	2.9	1.4	1.66	1.20	0.75

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# Response of Sweet Pepper to some Growth Regulator 1-Photosynthetic Pigments and Anatomical Structure

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## **Abstract**

Pots experiments were carried out at the farm Kafr El-Sheikh, Faculty of Agriculture during the two successive summer seasons of 1992 and 1993. The main objective of this study was to recognize the responses of sweet pepper (*Capsicum annuum* L.) California wonder variety to foliar applications of several concentrations of some growth regulators, i.e., kinetin cycocel (ccc), ethrel and morphactin (CME) beside the control (water spray) on photosynthetic pigments and anatomical characteristics. The results are summarized as follows:

**Physiological studies:** All growth regulators increased concentrations of photosynthetic pigments of leaf.

**Anatomical studies:** These four growth regulators affected significantly structure of root, stem and leaf of sweet pepper plants.

## **Introduction**

Family Solanaceae is one of the most important economic families which includes about 85 genera and more than 2200 species, many of its plants are grown as vegetable crops such as tomato, pepper, potatoes, eggplant etc. One of the most important genera is *Capsicum* of which the under investigation in one of its edible species.

California Wonder (*Capsicum annuum* L.) a nonpungent cultivar, is widely produced in Egypt during summer season for local market as it needs a relatively long growing season of high temperature.

Consumed fresh pepper in one of the best means for supplementing ascorbic acid (Vitamin C), whereas it is considered one of the higher nutritional value crops, particularly in vitamins. It is a favourite vegetable throughout the year and it is used as fresh, cooking, pickle food and may be stuffed with rice and minced meat cooked.

During the past 10 years, the use of plant growth regulators has increased more than other agricultural chemical groups (Davis and Curry, 1991). Growth regulators are used on a wide variety of ornamental crops to improve rooting, increase shoot formation, shorten internodes, and induce flowering. The effect of some of these compounds on pests has been investigated on many crops, (Osborne and Chase, 1990). The application of the plant growth regulators might improve the growth of plants and fruit set leading to increasing fruit yield and fruit quality. Therefore, certain experiments were carried out to study the effect of some growth regulators, i.e., kinetin, cycocel (CCC), ethrel and morphactin (CME) on morphological, physiological and anatomical characteristics as well as yield and its components besides fruit quality of sweet pepper (*Capsicum annuum* L.) California Wonder variety.

## Materials and Methods

The present experiments were carried out during the late summer of 1992 and 1993 seasons in clay pots 30 cm inner diameter in the glasshouse of the Department of Agricultural Botany, Faculty of Agriculture, Kafr El-Sheikh Tanta University. The aim of this work was to study the effects of 4 growth regulators with different concentrations on morphological, physiological and anatomical characteristics of sweet pepper *Capsicum annuum* L., var California wonder.

### Photosynthetic pigments:

Leaf pigments, i.e. chlorophyll a, b and carotenoids of the fifth leaf from the shoot tip were determined at 30 and 60 days after transplanting date i.e., 15 and 45 days after application of the plant growth regulators (Wettstein, 1957).

### Anatomical studies:

The effect of growth regulators on the anatomical structure of leaves (lamina), stems and roots was studied after 15 days after application. Specimens 1 cm long were taken from the fifth internode and the fifth leaf including the midrib. Concerning the roots 1 cm samples from the subapical part of secondary root tip were cut. Sections were stained then cleared in xylol and mounted in Canada balsam and prepared for microscopic examination (Ghamrawi and Zaher, 1953).

## Results and Discussion

### Photosynthetic pigments:

Data presented in Tables (1 and 2) show that kinetin at all levels significantly increased photosynthetic pigments concentrations (Chl. a, Chl. b, Chl. a + b and carotenoids) at two sampling dates (15 and 45 days after application) in both seasons. The increase in carotenoids was not significant at 25 and 50 mg/L at the second sampling date in the first season. In fact, the increase in photosynthetic pigments occurred due to a corresponding increase in Lamina thickness. In addition, cytokinin increase a number of chloroplast in young leaves by increasing both intensity of cell growth phytohormones and the activity of cytoplasm ribosomes, thus chlorophyll synthesis is stimulated (Borzenkova and Mokronosov, 1976).

**Table (1): Effect of some growth regulators on photosynthetic pigments concentrations of sweet pepper leaves (*Capsicum annuum* L. var. California wonder) during 1992 season.**

Growth regulators (mg/L)	Pigments concentrations (mg/dm <sup>2</sup> )								
	15 days after application				45 days after application				
	Chl. a	Chl. b	Ch. (a+b)	Carotenoids	Chl. a	Chl. b	Ch. (a+b)	Carotenoids	
Control	1.20	0.89	2.09	0.81	1.88	0.80	2.68	1.59	
Kinetin	25	1.95	1.49	3.44	1.40	3.32	2.20	5.52	1.84
	50	2.00	1.79	3.79	1.60	3.50	2.42	5.82	1.67
	100	2.66	2.36	5.02	1.90	3.80	2.07	5.87	2.00
CCC	500	1.50	1.64	3.14	1.20	2.23	1.13	3.46	1.85
	1000	1.69	1.31	3.00	1.44	2.33	1.30	3.63	1.67
	2000	1.93	1.31	3.24	1.44	2.53	1.30	3.83	1.84
Ethrel	100	2.06	1.79	3.86	1.25	3.18	2.09	5.30	2.10
	200	1.74	1.30	3.04	1.26	2.69	1.84	4.52	2.05
	400	1.85	1.46	3.31	1.20	3.00	2.30	5.27	1.95
CME	2.5	3.15	2.89	6.04	2.47	3.13	2.28	5.41	2.24
	5	2.18	1.42	3.60	1.71	3.04	2.23	5.27	2.13
	10	2.39	2.05	4.43	1.99	2.75	2.06	4.81	2.32
L.S.D.	5%	0.20	0.39	0.51	0.38	0.37	0.31	0.65	0.32

**Table (2): Effect of some growth regulators on photosynthetic pigments concentrations of sweet pepper leaves (*Capsicum annuum* L. var. California wonder) during 1993 season.**

Growth regulators (mg/L)	Pigments concentrations (mg/dm <sup>2</sup> )								
	15 days after application				45 days after application				
	Chl. a	Chl. b	Ch. (a+b)	Carotenoids	Chl. a	Chl. b	Ch. (a+b)	Carotenoids	
Control	1.26	0.80	2.12	1.05	1.79	0.90	2.69	1.45	
Kinetin	25	2.10	1.64	3.37	1.59	2.70	1.88	4.58	2.01
	50	2.11	1.31	3.42	1.73	2.70	1.97	4.67	1.94
	100	2.22	1.99	4.21	2.02	2.78	2.08	4.86	1.85
CCC	500	1.80	1.23	3.03	1.60	2.95	1.89	4.84	1.76
	1000	1.81	1.23	3.04	1.62	2.08	1.87	3.95	1.76
	2000	1.81	1.55	3.36	1.60	2.21	1.91	4.12	1.80
Ethrel	100	1.92	1.50	3.42	1.73	3.15	2.44	5.59	2.00
	200	1.90	1.23	3.13	1.88	2.40	1.81	4.21	2.13
	400	1.90	1.55	3.45	1.59	2.70	1.89	4.59	1.91
CME	2.5	3.15	2.38	5.53	2.71	3.70	2.11	5.81	2.21
	5	2.59	2.29	4.88	1.36	3.32	2.35	5.67	2.19
	10	2.23	2.01	4.24	2.02	3.23	2.11	5.34	2.13
L.S.D.	5%	0.34	0.42	0.64	0.32	0.60	0.40	0.56	0.23

The plants treated with CCC at 500, 1000 and 2000 mg/L significantly increased photosynthetic pigments (Chl. a, Chl. b, Chl. a + b and carotenoids concentrations) at two sampling dates (15 and 45 days after application) during both seasons, except in case of carotenoids at the second sampling date during the first season. It is concluded that the favourable effects of cycocel on the concentration of photosynthetic pigments of pepper plant leaves may be due to the assumption that CCC retards chlorophyll that breakdown via inhibition of chlorophyllase enzyme (Gaber *et al.*, 1983).

Plants treated with ethrel at all concentrations used significantly increased Chl. a, Chl. b, Chl. a + b and carotenoids concentrations at all sampling dates during both seasons. The produced increase in photosynthetic pigments by ethrel may be due to the increase in Lamina thickness observed in this work. Furthermore the increase in photosynthetic pigments due to ethrel application may be attributed to an increase in the biosynthesis of these pigments and their enzymes activity (El Zawily *et al.*, 1984) on onion.

CME treatments significantly increased Chl. a, Chl. b, Chl. a + b and carotenoids at all sampling dates during both seasons. The highest increase in photosynthetic pigments was recorded at 2.5 mg/L followed by 5 and 10 mg/L, respectively at the second sampling dates during both seasons as well as the first sample at the first season. As regards the favourable effect of CME on the concentration of photosynthetic pigments may be due to the increase in Lamina thickness and leaf area observed in this work. In addition, the effect of morphactin may be interpreted also by a delay in senescence of the leaves and retarding breakdown of chlorophyll. This is in agreement with the opinion of Schneider (1970).

### **Anatomical studies:**

#### **The root structure:**

Data in Table (3) show that kinetin decreased the diameter of root by decreasing thickness of cortex and the diameter of vascular cylinder which may be due to decreasing the size of the individual cells as previously mentioned by Sakr and El-Kady (1981) on bean. On the other hand, diameter of xylem vessels was increased due to that kinetin induces cell enlargement (Devlin and Witham, 1983).

Cycocel at all concentrations increased the diameter of root by increasing thickness of cortex tissues, diameter of vascular cylinder and xylem vessels inside the vascular. The secondary roots were increased by all levels of cycocel. Similar results were obtained by Mahmoud (1987).

The ethrel at all concentrations increased both thickness of cortex tissues, diameter of root xylem vessels and secondary roots. The work of Boovarah (1974) shows that ethrel induced radial enlargement of been cells. The diameter of vascular cylinder was not affected with ethrel at 100 and 200 mg/L, but 400 mg/L ethrel very slightly decreased the diameter of vascular cylinder which may be due to that the effect of ethrel on vascular tissue and pith was normal as control.

**Table (3): Effect of some growth regulators on the root structure of sweet pepper (*Capsicum annum* L. var. California wonder) in 1993 season.**

Growth regulators (mg/L)	Diameter of root (u)	Thickness of cortex tissues (u)	Diameter of	
			Vascular cylinder (u)	Xylem vessels (u)
Control	1348	392	564	24
Kinetin	25	997	287	423
	50	1004	283	438
	100	1005	266	473
CCC	500	1534	444	464
	1000	1675	466	743
	2000	1738	493	752
Ethrel	100	1460	450	560
	200	1464	452	560
	400	1526	496	534
CME	2.5	1069	293	483
	5	1039	278	483
	10	997	276	445

All concentrations of morphactin decreased diameter of root, thickness of cortex tissue and diameter of vascular cylinder. For another point of view, morphactin increased diameter of xylem vessels and organized secondary root. From these results, it could be concluded that induction of cell divisions was stimulated. So the number of primordia may increase but the organization of primordia seems to be often histologically disturbed and thus the extension growth of the root may not take place normally or retarded (Schneider *et al.*, 1969).

#### **The stem structure:**

Data in Table (4) show that kinetin decreased diameter of stem, thickness of cortex layer, vascular cylinder, xylem vessels and thickness of xylem tissues. However, the number of vascular bundles was increased. These results confirm those of Sakr and El-Kady (1981) on *Vicia faba* L.

**Table (4): Effect of some growth regulators on the stem structure of sweet pepper (*Capdsicum annum* L. var. California wonder) in 1993.**

Growth regulators (mg/L)	Diameter of stem (u)	Diameter of epidermal cell (u)	Thickness of cortex layer (u)			Vascular cylinder				
			Collenchyma tissues	Parenchyma tissue	Total	Diameter of vascular cylinder (u)	No. of Vascular bundles	Xylem tissue		
								Thickness (u)	Diameter vessel (u)	
Control	2088	16	150	134	284	1488	5	440	28	
Kinetin	25	2046	17	182	98	280	1452	9	420	22
	50	197	17	163	105	268	1400	8	420	22
	100	2008	17	162	104	266	1442	9	403	21
CCC	500	2252	24	222	110	332	1540	10	513	42
	1000	2458	20	222	118	340	1738	11	550	40
	2000	3160	30	230	119	349	2402	11	564	42
Ethrel	100	2460	24	202	142	344	1724	11	502	38
	200	2030	24	194	88	282	1700	9	482	36
	400	2020	24	183	103	286	1400	9	480	34
CME	2.5	3248	32	240	130	370	2444	10	624	36
	5	2852	32	240	132	372	2044	8	602	36
	10	3160	30	240	131	371	2358	9	602	32

Diameter of stem was increased with increasing concentration of cycocel. This effect may be due to increasing the diameter of epidermal cells and thickness of cortex layer. Diameter of vascular cylinder, diameter/vessel and thickness of xylem tissues as well as number of vascular bundles in vascular cylinder were also increased. Similar results were obtained by Fouad *et al.* (1979), Mahmoud (1987) on pepper and tomato.

Ethrel increased the diameter of stem, diameter of epidermal cells and thickness of cortex layer. Diameter of vascular cylinder, diameter/vessel, thickness of xylem tissues and number of vascular bundles were increased. The highest increase was obtained with 100 mg/L. These results confirm those of Pooviah and Leopod (1974) on bean who reported that ethrel treatment caused extensive radial enlargement of cells rather than cell division in vascular region.

CME increased diameter of stem by increasing diameter of epidermal cells and thickness of cortex layer. Also diameter of vascular cylinder, thickness of xylem tissue and diameter/vessels were increased. The lowest concentration of CME gave the highest number of vascular bundles. Similar results were obtained by El-Masry *et al.* (1994) on *Orobanche crenata* and El-Nady (1994) on eggplant who concluded that morphactin increased diameter of stem.

### The leaf structure:

Data in Table (5) show that kinetin caused thickening of the leaf blade with large diameter of epidermal cells and thickness of the mesophyll tissue as well as elongation of palisade cells and size of spongy tissue. These effects tended to increase as kinetin concentration increased due to that kinetin promoted enlargement and elongation of cells (Devlina and Witham, 1983).

Cycocel treatments caused large mesophyll cells by increasing size of palisade cells and spongy tissue. Diameter of epidermal cells tended to wide as cycocel concentrations increased. Similar results were recorded by Bandarenko and Ledovshii (1976), El-Kassas (1992) and El-Nady (1994) on pepper, cucumber and eggplant, respectively who reported that cycocel caused thickening of leaves.

**Table (5): Effect of some growth regulators on the leaf structure of sweet pepper (*Capsicum annuum* L. var. California wonder) in 1993 season.**

Growth regulators (mg/L)	Diameter of epidermal cell (u)	Thickness of mesophyll tissue (u)		Vascular bundles		
		Palisade	Spongy	No. of vascular/midrib	Thickness of xylem	Diameter/vessel (u)
Control	15	40	78	10.5	132	10
Kinetin 25	24	70	86	13.5	133	14
50	24	74	90	13.0	132	14
100	24	73	96	14.5	133	15
CCC 500	20	52	92	13.0	136	14
1000	24	60	92	13.5	139	16
2000	24	62	100	13.0	142	20
Ethrel 100	24	60	84	12.2	142	18
200	24	56	82	12.6	133	18
400	24	50	82	12.6	132	10
CME 2.5	20	46	112	9.5	109	16
5	18	45	100	9.0	92	16
10	18	45	108	9.5	94	12

Ethrel caused thickening of the leaf blade by increasing diameter of epidermal cell. Thickness of mesophyll tissue tended to increase as a result of elongation of palisade cells and size of spongy tissue.

CME treatments caused larger mesophyll cells as larger size of spongy tissue is due to induced enlargement and increased number of cells by cell division and decreased air spaces, but thickness of palisade cells and diameter of epidermal cell were slightly increased under CME treatment similar results were obtained by Mahmoud (1987) on tomato who reported that CEL produced abnormal tomato leaflets and large cells of mesophyll.

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# **Synergic Effect of Herbicides Formulation on Energy Compounds and Myokinase Activity of Albino Rats Organs**

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## ***Abstract***

The present work evaluate the effects of single and multi doses of glyphosate and fluazifop-butyl as herbicides in pure and formulated forms on the energetic compounds and myokinase activity in the organs of albino rats. The results indicated the following remarks:

The single dose showed an increase in ATP content in all investigated rat organs by both herbicides ingestion. However, the increase induced by formulated herbicides was more clear than those of pure ones. In contrast, the levels of ADP and AMP were decreased vigorously under the herbicides ingestion. The decrease caused by formulated herbicides was higher than that of the pure ones. Herbicides exhibited a remarkable inhibition in myokinase activity in all examined rat organs relative to control. The inhibition caused by formulated herbicides was more obvious than those of pure herbicides.

The results showed that, the effects of multi doses of herbicides were similar to the influence of the single dose in all items such as ATP, ADP, AMP contents and myokinase activity. However, these effects were more than that of single dose. The influence of the formulated herbicides was more obvious (toxic) than the pure ones .

## ***Introduction***

To establish any toxicological data acute toxicity tests are considered the base line or preliminary studies for chronic toxicity tests. In this respect, glyphosate and fluazifop-butyl are commonly used in Egypt. It should be emphasized that no or very little data are available in the literature about this influence of pure and formulated herbicides on different living organisms and human health.

In developing countries, the use of pesticides has become so important that their use is inextricably linked with improvement of human welfare (Osibajo, 1989). Pesticides are usually applied in their formulated form where the active ingredient is combined with organic solvents, emulsifying and wetting agents, which affect the pesticides penetration. The formulations way cause synergism or antagonism to the toxicity of the active ingredient (El-Sebae, 1985). Recently, the W.H.O. (1991) emphasized that the final toxic classification of any pesticide in intended to be by its formulation. Indeed, literature background revealed that a few reports dealt with the metabolic changes and with other side effects of formulated herbicides as compared with pure one. Abou-Zeid et al., (1993) observed that formulated malathion was more toxic to

rats than that of the pure technical ingredient, and blood serum profile was changed by formulated malathion more than that by pure one with dermal treatment.

In this respect, Abdel-Rahim et al (1994e) and Knopp and Glass (1997) reported that organs tissue contents of adenosine-5-phosphate (ATP) were increased, whereas the contents of adenosine-5-diphosphate (ADP) and adenosine-5-monophosphate (AMP) were decreased and accompanied by inhibiting the activity of myokinase either under the effect of pure or formulated herbicides of all tested organs, relative to control.

In the present study, pure herbicides and formulated ones in single and multi doses were administered separately in dose of 1/20 from LD<sub>50</sub> every 48 hours to adult albino rats. The effect of these doses on the energetic compounds ATP, ADP, AMP, and myokinase were investigated.

## **Materials and Methods**

### **Herbicides:**

Two herbicides were used; the first one is known as Glyphosate (N-(phosphonomethyl)glycine); belongs to organophosphorous family, non-selective systemic herbicide, acts on various enzyme systems, thus interfering with the formation of amino acids and other important endogenous chemicals. Second one is known as Fluazifop-butyle (butyl(RS)-2-(4-(5-trifluoromethyl-12-pyridyloxy)phenoxy)propionate); belongs to phenoxy, trifluoromethyl and pyridine family; selective systemic herbicide, acts by interfering with ATP production (Agrochemicals Handbook, 1987). The herbicides were obtained from Katou Jonker, Denmark, and was provided from the central Agricultural Pesticide Laboratory, ARC, Ministry of Agriculture, Dokki, Egypt.

### **Experimental Animals:**

A total of 45 adult male albino rats weighing 100-120 g were used in the present study and raised in the animal house of the Biochemistry Department, Faculty of Agriculture; Cairo University. The albino rats were kept under normal laboratory conditions for two weeks before the comencing of the experiments. The animal were allowed free access of water and fed on a uniformly basal diet for a period of three months and were orally administrated herbicides at one single dose of 1/4 from LD<sub>50</sub> and multi doses of 1/20 from LD<sub>50</sub> every two days as follows:

Group(1) control, untreated.

Group (2) rats administrated pure glyphosate at a dose of 165 mg/Kg b.w.

Group (3) rats administrated formulated glyphosate at a dose of 330 mg/Kg b.w.

Group(4) rats administrated pure fluazifop-butyl at 280 mg/Kg b.w.

Group (5) rats administrated formulated fluazifop-butyl at 560 mg/Kg body weight.

The animals were killed by decapitation after 2 days of the last induction, then liver, brain, spleen, kidney and hearts were dissected out.

### **Chemical Analysis:**

A spectrophotometric method was used for the determination of ATP, ADP and AMP in the rat organs homogenates using a Pye Unicam spectrophotometer (Model Sp 1800), where ATP was determined according to Lamprecht and Trauschold (1962) and ADP and AMP were determined as described by Adams (1962). The activity of myokinase in the rat organs homogenates was also spectrophotometrically measured as reported by Bergmeyer (1974).

### **Statistical Analysis:**

The obtained data were statistically analyzed using the method of Kalton (1967). The probability was determined by reference to (t) distribution table probability at 0.05 and used as a point of significance according to Bailay (1955).

## **Results**

### **A- Single Dose:**

#### **A-1- Herbicidal Effect on ATP, ADP, and AMP Contents :**

After two days of ATP, ADP and AMP were determined in different rat organ tissues. The results are shown in **Tables 1, 2 and 3**.

A significant decrease in the ADP and AMP contents in all investigated organs by herbicides induction was noticed. On the other hand, ATP showed an opposite trend where an increase in ATP level was encountered under herbicides application (**Table 1**). The ATP levels were increased by 20.00%, 26.67%, 13.33% and 22.67% for brain; 13.64%, 18.18%, 10.91% and 19.09% for liver; 12.50%, 25.00%, 17.50% and 17.50% for spleen; 15.00%, 50.00%, 15.00% and 50.00% for kidneys and 9.80%, 17.65%, 13.73 and 17.65% for heart relative to control under the ingestion of pure and formulated glyphosate and fluazifop-butyl, respectively.

On the other hand, the ADP levels (**Table 2**) were decreased by 21.54%, 36.92%, 23.08% and 35.38% for brain; 33.33%, 46.67%, 26.67% and 53.33% for liver; 13.64%, 22.73%, 18.18% and 22.73% for spleen; 37.50%, 43.75%, 31.25% and 50.00% for kidneys and 15.00%, 20.00%, 20.00% and 25.00% for heart than control under the effect of pure and formulated glyphosate and fluazifop-butyl, respectively.

In connection with AMP (**Table 3**), its levels were reduced than control by 35.48%, 41.94%, 32.26% and 38.71% for brain; 17.81%, 30.14%, 21.92% and 30.14% for liver; 14.29%, 22.86%, 17.14% and 25.71% for spleen; 13.64%, 22.73%, 18.18% and 22.73% for kidneys and 25.00%, 45.00%, 30.00% and 40.00% for heart, respectively after the administration of pure and formulated glyphosate and fluazifop-butyl.

#### **A-2- Herbicidal Effect on Myokinase Activity :**

The myokinase activity were determined in the various organ tissues after herbicides administration to rats and the results are shown in **Table 4**. The results indicated that herbicides caused a remarkable decrease in myokinase activity of all organs tissues. The decreased values were 31.91%, 40.43%, 27.66% and 40.43% for brain; 33.33%, 46.67%, 31.11% and 37.78% for liver; 20.00%, 37.14%, 17.14% and 34.29% for spleen, 35.00%, 45.00%, 30.00% and 30.00% for kidneys and 20.00%, 25.00%, 22.50% and 25.00% for heart relative to control respectively under the effect of pure and formulated glyphosate and fluazifop-butyl.

**Table (1): Effect of herbicides single dose on ATP level in different organs of albino rats.**

Organ		Control	Glyphosate		Fluazifop-butyl	
			Pure	Formulated	Pure	Formulated
Brain	*	7.5 ± 0.8 a	9.0 ± 0.8 b	9.5 ± 0.8 b	8.5 ± 0.6 b	9.2 ± 1.0 bc
	%	100.00	120.00	126.67	113.33	122.67
Liver	*	11.0 ± 1.0 a	12.5 ± 1.01 b	13.0 ± 1.1 b	12.2 ± 1.2 b	13.1 ± 1.2 bc
	%	100.00	113.64	118.18	110.91	119.09
Spleen	*	4.0 ± 0.3 a	4.5 ± 0.5 b	5.0 ± 0.4 bc	4.7 ± 0.5 b	4.7 ± 0.5 b
	%	100.00	112.50	125.00	117.50	117.50
Kidneys	*	2.0 ± 0.2 a	2.3 ± 0.3 b	3.0 ± 0.2 bc	2.3 ± 0.2 b	3.0 ± 0.3 bc
	%	100.00	115.00	150.00	115.00	150.00
Heart	*	5.1 ± 0.5 a	5.6 ± 0.6 b	6.0 ± 0.5 b	5.8 ± 0.6 b	6.0 ± 0.6 b
	%	100.00	109.80	117.65	113.73	117.65

The numbers in the row followed by the same letter are not significantly different at P = 0.05 for each parameter. \* = µM/g tissue

**Table (2): Effect of herbicides single dose on ADP level in different organs of albino rats.**

Organ		Control	Glyphosate		Fluazifop-butyl	
			Pure	Formulated	Pure	Formulated
Brain	*	0.65 ± 0.07 a	0.51 ± 0.06 b	0.41 ± 0.04 b	0.50 ± 0.04 b	0.42 ± 0.04 bc
	%	100.00	78.46	63.08	76.92	64.62
Liver	*	0.15 ± 0.01 a	0.10 ± 1.01 b	0.08 ± 0.01 bc	0.11 ± 0.10 b	0.07 ± 0.01 bc
	%	100.00	66.67	53.33	73.33	46.67
Spleen	*	0.22 ± 0.02 a	0.19 ± 0.02 b	0.17 ± 0.02 b	0.18 ± 0.01b	0.17 ± 0.02 b
	%	100.00	86.36	77.27	81.82	77.27
Kidneys	*	0.16 ± 0.02 a	0.10 ± 0.01 b	0.09 ± 0.01 bc	0.11 ± 0.01 b	0.08 ± 0.01 bc
	%	100.00	62.50	56.25	68.78	50.00
Heart	*	0.20 ± 0.02 a	0.17 ± 0.02 b	0.16 ± 0.01 b	0.16 ± 0.02 b	0.15 ± 0.01 b
	%	100.00	85.00	80.00	80.00	75.00

The numbers in the row followed by the same letter are not significantly different at P = 0.05 for each parameter. \* = µM/g tissue

**Table (3): Effect of herbicides single dose on AMP level in different organs of albino rats.**

Organ		Control	Glyphosate		Fluazifop-butyl	
			Pure	Formulated	Pure	Formulated
Brain	*	0.31 ± 0.03 a	0.20 ± 0.02 b	0.18 ± 0.02 b	0.21 ± 0.01 b	0.19 ± 0.02b
	%	100.00	64.52	58.86	67.74	61.29
Liver	*	0.73 ± 0.07 a	0.60 ± 0.0 b	0.51 ± 0.05 bc	0.57 ± 0.06 b	0.51 ± 0.05 bc
	%	100.00	82.19	69.86	78.08	69.86
Spleen	*	0.35 ± 0.03 a	0.30 ± 0.02 b	0.27 ± 0.03 b	0.29 ± 0.03 b	0.26 ± 0.02 bc
	%	100.00	86.71	77.14	82.86	74.29
Kidneys	*	0.22 ± 0.01 a	0.19 ± 0.02 b	0.17 ± 0.02 bc	0.18 ± 0.01 b	0.17 ± 0.02 b
	%	100.00	86.36	77.27	81.82	77.27
Heart	*	0.40 ± 0.03 a	0.30 ± 0.03 b	0.22 ± 0.02 bc	0.28 ± 0.03 b	0.24 ± 0.02 bc
	%	100.00	75.00	55.00	70.00	60.00

The numbers in the row followed by the same letter are not significantly different at P = 0.05 for each parameter. \* = µM/g tissue

**Table (4): Effect of herbicides single dose on Myokinase level in different organs of albino rats.**

Organ		Control	Glyphosate		Fluazifop-butyl	
			Pure	Formulated	Pure	Formulated
Brain	*	0.47 ± 0.05 a	0.32 ± 0.03 b	0.28 ± 0.03 bc	0.34 ± 0.04 b	0.28 ± 0.02 bc
	%	100.00	68.09	59.57	72.37	59.57
Liver	*	0.45 ± 0.05 a	0.30 ± 0.02 b	0.24 ± 0.02 bc	0.31 ± 0.03 b	0.28 ± 0.03b
	%	100.00	66.67	53.33	68.89	62.22
Spleen	*	0.35 ± 0.04	0.28 ± 0.03 b	0.22 ± 0.02 bc	0.29 ± 0.03 b	0.23 ± 0.02 bc
	%	100.00	80.00	62.86	82.86	65.71
Kidneys	*	0.20 ± 0.01 a	0.13 ± 0.01b	0.11 ± 0.01 bc	0.14 ± 0.01 b	0.14 ± 0.01 b
	%	100.00	65.00	55.00	70.00	70.00
Heart	*	0.40 ± 0.03 a	0.32 ± 0.03 b	0.30 ± 0.03 b	0.31 ± 0.03 b	0.30 ± 0.03 b
	%	100.00	80.00	75.00	77.50	75.00

The numbers in the row followed by the same letter are not significantly different at P = 0.05 for each parameter.

\* =  $\mu\text{M}/\text{mg}$  protein.

## B- Multi doses:

### B-1- Herbicidal Effect on the Levels ATP, ADP and AMP:

In this respect, the levels of ATP, ADP and AMP in different organs were determined and the data were presented in **Tables 5, 6 and 7**. The results illustrated that the ATP content (**Table 5**) of herbicides induced rat organs was higher than that of control. The levels were 33.33%, 46.67%, 33.33%, and 33.33% for brain; 18.18%, 27.27%, 13.64% and 27.27% for liver; 17.95%, 28.21%, 15.38 and 28.21% for spleen; 20.00%, 25.00%, 25.00% and 25.00% for kidneys, and 14.00%, 20.00%, 16.00% and 20.00% for heart relative to control under the effect of pure and formulated glyphosate and fluazifop-butyl, respectively. Generally speaking, the formulated and pure herbicides under study possessed the same effect on ATP level of rats.

ADP and AMP contents were decreased in all rat organs than control after the herbicides induction period. The ADP decreased values than control (**Table 6**) were 24.24%, 31.82%, 22.73% and 28.79% for brain; 37.50%, 37.50%, 43.75% and 31.25% for liver; 17.39%, 30.43%, 13.04% and 21.74% for spleen; 33.33%, 53.33%, 40.00% and 46.67% for kidneys, and 19.05%, 28.57%, 19.05% and 28.57% for heart relative to control under the effect of pure and formulated glyphosate and fluazifop-butyl, respectively.

On the other hand, the decreased values than control of AMP (**Table 7**) were 30.00%, 40.00%, 36.67% and 36.67% for brain; 20.27%, 32.43%, 17.57% and 25.68% for liver; 14.29%, 22.86%, 11.43% and 20.00% for spleen; 17.39%, 30.43%, 13.04% and 30.43% for kidneys, and 29.27%, 51.22%, 24.39% and 46.34% for heart relative to control. Here again, the pure and formulated herbicides caused the same effect on the levels of energy compounds in most cases.

### B-2- Herbicidal Effect on Myokinase Activity:

After the herbicides induction, myokinase activity was determined in brain, liver, spleen, kidneys and heart; and the results are shown in **Table (8)**. A remarkable decrease was observed in myokinase activity in all investigated organs by the herbicides induction. The decreased values than control were 37.50%, 43.75%, 27.08% and 37.50% for brain; 36.96%, 41.30%, 30.43% and 36.96% for liver; 22.22%, 41.67%, 13.89% and 30.56% for spleen; 38.10%, 52.38%, 39.10% and 47.62% for kidneys, and 25.00%, 25.00%, 20.00% and 25.00% for heart relative to control under the effect

of pure and formulated glyphosate and fluazifop-butyl, respectively. Once again, the pure and formulated herbicides under study possessed the same effect on myokinase activity in most cases.

**Table (5): Effect of herbicides single doses on ATP level in different organs of albino rats.**

Organ		Control	Glyphosate		Fluazifop-butyl	
			Pure	Formulated	Pure	Formulated
Brain	*	7.5 ± 0.6 a	10.0 ± 1.0 b	11.0 ± 1.1 bc	9.5 ± 0.9 b	1.0 ± 7.5 b
	%	100.00	133.335	146.67	126.67	133.33
Liver	*	11.0 ± 1.0 a	13.0 ± 0.9 b	14.0 ± 1.3 b	12.5 ± 1.2 b	14.0 ± 1.3 bc
	%	100.00	118.18	127.27	113.64	127.27
Spleen	*	3.9 ± 0.4 a	4.6 ± 0.5 b	5.0 ± 0.4 bc	4.5 ± 0.4 b	5.0 ± 0.4 bc
	%	100.00	117.95	128.21	115.38	128.21
Kidneys	*	2.0 ± 0.2 a	2.4 ± 0.2 b	2.0 ± 0.3 b	2.5 ± 0.1 b	2.5 ± 0.2 b
	%	100.00	120.00	125.00	125.00	125.00
Heart	*	5.0 ± 0.5 a	5.7 ± 0.6 b	6.0 ± 0.5 b	5.8 ± 0.5 b	6.0 ± 0.5 b
	%	100.00	114.00	120.00	116.00	120.00

The numbers in the row followed by the same letter are not significantly different at P = 0.05 for each parameter.

\* =  $\mu\text{M/g}$  tissue.

**Table (6): Effect of herbicides multi doses on ADP level in different organs of albino rats.**

Organ		Control	Glyphosate		Fluazifop-butyl	
			Pure	Formulated	Pure	Formulated
Brain	*	0.66 ± 0.06 a	0.50 ± 0.04 b	0.54 ± 0.05 b	0.51 ± 0.04 b	0.47 ± 0.05 b
	%	100.00	75.765	68.18	77.27	71.21
Liver	*	0.16 ± 0.01 a	0.10 ± 0.01 b	0.10 ± 0.01 b	0.09 ± 0.01 b	0.11 ± 0.01 b
	%	100.00	62.50	62.50	56.25	68.75
Spleen	*	0.23 ± 0.02 a	0.19 ± 0.02 b	0.16 ± 0.01 bc	0.20 ± 0.02 b	0.18 ± 0.02 b
	%	100.00	82.61	69.57	86.96	68.75
Kidneys	*	0.15 ± 0.01 a	0.10 ± 0.01 b	0.07 ± 0.01 bc	0.09 ± 0.01 b	0.18 ± 0.02 b
	%	100.00	66.67	46.67	60.00	78.26
Heart	*	0.21 ± 0.02 a	0.17 ± 0.02 b	0.15 ± 0.01 b	0.17 ± 0.01 b	0.08 ± 0.01 b
	%	100.00	80.95	71.43	80.95	71.43

The numbers in the row followed by the same letter are not significantly different at P = 0.05 for each parameter.

\* =  $\mu\text{M/g}$  tissue

**Table (7): Effect of herbicides multi doses on AMP level in different organs of albino rats.**

Organ		Control	Glyphosate		Fluazifop-butyl	
			Pure	Formulated	Pure	Formulated
Brain	*	0.30 ± 0.02 a	0.21 ± 0.02 b	0.18 ± 0.08 bc	0.19 ± 0.001 b	1.19 ± 0.01 b
	%	100.00	70.05	60.00	63.33	63.33
Liver	*	0.74 ± 0.07 a	0.59 ± 0.06 b	0.50 ± 0.05 bc	0.61 ± 0.05 b	0.55 ± 0.05 b
	%	100.00	79.73	67.57	82.43	74.32
Spleen	*	0.35 ± 0.04 a	0.30 ± 0.02 b	0.27 ± 0.02 b	0.31 ± 0.02 b	0.28 ± 0.02 b
	%	100.00	85.71	77.41	88.57	80.00
Kidneys	*	0.23 ± 0.02 a	0.19 ± 0.02 b	0.16 ± 0.01 bc	0.20 ± 0.02 b	0.16 ± 0.01 bc
	%	100.00	82.61	69.57	86.96	69.57
Heart	*	0.41 ± 0.04 a	0.29 ± 0.03 b	0.20 ± 0.02 bc	0.31 ± 0.03 b	0.22 ± 0.02 bc
	%	100.00	70.73	84.78	75.61	53.66

The numbers in the row followed by the same letter are not significantly different at P = 0.05 for each parameter.

\* =  $\mu\text{M/g}$  tissue

**Table (8): Effect of herbicides multi doses on Myokinase level in different organs of albino rats.**

Organ		Control	Glyphosate		Fluazifop-butyl	
			Pure	Formulated	Pure	Formulated
Brain	*	0.48 ± 0.05 a	0.30 ± 0.03 b	0.27 ± 0.03 b	0.35 ± 0.03 b	0.30 ± 0.02 bc
	%	100.00	62.505	56.25	72.92	62.50
Liver	*	0.46 ± 0.04 a	0.29 ± 0.03 b	0.27 ± 0.03 b	0.32 ± 0.03 b	0.29 ± 0.03 b
	%	100.00	63.04	58.70	69.57	63.04
Spleen	*	0.36 ± 0.04 a	0.28 ± 0.02 b	0.21 ± 0.02 bc	0.31 ± 0.03 b	0.25 ± 0.02 bc
	%	100.00	77.78	58.33	86.11	69.44
Kidneys	*	0.21 ± 0.02 a	0.13 ± 0.01 b	0.10 ± 0.01 bc	0.13 ± 0.01 b	0.11 ± 0.01 b
	%	100.00	61.90	47.62	61.90	52.38
Heart	*	0.40 ± 0.03 a	0.30 ± 0.03 b	0.30 ± 0.02 b	0.32 ± 0.03 b	0.30 ± 0.02 b
	%	100.00	75.00	75.00	80.00	75.00

The numbers in the row followed by the same letter are not significantly different at P = 0.05 for each parameter.

\* =  $\mu\text{M}/\text{mg}$  protein

## Discussion

### A- Herbicidal Effect on The Energy Compounds :

Adenosine-5-triphosphate (ATP), adenosine-5-diphosphate (ADP) and adenosine-5-phosphate (AMP) were determined in different organ tissues of induced rats. A remarkable decrease was observed in ADP and AMP contents. In contrast, ATP content was increased in all investigated organs by herbicides ingestion.

The significant effects of the investigated herbicides on the different organs are summarized in **Table (9)**.

These results might be related either to the high rate of ATP synthesis or the energy liberated during the metabolic processes through trapping inorganic phosphate with AMP and ADP to form ATP. These findings were in parallel with the results of Abdel-Rahim et al., (1994e) and Knopp and Glass (1997).

The results of ATP, ADP and AMP led to suggest that at any circumstances associated with diminished availability of the prime dietary source of energy, namely carbohydrate, will accentuate utilization of fatty acids for this purpose. In this respect, the stimulation of glycolytic metabolism (forms pyruvic acids and then acetyl CoA) led to accumulate ATP and creatinine stores (Lehninger, 1982 and Abdel-Rahim et al, 1994b). ATP is rapidly utilized in protein biosynthesis through converting to cAMP which stimulated by the adenylate cyclase (Adams et al, 1993).

### B- Herbicidal Effect on Myokinase Activity:

After herbicides ingestion the myokinase activity was determined in different organs tissues of rats and a remarkable decrease in the myokinase activity was noticed in all tissues relative to control.

In general, the increase in ATP level after herbicides ingestion was mainly due to the effect of herbicides on the respiratory system. The maintenance of tissues energy is likely accomplished through increase the glycolysis process. Accordingly, an inhibition in LDH activity caused an increase of energy utilization for tissue processes (Abdel-Rahim et al, 1994b).

The tight coupling of oxidation to phosphorylation, provided a means by which the role of oxidation of food stuffs by respiratory oxygen. The utilization of ATP to drive the divers energy requiring processes of the cells automatically increased the available supply of ADP and inorganic phosphate, which in turn become available to react in the

coupling mechanism and permit respiration to proceed. In the herbicides ingestion condition, the oxidative phosphorylation was stimulated due to the respiration oxygen and the increase of ATP formation (Lehninger, 1982).

Myokinase catalyzes the conversion of 2 molecules of ADP to one molecule of each of ATP and AMP through the following reaction:



This reaction was observed after the complete utilization of ATP. The higher level of ADP than AMP might be due to the utilization of high amounts of ATP in metabolic processes and was converted to ADP (Lehninger, 1982).

The results of the present work emphasized that an urgent rules are needed for global regulation to impose legislation and guidelines for registration and handling of agro-chemical including pesticides which have direct access to the food chain, ought to include methodologies and laboratory facilities for their implementation in many of the developing countries.

**Table (9): The influence of Glyphosate and Fluazifop[-butyl on rat organs parameters.**

Parameters	Glyphosate		Fluazifop[-butyl	
	Pure	Formulated	Pure	Formulated
<b>Heart parameters</b>				
ATP level	+	++	+	+
ADP	-	-	-	-
ADP	-	--	-	--
Myokinase	-	-	-	-
<b>Kidneys parameters</b>				
ATP level	+	++	+	++
ADP	-	--	-	--
ADP	-	--	-	-
Myokinase	-	--	-	-
<b>Spleen parameters</b>				
ATP level	+	++	+	+
ADP	-	-	-	-
ADP	-	--	-	--
Myokinase	-	-	-	--
<b>Brain parameters</b>				
ATP level	+	++	+	++
ADP	-	-	-	--
ADP	-	-	-	-
Myokinase	-	--	-	--
<b>Liver parameters</b>				
ATP level	+	+	+	++
ADP	-	--	-	--
ADP	-	--	-	-
Myokinase	-	-	-	-

The symbols (+, -) and (++, --) indicates significant and highly significant increase or decrease, respectively relative to control rats group.

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## Improved Wheat Production During some Agricultural Practices and Reducing Environmental Pollution

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### **Abstract**

Two field experiments were conducted at extension farm, in El-Mansoura Center, Dakahlia district, Egypt, during 1996/97 and 1997/98 seasons to study the effect of different fertilization treatments; times of foliar spraying of super Grow of some wheat cultivars on the chemical composition of grains and straw for reducing pollution. The trails were arranged in a strip split plot design with four replications. The main findings could be summarized as follows:

The recommended NPK fertilization recorded highest concentrations of cadmium, lead, zinc, iron, nitrate, nitrite in grains and concentrations of nitrate and nitrite in straw compared with other fertilization treatment in both seasons. However, the lowest concentrations produced from biofertilization (syrialin + phosphorin + organic fertilizers) compared with other treatment over both seasons.

Foliar application of super Grow at tillering + elongation and or at tillering + heading stages significantly increased the concentration of cadmium, lead, zinc, iron, nitrate, nitrite in grains as well as concentrations of nitrate and nitrite in straw compared with other time of applications over both seasons. However, the lowest concentration of cadmium, lead, iron, zinc, nitrate, nitrite in grains as well as concentrations of nitrate and nitrite in straw produced from foliar application at tillering stage (40 days from sowing) over both seasons.

The three wheat cultivars did not differ in cadmium, lead, nitrate, nitrite concentration in grains and nitrate, nitrite in straw over both seasons. However, the maximum cadmium and lead concentration in grains were produced from the Gemmiza 3 cultivar (0.120 and 0.114 ppm) followed by Sakha 69 cultivar (0.116 and 0.106 ppm) and Sids 8 cultivar (0.117 and 0.109 ppm) over the two seasons. Highest zinc and lead concentrations in grains was obtained from Sakha 69 cultivar followed by Gemmiza 3 and Sids 8 cultivars.

Maximum concentration of cadmium in grains was obtained from adding the recommended NPK fertilization with spraying Super Grow at tillering + heading stages (40 + 80 days from sowing) over both seasons. The highest concentration in grain from adding the recommended NPK fertilization with spraying at tillering + elongation stages (40 and 60 days from sowing) and/or at tillering + heading stages (40 + 80 days from sowing) over both seasons. The minimum concentration of zinc and iron in grain was produced from spraying Super Grow at tillering + elongation stages (40 and 60 days from sowing) and sown Sakha 69 and/or Gemmiza 3 cultivars over both seasons.

Generally, it can be concluded that adding biofertilization of syrialin + phosphorin + organic fertilizer, spraying Super Grow at tillering + elongation stages (40 and 60 days from sowing) and sown sids 8 or Gemmiza 3 cultivars was the most effective treatment for raising wheat productivity and reducing mineral fertilization as well as reducing pollution under environmental conditions of Dakahlia Governorate.

## **Introduction**

Wheat (*Triticum aestivum*, L.) is considered one of the main cereal crops in the world as well as in Egypt and Libya. The importance of wheat as a major food source for man in many countries has increased consistently in the last decade. Increasing wheat productivity is a national target in Egypt and Libya to fill the gap between wheat consumption and production.

The total cultivated wheat area with wheat in Egypt was about million hectares (2.5 million faddans) producing was about 6.3 million tons (42 million ardabs) in 1999 season with an average of 6.76 ton/hectares (18.94 ardab/faddan), (Gomaa, 1999). Meanwhile, the total cultivated area with wheat in Libya was about 30 thousand hectares (12.6 thousand faddans) in 1999 season with a national average of about 5.41 ton/hectares (15.15 ardab /faddan)\*.

Environmental pollution, especially by increasing chemical fertilization is one of the most effective factors in the destruction of the biosphere components. Among all chemical contaminants nitrate, nitrite and heavy metal particularly in soil and subsequently plants are considered potential hazardous contaminants in the biosphere to human health. The utilization of chemical fertilization on agricultural land introduces harmful substances into soil. When absorbed by wheat plants these contaminants enter the food chain affecting both animal and human.

The nitrates being in water and food have serious effects, as they cause diseases for children and ruminant animals called "Methemoglobinemia" that caused a high ratio of mortality for children and animals, while the adult can endure nitrates being in water. These diseases are caused when the child or animal drink water full of high ratio of nitrates or take food full of a high ratio more than 10 parts of million and, in this case the nitrates are to be reduced in the bowels to nitrites that are to be absorbed in the blood current, then combined with hemoglobin transforming it to methemoglobin, and blood comes to be incapable of carrying oxygen during respiration. Of the bad effects that are possible for nitrification process is composing of nitrosamines compounds and these consist by combining of nitrite (whether consisted by ammonia oxidation or nitrates reduction) with some products of insecticides decay. It has become evident that these compounds cause cancer and cells mutation (W.H.O., 1984). According to Bergstrom and Brink (1986), it is reasonable to expect that the loss of nitrate by leaching occurs more readily than ammonium especially in coarse-texture soils. Ammonium may be retained in soils as an exchangeable ion on clay surface or it may form relatively stable complexes with some organic substances. Ibrahim (1990) found that the concentration of  $\text{NH}_4\text{-N}$  and  $\text{NO}_3\text{-N}$  in the drainage water from silty clay soils is much higher than from clay soil. Tahoun *et al.* (1993) did a quantitative estimate of nitrogen losses from Egyptian soils. Fields with tile drain facilities were monitored for nitrogen inputs and outputs. They found that leaching losses of nitrogen from soils under corn ranged between 7 and 49 kg/fad. Also, Sveda *et al.* (1992) found that ammonium fertilizers and urea may undergo loss by volatilization soon after application but, denitrification and leaching loss may occur later when the  $\text{NH}_4\text{-N}$  has been oxidized to  $\text{NO}_3\text{-N}$ .

Plants absorb nitrogen from soil in the nitrate form or ammonium or both depending on the availability of each. As early as El-Baisary *et al.* (1982) studied the effect of N applied as calcium ammonium nitrate or urea to wheat plant. They stated that the amount of nitrogen accumulated in grains was less with calcium ammonium

nitrate than with urea. In addition, the amount of nitrogen in straw greatly affected by nitrogen application without significant differences among nitrogen forms. In another study, Mabler *et al.* (1994) found that grain yield of wheat and nitrogen use efficiency were insignificant affected when  $\text{NH}_4\text{NO}_3$  or urea were used.

Toxic metals derived from soil parent materials usually constitute by far the major group in soils. Hassan (1997) cited from literature that cadmium pollution of the environment has been rapidly increasing in recent decades as a result of rising consumption of cd by industry. Unlike pb and cu which have been utilized for centuries, cd had only been widely used this century. More than half of the cd ever used in industry was produced in the last 25 years. Hutton (1982), also mentioned that sources of soil contamination by cd are the mining and smelting of pb and zn, atmospheric and soil pollution. He has also added that phosphate fertilizers are an important example of cd impurity and their continual use has led to significant increases in the cd, zn, fe, content of many agricultural soils.

The objectives of this investigation was to study the utilization of some agricultural practices to improve wheat productivity for the three evaluated wheat cultivars, Sakha 69, Sids 8 and Gemmiza 3 through different fertilization treatments, time of foliar nutrients application and their interaction. Minimizing the environmental pollution with the mineral fertilizers, in particular nitrogenous ones is considered among the study targets.

### **Materials and Methods**

Two field experiments were conducted in Mansoura Center, Dakahlia Governorate, during 1996/97 and 1997/98 seasons. This investigation was aimed to study the effect of different fertilization treatments

- 1- without
- 2- recommended NPK (70 kg N, 23 kg  $\text{P}_2\text{O}_5$  and 25 kg  $\text{K}_2\text{O}$ /fad)
- 3- 40  $\text{m}^3$  farmyard (FYM) manure/fed
- 4- inoculation grains of syrialin (400) + phosphorin (600) + 40  $\text{m}^3$  organic fertilizer/fed. 5- inoculation grains of syrialin (600) + phosphorin (600) + 40  $\text{m}^3$  organic fertilizer/fed and
- 5- syrialin 800 gm /fad + phosphorin 800 gm /fad + organic fertilizer at rate 40  $\text{m}^3$  /fad.

Times of foliar nutrition of Super Grow nutrient at tillering (40 days from sowing), at elongation (60 days from sowing), at heading (80 days from sowing), at tillering + elongation stages, at tillering + heading stages on growth, yield and yield components of the three wheat cultivars i.e. Sakha 69, Sids 8 and Gemmiza 3.

A strip split plot design with four replications was used. The horizontal plots were devoted as above mentioned six fertilization treatments. The vertical plots were allocated with the five times of foliar application of Super Grow nutrients as above mentioned. The sub plots were occupied by the chosen three wheat cultivars, namely Sakha 69, Sids 8 and Gemmiza 3. The sub plots area was 3.0 x 3.5 m (10.5  $\text{m}^2$ ) i.e. 1/400 fad. The recommended of nitrogen fertilization in the form of urea (46.5 % N) was used at a rate of 70 kg N /fad and applied in two equal portions with the first watering and before the second watering. Calcium super phosphate at a rate of 150 kg/fad (15.5 %  $\text{P}_2\text{O}_5$ ) and potassium sulphate at a rate of 50 kg  $\text{K}_2\text{O}$ /fad (50 %  $\text{K}_2\text{O}$ )

were added during land preparation. Bacterial inoculation of wheat grains was done immediately before sowing irrigation. Bio-fertilizer included Azotobacter, Azospirillum and Bacillus bacteria and obtained from A.R.C. Ministry of Agriculture. Organic fertilizer as farmyard manure was taken from dairy farm, Agric. Experiments Station Fac. of Agric. Mansoura Univ. and its contents are shown in Table 1. Foliar application of Super Grow 20-20-20 at a rate of 50 gm/300 liter water was used in this study. Super Grow contains 20 % of total nitrogen, 20 % available phosphoric acid ( $P_2O_5$ ), 20 % soluble potash ( $K_2O$ ), 0.15 % Fe, 0.05 % Mn, 0.05 % Cu, 0.005 % Mo, 0.2 % S, 0.15 % Zn, 0.05 % Mg, 0.05 % Ca and 0.02 % B. Grains of wheat cultivars were obtained from Wheat Breeding Section, A.R.C. The experimental soil was loamy clay texture, the mechanical and chemical analysis of experimental soil are presented in Table 2. Water samples were collected from the different drains passing through the area and used in irrigating the soils at different periods. Also, water samples were taken from normal canal (Dommita branch) to represent Nile water, the chemical composition of Nile water from normal canal (Dommita branch) are presented in Table 3.

**Table 1: Chemical analysis of the Farmyard manure in the two seasons.**

PH	Organic carbon %	Total nitrogen %	C/N ratio %	Total phosphorus %	Total potassium %
7.21	19.35	1.46	13.1	0.26	1.41

**Table 2: Mechanical and chemical analysis of experimental soil in both seasons.**

seasons	Mechanical analysis						pH	Total nitrogen %
	Coarse sand %	Fine sand %	Silt %	Clay %	Organic matter %			
1996/97	5.49	19.80	36.29	38.42	1.88	7.80	0.122	
1997/98	6.59	18.80	40.41	34.20	1.81	7.75	0.117	

In both seasons, wheat was preceded by maize. Grains of wheat cultivars were sown on mid November at a rate of 70 kg/fad in both seasons. At harvest, ten guarded plants of one square meter of each sub plots were taken at random to estimate the following characters:

- 1- Heavy metals (cadmium, lead, zinc and iron) was estimated in a digestive solution ( $HClO_4 - H_2SO_4 - HNO_3$ ) by an atomic absorption spectrophotometer method according A.O.A.C. (1980).
- 2- Nitrates in the plant: As described by Singh (1988), 0.1 gm of finely ground sample with 50 ml of 2 % acetic acid in a conical flask was rotary shaken for 20 minutes and filtered. Nitrate was determined in the filtrate according to Bremner (1965).

**Table 3: Chemical composition of Nile water from normal canal (Dommitte branch) in 1996/97 and 1997/98 seasons.**

Variables	Seasons	
	1996/97	1997/98
pH	7.55	7.53
Ec ds/m	0.48	0.47
<b>Soluble anions and cations (mg/L):</b>		
CO <sub>3</sub> (ppm)	---	---
HCO <sub>3</sub> <sup>-</sup> (ppm)	3.10	3.09
Cl <sup>-</sup> (ppm)	1.42	1.39
SO <sub>4</sub> <sup>-</sup> (ppm)	0.28	0.22
Ca <sup>++</sup> (ppm)	1.79	1.77
Mg <sup>++</sup> (ppm)	1.22	1.21
Na <sup>+</sup> (ppm)	1.55	1.50
K <sup>+</sup> (ppm)	0.24	0.22
Fe (ppm)	0.400	0.300
Mn (ppm)	0.080	0.070
Zn (ppm)	0.070	0.090
Cu (ppm)	0.010	0.020
Co (ppm)	0.050	0.040
Ni (ppm)	0.010	0.010
Cd (ppm)	0.001	0.002
Pb (ppm)	0.050	0.051

Data of the two seasons were subjected to the proper statistical analysis of the technique of analysis of variance of strip split plot design as mentioned by Gomez and Gomez (1984). Treatment means were compared using New Least Significant Differences (N.L.S.D.) test at 5 % and 1 % level of probability.

## **Results and Discussion**

### **A- Fertilization treatments effects:**

Data presented in Tables 4 and 5 show that fertilization treatments significantly affected the concentrations of cadmium, lead, zinc, iron, nitrate, nitrite in grains and nitrate, nitrite in straw over both seasons. Adding the treatments of recommended NPK fertilization as mineral fertilization produced highest concentration of cadmium, lead, zinc, iron, nitrate, nitrite in grains and nitrate, nitrite in straw compared with other treatments over both seasons, which were 0.204, 0.177, 40.50, 38.35, 4.140, 0.198 ppm in the grains and 3.168, 0.136 ppm in the straw, respectively. In addition, the lowest concentrations produce from without fertilization treatment followed by bio-fertilization treatments

### **B- Time of foliar nutrition effects:**

Super Grow foliar application at different stages significantly affected concentrations of cadmium, lead, zinc, iron, nitrate, nitrite in grains and nitrate, nitrite in straw as presented in Tables 4 and 5. Foliar application of Super Grow at tillering + elongation and/or at tillering + heading stages maximized concentrations of cadmium, lead, iron, nitrite in grains and nitrate, nitrite in straw compared with other times of spraying in both seasons. Meanwhile, foliar spraying of Super Grow at tillering + elongation stages significantly maximize concentrations of zinc and nitrate in grains compared with other time of spraying in both seasons. In addition, the lowest concentration produce from foliar spraying at tillering stage.

### **C- Cultivar performance:**

Data presented in Tables 4 and 5 show that tested cultivars significantly differed in concentrations of zinc and iron in both seasons. Maximum concentration of iron in grains were obtained from sown Gemmiza 3 cultivar followed by Sakha 69 and Sids 8 cultivar came in the last rank, which were 29.39, 29.08 and 28.80 ppm over both seasons. Meanwhile, the highest concentration of zinc in grains were obtained from sown Sakha 69 cultivar followed by Gemmiza 3 and Sids 8 cultivars came in the last rank, which were 28.25, 28.11 and 27.64 ppm over both seasons. Over both seasons, concentrations of cadmium, lead, nitrate, nitrite in grains and nitrate, nitrite in straw of wheat cultivars was not significantly affected in wheat cultivars, but Gemmiza 3 cultivar tended to be the highest as shown in Tables 4 and 5.

### **D- Significant interaction effects:**

The interaction between fertilization treatments and times of foliar nutrient application significantly affected concentrations of Cadmium and lead in both seasons as shown in Table 6. Maximum concentration of cadmium was obtained from adding recommended NPK fertilization and foliar application at tillering + heading stages over both seasons compared with other treatments. Meanwhile, the highest concentration of lead was obtained from adding recommended NPK fertilization and foliar application at tillering + elongation and/or at tillering + heading stages, which were 0.205 and 0.207 ppm with insignificant differences over both seasons. The lowest concentrations of cadmium and lead in grains were produced from the interaction between without fertilization treatment and foliar application at all stages with insignificant differences over both seasons.

The interaction between times of foliar application and some wheat cultivars significantly affected concentration of zinc and iron in both seasons as presented in Table 7. Maximum concentration of zinc and iron were produced from foliar application on super grow at tillering + elongation and/or at tillering + heading stages and sown Sakha 69 or Gemmiza 3 cultivars in both seasons, which were 29.73, 30.17 and 31.32, 31.37 ppm and/or 29.35, 29.38 and 31.35, 31.76 ppm respectively. All interactions had insignificant effects on concentration of nitrate, nitrite in grains and nitrate, nitrite in straw over both seasons indicating that each both the three tested factors acted separately.

**Table 4: Means of cadmium, lead, zinc and iron concentrations in grains (ppm) as affected by fertilization treatments, time of foliar nutrition of some wheat cultivars over both seasons.**

Characters Treatments	Concentrations in grains (ppm)			
	Cadmium	Lead	Zinc	Iron
<b>A: Fertilization treatments</b>				
Without fertilization	0.060	0.051	18.80	19.46
NPK fertilizer (Recom.)	0.204	0.177	40.50	38.35
Organic fertilizer	0.115	0.111	29.79	28.63
S 400+P 400+O40	0.108	0.105	27.79	28.96
S 600+P 600+O40	0.107	0.106	25.53	29.58
S 800+P 800+O40	0.111	0.107	25.59	29.56
F-Test	*	*	**	*
N-LSD at 5 %	0.003	0.002	0.43	0.37
N-LSD at 1 %	---	---	0.58	---
<b>B: Time foliar nutrition</b>				
At tillering stage	0.098	0.091	24.56	25.58
At elongation stage	0.118	0.109	28.13	27.06
At heading stage	0.121	0.112	28.55	30.07
At tillering + elongation	0.125	0.119	29.61	31.33
At tillering + heading	0.126	0.119	29.16	31.40
F-Test	*	*	**	*
N-LSD at 5 %	0.001	0.004	0.25	0.25
N-LSD at 1 %	---	---	0.34	---
<b>C: Cultivars</b>				
Sakha 69	0.116	0.106	28.25	29.08
Sida 8	0.117	0.109	27.64	28.80
Gemmiza 3	0.120	0.114	28.11	29.39
F-Test	N.S	N.S	**	**
N-LSD at 5 %	---	---	0.21	0.20
N-LSD at 1 %	---	---	0.27	0.26

S= Syrialin , P= Phosphorin and O= Organic fertilizer

**Table 5: Means of nitrate, nitrite concentration in grains and straw (ppm) as affected by fertilization treatments, time of foliar nutrition of some wheat cultivars over both seasons.**

Characters Treatments	Concentrations in grains		Concentrations in straw	
	Nitrate (ppm)	Nitrite (ppm)	Nitrate (ppm)	Nitrite (ppm)
<b>A: Fertilization treatments</b>				
Without fertilization	2.122	0.102	1.021	0.044
NPK fertilizer (Recom.)	4.140	0.198	3.168	0.136
Organic fertilizer	3.242	0.129	2.424	0.109
S 400+P 400+O40	3.046	0.135	2.342	0.102
S 600+P 600+O40	2.837	0.128	2.329	0.098
S 800+P 800+O40	2.955	0.127	2.331	0.106
F-Test	*	*	**	*
N-LSD at 5 %	0.008	0.003	0.014	0.003
N-LSD at 1 %	---	---	0.019	---
<b>B: Time foliar nutrition</b>				
At tillering stage	2.551	0.125	2.087	0.083
At elongation stage	2.908	0.136	2.267	0.096
At heading stage	3.246	0.139	2.309	0.104
At tillering + elongation	3.306	0.141	2.342	0.106
At tillering + heading	3.274	0.142	2.340	0.106
F-Test	**	*	*	*
N-LSD at 5 %	0.008	0.002	0.007	0.003
N-LSD at 1 %	0.010	---	---	---
<b>C: Cultivars</b>				
Sakha 69	3.058	0.143	2.277	0.100
Sida 8	3.043	0.134	2.255	0.099
Gemmiza 3	3.069	0.133	2.275	0.098
F-Test	N.S	N.S	N.S	N.S
N-LSD at 5 %	---	---	---	---
N-LSD at 1 %	---	---	---	---

S= Syrialin , P= Phosphorin and O= Orgaic fertilizer

**Table 6: Means of cadmium and lead concentrations in grains (ppm) as affected by the interaction between fertilization treatments and time of foliar nutrients over both seasons.**

Characters Treatments		Concentrations in grains (PPm)	
		Cadmuim	Lead
Without fertilization	At tillering stage	0.058	0.050
	At elongation stage	0.058	0.049
	At heading stage	0.060	0.051
	At tillering +elongation	0.062	0.055
	At tillering + heading	0.062	0.051
NPK fertilizer (Recom.)	At tillering stage	0.158	0.133
	At elongation stage	0.200	0.175
	At heading stage	0.212	0.167
	At tillering +elongation	0.225	0.205
	At tillering + heading	0.226	0.207
Organic fertilizer	At tillering stage	0.109	0.103
	At elongation stage	0.117	0.110
	At heading stage	0.118	0.117
	At tillering +elongation	0.117	0.112
	At tillering + heading	0.114	0.115
Syrialin 400 + phosphorin 400 + organic 40	At tillering stage	0.082	0.083
	At elongation stage	0.113	0.105
	At heading stage	0.111	0.107
	At tillering+elongation	0.117	0.115
	At tillering + heading	0.116	0.115
Syrialin 600 + phosphorin 600 + organic 40	At tillering stage	0.082	0.085
	At elongation stage	0.111	0.107
	At heading stage	0.111	0.112
	At tillering +elongation	0.112	0.113
	At tillering + heading	0.119	0.113
Syrialin 800 + phosphorin 800 + organic 40	At tillering stage	0.099	0.090
	At elongation stage	0.110	0.106
	At heading stage	0.112	0.115
	At tillering+elongation	0.119	0.111
	At tillering + heading	0.117	0.111
F-Test		**	**
N-LSD at 5 %		0.007	0.006
N-LSD at 1 %		0.009	0.008

**Table 7: Means of zinc and iron concentrations in grains (ppm) as affected by the interaction between time of foliar nutrients and wheat cultivars over both seasons.**

Characters Treatments		Concentrations in grains (PPm)	
		Cadmuim	Lead
At tillering stage	Sakha 69	25.13	25.98
	Sids 8	24.31	25.45
	Gemmiza 3	24.23	25.32
At elongation stage	Sakha 69	28.70	26.67
	Sids 8	27.64	26.48
	Gemmiza 3	28.05	28.02
At heading stage	Sakha 69	28.36	30.07
	Sids 8	28.54	29.66
	Gemmiza 3	28.74	30.48
At tillering+elongation	Sakha 69	29.73	31.32
	Sids 8	28.94	31.29
	Gemmiza 3	30.17	31.37
At tillering + heading	Sakha 69	29.35	31.35
	Sids 8	28.76	31.10
	Gemmiza 3	29.38	31.76
F-Test		**	**
N-LSD at 5 %		0.51	0.49
N-LSD at 1 %		0.67	0.65

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## **Socio Economics (Group Sphinx)**

### **Rural and Agricultural Development of Egypt**

Margund Hantl

#### **Introduction**

In order for governing organisations to be able to communicate in international co-operative projects, required are the following:

- the population concerned is *partner* in the development process
- the population concerned receives an education which is target group-oriented
- the population concerned learns location adapted self-help measures through *motivation*

#### **Knowledge Society of the rural population**

With the growing role of knowledge as a crucial factor of production (knowledge society), the society will become the key locational determinant. Of decisive importance will be its ability to generate and use locally relevant knowledge to solve specific problems.

Without highly qualified manpower, it would be impossible to maintain an efficient, democratic, governmental and administrative apparatus, modern infrastructure and education and research.

*„Higher education is no longer a luxury: it is essential to national social and economic development.“* (Dr. W. von Richter, 2000)

- The *goal* for the external project planner is a project cooperation, which ends in a goal-directed self-initiative of the population concerned.
- By that means, the *durability* and *carrying capacity* of the measures are ensured.
- *Target group-oriented measures in vocational training* lead to autonomous self-help groups.
- Within socio-cultural, substructural, ecological and political conditions, the *quality of life* of the target group *becomes elevated and is durable*.
- The complex relationships within the social system and landscape must be *multi-factoral* and must offer *network solutions*, at least when the land is integrated in the *world market*.

### ***Goal: Reduction of urban-rural contrasts***

- The individual household plays a central role in its wide-ranging dependence upon the ecological, socio-economical, socio-cultural and political conditions in the individual villages.
- Agricultural side-business develop well under the networking of alternative employment possibilities and development resources of status-differing populations.

### ***Higher education in learning regions***

An innovative, regionally assimilated education and research milieu is essential for the

- formation of regional subcentres (learning regions)
- business concentrations (clusters)
- techno-economic growth
- higher education institutions
- training and continuing education centres
- consultancy providers
- organisers of research cooperation projects

In global competition for foreign investments, the regional density of training, research and development institutions (institutional thickness) combined with a corresponding institutional networking capability is a decisive advantage.

### ***Higher education in learning regions promises in every system Success through motivation***

with the durable dependability of elevated

- quality of life,
- quality of wages,
- quality of the environment,
- quality of employment, and
- quality of knowledge.

### **Goal: Change of consciousness „in the heads“**

The Fellachen are able to adapt to changed environmental conditions based on their tradition. So exists a state of consciousness for the necessary change within the Egyptian population.

### ***Summary***

#### **Only higher education is able to sustain development.**

This includes:

- educational systems
- poverty alleviation
- environmental protection and resource conservation
- private sector development
- developing civil society

Important is:

- development from „below“ and development from „above“ supplement each other
- small, decentral projects within the rural regions
- principles of target group-orientation, self-help and participation
- organisation of alternative economic branches within rural regions
- didactic assignments
- not from external sources, rather from the population concerned

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## ***University Staff Development (Group Papyrus)***

### **Graduate Employment and Work - A Challenge for University Staff**

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Concern has grown rapidly about graduate employment and work in European countries recently. At the same time, the number of surveys on graduates employment and work has increased substantially. In the *European Journal of Education* (Vol. 35, No. 2, June 2000), a selected number of such surveys about different European countries has been published.

One of the main reasons for the increase of such surveys is the structural and functional changes that have taken place and are still taking place in universities.

These changes lead to the assumption that the discrepancy between competences acquired in education and those required in "real life" has grown to a large extent. Kellermann & Sagmeister (162/2000) point out three possible origins for this discrepancy. "First, the educational system might be so far removed from the workplace that educators are unable to anticipate the competences graduates will need for a productive life (under-qualification)". Second, the workplace might be organized in such a way that graduates' skills cannot be used efficiently (under-utilization) and finally the graduates might be overqualified according to the discrepancy itself, especially from the graduates' point of view.

Teichler (151/2000) assumes that the number of privileged and intellectually highly demanding positions has not grown over the last few decades in the line with the expansion of higher education. He assumes further that the perceived threshold between a somewhat appropriate graduate job and underemployment or inappropriate employment certainly has changed as a consequence of the growing supply of graduates, and finally it seems obvious that employment in general – and more especially that of higher education-trained persons – has become more risky in recent years than "regular employment" for a graduate in past.

In developing countries the problems of graduates' employment do not seem to be of crucial importance in comparison to other multifold problems of universities at the present. However, a number of surveys in the 90's concerning the role of higher education in general and the role of universities specially assume that change in universities world wide is necessary if they are going to survive (World Bank, 1994, World Conference on Higher Education, 1998, Gibbons, 1994, World Conference on Higher Education for all, 1990).

This paper focuses on these changes in close relation to graduates employment and work in universities and tries to point out the importance of research in this area and discusses some methodological bias to such a kind of research, especially in the universities of developing countries.

## ***Need for Change***

The debate on necessary changes in universities points out the following aspects:

- Universities worldwide are facing crucial problems due to the new role that they have to play in the near future,
- the survival of universities depends very much on the readiness of universities to actually take the future changes into consideration,
- Internalisation and globalisation put the economies and science under pressure and require the implementation of necessary changes in the universities and ask for their positions and programmes,
- the universities are facing severe financial crisis according to their efficiency, competition patterns and their co-operation with corresponding institutions in the society,
- governmental support of universities probably will be replaced by self-management and operational autonomy in the near future,
- the change of paradigms in universities' teaching, research and administration has already started in many universities. For their quality assurance, universities need more efficiency, co-operation and competition.

Universities under state control have hitherto rarely involved themselves with organisational changes on their own support. They have more so reacted on the decision-makings of their governments in the case of innovations. It has been possible or necessary to improve the curriculum, the teaching, the research and the administration in favour of students and graduates of their university.

## ***Need for research on graduates' employment***

The employment and work situation of graduates is one of the issues most frequently referred to in the current debates on the social function of higher education. Information about graduate employment and work is generally considered as a core area of knowledge that can stimulate reflections on the function of higher education. Information about graduates' employment is, however, far from satisfactory (Paul, Teichler, van der Velden 139/2000). The reasons are firstly that the universities and staff are essentially not interested in dealing with the processes of transition of their graduates and leave the regulation of the employment to the economy of the societies. Secondly, reflection and research on the relationship between education and employment are frequently depicted as being ideologically bound to support a belief that higher education should subordinate itself to the needs of the economy. Thirdly, tracer studies have not been taken seriously into consideration and have mainly been done by individual university staff members according to their very close personal interests. The effects of such studies and their practical implementation have been hardly tangible. Fourthly, students in universities are basically and mainly not interested in dealing with future employment and work during their studies. They simply shield the aspects of future employment, believing strongly in the given chances compared to the non-educated in the society.

However, thinking in a much broader conceptualisation of graduates' employment opens not only an innovative search area in social and economic sciences, but enables the achievement of substantial arguments in debates on the economic and social functions of universities and the growing relationship between universities and other institutions of society. This is in terms of co-operation rather than the above mentioned sub-ordination to/or even the domination of the economy.

## ***Research on employment and work***

Research on employment and work is of course based upon the existing secondary statistics of graduates. These are on the one hand not complete and occasionally not correct, and on the other hand they do not focus on the relevant research aspects in this area. Teichler (2000) suggests themes addressed in graduate surveys as follows:

The collection of information about the graduate labour market,

- the support sought for and provided by employment agencies, institutions of higher education, friends and relatives, etc.,
- the length of the search,
- search activities,
- search criteria as well as perceived recruitment criteria on the part of the employers,
- transitory activities, such as accepting jobs that are not considered related to one's professional identity,
- timing of transition to first regular employment,
- characteristics of first employment, e.g. Short-term contact, involuntary part-time contact, etc.

Following the above-mentioned themes in research on graduates' employment, one recognises easily that a combined research methodology is required to cover all of those aspects.

The experiences in the University of Kassel – Witzenhausen show that the use of combined methods for an integrated search on graduates' employment is not easy if the research is to be carried out by individual researchers. Besides the findings of some of the integrated parts of survey do not necessarily justify the efforts that lie behind it.

The following instruments are however necessary if an integrated research is planned in this area:

- Critical review of existing research materials on graduates employment and work
- Development of new instruments and techniques to study change and employment
- Organization of interaction between employment and university
- Support of students in their employment and work conceptions and of innovations in the world of work.

## ***Methodological Issues***

### **Survey on new entrance students**

It is not only of importance to have statistics on the total number of students available for the survey, but to organise a special survey to collect relevant data, especially in terms of the future perspectives of the freshmen and of their future occupational visions. To achieve this, the groups of freshmen are invited to give information about their social origin, their motivations to study certain subjects, their expectations and last, but not least, to give information about their attitudes concerning the world of work and also the kinds of work that they may prefer to do after graduation. The most important objectives of this kind of survey which can be carried out in close co-operation with the registrar's offices of the universities, which very often have similar information collection, is to follow the changes of the profile of entrance students permanently and identify the changes that might have taken place over a period of years.

In countries in which surveys of this kind are totally new, the establishing of a data bank seems to be essential and can be used for further surveys, especially for tracer studies in years after education. A second important objective might be the analysis of data in relationship with the curriculum of higher education and to discuss whether the given curriculum is close to the expectations or is far from it. This can be used as an indicator for the organisation of students' career planning and somehow for the slight functional changes in the curriculum or syllabi. As an example, there has been a tradition in the Faculty of Eco-Farming in Witzenhausen/University of Kassel since 1985 (Bichler/Amini 1999) to carry out surveys on entrance students (92/93 (100); 93/94 (59); 96/97(62); 97/98 (50); 98/99 (60)), where we could follow and analyse the decreased number of students (1991: 1018; 1997: 605), increased number of female students among all students: 92/93 (34/76); 98/99 (59/41), increased number of entrances with German school leaving certificate (Abitur): 96/97 (66%); 97/98 (74%); 98/99 (81,7%) and finally the decreased number of students with parents owning agricultural farms (since 1996 nearly 1/4 of the students).

### ***Longitudinal surveys***

The second kind of survey focuses on the changes in attitudes of the students that might take place during their education. Panel surveys are especially adequate to follow the specific changes in attitudes that might have taken place during the students' active participation in lectures, seminars, excursions, laboratory work and the life on the university campus. Longitudinal studies are not only very expensive, but also very work-intensive. What is much more important is that many experiences and surveys show little outcome of this kind of survey, because the attitudes of the students generally do not change significantly during their study. For the above-mentioned experience at the University of Kassel, there were changes in a few areas only in terms of the future occupational conceptions as the following figure stresses:

Future employment	Average 1=very much; 5=not at all	Tendency at Repetition
Environment/Protection	<b>2,07</b>	-
Practical Agriculture/Farm Management	<b>2,12</b>	0
Co-Farming	<b>2,50</b>	-
Development/Aid	<b>2,74</b>	0
Public services	<b>2,90</b>	0
Marketing	<b>2,93</b>	0
Research/Science	<b>3,01</b>	0
Regional Planning	<b>3,01</b>	Not compared
Farm Foundation	<b>3,03</b>	0
Education	<b>3,03</b>	0
Consulting	<b>3,11</b>	+
Industry	<b>3,17</b>	0
Continuing Education	<b>3,41</b>	+
Homework/Family	<b>3,66</b>	0
Administration	<b>4,13</b>	+

However, longitudinal surveys might play a great role in other cases, where search on this theme is missing and no experiences have been existent before.

### **Conferences and workshops**

It is of crucial importance to organise workshops with this theme during the survey. There are two kinds of workshops relevant in this case. First, workshops might be organised to discuss with representatives of the corresponding employers, students and staff members the issues of employment and work from different viewpoints. It is necessary to follow the survey in line with the experiences and expectations of these three parties and make it clear that all viewpoints have been taken into consideration. Furthermore, employers are emphasized to get in contact with universities if they are to know how to manage it. Such contacts may lead to a kind of starting co-operation with the world of work and try to integrate some legitimate expectations of the potential employers into the curriculum. Our experiences in Witzenhausen show that there are a number of potential employers, who miss several basic key qualifications, which are not thought of at the university. The employers themselves do not have the necessary equipment to train the candidates easily at their place of employment. Other employers have very specific expectations not to be dealt with at the university, especially in the case of administration the public sector (Amini/Jahr, 1999). However, this must be checked out from case to case. Another interesting issue in these kinds of workshops is the opportunity to identify potential employers, who can join a mentor-programme, which might be of eminent importance for the future employment of later graduates. However, the organisation of mentor-programmes might be not easy, but quite effective. Secondly, workshops might be organised with experts from different universities to discuss the methods of surveys on graduates' employment. The standards of these kinds of surveys to make a comparison of different surveys looked for (Amini/Jahr, 1998).

### **Supply of courses on employment and work for students**

The supply of elective courses might be of interest to some of the students. They will not only be motivated to deal with their future employment during the study, but also learn a lot about the techniques of application, special communication skills, dialogues etc. Our experience shows that this kind of supply is very effective and is evaluated very positively by students who have participated in these courses. However, from different points of view the number of students, who demand such courses, is small.

### **Tracer Studies**

Tracer studies are the main part of search on graduates' employment and work. The specific objective of tracer studies is to collect information about the process of the employment of the graduates in terms of the transition from academic life into the "real life", adequateness and appropriateness of the occupation in close relation to academic qualification, the career planning of the graduates in relation to non-academic employees and finally the graduates' interpretation and evaluation of their actual position at work. Besides, it is necessary to collect information about the potential employers in corresponding fields and the economic and social aspects of the labour market in the corresponding society. From this, tracer studies need information about the link between the higher education system and the society (Teichler/1989).

Tracer studies take the personal socio-economic background of graduates into consideration. Starting with a tracer study, the question may come up, whether graduates can be identified by addresses, since it works necessarily with a questionnaire. This is

probably one of the greatest difficulties of the tracer study, especially in the case when a data bank with addresses of the graduates is missing. This is very often the case in developing countries, simply because the connection to the university breaks down after graduation. After a period of years, there is not any information about the former graduates. Their addresses have changed several times and the permanent addresses do exist only in a few cases. There is simply no solution to this problem, except that a planned tracer study in future is to be prepared systematically. This will be by collecting data of graduates who then remain in permanent contact so that their addresses can be actualised from time to time. This is probably not an easy job and must be organised at the university institutionally. The title of this paper refers to UNISTAFF as a possible form of institution, which may take this interesting task into consideration (see below).

Another difficulty of tracer studies is that the existence of a data bank with addresses is so far no guarantee for getting answers from graduates, should they not see the sense of these kinds of investigations and their contact to their former universities. This is of course, a large challenge to the institution dealing with the organisation of surveys of this kind. However, dealing with this question gives many interested researchers the opportunity to open a new area of research with an interesting paradigm and enable them to develop themselves as experts in this area of research. This is not only crucial to the scientific community, but also to policy makers, university and curriculum planners and higher education managers.

Tracer studies usually collect data about the ratio of graduates in the age group, age at the time of graduation (delays in finishing education or the age of entrance, etc.), gender issues, participation in the labour force, higher education and income, the relevance of the graduation rate, employment problems of the graduates, equality of opportunity and graduate employment, the time of transition and the different occasional jobs until permanent employment and finally their satisfaction.

Referring to our experience in Witzenhausen again, we could identify the following selected findings in a tracer study carried out in 1998/99 about the graduates of Eco-Farming from 1992 – 1998:

710 Graduates between 1992 and 1998 in Witzenhausen; 45% of which answered our questionnaire.

The background was the survey on graduates by Bichler/Schomburg (1979 to 1992). Questions were about motivation of study in Witzenhausen, personal situation, employments procedures, career planning and finally the actual employment situation; special attention was paid to the graduates of Eco-farming. The survey methodology was prepared due to a conference that had taken place by inviting experts in the field of research on employment and work for improvement of databases and of unified models enabling the comparison of findings.

As it can be seen from the table below the average income of the graduates from Eco-Farming is under standardised conditions less than half of the graduates of the classical fields of study. This finding was very important to check the risks of innovative courses, which are not yet fully integrated in the system of labour market and to enable change in parts of the curriculum, taking for example the economic aspects of the curriculum into account.

### Income situation of graduates in Witzenhausen

Field of Study	Average p. a. gross Income [DM]
Eco-Farming	28669,35
International Agriculture	31059,35
Farm Management	60650,63
Animal Production	45202,29
Plant Production	62478,26
Total	47912,08

The next table shows the income of male and female graduates, which is partly to 1/3 lower with female. This is a crucial problem of society as a whole and demonstrates once more that even the same academic qualification gives rise to differences in employment in terms of gender.

### Gender and income situation in Witzenhausen

Field of Study	Average p. a. gross Income male [DM]	Average p. a. gross Income female [DM]
Eco-Farming	31425	25523
International Agriculture	37961	21855
Farm Management	62481	55347
Animal Production	54277	35592
Plant Production	68144	42080
Total Average	50857,6	36079,4

The satisfaction of graduates is demonstrated in the next table. On a scale from 1 to 5 (very satisfied - not satisfied at all), the indices for satisfaction in terms of different levels of satisfaction are stated. The figures show that the satisfaction of the graduates of Eco-Farming is less in general to other graduates, except the ethical satisfaction, which somehow makes sense in the case of employment in environmental sectors. The results might be disappointing in regards to the curriculum, but it should be stressed that first, Eco-Farming is a new and innovative course. The economy needs time to adapt this kind of education into its programme and second, the question is still open, whether the graduates in Eco-Farming could have any chance to find a job without higher education.

### Satisfaction of employment of the graduates in Witzenhausen

	Eco-Farming	Inter-national Agriculture	Farm Management	Animal Production	Plant Production	Total
Financial	3,21	3,03	2,53	2,63	2,52	2,74
Employment	2,13	2,33	2,01	2,17	2,32	2,16
Career	3,00	2,68	2,59	2,67	2,77	2,72
Ethical	2,08	2,26	2,68	2,61	2,52	2,48
Personal	2,41	2,18	2,08	2,28	2,45	2,24
Total	2,55	2,38	2,08	2,23	2,26	2,26

The examples given above cover only a few findings of surveys on employment and work. Other issues that have been named in this paper, are the further results which partly focus on the communication and interaction between university and society and refer to a number of changes derived out of findings in favour of improvement of the university, university staff, students, graduates and policy decision-makers. For the further procedures, a comparative study can be carried out for the identification of differences in employment and work among different disciplines, like Engineering, Social and Economic Sciences, Humanistics and Natural Sciences, which might have different patterns of transition into the working world.

### Institutional and Organisational Issues

It seems to be evident that search on employment and work, if it should be carried out in the suggested integrated model, cannot be easily done by individual researchers in universities. Individual researchers are probably able to carry out parts of the survey and introduce parts of the model from their very narrow viewpoint only. Therefore, it is necessary to look for organisations in the university which take these themes into their programme and care for a continuous process of collecting data.

Local University Staff Development Programmes (UNISTAFF) that have been established in universities that have the objective of improving teaching and learning, organisation of the university and finally research management, might play an important role in this context.

UNISTAFF-Programmes that have taken “Research Management” as a part of their programme (these are quality assurance of research, research training, research policy) may add doing research into their programme to demonstrate practically co-research work with an interdisciplinary approach as it is very often the case in research on employment and work. The idea that this kind of research is located in economic and social sciences is no longer feasible, simply because search on employment and work cannot be carried out without the participation of representatives of the corresponding disciplines, who might have a better view of the insight of the their discipline.

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## Essentials for the Establishment of a Local University Staff Development Program in Egypt. Menoufia as a Center

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At the present time all over Egyptian Universities, there is a trend for the development of higher education sector in order to compete the requirement of job market. Many events had occurred in the last five years as the establishment of private universities elsewhere in Egypt. This was consequence for the increasing number of students at the governmental universities. Some Egyptian universities applied the credit hour system as a new system for learning and evaluation. University staff development lies in the first position for developing higher education due to the following reasons:

- It realized that university education had fallen short of expectations. For example, it was accused of having failed to apply research to the problems of national development.
- Universities were producing graduates for non-existent jobs, while failing to meet the changing manpower requirements in key areas of national development, such as agriculture, health, engineering, and economics. Indeed, there was a mismatch between university and manpower requirements
- The economic recession and the rising number of students resulting in the need for extra finances, on the other hand, has a marked effect on the quality of education offered by the universities? This situation has been aggravated by the scarcity, obsolescence or neglected condition of technical equipment in many tertiary institutions. In addition, textbooks, references, teaching aids, laboratory equipment, scientific literature and periodicals are all in short supply.

Nowadays, throughout Africa, institutions of higher education are in state of crisis. Universities are bursting at the seams due to the ever-increasing students numbers. They are starved of resources and their libraries are experiencing on acute book famine. These woes are not only threatening lower academic standards but the very existence of the university itself.

In the face of such serious problems, it is becoming more and more evident that the quality of staff is a crucial element in ensuring universities retain their traditional mission of discovering, transmitting and preserving knowledge. Sadly, staff development has received little attention, being measured by the mere advancement up the academic ladder.

Currently, only a handful of lectures has been professionally trained in the art of teaching. The assumption has all along been that the lecture needed in order to be able to teach in a university. The rest one imbibed through osmosis.

That is not the case today. All over the world, it is now recognized that excellence in teaching must be natured. Since universities have little control over basic economic and political conditions, their ask is to take up challenge for providing excellent educa-

tion in the prevailing situations and use their most valuable resource, their staff, to plan and execute structural reforms. It therefore follows, that the rather complex system of generating and transmitting and a technical mastery of their staff teaching, research and constancy functions. This is the essence of staff development.

### ***Function of Universities***

Higher education is of paramount importance in the process of development in Egypt. High level manpower must be trained and quality research carried out if development policies are to be correctly formulated, programs appropriately planned and projects effectively implemented. Consequently, the contributions and functions of universities in Egypt may be considered as threefold: Training, Research and Public Service.

#### **Development of personnel (Training function):**

Egyptian governments expect the universities to prepare the needed personnel to fill high level scientific, technical, and professional and management jobs. One of the most important roles, of university lectures, is to produce graduates capable of performing such jobs.

#### **Development of knowledge (Research function):**

- Egyptian governments expect the universities to generate the knowledge and innovations needed for development through indigenous scientific research and technical know-how as well as to disseminate information.
- University lecturer has to initiate and carry out research that will generate knowledge and contribute to development.
- Encourage students in their research efforts as well as guide and supervise them.

#### **Provision of necessary service (Public service function):**

- Egyptian governments look forward to universities rendering needed high skill service to the community by the staff involving themselves in local activities.
- The universities constitute reservoirs of expertise, which can be trapped by the government private sector.
- The community members, therefore, expect staff member to lead them in their development activities by sitting on various committees and board.

### ***Role of University lecture***

#### **As an authority in his discipline:**

Lectures fail to perform efficiently because of one or all of the following:

- Lack of adequate preparation
- Poor delivery techniques
- Pitching the lecture above or below the academic level of the students.
- In sensitivity to the expectation of the students.

#### **As a planner and manager of time:**

As a university teacher you must develop the skills to plan and manage your time. You have to plan your day, your week and the entire academic year so that you can accomplish all your work.

You need time to:

- Prepare your lecture,
- Give your lecture,
- Supervise students carrying out research,
- Carry out your own research,
- Grade the assignments you have given to your students,
- Set and mark your examination papers,
- Attend departmental meetings and conferences, and
- Attend and serve on committees to which you are elected or appointed.

**As an academic guide to students:**

Many students will register to take the courses you offer because they need them as requirements for earning a degree and also because they think that they can cope with the work involved.

As a university lecturer, you also assume that your students can follow the course you give.

**As an adviser and counselor:**

1. The staff in clinic departments is usually professionals; they normally organize clinics for students who need counseling.
2. Students will also come to staff for advice on personal matters
  - Staff older than students do, so they take the role of parents.
  - Confidence between students and staff.
  - Advice the student to go to a particular person who you consider can be of help.

**As a researcher:**

- Three indicators of the efficiency of a university teacher are linked:  
Research – Publication – Promotion
- Many university teachers do not engage in research and even if they do, many seem to avoid empirical and longitudinal studies. This is actually due to:
  1. Lack of adequate funds.
  2. Anxiety to accumulate a number of publications over a short period.
- In carrying out research, you should involve your students as much as possible.

**As a consultant:**

- The establishment of a university in a community is looked upon as a blessing in many respects.
- Local University provides immediate employment for the middle level manpower and it also acts as a reservoir from which experts can be drawn for local and national activities.
- These experts are expected to render high skill service for the community. Thus university lecturers have been invited to:
  1. Give public lectures and academic topics.
  2. Chair function organized in the community.
  3. Carry out research on relevant issues in the community.
  4. Participate in local politics.
  5. Act as role models.
  6. Assist with extension work.

# The Role of University Lecturer in Development of Higher Education - Evaluating University Education

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## **Abstract**

This paper has attempted to highlight course evaluation and to focus on student evaluation. Course evaluation is an area, which is often taken for granted or completely neglected. It has been suggested that university courses be in danger of decaying and falling out of step with the needs of society because of the lack of evaluation. The first part focused on course evaluation and discusses:

- |                                    |   |
|------------------------------------|---|
| 1= The scope of course evaluation. | 2= Course design.                         |
| 3= Course outlines.                | 4= Teaching materials.                    |
| 5= Teaching and learning methods.  | 6= Course monitoring and quality control. |

The second part focused on student evaluation and examines:

- |                             |                                   |
|-----------------------------|-----------------------------------|
| 1= The purpose of testing.  | 2= Assessing student performance. |
| 3= Construction test items. |                                   |

Finally both course evaluation and students evaluation are underdeveloped. We need to have to clear idea of what good education is, and how best to assess our students. Therefore, in addition to research in your field, you should also be taking a greater interest in analyzing the educational needs of your students.

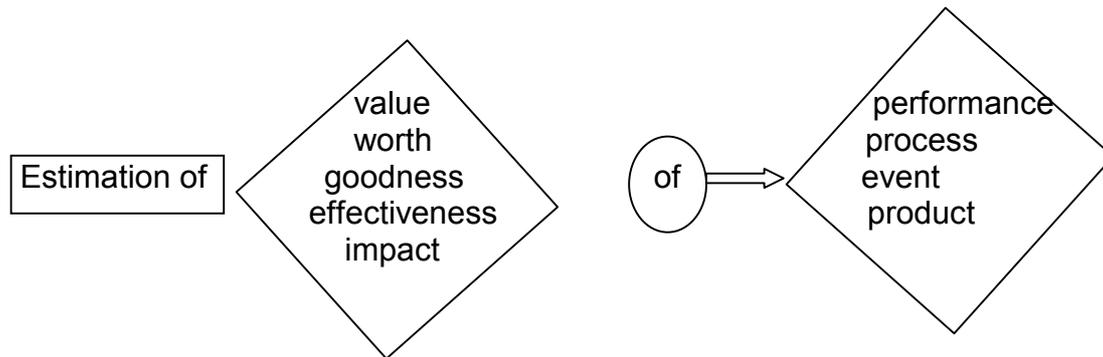
University education the world over is controlled by special legislative acts and chapters, which confer unlimited powers on the universities to carry the following functions with minimal direct influence from outside:

- Design and develop curricula.
- Determine when and how to implement the curricula.
- Control the quality of the curricula.
- Determine student performance.

Literature has a rich variety of definitions of evaluation; we should be familiar with many of these. The evaluation of university education means review and quality control of university courses, on the one hand, and determination of student performance and achievement on the other.

The first hand of university evaluation includes course evaluation:

## The scope of course evaluation



### Forms of evaluation:

There are three types of evaluation:

- Internal evaluation.
- External evaluation.
- Participatory evaluation.

The form of evaluation can depend on “who conducts evaluation?” and “When evaluation done?”

According to who conducts evaluation the evaluation can be classified into:

*Internal evaluation:* - conducted by internal evaluators, university’s administrators and / or academics. They are suited to evaluate their programme because they know about the course context and students characteristics.

*External evaluation:* - conducted by external evaluators, the evaluators are from outside the university and they must be:

- Professionally well trained for the job.
- Have wide experience gained by evaluating other projects.
- Have no interests or weaknesses to protect.

But they lack knowledge of the university environment and internal processes.

*Participatory evaluation:* - conducted by both internal and external evaluators closely with all staff and students. In this case course participants are involved in deciding what should be evaluated and how the evaluation should be done.

When evaluation done?

*Formative evaluation:* - The critical points when evaluation should be conducted are at the beginning of the course or during the life of a programme. This type of evaluation refers to course review and mid- course examination of students.

*Summative evaluation:* - The evaluation conducted at the end of the course and refers to end-term research and terminal assessment.

An evaluation problem may be formulated because a course seems to be doing badly (Students appear to avoid a whole course or parts of it, students may be finding a course difficult).

## Evaluation methods and instruments

The common instruments used in course evaluation are:

- |                           |                    |
|---------------------------|--------------------|
| 1- Expert judgement.      | 2- Library search. |
| 3- Questionnaires.        | 4- Interviews.     |
| 5- Observation schedules. | 6- Tests.          |

**1- Expert judgement:** Many aspects of course evaluation as course design, course objectives, learning methods, instructional materials and student assessment are best reviewed by teaching technology specialist, psychologists and test experts.

**2- Library search:** Library search is important in the preparation for all forms of investigation, including evaluation. A great deal of the actual evaluation investigation in course design, course outlines and content review is normally based on documentary sources which form part of a library search.

**3- Questionnaires:** are useful in evaluation studies involve collecting information from many respondents over a large area as students and employers. The questions should be short, clear, written by simple language and the answers of it by one word.

**4- Interviews:** are either based on structured interview schedules or on free discussion around a few issues. The discussion either formal (Table discussion) or informal one.

**5- Observation schedules:** it is usually difficult to observe university courses during teaching, unless the lecturer allows the evaluator to sit in his classes. However, you can take note of your classes, especially practical work, group discussion, individual work and reactions to tests and examinations.

**6- Tests:** tests and examinations provide information that can be used to evaluate the course design, teaching process and student performance.

### Evaluation of course design

University courses are in many ways very conservative and unresponsive to changes taking place in the world outside the institution. A curriculum can easily get out of step with the needs of the consumer community if course evaluation is not regularly conducted or if it is not sufficiently accurate. However, the need to make a fresh start, or to make drastic curriculum changes arises from time to time in both old, well established universities as well as newer ones because:

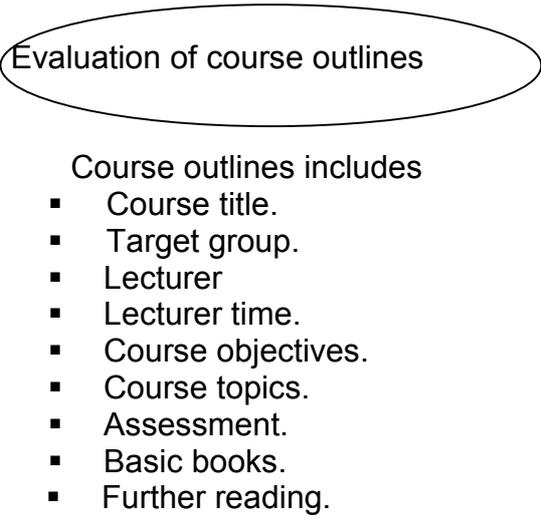
- The government may request universities to increase their student intake in response to population increase and other developments in the country.
- There may be need to create new areas of learning, leading to new career openings.
- Available resources may be shrinking, making it imperative to cut back existing courses.

**Sources of information for course design evaluation:**

- ❑ Course outlines from other universities.
- ❑ Course materials (textbooks, research papers, and journal articles).
- ❑ Colleagues in your department and other departments.
- ❑ External examiners.
- ❑ Experienced teachers in the field and in related fields.
- ❑ Educational and economic planners.
- ❑ Employers of your graduates and the general public.

**Methods and instruments for course design evaluation:**

- ☞ Expert judgements to elicit information from specialists as subject specialists, university administrators, educational and economic planners.
- ☞ Library search to elicit information from course materials, national development records, literature from other universities, research papers and professional journals.
- ☞ Questionnaires for current and former students, professionals in the field, employers and members of the public.
- ☞ Interviews with subject and curriculum specialists.



Evaluation of course outlines

## Course outlines includes

- Course title.
- Target group.
- Lecturer
- Lecturer time.
- Course objectives.
- Course topics.
- Assessment.
- Basic books.
- Further reading.

**Sources of information for course outlines evaluation: -**

- Subjects specialists.
- Psychologists.
- Administrators.
- Curriculum developers.
- Educational planners.

**Methods and instruments for course outlines evaluation:**

- 1- Expert judgements.
- 2- Library search.
- 3- Questionnaires.
- 4- Interviews.

## Evaluation of teaching materials

Since the university is more specialized, they are expected to buy, develop and use a wider range of teaching materials such as:

Textbook.	Filmstrips.	Slides.
Pre- recorded tapes.	Chart.	Maps.
Diagrams.	Self-instructional books.	Journal articles.
High quality papers.	Pictures.	Real objects.

All these teaching materials to increase interest and to reinforce learning. Our students' tendency to depend on lecture notes and avoid using the libraries, lack of interest to build personal libraries by buying books may be partly due to the lecturers' style and completely to financial reasons. Dictation encourages students to copy lecturers' notes and regurgitate them in term examinations.

### **Sources of information for teaching evaluation:**

Evaluation of teaching materials should generate the following information from lecturers, students and specialists in the use of teaching media:

- Suitability of the materials.
- Frequency of use of different teaching materials.
- Effectiveness of the materials.
- Cost of materials.
- The variety of teaching materials used.

### **Methods and instruments for evaluating teaching materials:**

- Review by media specialists and subject specialists.
- Review of catalogues of materials in the department or university "teaching resources bank".
- Interviewing colleagues on availability and suitability of existing materials.
- Obtaining a feedback from students.

## Evaluation of teaching methods

Teaching at university level tends to be plain and monotonous when compared by teaching at school level. With the growing size of classes in our universities, teaching methods need to be modified to make the learning process richer and more interesting.

### **Sources of evaluation information for teaching methods:**

The main sources of information on teaching methods are:

- Subject.
- Management training specialists.
- Students and their feeling on the use of different teaching methods.

**Methods and instruments for evaluating teaching:**

- Expert judgements: subject specialists, teacher trainers and management trainers can give suggestions on teaching methods.
- Observation: where appropriate, you can observe your colleagues teaching.
- Questionnaires: to elicit more detailed information from colleagues and students without them having to identify themselves.
- 4- Interviews: to find out if your teaching methods are appropriate.

Course monitoring and quality control

With the increase number of university graduates and the simultaneous decline in employment opportunities, employers will begin to look more closely at the abilities of graduates of different universities. Graduates without professional degrees will face even more difficulties. Therefore the universities courses has to be inspected and updated regularly to maintain the required academic standards.

**The course monitoring involve the following questions:**

- Are subject objectives being met?
- Is the course relevant to the needs of students and employers?
- Are there gaps in the topics covered?
- Is the material covered suitable and adequate for this level?
- Is course content up-to-date?
- Is there any evidence of course deterioration, or does student performance show unexpected variations?

**Sources of information for monitoring and quality control:**

- Lecturers who teach the course.
- The students and former students.
- Employers or the graduates.
- External examiners.
- Subject specialists and researchers in the area of study.

**Methods and instruments for monitoring and quality control:**

- Questionnaires and interviews regularly administered to students.
- Inspection of student performance in test.
- Taking stock of the teaching materials available.
- Noting students' reactions to different content areas.

## ***The scope on student evaluation***

Determination of student performance and achievement are the other of the university duty. This can be done through testing.

### Purpose of testing

Testing is used to determine knowledge, ability, competence and experience in and outside the formal learning settings. These range of informal questioning of students during lectures to formal assessment such as quizzes, term papers, mid-term papers, practical work, continuous assessment tests, project work, terminal examinations and social research items used to assess skills, knowledge, attitudes and experiences. The students are an important source of course evaluation information. Student's scores tell us as much about student achievement and ability as they do about the quality of the course outline and the process of teaching.

### **What do tests show?**

Tests can show the following points:

- Students' ability to learn.
- Recall of the subject matter (superficial understanding).
- Depth of understanding of a subject.
- Ability to apply what has been learned.
- Long-term use of the subject matter.

### Assessing student performance

University tests are depends on essay type questions. Most test questions are build around a limited number of key word such as Mention, Describe, Enumerate, Explain, and Discuss. Over a period of time, the student becomes familiar with all possible questions on a topic, and, therefore, develops model answer for the few test options available in the area of study.

As an alternative to the essay type test, we wish to suggest that short answer test items:

- Allow a wider range of test techniques and possibilities.
- Provide more through coverage of the syllabus.
- Encourage testing of varied abilities in students.
- Give opportunities for detailed accurate and feed-back to students.
- Discourage students from concentrating their efforts on selected areas, which are thought to be 'examinable'.

Short answer tests are easier to adapt for scoring by computer, and opening up the possibility of your giving feedback to a large class students number within a week or less.

## Construction test items

Suggestions that putted in mind when designing and constructing test items are:

- Define the content area to be tested.
- State the objectives of the test.
- Clarify the levels of understanding to be tested.
- Use enough items to maximize the reliability of the test.
- Decide on the length of the test.
- Arrange the items in logical sequence.
- Use formal language and correct grammar.
- Give specific and complete directions.

In addition, you should:

- Avoid using difficult language.
- Avoid testing unimportant details.
- Avoid using vague qualitative terms as 'few', 'much', 'most' and 'seldom'.
- Avoid using absolute terms as 'always', 'never' and 'all'.
- Avoid construction of questions that do not have a clear answer, which may be answered by two answers.

# Internet gestützte Lern- und Lehrformen und ihre Nutzung in virtuellen Studienprogrammen

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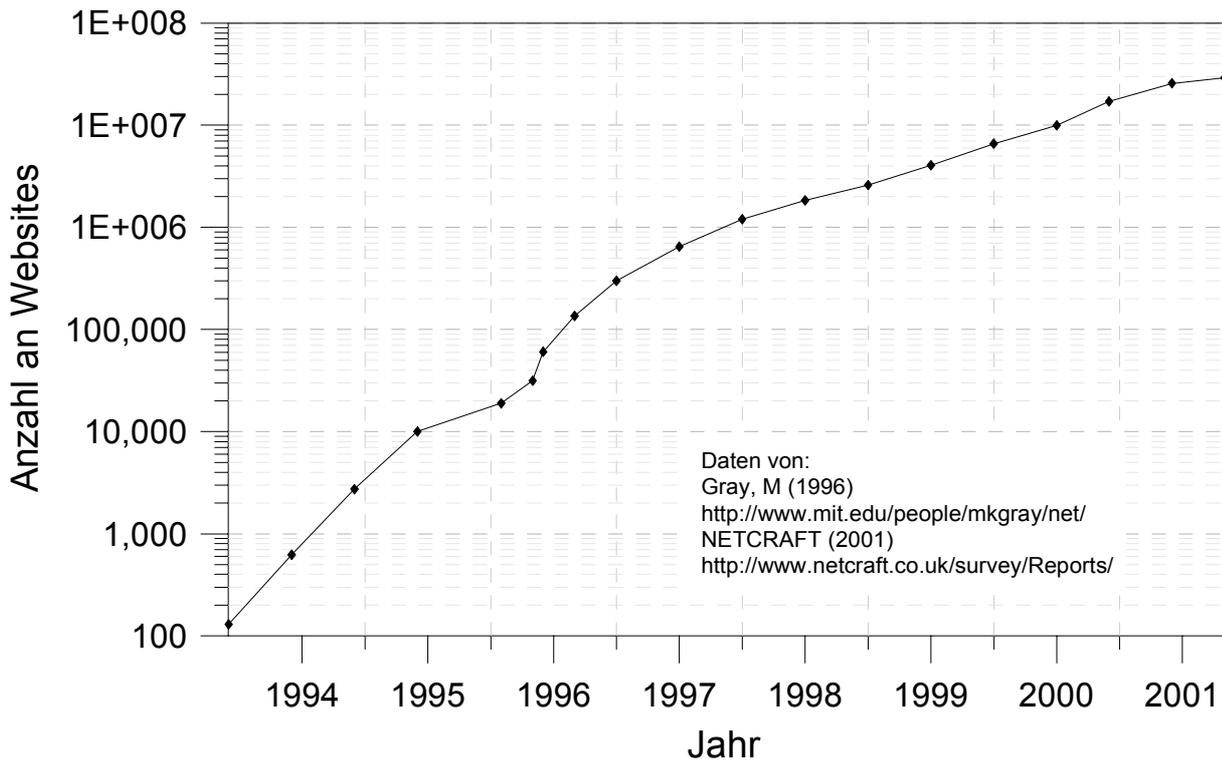
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## **Einleitung**

In weniger als einem Jahrzehnt hat sich das Internet als eine Alternative zu den traditionellen Formen des Informationsflusses etabliert. Elektronische Medien für die Informationsbeschaffung und den Informationsaustausch gewinnen dabei zunehmend an Bedeutung und tragen ganz wesentlich dazu bei, dass der Prozess der sog. Globalisierung immer weiter voranschreitet. Das Internet macht dabei vor kaum einem Bereich der Wirtschaft oder des öffentlichen Lebens halt und dringt immer mehr sowohl in den beruflichen als auch in den privaten Alltag der Nutzer ein. Die offensichtlichen Vorteile, welche die Benutzung dieses Mediums besitzt, werden an zwei Tatsachen klar augenfällig, nämlich an der stetig steigenden Anzahl der Nutzer dieser neuen elektronischen Medien als auch an dem exponentiellen Wachstum der angebotenen Informationen. Gemäß einer Studie aus dem ersten Quartal 2001 sind derzeit in Europa bereits 45,4 % der Bevölkerung über 15 Jahren online, dies entspricht 144,5 Mio. Internet-Nutzern [16]. Allerdings ist hierbei ein starkes Nord-Südgefälle zu konstatieren [13]. Während im Norden Europas das Niveau der Internetnutzung bereits auf demjenigen der USA liegt (Norwegen: 69,0%, Schweden: 73,5%), rangieren Portugal und Spanien mit 15,7 bzw. 21,2 % auf den hinteren Plätzen. In Deutschland, wo mit 49,1% ca. 31 Millionen Erwachsene online sind, beträgt die mittlere tägliche Nutzungsdauer sowohl werktags als auch am Wochenende ca. 90 Minuten [18], das Internet ist damit für viele Nutzer aus dem täglichen Leben nicht mehr wegzudenken. Eine analoge Entwicklung ist hinsichtlich der über das Internet angebotenen Informationsmenge zu verzeichnen. Das sog. Netz der Netze wächst dabei exponentiell und umfasst derzeit bereits mehr als 27 Mio. Websites (Abbildung 1). Mit einem ähnlichen Wachstum wird auch für die Zukunft gerechnet. Dieses immense Wachstum zeigt klar die Vorteile dieses Mediums auf, wobei jeder neue User oder jede neu geschaffene Webpräsenz als Zustimmung zu dieser Technologie und damit zugleich als ein Votum für die Möglichkeiten und die weitere Nutzung dieses Mediums angesehen werden können.

## **Vorteile webgestützter Studienprogramme**

Angesichts der stürmischen Entwicklung des Internets ist es nicht verwunderlich, dass der Einsatz der neuen elektronischen Medien auch im Bildungswesen sowohl im Schul- als auch im Hochschulsektor Gegenstand zahlreicher Initiativen, Projekte und Aktionen ist (vgl. **Tabelle 1**). Alle diese Unternehmungen versuchen dabei die folgenden potentiellen Vorteile webgestützter Studienprogramme zu nutzen:



**Abbildung 1: Weltweites Wachstum der Websites von Juni 1993 bis Mai 2001. Datengrundlage: GRAY (1996) und NETCRAFT (2001).**

Traditionelle Lehr- und Lernformen finden zu bestimmten Unterrichtszeiten an bestimmten Orten (Hörsaal, Klassenzimmer, ...) statt. Der sicherlich bedeutendste Vorteil des sog. „remote distance learnings“ liegt darin, dass für den Studierenden eine starke Flexibilisierung hinsichtlich der Lokalität und Zeit der Bildungsmaßnahme erreicht wird. Der Studierende kommt nicht mehr an den Ort der Informationsvermittlung, vielmehr wird die Information über die Leitungswege des Internets zum Wohnort des Lernenden übertragen. Dies ermöglicht das Studium auch in abgelegeneren Gebieten, zudem wird das Studium bei begrenzten oder stark termin gebundenen zeitlichen Ressourcen wesentlich vereinfacht, da die Anreisezeit zum Studienort wegfällt und der Zeitpunkt der einzelnen Lektionen weitgehend selbst bestimmt werden kann.

Ferner ergibt sich eine erhöhte Flexibilität gleichermaßen für Studierende wie für Lehrende. Dies betrifft zum einen die Auswahl zwischen den einzelnen Bildungsangeboten. Hier erhöhen sich die Auswahlmöglichkeiten für den Studierenden sehr stark, da er nicht mehr an Bildungseinrichtungen in seinem räumlichen Umfeld gebunden ist, sondern prinzipiell weltweit aus den Bildungsangeboten auswählen kann. Die sich dadurch ergebende Verschärfung des Wettbewerbs zwischen den Hochschulen könnte einen positiven Einfluss auf die Qualität der Lehrangebote nehmen. Für die Lehrenden ergeben sich große Vorteile dadurch, dass die im Internet publizierten Lehrinhalte – anders als beim Einsatz von Printmedien – sehr einfach und sehr schnell modifiziert werden können [17]. Dies bietet die Chance, das Lehrangebot stets zeitnah und aktuell zu halten und aktuelle Ereignisse des Zeitgeschehens als Lehrinhalte mit einzubeziehen und zu reflektieren. Nicht zuletzt gilt es zu bedenken, dass die relative Anonymität der Computer basierten Kommunikation sich als vorteilhaft für zurückhaltende Personen erweisen kann, wobei die Bewertung der Äußerungen der Lernenden, etwa in Chaträumen, unbeeinflusst von Äußerlichkeiten, allein aufgrund des Aussagegehalt des Wortbeitrags, erfolgt.

## ***Bestandsaufnahme der aktuellen Situation***

Der erste Schritt auf dem Transitionsprozess hin zu online gestützten Lernformen ist die Nutzung elektronischer wissenschaftlicher Informationen in der Hochschulausbildung. Wie eine im Juni 2001 veröffentlichte, im Auftrag des Bundesministeriums für Bildung und Forschung erstellte Studie [10] belegt, sind hierbei im aktuellen Wissenschaftsbetrieb teils erhebliche Defizite zu beklagen, und zwar sowohl bezüglich der formalen Verankerung dieser Elemente im Studium als auch bezüglich ihrer Anwendung durch Studierende und ihrer Vermittlung durch Hochschullehrende. So vertraten in einer Umfrage immerhin 36,7 % der Studierenden die Meinung, mehr über elektronische wissenschaftliche Informationen zu wissen als die Lehrenden, nur 23,7 % der Lehrenden wurde bescheinigt, sich in diesem Sektor gut auszukennen. Hinsichtlich der Schulung in diesem Sektor besteht offensichtlich ein erhebliches Defizit, so gaben 79,6 % der Studierenden und 68 % der Lehrenden an, die Nutzung elektronischer wissenschaftlicher Informationen alleine, dem trial and error-Prinzip folgend, erlernt haben.

Wenn bereits bei der Informationsgewinnung erhebliche Defizite zu konstatieren sind, dürfte dies noch viel mehr für die Erstellung und den Einsatz von Online-Lernprogrammen gelten [3]. Dabei ist unumstritten, dass solche Lernformen sowohl hinsichtlich des Lernerfolgs als auch hinsichtlich des Kostenaufwands höchst effektiv gestaltet werden können [15]. Unbestritten ist auch die Tatsache, dass es in Zukunft durch den verstärkten Einsatz des Distance-Learnings zu einer Globalisierung und damit verbunden zu einer „Entstaatlichung“ des Bildungsmarktes kommen wird, was die Universitäten in Konkurrenz zu privaten, global agierenden Mitbewerbern mit innovativen Geschäftsideen setzen wird. Um auf dem globalen Aus- und Weiterbildungsmarkt, dessen Größe allein in den USA auf jährlich 600 bis 700 Milliarden Dollar geschätzt wird [5], bestehen zu können, sind neben einer ausreichenden Hardwareausstattung vor allem entsprechende didaktische Lernkonzepte zu erstellen und eine soziale Infrastruktur des Lernens zu entwickeln [7], ohne welche der Nutzen solcher Bildungsprogramme zweifelhaft bleiben muss [2].

Erfolgreiche Lernprogramme nutzen dabei die gesamte Bandbreite der Internet Ressourcen aus, welche nachfolgend detaillierter beschrieben ist.

## ***Internet Ressourcen und ihre Nutzung für Online Lehr- und Lernformen***

### **Das Internet – eine Definition**

Gemäß einer Definition [6], welche das US Federal Networking Council einstimmig verabschiedet hat, wird mit dem Begriff Internet ein globales Informationssystem charakterisiert,

- welches durch einen eindeutigen globalen, auf dem sog. Internet Protocol (IP) basierenden Adressraum logisch miteinander verbunden ist,
- innerhalb dessen durch ein spezifisches Übertragungsprotokoll (TCP/IP) die Kommunikation ermöglicht wird und
- welches verschiedene Dienste zur Verfügung stellt, welche auf dieser beschriebenen Kommunikations-Infrastruktur aufsetzen.

In diesem Zusammenhang ist es bedeutsam, dass jeder Computer, welcher – und sei es auch nur vorübergehend – Bestandteil des Internets ist, über eine eindeutige Identifizierung in Form der sog. IP-Adresse verfügt, dies ist eine unabdingbare Voraussetzung, um jegliche Art von Services zu nutzen sowie um die Anfragen anderer Computer abarbeiten zu können.

## Traditionelle, statische Ressourcen

### *World Wide Web (WWW)*

Ursprünglich von Tim Berners-Lee am Kernforschungszentrum CERN während der Arbeit an einem verteilten Informationsprojekt entwickelt, ist das World Wide Web mittlerweile einer der bedeutendsten, wenn nicht sogar der bedeutendste, auf der Infrastruktur des Internets basierende Dienst. Das WWW ist dabei speziell für den Austausch von Dokumenten konzipiert. Diese Dokumente sind dabei in der Plattform unabhängigen Seitenbeschreibungssprache HTML (Hyper Text Markup Language) verfasst, anders als herkömmliche lineare Texte verfügen sie zumeist über erweiterte Möglichkeiten der Navigation, etwa in Form von Sprungmarken auf Textteile oder andere Dokumente im Internet. Die Anzeige dieser Dokumente, das sog. Rendering der Seiten, wird von einem „Browser“ genannten Anwendungsprogramm vollzogen. Die beiden wichtigsten und weitest verbreiteten Browser sind der Netscape Navigator sowie der Internet Explorer der Firma Microsoft.

**Tabelle 1: Ausgewählte WWW-Seiten zum Themenkomplex „Onlinebasierte Lehr- und Lernformen“**

URL	Beschreibung
<b>Internationale Angebote</b>	
<a href="http://www.gnacademy.org">http://www.gnacademy.org</a>	Globewide Network Academy
<a href="http://www.le.ac.uk/TALENT/">http://www.le.ac.uk/TALENT/</a>	TALENT-Consortium: Universities of Canterbury, Leicester, Northampton and Kent
<a href="http://webster.commnet.edu/HP/pages/darling/distance.htm">http://webster.commnet.edu/HP/pages/darling/distance.htm</a>	Resources for Distance Education
<a href="http://www.hoyle.com/distance/portals.html">http://www.hoyle.com/distance/portals.html</a>	Distance Learning on the Net: Distance Learning Portals
<a href="http://www.dlrn.org/">http://www.dlrn.org/</a>	Distance Learning Resource Network
<a href="http://www.eduvinet.de/">http://www.eduvinet.de/</a>	EDUVINET Service: Education via Networks in the European Union
<a href="http://www.edna.edu.au/">http://www.edna.edu.au/</a>	EdNA: Education Network Australia
<b>Nationale Angebote</b>	
<a href="http://www.studieren-im-netz.de/">http://www.studieren-im-netz.de/</a>	Service der Bund-Länder-Kommission für Bildungsplanung und Forschungsförderung (BLK)
<a href="http://www.virtuelle-hochschule.de">http://www.virtuelle-hochschule.de</a>	Projekt des Landes Baden-Württemberg zum Einsatz von Multimedia und Telematik in der Hochschullehre
<a href="http://www.bildungsserver.de">http://www.bildungsserver.de</a>	Deutscher Bildungsserver: Gemeinschaftsservice von Bund und Ländern
<a href="http://remus.jura.uni-sb.de/">http://remus.jura.uni-sb.de/</a>	remus - Rechtsfragen von Multimedia und Internet in Schule und Hochschule
<a href="http://www.initiated21.de">http://www.initiated21.de</a>	Initiative D 21: Förderung des Wandels vom Industrie- zum Informationszeitalter
<a href="http://www.schulweb.de">http://www.schulweb.de</a>	Teilprojekt des Deutschen Bildungsservers, Finanzierung: DFN
<a href="http://www.san-ev.de/">http://www.san-ev.de/</a>	Schulen ans Netz e. V., Initiative des BMBF sowie der Telekom AG

Naheliegenderweise bedienen sich viele onlinebasierte Studienprogramme des World Wide Web, sowohl für die Außendarstellung als auch für die Vermittlung der Lehrinhalte an die Studierenden. **Tabelle 1** bietet eine Auswahl von WWW-Seiten im Bereich der Initiativen und Projekte des Online-Teachings. Eine große Hilfe auf der Suche nach entsprechenden Ressourcen können entsprechende Auflistungen von Studienprogrammen und Ressourcen sein. So sind auf dem online verfügbaren Katalog der Globewide Network Academy innerhalb 3357 verschiedener Studienprogramme insgesamt 25333 Kursangebote verzeichnet. Eine umfangreiche Linkliste zu Ressourcen für den Schulunterricht findet sich bei HANSEN [8].

Zur Suche nach speziellen, nicht in **Tabelle 1** aufgeführten Projekten oder anderen Themen im Zusammenhang mit der onlinebasierten Wissensvermittlung sei der Gebrauch entsprechender Suchmaschinen empfohlen.

### *Limitationen statischer Ressourcen*

Zwar bietet die Seitenbeschreibungssprache HTML für die Darstellung von über das WWW distribuierten Dokumenten erweiterte Darstellungsmöglichkeiten, etwa für die weltweite Vernetzung von WWW-Dokumenten untereinander mittels sog. Sprungmarken (Links) oder für die Einbindung von Multimediaelementen, wie von Sound- oder Videoclips. Dennoch ähneln solche sog. Hypertexte herkömmlichen gedruckten Dokumenten nach wie vor sehr stark, so dass der wesentliche Unterschied in der elektronischen Form der Distribution besteht.

Nun existieren bereits seit vielen Jahren sog. Fernlernprogramme, diese sind somit keine Erfindung des Internetzeitalters. Alle bisherigen Erfahrungen zeigen dabei jedoch, dass die alleinige Lektüre und das bloße Studium von Büchern alleine keinesfalls den Lehrer sowie den Unterricht ersetzen können. Genau so wenig wie eine Bibliothek einen Lehrbetrieb ersetzen kann, reicht das WWW mit seinen rein statische Ressourcen alleine keinesfalls für erfolgreiche virtuelle Lernprogramme aus.

Glücklicherweise sind in jüngerer Vergangenheit zahlreiche neue Techniken aufkommen, welche für die interaktive Gestaltung von Webseiten genutzt werden können. Solche interaktiven Inhalte sollten dabei integraler Bestandteil eines jeden Internet gestützten Kursprogramms sein, da erst über die Interaktion des Lernenden mit dem Lerninhalt in seiner erweiterten Darstellung der nachhaltige Erfolg der Lehreinheiten sichergestellt werden kann. Nachfolgend sollen einige dieser Methoden zur interaktiven Gestaltung von Webseiten besprochen werden. Die Erstellung solcher interaktiver Inhalte ist dabei durchwegs nicht so schwierig, wie es zunächst den Anschein erwecken mag.

## **Interaktive Ressourcen und ihre Realisierung**

### *JavaScript*

Interaktivität kann u.a. dadurch erreicht werden, dass vom Webserver in Abhängigkeit von verschiedenen Bedingungen unterschiedliche Seiteninhalte serviert und beim Nutzer angezeigt werden. Dies macht den Einsatz einer Programmiersprache erforderlich, welche den Ablauf der Anzeige steuert und für die Auswahl der unterschiedlichen Inhalte sorgt. Mit JavaScript existiert eine direkt für den Einsatz in Webseiten geschaffene Programmiersprache, deren Entwicklung ursprünglich von der Fa. Netscape ausging. Mittlerweile haben andere Firmen dieses Konzept aufgegriffen und weiter mitentwickelt, so dass JavaScript inzwischen von allen namhaften Browsern über einen unmittelbar in den Browser integrierten Interpreter unterstützt wird. JavaScript ist eine interpretierte Sprache, bei clientseitigem JavaScript wird der Programmcode für die Ablaufsteuerung meist direkt in das HTML-Dokument integriert und

ist folglich für jeden Nutzer offen ersichtlich. Dort, wo nur gelegentlich kleinere Programme zu realisieren oder gar nur einfache Berechnungen in eine HTML-Seite zu integrieren sind, führt kein Weg an JavaScript vorbei.

### *Java*

Bei der Realisierung aufwändigerer Programme stößt man mit JavaScript schnell an die Grenzen des Machbaren. Fortgeschrittenere Anwendungen verlangen den Einsatz einer vollwertigen Programmiersprache. Nun erzeugen jedoch die traditionellen Hochsprachen, wie Pascal, C oder Basic, Plattform abhängigen Programmcode, der nicht für die Distribution im WWW geeignet ist. Abhilfe kann hier der Einsatz der 1995 von der Fa. Sun vorgestellten Programmiersprache Java schaffen, welche im Gegensatz zu allen bislang bekannten Programmiersprachen als Plattform unabhängige Sprache konzipiert ist, so dass sich in Java programmierte Anwendungen ohne erneute Anpassungen auf den verschiedensten Rechnerplattformen ausführen lassen. Dies eröffnet erstmals die Möglichkeit, in Java erstellte Anwendungsprogramme online als Bestandteile von Web-Dokumenten zu distribuieren und ablaufen zu lassen.

Um für Java-Programme diese Eigenschaft der Plattform Unabhängigkeit zu erreichen, wird bei der Programmerstellung ein eigener, neuartiger Weg eingeschlagen. So wird der vom Programmierer erstellte Java-Quelltext vom Java-Compiler (javac.exe) nicht – wie etwa in den Hochsprachen C oder Pascal – direkt zu einer ausführbaren Datei verarbeitet, sondern zu einer sog. Bytecode-Datei, welche die Erweiterung .class trägt. Diese Bytecode-Datei enthält das Java-Programm in Plattform unabhängiger Form und stellt gleichzeitig die Form dar, in der Java-Programme distribuiert werden. Um das Programm selbst auf einer bestimmten Plattform ablaufen zu lassen, wird eine sog. Java Virtual Machine (JVM) benötigt, welche die Java-Bytecode-Dateien quasi interpretiert und damit für den Programmablauf sorgt. Insofern ist Java als eine Zwischenform zwischen einer compilierten und einer interpretierten Programmiersprache anzusehen.

Als absolutes Novum lassen sich dergestalt erstellte Programme auch in HTML-Seiten integrieren, und zwar in der Form von sog. Java-Applets, also einer Art „kleinen Anwendung“. Hierfür werden die Bytecode-Dateien auf dem Webserver hinterlegt und beim Besuch der Webseite an den aufrufenden Client transferiert. Die Ausführung der Bytecode-Dateien übernimmt dann eine in den Browser integrierte JVM. Mittlerweile verfügen die meisten der derzeit gebräuchlichsten Browser über eine integrierte JVM. Zusätzlich bietet die Fa. Sun Browser Plug-Ins in den jeweils aktuellen Sprachversionen im Internet zum Download an (<http://java.sun.com/products/plugin/>).

Aufgrund der Mächtigkeit des Sprachumfangs, sowie aufgrund der Implementierung von Klassen und Methoden zur Programmierung der grafischen Anwenderschnittstelle (GUI) ist die objektorientierte Programmiersprache Java prinzipiell für alle Anwendungsbereiche geeignet. Allerdings wird sich die Einarbeitungszeit in Java meist nur dann lohnen, wenn innerhalb von Lernmodulen tatsächlich komplexere Sachverhalte vermittelt oder umfangreichere Ablaufsteuerungen vonnöten sind. Dann allerdings steht mit Java ein Werkzeug bereit, mit welchem alle diese Aufgaben bewältigt werden können.

### *Weitere Formate*

Aufgrund der lukrativen Gewinnchancen im Marktsegment der Erstellung interaktiver Webinhalte bemüht sich eine entsprechend große Anzahl von Anbietern um die Etablierung von Standards zur Vermittlung dynamischer Inhalte [11]. Die Palette der Lösungen reicht dabei von Erweiterungen des traditionellen Sprachstandards HTML bis

hin zu neuen Standards für online distributierte Texte, – etwa in Form des Portable Dokument Formats (PDF) [1] – oder für Audio- und Videoformate (z.B. [19]). Mit dem Vektoranimationsformat Flash des Grafikspezialisten Macromedia [12] hat sich in jüngster Vergangenheit ein Standard etabliert, welcher sehr gut für die Umsetzung von Animationen geeignet. Derselbe Hersteller vertreibt auch mit seinen Softwaresystemen AUTHORWARE und DIRECTOR zwei speziell für die Erstellung von Online-Kursen prädestinierte Programmpakete. Zur Anzeige dieser Inhalte sind sog. Browser-Plugins erforderlich, welche vom Hersteller unentgeltlich zum Download angeboten werden, teils sind sie bereits im Lieferumfang der Standardbrowser enthalten.

Insbesondere dann, wenn Lernprogramme nicht via CD ablaufen, sondern direkt über das Internet bezogen werden sollen, ist darauf zu achten, dass die für die Erstellung der Animation verwendeten Technologien von den gängigen Webbrowsern in konsistenter Weise unterstützt werden. Dies ist bei weitem nicht selbstverständlich, wie das Beispiel von DHTML (Dynamic Hyper Text Markup Language) lehrt, deshalb ist vom Einsatz dieser Technologie abzuraten [9].

### **Internet-Services für die Kommunikation bei webbasiertem Lernen**

Bei allen Möglichkeiten, die statische und v.a. dynamische, interaktive Webinhalte für das Lernen am Bildschirm mit sich bringen, darf nicht vergessen werden, dass sich der Lernprozess immer auch über die Kommunikation mit anderen Individuen vollzieht, seien es Lehrer oder Mitschüler. Ohne solch einen Austausch werden nur die wenigsten Lernenden die Motivation und den Durchhaltewillen für den erfolgreichen Abschluss des Kurses mit sich bringen. Zwar ist naturgemäß durch die räumliche Distanz zwischen den Individuen der Kommunikationsfluss erschwert, was jedoch nicht bedeutet, dass das Internet keine entsprechenden Ressourcen für die Kommunikation zwischen den involvierten Personen bietet. Bei den entsprechenden Ressourcen ist zu unterscheiden zwischen Werkzeugen für die Kommunikation in Echtzeit und solchen, die eine zeitversetzte Kommunikation bedingen. Letzterem zuzurechnen ist das E-Mail als einer der wichtigsten internetbasierten Dienste für den personenbezogenen Informationsaustausch, ebenso fallen Diskussionslisten und Newsgroups in diese Kategorie. Als Werkzeuge zur Echtzeitkommunikation sind der Chat als Mittel des bloßen schriftlichen Informationsaustausches sowie Videokonferenzen zu benennen, bei denen sowohl Bild als auch Ton übertragen werden. Letztere bedingen zwar generell größere Bandbreiten, ermöglichen aber die Interaktion zwischen Lehrenden und Lernenden ähnlich einer Situation im Klassenzimmer bzw. im Hörsaal. Es ist damit zu rechnen, dass die sich vergrößernden Bandbreiten der Internetanbindung dem Einsatz von Videokonferenzen in interaktiven Lernprogrammen Vorschub geben werden und damit die Programme besser auf den jeweiligen Lernfortschritt und die Bedürfnisse der Teilnehmer abgestimmt werden können.

### **Diskussionslisten und Newsletter**

Wer sich hinsichtlich der Thematik Internet gestützter Lernformen auf dem Laufenden halten will oder sich mit anderen Personen zu dieser Thematik austauschen möchte, dem seien die zahlreichen Newsletter und Diskussionslisten zu dieser Thematik empfohlen. Tabelle 2 bietet einen Überblick über verfügbare Newsletter und Diskussionslisten auf dem Gebiet der Fernlernens. Unter dem Begriff „Newsletter“ werden dabei zumeist in regelmäßigen zeitlichen Intervallen verfasste und an den Mitgliederkreis versandte Email-Dokumente verstanden, welche, meist aktuelle Themen aufgreifend, der Vermittlung aktueller Informationen dienen sollen und dabei oftmals auch Denkanstöße bieten können.

**Tabelle 2: Diskussionslisten und Newsletter zum Themenkomplex „Onlinebasierte Lehr- und Lernformen“**

<b>Ressource</b>	<b>URL, An- und Abmeldung</b>
Newsletter: Rechtsfragen von Multimedia und Internet in Schule und Hochschule	<a href="http://remus.jura.uni-sb.de/newsletter/index.html">http://remus.jura.uni-sb.de/newsletter/index.html</a>
SaN-News: Schule ans Netz	<a href="http://www.san-ev.de/">http://www.san-ev.de/</a>
Newsletter: Guter Unterricht aktuell	<a href="http://www.guterunterricht.de/GU_aktuell/gu_aktuell.html">http://www.guterunterricht.de/GU_aktuell/gu_aktuell.html</a>
Newsletter der Initiative D21	<a href="http://www.initiaved21.de">http://www.initiaved21.de</a>
Diskussionsforum: Auf dem Weg zur virtuellen Hochschule	<a href="http://www.domeus.de/groups/studieren-im-netz-f1">http://www.domeus.de/groups/studieren-im-netz-f1</a>
Diskussionsliste: SCHULWEB- L	<a href="http://www.listserv.gmd.de/htbin/wa.exe?SUBED1=SCHULWEB-L&amp;A=1">http://www.listserv.gmd.de/htbin/wa.exe?SUBED1=SCHULWEB-L&amp;A=1</a>
Newsletter: Web Tools for Teaching	<a href="http://webtools.cityu.edu.hk/news/index.html">http://webtools.cityu.edu.hk/news/index.html</a>
Newsletter: Innovative Teaching	<a href="http://groups.yahoo.com/group/innovative-teaching">http://groups.yahoo.com/group/innovative-teaching</a>

Diskussionslisten hingegen sind für den bidirektionalen Informationsaustausch konzipiert und bieten jedem Ratsuchenden oder Diskussionswilligen eine Online-Plattform für die Diskussion von Fragen zum Themenkomplex des Online-Lernens, wobei der Diskussionssteilnehmer sowohl die Rolle des Fragenden als auch des Antwortenden einnehmen kann. Alle Diskussionsbeiträge erfolgen dabei in Form von E-Mails und werden von einem dedizierten Computer, dem Listserver, der als Nachrichtenverteiler fungiert, an die Mitglieder versandt.

Während Newsletter genutzt werden können, um sich über aktuelle Entwicklungen auf dem Laufenden zu halten, stellen Diskussionslisten ein ideales Medium dar, falls eine Frage auftaucht, auf welche mittels der einem verfügbaren Informationsquellen – seien es Kollegen, Bibliotheken oder das WWW – keine befriedigende Antwort gefunden werden kann.

### ***Einschränkungen und Limitationen von Online-Lernprogrammen***

Bei aller Euphorie, mit welcher derzeit die Diskussion um das Thema internetgestützter Studienprogramme geführt wird, sollte dennoch nicht vergessen werden, dass deren Einsatz systemimmanent auch Nachteile mit sich bringt und dass es viel Erfahrung bedarf, um diese Programme zu wirklich brauchbaren und wertvollen Instrumenten in der Ausbildung der Studienteilnehmer zu machen.

Als erste Limitation in diesem Zusammenhang muss die Tatsache gelten, dass sich beim Einsatz solcher Programme fast zwangsläufig eine sehr starke Abhängigkeit von der verwendeten Technik und von den infrastrukturellen Gegebenheiten am Standort des Lernenden ergibt, insbesondere, was die Hardwareausstattung und die verfügbare Bandbreite des Internetanschlusses betrifft. Hier ist zu befürchten, dass - insbesondere in den sog. Entwicklungsländern - etliche Interessierte von der Anwendung solcher Lernprogramme ausgeklammert werden, da zeitgemäße Computermodelle für sie unerschwinglich sind und an den Studienstandorten nicht genügend und zudem häufig überalterte Hardware vorhanden ist. Genauso gravierend dürfte es im Hinblick auf die Internetanbindung aussehen. Sofern überhaupt Zugangsmöglichkeiten bestehen, ist zu befürchten, dass die Bandbreiten nicht ausreichend sind, um ein zügiges Arbeiten zu ermöglichen [17], was aufgrund der langen Wartezeiten auf Dauer fast zwangsläufig zur Frustration und Unzufriedenheit der Nutzer führt. So gesehen könnte der Einsatz solcher Programme eher zu einer weiteren Vertiefung des Bildungsgefälles als zu seiner Beseitigung beitragen.

Wie bereits dargestellt, kann lediglich durch den Einsatz interaktiver Ressourcen ein dauerhafter Studienerfolg sichergestellt werden. Dies impliziert jedoch auch, dass das Lehrpersonal, welches solche Online-Lehrprogramme erstellen soll, zur Erstellung solcher interaktiven Inhalte befähigt sein muss. Dies bedeutet, dass - sofern nicht externe Spezialisten mit der Erstellung betraut werden - ein enormer Schulungsbedarf gerade auch bei den Lehrenden besteht, um sie mit dieser für sie meist neuartigen Materie vertraut zu machen. Daneben sei angemerkt, dass es - wie in jedem anderen Wissensgebiet auch - sowohl bei der Erstellung solcher interaktiven Inhalte als auch bei der erfolgreichen Nutzung der neuen und erweiterten Möglichkeiten der neuen elektronischen Medien großer Erfahrung bedarf, um letztlich qualitativ hochwertige Programme anbieten zu können, die zu dem gewünschten Lernerfolg führen.

Bei aller verständlichen Begeisterung für die erweiterten Möglichkeiten bei der Darstellung, Präsentation und Vermittlung des Lernstoffes sollte dennoch niemals übersehen werden, dass die alleinige Verwendung des Internets noch lange keine Garantie für die hohe fachliche Qualität der präsentierten Lerninhalte gibt. So fungiert das Internet zwar als ein Medium, das ein hohes Potenzial für die anschauliche Vermittlung des Lernstoffes bietet, das jedoch keinerlei Einfluss auf die übertragenen Informationen bzw. den Lernstoff selbst nimmt, da lediglich die Infrastruktur und die Leitungswege für die Übertragung dieser Informationen zur Verfügung gestellt werden. Insofern kann ein veraltetes, fachlich falsches oder didaktisch schlecht strukturiertes Lehrangebot von minderer Qualität auch durch den Einsatz des Internets für dessen Vermittlung nicht oder nur sehr geringfügig aufgewertet werden.

Fernerhin sei darauf hingewiesen, dass das Internet zwar hervorragende Möglichkeiten bietet, die vermittelten Lehrinhalte ständig aktuell zu halten da - anders als bei Printmedien, wo Aktualisierungen nur in großen zeitlichen Abständen, meist im Rahmen einer Neuauflage, erfolgen - jederzeit eine inhaltlich aktualisierte Fassung erstellt und selbst auf dem Webserver eingespielt werden kann. Andererseits bringt diese Tatsache auch eine Erwartungshaltung der Nutzer mit sich, dass sich das Angebot ständig auf dem aktuellsten Stand befindet. Dies führt sehr schnell dazu, dass auch nur kurzzeitig veraltete Angebote zukünftig nicht mehr oder nur wesentlich seltener frequentiert und genutzt werden. Der zeitliche Aufwand, der für die ständige Aktualisierung des Angebots vonnöten ist, sollte dabei keinesfalls unterschätzt werden.[4]

Eine gewisse Gefahr bei Fern-Lernprogrammen besteht darin, dass Studierende mit guten Fähigkeiten im theoretischen Sektor gegenüber Kursteilnehmern bevorzugt werden, deren Stärken mehr im Bereich der praktischen Umsetzung liegen. Ferner ist bei Online-Programmen eine höhere Selbstdisziplin vonnöten [14].

Abschließend sei darauf hingewiesen, dass durch das Internet nur eine virtuelle Realität vermittelt wird, welche nicht vollständig mit dem beschriebenen Gegenstand, sei es etwa eine anatomische Sektion, ein chemisches Analyseverfahren oder eine Landschaft, übereinstimmt, da wesentliche Aspekte von der Übertragung ausgeklammert sind. Dasselbe gilt für den Bereich der direkten zwischenmenschlichen Kommunikation, deren gesamte Bandbreite nicht über das Internet übertragen werden kann. Man denke nur etwa an die Körpersprache, an Gerüche, oder an ein Lächeln, welches im Laufe eines Gesprächs einer Person geschenkt wird. So sind etwa die sog. Emoticons nichts als ein schwacher Versuch, einen gewissen Ausgleich dieses Mangels zu erreichen.

Aus all diesen Gründen wird auch in Zukunft der herkömmliche Unterricht in Hörsälen oder Klassenzimmern im Rahmen von Vorlesungen, Seminaren oder Praktika weiterhin integraler und elementarer Bestandteil universitärer Ausbildungsprogramme bleiben, welcher freilich unzweifelhaft durch webgestützte Lernformen eine erhebliche Bereicherung - insbesondere bei der Nachbereitung des Lernstoffes - erfahren kann.

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## Science Projects – a Modular Approach

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Mutual contacts of research scientists and further relations between scientific institutions in Egypt and Germany are steps on the way of wider understanding between nations of the two countries. The spirit of cooperation between the German and Egyptian partners can be reconfirmed indeed through joint works and scientific projects that achieve the overall objective, namely, encouraging the pursuit of science by supporting excellence in scientific research.

### ***General requirements for scientific projects:***

A- Data and information bank which helps in:

- Surveying and assessment of the previous studies and present situation on an international scale.
- Cost information related to different items of technical tasks, services, and equipments.
- Standard tests by which it is going to evaluate the output of the research.

B- Administrative and financial management systems.

C- Computer-assisted system for analysis of quantitative data

D- Publication contribution that guarantee the diffusion of information among working team and public.

In planning for a project, different aspects must be taken in consideration:

- Technical and economic limitations (production of safe products, etc)
- Easy adaptation and application.
- Economic feasibility and scientific value.
- Technology implemented especially those to be developed.
- Cost efficiency.

### **Evaluation criteria:**

Evaluation of projects depends upon criteria on 5 levels

A- Personnel: background and capabilities of principal investigator and his team, and experience in similar projects.

B- Institutional experience: contribution in similar projects - facilities and services, and their relevance to the work of the project

C- Technical approach: appropriateness of the proposed project - comprehensiveness of the tasks – efficiency of the tasks – and the project must be oriented to local or global problem.

D- Benefits: economic impact, social impact, environmental impact with good definition of the end-user

E- Total budget: budget required should be reasonable and in direct proportion to the benefits.

## ***Guidelines for the preparation of proposals***

### **Title:**

It is a concise description of the activity proposed .

### **Background:**

This section is aiming at providing pertinent background information needed to set the stage for the proposed project; the most important information are:

- Historical development
- Previous or related studies.
- Field-level data collection
- Proper methods of analysis

### **Problem identification:**

Description of the problem to be solved

Origin and causes of the problem

What would be the effects of :

- Doing nothing
- Carrying out work at current rate and quality
- Sustainability (chances that the proposed work will continue after completion).

### **Purpose (goal):**

What questions are you trying to answer?

What experimental data are you seeking? Be sure to have limited your purpose to a goal you can attain.

### **Objectives:**

This is the ultimate goal. It Can be and should be stated in one sentence.

Objective statements may take the form of :

- The objective is to investigate .....
- The objective is to compare .....
- The objective is to determine the relationship of .....
- The objective is to determine the effect of scientific and technical merit

### **Project schedule:**

What is to be done

When

How it will be carried out (methodology)

By whom

### **Benefits:**

Economic benefits

Technical benefits

Social benefits

Add to national resources

### **Proposal duration:**

Number of months

Maximum duration

Effective date

Date of submission

**Facilities, services available:**

Types of work needed  
Timetable

**Equipments and spare parts needed:**

Type  
Quantity  
Quality  
Frequency of use  
Anticipated future use  
Upgrading

**Local materials and supplies available****Training and visits required:**

Names of trainee  
Number  
Training program  
Timing  
Location

**Resource loading:**

Personnel  
Equipment  
Travel  
Materials and supplies  
Direct cost

**Cost proposal:**

Requested budget  
Salaries  
Consultants  
Equipments and spare parts  
Supplies  
Travel (in-country and abroad)  
Other direct costs:  
includes any expenditures that does not fall within any of the specified items.  
Local operating and maintenance costs  
Customs duty fees  
Remodelling costs  
Cost sharing (in multi-institutional projects)

**Principal investigator:**

Name and title  
Telephone number  
Address  
Previous studies relevant to the problem

**Research team:**

Number  
Qualifications

**Consultants:**

- Name and description of the specialty
- Reason for consultation
- Expected length for consultation
- Expected rate for consultant fee to be paid

**Proposing organization(s):**

- Name and title
- Telephone number
- Address
- Institutional experience

**Analysis and data processing****Project management:**

How it is planned to manage the project both administratively and financially (planning, organizing, directing, control, relationship between the research team and the institute, division of the work among the participants, technical meetings, etc.)

**Progress reports:**

Throughout the duration of the project, two types of reports are required for performance analysis:

- Quarterly, half-annual, annual reports.
- Final report after completion of the project.

**Quality control and quality assurance:**

- Bench-scale study on the identified process to validate the physical, chemical, biological, and economical projective.
- Conduction of pilot plant to validate the results of bench-scale testing.
- Full-scale trials to validate the feasibility studies.

**Scientific and technical publication:**

- Secretary
- Publishing date
- Cost
- Translation

**Summary of proposed work and key words:**

Consist of an abstract (300-500 words) which must fulfill:

- Purpose of goal
- Describe how the results are beneficial
- Method of approach (how the work will be carried out)
- Potential to contribute benefits to end-user

English summary

Arabic summary

**Salary:**

The total budget allocated for salaries should not exceed 20 % of the total budget of the project

**Employees :**

Laboratory and university researchers may be compensated at the hourly rates for the hours actually worked on up to a maximum of 9 (nine) hours per week (full-time working hours is  $6 \times 6 = 36$  hours/week) assuming that the project work is outside their normal duties. However, in no event may the salary paid exceed 200 % of the researcher's basic salary.

**Travel:**

The average rate for allowance for the Egyptian travelling abroad varies from time to time and from one city to the other.

Travel and per diem expenses of consultants (foreign and Egyptian) should be shown in the budget.

**Employee on leave without pay :**

Compensation is allowed at "reasonable" amounts considering salary levels paid in the private market for similar work.

**Consultants:**

The correct maximum fee for (US) consultant should not exceed US\$ that his/her salary history for the last three years can justify it.

## ***Natural Resources / Environment (Group Hapi)***

### **Studies on the Effect of Lead and some Agents for Remediation of Lead Ions on the Performance of Carrot Plant (*Daucus carrota L.*)**

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#### ***Abstract***

During the winter seasons of 1998-1999 and 1999-2000, pot trails were conducted at the Experimental Farm, Faculty of Agriculture, Shibin El-Kom, Egypt, with aim to study the performance of carrot plant cv. "Red Core Chantenay" grown in polluted soil with lead in forms of  $PbCl_2$  and  $Pb(NO_3)_2$  at rates: 0, 1000, 2000 and 4000  $\mu g$  Pb/g soil, without or with adding some agents for removal lead ions: Bacteria (*Bacillus subtilis*, isolate No.13) and phosphorus. Vegetative growth characters of roots and shoot were significantly inhibited with increasing the Pb concentration in soil. The inhibitory effect of Pb was more severely in the length and size of roots, root and shoot dry weights and root/shoot ratio than others characters, this effect was more pronounced in the presence of  $Pb(NO_3)_2$  than in  $PbCl_2$  application. Also, both Pb salt types had a deleterious effect on leaf chloroplast pigments, both chlorophyll a and b were more negative affected by Pb ions than that of carotenoids. Leaf water relations were significantly differed in responses to lead. Total water content (TWC), leaf water deficit (LWD) and transpiration were increased, whereas relative water content (RWC) was decreased as a result of Pb application. Pollution of soils with Pb significantly reduced the root, top and total yield of carrots more in the presence of Pb chloride than in that the presence of Pb nitrate. Total soluble solids (TSS) and total soluble sugars were increased, whereas carotene, vit. A, and vit. C were decreased in the roots of carrot plants treated with lead. Pb concentration in both root and top was significantly enhanced more in the presence of Pb chloride than that in the presence of Pb nitrate.

Adding *Bacillus* bacteria as a bioagent and phosphorus as a chemoagent to the Pb polluted soils not only led to overcome the deleterious effect of intolerable Pb levels (2000 and 4000  $\mu g$  Pb/ g soil) on most above mentioned characters, but also stimulated the growth, increased the yield, regulated the plant water relation, protected the photosynthetic pigments and sharply reduced the Pb concentration in both root and top. Application of P was the best in this respect.

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**Key words:** Carrot plant, lead, bacillus bacteria, phosphorus, growth, photosynthetic pigments, water relations, yield quantity and quality, lead accumulation.

## Introduction

Lead is one of the heavy metals and is considered one of the dangerous environmental pollutants. It is omitted from industries, motor vehicles, stationary fuel, road dust composition and traffic roads. Lead is not only a toxic element but also can be accumulated in plant organs and agricultural products (Burzynki, 1987; Mahmoud and El-Beltagy, 1998), consequently enter human food chain (Wagner, 1993). As a result of consumption of food, lead accumulates in human body and it may cause renal failure, brain and liver damage and it can attack the nervous system and cause failing of sickness (Lucky and Kenugopal, 1977; Ramade, 1987). Lead has a deleterious effect on crop plants. It was found that the high levels of lead inhibited the growth of higher plants such as wheat (Kletecka and Niklasova, 1986; Karataglis *et al.*, 1991), vegetable crops (Ali, 1982; Xian, 1989; Moftah, 2000). Also, lead tended to have an inhibitory effect on some physiological processes, i.e. photosynthesis (Rebenchini and Harzly, 1974; Poskuta *et al.*, 1987, Becerril *et al.*, 1988), protein synthesis (Stibrova *et al.*, 1986; Taiz and Zeiger, 1998) and amino acids (McCrea, 1984; Poskuta *et al.*, 1988), carbohydrate and sugar content (Kandil, 1995), activity of some enzymes (Stibrova *et al.*, 1986), chlorophylls (Prasa *et al.*, 1989; Tomasevic *et al.*, 1991) and some water relations (Burzynki, 1987; Ewais, 1997). In addition, some investigators found that lead in soil at higher rates decreased the yield of some crops whereas the lower one had an insignificant effect on it (Xian, 1989; Moftah, 2000). Nowadays, great efforts were made to remove or degrade and detoxify the heavy metal pollutants from water and soil using modern technology called bioremediation and phytoremediation. Many investigators used bacteria (Ibeanusi *et al.*, 1995; Cuero, 1996; Margeay *et al.*, 1997; Mahmoud and El-Beltagy, 1998) and fungi (Gadd, 1986) as bioremediants as well as algae (Oliguin, *et al.*, 1994; Kaplan *et al.*, 1998) and plants (Brown, 1995; Brook and Robinson, 1998) as phytoremediants. In this connection, Cuero (1996) studied the effect of the aminopolysaccharides chitosan and *Bacillus subtilis* each alone and in combination on metal accumulation in sandy loam soil contaminated with heavy metals. Mahmoud and El-Beltagy (1998) isolated and identified some lead tolerant bacteria strains from naturally lead polluted soils and tested them for lead reduction in rocket salad plant grown on polluted soils. They found that the reduction percentage of lead uptake by rocket salad plant using strains No.1 (*Streptomyces ambifaciens*), No.2 (*Streptomyces setonii*), No.13 (*Bacillus subtilis*), No. 15 (*Bacillus cereus*) and mixed were 72.6, 71.2, 96.4, 89.2 and 50.4, respectively. However, study the effect of such bioremediants on the growth, physiology and biochemistry as well as yield of plants were rare or not published. Also, application another agents as lead remediants such as nutrients or chemicals may be still under research. Moftah (2000), tested the responses of lead-polluted tomato and eggplant to the antioxidant ethylendiurea (EDU) and found that EDU treatment seemed to be useful in the counteracting the harmful effects exerted by Pb contamination on tomato and eggplant by regulating certain enzymes.

Therefore, the aim of this investigation was to study the effect of lead pollutant in forms  $PbCl_2$  and  $Pb(NO_3)_2$  at different rates, with or without application bacteria (*Bacillus subtilis*, isolate No. 13) and phosphorus in form calcium superphosphate, on growth, photosynthetic pigments, water relations and yield quantity and quality of carrot as well as lead accumulation in both root and top of carrot plant.

## **Material and Methods**

Pot experiments were conducted at the Experimental Farm, Faculty Agriculture, Shibin El-Kom, Egypt. Sowing was carried out in plastic pots with 30 cm inner diameter, in October 5, 1998 and 1999 using carrot seeds cv. "Red Core Chantenay" obtained from the Horticulture Dept., Faculty of Agriculture, Minufiya University. Pots were filled with 8 kg clay loam soil taken from the Experimental Farm of Agric. Faculty of Agriculture (ECe=2.8 mmhos/cm; pH=7.9; Soluble salts=0.16%; Pb=68.6 ppm). Pots were divided into two sets: first was mixed with lead chloride and the second with lead nitrate at lead concentrations 0, 1000, 2000 and 4000  $\mu\text{g Pb/g soil}$ . Each set was divided into three groups: the first without any adding agents, the second inoculated with *Bacillus subtilis*, strain No. 13 grown in NPM and the third with adding phosphorus. *Bacillus subtilis* strain No. 13 as a Pb tolerant isolate was obtained from the Agricultural Microbiology Branch, Agric. Botany Dept., Faculty of Agriculture, Shibin El-Kom, Egypt. In P treatments, phosphorus was added as calcium superphosphate (15.5%  $\text{P}_2\text{O}_5$ ) at rate 4 g/pot. Pots were irrigated with tap water whenever to keep the moisture in soil at about 65% of the total water holding capacity of the soil during the experimental period.

One week before the harvest time, a random sample of 10 plants was carefully taken from each treatment and the following measurements were done:

- Vegetative growth characters: Root length (cm), root and core diameter (cm), root size ( $\text{cm}^3$ ), root, shoot and whole plant dry weights (g/plant), then the root/shoot ratio was calculated.
- Photosynthetic pigments were extracted from fresh leaves using acetone 80% and estimated according to Wettstein (1957), then calculated as mg/g dry weight.
- Leaf water relations: Total water content (TWC, %), relative water content (RWC, %), leaf water deficit (LWD, %) and transpiration rate (mg/ g fwt. h) according to Kalapos (1994) and Kreeb (1990).

At the harvest time, plants in each treatments were carefully taken and cleaned then the root, top and total yield/pot were estimated then calculated as  $\text{kg/m}^2$ . The harvest index (%) was measured using the formula ( $\text{HI} = (\text{root yield}/\text{total yield}) * 100$ ). Another random sample was taken and the total soluble solids (%) using an Abe hand refractometer, vit. A (IU/100 g fwt.), vit. C. (mg/100 g fwt.) and carotene (mg/ 100 g fwt.) in fresh root were estimated using the methods of A.O.A.C. (1970). Hundred grams from the roots and tops from each treatment were dried at  $70^\circ\text{C}$ , 0.2 gm from each dried ground organs was acid digested for estimation the total lead concentration ( $\mu\text{g/g dwt.}$ ) using Atomic Absorption Spectrophotometer at Faculty of Science, Minufiya University according to Allen (1974). Another 0.2 gm from dried ground root was used to determine the soluble sugars concentration (mg/g dwt.) according to Dubois *et al.*, (1956).

A randomized complete block design with ten replicates was used. Data were statistically analyzed and the L.S.D. test at 5% level of probability was used to compare the means of the treatments (Waller and Duncan, 1969) with help the COSTAT C Statistical package (American Computer Program).

## Results and Discussion

### Vegetative growth

**Root length:** Data presented in Table (1) illustrate that lead at all levels significantly inhibited the root length and it was more severely at the high Pb level. Under the intolerable level (4000  $\mu\text{g Pb/g}$  soil) the reduction in it of plants grown in soil polluted with  $\text{PbCl}_2$  and  $\text{Pb}(\text{NO}_3)_2$  reached about 13.1 and 25.5% (1<sup>st</sup> season) and 22.4 and 34.4% (2<sup>nd</sup> season) compared with the non treated plant, respectively, indicating that  $\text{Pb}(\text{NO}_3)_2$  had more harmful effect on root length. These results are in accordance with those obtained by Stiborova *et al.*, (1986) and Obraucheva *et al.*, (1998).

In the unpolluted soil, adding bacillus bacteria caused a slight increase in it, whereas adding P significantly increased it. In the polluted lead soils at all Pb levels, application of both bacteria and P had a high significant effect in this respect. The increase in it resulted from adding bacillus bacteria to the polluted soil with  $\text{PbCl}_2$  and  $\text{Pb}(\text{NO}_3)_2$  at 4000  $\mu\text{gPb/g}$  soil was about 15.8 and 19.3% (1<sup>st</sup> season), 30.7 and 33.3% (2<sup>nd</sup> season), whereas with adding P to both polluted soils, the increase was about 28.6 and 17.8% (1<sup>st</sup> season), 42.3 and 35.2% (2<sup>nd</sup> season), respectively. This indicates that application P to the polluted soil with  $\text{PbCl}_2$  and  $\text{Pb}(\text{NO}_3)_2$  was more useful for stimulating the growth of root.

**Root diameter:** The same trend of root length was observed in root diameter, but the percentages of reductions in root diameter of plants grown in soil polluted with 4000  $\mu\text{gPb/g}$  soil were lower (-12.8 and -19.4% for  $\text{PbCl}_2$ ; -16.3 and -26.8% for  $\text{Pb}(\text{NO}_3)_2$ ). Also, inoculation the lead polluted soil with bacteria or adding P had a positive effect in this respect. Again, P was more effective in this respect.

**Root size:** It can be seen from the same Table that the root size was sharply decreased with increasing the Pb level in soils polluted with  $\text{PbCl}_2$  and  $\text{Pb}(\text{NO}_3)_2$  recording the smallest size at the level of 4000  $\mu\text{gPb/g}$  soil with reduction reached about -33.9 and -47.8% (1<sup>st</sup> season), -50 and -64.8% (2<sup>nd</sup> season) less than the untreated plants. Similar results were achieved by Stiborova *et al.* (1986) and Obraucheva *et al.* (1998).

Treating the lead chloride and nitrate polluted soils with bacillus led to a great increase in root size reached to about 54.6 and 76.9% (1<sup>st</sup> season), 71.1 and 96.4% (2<sup>nd</sup> season), whereas its treating with P increased it more and reached about 79.3 and 75.6% (1<sup>st</sup> season), 123.7 and 150.1% (2<sup>nd</sup> season) over the plants treated with 4000  $\mu\text{g Pb/g}$  soil of two salt types.

**Core diameter:** A slight change in core diameter as a result of Pb treating was observed in the 1<sup>st</sup> season but a marked decrease was recorded in the 2<sup>nd</sup> one. Using bacillus bacteria in the lead polluted soils tended to be more effective in increasing the core diameter than using phosphorus (Table 1).

**Plant height:** A significant decrease in plant height was observed in the plants soils treated with 2000 (-20.9, -14.2, 1<sup>st</sup> season, and -23.01, -15.4%, 2<sup>nd</sup> season, for Pb chloride and nitrate respectively) and 4000 (-31.7, -35.3%, 1<sup>st</sup> season and -30.2, -28.2%, 2<sup>nd</sup> season)  $\mu\text{g Pb/g}$  soil of both salt types, whereas the low level (1000  $\mu\text{gPb/g}$  soil) tended to increase it. The obtained results are in agreement with those reported by Gadallah (1995) who found that the heavy-metal toxicity appears in the reduction of plant height and dry mass accumulation.

The results obtained in Table (1) indicate that application of bacillus bacteria to the lead polluted soils by  $\text{PbCl}_2$  and  $\text{Pb}(\text{NO}_3)_2$  did not show a clear trend in this respect, whereas application of P overcame the deleterious effect of Pb and increased the plant height by about 22.5 and 21.8% in the 1<sup>st</sup> season, 28.5 and 21.7% in the 2<sup>nd</sup> season, respectively.

*Dry weights of root, shoot and whole plant:* Data presented in the same Table show that the dry weights of root and shoot as well as whole plant were significantly decreased with increasing the Pb level in soil. At the highest level of Pb (4000  $\mu\text{g}$  Pb/g soil), the reduction in the dry weights of root, shoot and whole plant grown in polluted soils with  $\text{PbCl}_2$  reached about -59.3, -43.5 and -54.2%, respectively, (1<sup>st</sup> season); -32.9, -7.8 and -23.7% (2<sup>nd</sup> season), but in the polluted soils with  $\text{Pb}(\text{NO}_3)_2$  were about -68.9, -41.6 and -60.2% (1<sup>st</sup> season); -35.1, -5.9 and 24.5% (2<sup>nd</sup> season). These results indicate that Pb in form  $\text{Pb}(\text{NO}_3)_2$  was more harmful than in form  $\text{PbCl}_2$ . Similar results were obtained by Carlson et al. (1975) on maize plant, Ali (1982) on pepper and jews mellow plant; Gadallah (1995) on and Begonia *et al.*, (1998) on *Brassica juncea* plant.

Inoculating the lead chloride polluted soils with bacillus bacteria as well as adding P was not only more useful in overcame the inhibitory effect of Pb on root dry matter but also a great increase in it (97.8 and 129.3% for bacteria; 57.6 and 154.4% for P) was recorded. Shoot dry matter as well as whole plant tended to be more affected by bacillus bacteria (35.2 and 101.1% for shoot; 73.1 and 116.9% for whole plant) than that by P (16.5 and 26.6% for shoot; 41.3 and 98.1% for whole plant). Regarding the polluted soils with lead nitrate, it was found that adding both of bacillus and P showed a positive effect on root dry matter but shoot and whole dry matters tended to be more affected by P than bacillus.

*Root/Shoot ratio:* Data in the same Table show that a significant reduction in R/S ratio in all Pb treatments was observed. In this connection, Mishra and Choudhuri (1998) found that Pb decreased shoot/root ratio of two cultivars rice differing in their tolerance to heavy metal stress. Using both bacteria and P in the untreated and polluted soils led to a great increase in it. Bacillus was more effective in the lead nitrate polluted soil whereas P was more useful in case of the lead chloride polluted soils.

The deleterious effect of lead at the intolerable levels (2000 and 4000  $\mu\text{g}$  Pb/ g soil) on growth of carrot plant may be due to lead retarded cell division and differentiation thus inhibited their elongation and that lead to a reduction in plant growth (Kastori et al., 1998). Moreover, the inhibition in root growth may be ascribed to the toxic effect of lead on the meristematic region of root, thus retarded their growth and distribution (Stiborova *et al.*, 1986) or/and that may be due to its inhibition effect on both cell division and elongation through the reduction of meristem size and decreasing the number of mature cells (Obroucheva *et al.*, 1998).

The stimulating effect on growth parameters of carrot plant as a result of adding bacillus bacteria to the lead polluted soil may be attributed to action of bacteria for bioremediation of lead from contaminated soil thus inhibited its toxic effect (Ibeanusi et al., 1995), or may be due to their beneficial effect on improving nutritional status, producing growth regulators i.e. IAA, GA and cytokinins (Lazarovites, 1995; Arshad and Frankenberger, 1991) or to their ability to produce anti-bacterial and anti-fungal compounds that reduce diseases (Pandy and Kumar, 1989). As for the favourable effect of P on the growth may be due to its effect as a growth limiting factor or due to enhancing the absorption of other nutrients (Marschner, 1995), beside its inhibitory effect on lead by precipitation of lead ions.

### Photosynthetic pigments

Data presented in Table (2) reveal that a sharply decrease and degradation in both chlorophyll a and b as well as total chlorophyll and carotenoids. In the lead chloride polluted soil, the percentage reduction in the above-mentioned pigments were about -90.9, -89.1, -90.2 and -44.5%, respectively, in the 1<sup>st</sup> season, and about -95.9, -90.7, -94 and -36.4 % in the 2<sup>nd</sup> one. Meanwhile in the lead NO<sub>3</sub> polluted soil, they were about -88.8, -53.9, -75.3 and -80.7% (1<sup>st</sup> season); -80.5, -90.7, -84.3 and -63.1% (2<sup>nd</sup> season), respectively. This indicates that Pb in any form had a severely harmful effect on all photosynthetic pigments. Similar results were reported by Burzynski (1985); Stbirova *et al.*, (1986); Sengar and Pandey (1996) and Fodor *et al.* (1998). The deleterious effect of lead on chloroplast pigments may be due to that Pb inhibits the biosynthesis of aminolevulinic acid (ALA) a precursor of chlorophyll (Thomas and Singh, 1996), and/or stimulates the activity of chlorophyllase and chlorophyll degradation (Abdel Basset *et al.*, 1995), and/or it can alter chlorophyll biosynthesis by inhibiting protochlorophyllide reductase through interfering the sulfhydryl site on the enzyme (Lagriffoul *et al.*, 1998), and/or it decreases the carotenoids that prevent chlorophyll photodestruction, or/and it inhibits Fe uptake and transport to plant leaves (Fodor *et al.*, 1998).

Treating the lead polluted soils with bacillus and P not only led to counteracting the inhibitory effect exerted by Pb but also increased their concentrations from seven to ten times for chl. a, one to five times for chl. b, one to seven times for total chlorophyll, and less or more than unit for carotenoids. P was more effective than bacillus in this respect.

The role of bacteria in enhancing the photosynthetic pigments may be attributed to its indirect effect by reducing the concentration of lead ions in root medium to extent to become non toxic. The promoting effect of P on photosynthetic pigments under the normal conditions as well as the lead polluted soils may be due to its effect on reducing the concentration of lead ions as shown our results in the same work and/or due to its providing the plants with ATP and NADPH and other compounds that play a vital role in biosynthesis of chlorophylls and other pigments (Marschner, 1995).

### Leaf water relations

Data recorded in Table (3) indicate that the leaf total water content (TWC) tended to be decreased in the plants grown in the lead chloride polluted soils (-3.44% and -1.635% at the rate of 4000 µg Pb/g soil), whereas it tended to be increased in the lead nitrate polluted soil (+8.11 and +7.4% at the same Pb rate). In the unpolluted soils, application bacillus bacteria seemed to have not a clear effect on TWC (increased in the 1<sup>st</sup> season but decreased in the 2<sup>nd</sup> one), whereas adding P led to decrease it. In the lead-polluted soils, bacillus treatments caused a decrease in TWC ranged from 2 to 7%, whereas P treatments increased it.

Concerning the relative water content (RWC) and leaf water deficit (LWD) in relation to Pb treatments, agents treatments as well as their interactions, it was found that RWC sharply decreased in the Pb polluted soils with PbCl<sub>2</sub> (-14.52 and -11%) and P(NO<sub>3</sub>)<sub>2</sub> (-15.5 and -12.62%) at rate 4000 µg Pb/g soil, whereas LWD was dramatically increased by 66.9 and 49.4% (chloride) and 71.4 and 56.8% (nitrate) at the same Pb rate. Treating the polluted soils with bacillus bacteria relatively improved RWC and increased it by about 7.2 and 6.6 (chloride); 11.1 and 12.3% (nitrate), whereas treating with P increased it more (15.4 and 16%, chloride; 22.6 and 19.9%, nitrate). LWD was decreased by about -16.9 and -17.7% (chloride); -25.3 and -31% (nitrate) in the polluted soils treated with bacillus, meanwhile the decrease in it was higher as a result of treating with P and reached about -36.3 and -42.9% (chloride); -51.3 and -49.8% (ni-

trate). Regarding the rate of leaf transpiration (TR), data in the same Table show that TR was significantly increased under lead contamination conditions reached about 55 and 25.9% (chloride); 30.2 and 58.2% (nitrate) at rate of 4000  $\mu\text{g Pb/g soil}$ . Both bacillus bacteria and P regulated the loss of water from leaves and decreased its rate. P treatment was more effective than bacillus in this respect. The obtained results agreed with those obtained by Burzysnki (1987) who found that the placement of two week old bean, wheat and cucumber plants in lead chloride solution caused a significant decrease in transpiration and water uptake.

### **Yield attributes**

*Root, top and total yield:* The results obtained in Table (4), show that the root and top as well as total yield of carrot were negatively affected by Pb treatments and were severely in the polluted soils with Pb chloride and nitrate at rates of 2000 and 4000  $\mu\text{g Pb/g soil}$ . The highest reduction was recorded in root yield (-56.3 and -57.14, (Pb chloride); -45.8 and -58.1% (Pb nitrate)) followed by total yield (-51.8 and -49.8%, (Pb chloride), -34.8 and -45.8% (Pb-nitrate). A higher reduction in top yield was observed in the plants grown in contaminated soils with  $\text{PbCl}_2$  (-41.5 and -33.8%) whereas a lower reduction in it (-10.1 and -19.2%) was recorded in soils with  $\text{Pb}(\text{NO}_3)_2$  indicating that lead chloride was more harmful than nitrate. Similar results were reported by McCrea (1984) and Xian (1989) on kidney beans and Mofteh (2000) on tomato and eggplant.

Adding bacillus bacteria to the lead polluted soils led to counteract the deleterious effect lead and increased the root, top and total yields by about 30.1, 35.9 and 32.3% (1<sup>st</sup> season); 72.3, 20 and 42.9%(2<sup>nd</sup> season), respectively, in the soils polluted with  $\text{PbCl}_2$ , meanwhile by about 13.5, 12.7 and 13.1% (1<sup>st</sup> season); 94.9, 3.3 and 51.9% (2<sup>nd</sup> season) in the soils polluted with  $\text{Pb}(\text{NO}_3)_2$ . Using P as a remediator for lead did not only remove the harmful effect of lead but also gave higher increases in root yield (106.4 and 65.3%), top yield (88 and 25%) and total yield (99.6 and 48.6%) in case of  $\text{PbCl}_2$ . The same trend was observed in the soil polluted soils but the percentage increases in yield were lower.

*Harvest index:* Data in the same Table indicate that the Harvest index (HI) was significantly decreased at all Pb levels and recorded the lowest values at the rates of 2000 and 4000  $\mu\text{g Pb/g soil}$ . These reductions ranged from about 9 to 25%. Adding bacillus bacteria to the polluted soils had no significant effect on it in the 1<sup>st</sup> season but a clear increase (21.1 and 28.3%) was observed in the 2<sup>nd</sup> one. A slight increase in HI (3.4 and 4.6%) in the 1<sup>st</sup> season but a relatively increase (11.2 and 13.1%) in the 2<sup>nd</sup> one was recorded with the P treatments.

The inhibitory effect of lead on the above mentioned yield attributes of carrot may be due to its toxic effect on growth as shown our results in the same work and its inhibitory effect on the uptake and translocation of some major and micro elements within plant roots (Larcher, 1980); activity of some enzymes as well as biosynthesis of photosynthetic pigments which reflect an carrot yield. Adding bacteria or P led to a marked increase in yield components and that may be not only due to its role in removing the toxic effect of lead but also its role that play in promotion of strong root and shoot (Mohandas, 1987), the high bacterial production of phytohormones (Lazarovites, 1995), improving nutrition (Lazarovites, 1995) as well as increasing the root weight (Selim, 1999).

### Chemical properties of roots

**Total soluble solids (TSS):** Data given in Table (5) reveal that TSS was positively affected by Pb application more in the presence of lead nitrate (28.9 and 26.8%) than in lead chloride (3.8 and 5%). TSS tended to be decreased in the polluted soils and treated with bacillus bacteria but increased in the roots of plants grown in non polluted soils. P significantly increased it in the non-polluted and polluted soils with PbCl<sub>2</sub>, however a higher decrease (-24.1 and -21.2%) was observed by Pb(NO<sub>3</sub>)<sub>2</sub>.

**Carotene:** A significant decrease in carotene content was found in the roots of plants grown in contaminated soils with lead chloride and nitrate at rates of 2000 and 4000 µg Pb/g soil but a slight increase in it was found at rate 1000 µg Pb/ g soil (Table 5). Treating the polluted soils with bacillus bacteria gave a great increase in root carotene content arrived to 56.5 and 110.14% in the presence of PbCl<sub>2</sub>, and to 101.2 and 48.1% in the presence of Pb(NO<sub>3</sub>)<sub>2</sub>. P treatments gave higher increases in the presence of PbCl<sub>2</sub> (85 and 122%) but lower increases in the presence of Pb(NO<sub>3</sub>)<sub>2</sub> (48.8 and 11%). Similar results were observed by Moftah (2000) on tomato and eggplant.

**Vitamin A:** It was found that Vit. A was significantly decreased with increasing the Pb concentrations in the lead polluted soils, reached the lowest content at the highest rate of Pb (4000 µg Pb/g soil), (Table 5). The deleterious effect of lead was more pronounced in the presence of PbCl<sub>2</sub> (-25.3 and -38%) than in the presence of Pb(NO<sub>3</sub>)<sub>2</sub> (-17.6 and -21.3%). Adding bacillus bacteria to the non polluted soils caused a significant increase in it whereas in the polluted soils did not show a clear trend. Using P in both the non-polluted as well as lead chloride polluted soils resulted in increasing Vit. A, meanwhile a slight increase in the presence of lead nitrate.

**Vitamin C:** Data given in the same Table demonstrate that Vit. C in root was negatively affected by Pb at all concentration and was more severely at the rate of 4000 µg Pb/g soil in both salt types. The reduction in it reached about -27.4 and -30.1% in the presence of lead chloride and -49.1 and -25.6% in the presence of lead nitrate if compared with the control. Inoculation the non-polluted as well as the polluted soils by lead nitrate with bacillus bacteria led to a significant increase but not in presence of lead chloride. Adding P to the non and the polluted soils with lead (two types) overcome the deleterious effect and increased it by about +15 and +36.1 (Chloride) and +27.3 and +2.3% (Nitrate).

**Soluble sugars:** Data illustrated in Fig (1) showed that the total soluble, reducing and non-reducing sugars were markedly decreased under all levels of lead application. Under the lead stress conditions, application of both bacillus and P led to marked increases in the concentrations of total soluble and non-reducing sugars but the reducing sugars were decreased. In this respect, Kandil (1995) revealed that lead decreased total, soluble and non-soluble carbohydrates of wheat grains. Also, Ali (1982) found that 100-1000 ppm of lead as foliar application or soil treatment decreased the non-reducing sugars in some vegetable crops. The reduction in carbohydrate concentration as a result of lead treatment may be attributed to Pb causes a decrease in the photosynthetic pigments (Sengar and Pandey, 1996) and ribulose diphosphate carboxylase (the key enzyme for carbohydrates synthesis) which in turn in decreasing in all sugar fractions (Stibrova *et al.*, 1986).

As shown from the above mentioned results, adding bacillus bacteria or phosphorus as calcium superphosphate to the polluted and non polluted soils with lead significantly improved the chemical properties of carrot roots and that may be due to its promotion effect on growth and yield as well as vital roles in physiological and biochemical processes in plant. In this connection, Antipchuk *et al.* (1982) and Ali and Selim (1996) observed that inoculation of tomato plants with Azotobacter resulted in a rise in fruit sugars and vitamin C contents. Bagal *et al.* (1989) found that protein, sugars,

ascorbic acid and mineral contents were significantly increased by increasing the rates of N, P and K application. Marschner (1995) stated that P is a component of RNA and DNA, therefore, it might be expected that P supply would have important effect on biosynthesis of many compounds e.g. sugars, proteins and hormones. Moreover, Bender *et al.* (1986) revealed that photosynthetic CO<sub>2</sub> fixation and assimilates translocation were considerably increased in plant with the optimum P supply in comparison with the low P level.

### Lead concentration

Data illustrated in Fig. (2&3) that Pb accumulated more in shoot than in root and reached about five times. In both shoot and root Pb concentration was dramatically increased with increasing the Pb rates in soils. At the highest level of Pb, the increase percentage in Pb accumulation in shoot reached about 900 and 985.4% in the presence of PbCl<sub>2</sub>, about 433.3 and 448.9% in the presence of Pb(NO<sub>3</sub>)<sub>2</sub>, whereas in root reached about 85.7 and 115.5% in the presence of PbCl<sub>2</sub>, while about 57.2 and 84.6% in the presence of Pb(NO<sub>3</sub>)<sub>2</sub>, if compared with its concentration in the control plants. This indicates that carrot plants prefer to Pb uptake in salt form PbCl<sub>2</sub> more than in form Pb(NO<sub>3</sub>)<sub>2</sub>. These results may be explained why the deleterious effect of lead chloride on most characters measured in shoots was more extremely. The obtained results are in agreement with some those obtained by Gaweda (1995 and 1997), Hooda *et al.* (1997) and Moftah (2000).

In the polluted lead soils with PbCl<sub>2</sub> at rates of 1000, 2000 and 4000 µg Pb/g soil, adding bacillus bacteria as bioremediant for lead ions led to a reduction in its concentration by about 50.1, 43.4 and 51.6% in shoot, and by about 44.6, 51.3 and 53.2% in root, respectively, whereas in the presence Pb(NO<sub>3</sub>)<sub>2</sub> were about 32.3, 32.2 and 65.1% in shoot, 44.1, 42.4 and 49.8% in root, (Fig. 4). Regarding the effect of using P as a chemical agents for lead remediation, it was found that adding P to the contaminated soils with PbCl<sub>2</sub> at the same above mentioned rates reduced Pb concentration by about 62, 36.6 and 59.3% in shoot, about 48, 60.4 and 72.1% in root, whereas in the presence of Pb(NO<sub>3</sub>)<sub>2</sub> the reductions were about 38.4, 53.8 and 55.8% in shoot, about 58.7, 47.9 and 54.2% in root (Fig. 4). These results pointed out that using the P was more useful for lead remediation and consequently overcome the toxicity effect of lead on carrot plant. The obtained results of bacillus-lead interaction are in accordance with those reported by Mahmoud and El-Beltagy (1998), who found that using bacillus bacteria strain No. 15 in the naturally lead-polluted soils reduced the lead uptake by 96.4% in the rocket salad plant, whereas the reduction was 73.49% in the soil polluted with 400 ppm lead. The reduction in lead accumulation as a result of using bacteria as bioremediants may be attributed to precipitation of metal ions, adsorption at bacterial sites and reduction by change of oxidation states (Ibeanusi *et al.*, 1995)

As for the P-lead interaction, Gaweda (1997) indicated that using phosphorus (800 mg P/kg DW), calcium (1500 mg Ca/kg DW) and magnesium (240 mg/kg DW) as fertilizer or liming to increase soil pH from 5.1 to 6.2 considerably limited the accumulation of Pb in carrot roots.

Figures 1 - 4<sup>4</sup>

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<sup>4</sup> Figures 1-4 and the tables 1 to 5 are only available in the print copy (Beiheft zu *Der Tropenlandwirt* Nr. 71).

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## **Zur Weiterentwicklung des ägyptischen Bewässerungssystems – Anmerkungen eines externen Beobachters**

### **Development of Egypt's Irrigation System – Remarks of an External Observer**

Prof. Dr. Peter Wolff

#### ***Einführung***

Die sich weltweit vollziehenden politischen, gesellschaftlichen und wirtschaftlichen Veränderungen und Umbrüche gehen an der Bewässerungswirtschaft nicht spurlos vorüber (Wolff u. Hübener, 1999). Die mit dem Bevölkerungswachstum und der Industrialisierung eingetretene zunehmende Verknappung des Pro-Kopf-Wasserdargebotes verbunden mit den Sorgen um die Erhaltung bzw. Wiederherstellung gesunder Umweltverhältnisse bringen die Bewässerungslandwirtschaft weltweit in Bedrängnis. Sie muss verstärkt mit den anderen Nutzungssektoren um die knapper werdenden Wasserressourcen konkurrieren. Und zwar mit Sektoren, wie der Industrie, dem Gewerbe und den Kommunen, die eine wesentlich höhere Wertschöpfung aufweisen und damit auch wesentlich mehr für das Wasser bezahlen können. In den ländlichen Gebieten, d.h. in ihrem unmittelbaren Umfeld, muss sich die Landwirtschaft und insbesondere die Bewässerungslandwirtschaft den Zwängen des Natur- und Umweltschutzes stellen und ihren Beitrag zu einem nachhaltigen Management der natürlichen Ressourcen leisten. Durch die Öffnung der Märkte, die Globalisierung, ist sie andererseits einem erheblichem ökonomischen Druck ausgesetzt, sie muss auf die Kräfte der freien Marktwirtschaft flexibel, schnell und kostenbewusst reagieren. Die Bewässerungslandwirte können allerdings nur umweltbewusst, nachhaltig und ökonomisch erfolgreich wirtschaften, wenn u.a. das jeweilige Wasserbereitstellungssystem eine solche Wirtschaftsweise ermöglicht. Dies ist insbesondere in den großen Bewässerungssystemen nicht immer der Fall, da diese Systeme von der Technik und dem Management her nicht die notwendige Flexibilität in der Wasserbereitstellung aufweisen. Die Systeme bedürfen einer Überprüfung und gegebenenfalls einer weitreichenden Modernisierung. Nachfolgend sollen beispielhaft die Probleme und Ansätze der Weiterentwicklung des ägyptischen Bewässerungssystems dargestellt werden.

#### ***Das Bewässerungssystem***

Die ägyptische Bewässerungslandwirtschaft befriedigt ihren Wasserbedarf zum überwiegenden Teil aus dem Lake Nasser, einem Überjahresspeicher, der durch den Bau des Hochdammes von Assuan im Zeitraum 1960 –70 geschaffen wurde. Aus diesem Stausee wird das Bewässerungswasser über den Nil und den von ihm abgehenden Kanälen mittels eines weitverzweigten Zuleitungsnetzes den einzelnen Bewässerungsflächen zugeleitet. Die Ableitung aus dem Nil erfolgt mit Hilfe von Stauwehren

und Pumpenanlagen (Oberägypten). Die Stauwehre, wie auch die Primär- und Sekundärkanäle sind öffentliche Einrichtungen. Sie werden vom Ministry of Water Resources and Irrigation (MWRI) betrieben und unterhalten. Das öffentliche Kanalnetz endet im Übergangsbereich zu den sogenannten Mesquas, den unter Aufsicht des Ministeriums stehenden privaten Kanälen. Sie sind von den Anliegern bzw. Nutzern zu betreiben und zu unterhalten. Den Mesquas wird das Bewässerungswasser aus dem öffentlichen Kanalnetz über bis zu 10m lange, unterirdisch verlegte Rohrleitungen zugeleitet. Die einzelnen Bewässerungsflächen liegen im Regelfall 0,5 bis 1,0 m oberhalb des Wasserspiegels der Mesquas, so dass das Wasser stets mittels einer Wasserfördereinrichtung auf das Niveau der jeweiligen Fläche gehoben werden muss. Man bediente sich hierzu ursprünglich der manuell betriebenen „Archimedischen Schraube“ oder der tierbetriebenen Sakia. Diese Fördereinrichtungen sind in den letzten Jahrzehnten zunehmend durch dieselbetriebene Motorpumpen ersetzt worden (Wolff, 1989). Sofern die Bewässerungsflächen nicht direkt von den Mesquas mit Wasser versorgt werden können, wird es diesen über Feldzuleiter (Marwas) zugeführt. Von einer Mesqa werden im Regelfall 100 – 500 feddan<sup>5</sup> Bewässerungsfläche mit Wasser versorgt. Die aus den Mesqa's gespeisten Marwa's versorgen 10 – 100 feddan mit Wasser. Die Wasserverteilung auf den einzelnen Bewässerungsflächen erfolgt mittels Oberflächenbewässerungsverfahren und zwar vorwiegend in Form des Flächenüberstaus. Die einzelnen Staubecken sind oft nicht größer als 10x10m. Zu Gemüse- und Obstkulturen aber auch zu anderen Reihenkulturen wird gelegentlich die Furchenbewässerung angewandt.

In den Neulandgebieten erfolgt die Wasserbereitstellung durch Wasserförderung aus dem Grundwasser oder durch ober- bzw. unterirdische Zuleitung aus dem Niltal oder Nildelta. Hier ist die Anwendung moderner Bewässerungsverfahren (Beregnung, Tropfbewässerung) wegen der hohen Durchlässigkeit und der geringen Wasserspeicherfähigkeit der Böden gesetzlich vorgeschrieben. Die Anwendung der traditionellen Oberflächenbewässerungsverfahren würde hier systembedingt zu hohen Wasserverlusten und damit zu einem sehr geringen Wirkungsgrad führen.

Die Hauptkanäle im Niltal und Nildelta werden nach der Verfahren der Oberstromkontrolle (upstream control) bei dauernder Wasserführung betrieben. Die Sekundär- und Tertiärkanäle werden dem gegenüber nach einem Saison angepassten Rotationsplan betrieben. D.h. im Bereich der sogenannten Altländereien erfolgt die Wasserbereitstellung über das öffentliche Zuleiternetz noch weitgehend in Form des unterbrochenen Zuflusses (Rotation). Zu diesem Zweck sind die von einem Hauptkanal zu speisenden nachgeordneten Kanäle in wenigstens 2 bis 3 Gruppen eingeteilt, mit je einem etwa gleich großen Bedarf an Bewässerungswasser. Die einzelnen Gruppen werden in einem vorgeplanten Turnus mit Bewässerungswasser versorgt. Dabei wird versucht, die aus der anstehenden Bodenart, dem jeweiligen Anbauverhältnis und der Jahreszeit resultierenden Unterschiede im Wasserbedarf auszugleichen, was aber meist nicht befriedigend gelingt. Bei dem Rotationssystem der Wasserverteilung wird in Ägypten unterschieden zwischen der Periode, in der der einzelne Verteilerkanal eine Wasserzuleitung erfährt und der Periode, in der dem jeweiligen Verteilerkanal kein Wasser zugeleitet wird. Erstere wird als „on-period“, die zweite Periode wird als „off-period“ bezeichnet. Bei vorwiegendem Reisanbau beträgt die „on“ und „off-period“ beispielsweise 4 Tage. Überwiegen andere Kulturen beträgt die „on-period“ 4 Tage und 8 – 10 Tage die „off-period“.

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<sup>5</sup> 1 feddan = 0,42 ha

## **Organisations- und Managementstruktur**

Das ägyptische Bewässerungssystem ist nach einer Klassifikation von Uphoff et al. (1991) als ein „Large-Scale-System“ einzustufen. Ein solches System ist durch fünf oder mehr Organisations-/Betriebsebenen gekennzeichnet und umfasst mehr als 30.000 ha Bewässerungsfläche. Diese Charakterisierung trifft ohne Zweifel für das ägyptische Bewässerungssystem zu.

Alle Managementaufgaben oberhalb der Mesqa-Ebene werden vom Ministry of Water Resources and Irrigation wahrgenommen. Das Ministerium erschließt die Wasservorkommen, teilt das Wasser zu und verteilt es an die Wassernutzer und führt das Entwässerungswasser ab. Es plant, entwirft, baut, betreibt und unterhält das Hauptzu- und -ableitungssystem. Das Ministerium formuliert die Wasserpolitik des Landes und setzt diese um, es entscheidet alle Wassermanagementfragen, mobilisiert finanzielle Ressourcen (aus dem Staatshaushalt), kommuniziert mit dem eigenen Personal, den Wassernutzern, insbesondere den Landwirten, und der Öffentlichkeit. Es ist in wichtigen Bereichen des Konfliktmanagement tätig, insbesondere in den Bereichen Betrieb und Unterhaltung des Systems.

Das Ministerium besteht aus vier Hauptabteilungen (Irrigation, Finance, Planning, Mechanical & Electrical), vier nachgeordneten Behörden/Authorities (Drainage, High Dam, Coastal Protection und Survey), sechs öffentlichen Baufirmen und dem Water Research Center, bestehend aus 11 Forschungsinstituten. Die Baufirmen befinden sich im Prozess der Privatisierung.

In der Fläche besteht das ägyptische Bewässerungssystem aus ca. 50 Command Areas<sup>6</sup> die nicht deckungsgleich mit den administrativen Einheiten sind. Administrativ ist das System gegliedert in 22 Directorates. Letztere sind die administrativen, regionalen Außenstellen der Hauptabteilung Irrigation, ihnen nachgeordnet sind 48 Inspectorates und 167 Irrigation Districts. Der leitende District-Engineer ist verantwortlich für den Betrieb des Zuleitersystems von jeweils 30.000 bis 40.000 feddan mit 20 bis 50 Zweigkanälen. Dem einzelnen District-Engineer sind ca. 10 Gate Keepers unterstellt, die jeweils für den Betrieb von 4 – 7 Gates zuständig sind. Hinzu kommen ca. 40 Arbeiter für die Ausführung von kleineren Unterhaltungs- und Instandsetzungsarbeiten. District-Engineer and Gate Keeper sind faktisch die einzigen Mitarbeiter des Ministeriums die einen mehr oder weniger ständigen Kontakt zu den Wassernutzern, den Farmern haben. Mit dem Irrigation Improvement Project und der Einrichtung des Irrigation Advisory Service hat sich dies in den Projektgebieten geändert. Hier wird versucht die Nutzer in den Managementprozess mit einzubeziehen.

Neben den regionalen und örtlichen Dienststellen des MWRI spielen für die Funktion des Bewässerungssystems die auf örtlicher Ebene tätigen Mitarbeiter des MALR und die Landwirtschafts-Genossenschaften eine gewisse Rolle. Beide kontrollierten vor allem die Einhaltung des den Landwirten auferlegten Anbauzwanges. Allerdings ist zwischenzeitlich die Rolle der Landwirtschafts-Genossenschaften mit der Aufhebung des Anbauzwanges und der Liberalisierung des Agrarmarktes stark rückläufig.

Neben den staatlichen administrativen Einrichtungen gibt es einige traditionelle, informelle Institutionen die eine spezifische Rolle in der Organisation und dem Management der Bewässerungsaktivitäten auf lokaler Ebene spielen. Hierzu gehört vor allem der jeweilige Dorfbürgermeister (Omda) und die Dorfbeiräte (Sheik al-Balad), wie auch führende Persönlichkeiten entlang des jeweiligen Bewässerungskanal (Mesqa). Bis zur Einrichtung der Village Councils im Jahre 1960 war der Omda die zentrale Ver-

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<sup>6</sup> Command area: ein Gebiet, das von einem über der durchschnittlichen Geländehöhe liegenden Kanal(auslass) mit Bewässerungswasser versorgt wird.

bindungsstelle zwischen den Dorfbewohnern und den staatlichen Organen. Der Omda war zuständig für die Einziehung der Steuern, die Aufrechterhaltung der öffentlichen Ordnung, Überwachung der Einhaltung gesetzlicher Vorschriften, die Organisation der Hand- und Spanndienste für Betrieb und Instandhaltung des Bewässerungssystems. Eine wesentliche Funktion des Omda war das Konfliktmanagement, vor allem in Angelegenheiten des Land- und Wassermanagements. Die Rolle des Omda wurde in den letzten Jahrzehnten mehr und mehr eingeschränkt, in dem viele seiner früheren Zuständigkeiten den auf der dörflichen Ebene angesiedelten Repräsentanten zentraler staatlicher Institutionen übertragen wurden. Es sind dies im Be- und Entwässerungsbereich vor allem die örtlichen Dienststellen des MWRI und des MALR.

Auf der Mesqa- und Marwa-Ebene bestehen allerdings auch weiterhin informelle lockere Organisationsstrukturen der Wassernutzer, die für Außenstehende oft schwer erkennbar sind. Bisher besonders wirkungsvoll waren die Sakia-Gemeinschaften, die sich mit der Umstellung auf Motorpumpen aufgelöst haben (Wolff, 1989). Das Irrigation Improvement Project (IIP) hat dazu geführt, dass nunmehr die rechtlichen Grundlagen für die Bildung von Water User Associations geschaffen wurden. Letztere sind derzeit im Aufbau und haben ihre Bewährungsprobe noch zu bestehen. Mit niederländischer Hilfe werden z.Zt. Dachorganisationen, die Water Boards, der Water User Associations aufgebaut. Ob dieser top-down approach wirkungsvoll und nachhaltig sein wird, bleibt abzuwarten.

## ***Wasserallokation***

Das zur Nutzung verfügbare Wasserdargebot wird jährlich unter den verschiedenen Wassernutzungssektoren durch das Inter-Ministerial Committee on Water Planing (ICWP) aufgeteilt. Die Wassernutzungssektoren werden in diesem Committee durch das für den Sektor zuständige Ministerium vertreten. Es sind dies neben dem Ministry of Water Resorces and Irrigation folgende Ministerien: Ministry of Agriculture and Land Reclamation (MALR), Ministry of Electricity and Energy, Ministry of Housing and Public Utilities, Ministry of Industry sowie Ministry of Tourism and Civil Aviation. Die Ministerien melden dem ICWP den Bedarf des von ihnen vertretenen Sektors für das kommende Wasserwirtschaftsjahr und das ICWP entscheidet dann über die Wasserallokation für die einzelnen Nutzungsbereiche. Das MALR vertritt im ICWP die Interessen der Bewässerungslandwirtschaft und deren Wasseransprüche.

Der Bedarf der Bewässerungslandwirtschaft wird für jeden Zweigkanal bzw. Verteilerkanal separat vom MALR berechnet. Dies geschieht auf der Basis (a) der Fruchtfolge; (b) des Wasserbedarfs der einzelnen Kultur; (c) die Größe der mit Bewässerungswasser zu versorgenden Fläche; (d) dem vorherrschenden Bodentyp; und (e) die zu erwartenden Zuleitungs- und Verteilungsverluste. Wenn dem Ministerium die Größe der Anbauflächen der einzelnen Kulturarten im Bereich der jeweiligen Zweig- bzw. Verteilerkanäle bekannt sind, dann ist der Wasserbedarf problemlos zu berechnen und die Wasserbereitstellung für die kommende Saison zu planen. Dies war solange der Fall, wie die Bewässerungslandwirte strikt einer Fruchtfolge folgten und dem staatlichen Anbauzwang unterlagen. Letzterer wurde durch die Genossenschaften, die Agrarian Reform Cooperative oder die Agricultural Cooperative vor Ort kontrolliert. Mit dem Wegfall des Anbauzwanges und der Einführung der freien Marktwirtschaft müssen die Landwirte zunehmend flexibler auf den Markt reagieren und ihre Fruchtfolge u.U. kurzfristig ändern. Dies hat zur Folge, dass es zunehmend schwieriger wird,

die Wasserbereitstellung in Einklang mit dem Wasserbedarf der Bewässerungslandwirte zu bringen.

Erschwerend zu obigem Problem kommt hinzu, dass das handregulierte, auf Rotationsbasis betriebene Zuleitungssystem nicht in der Lage ist, schnell auf einen wechselnden Bedarf zu reagieren, dass es insgesamt sehr schwerfällig ist und dass die aktuelle Wasserbereitstellung zeitlich und mengenmäßig aus unterschiedlichen, meist sozialen und politischen Gründen nicht immer der Planung folgt.

## **Probleme**

Aufgrund der in den letzten Jahren zunehmenden Diversifizierung des Anbaues, d.h. es werden in Ägypten mehr und mehr Gemüse, Obst und diverse Sonderkulturen anstelle der traditionellen Kulturen Weizen, Alexandrinerklee, Baumwolle und Reis angebaut. Hinzu kommt, dass die Landwirte auch den Anbau der traditionellen Hauptkulturen, vor allem der Marktfrüchte (Cash crops) zunehmend von den erwarteten Vermarktungsmöglichkeiten abhängig machen. So wurde z.B. im Sommer 2000 im Nildelta verhältnismäßig viel Reis und entsprechend wenig Baumwolle angebaut. Aus all diesen Gründen wird das Rotationssystem der Wasserverteilung nicht mehr den Ansprüchen der Bewässerungslandwirtschaft gerecht. Dies ist einmal auf die generell höheren Ansprüche der Intensivkulturen an die Wasserversorgung zurückzuführen und zum anderen liegt es daran, dass sich die Diversifizierung vor allem auf der einzelbetrieblichen Ebene vollzieht. Die vielfältiger werdenden und wechselnden Fruchtfolgen der Einzelbetriebe stellen an die Bewässerung und damit auch an die Wasserbereitstellung wesentlich differenziertere Anforderungen.

Hinzu kommt, dass die Wasserverteilung auf Rotationsbasis in Ägypten in zahlreichen Fällen nicht zur Zufriedenheit der Wassernutzer funktioniert. Es kommt immer wieder vor, dass ein Turnus völlig ausfällt oder während eines Turnus` nicht ausreichend Wasser zur richtigen Zeit bereitgestellt wird. Die Landwirte reagieren darauf im Regelfall mit Überbewässerung. Sie führen ihren Flächen nicht nur bei der einzelnen Bewässerung mehr Wasser zu, als im durchwurzelbaren Bodenraum gespeichert werden kann, sondern sie bewässern ihr Feld während der „on-period“ u.U. gleich zweimal, d.h. am Anfang und am Ende der Periode, wenn immer möglich. Durch ein solches Verhalten wird nicht nur der Ablauf der Wasserverteilung erheblich gestört, es kommt infolge dieser Überbewässerung zu Vernässungs- und Versalzungsproblemen und, was in Ägypten zunehmend schwerer wiegt, zu einer Verschwendung der knappen werdenden Ressource Wasser. Leidtragende dieser in Unordnung geratenen Wasserverteilung sind vor allem die sogenannten „tail-end-users“, die Landwirte die mit ihren Bewässerungsflächen am Ende der Mesqas, des Wasserverteilungssystems liegen. Sie bekommen vor allem während der Sommermonate selten ausreichend Wasser. Untersuchungen des MWRI in den Governoraten Baheira und Kafr El-Sheikh haben ergeben, dass die sogenannten „tail-end farmers“ bei den Winterkulturen um 10 – 20% niedrigere Erträge erzielen als die „upstream farmers“, d.h. als die Bewässerungslandwirte die am Anfang des Verteilsystems wirtschaften. Bei den Sommerkulturen betragen die Ertragsunterschiede gar 30 – 40 %. Die durch unbefriedigende Wasserbereitstellung in den Endbereichen des Wasserverteilungssystems bedingten geringeren Erträge sind nicht nur eine Folge des unmittelbaren Einflusses des Wassermangels auf den Ertrag, sondern auch auf durch Wassermangel bedingte Verzögerungen bei der Bestellung und Entwicklung der Bestände zurückzuführen.

Beim Verteilungssystem für Bewässerungswasser handelt es sich, wie oben bereits angedeutet, in Ägypten noch weitgehend um ein handreguliertes System mit veränderlicher Regulierung während einer Bewässerungsperiode. Die wechselnden Bewässerungspläne werden allerdings wenig flexibel gehandhabt. Es erfolgt meist nur eine vorgeplante Veränderung der Regulierung, die variierenden Bedarfssituationen nicht gerecht wird und aufgrund der unzureichenden technischen Ausstattung auch kaum gerecht werden kann. Die technischen Mängel des Verteilungssystems liegen neben der unzureichenden Ausstattung mit Mess- und Regulierorganen vor allem in der Tatsache begründet, dass die Querschnitte der Zuleiter oft nicht den hydraulischen Erfordernissen entsprechen. Eine Überdimensionierung von 25% ist bei den Zuleitern nicht selten. Hinzu kommt die oft unzureichende Qualifikation und Motivation des Personals der einzelnen Irrigation Districts. Insgesamt resultieren aus diesen Mängeln unverhältnismäßig hohe Regulierungsverluste der Verteilungssysteme. Die Regulierungsverluste weisen seit einigen Jahren steigende Tendenz auf. Bedingt ist dies durch die Tatsache, dass die Landwirte, wo und wann immer möglich, von der Nachtbewässerung Abstand nehmen. Da die Verteilsysteme in Ägypten aber auf 24-Stundenbetrieb ausgelegt sind und das Kanalnetz nur begrenzte Speichermöglichkeiten bietet, fließt während der Nachtstunden zunehmend Wasser ungenutzt direkt aus den Zuleitern in die Entwässerungsgräben. Da das Entwässerungswasser, wenn es noch eine hinreichende Qualität aufweist, spätestens am nächsten Schöpfwerk wieder dem Zuleitersystem zugeführt wird, weist das Gesamtsystem trotz der bestehenden Mängel eine relativ hohe Effizienz auf.

Neben den Regulierungsverlusten kommt es vor allem durch Versickerung im Zuleitungsbereich zu weiteren Wasserverlusten. Nach Untersuchungen, die z.B. im Rahmen des Egyptian Water Use and Management Project durchgeführt wurden, liegen die Wasserverluste im Zuleitungsbereich in Ägypten zwischen 10 und 40%. Im Vergleich zu anderen Ländern mit einer vergleichbaren technischen Ausstattung der Bewässerungsanlagen, sind diese Verluste nicht übermäßig hoch. Im Hinblick auf den steigenden Wasserbedarf Ägyptens, bei kaum wesentlich vermehrbarem Wasserdarbot, sind Verluste in dieser Größenordnung jedoch nicht zu akzeptieren.

Unbefriedigend ist in Ägypten auch das Bewässerungsmanagement auf der Ebene der Bewässerungsflächen, d.h. im Bereich der Mesqas bis hin zu den einzelnen Bewässerungsflächen. Die Probleme reichen hier von der unbefriedigenden Wasserführung in den Mesqas über die Probleme bei der Organisation der Wasserverteilung im Mesqabereich, den geringen Bewässerungswirkungsgraden, der unzureichenden Planung der Bewässerungsflächen, der fehlenden Steuerung des Bodenfeuchtegehaltes, der mangelhaften Entwässerung, der unzureichenden Unterhaltung der Be- und Entwässerungsanlagen bis hin zu den ackerbaulichen und betriebswirtschaftlichen Komponenten der Bewirtschaftung der Bewässerungsflächen.

Insbesondere die Unterhaltung der Be- und Entwässerungseinrichtungen stellt sich zunehmend als ein schwer lösbares Problem dar. Mangelhafte Unterhaltung, vor allem der Be- und Entwässerungskanäle, führt in Ägypten nur zu oft zu einer unzureichenden und nicht termingerechten Wasserbereitstellung sowie zu einer mangelhaften Abführung des Entwässerungswassers. Letzteres hat hohe Grundwasserstände, Bodenvernässung und Bodenversalzung zur Folge und beeinflusst damit die ökologischen Verhältnisse im Niltal und Nildelta negativ. Letztendlich führt eine unzureichende Gewässerunterhaltung zu erheblichen Ertragsverlusten in der Bewässerungslandwirtschaft, die sich Ägypten angesichts des starken Bevölkerungswachstums nicht leisten kann. Ägypten besitzt derzeit öffentliche, d.h. vom Staat zu unterhaltende, Be-

und Entwässerungskanäle in einer Gesamtlänge von 47.868 km plus 1.427 km Flusstrecke des Nils zwischen Assuan und dem Mittelmeer, ferner ca. 560 größere Pumpstationen und ca. 22.000 Reglerbauwerke. Hinzu kommen ca. 80.000 km durch die Wassernutzer zu unterhaltende tertiäre Kanäle und Feldkanäle (Mesqa und Marwas). Das ägyptische Gewässernetz stellt insgesamt ein äußerst komplexes, sich in vielfältiger Weise gegenseitig stark beeinflussendes System dar, von dessen lückenloser Funktionsfähigkeit in diesem Land nicht nur die Bewässerungswirtschaft abhängig ist. Nach Beobachtungen des Verfassers sind die Ursachen der unbefriedigenden Gewässerunterhaltung in Ägypten äußerst vielschichtig. Bei den anstehenden Problemen auf diesem Gebiet handelt es sich um technische, organisatorische und institutionelle Probleme.

Die Betriebsorganisation sieht vor, dass der Gatekeeper täglich alle Bereiche des von ihm zu betreuenden Kanals bzw. Kanalabschnittes aufsucht und als Anlaufstelle für die Wassernutzer dient. In der Realität besuchen die Gatekeepers nur selten die unteren Bereiche des Kanals. Die Messpunkte, die für die Steuerung des Systems wichtig sind, werden gleichfalls nicht regelmäßig aufgesucht und die Messungen dementsprechend nicht durchgeführt. Radwan (1997) berichtet, dass z.B. die Farmer entlang der Um Aisha Mesqa im al-Bagoor District in der Provinz Minoufia den für sie zuständigen Gatekeeper noch nie zu Gesicht bekommen haben. Da dort überreichlich Wasser zur Verfügung steht, sahen die Bauern in der mangelhaften Kommunikation kein Problem, da die damit zusammenhängende Wasserverschwendung für sie kein Thema ist. Im Bereich der Sibiliya Mesqa im gleichen Distrikt, wo die Wasserzuleitung über einen längeren Zeitraum geringer als der Bedarf war, beschränkt sich der Kontakt zu den örtlichen Mitarbeitern des MWRI auf Auseinandersetzungen über widerrechtliche Handlungen in Zusammenhang mit der Manipulation der Wasserzuleitung seitens der Landwirte.

Das offene Gewässernetz stellt nach wie vor die entscheidende Quelle für die Bilharzioseerkrankungen der ländlichen Bevölkerung Ägyptens dar. Fehlendes Problembewusstsein weiterer Bevölkerungskreise führt dazu, dass das Wasser infizierter Oberflächengewässer unbehandelt als Brauch- und teilweise sogar als Trinkwasser genutzt wird. Auch werden die Gewässer in den entlegenen ländlichen Gebieten noch immer als Abort genutzt, oder es werden ihnen Siedlungsabwässer unbehandelt zugeleitet. Dies hat zur Folge, dass viele Personen, die mit dem Wasser in Hautkontakt kommen, immer wieder an Bilharziose erkranken. Hinzu kommt, dass der schlechte Unterhaltungszustand der Gewässer der Vermehrung der Wirtstiere (Schnecken) Vorschub leistet.

## ***Lösungsstrategien***

In Erkenntnis der oben aufgezeigten Probleme des ägyptischen Bewässerungssystems wurde im Rahmen eines speziellen Projektes, dem Egypt Water Use and Management Project, versucht, die Probleme im Detail zu analysieren, Lösungsansätze zu erarbeiten und zu erproben. Das Projekt wurde vom Ministry of Irrigation (heute: Ministry of Water Resources and Irrigation) und dem Ministry of Agriculture and Land Reclamation (MALR) mit Unterstützung von USAID von 1976 bis 1984 durchgeführt und konzentrierte sich auf die Standorte El Mansuriya in der Nähe von Kairo, Abu Raya im nördlichen Nildelta und Abbyuha südlich von El Minia (EWUP, 1984).

Die Ergebnisse des obigen Projektes machten deutlich, dass nur durch ein Bündel von Maßnahmen eine nachhaltige Verbesserung der Leistungsfähigkeit und der damit

zusammenhängenden ackerbaulichen und sozioökonomischen Probleme der ägyptischen Bewässerungslandwirtschaft zu erreichen ist. Besonders deutlich machte das Projekt aber auch, dass diese Verbesserungen zwingend notwendig für die Nachhaltigkeit und Weiterentwicklung der ägyptischen Bewässerungslandwirtschaft wie auch für die Armutsbekämpfung in den ruralen Gebieten sind.

Auf der Grundlage der Erkenntnisse obigen Projektes wurde seitens des Ministry of Irrigation eine Strategie für die Entwicklung der Bewässerungswirtschaft in Ägypten bis zum Jahr 2000 (Strategy for Irrigation Development in Egypt up to the Year 2000) entwickelt (Übersicht 1).

Wie Übersicht 1 zu entnehmen ist, sah die Strategie zur Entwicklung bzw. zur Weiterentwicklung des ägyptischen Bewässerungssystems drei Stufen vor. Hauptziel der Stufe 1 war die Verbesserung der Effizienz des Zuleitersystems und zwar bis hin zu den Farm- bzw. Feldauslässen. In der zweiten Stufe sollte dann die Effizienz der Wassernutzung auf Farm- bzw. Feldebene erreicht werden und schließlich sollte in der dritten Stufe ein System der Erhebung von Wassergebühren eingeführt werden.

Das Ministerium war sich bewusst, dass die oben skizzierte Weiterentwicklung der Bewässerung in Ägypten nur realisiert werden kann, wenn die institutionellen und organisatorischen Voraussetzungen dafür geschaffen würden und die Bereitschaft seitens der Wassernutzer bestehen würde, diese Weiterentwicklung aktiv mitzutragen. Daher wurde gleichrangig zu den technischen Maßnahmen der Aufbau einer Beratungsinstitution für den Bereich Wassermanagement auf der Mesqa-Ebene vorgesehen. Nicht erwähnt wurde in dem Strategiepapier des Ministeriums die gleichfalls als notwendig angesehene Entwicklung einer Selbstverwaltungsorganisation der Wassernutzer vor allem auf den Gebieten Be- und Entwässerung.

## **Übersicht 1. Strategie zur Entwicklung des ägyptischen Bewässerungssystems bis zum Jahr 2000**

### **1. Stufe 1: Verbesserung der Verteilung des Bewässerungswassers**

#### **1.1 Im Bereich des Hauptzuleitersystems**

- Überprüfung und Verbesserung der Kanalquerschnitte und Reglerbauwerke im Hinblick auf deren hydraulische Leistung;
- Überprüfung des Rotationssystems der Wasserverteilung und evtl. Umstellung auf Verteilung durch laufenden Zufluss;
- Minimierung der Versickerungs- und Regulierungsverluste des Kanalsystems;
- Berücksichtigung der kapillaren Aufstiegsrate aus dem Grundwasser bei Bemessung der Zuleitungsmenge;
- Verbesserung der Methoden der Messwerterfassung, deren Übermittlung und Verwendung bei der Steuerung des Zuleitersystems;
- „Flurbereinigung“ des Kulturpflanzenanbaues auf der Sekundär- bzw. Tertiärkanalebene zur Erleichterung der Steuerung des Zuleitersystems.

#### **1.2 Im Bereich der privaten Kanäle (Mesqas) und auf der Farm- bzw. Feldebewässerungsebene**

- Erneuerung und Entwicklung der Entnahmbauwerke;
- Unterhaltung der Zuleiter und privaten Feldentwässerungseinrichtungen, speziell der Entwässerungsgräben;
- Generelle Einführung der Bewässerung mit künstlicher Förderung und Mechanisierung der Wasserförderung;
- Förderung der Nachtbewässerung.

### **2. Stufe 2: Entwicklung der Feldebewässerungssysteme**

### 2.1 Im Bereich der Altländereien im Niltal / Nildelta

- Anwendung ordnungsgemäß geplanter Furchenbewässerungssysteme in großem Umfang;
- Einebnung der Bewässerungsflächen;
- Auskleidung von Kanalabschnitten oder die Verwendung geschlossener Zuleiter;
- Reduzierung der Anzahl der Entnahmen an den Zweigkanälen.

### 2.2 Im Bereich der Neulandgebiete

- Anwendung moderner Bewässerungsverfahren (Beregnung, Tropfbewässerung etc.);
- Verbesserung der Unterhaltung der Feldbewässerungssysteme.

## 3. Stufe 3: Erhebung von Wassergebühren

Quelle: Samaha, M.A. und Abu-Zeid, M., 1980

## **Umsetzung der Strategie**

Zur Umsetzung obiger Strategie wurde das Regional Irrigation Improvement Project (RIIP) 1985 eingerichtet. Die Arbeit des RIIP (1985-87) bezog sich auf Verbesserungen des Hauptzuleitersystems. Das Nachfolgeprojekt, das Irrigation Improvement Project (IIP) befasst sich seit 1988 vor allem mit der Verbesserung der Technologie auf Mikroebene und deren landesweiter Implementierung. In einem „step-by-step“ Prozess wurde im Rahmen des IIP das sogenannte „Down Stream Control (DSC) package“ entwickelt. Dieses „package“ stellt nicht die technisch optimale Lösung dar, sondern wie Hvidt (1998) es formulierte:

*The aim of those who developed this package was to seek the 'best' solution in contrast to the 'optimal' technical solution. The best solution takes into account the social, financial and political aspects of the environment in which the technology is to be implemented.*

Ziel des „DSC technological package“ ist die Sicherstellung einer effizienten Wassernutzung und einer optimalen Pflanzenproduktion in Ägypten, in dem den Bewässerungslandwirten die notwendige Flexibilität verliehen wird, ihre Kulturpflanzenbestände zur rechten Zeit, mit der notwendigen Wassermenge in der erforderlichen zeitlichen Folge zu bewässern. Erreicht werden soll dies nicht nur durch eine Verbesserung des Zuleiter- und Bereitstellungssystems, sondern auch durch institutionelle und politische Änderungen innerhalb des Ministry of Water Resources and Irrigation. Letzteres soll nicht Gegenstand dieses Berichtes sein, hier soll nur der erstgenannte Aspekt kurz dargestellt werden.

Das „DSC package“ umfasst sowohl technische wie auch soziale Veränderungen der Bewässerungseinrichtungen die von den Landwirten betrieben werden.

## Übersicht 2. Charakteristika des traditionellen und verbesserten ägyptischen Bewässerungssystems (Hvidt, 1998)

Traditional Irrigation Technology		The DSC Technological Package	
Technique:	Knowledge:	Technique:	Knowledge
Rotation system Private pumps Earthen low level mesqas Multiple point lifting	Pump operation Traditional farming knowledge	Continuous flow in branch canal Organizational pumps Improved mesqas: - Raised lined - Pipeline Single point lifting	Pump O&M Mesqa O&M Accounting practices Irrigation scheduling Organization building Scientific knowledge of agricultural practices On-farm water management
Organization:	Product:	Organization:	Product:
Ad hoc cooperation  Shared ownership of e.g. pumps Shared mesqua cleaning	Low yielding crops	Permanent organizations Delegation of responsibility Dissemination of knowledge	High yielding crop varieties Change in cropping pattern

Die grundlegende Veränderung, die durch das IIP vorgenommen wird, stellt die Umstellung von der individuellen, multiplen Wasserförderung auf die gemeinschaftliche Einpunkt-Wasserförderung im Mesqabereich dar. Um dies zu ermöglichen, wird das Bewässerungssystem im Rahmen des IIP vom unterbrochenen (Rotation) auf laufenden Zufluss umgestellt, die Mesqas über Geländehöhe angehoben, die multiple durch die Einpunkt-Wasserförderung am Anfang der jeweiligen Mesqa ersetzt, und die Steuerung des Kanalnetzes von der Oberwasserregulierung auf Unterwasserregulierung umgestellt. Des weiteren werden Water-User Assoziations und ein Irrigation Advisory Service eingerichtet. Die Unterschiede zwischen traditionellen und dem verbesserten Bewässerungssystem sind in der Übersicht 2 dargestellt.

Die Projektfortschritt des IIP ist mit derzeit etwa 30.000 feddan pro Jahr relativ gering. Bisher wurden 130.000 feddan mit einer verbesserten Wasserbereitstellungsinfrastruktur ausgestattet. USAID hat kürzlich die Pilotvorhaben, die zum IIP führten und nach deren Vorbild das IIP geplant wurde, im Hinblick auf die erreichte Effektivität untersuchen lassen. Die Untersuchung ist zu dem Ergebnis gekommen:

- *to promote sustainability, cost sharing program with farmers is essential;*
- *there is a lack of staff to accomplish project goals;*
- *tripartite coordination between the farmers, Irrigation Advisory Service (IAS) and agricultural extension for improvement of water conservation and yield is lacking; and*
- *the construction program is behind schedule mainly due to late start and lack of experience of construction contractors, which require proper selection and close supervision of contracts.*

Als externer Beobachter kann man sich des Eindrucks nicht erwehren, dass das IIP vor allem die betroffenen Wassernutzer überfordert. Die vorgenommenen Änderungen sind für die Wassernutzer, insbesondere die Kleinbauern sehr gravierend. Sie brauchen ganz offensichtlich mehr Zeit, um sich mit der neuen Situation, mit ihrer neuen Rolle etc. vertraut zu machen.

## ***On-Farm Water Management***

Unter On-Farm Water Management (OFWM) ist die Manipulation oder Handhabung des Wassers im Bereich der individuellen Farm zu verstehen. Räumlich versteht man darunter in Ägypten den Bereich, der dem tertiären Zuleitersystem, der Mesqa-Ebene, nachgelagert ist. Dazu gehören neben den einzelnen Bewässerungsflächen auch die Farmkanäle, die sogenannten Marwas. Entsprechend obiger Definition gehören auch die Felddrönanlagen und deren Management, bis hin zum Vorfluter dazu. In Ägypten werden die Felddrönanlagen allerdings bis hin zum letzten Sauger noch von der Egyptian Public Authority for Drainage Projects (EPADP) betrieben und unterhalten. Es ist jedoch kaum zu erwarten, dass die EPADP auf Dauer die notwendigen Haushaltsmittel zugewiesen bekommt, um den ordnungsgemäßen Betrieb der Felddrönanlagen durchzuführen. Früher oder später müssen diese Aufgaben von den Nutzern, d.h. den Bewässerungslandwirten wahrgenommen werden. Wobei die Funktionskontrolle wie auch die Instandhaltung der Felddrönanlagen in den unmittelbaren Zuständigkeitsbereich des jeweiligen Landeigentümers/Landnutzers fallen und damit zum Bereich des OFWM gehören dürfte, wie dies weltweit üblich ist.

Der Bereich in dem OFWM stattfindet beginnt in Ägypten, wie oben dargelegt im Übergangsbereich von der Mesqa zur Marwa und endet mit der Drönanlage, d.h. der Abgabe des Drönanwassers an den Sammler bzw. Vorfluter. Zwischen diesen beiden Punkten hat der einzelne Landwirt unterschiedliche Möglichkeiten der Handhabung des Bewässerungswassers. Seine Möglichkeiten werden allerdings mehr oder weniger stark eingeschränkt durch die Zwänge, die sich aus der zeitlichen und mengenmäßigen Wasserbereitstellung und durch die Interessen des MWRI ergeben. Das MWRI hat vor allem ein Interesse daran, dass das System funktioniert und dass die Landwirte eine ressourcenschonende Handhabung des Wassers praktizieren. Durch die von den Landwirten geforderte ressourcenschonende Handhabung soll Wasser eingespart, qualitativ nicht abgewertet und für Bewässerungsvorhaben in den Wüstengebieten abgezweigt werden. Im Gegensatz dazu haben die einzelnen Landwirte im Regelfall ein ausschließliches Interesse daran, ihre eigenen Kulturpflanzenbestände hinreichend mit Wasser zu versorgen und damit die Erträge zu sichern, gegebenenfalls zu steigern sowie ein sicheres, möglichst hohes Einkommen zu erwirtschaften. Es interessiert sie nicht Wasser zu sparen, um dadurch die Ausweitung des ägyptischen Agrarwirtschaftsraumes zu ermöglichen. Diese Interessengegensätze sind nicht unüberbrückbar. Im Gegenteil: eine bedarfsgerechte, auf Ertrags-sicherung und –steigerung ausgerichtete Bewässerung ist im Regelfall auch durch eine relativ hohe Effizienz der Wassernutzung und damit durch Wassereinsparungen gekennzeichnet. Entscheidend für den ägyptischen Bewässerungslandwirt ist allerdings, dass sich die für die Effizienzsteigerung notwendigen Investitionen lohnen, dass sie einen deutlichen Gewinn abwerfen.

Zu den Maßnahmen die in Ägypten derzeit unter OFWM verstanden werden zählen: Förderung des Wassers aus der jeweiligen Mesqa in die Marwa, Wasserzuleitung zu den Bewässerungsflächen mittels der Feldkanäle (Marwa's), Flächenvorbereitung für die Verteilung des Wassers auf der Fläche, meliorative Maßnahmen zur Verbesserung des Bodenwasser- und -lufthaushaltes, Aufleitung und Verteilung des Wassers auf der Fläche, Ableitung des Überschusswassers. Für die Bewässerungslandwirte stellen der Betrieb und die Instandhaltung der Marwa's ein zunehmendes Problem dar, da sie sehr arbeitsaufwendig sind. Hinzu kommt, dass es verhältnismäßig lange dauert, bis die Marwa's während der „on-period“ mit Wasser gefüllt sind, d.h. bis die

eigentliche Bewässerung beginnen kann. Damit wird die „on-period“ für den einzelnen Landwirt verkürzt und kann dazu führen, dass ihm nicht genügend Zeit für die Bewässerung seiner Felder zur Verfügung steht. Bei Auskleidung oder Verrohrung der Marwa tritt dieses Problem nicht auf. Wenn der einzelne Landwirt in Kooperation mit seinen Feldnachbarn die Marwa durch Gated Pipes ersetzen kann, erlangt er zusätzlich Flexibilität in der Wasserverteilung und spart unproduktive Fläche ein. In Pilotprojekten hat sich die Verwendung von Gated Pipes in Ägypten bereits bestens bewährt.

Bei der Oberflächenbewässerung spielt die Oberflächengestalt der Bewässerungsfläche eine entscheidende Rolle für die Gleichmäßigkeit der Wasserverteilung und damit für die Wasserversorgung der Pflanzen und deren Ertragsleistung. Bisher haben die ägyptischen Bewässerungslandwirte versucht dies durch Unterteilung ihrer Bewässerungsfläche in eine Vielzahl von Minibecken (etwa 10x10 m) zu erreichen. Die jeweils nach der Grundbodenbearbeitung erneut manuell herzustellenden Begrenzungsdämme dieser Minibecken erweisen sich zunehmend als ein großes Hindernis für die Mechanisierung der Pflege- und Erntearbeiten. Hinzu kommt, dass die Herstellung dieser Dämme, wie auch die manuelle Planierung sehr arbeitsaufwendig ist. Mit der Lasertechnik können heute auch unter ägyptischen Verhältnissen Planierungsarbeiten sehr exakt und kostengünstig ausgeführt werden, so dass sich die Anlage von Minibecken erübrigt und die Wasserverteilung auf der Fläche gleichmäßiger und weniger arbeitsaufwendig erfolgen kann.

Mit der Untergrundlockerung, sowie gegebenenfalls mit der Gipsdüngung und in Kombination mit der Dränung lässt sich der Bodenwasser- und -lufthaushalt vor allem im nördlichen Delta deutlich verbessern und damit ein Beitrag zur Ertragssicherung und -steigerung leisten. Auch tragen diese meliorativen Maßnahmen dazu bei, der Bodenversalzung und Bodenalkalisierung entgegen zu wirken. Gedrängt werden in Ägypten grundsätzlich alle Flächen, die einen Grundwasserstand von <1,00 m unter Flur aufweisen. Eine Anpassung des Grundwasserstandes an die Bedürfnisse der angebauten Kulturpflanzen (z.B. Reis) kann mit den installierten Dränanlagen z.Zt. nicht erfolgen.

Eine gezielte Steuerung der Bewässerung erfolgt in Ägypten z.Zt. noch nicht. Damit steht der Bodenwasserhaushalt auch selten in Einklang mit den Ansprüchen der bewässerten Kulturpflanzen. Hier dürfte noch ein erhebliches ungenutztes Ertragspotential und zugleich ein Wassereinsparungspotential vorliegen. Bei agronomischen Entscheidungen bleibt die Frage einer gezielten Wasserapplikation bisher unberücksichtigt.

Völlig unterentwickelt sind betriebswirtschaftliche, arbeitswirtschaftliche Überlegungen in Zusammenhang mit einem verbesserten On-Farm Water Management. Man hat noch nicht erkannt, dass die ägyptische Landwirtschaft in Zukunft nicht nur ihren Beitrag zur Sicherstellung der Ernährung der rapide wachsenden Bevölkerung zu leisten hat, sondern dass sie mit weniger Wasser auskommen muss und dass sie vor allem eine höhere Wertschöpfung pro eingesetzter Wassermenge erzielen muss. OFWM ist daher mehr als nur die Entwicklung technologischer Lösungsansätze.

Zur Lösung der Probleme im OFWM wurden in den vergangenen Jahren eine Reihe von Pilotvorhaben durchgeführt. Hierzu gehört u.a. das mit kanadischer Unterstützung durchgeführte National Development Project On-Farm Water and Soil Management

Project (OWSOM) und das Agriculture Policy Reform Program (gated pipes in der Zuckerrohrbewässerung) sowie das Egyptian German Cotton Sector Promotion Program (gated pipes, Beregnung, Tropf- bzw. Mikrobewässerung). Mit japanischer Unterstützung ist gerade ein weiteres Vorhaben angelaufen. Alle diese Vorhaben haben interessante Aspekte eines verbesserten OFWM erarbeitet, die einer landesweiten Einführung in der Praxis der Bewässerungslandwirtschaft harren. Die schnelle landesweite Verbreitung und Anwendung der erarbeiteten technologischen Ansätze ist trotz dieser Projekte bisher an der Skepsis der Bewässerungslandwirte gescheitert. Sie sind zwar interessiert, sehen aber noch nicht die wirtschaftlichen Vorteile, die entsprechende persönliche Investitionsentscheidungen rechtfertigen. Effizienzsteigerung in der Wassernutzung ist für sie in der Regel kein Argument.

### **Zusammenfassung**

Das ägyptische Bewässerungssystem, das sich seit dem Bau des ersten Nil-Stauwehres und verschiedener Bewässerungskanäle im Jahre 1861 bis heute entwickelte, stößt zunehmend an seine Grenzen und bedarf dringend der Modernisierung. Dies vor allem, weil es nicht mehr in der Lage ist, allen Bewässerungslandwirten die für die Versorgung ihrer Kulturpflanzenbestände notwendige Wassermenge in der notwendigen Quantität und Qualität termingerecht bereitzustellen. Es werden die entwickelten Lösungsstrategien sowie die bis dato vorgenommene Umsetzung dieser Strategien aufgezeigt. Auf die Bedeutung des On-Farm Water Managements wird gesondert hingewiesen.

### **Summary**

The present Egyptian irrigation system has evolved since the construction of the Nile barrages and irrigation canals in 1861. The system increasingly shows its limits and has to be urgently modernised. This is because the system is not any more able to supply all farms in time with the quantity and quality of water needed to supply the crops grown according to their needs. The paper describes the strategies developed to solve the problems of the Egyptian irrigation system and the measures undertaken so far to solve these problems. The importance of a modern on-farm water management is especially mentioned.

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By no means, Egypt can embark into the 21<sup>st</sup> Century while the existing public attitude towards water resources is still based on the belief that the Nile water has been flowing endlessly from time immemorial and forever, and that there is no reason for concern over the scarcity of water, whatever the case may be. It follows, therefore, that the abolition of water waste should be a basic requirement for proper management of water resources, and an intrinsic component of our culture, to be fully absorbed by the coming generations, in order to conserve their resources, when faced with increasing needs (Egypt in the 21<sup>st</sup> Century – Vision 2017)

## **Zunehmende Wasserverknappung in Ägypten: Herausforderungen und Strategien**

### **Increasing Water Scarcity in Egypt: Challenges and Strategies**

Prof. Dr. Peter Wolff, Witzenhausen

#### ***Einführung***

In einer umfangreichen Studie hat das International Water Management Institute die Wasserbedarfs- und Wasserbereitstellungssituation von 118 Ländern untersucht (Seckler et al., 1998). In dieser Studie wurden 17 Länder in Nordafrika, Westasien und Südafrika sowie die Trockengebiete des westlichen, südlichen Indien und des nördlichen China als Gebiete mit extremem Wassermangel im Jahr 2025 identifiziert. In diesen Regionen leben heute 1 Mrd. Menschen. Im Jahr 2025 werden es voraussichtlich 1,8 Mrd. sein. Die meisten der Länder dieser Regionen werden nicht in der Lage sein, aus dem verfügbaren Wasserdargebot die Aufrechterhaltung der Nahrungsmittelproduktion auf dem Niveau des Jahres 1990 sicherzustellen, und dabei zugleich den Wasserbedarf der Industrie, der Siedlungswasserwirtschaft und der Umwelt zu befriedigen. Viele dieser Länder sind schon heute mangels ausreichender Mengen an Bewässerungswasser auf den Import großer Getreidemengen angewiesen. Künftig werden sie dies vermehrt und in größerem Umfang tun müssen. Die betroffenen Länder sind ganz offensichtlich an die Grenzen der Wasserbereitstellung gestoßen. Eines dieser Länder ist Ägypten, wo Wasserdargebot und Wasserbedarf zunehmend in ein geradezu dramatisches Missverhältnis geraten. Am Beispiel Ägyptens soll in diesem Beitrag untersucht werden, wie die Politik auf die Situation reagiert und welche Strategien sie verfolgt.

#### ***Zur Wasserdargebots- und –verbrauchssituation in Ägypten***

Bedingt durch seine geographische Lage in einer der niederschlagärmsten Regionen der Welt ist Ägypten im Hinblick auf seine Wasserversorgung fast ausschließlich von dem Nilzufluss abhängig. Der Nil durchströmt das Land als sogenannter Fremdlingsfluss von Süd nach Nord, d.h. er erhält in Ägypten keinen natürlichen Zufluss. Von dem mittleren jährlich nutzbaren Nilabfluss von 74 Mrd. m<sup>3</sup> stehen Ägypten 55,5 Mrd. m<sup>3</sup> zur Verfügung. Im Bereich der Mittelmeerküste beträgt die Jahresniederschlagssumme ca. 200 mm in Alexandria und ca. 75 mm in Port Said. Der Niederschlag wird dort u.a. im Regenfeldbau und in Form des Wasserkonzentrationsanbaues genutzt.

Zum Landesinneren hin nimmt die Niederschlagsmenge ab. In Kairo fallen durchschnittlich 20 mm Niederschlag pro Jahr, in Assuan sind es nur noch 2 mm/Jahr. Vor allem im südlichen Teil der Halbinsel Sinai und entlang des Roten Meeres kommt es hin und wieder zu wolkenbruchartigen Niederschlägen und in deren Folge zu Sturzfluten.

In sehr begrenztem Umfang ist in der westlichen Wüste und auf Sinai fossiles, nicht erneuerbares Grundwasser nutzbar. Derzeit werden etwa 0,5 Mrd. m<sup>3</sup> pro Jahr aus diesem Grundwasservorkommen genutzt. Die großen Tiefen dieser Vorkommen (bis zu 1.500 m) und deren Qualität beschränken deren Nutzung. Da die Vorkommen nicht erneuerbar sind, handelt es um eine zeitlich und mengenmäßig begrenzte Nutzung, kaum geeignet für eine längerfristig angelegte Besiedelung der Wüstengebiete und eine darauf aufbauende Bewässerungslandwirtschaft. Die Grundwasservorkommen des Niltales und Nildeltas können nicht als ein eigenständiges Wasservorkommen gewertet werden, da sie ausschließlich durch Versickerung von Nilwasser gespeist werden. Die Entnahme aus diesem Grundwasservorkommen kann daher nicht als ein zusätzliches Wasserdargebot angesehen werden. Das Vorkommen ist vielmehr ein unterirdisches Nilwasserreservoir. Z.Zt. werden etwa 4,8 Mrd. m<sup>3</sup> pro Jahr aus dem erneuerbaren Speicherraum von nur 7,5 Mrd. m<sup>3</sup> entnommen.

Die Entsalzung von Meer- und Brackwasser wurde in Ägypten bisher nicht als Möglichkeit der Mehrung des Wasserdargebotes angesehen, weil die Kosten je Kubikmeter mit 3 – 7 LE (ägyptischen Pfund) zu hoch sind. Die Nutzung von entsalztem Wasser zu landwirtschaftlichen Zwecken dürfte auch in Zukunft nicht wirtschaftlich sein. Möglichkeiten einer entsprechenden Nutzung werden in den Touristen- und Freizeitgebieten entlang des Mittelmeeres und des Roten Meeres gesehen. Die Verwendung von entsalztem Meerwasser umfasst in Ägypten z.Zt. ca. 0,03 Mrd. m<sup>3</sup>/Jahr.

Die ägyptische Regierung erwartet, dass das Jonglei-Kanalprojekt im Süden des Sudan in absehbarer Zeit verwirklicht wird und sich damit das nutzbare Wasserdargebot um 2 Mrd. m<sup>3</sup>/Jahr erhöht. Diese Hoffnung wird allerdings schon seit mehr als 25 Jahren gehegt. Das Vorhaben sieht vor, durch den Bau eines Kanals durch den Sudd, einem großen Sumpfgebiet, den Abfluss des Weißen Nils zu kanalisieren und zu beschleunigen. Dadurch erhofft man eine deutliche Einschränkung der Verdunstungsverluste zu erzielen und damit eine Erhöhung der Abflussmenge in den Hochdamm von Assuan. Das Vorhaben ist aus ökologischen Gründen sehr umstritten.

In Tabelle 1 ist die ägyptische Wasserbilanz des Jahres 90/91 der erwarteten des Jahres 2000 gegenübergestellt.

**Tabelle 1: Wasserbilanz der Arabischen Republik Ägypten in den Jahren 1990/91 (aktuell) und 2000 (erwartet)**

Wasserdargebot/Wasserverbrauch	1991/91 (aktuell) Mrd. m <sup>3</sup>	2000 (erwartet) Mrd. m <sup>3</sup>
Verfügbares Wasserdargebot	55,5	55,5
Beitrag des Jonglei-Projektes etc.		2,0
Evapotranspiration	36,6	38,9
Nutzung durch Haushalte, Gewerbe und Industrie	1,5	4,8
Verdunstungsverluste	2,0	2,7
Abfluß ins Mittelmeer	12,1	11,8
Schifffahrt, Wasserenergie	1,6	0,3
Überschuss	1,7	-1,0

Das Drainage Research Institute des Water Research Centers hat in umfangreichen Studien ermittelt, dass zur Aufrechterhaltung einer ausgeglichenen Salzbilanz aus dem Niltal und Nildelta jährlich mindestens ca. 20 Mio. t Salz in das Mittelmeer ausgetragen werden müssen. Wenn man davon ausgeht, dass Dränwasser mit einem Salzgehalt von 2.500 mg/l nicht mehr genutzt werden kann und damit ins Meer abgeleitet werden muss, dann ist für den Austrag von 20 Mio. t Salz eine Wassermenge von ca. 8 Mrd. m<sup>3</sup> erforderlich. D.h. 8 Mrd. m<sup>3</sup> Nilwasser müssen durch das ägyptische Be- und Entwässerungssystem zur Aufrechterhaltung einer hinreichend ausgeglichene Salzbilanz des Niltales und Nildeltas hindurchfließen. Auf der Grundlage eines erneuerbaren Wasserdargebotes von 55,5 Mrd. m<sup>3</sup>, das kaum wesentlich vermehrbar ist, und dem absoluten Vorrang der Wasserversorgung der Kommunen, des Gewerbes und der Industrie kann die künftige Wasserbilanz Ägyptens nur, wie in Tabelle 2 dargestellt, aussehen. Hinsichtlich des Anteils des Agrarsektors an der Nutzung des Wasserdargebotes ist langfristig von einer abnehmenden Tendenz auszugehen.

**Tabelle 2. Geschätzte künftige Wasserbilanz Ägyptens**

	Wasserdargebot Mrd. m <sup>3</sup>	Wasserverbrauch Mrd. m <sup>3</sup>
Nilwasserzufluß	55,5	
Netto-Wasserverbrauch Kommunen		2,5
Netto-Wasserverbrauch Industrie		2,0
Unvermeidbare Verdunstung		2,0
Wasserbedarf für Salzaustrag etc.		8,0
Netto-Evapotranspiration der landw. Kulturen		41,0

Wenn man für Ägypten eine mittlere Netto-Evapotranspiration von 1.200 mm/a annimmt, reichen die 41 Mrd. m<sup>3</sup>, die für landwirtschaftliche Kulturen zur Verfügung stehen, zur Bewässerung von etwa 3,4 Mio. ha. Derzeit beträgt die Gesamtbewässerungsfläche ca. 2,86 Mio. ha, das bedeutet, dass theoretisch noch für 0,54 Mio. ha Bewässerungswasser zur Verfügung steht.

Wenn die in der Planung schon weit vorangeschrittene Landerschließung auf Sinai (240.000 feddan), sowie im Bereich des östlichen und westlichen Delta (360.000 feddan) und wenn die bereits erschlossenen, aber noch nicht genutzten Flächen (200.000 feddan) demnächst in Produktion gehen, dann erhöht sich die landwirtschaftliche Nutzfläche Ägyptens auf ca. 3,2 Mio. ha. Damit reduziert sich die weitere mögliche Extension der landwirtschaftlichen Nutzfläche Ägyptens auf ca. 200.000 ha.

In obiger Wasserbilanz (Tabelle 2) sind die Niederschläge und das Eindringen von Meerwasser in das Grundwasser nicht berücksichtigt. Der effektive Niederschlag wird auf 1 – 2,5 Mrd. m<sup>3</sup> pro Jahr geschätzt. Er ist allerdings nur von einer gewissen wasserwirtschaftlichen Bedeutung in den nördlichen, küstennahen Gebieten des Landes. Nach Bayoumi et al. (1997) dringen jährlich etwa 2 Mrd. m<sup>3</sup> Meerwasser in die küstennahen Grundwasserleiter ein.

Nicht berücksichtigt in den obigen Wasserbilanzen (Tabelle 1 und 2) ist die Tatsache, dass Ägypten ganz offensichtlich mehr als die vertraglich garantierten 55,5 Mrd. m<sup>3</sup>/a genutzt hat und gegenwärtig nutzt. Ein Nachweis dafür findet sich in den offiziellen ägyptischen Veröffentlichungen nicht. Dies dürfte politische Gründe haben. Da der Sudan seinen Anteil am Nilabfluss, der im Lake Nasser gespeichert wird nicht in vol-

lem Umfang nutzt, die entsprechende ungenutzte Wassermenge sich im Speicher nicht wieder findet, muss man davon ausgehen, dass diese von Ägypten dem Speicher entnommen wurde und wird. Radwan (1997) schätzt die entsprechende Wassermenge auf 5 Mrd. m<sup>3</sup>/a. Je weiter der Sudan künftig seine Bewässerungslandwirtschaft ausdehnt um so mehr wird er seinen Anteil am Nilabfluss ausschöpfen. Dies bedeutet, dass sich das aktuelle Wasserdargebot für Ägypten schon aus diesem Grund künftig mehr und mehr vermindern wird.

Die Verfügbarkeit von nutzbaren Wasserressourcen ist nicht nur eine Frage der Wasserquantität sondern zunehmend vor allem eine Frage der Wasserqualität. Obwohl die Wasserqualität im Lake Nasser noch gut ist, besteht Anlass zur Besorgnis. Sorgen bereiten in diesem Zusammenhang die Siedlungsaktivitäten an den Ufern des Stausees sowie die Entwicklungen im Einzugsgebiet des Nil und die damit zusammenhängende mögliche Belastung der Gewässer. Aufgrund der Tiefe des Stausees (bis zu 130 m) und der saisonalen Variation der Temperatur kommt es zu einer Temperaturschichtung und einer Einschränkung der vertikalen Durchmischung des Wassers. In Folge dieser Temperaturschichtung werden die unteren Wasserschichten nicht hinreichend mit Sauerstoff versorgt. Dies führt zu anaeroben Bedingungen und einer Minderung der Wasserqualität. Der Sauerstoffmangel und das Auftreten von anaeroben Bedingungen wird zunehmen, wenn der Stausee durch den Eintrag zusätzlicher Mengen organischer Substanz und mineralischer Nährstoffen zunimmt. Aus diesem Grund ist der Schutz der Nilwasserqualität nicht nur ein Problem flussabwärts des Hochdammes von Assuan. Schutzbedürftig ist der Stausee selbst und alle seine Zuflüsse.

Die Wasserqualität des Nils flussabwärts vom Hochdamm von Assuan, soweit es den Salzgehalt und den löslichen Sauerstoffgehalt betrifft, hat sich in den letzten Jahrzehnten nicht gravierend verändert. Wenn man jedoch weitere Qualitätskriterien in die Bewertung einbezieht, ist eine Minderung der Wasserqualität auszumachen. Besonders stark belastet sind die Entwässerungskanäle, in die verbotswidrig zunehmend unbehandelte oder nur teilbehandelte Industrieabwässer, Abwasserschlämme und sogar Siedlungsabfälle eingeleitet werden. Das Dränwasser ist daher teilweise sehr stark mit Schadstoffen belastet. Diese Belastung führt vor allem in Oberägypten zur Belastung des Nilwassers, da dort das Dränwasser über den Nil abgeführt wird. Im Delta erfolgt dies nur teilweise. Dort, vor allem im nördlichen Delta, wird das Dränwasser über Entwässerungskanäle den Küstenseen zugeführt oder direkt ins Mittelmeer abgeführt.

### ***Strategien der ägyptischen Regierung***

Ägypten hat 1975 erstmals seine Wasserpolitik formuliert und mit einer systematischen wasserwirtschaftlichen Planung begonnen. Seit dieser Zeit betreibt das Land eine sehr dynamische Wasserpolitik und wasserwirtschaftliche Planung, die von 1975 bis heute mehrfach reformiert wurde. Die Notwendigkeit einer in die Zukunft gerichteten Wasserpolitik und wasserwirtschaftlichen Planung wurde den politischen Entscheidungsträgern spätestens in Folge der achtjährigen Dürreperiode von 1979 – 85 deutlich. Bis dahin war in Ägypten selbst bei den Entscheidungsträgern die Meinung weit verbreitet, dass Wasser reichlich zur Verfügung steht, dass der Nil unerschöpflich sei. Die Ägypter mussten schließlich erkennen, dass sich mit dem rasanten Bevölkerungswachstum das jährliche Pro-Kopf-Wasserdargebot dramatisch abnahm

und immer weiter abnimmt. In den 80er und 90er Jahren näherte sich das Pro-Kopf-Wasserdargebot dem international gebräuchlichen Grenzwert von  $1.000 \text{ m}^3$ , d.h. einer verfügbaren Wassermenge ab der nach internationalen Erfahrungen die Wasserversorgung kritisch wird. Zwischenzeitlich ist die ägyptische Bevölkerung auf ca. 69 Mio. gestiegen und das Pro-Kopf-Wasserdargebot liegt mit ca.  $800 \text{ m}^3/\text{a}$  deutlich unter dem obigen Grenzwert. Die Tendenz ist weiter fallend.

Die seit 1975 betriebene Wasserpolitik und wasserwirtschaftliche Planung war und ist noch immer durch ein Wasserbereitstellungsmanagement gekennzeichnet, d.h. die Wasserpolitik war und ist auf eine Mehrung des Wasserdargebotes durch Grundwassererschließung, die Wiedernutzung des Entwässerungswassers, Einschränkung des Winterwasserabflusses und die Mehrung des Abflusses des Weißen Nils ausgerichtet. Zu den häufigen Änderungen der Wasserpolitik, insbesondere der entsprechenden Planungen war man gezwungen, weil die getroffenen Annahmen nicht eintrafen und weil die Neuaufgabe und Ausweitung der Neulandgewinnung in den Wüstengebieten dazu zwang.

Ein quasi übergeordnetes Ziel der ägyptischen Wasserpolitik ist die Abzweigung von „Überschusswasser“ für die Bewässerung von Neuland in den Wüstengebieten des Landes. Dies insbesondere da alle ägyptischen Regierungen der Neulandgewinnung seit der Revolution eine besonders hohe Priorität eingeräumt haben bzw. immer noch einräumen. Die volkswirtschaftliche und wasserwirtschaftliche Sinnhaftigkeit der Wüstenkultivierung wurde dabei nie in Frage gestellt.

Das Ministry of Water Resources and Irrigation (MWRI) geht in seinem Water Policy Paper (Ammer, 1999) davon aus, dass ab dem Jahr 2017 ein Wasserdargebot von  $87,67 \text{ Mrd. m}^3$  pro Jahr zur Verfügung steht. Damit soll der voraussichtliche Bedarf von  $86,74 \text{ Mrd. m}^3$  im Jahr 2017, wie in Tabelle 3 dargestellt, abgedeckt werden. Dabei wird davon ausgegangen, dass bis zum Jahr 2017 das Jonglei-Kanalprojekt im Süd-Sudan ausgeführt und damit der jährlich durch Ägypten nutzbare Nilabfluss um  $2 \text{ Mrd. m}^3$  erhöht wurde. Weiter wurde von folgenden Annahmen ausgegangen:

- Nutzung des Niederschlagsabflusses und der Sturzfluten (Rainfall and flash flood harvesting) nimmt zu von  $1,0$  auf  $1,5 \text{ Mrd. m}^3/\text{Jahr}$ ;
- Nutzung fossiler Grundwasservorkommen in den Wüstengebieten und auf Sinai steigt von  $0,57$  auf  $3,77 \text{ Mrd. m}^3/\text{Jahr}$ ;
- Grundwassernutzung im Niltal und Nildelta steigt von  $4,8$  auf  $7,5 \text{ Mrd. m}^3/\text{Jahr}$ ;
- Wiedernutzung des Entwässerungswassers im Nildelta nimmt zu von  $4,9$  auf  $8,4 \text{ Mrd. m}^3/\text{Jahr}$ ;
- Abwasserverwertung steigt von  $0,2$  auf  $2,0 \text{ Mrd. m}^3/\text{Jahr}$ ;
- Entsalzung von Meerwasser kommt nur in den Küstengebieten in der Siedlungswasserwirtschaft zur Anwendung.

Bei der Abschätzung des Wasserbedarfs der Landwirtschaft wurde davon ausgegangen, dass bis zum Jahr 2017  $3,5 \text{ Mio. feddan}$  Neuland zu der derzeitigen landwirtschaftlichen Nutzfläche von  $8,5 \text{ Mio. feddan}$  hinzu gekommen sind. Es wird angenommen, dass  $4 \text{ Mrd. m}^3$  durch Verbesserung der Bewässerung eingespart werden können und  $3 \text{ Mrd. m}^3$  durch Änderung der Fruchtfolge, d.h. durch Reduktion des Anteils wasseraufwendiger Kulturen zu Gunsten von Kulturen mit einem geringeren Wasserverbrauch.

Bei dem in Tabelle 3 aufgelisteten Wasserdargebot aus der Wiedernutzung des landwirtschaftlichen Dränwassers und des Grundwassers aus dem Niltal und Nildelta handelt es sich nicht wirklich um ein zusätzliches Wasserdargebot, da dieses Wasser, wie oben schon angedeutet, dem Nilwasserabfluss entstammt und ausschließlich durch diesen gespeist wird. Die Wiedernutzung bereits gebrauchten Wassers ist eine wichtige Maßnahme zur Erhöhung der Wassernutzungseffizienz innerhalb eines Wassereinzugsgebietes, und daher unter den derzeitigen Bedingungen durchaus erstrebenswert. Die Einbeziehung dieses wiedergenutzten Wassers in die Wasserbilanz ist jedoch problematisch, da dies ein Wasserdargebot vortäuscht, das in Wirklichkeit nicht oder nur bedingt vorhanden ist.

Das Entwässerungswasser wird in Ägypten derzeit als eine zusätzliche Wasserressource angesehen und geht, wie oben aufgezeigt, als solche auch in die wasserwirtschaftliche Planung ein. Es wurden in der Vergangenheit erhebliche Investitionen getätigt um das Entwässerungswasser dem Zuleitersystem zuzuführen und es mit Nilwasser zu vermischen. Die Frage die sich hier stellt, ist die Frage der Nachhaltigkeit. Es ist davon auszugehen, dass mit einer Verbesserung des Wassermanagements, mit der effizienteren Gestaltung der Wasserzuleitung und –verteilung, der Anwendung moderner Bewässerungstechniken, der Umstellung auf wassereffiziente Fruchtfolgen, die Ausweitung des Agrarwirtschaftsraumes in die Wüstengebiete (Toshka, Sinai etc.) das Entwässerungswasseraufkommen abnehmen und die Salz- sowie die Schadstoffbefrachtung zunehmen wird. Da eine Aufbereitung des hochbelasteten Wassers aus Kostengründen nicht möglich ist, wird zunehmend weniger Entwässerungswasser einer Wiedernutzung zugeführt werden können. Mit steigendem Salzgehalt des zur Wiederverwendung gewonnenen Wassers steigt zudem der Auswaschungsbedarf sowie die zu applizierende Wassermenge und damit wiederum die Entwässerungswassermenge und die Kosten für die Abführung des Entwässerungswassers. Die derzeitige Betrachtungsweise der Wiedernutzung des Dränwassers wird sich ändern müssen, das heißt man wird versuchen müssen, das Entwässerungswasseraufkommen weiter zu reduzieren anstatt das Entwässerungswasser einer Wiedernutzung zuzuführen. Selbst die derzeitige Wiederverwendung ist wirtschaftlich und ökologisch problematisch, da sie mit relativ hohen Kosten und hohem Energieaufwand verbunden ist.

**Tabelle 3. Wasserdargebot Ägyptens im Jahr 2017 nach Annahmen des Ministry of Water Resources and Irrigation (NWRP Project, 1999)**

Wasserbedarf		Wasserdargebot	
Nutzungssektor	Mrd. m <sup>3</sup> /Jahr	Wasserressource	Mrd. m <sup>3</sup> /Jahr
Landwirtschaft	67,13	Nil (einschl. Jonglei)	57,50
Evaporationsverluste im System	2,30	Grundwasser aus dem Nil-Aquifer	7,50
Kommunen	6,60	Wiedernutzung des landw. Dränwassers	8,40
Industrie	10,56	Wassereinsparungen:durch Änderung der Fruchtfolge durch Verbesserung der Bewässerung	3,00
			4,00
Schifffahrt	0,15	Grundwasser der Wüstengebiete und Sinai	3,77
		Abwasserverwertung	2,00
		Rainfall/flash flood harvesting	1,50
Gesamt:	86,74	Gesamt:	87,67

Die obige Strategie enthält sowohl Elemente des Bereitstellungs-Managements (Supply-Management) wie auch des Nachfrage-Managements (Demand-Management), wobei ersteres deutlich überwiegt. Die Strategie geht nach wie vor von einer Extension des Agrarwirtschaftsraumes aus und hinterfragt nicht dessen wasserwirtschaftliche und volkswirtschaftliche Sinnhaftigkeit. Insgesamt ist die Wasserpolitik der ägyptischen Regierung nach wie vor auf die Bereitstellung zusätzlicher Wassermengen fixiert. Demgegenüber erfahren Probleme der Wasserqualität, der Umweltqualität nur relativ geringe Aufmerksamkeit. Die derzeitige Wasserpolitik widmet den sozio-ökonomischen Erfordernissen wie auch den Umweltwirkungen ihrer Entscheidungen und einem in die Zukunft gerichteten Nachfrage-Management nur unzureichende Beachtung. Auch ist die vorgenommene Bilanzierung in sich nicht ganz schlüssig. So wird im Inception Report des National Water Resource Plan for Egypt (NWRP Project, 1999) bemängelt, dass die Schätzung der Wassernachfrage der nichtagrarischen Sektoren einer gründlichen Analyse entbehren. Ferner heißt es in diesem Bericht u.a.

*Due to the use of gross water demand and supply values in the water balance, there is a risk of double counting, for example by adding water savings by irrigation improvement, cropping pattern changes and drainage and ground water reuse.*

Die Wasserpolitik Ägyptens bedarf einer grundsätzlichen Überprüfung und einer Ausrichtung auf die Erfordernisse der Zukunft. Es ist zu hoffen, dass das von den Niederlanden unterstützte NWRP Project und die Bemühungen der von USAID geförderten APRP-RDI Unit der ägyptischen Regierung helfen, zu einer grundsätzlichen Neuausrichtung ihrer Wasserpolitik zu gelangen.

Ansätze für eine grundsätzliche neue Ausrichtung der Formulierung der ägyptischen Wasserpolitik wurden in jüngster Zeit sichtbar. So wird im Country Paper zur 7. Nile 2000 Conference von einem Paradigmenwechsel in der Wasserpolitik gesprochen. U.a. heißt es in diesem Papier:

*Dynamic interrelationships among water resources systems components impose the integrated approach on policy makers. Past experience shows that when an action or a strategy is planned and implemented in isolation from other system components, disruptive impacts are perceived. Using the ecological, social and economic systems as boundary conditions for the water resources system is an obsolete assumption. A multidisciplinary dialogue has to be adopted in the policy formulation process. Development of a long-term national policy means extended planning horizon and wide spatial coverage that leads to high uncertainty. Therefore, uncertainty has to be explicitly considered in the policy formulation rather than just being ignored. Conducting a deterministic analysis rather stochastic one should be disengaged. Increasing environmental awareness and quality deterioration of the limited fresh resources necessitate the replacement of water quantity management by quantity and quality management. Public and stakeholder participation in water resources planning and management is dictated through privatization and progressing role of the NGO's. Transparency of the policy formulation process and general public approval are the key elements to achieve the policy objectives.*

Das Oberziel der ägyptischen Wasserpolitik ist nach Ammer (1999) „to utilize the available conventional and non-conventional water resources to meet the socio-economic and environmental needs of the country“. Die vom MWRI formulierte Wasserpolitik ist auf die folgenden Ziele ausgerichtet:

- Shift the management from the supply-oriented approach to the integrated approach that considers both supply and demand sides of the equation.
- Demand management that requires improving water use efficiencies.
- Developing new water resources through increasing Egypt's share in the Nile water through water conservation projects in the Upper Nile, harvesting rainfall, and desalinating brackish groundwater of 3,000 – 12,000 ppm salinity.
- Environmental protection of water resources.

Das Irrigation Improvement Project (IIP), das auf eine Verbesserung des ägyptischen Bewässerungssystems abzielt, den Bewässerungslandwirten eine wassersparende Bewässerung und Einkommensverbesserungen ermöglichen soll, wird als das Kernstück der Wasserpolitik des 21. Jahrhunderts angesehen. Es soll zugleich den Einstieg in das Nachfragemanagement (demand management) ermöglichen. Ein weiterer wichtiger Aspekt der künftigen Wasserpolitik stellt, neben der Sicherstellung der Nachhaltigkeit der ägyptischen Bewässerungslandwirtschaft, die Optimierung der Nutzung der verfügbaren Wasserressourcen dar. Dabei geht es darum, die Wasserverluste zu minimieren und den Gewinn pro Einheit Wasser zu maximieren. Folgende Strategien sollen künftig verfolgt werden:

## **A. Optimal use of available resources**

### **(1) Reducing water losses**

- Using pipes or lined ditches in the new reclaimed areas, which have high porosity to reduce infiltration.
- Developing the integrated use of surface and ground water to reduce losses of conveyance including evaporation.
- Calibration of all hydraulic structures erected on the River Nile and canals.
- Updating the utilizing modern methods of weed control to improve the efficiency of conveyance and reduce evaporation losses.
- Improvement of the Nile River navigation path and facilities to reduce, or eliminate, the amount of water released for that purpose during the winter period.

### **(2) Irrigation improvement projects**

- improvement of water use efficiency at mesqa and farm level
- water user participation in operation, maintenance and management of irrigation system

**(3) Set up of a cost recovery system** in which water users pay for the services of water distribution and network maintenance. Since the subject is highly sensitive, the introduction is planned step by step.

### **(4) Changing the cropping pattern to save water**

The most important proposed strategies are:

- Replacement of some areas of sugar cane by sugar beet will be done gradually due to the need of replacing the sugar cane factories by factories of the later.
- Reducing the rice areas to be 700,000 feddans, which is the minimum limit for protecting the Delta from sea water intrusion.

- Decreasing the gap between the net return from winter and summer cultivation.
- Defining a cropping pattern for each region according to its climatic conditions, soil type and water quantities and penalizing offenders.

## **B: Groundwater development strategies**

### **(1) Renewable aquifer underlying the Nile Valley and Delta**

the strategy depends on the conjunctive use of Nile surface and groundwater through:

- Utilizing the aquifer as a storage reservoir, used to supplement surface water supply during peak periods and recharged during the minimum demand period.
- Use of modern irrigation methods in the new lands (sprinkler and trickle) that uses groundwater as the source of water to prevent water logging and keep the groundwater table far from the root zone.
- Use vertical wells drainage systems in Upper Egypt to prevent the groundwater table from reaching the root zone avoiding water logging and increasing productivity.
- Groundwater could be used as a source of water for artificial fish fields as it has consistent and steady temperature and good quality.
- Augment the canal water supply by pumping groundwater pumped from low capacity private wells at tail ends of long mesqas where water shortage is experienced.

### **(2) Groundwater aquifers in the Western Desert and Sinai**

- Use modern technologies for determining the main characteristics of each aquifer, as basic criteria for selection of most suitable projects.
- New small communities (2,000 to 5,000 feddan) in the desert areas should be designed to utilize all the available natural resources through integrated planing.
- Use of non-conventional sources of energy (solar and wind energy) to minimize the cost of pumping.
- Use of the new technologies for farm irrigation in desert areas to minimize field losses especially deep percolation due to the high porosity of such soils.

## **C: Reuse of agricultural drainage water**

- Increase the amount of drainage water reuse
- Improve the quality of drainage water
- Implementing an integrated information system for water quality monitoring in drains
- Monitoring and evaluation of the environmental impacts due to the implementation drainage water reuse policy

## **D: Reuse of sewage water**

- Increase the use of secondarily treated wastewater
- Limit the use of treated wastewater to irrigation of non-food crops
- Separate sewage and industrial wastewater collection

## **E: Surface water resource development**

- Upper Nile projects
- Desalination of brackish water
- Harvesting of rainfall and flash floods water

## **F. Water quality management**

- Industrial sector
- Domestic wastewater
- Agricultural sector
- Navigation

Die obigen Strategien lassen noch keinen eindeutigen Paradigmenwechsel erkennen. Er wird jedoch kommen müssen, wenn sich Ägypten den Herausforderungen der dramatischen Wasserverknappung in den kommenden Jahrzehnten stellen will. Im Strategiepapier des MWRI werden allerdings schon Andeutungen gemacht, die auf eine Änderung der Wasserpolitik hinweisen. So wird auf die wasserwirtschaftlichen Grenzen der Landerschließung in den Wüstengebieten hingewiesen.

Vom Agriculture Policy Reform Program, das von USAID gefördert wird, wurde die folgende ***Vision through the year 2003*** entwickelt:

*The Government of Egypt, with stakeholder participation, will develop clear policy objectives and priorities and implement policies to (1) increase production and income from Egypt's water resources; (2) improve water use efficiency, and (3) safeguard and improve water quality.*

Der Verwirklichung obiger Vision stehen nach Auffassung der Autoren einige Widerstände entgegen, es sind dies

- die Begrenzung verfügbarer Wasserressourcen;
- die Begrenzung verfügbarer und zu mobilisierender personeller und finanzieller Ressourcen;
- geringe öffentliche Wahrnehmung der kritischen Wassersituation.

## ***Herausforderungen der Bewässerungslandwirtschaft***

Die ägyptische Landwirtschaft ist mit über 80% der größte Wasserverbraucher des Landes. Da die Wertschöpfung pro Einheit Wasser in allen anderen Sektoren der ägyptischen Volkswirtschaft wesentlich höher ist als in der Landwirtschaft, wird die Landwirtschaft in Zukunft gezwungen sein, mehr und mehr Wasser an die anderen Sektoren abzugeben. Andererseits wird von ihr erwartet, dass sie einen entscheidenden Beitrag zur Nahrungsmittelversorgung leistet. D. h. sie soll mit weniger Wasser mehr produzieren. Da der Wert des Wassers mit der Verknappung steigen wird, wird die Landwirtschaft in Zukunft gezwungen sein, eine höhere Wertschöpfung pro eingesetzter Wassermenge zu erzielen. Es ist durchaus denkbar, dass der Maßstab der Leistung der Landwirtschaft künftig nicht mehr die Ertragsleistung pro Flächeneinheit sondern die Ertragsleistung pro Einheit eingesetzter Wassermenge darstellen wird.

Die Landwirtschaft und die nachgelagerte Industrie tragen durch ihrer verschiedenen Aktivitäten zur stofflichen Befrachtung der Wasserressourcen bei. Bei übermäßiger Befrachtung wird Wasser für die Nutzung unbrauchbar. D.h. vor allem die Befrachtung der Gewässer mit Schadstoffen führt zu einer Minderung des nutzbaren Wasserdargebotes. Eine Entwicklung die sich Ägypten, angesichts immer knapper werdender Wasserressourcen, nicht leisten kann. Die Landwirtschaft ist daher gefordert, ihren Beitrag zur Reinhaltung der Gewässer zu leisten.

Es zeichnet sich bereits heute ab, dass das MWRI weder finanziell noch organisatorisch langfristig in der Lage ist, das Bewässerungssystem bis hin zur Mesqa-Ebene den Ansprüchen der Bewässerungslandwirtschaft entsprechend zu managen und zu finanzieren. Die ägyptischen Bewässerungslandwirte müssen sich daher in das Management des Bewässerungssystems einbringen. Sie müssen Managementaufgaben selbst übernehmen und/oder ihre Ansprüche anmelden. Sie werden wesentlich stärker als bisher gemeinschaftlich handeln müssen. Mittelfristig wird der Staat nicht mehr in der Lage sein, den Betrieb des Be- und Entwässerungssystems aus dem Staatshaushalt zu finanzieren. Die Bewässerungslandwirte müssen sich daher darauf einstellen, dass sie sich an den Kosten in einem erheblichem Umfang beteiligen müssen.

Das Bewusstsein Verantwortung zu tragen für einen schonenden Umgang mit den Wasserressourcen und deren Schutz vor qualitätsmindernden Befruchtungen ist unter den ägyptischen Landwirten, wie in der ägyptischen Bevölkerung, generell noch sehr schwach ausgeprägt. Unter dem Zwang der zunehmenden Wasserverknappung beginnt das MWRI derzeit den Gesetzen und Verordnungen zum Schutz der Gewässer Geltung zu verschaffen. Die Landwirte werden künftig gezwungen sein, die gesetzlichen Vorschriften zu befolgen und ihr Handeln darauf einzustellen.

Die ägyptische Agrarpolitik ist derzeit in erster Linie noch fast ausschließlich auf eine Erhöhung der Agrarproduktion und die Sicherung der Nahrungsmittelversorgung ausgerichtet. Die Effizienzsteigerung in der Wassernutzung ist aber durchaus auch ein vorrangiges Ziel des Ministry of Agriculture and Land Reclamation (MALR). Im Strategiepapier des MALR für den Zeitraum 1997/98 bis 2016/17 wird unter den 14 „pillars of the strategy“ als Punkt 8 genannt:

*Place more emphasis on irrigation, water use efficiency and agricultural soil improvement and maintenance projects. The executive Authority for Land Improvement Projects (EALIP) assumes to perform extra services such as agricultural gypsum addition, deep plowing, laser land levelling and tiled drainage.*

Eine Effizienzsteigerung der Wassernutzung fördert das MALR allerdings vor allem unter dem Gesichtspunkt, Wasser für die Ausweitung des Agrarwirtschaftsraumes in die Wüstengebiete zu gewinnen. Die kulturpflanzen-spezifische Steuerung, mit deren Hilfe mehr pro Einheit Wasser produziert werden könnte, ist z.Zt. noch kein vorrangiges Thema, wird es mit der zunehmenden Wasserverknappung aber werden müssen. D.h. die Landwirte müssen lernen, ihre Kulturpflanzenbestände bedarfsgerecht im Verlauf der Wachstumsperiode mit Wasser zu versorgen. Sie müssen sich verabschieden von der bisherigen Praxis: „viel hilft viel“.

## **Zusammenfassung**

Das Wasserdargebot Ägyptens ist im wesentlichen auf den Nilabfluss begrenzt. Auf der Grundlage eines zwischenstaatlichen Übereinkommens mit dem Sudan stehen Ägypten jährlich 55,5 Mrd. m<sup>3</sup> Nilwasser zur Verfügung. Bedingt durch den Bevölkerungsanstieg auf nunmehr 69 Mio. liegt das Pro-Kopf-Wasserdargebot mit ca. 800 m<sup>3</sup>/a unter dem international gebräuchlichen Grenzwert von 1.000 m<sup>3</sup>/a. Tendenz weiter fallend. Die Versuche der ägyptischen Regierung auf diese bedrohliche Situation mit Hilfe ihrer Wasserpolitik zu reagieren werden dargestellt. Dabei wird deutlich, dass in Ägypten noch immer bevorzugt Instrumente des Wasserbereitstellungs-

managements angewandt werden. Eine Neuorientierung der ägyptischen Wasserpolitik auf ein Nachfragemanagement zeichnet sich ab. Auf die Landwirtschaft, dem derzeit größten Wasserverbraucher des Landes, kommen große Herausforderungen zu. Von den Landwirten wird erwartet, dass sie mehr mit weniger Wasser produzieren.

### **Summary**

Egypt's main and almost exclusive resource of fresh water is the Nile River. Egypt relies on the available water storage of Lake Nasser to sustain its annual share of Nile water that is fixed at 55.5 billion m<sup>3</sup> annually by agreement between Egypt and Sudan in 1959. Due to the increase of population the per capita available water resources dropped during recent years below 1.000 m<sup>3</sup>/capita/year. By international standards Egypt is therefore considered a water scarce country. At present the availability of fresh water resources amounts to 800 m<sup>3</sup> per capita and year. The decline goes on as the population increases. With the population reaching 117 Mio. in 2025 there will be only 470 m<sup>3</sup> per capita and year available. The paper shows how the Government of Egypt tries to react by its water policy and related management measures to this situation. Egypt's water policy is still very much supply oriented. A new orientation or shift towards a policy of demand management becomes visible. Irrigated agriculture, the sector which uses presently more than 80% of the available water, will be faced by big challenges in the years to come. Farmers are asked to produce more with less water.

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## Effect of Different Nitrogen Sources and Rates on Potato Growth, Nutrients Uptake, Yield and Resistance to some Diseases

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### **Abstract**

Two field experiments were conducted to study the effect of N sources as ammonium sulphate (AS), ammonium nitrate (AN) and the combination of AS with either AN or CaN (calcium nitrate) at the rates of 0, 60, 120, 180 or 240 kg N per feddan on potato growth, nutrients uptake, tuber yield and its quality as well as plant resistance to some fungal and bacterial diseases. Adding nitrogen to potato plants as AS in both 1<sup>st</sup> and 2<sup>nd</sup> doses followed with AN in 3<sup>rd</sup> dose was more convenient and had a stimulatory effect on dry weight of leaves and stems per plant, tuber yield as well as tuber quality. Tuber yield significantly increased by split application of a total N rate of 120 and/or 180 kg / fed. At 120 and / or 180 kg N / fed. treatments, nitrate concentration tended to decrease in potato tuber (> 200 mg / kg). Addition of nitrogen at the higher rate (240 kg / N) significantly increased the fungal and bacterial diseases.

### **Introduction**

Potato is one of the most important vegetable crops grown in Egypt for both local consumption and exportation (El-Sayed, 1998). Thus, improving potato crop production and using the most suitable culture practices could increase yield of the crop and solve some problems facing potato production and exportation. Supplying nitrogen to potato plants is most important for tuber yield production. Potato yield have been increased by splitting N application (Abo-Sedera and Shehata, 1994 and Arisha, 1994). In this respect, Satyanarayan and Arora (1985) found that potato plants given 150 kg N resulted in higher tuber yield.

The most important sources of N for fertilization in Egypt are ammonium sulphate and ammonium nitrate. Both  $\text{NO}_3^-$  and  $\text{NH}_4^+$  forms of nitrogen can be taken up by plants (Mengel and Kirkby, 1987). Many plants accumulate nitrate in their roots and above – ground parts, when uptake exceeds metabolic needs. The accumulation of nitrate depends upon many environmental factors e.g. amount and source of nitrogen application (Pate, 1980; Carman and Esther, 1988 and Blom-Zandstra, 1989). In this connection, Corre and Breimer (1979) stated that the permitted residue limit of nitrate concentration in potato tuber was less than 200 mg per kg. Potato diseases infection dramatically increase when excess of nitrogen was used (Cullen and Andrews, 1984 and El-Sayed, 1998).

The objectives of this study were to elucidate the effect of different nitrogen sources and their rates on potato growth, nutrients uptake, tuber yield, and its quality as well as diseases susceptibility of potato.

## Materials and Methods

Two field experiments were undertaken during 1997 and 1998 at the Agricultural Experimental Farm, Faculty of Agriculture, Minufiya University. Some physical and chemical characteristics of the alluvial soil under study were determined as described by Chapman and Pratt (1961) as shown in Table (1).

**Table 1: Some physical and chemical characteristics of the experimental soil**

Property	Value	Property	Value
<b>Mechanical analysis:</b>		<b>Soluble ions (meq 100 g<sup>-1</sup>):</b>	
Coarse sand, %	2.2	Ca <sup>2+</sup>	0.80
Fine sand, %	17.3	Mg <sup>2+</sup>	0.45
Silt, %	25.6	Na <sup>+</sup>	1.50
Clay, %	54.9	K <sup>+</sup>	0.32
Texture class	clayey	HCO <sub>3</sub> <sup>-</sup> + CO <sub>3</sub> <sup>=</sup>	1.20
<b>Chemical analysis:</b>		Cl <sup>-</sup>	0.41
OM, %	1.98	SO <sub>4</sub> <sup>=</sup>	1.51
pH (1 : 2.5 soil/water sus.)	7.97	Total N, %	0.12
EC (ds / m)	0.62	Available P, ppm	99.00

Tubers of potato cv. Diamond were sown on February 25<sup>th</sup>, 1997 and February 15<sup>th</sup>, 1998. Plot area was 17.5 m<sup>2</sup>, each consisted of 5 rows (5 m in length × 70 cm width). Sowing distance was 25 cm. The outermost rows of each side were considered as guard rows, meanwhile, the 3 inner rows were used for collecting the experimental data. Moreover, the units were separated from each other by not less than 80 cm to reduce fertilizers overlapping as possible.

Two nitrogen sources were tested i.e. ammonium sulphate (20.5% N), ammonium nitrate (33% N) and the combination of AS with either AN or CaN (calcium nitrate). The amounts of each nitrogen fertilizer were applied in three equal portions as soil application. The first dose was applied at the first irrigation, while the second and third doses were added on 15 and 30 days after the first dose as shown in Table (2). Five rates of nitrogen fertilizer were applied i.e., 0, 60, 120, 180 and 240 kg N per feddan.

**Table 2: Time of schedule of the various nitrogen fertilizations**

N sources	1 <sup>st</sup> dose (at the 1st irrigation)	2 <sup>nd</sup> dose (15 days after 1 <sup>st</sup> dose)	3 <sup>rd</sup> dose (15 days after 2 <sup>nd</sup> dose)
Ammonium Sulphate (AS)	AS	AS	AS
Ammonium Nitrate (AN)	AN	AN	AN
AS + AN	AS	AS	AN
AS + Calcium Nitrate (CaN)	AS	AS	CaN

A split plot design with three replicates was adopted. Splitting nitrogen sources were allocated randomly to main plots, while the nitrogen levels were randomly assigned to the subplots. In addition to nitrogen fertilizer, each treatment received 300 kg / feddan calcium superphosphate (15.5%  $P_2O_5$ ) and 200 kg / feddan potassium sulphate (48%  $K_2O$ ). The superphosphate was totally applied preseeding (during soil preparation), whereas potassium sulphate was added on the same days of nitrogen fertilization in 3 equal doses.

Plant samples were taken after 65 days from sowing, washed, air dried and divided into two parts. The first part was dried at 105°C for dry matter determination. The second one was dried at 70°C for chemical analysis, thoroughly ground and ash by wet digestion, according to Jackson (1958). Total N was determined after Jackson (1958). Total P and K were determined as described by Chapman and Pratt (1961).

Nitrogen use efficiency (NUE), represented by kg DM produced per kg N applied was calculated according to Guillard *et al.* (1995) as follows: (yield at  $N_x$  - yield at  $N_o$ ) / applied N at  $N_x$ .

Where,  $N_x$  = N fertilized soil, and  $N_o$  = unfertilized soil (control).

At harvest time, the tubers were collected and total tuber yield per feddan was determined. Nitrogen concentration in tubers was estimated using semi micro-kjeldahl method as described by (Jackson, 1958) and protein by multiplying N%  $\times$  6.25. Nitrate concentration in tubers was estimated using xylenol method according to Balrs and Reekers (1960). Starch content was determined according to A.O.A.C. (1975). Dry matter percent in tubers was determined. Samples of 30 tubers per treatment were stored at room temperature (22 - 26°C) for 4 weeks. The percentage of fungal and bacterial disease incidence was estimated. Data were subjected to statistical analysis of variance according to Gomez and Gomez (1983).

## Results and Discussion

**1. Dry matter yield:** Dry matter yield of potato leaves and stems was significantly increased by different nitrogen sources and rates (Table 3). No significant differences were found among AS, AN and AS plus AN. Meanwhile, it was significantly decreased in case of AS in combination with CaN. The stem dry matter did not express significant differences in response to nitrogen fertilization as AS and AN. Meanwhile, it was significantly decreased by application of AS plus CaN comparing with the other nitrogen forms. The increase in potato dry matter by application of AS plus AN may be due to the increase in NUE in this treatment (Table 7). In this concern, Drouinau and Blanc (1961) found that the addition of  $NH_4^+$ -N to  $NO_3^-$ -N resulted in highest growth rates.

Increasing the rate of N fertilization progressively increased the dry matter in both leaves and stems. However, no significant differences were detected among the various rates of N application in respecting with dry matter of potato leaves. On the contrary, level of N fertilization significantly increased the stem dry matter. At the rate of 180 kg N / fed. resulted in the greatest yield of dry matter. The excess of N fertilizer to 240 kg N / fed. depressed the dry matter yield as compared to application of 180 kg N / fed. The interaction between the nitrogen sources and nitrogen rates had a significant effect on dry matter. Supplementation potato with AS plus AN at the rate of 180 kg N/fed. yielded the greatest dry matter in both leaves and stems. Similar results were obtained by Vos and Biemond (1992) and Arisha (1994).

**Table 3: Effect of nitrogen sources and rates on dry matter of potato leaves and stems (g / plant) after 65 days from sowing (1998 season)**

N sources	AS	AN	AS + AN	AS + CaN	Mean
<b>Dry matter in leaves g / plant</b>					
0 kg/fed.	15.9	15.8	15.2	16.0	15.7
60 kg/fed.	24.2	24.2	26.1	22.0	24.1
120 kg/fed.	24.5	25.4	27.2	23.2	25.1
180 kg/fed.	28.3	28.4	28.6	24.5	27.5
240 kg/fed.	25.2	25.6	25.5	23.6	25.0
Mean	23.6	23.9	24.5	21.9	—
<b>Dry matter in stems g / plant</b>					
0 kg/fed.	11.0	11.4	12.2	11.5	11.5
60 kg/fed.	16.2	18.2	18.8	14.8	17.0
120 kg/fed.	18.9	18.1	21.9	17.8	19.2
180 kg/fed.	23.6	23.2	24.2	19.5	22.6
240 kg/fed.	17.7	19.9	17.2	16.2	17.8
Mean	17.5	18.2	18.9	16.0	—

L.S.D. 5%	N sources	N rates	Rates × source
Leaves	1.6	6.4	9.2
Stems	1.4	5.2	7.6

The increase in plant growth may be attributed to the beneficial effects of N on stimulating meristematic activity for producing more tissues and organs, since N plays major roles in the synthesis of structural proteins and other several macromolecules, in addition to its vital contribution in several biochemical processes in the plant related to growth (Marschner, 1986).

**2. Plant minerals content:** Data in Table (4) show that N, P and K percentages and uptake in potato leaves and stems were increased when potato supplied with AS plus AN as compared with other N sources. On the contrary the nitrogen applied with AS plus CaN gave the lowest value. Higher N uptake rates were observed by Blondel and Blanc (1973) when both N forms ( $\text{NH}_4\text{-N}$  and  $\text{NO}_3\text{-N}$ ) were applied to soil. This observation is consistent with earlier reports of Drouineau and Blanc (1961). This beneficial effect of  $\text{NH}_4\text{-N}$  in combination with  $\text{NO}_3\text{-N}$  on growth may be due to reduction of  $\text{NO}_3^-$  to  $\text{NH}_4^+$  which requires energy. It may be supposed that by supplying  $\text{NH}_4^+$  energy is conserved and diverted to other metabolic processes including ion uptake and growth. Similar results were reported by Rao and Rains (1976).

With regard to the effect of N rates on N, P and K contents in both potato leaves and stems increased with increasing N rates, however, their values in stems were less than in leaves. Moreover, nitrogen application increased the total nitrogen uptake in both leaves and stems owing to the increase in dry matter. These findings are in good agreement with those obtained by Arisha (1994) and Guillard *et al.* (1995).

**3. Tubers yield:** Data in Table (5) clearly appears that, there were no significant differences in potato yield among AS, AN and AS plus AN in the first season. Fertilization of potato with AS plus CaN gave the inferior yield and the depression was significant in comparing with the other N forms. With regard to the effect of nitrogen rates on the potato yield, it is evident from Table (5) that the potato yield was increased by increasing nitrogen rates until 180 kg N / feddan in both seasons. The interaction between the effect of nitrogen forms and N rates, the application of AS plus AN at the rate of 180 kg N / fed. gave the highest tuber yield.

**Table 5: Effect of different nitrogen sources and rates on tubers yield of potatoes (Ton / fed.)**

N sources	AS	AN	AS + AN	AS + CaN	Mean
N rates	<b>1997 season</b>				
0 kg/fed.	5.40	5.40	5.40	5.40	5.4
60 kg/fed.	9.10	8.90	9.40	8.10	8.9
120 kg/fed.	10.10	10.0	10.5	9.8	10.1
180 kg/fed.	10.8	10.2	10.9	10.0	10.5
240 kg/fed.	10.3	10.0	10.3	9.8	10.1
Mean	9.14	8.90	9.30	8.62	—
	<b>1998 season</b>				
0 kg/fed.	6.6	6.6	6.6	6.6	6.6
60 kg/fed.	10.0	9.8	10.9	10.0	10.2
120 kg/fed.	11.3	10.9	11.3	10.5	11.0
180 kg/fed.	11.7	11.5	12.1	10.9	11.6
240 kg/fed.	9.2	9.0	9.1	8.5	9.0
Mean	9.8	9.6	10.0	9.3	—

L.S.D. 5%	N sources	N rates	Rates × source
1997	0.65	3.80	4.50
1998	0.35	3.50	5.50

The increment in yield was combined with a substantial increase in both protein and starch contents in tuber (Table 6). It may be also due to the increase in plant growth as a consequence of increasing nitrogen rate. The yield is a function of physiological plant growth, consequently, increasing the translocation and accumulation of carbohydrates to tubers. These results are in accordance with those obtained by Khalil (1990) and Arisha (1994), Abo-Sedera and Shehata (1994).

**4. Tubers quality:** It is obvious from Table (6) that dry matter, starch and protein contents of potato tubers were increased by adding AS in combination with AN as compared to other nitrogen sources. Meanwhile, the application of nitrogen as AS plus CaN gave the minimum values.

Data in Table (6) reveal that, the increasing N rates led to increase in starch and protein yields of tubers until 180 kg N / feddan. Meanwhile, the supplementation of nitrogen to potato plants at the higher rates decreased the starch and protein contents. These results are in agreement with those obtained by Anand and Krishnappa (1992) and Arisha (1994).

The nitrate concentration in potato tubers was not significantly affected by different nitrogen sources. The application of nitrogen rates until 180 kg N / feddan gave the lower NO<sub>3</sub> than 200 mg / kg. On the contrary, the high rate of N (240 kg N) gave the higher NO<sub>3</sub> than 200 mg / kg. In this concern, Custic *et al.* (1994) stated that increased N levels led to an increase in nitrate content of the crop tissues without significant increase in yield. The permitted residue limit of nitrate in potato tuber was 200 mg / kg (Carter and Bosma, 1974; Corre and Breimer, 1979 and Blom-Zondstra, 1989).

**5. Nitrogen use efficiency:** It is clear from Table (7) that the NUE decreased gradually as the rate of the nitrogen fertilizer increased. Adding nitrogen as AS in combination with AN improved the NUE as compared with other nitrogen forms. At rates > 60 kg N / feddan, NUE values were decreased. These results are in accordance with those obtained by Varvel and Pterson (1990) and Gurillard *et al.* (1995).

**Table 6: Effect of different nitrogen sources and rates on tuber quality of potato, (1998 season)**

Characters N-Sources	Dry matter %	Starch		Protein		NO <sub>3</sub> ppm
		%	kg/fed.	%	kg/fed.	
AS	23.5	17.60	1725	8.13	796	95
AN	24.9	17.21	1657	8.00	768	117
AS + AN	25.4	18.00	1800	8.25	825	104
AS + CaN	21.8	15.60	1451	7.88	733	96
L.S.D. 5%	1.2	1.35	152	0.20	62	N.S.
N levels						
0 kg/fed.	20.8	17.6	1162	5.00	330	40
60 kg/fed.	25.2	18.0	1836	7.06	724	100
120 kg/fed.	24.9	18.5	2079	8.44	924	131
180 kg/fed.	25.2	18.9	2192	9.69	1125	165
240 kg/fed.	23.5	17.0	1530	11.75	1062	210
L.S.D. 5%	1.3	1.0	560	2.36	680	25.0

**Table 7: Effect of nitrogen sources and rates on nitrogen use efficiency in potato plants (1998 season)**

N-sources N-rates	AS	AN	AS + AN	AS + CaN	Mean
0 kg/fed.	—	—	—	—	—
60 kg/fed.	56.7	53.3	71.7	56.7	59.6
120 kg/fed.	39.2	35.8	39.2	32.5	36.7
180 kg/fed.	28.3	27.2	30.6	23.9	27.0
240 kg/fed.	10.8	10.0	10.4	7.9	9.8
Mean	33.8	31.6	38.0	30.3	

**6. Potato diseases:** The application of different sources and rates of nitrogen were studied to illustrate their effects on control of fungal and bacterial diseases (Table 8). The application of AS led to a significant decrease in most potato diseases incidence (soft rot, black leg, late blight and dry rot) as compared with other nitrogen forms. Meanwhile, brown rot disease showed a positive correlation with the adding of nitrogen as AS in combination with CaN.

The application of nitrogen at higher rate (240 kg N / fed.) led to an increase in most potato diseases incidence, this may be due to the presence of high nitrogen level causes depression in secondary toxic metabolites produced by many antagonists (Turner, 1971). Increasing the nitrogen rate in soil, also led to increase numbers of saprophytic bacteria which compete with antagonists for oxygen space, consequently reduce the effect of these antagonists (Cullen and Andrews, 1984). This also is due to the presence of high N content in plant which makes these plants able to absorb more water as a consequence. The high content of water in tubers leads to increasing susceptibility of tubers to be invaded by different pathogenic bacteria (Robert, 1975).

Generally, adding nitrogen to potato plants as AS in combination with AN seemed to have stimulatory effect for tuber yield and its quality. Application of nitrogen to potato plants at the rate of 180 kg N / fed. led to a good tuber yield and a decrease in nitrate concentration as well as potato diseases.

**Table 8: Effect of different nitrogen sources and rates on potato diseases incidence after 4 weeks storage (1998 season)**

N-Sources	Brown-rot %	Soft-rot %	Black-leg %	Common-scab %	Late blight %	Dry-rot %
<b>a. Nitrogen sources</b>						
AS	9.0	2.7	4.6	1.80	1.25	7.2
AN	9.1	6.8	9.4	0.00	2.60	7.9
AS + AN	10.7	5.5	5.7	0.78	2.90	9.2
AS + CaN	8.3	4.3	8.9	1.50	1.50	8.8
L.S.D. 5%	2.1	3.4	3.8	0.8	1.0	1.8
<b>b. Nitrogen rates</b>						
0 kg/fed.	7.3	4.3	2.1	0.00	2.60	7.3
60 kg/fed.	7.7	4.4	6.2	0.60	2.73	8.2
120 kg/fed.	8.7	4.9	6.7	0.73	2.90	8.3
180 kg/fed.	9.9	5.2	6.9	0.95	3.00	9.1
240 kg/fed.	10.9	5.9	8.5	1.50	3.50	9.2
L.S.D. 5%	2.8	1.9	5.3	1.2	1.4	2.0

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## ***Veterinary Medicine (Group Hathor)***

# **Vermeidung und Bekämpfung von Durchfallerkrankungen beim Kalb**

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Verdauungsstörungen stellen beim jungen Kalb die häufigste und verlustreichste Aufzuchtkrankheit dar. Bis etwa zur 4. Lebenswoche treten auf diese Weise bis zu 40 % Kälberverluste auf, in Einzelbeständen liegt die Sterblichkeit sogar noch höher. Im allgemeinen gelten dagegen Abgänge bis zu 4 % als hinnehmbar.

Eine wirksame Prophylaxe und Therapie setzen genaue Kenntnisse und Untersuchungen zur Formenvielfalt, zur Ätiologie und Pathogenese sowie zur Bestandsituation voraus. Wichtigstes Symptom der Verdauungsstörungen beim jungen Kalb ist der Durchfall (Diarrhoe). Aus seiner Beschaffenheit können keine Rückschlüsse auf Art und Weise der Erkrankung gezogen werden. Dennoch liefert die mikrobiologische Untersuchung von Kotproben die wichtigste diagnostische Möglichkeit zur Abklärung der Ätiologie. Nur in einem Teil der Fälle sind spezifische Erreger beteiligt. Ein weiterer wichtiger Ursachenkomplex sind Fütterungsfehler.

### **Einteilung der Durchfallerkrankungen**

Zu unterscheiden sind einerseits fütterungs- und haltungsbedingte (sog. unspezifische Diarrhoe) sowie erregerbedingte Formen (sog. spezifische Diarrhoe) (Übersicht 1). Eine Klärung setzt zunächst eine Fütterungsanamnese zur Abklärung etwaiger Fütterungsfehler voraus (Übersichten 2 a und 2 b).

### **Untersuchungsgang**

Neben der sorgfältigen Aufzeichnung eines genauen Vorberichtes sollte auf eine ausführliche klinische Untersuchung geachtet werden (Übersicht 3). Dabei muss sowohl der klinische Befund als auch soweit möglich ein Laborbefund erhoben werden (Übersicht 4). Nach Vorliegen einer klinischen Befundung erfolgen mikrobiologische Untersuchungen an frisch entnommenen Proben zur Ursachenklärung (Übersicht 5). Für den Erhalt aussagekräftiger Ergebnisse sollte auf schnellsten Transport geachtet werden.

### **Therapie des Kälberdurchfalls**

Auf der Grundlage von Haltungs- und Fütterungsanamnese, klinischem Befund und Erregernachweis sind je nach Form der Erkrankung umfassende Maßnahmen erforderlich, da häufig mehrere Faktoren die Krankheit verursachen (Übersichten 7a und 7 b).

### **Bekämpfung und Krankheitsvorbeugung**

Eine wirksame Bekämpfung der Erkrankung hat die exakte Kenntnis der Ursachen, der beteiligten Erreger und der bisher eingeleiteten Maßnahmen zur Folge. Sie hat die völlige Eliminierung der Krankheitsursachen aus dem Bestand zum Ziel. Eine sehr

wirksame Möglichkeit bieten dabei Vakzinationsprogramme, soweit es sich um erregerbedingte Formen handelt. Hierfür stehen heute z. T. gut wirksame Impfstoffe zur Verfügung. Allerdings sollten sie nicht wahllos, willkürlich und planlos eingesetzt werden. Erforderlich sind exakte und auf den jeweiligen Krankheitsfall zugeschnittene Impfprogramme (Übersichten 8 und 9). Als Beispiel dafür sei ein von uns empfohlenes Impfprogramm gegen die BVD-Infektion (Heckert, 2000) (Übersicht 10) aufgeführt.

### **Zusammenfassung**

Durchfallerkrankungen stellen in den ersten 3-4 Lebenswochen der Kälber die häufigste und verlustreichste Aufzuckerkrankung dar. Bei sorgfältiger Untersuchung und Ursachenklärung steht ein breit gefächertes Spektrum an wirksamen Therapiemöglichkeiten zur Verfügung. Die Prophylaxe besteht vor allem in der Schutzimpfung, soweit Impfstoffe vorhanden sind. Allerdings sollten dazu bewährte, auf den Einzelbetrieb zugeschnittene Impfprogramme als Grundlage dienen.

### **Summary**

Diarrhoea is the most common and whitespread disease of young calves, up to the 3<sup>rd</sup> or 4<sup>th</sup> week of life. After careful examination, anamnesis and determination of the etiology very different possibilities for treatment are available. Vaccination is the most common and effective way of prophylaxis, if vaccines are in the market. It is most effective to use vaccination programs, which arised both from experience and specific situation in the herd.

*The figures 1-10 are only available in the print copy (Beihefte zu der Tropenlandwirt Nr. 71)*

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## Control of Brucellosis in Animals in Egypt

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In Egypt, brucellosis in animals was reported for the first time in 1939. The prevalence of serological reactors on limited surveys has varied however from one author to the other. In cows it was reported to be between 16.5% and 23.3%. The prevalence among buffaloes varied from 7-10%. Isolations of *Brucella abortus* from cattle were made by various workers as early as 1943. Since 1970, *Brucella melitensis* has been isolated from sheep and goats and also cattle. During the 1960s, with the importation of Friesian cows for the establishment of governmental farms with large numbers of animals, the incidence of brucellosis in cattle on some farms became very high. In Touch Tambesha farm in Menofia, for example, it reached up to 38%. Such a high incidence was observed only in farms with large numbers of animals concentrated on relatively small amounts of land.

Parallel with the open door policy in the seventies and early eighties, there was a marked increase in the number of intensive breeding farms, both governmental and private. This was based on the importation of large numbers of Friesian cows from different countries. As an example, 8136 breeding animals were imported in the year 1983. The appearance of brucellosis among these newly established farms in most governorates at high rates was alarming. It was in fact a dilemma for the owners as well as the veterinary authorities. The load on the diagnostic laboratory at the Central Veterinary Laboratory in Dokki was great. The quarantine measures were applied on farms having positive reactors. The owners sought advice from all possible sources with the result that several types of vaccines were used, sometimes in the same animal. This resulted in very high reactor rates that reached in a farm in Sharkia for example to 71% positives and 14% suspicious cases, which could not be judged as infected or vaccinated. In such cases, the policy of test and slaughter was a burden on the government.

The initiation of a control programme based on calfhood vaccination with the reduced dose of *Brucella abortus* S 19 vaccine was made possible through the American-Egyptian Project (EG-APHIS-217). It was decided to use the reduced dose (3-10 billion organisms) in serologically negative female calves, 4-6 months old. The adult vaccination (0.5 billion) was not approved, instead, the adults were allowed to be vaccinated with the killed 45/20 vaccine. It was decided to use Rose Bengal and Buffered Acidified Plate Antigen tests for screening and Rivanol as well as Complement fixation tests for confirmation. In dairy farms, the milk ring test was to be applied to bulk milk samples every 3-4 months and positive herds were to be subjected to blood testing of individual animals. All imported animals are to be kept in quarantines for at least 30 days. Pregnant imported animals should be negative when tested 14 days after calving. Herds containing even one positive animal are kept under quarantine and all

animals are to be subjected to periodical testing every 21 days. Quarantine measures are released only if the animals pass three consecutive negative tests at 21 days intervals.

In my opinion, all these measures, namely, the periodical testing, slaughtering of the positives, calfhood vaccination of the negative females with the reduced dose S19 vaccine, adult vaccination with 45/20 killed vaccine, strict hygiene and quarantine measures and testing of imported animals and infected herds, have led to the drastic drop in the incidence of brucellosis in cattle and buffaloes at several farms in selected governorates.

The success achieved through this project has encouraged the FAO to support the continuation of the surveillance programme and vaccination in 4 other governorates in the Delta and one governorate in Upper Egypt. In addition, this project supported the establishment of Brucella Control Units in these governorates which carried out field tests, namely Rose Bengal, Buffered acidified Plate Antigen and Milk Ring tests. The positive samples are then confirmed in the provincial laboratories using tube agglutination and rivanol tests. The Central Laboratory at Dokki serves now as the reference laboratory for final confirmation, isolation, biotyping, checking of the vaccines, antigens, etc.

To eliminate any confusion concerning brucellosis epidemiology, diagnosis and control, training courses for field veterinarians were conducted and a guide covering the most essential facets of brucellosis in cattle was printed and distributed. The American-Egyptian Project 416 supported the establishment of more Brucella control units, so that now we have 73 units distributed all over the governorates. This project which ended in 1997 has enabled the government to test almost 40% of the animals in Egypt. In all cases, the positive animals are slaughtered and the government compensates the owners. The average incidence of reactors dropped drastically in 1997 to 0.8%. However, due to limited budget for Brucella control at present, the rate of reactors is increasing again. At the same time, little is done to control brucellosis in sheep and goats. Rev. 1 vaccine, which is not licensed in Egypt, is used only on a trial basis to vaccinate sheep and goats. This may be the reason for the increasing incidence of *Brucella melitensis* biovar 3, which is the principle cause of brucellosis in sheep and goats, in cattle and buffaloes. Moreover, nothing is done for camels, swine, dogs and other animals.

Because, the production of *Brucella abortus* Strain 19 vaccine in USA was stopped in the last 2 years and the *Brucella abortus* RB51 is now considered the official vaccine, two trials have emerged recently. The Veterinary Serum and Vaccine Research Institute at Abbasia started to produce the S19 vaccine and the RB51 was imported to be used on a trial basis, but not yet licensed. I do not know which vaccine will be the official one in the near future. Also, with regard to the control policy, there is a trend in the region supported by the FAO to apply mass vaccination of all animals irrespective of the breed, age, sex etc. In Egypt, this policy was not yet approved. This means, we still apply the test and slaughter policy and the vaccination of the negative female calves with S 19 vaccination.

## Vergleichende Betrachtungen zu aktuellen, parasitär bedingten Zoonosen

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Zu den Aufgaben des Veterinärmediziners zählen nicht nur die Belange um das erkrankte und gesunde Tier selbst. Aufgrund seiner Fachkenntnisse ist er vielmehr auch verpflichtet, Schaden vom Menschen abzuwenden und das Entstehen von Zoonosen zu verhindern. Es binden nämlich auch Parasiten gelegentlich den Menschen in ihren Entwicklungskreislauf ein, obwohl für den Schmarotzer vielfach keinerlei Aussicht auf Vervollständigung seines Zyklus besteht. Das Infektionsrisiko des Menschen wird dabei von verschiedenen Faktoren beeinflusst. Die Häufigkeit und Stärke des Vorkommens erhöht ebenso die Infektionsmöglichkeiten wie der enge Kontakt mit dem Parasitenträger. Im Vordergrund stehen hierbei die Kinder, die zu Fragen der Hygiene beim Umgang mit Tieren bekanntlich noch wenig Verständnis aufbringen. Sehr einflußreich sind die Nahrungsgewohnheiten des Menschen und bei vergleichender Betrachtung lassen sich hier Besonderheiten bzw. Abweichungen zwischen Mitteleuropa und Afrika finden. Der Tierarzt hat also infolge seiner fundierten Ausbildung als Experte die Aufgabe, durch entsprechende Untersuchungen *intra vitam* und *post mortem* die Parasiten rechtzeitig zu erkennen und zum Nutzen von Mensch und Tier geeignete Maßnahmen einzuleiten. Große Verantwortung trägt er vorbeugend bei der Beratung und Aufklärung des Tierbesitzers. Die größten Gefahren gehen einerseits von den Wiederkäuern (und Equiden) aus und auf der anderen Seite kann durch Fleischfresser eine Palette verschiedener Parasitenspezies übertragen werden. Selbst am Haarkleid der als recht reinlich bekannten Katze, die ihren Kot und damit Infektionsmaterial vergräbt, haften übrigens nach eigenen Erfahrungen noch Stadien.

Langjährige Studien über bestimmte Parasiten der genannten Wirte, Erkenntnisse aus zahlreichen Lehr- und Forschungsaufenthalten hier in Ägypten sowie die Berücksichtigung von einschlägigem eigenem Schrifttum bilden die Basis zu den nachfolgenden, freilich noch ergänzbaren Ausführungen zu Zoonosen, an denen Parasiten vom Tier ursächlich beteiligt sein können.

Die durch *Fasciola hepatica* und *F. gigantica* hervorgerufenen Beschwerden beim Menschen sind in Ägypten häufiger zu beobachten und ergaben einen Anteil von 8,7% und 43,0%. In landwirtschaftlichen Gebieten mit regelmäßiger künstlicher Bewässerung aus Vorflutern finden die Zwischenwirtsschnecken ideale Entwicklungschancen und damit Wege zur Aufrechterhaltung des Zyklus dieses **Trematoden**. Mit Metazerkarien kontaminierte Grünpflanzen, die evtl. unzureichend gewaschen und roh als Viehfutter oder zur menschlichen Ernährung genutzt werden, tragen zur Infektion definitiver und inadäquater Endwirte bei. Ebenso kann die Unsitte, Grashalme in den Mund zu nehmen, zur Aufnahme von Infektionsmaterial führen. Da dieses jedoch nur verbreitet werden kann, wenn derart infizierte Endwirte vorhanden sind, waren schon stets entsprechende Untersuchungen von Interesse. So ergab sich vor 10 Jahren in Beni Suef bei Rindern und Wasserbüffeln eine Befallsrate von 26,1 bzw. 23,5%. Später zeigten sich bei den eigenen Untersuchungen in Kafr El-Sheikh im Frühjahr '96 sowohl 59,8% der Rinder als auch 41,7% der Wasserbüffel befallen, im Sommer wurden dort nur Werte von 8,7% bzw. 16,0 ermittelt. Im Giza Gouvernorate war dagegen mit 9,2% (6 von 65 Rindern) und 19,3% (22 von 114 Wasserbüffeln) der Anteil positiver Wiederkäuer geringer. Bei Überprüfung von 156 Eseln im Nildelta (Kafr El-Sheikh)

beherbergten 29% (18,6) Leberegel; männliche Tiere waren stärker befallen als weibliche, und die höchsten Infektionsraten wurden im Alter zwischen 9 und 20 Jahren gefunden.

Mit diesen wenigen Zahlen aus umfangreichen Felduntersuchungen ergibt sich die Notwendigkeit, die Reduzierung beim Endwirt anzustreben und geeignete Maßnahmen zu überdenken. Die Bekämpfung der Zwischenwirte scheidet aus praktischen, wirtschaftlichen und umwelttechnischen Gründen von vornherein aus. Für die Chemotherapie beim definitiven Endwirt bieten sich aber eine Reihe von Faszioziden an (Tab. 1). Abgesehen von den Kosten sollte man sich allerdings bei der Auswahl des geeigneten Mittels daran erinnern, daß bei einigen Präparaten wegen der Ausscheidungswege des Wirkstoffes bestimmte Karenzzeiten bestehen, sobald Milch und Milchprodukte für den menschlichen Verzehr bestimmt sind.

**Tab. 1: Fasziozide bei großen Wiederkäuern**

Handelsname	Wirkstoff	effektiv gegen	
		jugendliche	adulte
Acedist ®	Bromphenophos	++	+++
Diplin ®	Oxycyclonazid	-	+++
Fasinex ®	Triclabendazol	+++	+++
Raniden ®	Rafoxanid	+++	+++
Valbazen ®	Albendazol	++	+++

Bezüglich der **Zestoden** rücken die Fleischfresser mehr in den Vordergrund. Die Entwicklung über Zwischenwirte ermöglicht es, die Bekämpfungsstrategie mit der Zielsetzung zu führen, den Entwicklungszyklus an irgendeinem Punkt zu unterbrechen. Diese Gelegenheit ist in vielen Fällen schon dann gegeben, wenn dem Endwirt vorbeugend der Zugang zu finnenhaltigem Material verwehrt wird. Dagegen muß sich nach unkontrollierter Aufnahme die Eliminierung der adulten Zestoden aus dem Endwirt chemotherapeutisch durch Einsatz moderner Anthelminthika (Tab. 2) vollziehen, die je nach Wirkstoff entweder nur die einmalige Anwendung oder aber auch mehrtägige Bemühungen verlangen.

*Diphyllbothrium latum* ist ein typischer Bandwurm von Hund und Katze und kommt den Zwischenwirten (1.Kleinkrebse, 2.Fische) entsprechend in Küstengebieten und an anderen Gewässern vor. Die Ansteckung der Endwirte erfolgt durch Plerozerkoide enthaltenden rohen Fisch. Bei domestizierten Tieren geschieht dies also durch Verfütterung suspekter Fischteile, in der Natur durch erbeutete Fische. In den Menschen gelangt dieses Material durch Genuß unzureichend oder nicht erhitzter Fischspeisen. Die Diphyllbothriose verläuft in den meisten Fällen symptomlos und uncharakteristisch. Während bei Haustieren erst nach koproskopischer Untersuchung oder Sektion ein Befall erkannt wird, können beim Menschen unspezifische Anzeichen in Form von Unterbauchbeschwerden oder Abgeschlagensein infolge Intoxikationen eine Infektion andeuten. Die Diagnose der gedeckelten, 70x50 µm messenden Eier ist zwar durch Flotation möglich, bessere Ergebnisse ergaben sich nach unseren Erfahrungen jedoch durch Sedimentation. Differentialdiagnostisch sind sie von den größeren Eiern der Leberegel (120/ µm) abzugrenzen.

Wegen des Flohes bzw. Haarlings als Zwischenwirt verlangt *Dipylidium caninum* neben der Bandwurmtherapie eine gleichzeitige Ektoparasitenbekämpfung an Tier und Lager. Nicht unbedenklich ist die Tatsache, daß er sich unter gewissen Umständen,

vordergründig beim Kind, dann zur Geschlechtsreife entwickeln kann, wenn am Fang befindliche Zystizerkoide durch Belegen überführt werden. Infektionen mit zur selben Familie gehörenden Joyeuxiella- und Diplopylidium-Arten sind dagegen praktisch nicht möglich. Wir haben in Ägypten (Kairo, Damanshour) diesen Bandwurm in 18 von 85 Katzen (21,2%) finden können. Hernach erwiesen sich von 172 Hunden aus ähnlichem Biotop in Beni Suef nur 12 (6,90%) als positiv. Gleichzeitig wurden in Ankara/Türkei mit derselben Flotations-Methode (Ovassay) 160 Kotproben überprüft und ergaben nur eine Befallsquote von 2,5% (4 Tiere); bei Sektionen fanden sich in 26 von 60 Hunden (43,3%) Exemplare von *D. caninum*. Diese sehr differierenden Werte weisen deutlich darauf hin, wie wichtig bei der Befunderhebung zuerst die makroskopische Untersuchung von Anusregion und Kot auf natürlich abgegangene Proglottiden ist. Im Einzugsbereich einer Kleintierpraxis auf dem Lande in Oberbayern<sup>7</sup> beherbergten 27 von 1.647 Hunden (1,6%) und 18 von 1.484 Katzen (1,2%) diese Zestodenspezies.

Was nun die Taenien betrifft, so handelt es sich mit *Taenia salium* und *T. saginata* um typische Bandwürmer des Menschen, deren Finnen (*Cysticercus cellulosae* bzw. *C. inermis*) im Schwein bzw. Rind vorkommen. *T. solium* begegnet man bei uns schon lange nicht mehr, d.h. diese Bandwurmspezies scheint in Mitteleuropa ausgerottet zu sein. Dank einer intensiven, gesetzlich vorgeschriebenen Schlacht tieruntersuchung ist auch das Vorkommen von *T. saginata* erheblich zurückgegangen. Die in gut durchbluteter Muskulatur beim Rind angesiedelten Finnen werden durch Schnitte in Kau-, Zungen- und Zwerchfellmuskulatur weitgehend entdeckt. Die dennoch übersehenen Finnen haben dann noch die Chance, über gehacktes, rohes Rindermett (Tartar) oder ungenügend gebratene Steaks (blutig, medium) in den Endwirt zu gelangen. Die mit der BSE verbundenen Gefahren haben allerdings bei uns in den letzten Jahren den Verzehr von Tartar erheblich reduziert.

Durch Hausschlachtungen wird es möglich, daß Hütehunde die am Gehirn von Schafen lokalisierte Finnen (*Coenurus cerebralis*) aufnehmen und Endwirt von *Multiceps multiceps* werden. Bei entsprechend unbedachtem Umgang mit dem so infizierten Tier kann der Mensch für am Fell haftende Eier empfänglich sein und hernach die im Magendarmtrakt frei werdenden Onkosphären cerebrospinale Tendenzen zeigen.

Zestoden- und Nematodeneier sowie Oo- und Sporozysten sind koproskopisch mittels Flotation anzureichern. Bei den radiär gestreiften, runden 45 µm großen Eiern aus Fleischfresserkot läßt sich jedoch morphologisch bedauerlicherweise nicht unterscheiden, ob sie von Taenien oder Echinokokken stammen. Zur endgültigen Klärung wäre deshalb letztendlich nur eine diagnostische Therapie von Nutzen.

Bei den zwei Echinokokkus-Spezies handelt es sich nämlich sodann um eine Zoonose, wenn der Mensch als inadäquater Zwischenwirt unnatürlich in den Zyklus eingeschaltet wird. Bekannt ist der meist 3-gliedrige *Echinococcus granulosus*, welcher adult im Hund parasitiert und Pferd, Wiederkäuer oder Schwein als Zwischenwirt nutzt. Wie erwähnt ist aber auch der Mensch als Fehlwirt für diesen domestischen Zyklus empfänglich. In ihm wächst die Finne (*E. cysticus*) jedoch meist gutartig und langsam. Die operative Entfernung aus Leber (60%) oder Lunge (20%) glückt in vielen Fällen; prognostisch ungünstiger sind die (20%) woanders angesiedelten Finnen.

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<sup>7</sup> Heinrich-Blanché, A. (1998): Aspekte zum Endoparasitenbefall bei Fleischfressern im tierärztlichen Alltag. Vet.-med. Diss., München

Die alveoläre Echinokokkose wird durch den mehr auf Mitteleuropa beschränkten, vom Fuchs beherbergten, 5-gliedrigen *Echinococcus multilocularis* verursacht. Zwischenwirte für die Finne (*E. alveolaris*) sind Kleinsäuger (Mäuse etc.). Folglich könnte die Katze mit Auslauf bei gleicher Nahrungsquelle in endemischen Gebieten als zusätzlicher Wirt dienen und ihn in die häusliche Gemeinschaft einschleppen. Die bisherigen Beobachtungen weisen aber mehr darauf hin, daß bei Katzen zwar eine Infektion angeht, aber die Bandwürmer in ihr kaum die Geschlechtsreife erreichen; empfänglicher zeigte sich dagegen der Hund. Auch bei diesem Zestoden kann der Mensch nach Aufnahme von Eiern vom Haarkleid des infizierten Fleischfressers oder beim Abbalgen des positiven Fuchses sowie mit durch infizierten Fuchskot (Losung) kontaminierten, vom Boden aufgenommenen und in ungewaschenem Zustand verzehrten Waldfrüchten (Beeren, Pilze) oder Fallobst als (unnatürlicher) Zwischenwirt im sylvatischen Zyklus dienen. Von wenigen Ausnahmen abgesehen ist der primäre Sitz von *E. alveolaris* die Leber (98%) und hier der Lobus dexter. In der menschlichen Leber wächst die Finne relativ rasch wie ein bösartiger Tumor, durchwuchert infiltrativ wachsend das Gewebe, auch das benachbarter Organe.

Während in Mittel- und Nordeuropa *E. granulosus* zwischen 0,5% (Schweiz) und 4,6% (England) bei Hunden verbreitet war, fanden sich in Südeuropa mit 7,2%(Spanien), 32,5%(Italien) und 54,0% (Türkei) wesentlich höhere Befallsraten. Andere, gemeinsame Untersuchungen in Ankara ergaben bei Sektionen nur einen Anteil von 3,3%, während in Beni Suef die koproskopische Überprüfung in 49 von 172 Hunden (28,5%) radiär gestreifte Eier von Taenien und / oder Echinokokken erbrachte. Über das Vorkommen von *E. multilocularis* beim Fuchs findet man Angaben aus Deutschland (8,5 - 44,8%), Frankreich (14,0 - 36,0 %), Österreich (1,0-35,0%), Liechtenstein (34,9%), der Schweiz (29,0%) und Polen (10,0%). Hunde waren in der Schweiz bzw. Frankreich zu 0,5% bzw. 5,6% infiziert und bei Katzen kam dieser gefährlichste der Echinokokken in Deutschland zwischen 0,5% und 3,4% vor, in der Schweiz erwiesen sich 0,22% als positiv. Ganz neue Zahlen liegen aus unserem Bundesland Bayern vor, wo vom 01.12.88 bis 31.03.00 insgesamt 5.551 Füchse seziert wurden, von denen 1.550 (27,9%) *E. multilocularis* beherbergten.

Zur Bekämpfung der Bandwürmer allgemein ist die Verwendung von handelsüblichen Präparaten zu empfehlen (Tab. 2). Das Mittel der Wahl stellt zweifellos das nach Tabletten und Lösung inzwischen auch als Pellet-Formulierung erhältliche Droncit® dar, weil es sich in hartnäckigen Fällen am effektivsten zeigt. Früher wurde bei erwiesenem Echinokokkus-Befall ausnahmslos die Euthanasie empfohlen. Auch gegenwärtig sollte trotz der Entwicklung des sehr effektiven Praziquantel wegen der enormen Gefährlichkeit von Spekulationen einer restlosen Eliminierung abgegangen werden und nach verläSSLicher Befunderhebung das Einschläfern des betreffenden Tieres zumindest in Erwägung gezogen werden.

**Tabelle 2: Anthelminthika für Fleischfresser-Zestoden**

Handelsname	Wirkstoff
DRONCIT®	Praziquantel
DRONTAL plus	Praziquantel + Pyrantel + Febatel
FLUBENOL p®	Flubendazol
LOPATOL®	Nitroscanat
PANACUR®	Febendazol
POLYVERKAN®	Niclosamid + Oxibendazol
SCOLABAN®	Bunamidinhydrochlorid
VALBAZEN®	Albendazol

Infolge der schon über ein Jahrhundert amtlich vorgeschriebenen, mikroskopischen Untersuchung von Haus- und Wildschweinen auf *Trichinella spiralis* konnte das Vorkommen allgemein auf ein Minimum reduziert werden; nur sporadisch werden Trichinen-Fälle von unterschiedlichem, meist recht geringem Umfang gemeldet. Daher konnte man es sich inzwischen leisten, bei diesem **Nematoden** von der herkömmlichen Einzeluntersuchung von Muskelproben aus den Zwerchfellspfeilern (Hauschwein) sowie zusätzlich Extremitätenmuskulatur (Wildschwein) abzugehen. Mittels Verdauungsmethode werden jetzt in einem Untersuchungsvorgang 100 Schweine überprüft. Lediglich bei positivem Befund ergibt sich die Notwendigkeit, gruppenweise das Material zu sondieren und den befallenen Tierkörper zu entdecken.

Die Larven von Hakenwürmern des Hundes, insbesondere *Ancylostoma caninum*, sind infolge ihres weitgehend perkutanen Infektionsweges in der Lage, beim Menschen das Erscheinungsbild der 'Larva migrans cutanea' hervorzurufen. Die Ansteckung, in erster Linie von barfuß herumlaufenden Kindern, erfolgt durch engen Hautkontakt mit durch Hakenwurmlarven kontaminierten Sandkästen, Rasenflächen und Badestränden. Deshalb wird nicht gerne gesehen, wenn Hunde auf solchen Arealen bei freiem, unkontrolliertem Auslauf ihren Kot absetzen.

Wegen ihrer unterschiedlichen Entwicklung, humanmedizinischen Bedeutung und Bekämpfung bedürfen die Spulwürmer koproskopisch einer Differentialdiagnose, die unschwer gelingt. Das Ei von *Toxocara canis* weist eine dunkle Furchungskugel auf, welche das Ei völlig ausfüllt. Das von *Toxascaris leonina* ist dagegen wesentlich durchsichtiger, zwischen der hellen Furchungskugel und Eihülle ist ein mehr oder weniger ausgeprägter Zwischenraum vorhanden. Die besondere Bedeutung von *T. canis* als Ursache der 'Larva migrans visceralis' verlangt, sich immer wieder über dessen Parasitenstatus im definitiven Wirt zu orientieren. Die weltweit teilweise recht hohen Befallszahlen machen deutlich, was anscheinend therapeutisch, in Unkenntnis der gesundheitlichen Belange für den Menschen, versäumt wurde und welches Infektionsrisiko nach Verunreinigung durch eihaltigen Hundekot auch gegenwärtig vielerorts besteht. Die Kontamination von Kinderspielplätzen und anderen öffentlichen Anlagen stellt sich also als relevantes hygienisches Problem dar. Man ist in diesem Zusammenhang etwas überrascht, daß hier in Ägypten spezielle Untersuchungen weniger von dafür fachkompetenten Tierärzten durchgeführt werden, sondern weitgehend den Humanmedizinern überlassen werden.

Entsprechend der unterschiedlichen Entwicklung beider Spulwurm-Spezies des Hundes geht die Chemotherapie (Tab.3) auch getrennte Wege. So konzentriert sich die Bekämpfung von *T. leonina* ausschließlich auf das erwachsene Tier, bei dem der Behandlungserfolg sogar sicher erfaßt werden kann. Dagegen hat die Eliminierung von *T. canis* grundsätzlich schon bei den Welpen, bei denen in vielen Fällen eine intrauterine Infektion zu unterstellen ist, zu beginnen und dies vor Ablauf der Präpatenzperiode, solange sich noch keine Larven zur Geschlechtsreife entwickelt haben und die Umgebung mit Eiern verunreinigen können.

Während in Mitteleuropa infolge der Impfgepflogenheiten bzw. -notwendigkeiten ideale Voraussetzungen bestehen, die wichtigsten Helminthen vorzeitig und regelmäßig zu eliminieren, bestehen bei streunenden Hunden mediterraner Anrainerstaaten keine Chancen, für die chemotherapeutische Beeinflussung des Parasitenvorkommens zu sorgen. Trotzdem zeigten sich in Deutschland in den letzten 15 Jahren zwischen 6,9% und 67,0% der überprüften Hunde von *T. canis* befallen und Ha-

kenwürmer kamen zwischen 2,5% und 7,0% vor. In der schon erwähnten Kleintierpraxis waren 208 von 1.647 Hunden (12,6%) mit *T. canis* infiziert, was bei der genannten Bekämpfungsmöglichkeit einen durchaus zu beachtenden Wert darstellt.

Den Zyklen entsprechend müßte also konsequent die erste Wurmkur vor Ablauf der Präpatenzperiode von galaktogen erworbenen Hakenwurminfektionen 2 Wochen post partum durchgeführt werden. Parallel dazu ließen sich bei diesem Termin auch die pränatal übertragenen *T. canis*-Larven aus dem Magendarmtrakt abtreiben.

**Tabelle 3: Anthelminthika für Fleischfresser-Nematoden**

Handelsname	Wirkstoff
BANMITH plus ®	Pyrantel + Oxantel
CITARIN®	Levamisol
DRONTAL®	Praziquantel + Pyrantel + Febantel
FLUBENOL KH®	Flubendazol
IVOMEC®	Ivermectin
LOPATOL®	Nitroscanat
PANACUR®	Febendazol
POLYVERKAN®	Niclosamid + Oxibendazol
TELMIN KH®	Mebendazol
TENAC®	Dichlorphos

## Zusammenfassung

In einem Überblick wurden mit *Fasciola hepatica*, *F. gigantica*, *Diphyllobothrium latum*, *Dipylidium caninum*, *Taenia saginata*, *T. solium*, *Multiceps multiceps*, *Echinococcus granulosus*, *E. multilocularis*, *Trichinella spiralis*, *Ancylostoma caninum*, (*Toxascaris leonina*) und *Toxocara canis* einige wichtige Helminthen besprochen, durch die nach Wechsel vom Tier zum Menschen besondere Risiken drohen und was die damit eng verbundene Ausgabe des Tierarztes als Hüter der menschlichen Gesundheit verdeutlichen sollte. Es war beabsichtigt, durch einige wesentliche Fakten an nennenswerte, für den Menschen bedeutsame tierische Parasiten zu erinnern, mit kurzen Hinweisen standortbezogene Unterschiede anzudeuten und anhand einiger Zahlen die gegenwärtige Situation zum Parasitenstatus zu belegen. Nach wie vor darf man es in diesem Zusammenhang nicht an Deutlichkeit fehlen lassen, immer wieder darauf hinzuweisen, wie wichtig tierische Parasiten als Zoonose-Erreger sein können und daß nicht nur die Chemotherapie allein, sondern ebenso die strikte Berücksichtigung hygienischer Aspekte beim Umgang mit dem Tier Aussicht auf Erfolg hat.

## Summary

The most important helminths hazardous for man and transmittable from animals are reviewed in order to put emphasis on the responsibility of the veterinary profession for the protection of health of human beings. Helminths hazardous for man are among others *Fasciola hepatica*, *F. gigantica*, *Diphyllobothrium latum*, *Dipylidium caninum*, *Taenia saginata*, *T. solium*, *Multiceps multiceps*, *Echinococcus granulosus*, *E. multilocularis*, *Trichinella spiralis*, *Ancylostoma caninum*, (*Toxascaris leonina*) and *Toxocara canis*. It was the intention to recall certain facts in connection with important ani-

mal parasites infectious for man, to describe location variations and to demonstrate the present situation and distribution of helminthic parasitism by means of figures. It should again be mentioned that helminthic parasites of animals can also be causative agents of zoonotic diseases. For the successful prevention and control of such zoonotic diseases caused by parasites are not only chemotherapeutic measures indicated, but also the strict consideration and implementation of hygienic measures while in contact with animals.

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## **A Comparative Study on some Claw and Blood Mineral Contents in Buffaloes and Cows**

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### **Summary**

Calcium, magnesium, copper and zinc contents were determined in the claw horny materials and serum of 10 healthy buffaloes, 10 healthy Egyptian cows, 10 healthy Friesian cows and 10 Friesian cows suffered from claw affections. The results showed that the claw calcium, magnesium, copper and zinc contents were significantly higher in buffaloes than cows. The average calcium, magnesium and zinc were significantly lower while the copper content was significantly higher in cows suffered from claw affections. Claw magnesium and copper contents were significantly higher in the hind claws than the fore ones whereas, insignificant differences were found between medial and lateral claws. The serum calcium was insignificantly higher whereas the magnesium was significantly higher in buffaloes than cows. The average serum calcium, magnesium and zinc concentration were insignificantly lower in cows suffered from claw affections. In conclusion, it can be said that the presence of macro- and micro-elements in an optimal contents is very important and facilitates a correct keratinization and cornification of the claw which are prerequisites for an optimal horn quality and the prevention of claw affections. There is a strong correlation between claw and serum mineral contents and the buffalo claws were of higher quality than Friesian cows, a result which should take in consideration in animal breeding program in Egypt.

**Keywords:** Buffaloes, cows, claw, claw affections, mineral contents.

### **Introduction**

Claw lameness in dairy cattle is a major cause of financial loss to the farmers and of pain and discomfort to the cattle. The claw horny material is largely responsible for protecting the claw from external influences such as hard abrasive surfaces, noxious substances or infectious agents. The ability of the claw horn to withstand the environment depends mainly on its physical properties, in particular its hardness, toughness and viscoelasticity which in turn are determined by the structure and chemical composition of the keratin forming the horn (Baggott et al., 1988).

The bovine claw is a modified epidermal structure indicates the health of domestic animals and reflecting a physiological adequate supply of nutrients, vitamins, minerals (calcium and phosphorus) and trace elements (zinc, copper and magnesium). The claw's health depends on the optimal horn quality which is determined by the horn cell structure (Mülling et al, 1999). The claw horn is made up of keratin which is basically protein linked by disulphide bonds and bound by small amounts of fat and minerals (Ca, P, Na, K, Mg, Cu, Fe, Zn, Se and S) and a variable amount of water (Baggott et al, 1988).

The horn quality is influenced by organic and inorganic components of the keratin, the intercellular cementing substance, and the architecture of horn cells in tubular and intertubular horn. Differences in the structure and composition of these factors determine the different degrees of claw horn quality. Horn of poor quality would be liable to more rapid abrasion from wear and tear and may reduce the protection offered to the solar region predisposing to claw affections (El-Ghoul, 1991 and Mülling et al., 1994). Deficiency of various macro- and microelements has been implicated in the pathogenesis of claw affections as these minerals are required for the production of healthy high quality claw horn. The most important minerals in relation to claw affections are calcium, magnesium, copper and zinc (Faye and Lescouret, 1989 and Johnson and Schugel, 1994). Mineral supplementation seems to be very beneficial to the claw health of dairy cows (Demertzis and Mills, 1973).

Claw horn hardness was differed among different breeds and specially the pigmented and unpigmented horny material which may be attributed to the difference in the chemical composition of the claw horn (Feder, 1969; Hubert, 1993 and Hong et al, 1996). A high incidence of claw affections was seen in friesian cows than in buffaloes and Egyptian cows (El-Ghoul, 1991).

The horny tissue indicates a state of continuous turnover and so a detailed knowledge of the mineral composition of claws may be important in cattle production (Hidiroglou & Williams, 1986). Determination of claw mineral composition was used as a tool for selecting bulls with high claw quality (Sugg et al., 1996).

The aim of the present work was to determine some inorganic elements of the claw horn and serum of normal buffaloes, Egyptian cows, friesian cows and friesian cows suffered from claw affections to search in the relation between claw mineral contents and the occurrence of claw affections. Also to search in the correlation between mineral contents in the claw and those in the serum.

## ***Materials and Methods***

### **Claw horny material examination**

The study was carried out on 10 healthy buffaloes, 10 healthy Egyptian cows, 10 healthy friesian cows and 10 friesian cows suffered from claw affections. After the claw was cleaned and pared, about 2 gm of claw horny material was collected using claw knife from the sole of left fore and hind claws of each animal. The claw samples were taken from the same anatomical region in all animals.

The claw samples were rinsed with distilled water and dried at 115°C for 24 hours. The dried samples were ashed in a muffle furnace at 550°C for 18 hours and the ash content expressed as a proportion of the dry matter. The samples were prepared by wet ashing in 25% H<sub>2</sub>SO<sub>4</sub> (Lepine et al, 1985). Calcium, magnesium, copper and zinc were then determined using atomic absorption spectrophotometer. All values were expressed as a proportion of the dry matter.

### **Blood examination**

Blood samples were taken from all the examined animals for serum collection which analyzed for calcium, magnesium, copper and zinc using autoanalyser. The data were analyzed by t-test and one-way ANOVA using SPSS (Statistical Product & Service Solutions) (Kuehl, 1994). All data were presented as mean ± standard error, and  $p < 0.05$  was considered significant.

## Results

### Claw mineral contents

The results showed that among the three examined species, the average claw horny material calcium and copper contents in buffaloes were significantly ( $p < 0.05$ ) higher than those in friesian cows. The magnesium and zinc contents in buffaloes were significantly ( $p < 0.05$ ) higher than those in friesian and Egyptian cows (Table 1).

**Table 1: Claw mineral contents in healthy buffaloes, Egyptian and friesian cows**

	Buffaloes	Egyptian cows	Friesian cows
<b>Calcium (mg/kg DM)</b>	1246.67 ± 56.91*	1170.36 ± 72.29	1119.26 ± 72.57
<b>Magnesium (mg/kg DM)</b>	321.03 ± 44.31*	248.93 ± 26.06	246.81 ± 23.86
<b>Copper (µg/kg DM)</b>	25.01 ± 4.56*	23.06 ± 5.82	13.62 ± 2.61
<b>Zinc (µg/kg DM)</b>	128.35 ± 8.04*	103.41 ± 9.62	105.96 ± 9.13

The average claw horny material content of calcium, magnesium and zinc were, significantly ( $p < 0.05$ ) lower and the copper content was significantly ( $p < 0.05$ ) higher in friesian cows suffered from claw affections than in healthy ones (Table 2).

**Table 2: Claw mineral contents in healthy and claw affected friesian cows**

	Healthy friesian cows	Friesian cows with claw affections
<b>Calcium (mg/kg DM)</b>	1319.26 ± 72.57	973.16 ± 81.42*
<b>Magnesium (mg/kg DM)</b>	246.81 ± 23.86	217.32 ± 29.79*
<b>Copper (µg/kg DM)</b>	13.62 ± 2.61	21.06 ± 4.19*
<b>Zinc (µg/kg DM)</b>	135.96 ± 9.13	71.14 ± 5.29*

In buffaloes hind claws, the magnesium and copper contents were significantly ( $p < 0.05$ ) higher than the fore ones and insignificant differences were found in the calcium and zinc contents. In the Egyptian cows, the magnesium and copper contents were significantly ( $p < 0.05$ ) higher and the zinc was significantly ( $p < 0.05$ ) lower in the hind claws than in the fore one. In friesian cows the magnesium content was significantly ( $p < 0.05$ ) higher in the hind claws than the fore one (Table 3).

**Table 3: Claw mineral contents in the fore and Kind claws of healthy buffaloes, Egyptian and friesian cows**

	Buffaloes		Egyptian cows		Friesian cows	
	Fore claw	Hind claw	Fore claw	Hind claw	Fore claw	Hind claw
<b>Calcium (mg/kg DM)</b>	1200.37 ± 26.68	1289.65 ± 107.64	1282.15 ± 103.56	1008.89 ± 69.17	1259.87 ± 86.49	1477.63 ± 97.44
<b>Magnesium (mg/kg DM)</b>	184.53 ± 19.15	468.04 ± 70.24*	191.23 ± 14.61	329.70 ± 49.90*	200.97 ± 10.23	327.02 ± 38.51*
<b>Copper (µg/kg DM)</b>	10.12 ± 1.97	41.05 ± 6.90*	9.80 ± 2.19	43.70 ± 11.77*	12.37 ± 1.94	15.81 ± 6.86
<b>Zinc (µg/kg DM)</b>	136.15 ± 12.63	123.80 ± 10.48	134.18 ± 8.29	60.34 ± 8.68*	139.08 ± 12.51	130.50 ± 14.14

Comparison of the mineral contents in the fore and hind claws in healthy and claw affected friesian cows revealed that the magnesium content was significantly ( $p < 0.05$ ) higher in the hind claws than the fore one. Insignificant differences were found in the average calcium, copper and zinc contents (Table 4).

**Table 4: Claw mineral contents in the fore and hind claws of healthy and claw affected friesian cows**

	Healthy friesian cows		Friesian cows with claw affections	
	Fore claw	Hind claw	Fore claw	Hind claw
<b>Calcium (mg/kg DM)</b>	1259.87± 86.49	1477.63± 97.44	1006.49±125.57	945.88 ±111.42
<b>Magnesium (mg/kg DM)</b>	200.97 ± 10.23	327.02 ± 38.51*	154.79 ± 44.07	265.43 ± 36.26
<b>Copper (µg/kg DM)</b>	12.37 ± 1.94	15.81 ± 6.86	23.60 ± 6.40	18.37 ± 5.47
<b>Zinc (µg/kg DM)</b>	139.08 ± 12.51	130.50 ± 14.14	67.62 ± 5.98	73.46 ± 7.88

Concerning the mineral contents in the medial and lateral claws insignificant difference were found in the average calcium, magnesium, copper and zinc contents among the three examined species and between clinically healthy and claw affected friesian cows (Table 5 & 6).

**Table 5: Claw mineral contents in the medial and lateral claws of healthy buffaloes, Egyptian and friesian cows**

	Buffaloes		Egyptian cows		Friesian cows	
	Medial claw	Lateral claw	Medial claw	Lateral claw	Medial claw	Lateral claw
<b>Calcium (mg/kg DM)</b>	1295.80 ± 90.06	1201.04 ± 72.16	1072.53 ± 109.35	1251.89 ± 93.86	1391.17 ± 96.81	1232.97 ± 107.21
<b>Magnesium (mg/kg DM)</b>	345.87 ± 78.54	301.16 ± 51.20	197.89 ± 16.35	299.97 ± 45.81	250.21 ± 37.31	242.73 ± 32.19
<b>Copper (µg/kg DM)</b>	31.05 ± 7.06	20.18 ± 5.86	16.20 ± 6.09	30.55 ± 10.02	14.77 ± 4.20	12.25 ± 3.20
<b>Zinc (µg/kg DM)</b>	119.40 ± 9.31	137.73 ± 10.16	105.56 ± 16.22	101.27 ± 11.09	141.39 ± 12.79	129.45 ± 13.91

**Table 6: Claw mineral contents in the medial and lateral claws of healthy and claw affected friesian cows**

	Healthy friesian cows		Friesian cows with claw affections	
	Medial claw	Lateral claw	Medial claw	Lateral claw
<b>Calcium (mg/kg DM)</b>	1391.17 ± 96.81	1232.97± 107.2	975.57 ± 103.8	970.21 ± 136.0
<b>Magnesium (mg/kg DM)</b>	250.21 ± 37.31	242.73 ± 32.19	172.47 ± 37.18	266.26 ± 44.33
<b>Copper (µg/kg DM)</b>	14.77 ± 4.20	12.25 ± 3.20	19.51 ± 5.39	22.70 ± 6.62
<b>Zinc (µg/kg DM)</b>	141.39 ± 12.79	129.45 ± 13.91	65.41 ± 6.28	76.36 ± 8.34

### Blood mineral concentration

The average serum calcium value was insignificantly higher and the magnesium was significantly ( $p < 0.05$ ) higher in the buffaloes than friesian cows. Insignificant changes were found in the serum copper and zinc concentration (Table 7).

Table 7: Serum mineral concentrations in healthy buffaloes, Egyptian and friesian COWS

Serum parameters	Buffaloes	Egyptian cows	Friesian cows
Calcium (mmol/l)	2.45 ± 0.023	2.39 ± 0.031	2.34 ± 0.020
Magnesium (mmol/l)	1.21 ± 0.022*	0.912 ± 0.014	0.875 ± 0.013
Copper (µmol/l)	10.43 ± 0.233	11.86 ± 0.135	11.28 ± 0.215
Zinc (µmol/l)	10.48 ± 0.276	10.52 ± 0.196	10.85 ± 0.293

It was found that the average serum calcium, magnesium and zinc values in cows affected by claw lesions were insignificantly lower than healthy ones (Table 8).

Table 8: Serum mineral concentration in healthy and claw affected friesian cows

Serum parameters	Healthy friesian cows	Friesian cows with claw affections
Calcium (mmol/l)	2.34 ± 0.020	2.10 ± 0.024
Magnesium (mmol/l)	0.875 ± 0.013	0.794 ± 0.019
Copper (µmol/l)	11.28 ± 0.215	<b>10.78 ± 0.210</b>
Zinc (µmol/l)	<b>10.85 ± 0.293</b>	<b>9.46 ± 0.286</b>

### Discussion

The results of mineral analysis of claw samples in healthy buffaloes, Egyptian cows and friesian cows indicated that the claw contents of calcium, magnesium, copper and zinc were significantly higher in buffaloes than cows. The difference in claw mineral contents in the three examined species indicated the role of genetic and breed difference in the predisposition to claw affections. The higher claw mineral contents in buffaloes may explain the high quality claw horny material which make the buffalo claw more resistance to the external and internal influences and decrease the incidence of claw affections. The lower mineral contents in the claws of friesian cows lead to structural alteration, production of soft low quality horny material predisposing to claw affections. This result was more or less in agreement with the findings of Bodurov et al. (1981) who found lower mineral contents in Black Pied breed that have higher incidence of claw affections. Meanwhile, Feder (1969) found insignificant differences in the claw wall contents of Ca, Mg, Cu and Zn of the normal claws of Schwarzbunt, Rotbunt and Angler cows.

Calcium plays an important role in the regulation of cellular differentiation and desquamation of epidermal keratinocytes and influence the hardness of keratins by virtue of its presence and the crystal structure of the complexes it form (Vicanova et al., 1998). Calcium is an essential element acting as an enzyme cofactor or activator during the process of keratinization. In this context, the calcium-dependent epidermal transglutaminase must be emphasized, since it plays a key role in the production of the cornified envelope protecting the horn cells against proteolytic enzymes. Copper is

important in the incorporation of disulphide bonds into the protein molecules which form a major part of the keratin matrix. Such bonds determine the physical properties of keratin. Zinc is known to be of importance in keratin synthesis and claw horn formation and it plays an important role in making the claw horn more resistance to stress (Banting, 1978).

Comparing the claw contents of calcium, magnesium, copper and zinc in healthy friesian cows in the present study with the previously reported analysis revealed similarities and differences among authors (Table 9).

**Table 9: Claw sole mineral contents in healthy friesian cows comparing the present study with previously reported analysis**

	Hidrioglou & Williams (1986)	Naumann et al (1987)	Baggott et al (1988)	Normal cows in the present study
<b>Ca (mg/kg DM)</b>	1565 ± 66.53	1200 ± 69.87	635 ± 25.0	1319.26 ± 72.57
<b>Mg (mg/kg DM)</b>	464 ± 22.45	800 ± 20.31	213 ± 11.1	246.81 ± 23.86
<b>Cu (µg/kg DM)</b>	2.8 ± 0.984	4.5 ± 1.01	6.28 ± 0.5	13.62 ± 2.61
<b>Zn (µg/kg DM)</b>	71.88 ± 8.14	110 ± 5.78	65.8 ± 1.7	135.96 ± 9.13

The average claw calcium, magnesium and zinc contents in cows suffered from claw affections were significantly lower whereas the average copper was significantly higher than those in healthy ones. This was similar to the findings of Demertzis and Mills (1973) who found zinc in reduced quantities in the claw horn of cows with claw disorders, whereas, copper content rises in inflamed tissues. Kovacs & Siliagy (1974) reported that calcium content of affected horn was significantly higher compared with that in healthy one, the copper content was normal, while magnesium and zinc contents were slightly above normal. Baggott et al while the copper and zinc contents were significantly lower in claw affected cows. On the other side, Kerk (1970) and Bodurov et al (1981) found insignificant differences. Such differences in mineral contents between healthy and affected horn could arise from generalised cellular incompetence due to pathological changes, malabsorption of these elements from the diet, or defective metabolism (Baggott et al., 1988). The deficiency of one or more elements induces structural alterations. These in turn result in a greater or lesser reduction of the horn cell quality which serves as a major parameter of claw health. Therefore, the above mentioned mineral elements must be considered in feeding (Mülling et al, 1999).

In the present study, the magnesium and copper contents in the hind claws of the three examined species were significantly higher than those in the fore ones. Meanwhile Baggott et al (1988) found insignificant increase in Ca and Mg and insignificant decrease in Cu and Zn in the affected hind claws. This would suggest that the observed changes in mineral contents might have been a consequence of generalised differences in availability of the elements to the keratin forming cells. On the other side, Kerk (1970) found insignificant differences in the claw calcium, magnesium, copper and zinc contents between the affected fore and hind claws.

Insignificant differences were observed between medial and lateral claws in healthy buffaloes and cows and also in friesian cows suffered from claw affections. This was in agreement with the findings of Baggott et al (1988) who found that the normal cows showed insignificant differences for any of the examined mineral components between the medial and lateral claws. In contrast, the lateral claw of lame cows had higher magnesium content than the medial one. The changes in the lateral claw might be ei-

ther the result of claw lesions which occur predominantly in the lateral claw or the difference effects an medial and lateral claw, for example, excessive loading (Toussaint - Raven, 1994).

Regarding the serum concentration of calcium, magnesium, copper and zinc the results showed that the calcium was insignificantly higher and magnesium was significantly higher in buffaloes than friesian cows. Blood mineral concentration is an important indicator of the general nutritional status of the animal and the changes in its concentration may affect the claw mineral contents (Moor et al, 1975 and Smart et al, 1992). Minerals are essential for activation of enzymes that are a prerequisite for physiological keratinization and cornification of the claws (Mulling et al., 1999).

The average serum concentration of calcium, magnesium and zinc in cows suffered from claw affections were insignificantly lower than healthy one. This was similar to the findings of Demertzis (1978) who found that zinc deficiency in cattle causes parakeratosis, abnormal claw growth, excessive growth of soft horn and lameness. Zinc plays an important role in securing keratin formation and integrity of the skin as a great part of zinc in feed is diverted to the skin and its appendices for keratin formation (Signorini., 1964). Supplementation of zinc methionine and zinc sulphate significantly increase claw strength and integrity and control the prevalence and severity of claw affections (Demertzis and Mills, 1973 and Moor et al, 1975). An increase in claw lameness was noticed in calcium deficient cows or persistently negative calcium balance (Smith, 1975).

The results of mineral analysis in the three examined species indicated a strong correlation between calcium, magnesium and zinc in the serum and claw horny material. In conclusion it can be said that the mineral contents of calcium, magnesium, copper and zinc in the buffaloes claw horny material were significantly higher than those in Egyptian cows and friesian cows claws; a result which may explain the low incidence of claw affections in buffaloes and the high incidence in friesian cows. The claw contents of calcium, magnesium and zinc were significantly lower and the serum concentration of calcium, magnesium and zinc was insignificantly lower in cows suffered from claw affections than healthy ones. A result which indicated a strong correlation between claw and serum mineral contents. The mineral contents of the claw are of central importance and play a key role in synthesis of the keratinized claw epidermis. The presence of these minerals in an optimal contents facilitates a correct keratinization and cornification of the claw, which are prerequisites for an optimal horn quality adapted to the local mechanical stresses. The deficiency of one or more minerals induces structural alterations. These in turn result in a greater or lesser reduction of the horn cell quality which serves as a major parameter of claw health. It can be said that the buffaloes claw horny material is genetically harder and of high quality than the friesian cows and must be considered in the breeding program in Egypt.

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## **Clinico-Biochemical Changes Associated with Bloody Diarrhoea of Lambs with Special Respect to Coccidiosis**

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### **Abstract**

This study was carried out on 18 lambs collected from Moshtohour village at Kaulubia governorate, five of them were clinically normal and free from internal and external parasites, while the remaining 13 lambs suffered bloody diarrhoea and their faeces had vegetative cells and oocysts of *Eimeria* species. Hematological picture indicated significant decrease of erythrocytic count and HB concentration, while there was significant increase of PCV% and total leucocytic count. Differential leucocytic count showed neutrophilia, lymphopenia, and eosinophilia. Serum analysis revealed significant decrease of sodium, iron, zinc, chloride, bicarbonate and total protein levels, with significant increase of potassium, total bilirubin levels, alanine aminotransferase, aspartate aminotransferase, gamma-glutamyl transferase and alkaline phosphatase activities. Also there were no changes of serum calcium, glucose and copper levels. Treatment of coccidiosis of lambs with sulfadimethoxine was more effective and faster than amprolium treated lambs.

### **Introduction**

Enteric diseases are most commonly manifested by diarrhoea and can result in significant mortality or economic losses from reduced conditions, (*Mottelib et al., 1993*). Ovine coccidiosis is one of the causes of haemorrhagic enteritis. Its importance is contributed to reduction of body weight, inefficient feed utilization and deaths of severely affected animals, (*Radostitis et al., 1995*). The disease is caused by protozoon parasite of Genus *Eimeria*, (*Georgi, et al., 1982*) which is characterized by a sporulated oocysts with 4 sporocysts and each of them has two sporozoites, (*Ernst and Benz. 1986*). Coccidiosis in lambs was always due to mixed *Eimeria* infestation and three species of *Eimeria* at least were recorded from each diarrheic lambs. Generally eight species of *Eimeria* were recognized including *E.Parva*, *E.Granulosa*, *E.Ovinodalis*, *E.Ovina*, *E.Faurei*, *E.ashata*, *E.Pallida* and *E.intricata*, (*Aly, 1990*). The different species of *Eimeria* had get a selective location in the intestinal tract, (*Ayaub, 1994*). The clinical findings of coccidiosis included depression, inappetance, grinding of the teeth, and abdominal pain. The faeces become watery, blood tinged mucoid or containing blood clots and affected animals some times suffered tenesmus. Anemia, weakness and dehydration were other additional clinical findings, (*Soulsby, 1968 and Levine and Ivens, 1970*).

Concerning the haematological changes associated with haemorrhagic enteritis caused with coccidia. *Pout and Harbutt (1968)* recorded haemoconcentration in lambs with coccidiosis. *Svanbaev and Gorbunova (1969)* detected reduction in total erythrocytic count and hemoglobin concentration in lambs infested with *E.ninakohylakimovae*. *Semenov (1973)* registered an increase in eosinophils and neutrophils percentage of lambs infested with mixed oocysts of coccidia. *Rama et al. (1978)* found a fall in RBCs count and hemoglobin concentration with an increase in the proportion of lymphocytes and neutrophils in lambs experimentally infested with *E.Parva* and *E.ninakohylakimovae*. *Shommein and Osman (1980)* recorded reduction in RBCs count and hemoglobin concentration, with an increase of MCV and PCV in goats infested with coccidia. Differential leucocytic count showed eosinophilia and moderate increase of the lymphocytic series. *Deghidy, et al. (1984)* reported an increase of both RBCs count and hemoglobin content and leucocytosis due to eosinophilia and significant increase of monocytes in sheep with coccidiosis. *Hayat et al. (1990)* found a decrease in RBCs count, PCV, hemoglobin concentration and means corpuscular hemoglobin concentration, with an increase in erythrocyte sedimentation rate and the mean corpuscular volume in sheep experimentally infested with coccidia. With regard to biochemical changes with coccidiosis, *Svanbaev and Gorbunova (1969)* reported falling in chloride and glucose contents of blood of lambs infested with coccidia. *Aly (1990) and Litvinskii (1981)* recorded significant increase of serum bilirubin, SGOT and SGPT activities while significant decrease of serum alkaline phosphate in sheep with coccidiosis. *Shommin and Osaman (1980), Begum and Anwar (1981), Ister et al. (1987) and Aly (1990)* observed that sheep with coccidiosis had significant decrease in serum sodium, phosphorus, calcium and copper, while significant increase in serum potassium levels.

With regards to treatment, symptomatic treatment including fluid therapy with saline and the use of hematinics as Iron preparation and vitamin B is essential to avoid complications of dehydration and anemia, *Radostitis et al. (1995)*. Specific treatment of coccidiosis was successfully attained by amprolium at dose of 0.05 gm / kg B.wt for 10 days, (*Hammond et al., 1967, Baker et al., 1972, Berkinbaev and Bisenova 1985 and Georgi and Georgi, 1990*). On the other hand *Mahrt (1969)* recorded that sulfonamides (sulphamerazine, sulphamethazine and sulphathiazole) when given in drinking water for 3 days followed by oxytetracycline for 2 days were affective for lambs suffering from coccidiosis. *Yvore et al. (1981) and Berkinbaev and Bisenova (1985)* found that animal treated with sulhadimethoxine with dose of 75 mg / kg. B.wt twice daily for 5 days had low oocysts count. *Gregory et al. (1982)* reported that addition of sulphdimidine to food and / or water reduced the oocyst output of ovine coccidiosis.

The aims of this work to solve this field problem among lambs by fulfilling the following points:

- Recording the clinical picture of this disease condition among lambs.
- Studying the side effect of this disease on the hematological and biochemical pictures.
- Evaluation and study the efficacy of two types of treatment against this diseases condition.
- Applying a symptomatic treatment to enhance general health condition among diseased lambs.

## **Material and Methods**

The study was conducted on eighteen lambs, aging 16 weeks to 6 months, collected from different private grazing flocks at Moshtohour village in Qualubia- Governorate. All lambs were subjected to clinical examinations according to *Kelly (1984)*. Fecal examinations were carried for each lamb according to *Soulsby (1982)*. Five lambs were clinically healthy and proved to be free from both external and internal parasites and kept as control, while other infested lambs had bloody diarrhea. Two blood samples were drained from jugular vein; the first was taken with anticoagulant (EDTA) for blood picture (RBCs, HB, PCV, WBCs, and differential leucocytic count) estimation according to (*Jain, 1986*). The second sample was collected without anticoagulant and allowed to clot at room temperature for 2 hours, then centrifuged at 3000 rpm. Clear and non-hemolysed sera were collected for the determination of sodium and potassium using flame photometer CORNING Model 400 (England Essex). Serum levels of calcium, iron, Glucose, chloride, total proteins, total bilirubin, direct bilirubin, indirect bilirubin, activities of AST, ALT, Gamma-glutamyl transferase (GGT) and alkaline phosphatase were estimated colormetrically by Spectroplus D (England) according to *Tietz (1970)*, *Ramsay, (1958)*, *Howanitz and Howanitz (1984)*, *Bauere, (1982)*, *Bartholomew and Delaney, (1966)*, *Jendrassik and Grap (1938)*, *Reitman and Frankel (1957)*, *Moss, (1984)* and *Belfield and Goldberg (1971)*. Serum copper and zinc levels were estimated by using atomic absorption spectrophotometer (PERKIN-ELMER CO., USA), according to *Wooton and Freeman (1982)*. Therapeutic trials were conducted by dividing diseased animals into two groups:

Group 1: Included 7 lambs treated orally by amprolium with dose rate 67.5 mg / kg body weight for 14 days, (*Ross, 1968*).

Group 2: Involved 6 lambs treated orally twice daily with sulfadimethoxine 75 mg / kg B.wt for 5 days, (*Yvore et al., 1981*).

All diseased lambs had intravenous fluid therapy (saline solution) and hematinics for anemia treatment, ferrous sulphate orally at dose rate 2 mg/ kg body weight 3 times daily for one week after (*Reynolds, 1989*) and Vit. B complex by intramuscular injection as supportive treatment (*Radostits et al., 1995*).

The efficacy of the both drugs (Amprolium and Sulfadimethoxin) was estimated by examination and observation of the diseased lambs after treatment and by hematological and biochemistry assessment three weeks post-treatment.

## **Results and Discussion**

The clinical inspection of diseased lambs revealed reduced appetite, depression, diarrhoea with faeces contained blood and threads of mucous, abdominal pain and pale watery visible mucous membranes. Fecal analysis showed vegetative cells and oocysts of *Eimeria* species. These findings were similar to those recorded by *Chapman (1974- a)* and *Berkinaev and Bisenova (1985)*. Hematological picture of diseased lambs (table. 1) revealed significant decrease of total erythrocytic count and haemoglobin content, while, there was significant increase of PCV% and total white blood cells. Differential leucocytic count indicated significant lymphocytopenia, significant neutrophilia and significant oesinophilia. These results were parallel with those of *Svanbaev and Gorbunova (1969)* who proved low total erthrocytic count and haemoglobin concentration in lambs infested with *E. ninakohylakimovae*. *Rama et al. (1978)* compared the hematological picture of lambs before and after infestation with *E.ninakohylakimovae* and registered falls in total erthrocytic count and haemoglobin concentration after infestation. *Berkinbaev and Bisenova (1985)* recorded anemia in

lambs experimentally infested with *E. ninakohylakimovae*. This significant decrease of RBCs and HB content might be due to haemorrhagic enteritis due to coccidiosis, (Deghidy *et al.*, 1984). The significant leucocytosis with significant lymphocytopenia, significant neutrophilia and significant eosinophilia was attributed to inflammatory condition of the intestine that was agreed with Deghidy *et al.* (1984) and Mottelib *et al.* (1993). The significant increase of PCV% was due to dehydration, which is agreed with Shommein and Osman (1980) and Mottelib *et al.* (1993). Serum analysis for lambs with coccidiosis (tables 2 & 3) indicated significant decrease of sodium level while significant increase of potassium level and significant decrease of chloride and bicarbonate levels. This may be attributed to the diarrhea associated with coccidiosis. These changes were similar to those of Svanbae and Gorbunova (1969) and agreed with Shommein and Osman (1990). Serum calcium, copper and blood glucose levels were slightly decreased with coccidiosis, which may be due to lower food intake associated with coccidia infestation. This result was coincided with that of Aly (1990). Serum iron level was significantly decreased and this result was parallel with that of Aly (1990). Also there was significant decrease of serum zinc level. These decreases may be attributed to secondary bacterial infection and mal- absorption from damaged intestine, (Deghidy *et al.*, 1984). The significant reduction in serum total protein in infested lambs may be attributed to integrated function of alimentary tract due to decreased absorption of nutrients from infection sites, damage caused by parasites and cell sloughing. These changes agreed with Catchpole and Gregory (1985). Also there were significant increase of serum bilirubin level, ALT and AST activities. This detection was similar to that of Ali (1990). Serum alkaline phosphatase was significantly increased and this coincided with that of Holst and Sevansson (1994) Serum GGT activity level was significantly increased. These changes of all previous enzymes with both total proteins and bilirubin levels pointed to that the liver might be affected by coccidiosis. There was significant decrease of chloride and bicarbonate levels, which was similar to that of Svanbae and Gorbunova (1969). The result of treatment of lambs with coccidiosis with amprolium and sulfadimethoxine indicated complete recovery that was completed by fluid therapy especially saline solution and hematinics. The efficacy of sulfadimethoxin was more potent than the efficacy of the Amprolium and all changed parameters nearly returned to normal values within three weeks post-treatment in second group treated by sulfadimethoxin more better and faster than in first group treated by Amprolium. This may be due to rapid responses of the lambs to the double and high doses of the sulfadimethoxin which lead lambs to retain normal appetite. This result was nearly similar to those of Ross (1968), Yvore *et al.* (1981) and Radostitis *et al.* (1995).

We concluded that treatment of lamb infected with coccidiosis by sulfadimethoxin was more potent and faster than those treated by Amprolium. Also applying of hygienic measures will reduce the incidence of infection by this disease.

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**Table (1): Mean values of hematological picture of healthy and diarrhoeic lambs due to coccidiosis.**

Hematological picture	Negative control lambs	Lambs		
		Before treatment	With After treatment in group (1)	Coccidiosis After treatment in group (2)
RBCs ( $10^6 \times \text{ul}$ )	11.83 $\pm$ 0.42	7.54** $\pm$ 1.08	10.59 $\pm$ 0.14	10.51 $\pm$ 0.26
Hb ( gm/ dl)	12.63 $\pm$ 0.15	7.41 ** $\pm$ 0.41	12.02 $\pm$ 0.21	11.97 $\pm$ 0.17
PCV %	36.2 $\pm$ 0.49	39.08 * $\pm$ 1.52	36.14 $\pm$ 0.47	37.43 $\pm$ 0.37
WBCs ( $10^3 \times \text{ul}$ )	6.48 $\pm$ 1.38	18.22** $\pm$ 0.82	6.98 $\pm$ 0.11	7.29 $\pm$ 0.17
Neutrophiles %	26.8 $\pm$ 0.67	44.6 ** $\pm$ 3.41	27.65 $\pm$ 0.44	28.70 $\pm$ 0.62
Lymphocytes %	64.4 $\pm$ 0.66	43.40** $\pm$ 2.64	62.16 $\pm$ 2.44	61.79 $\pm$ 0.47
Basophils %	0.6 $\pm$ 0.07	0.80 $\pm$ 0.19	0.67 $\pm$ 0.06	0.7 $\pm$ 0.05
Monocytes %	5.00 $\pm$ 0.21	4.60 $\pm$ 0.20	4.25 $\pm$ 0.20	4.79 $\pm$ 0.15
Eosinophils %	3.20 $\pm$ 0.20	6.6** $\pm$ 1.01	5.27 $\pm$ 0.24	4.02 $\pm$ 0.12

\* Values significant at  $P < 0.05$ .

\*\* Values significant at  $P < 0.01$ .

**Table (2): Mean values of some serum biochemical profile of healthy and diarrhoeic lambs due to coccidiosis.**

parameters	Negative for coccidiosis (control)	Lambs with coccidiosis		
		Before treatment	After treatment in group (1)	After treatment in group (2)
Sodium (Meq/ L)	144.31 $\pm$ 3.21	83.64* $\pm$ 2.71	137.7 $\pm$ 0.5	138 $\pm$ 0.78
Potassium (Meq/ L)	7.22 $\pm$ 0.12	9.53* $\pm$ 0.08	7.69 $\pm$ 0.10	7.5 $\pm$ 0.12
Calcium (mg%)	9.23 $\pm$ 0.38	8.74 $\pm$ 0.93	9.03 $\pm$ 0.10	9.03 $\pm$ 0.04
Iron (mg / uL)	147 $\pm$ 11.23	115.22* $\pm$ 3.62	136.61 $\pm$ 0.46	137.36 $\pm$ 1.14
Copper (ug / dl)	183.97 $\pm$ 11.7	165.01 $\pm$ 3.47	177.71 $\pm$ 2.05	178.14 $\pm$ 2.33
Zinc (ug / dl)	115.10 $\pm$ 2.77	64.8* $\pm$ 0.48	111.60 $\pm$ 0.63	112.75 $\pm$ 0.8
Glucose (mg %)	62.11 $\pm$ 3.15	48.2 $\pm$ 3.71	57.64 $\pm$ 0.39	58.23 $\pm$ 0.31
Chlorides (Meq/ L)	95.11 $\pm$ 2.54	60.81* $\pm$ 1.28	84.57 $\pm$ 1.67	86.33 $\pm$ 1.3
Bicarbonates (Meq/ L)	30.29 $\pm$ 0.42	14.81* $\pm$ 0.61	27.62 $\pm$ 0.68	28.47 $\pm$ 0.61

\* Values significant at  $P < 0.05$ .

\*\* Values significant at  $P < 0.01$ .

**Table (3): Mean values of some liver function parameters for healthy and diarrhoeic lambs with coccidiosis.**

parameters	Negative for coccidiosis (control)	Lambs with coccidiosis		
		Before treatment	After In Group (1)	treatment both Group (2)
AST (IU/ L)	170.24 $\pm$ 8.22	201.1* $\pm$ 10.3	186.21 $\pm$ 2.33	184.88 $\pm$ 1.11
ALT (IU/ L)	22.35 $\pm$ 1.78	28.12* $\pm$ 2.08	24.51 $\pm$ 0.68	23.57 $\pm$ 0.51
$\gamma$ - GGT (u / dl)	16.14 $\pm$ 0.72	19.43* $\pm$ 0.46	18.33 $\pm$ 0.29	17.93 $\pm$ 0.29
Alkaline phosphatase (u / dl)	17.54 $\pm$ 0.58	32.60* $\pm$ 0.46	20.13 $\pm$ 3.42	18.84 $\pm$ 0.50
Total bilirubin (mg %)	0.08 $\pm$ 0.01	0.13* $\pm$ 0.05	0.09 $\pm$ 0.007	0.09 $\pm$ 0.001
Direct bilirubin (mg %)	0.03 $\pm$ 0.004	0.04 $\pm$ 0.001	0.03 $\pm$ 0.01	0.03 $\pm$ 0.01
Indirect bilirubin (mg %)	0.05 $\pm$ 0.02	0.09 $\pm$ 0.01	0.08 $\pm$ 0.01	0.06 $\pm$ 0.007
Total protein (g/ dl)	8.01 $\pm$ 0.26	6.22 * $\pm$ 0.34	7.18 $\pm$ 0.21	7.27 $\pm$ 0.27

\* Values significant at  $P < 0.05$ .

\*\* Values significant at  $P < 0.01$ .

## Präsentation der Ergebnisse der Gruppe Hathor

M.-A. Hasslinger

Die Arbeitsgruppe Veterinärmedizin (Hathor) hat sich zusammengesetzt, um über aktuelle Krankheiten der Rinder zu sprechen. Dabei wurde besonderer Wert auf die Krankheitskomplexe in Ägypten gelegt. Nachfolgend sollen die wichtigsten Gesichtspunkte dargelegt werden:

Prof. Dr. W. HOFMANN (FU Berlin) berichtete über Bedeutung und Bekämpfung von Durchfallerkrankungen bei Kälbern. Er führte dabei aus, daß in Deutschland rund 48% aller Erkrankungen haltungsbedingt und rund 52% primär erregurbedingt sind. An erster Stelle der infektiösen Kälber-Diarrhö stehen in Deutschland die Rota- und Coronavirus-Infektionen in Verbindung mit Sekundärinfektionen durch *Escherichia coli* Keime ('Neugeborenen-Diarrhö'). Weitere wichtige Erkrankungen seien BVD und Salmonellose. In der Diskussion wurde deutlich, daß auch in Ägypten die Neugeborenen-Diarrhoe mit einer Frequenz von etwa 80% die wichtigste Form des Kälberdurchfalles darstellt. Daraus ergeben sich Parallelen und gemeinsame Konsequenzen für Therapie und Bekämpfung. Als wichtigstes therapeutisches Prinzip gilt in beiden Ländern die Infusions-Therapie, zur Bekämpfung die Muttertier-Vakzination.

Im zweiten Referat berichtete Prof. Dr. M. K. Refai (Cairo Universität) über den Stand der Brucellosedurchseuchung und -bekämpfung in Ägypten: Er wies besonders darauf hin, daß die Epidemiologie in seinem Land stark von der anderer Länder abweicht, weshalb die unmittelbare Übernahme von Maßnahmen aus anderen Ländern nicht geeignet sei. In Anlehnung an internationale Erfahrungen muß Ägypten einen eigenen Weg der Bekämpfung gehen. Er weist darauf hin, daß insbesondere auch die Verwendung eigenständiger Vakzine und Diagnostika den Vorrang haben sollte. Einen rein nationalen Weg hält er jedoch nicht ausreichend, sondern fordert vielmehr eine Kooperation in der Region.

Von Prof. Dr. S. N. El-Sukhon (Universität Irbid) wurden 649 Proben aus Milch und Milchprodukten (Milch, Eiscreme, Käse und Jameed) auf den Gehalt von Klebsielle-Spezies untersucht. Dabei konnte eine Keimanreicherung in Frischmilch sowie in lokal hergestellten und verpackten Milchprodukten festgestellt werden. Die Inzidenz schwankte bis zu rund 50% der Proben. Bisher ließ es sich noch nicht klären, wie es zu der Kontamination gekommen ist. Da die ausländischen Proben frei von *Klebsiella* spp. waren, kann sowohl eine nicht optimale Pasteurisierung, als auch eine nachträgliche Verunreinigung durch Menschen und Verpackung möglich sein.

Langjährige Studien über bestimmte Parasiten sowie Erkenntnisse aus zahlreichen Lehr- und Forschungsaufenthalten hier in Ägypten bildeten die Grundlage zu vergleichenden Ausführungen von Prof. Dr. M.-A. Hasslinger (LMU München) zu Zoonosen, an denen Parasiten vom Tier ursächlich beteiligt sein können. Es wurden einige wichtige Helminthen vom Wiederkäuer, (Schwein) und Fleischfresser erwähnt, durch die nach Wechsel vom Tier zum Menschen besondere Risiken drohen und die damit eng verbundene Aufgabe des Tierarztes als Hüter der menschlichen Gesundheit verdeutlichen. Mit kurzen Hinweisen wurden standortbezogene Unterschiede angedeutet und anhand aktueller Zahlen die differierenden Situationen zum Parasitenstatus belegt. Es

wurde deutlich darauf hingewiesen, wie wichtig tierische Parasiten als Zoonose-Erreger sein können und daß nicht die Chemotherapie allein, sondern nur die gleichzeitige Beachtung hygienischer Gesichtspunkte beim Umgang mit dem suspekten Tier zum erwünschten Erfolg führt.

Dr. W. S. El-Ghoul (Cairo Universität) stellte Untersuchungen an Wasserbüffeln, ägyptischen Rindern und importierten Holstein-Friesian-Rindern vor. Vergleichende Untersuchungen bezogen sich auf gesunde und stoffwechselkranke H-F-Rinder in Deutschland. Der Referent ermittelte eine abnehmende Mineralisierung des Klauenhorns bei allen drei Wiederkäuer-Spezies. Bei Stoffwechselstörungen komme es zu einer zusätzlichen Demineralisierung mit erhöhter Inzidenz von Klauenkrankheiten. Als Gegenmaßnahmen wurden besonders züchterische Aufgaben hervorgehoben.

Dr. R. S. Seleim (AHRI, Dokki / Cairo) berichtete abschließend (in einem zusätzlichen Referat) über Pathogenitätsmerkmale bei Pasteurellen.

Zusammenfassend kann festgestellt werden, daß dieses Seminar sehr viele Gemeinsamkeiten in der Betrachtung der Krankheitsprobleme aufgezeigt hat, die zur Kooperation ermutigen. Andererseits gibt es durchaus auch Eigenständigkeiten, die mehr unter lokalen Bedingungen zu berücksichtigen sind.

## ***Soil Science (Group Kemet)***

# **Wheat Response to Nitrogen and Zinc Fertilization under Saline Condition in Calcareous Soil**

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### ***Abstract***

A pot experiment was carried out to study the effect of nitrogen and zinc fertilization on the growth, nutrient uptake and yield of two wheat cultivars (Sakha 8 and Sakha 69) grown under saline water irrigation in calcareous soil. Nitrogen, as ammonium sulphate and ammonium nitrate, was applied at rate of 100 kg N/fed. Zinc was applied as zinc sulphate at rates of 0.0 and 5 kg/fed. Three salinity levels (EC 0.62; Nile water as control, wells water have 7.8 and 15.6 dSm<sup>-1</sup>) were applied.

Nitrogen and zinc fertilization enhanced the dry matter and grain yield of plants. However, ammonium sulphate was more effective than ammonium nitrate. N, P, K and Zn uptake in shoots and grains were increased by N and Zn fertilizers addition. Increasing salinity from EC 7.6 to 15.8 reduced the dry matter yield, grain yield and N uptake. Meanwhile, the Na concentration in shoots was increased. Sakha 8 was more effective than Sakha 69 for grain yield, minerals uptake. The cultivar Sakha 8 is more salt tolerant than Sakha 69.

### ***Introduction***

Wheat is one of the most important field crops for human food. Thus intensive efforts have been performed to increase its production by several agricultural means. One of these means is the use of N-fertilization (EL-KOUMEY and EL-SHAFIE, 1997).

Competition among all sectors of society for good-quality water has focused a great attention on the use of the poor-quality waters in agriculture (DEVITT et al., 1987). However, if saline or waste water is used, attention must be given to assess the impact of such water on productivity. Low quality of irrigation water, such as well water, has been used in some Egyptian areas for irrigation, whenever, the Nile water was not available. These areas may be subjected to salt accumulation. The potential of crop productivity under such conditions is depending on the plant response to osmotic stress and on the relative toxicity of some ions such as Na<sup>+</sup> and Cl<sup>-</sup> (MARSCHNER, 1995). In most cases, a reduction in the yield was normally associated with an accumulation of soluble salts in plant tissues (MENGEL and KIRKBY, 1987).

Nitrate and ammonium ions constitute the most important nitrogen forms taken up by plants. Moreover, in many arable soils where nitrification normally takes place rapidly, nitrate and ammonium are the prominent sources (EL-SHINNAWI et al., 1988).

Since zinc is very closely involved in the N metabolism within plant tissues, foliar spray of wheat plants with Zn under certain soil conditions such as high pH, in arid and semi-arid regions, had been found to have a positive effect on its growth and yield. This enhancing effect may be due to the high degree of nutrient utilization in plant tissues (DORING and GERIKE, 1985).

This work is an attempt to spot a light on the effect of two N forms (nitrate & ammonium) and Zn fertilization on the growth, nutrient uptake and yield of two wheat cultivars grown under saline conditions in calcareous soil.

## Materials and Methods

Surface (0 – 30 cm) calcareous soil samples were collected from the Experimental Farm of the soil salinity laboratory, Agric. Res. Center, Alexandria, Egypt. Soil samples were air dried and ground to pass through a 2 mm sieve. Physical and chemical properties of the used soil were determined according to BLACK (1982) as shown in Table (1 a).

**Table 1 a: Some physical and chemical characteristics of the experimental soil.**

Property	Value	Property	Value
<b>Physical characteristics:</b>		Soluble ions (meq 100 g <sup>-1</sup> ):	
Sand, %	81	Ca <sup>2+</sup>	1.66
Silt, %	10	Mg <sup>2+</sup>	2.87
Clay, %	9	Na <sup>+</sup>	7.29
Texture class	Loamy sand	K <sup>+</sup>	3.30
<b>Chemical characteristics:</b>		HCO <sub>3</sub> <sup>-</sup>	1.06
OM, %	0.40	Cl <sup>-</sup>	11.66
pH (1 : 2.5 soil / water sus.)	7.30	SO <sub>4</sub> <sup>=</sup>	2.40
EC, dS m <sup>-1</sup>	1.08	Total N, %	0.09
CaCO <sub>3</sub> %	33.14	Available P µg g <sup>-1</sup>	16.0
SAR	4.95	Zn µg g <sup>-1</sup>	1.80
ESP	4.52	Fe µg g <sup>-1</sup>	3.20
		Mn µg g <sup>-1</sup>	4.10

Glazed pots, (30 cm diameter and 25 cm depth) were filled with 12 kg air dried soil. Twenty grains of wheat (*Triticum aestivum* L., Sakha 8 and Sakha 69 cvs.) were sown and 20 days later, the seedlings were thinned to 10 per pot. The pots were arranged in a complete randomized block design with four replicates. The other agriculture practices were applied as recommended for wheat production in Egypt. Three salinity levels were used Nile water with EC 0.62 dSm<sup>-1</sup> as a control, ground water wells with 7.8, and 15.6 dSm<sup>-1</sup> in the Soil Salinity Laboratory at Abis, Alexandria Governorate. Water characteristics are tabulated in Table (1 b).

Two nitrogen forms, ammonium nitrate and ammonium sulphate were added to the soil at the rate of 100 kg N/feddan, corresponding to 3.6 and 5.7 g N/pot, respectively. N fertilizer was added in two equal portions, before the first and the second irrigation. Zinc sulphate was applied as foliar application at two rates 0 and 5 kg / fed. Foliage spray of Zn was applied at 35 days from sowing. Plant samples were taken during the

growth period (at 45, 90 and 120 days from sowing), washed, air dried. The plant materials were divided into two parts, one dried at 70°C (24 hrs) for chemical analysis and the another at 105°C for dry weight determination. Samples were thoroughly ground and ashed by wet digestion according to JACKSON (1967). Total N was determined using micro-kjeldahl method after JACKSON (1967). P, K and Na were determined by flame photometer as described by CHAPMAN and PRATT (1961). Available Fe, Zn and Mn in wheat shoots were determined using the atomic absorption spectrometer (Model Phillips Pu 9100).

At harvest time, the number and weight of spikes / pot, weight of 100 grains, grains weight (g/pot) were determined. N, P, K and Zn in grains were determined according to CHAPMAN and PRATT (1961). Grain crude protein content was calculated by multiplying N values by the conversion factor 6.25. All data were statistically analyzed according to GOMEZ and GOMEZ (1983).

**Table 1 – b: Chemical characteristics of irrigation water samples.**

Property	Irrigation water dSm <sup>-1</sup>		
	EC 0.62	EC 7.8	EC 15.6
pH	7.9	7.7	7.6
SAR	1.96	21.10	28.40
<b>Soluble ions mg L<sup>-1</sup>:</b>			
Ca <sup>++</sup>	2.20	6.45	20.19
Mg <sup>++</sup>	1.73	10.92	23.90
Na <sup>+</sup>	2.75	62.21	133.50
K <sup>+</sup>	0.18	3.90	6.31
HCO <sub>3</sub> <sup>-</sup>	3.55	2.90	4.35
Cl <sup>-</sup>	2.11	59.47	125.37
SO <sub>4</sub> <sup>=</sup>	1.20	21.11	54.8

## **Results and Discussion**

### **3.1. Dry matter yield**

Data in Table (2) revealed that the dry matter yield of wheat shoots increased gradually to reach a maximum value at 90 days from sowing, then tended to decrease. This decrease may be due to stopping the development of new leaves and / or leaf shedding in the late stages of growth. Moreover, the migration of minerals from leaves to grains may share the decrease in dry matter yield at late stage. Data in Table (2) indicated also that ammonium sulphate was more effective in increasing dry matter yield than ammonium nitrate. This enhancing effect of ammonium sulphate is probably due to its content from sulphur which is an essential nutrient element. Sulphur also may improve the soil pH since its solution has an acidic effect. Similar results were obtained by EL-SHINNAWI et al. (1988) EL-MOATASEM et al. (1993).

Zinc fertilizer showed an enhancing effect on the dry matter yield of wheat at both nitrogen forms. This results may be due to the role of Zn as a co-factor in the enzymatic reactions of the anabolic pathways in plant growth. These results are parallel to those obtained by EL-HABBAL et al. (1995) and EL-KOUMEY and EL-SHAFIE (1997).

Sakha 8 variety showed a superiority on Sakha 69 in its tolerance to salinization. The dry matter yield was not affected by the (EC 7.8) and slightly affected by the irrigation with the high level of salinity (EC 15.6). The higher level of saline water showed a depressing effect on dry matter yield of wheat plants. This effect may be attributed to the high osmotic pressure of the soil solution which induces a detrimental effect on the nutrient absorption by plants, consequently impairing the growth of wheat crops (MARSCHNER, 1995). This results are in accordance with those obtained by FRANCOIS et al. (1986), NOUR et al. (1990) and EL-HADDAD et al. (1993).

## Macronutrients

### Nitrogen

Data in Table (3) revealed that ammonium sulphate surpassed ammonium nitrate in increasing the concentration and uptake of nitrogen by both cultivars of wheat. This may be ascribed either to genetical properties of wheat plants which have a preference for taking up ammonium nitrogen, or to the enhancing effect of ammonium sulphate on the availability of nutrients in the soils consequently stimulating the plant growth and their capability to take up more nitrogen from the soil (MENGEL and KIRKBY, 1987). Zinc application with the both nitrogen forms showed a beneficial effect on enhancing the N-uptake of wheat plants. This may be due to the important role of Zn in plant growth. These results go along with those of EL-BASIONI et al. (1993).

Table 2: Dry weight of wheat shoots (g/pot) as affected by saline water, N and Zn fertilization at different growth stages.

Treatments	Salinity levels dSm <sup>-1</sup>								
	EC 0.62 (control)			EC 7.8			EC 15.6		
	45	90	120	45	90	120	45	90	120
	DAS	DAS	DAS	DAS	DAS	DAS	DAS	DAS	DAS
<b>Sakha 8</b>									
Zn <sub>0</sub> + N <sub>4</sub> H NO <sub>3</sub>	59.0	91.0	51.0	62.0	96.0	47.0	49.0	86.0	34.0
Zn <sub>1</sub> + N <sub>4</sub> H NO <sub>3</sub>	68.0	97.0	57.0	67.0	99.0	55.0	57.0	95.0	37.0
Zn <sub>0</sub> + (N <sub>4</sub> H) <sub>2</sub> SO <sub>4</sub>	67.0	104.0	56.0	66.0	105.0	57.0	53.0	91.0	40.0
Zn <sub>1</sub> + (N <sub>4</sub> H) <sub>2</sub> SO <sub>4</sub>	75.0	113.0	69.0	75.0	115.0	66.0	61.0	102.0	48.0
Mean	68.0	101.0	58.0	68.0	104.0	56.0	55.0	94.0	40.0
<b>Sakha 69</b>									
Zn <sub>0</sub> + N <sub>4</sub> H NO <sub>3</sub>	54.0	84.0	43.0	42.0	73.0	39.0	32.0	46.0	28.0
Zn <sub>1</sub> + N <sub>4</sub> H NO <sub>3</sub>	59.0	90.0	59.0	45.0	79.0	56.0	39.0	51.0	28.0
Zn <sub>0</sub> + (N <sub>4</sub> H) <sub>2</sub> SO <sub>4</sub>	59.0	93.0	53.0	50.0	79.0	49.0	34.0	57.0	31.0
Zn <sub>1</sub> + (N <sub>4</sub> H) <sub>2</sub> SO <sub>4</sub>	68.0	96.0	69.0	53.0	85.0	59.0	44.0	64.0	30.0
Mean	60.0	91.0	56.0	48.0	79.0	51.0	37.0	55.0	29.0

			45	90	120		
			DAS	DAS	DAS	DAS	Days after sowing
LSD	(A)	5%	4.4	4.0	6.0	(A)	Fertilizers
	(B)		3.7	3.0	5.0	(B)	Salinity
	(C)		3.0	3.0	4.0	(C)	Variety

Salinity at high level decreased N uptake by wheat plants. The average reductions of N uptake were 23 and 92% for Sakha 8 and Sakha 69, respectively. This decrease in the nitrogen uptake may reflect the inhibiting effect of the high salinity on the dry matter yield of plant shoots.

### Phosphorus

Data presented in Table (3)<sup>8</sup> showed that ammonium sulphate increased phosphorus concentration and uptake by wheat plant more than ammonium nitrate. This increase may be attributed to the acidic effect of ammonium sulphate added to the calcareous soil on elevating the availability of phosphorus in soil and consequently increasing its uptake by plants. Similar results in confidence with these findings are reported by MOSTAFA and HASSAN (1995). In this connection, SOON and MILLER (1977) found that the ammonium-fed plants usually have higher phosphorus contents in the shoots than nitrate-fed plants.

<sup>8</sup> Tables 3-6 are only available in the print copy (Beihefte zu Der Tropenlandwirt Nr. 71)

Phosphorus uptake by wheat plants greatly increased by zinc application with both nitrogen forms, however, the increase with  $(\text{NH}_4)_2\text{SO}_4$  tremendously excelled that one occurred by  $\text{NH}_4\text{NO}_3$  addition. These results obviously revealed the beneficial effect of zinc application to calcareous soil on stimulating the capability of wheat varieties to uptake more phosphorus, particularly under ammonium sulphate fertilization.

The same data elucidated also that the phosphorus concentration in wheat plants was slightly affected by salinity levels, however the P uptake was affected by the highest salt concentration of the applied water in Sakha 69. These results are in agreement with those obtained by MASHHADY et al. (1982), SOLIMAN et al. (1994), MOSTAFA and HASSAN (1995) and MASHEN (1996).

#### **Potassium**

Results in Table (3) show in most cases that application of N in different sources caused significant effects on K uptake. Furthermore, data reveal that addition of  $(\text{N}_4\text{H})_2\text{SO}_4$  recorded higher amounts of K contents than those obtained by using  $\text{N}_4\text{HNO}_3$ . Application of zinc fertilizer showed a marked increase in potassium concentration and uptake. This may be due to the beneficial effect of applied zinc. The high salinity level showed a significant decrease in dry matter yield of plant shoots, which has been reflected on the potassium uptake (Table 3). Similar results are reported by CHIPA and LAL (1986) and SHARMA (1996).

#### **Sodium**

The data in Table (3) showed that irrigation of the wheat plants by saline water vigorously raised  $\text{Na}^+$  concentration and uptake in comparison with the plants irrigated with the Nile water. This is referred to the remarkable diffusion and mass flow from the higher concentration gradient ( $\text{Na}^+$ ) of the saline soil solution to plant roots, consequently, plant tops. Similar results were obtained by REGGIANI et al. (1995), SHARMA (1996).

Zn application increased  $\text{Na}^+$  concentration and uptake by wheat plants. The enhancing effect of zinc was more obvious under salinization if compared with non-saline condition. This may be due to the role of zinc in raising the ability of plant to uptake more nutrients under salinization.

#### **Micronutrients**

With respect to the concentrations of Fe, Zn and Mn in wheat shoots, Table (4) showed that increasing the salinization alleviated the antagonistic effect between Zn and Fe. At the highest salinity level of the irrigation water, Zn application, particularly with Sakha 69, tended to enhanced rather than inhibited the Fe concentration and uptake by wheat plants. It is evident that ammonium sulphate influenced the concentration and consequently the uptake of Fe in treated plant tissues than ammonium nitrate as shown in the same table. Similar results were obtained by MENGEL and KIRKBY (1987) and IBRAHIM and SHALABY (1994).

The data in Table (4) showed no significant differences between ammonium sulphate and ammonium nitrate in their effect on Zn concentration and uptake by wheat plants. The same data explicated that the application of Zn enormously increased Zn concentration and uptake by wheat plants. Zn uptake by Sakha 69 was found to be more significantly decreased by salinity than Sakha 8, this reflects the depressive effect of salinity on dry matter yield of wheat plants and consequently, its nutrients uptake. These results are in a harmony with those reported by SALLAM (1992) and MOHAMED (1994).

Regarding the Mn contents in Zn-untreated wheat plants, data showed an increase in Mn concentration than those treated with Zn. The depressive effect of Zn on Mn con-

centration and uptake may be attributed to the antagonistic effect of high Zn application on Mn concentration and uptake. This antagonism may be attributed to the competition for binding sites in the roots during the uptake process (MARSCHNER, 1995). The same antagonistic effect of Zn on Mn was appeared also under salinity condition, although the highest level of saline water apparently reduced this effect. In contrast with the above mentioned results, ammonium nitrate surpassed ammonium sulphate in its enhancing effect on Mn concentration in wheat shoots. This results were confirmative to those of MENGEL and KIRKBY (1987).

### **Yield and its components**

Data in Table (5) showed that N and Zn fertilization significantly increased grain yield per pot, weight of 100 grains, number of spikes/pot and spikes weight (g/pot) of both cultivars of wheat plants.

The salt tolerant cultivar (Sakha 8) had a higher grain-yield of wheat plants than the susceptible one (Sakha 69). Data recorded in Table (5) indicated that the reduction in grain yield per pot at higher salinity level was lower in Sakha 8 than in Sakha 69. With regard to nitrogen forms, the ammonium sulphate was more effective in increasing grain yield per pot than ammonium nitrate. This positive effect of ammonium sulphate is probably due to its content of sulphur which is an essential nutrient element. Similar results were obtained by MOSTAFA and HASSAN (1995) and BOTELLA et al. (1997). Data presented in Table (5) showed that Zn application significantly increased the grain yield per pot and yield components of wheat plants. This may be due to the important role of Zn for the activation of various types of enzymes, such as those required for the CO<sub>2</sub> assimilation pathway (MARSCHNER, 1995).

The negative effects of salinity on the yield and its components in Sakha 69 was more sensitive to salinity than Sakha 8. The inhibition in growth of wheat plants is due to high salt concentration in the soil solution (i.e. high osmotic pressure and consequently low soil water potential) and high concentration of potentially toxic ions such as Cl<sup>-</sup> and Na<sup>+</sup> which might lead to ion toxicity and nutritional imbalance, consequently growth inhibition (MARSCHNER, 1995). Similar results were obtained by IELAND et al. (1994) and SOLIMAN et al. (1994).

### **Yield quality**

The data in Table (6) indicated that ammonium sulphate excelled ammonium nitrate in their effect on increasing N, protein, P, K and Zn percentages in the wheat grains. This may be attributed to the acidic effect of ammonium sulphate added to the calcareous soil on elevating the availability of P in soil and consequently increasing its uptake by wheat plants. Foliar application of Zn significantly stimulated N, protein, P, K and Zn concentrations in grains. This may be due to the important role of Zn for protein synthesis (MENGEL and KIRKBY, 1987).

Table (6) showed decrease in nitrogen content and increase in P, K and Zn percentages due to increasing salinity levels. The cultivar Sakha 8 showed more accumulation of N, P, K, Zn and protein contents of grains than Sakha 69. These results are in a harmony with those obtained by DEVITT et al. (1987).

Finally, it can be concluded from our results that the application of ammonium sulphate and zinc sulphate showed a beneficial effect on increasing growth, nutrient uptake and grain yield of wheat plants. On the other hand, Sakha 8 was found to be more tolerant to salinization than Sakha 69.

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## Effect of Balanced Fertilization and Ploughing Depth on Elemental Composition of Sugar Beet and some Chemical Properties in Salt Affected Soils

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### **Abstract**

Two field experiments were carried out during two successive seasons at the experimental farm of Faculty of Agriculture, Kafr El-Sheikh to study the interaction effect of balanced fertilization with NPK (N-rates: 0, 72, 144 and 216 kg N/ha, P-rates: 0, 36 and 72 kg P<sub>2</sub>O<sub>5</sub>/ha and K-rates: 0, 36, 72 and 108 kg K<sub>2</sub>O/ha) and soil ploughing depth (shallow at 15 cm and deep at 30 cm) on some soil properties and uptake of NPK by sugar beet plant (cultivar, Maribo Poli). The soil used had clay texture, 86 meq/L of total soluble salts and belongs to soil order of vertisol.

The results of plant analysis indicated that, NPK concentration were increased in shoots of sugar beet plant under deep ploughing compared with shallow one. The highest value of N concentration was obtained at 216 kg N/ha of N application whereas the highest value of P and K concentration were recorded at 72 kg P<sub>2</sub>O<sub>5</sub>/ha and 72 kg K<sub>2</sub>O/ha, respectively.

Soil analysis after sugar beet harvesting showed that, soil pH and total soluble salts were decreased under deep ploughing (30 cm depth) without any addition of fertilizers. On the other side, addition of NK fertilizers haven't significant decrease on soil pH but superphosphate fertilizer had partial effect on decreasing soil pH in the surface soil layer (0-15 cm). Statistical analysis showed that the relationship between NPK fertilizers and ploughing depths was highly significant in decreasing the electrical conductivity of soil solution.

The calculated values of sodium adsorption ratio (SAR) from soluble Ca<sup>+</sup>, Mg<sup>++</sup> and Na<sup>+</sup> measured in soil solution after harvesting of sugar beet plants and hence exchangeable sodium percentage (ESP) were decreased in the soil surface (0-15 cm) under deep ploughing at 30 cm compared to shallow ploughing at 15 cm. On the other side, the lowest value of SAR (2.27) and ESP (4.44%) were obtained under deep ploughing and addition of 72 kg N/ha, 72 kg P<sub>2</sub>O<sub>5</sub>/ha and 36 kg K<sub>2</sub>O/ha of added fertilizers.

### **Introduction**

Sugar beet has become one of the major winter field crop in Egypt due to its high income to the farmers. Its area tended to increase year after another especially in salt affected soils. Fertilization is one of the most important limiting factor for sugar beet production under Egyptian conditions. Complete and balanced fertilization of NPK is important for high crop production.

Ploughing is one of the main practices operated before sugar beet planting which used to provide the necessary soil conditions favorable to growth of that crop. Agboola (1981) showed that tillage and fertilizers application reduced the organic matter content, soil pH, and slightly increased exchangeable potassium and phosphorus. Rezk *et al.* (1982) found that, tillage operation had a general depressive effect on the EC of the surface of soil.

Many investigators reported that nitrogen is the most limiting nutrient for sugar beet (Kemp *et al.*, 1994, El-Attar *et al.*, 1995 and Rezk *et al.*, 1995). Other researchers concluded that application of phosphorus affected the yield and quality of sugar beet (Abbott and Nelson, 1983, Hegazy *et al.*, 1992 and Abou El-Soud *et al.*, 1994). On the other side, sugar beet plant has an affinity to potassium element, Mittchera (1978) and Ghaly *et al.* (1984) reported that increasing K fertilization rate resulted in increasing K content and sugar root yield.

Therefore, the objective of this research was to investigate the interaction effect between soil ploughing depth and NPK fertilization on some chemical properties of salt affected soil and nutrients uptake by sugar beet plants.

## Materials and Methods

A field experiment was conducted at the experimental farm of the Faculty of Agriculture, Kafr El-Sheikh, Tanta Univ., during two successive seasons. Some soil properties of the soil used are shown in Table (1) which had clay texture (50% clay) and belongs to vertisol order.

The experiments were carried out in split plot design with three replicates. The main treatments were ploughing depth (15 and 30 cm), while the subtreatments were different rates of NPK fertilizers. Nitrogen was added in the form of urea (46% N) at four rates of application (0, 72, 144 and 216 kg N/ha). Every rate was added in three equal portions after thinning and before the second and the third irrigation. Potassium sulphate (48% K<sub>2</sub>O) was added at four rates of application (0, 36, 72 and 108 kg K<sub>2</sub>O/ha). Each rate was applied in two equal portions, after thinning and before the second irrigation. Superphosphate fertilizer (15.5% P<sub>2</sub>O<sub>5</sub>) was added before planting at three rates of application (0, 36 and 72 kg P<sub>2</sub>O<sub>5</sub>/ha).

**Table (1): Mean values of some chemical properties of the studied soil before planting**

Soil characteristics	Soil depth, 0-15 cm
Electrical conductivity, dS/m (paste)	8.56
pH (1: 2.5 soil/water ratio)	8.85
Soluble cations, meq/L (paste):	
Ca <sup>++</sup>	18.00
Mg <sup>++</sup>	23.00
Na <sup>+</sup>	42.00
K <sup>+</sup>	2.00
Total carbonate (%)	3.42
Sodium adsorption ratio (SAR)	9.3
Exchangeable sodium percentage (ESP), %	11.12
Total nitrogen (%)	0.20
Available-P, NaHCO <sub>3</sub> -extractable P (mg/kg)	12.08
Available-K, NH <sub>4</sub> OAC-extractable K (mg/100 g)	21.84

Sugar beet cultivar (Maribo Marina Poli) was sown on November and harvested at the end of May (about 200 days). All agricultural practices were carried out according to conventional local recommendation of the Ministry of Agriculture, Egypt.

Plant samples (leaves) were collected from each plot at the end of every season. Each sample was washed with distilled water and dried in oven at 70°C. Wet digestion was used in H<sub>2</sub>SO<sub>4</sub>-H<sub>2</sub>O<sub>2</sub> mixture to determine the concentration of the three major elements (NPK) according to Chapman and Pratt (1961).

After harvesting, soil samples were taken at 0-15 cm depth, dried and prepared for chemical analysis. The electrical conductivity (EC) and water soluble cations (Ca<sup>++</sup>, Mg<sup>++</sup> and Na) were determined in the soil water ratio at 1: 5 according to Page *et al.*, 1982. SAR and ESP were calculated from values of soluble cations according to the following equations:

$$\text{SAR} = \frac{\text{Na}^+}{\sqrt{(\text{Ca}^{++} + \text{Mg}^{++})/2}} \quad \& \quad \text{ESP} = \frac{\text{ESR}}{1 + \text{ESR}} \times 100 \quad (\text{Black, 1983}).$$

Where:  $\text{ESR} = -0.0126 + 0.01475 \text{ SAR}$

Soil reaction (pH) was measured in soil suspension (1: 2.5 soil/water ratio). Data were statistically analyzed according to Snedecor and Cochran (1980) using multiple range test at 5% and 1% levels.

## **Results and Discussion**

### **Root yield of sugar beet crop:**

Data presented in the first part of this work by the same authors (Khalifa *et al.*, 2000) showed that, addition of 216 kg N/ha + 72 kg P<sub>2</sub>O<sub>5</sub>/ha + 108 kg K<sub>2</sub>O/ha were considered the most suitable needs from nutrients for sugar beet plants under deep ploughing (30 cm). The general mean of roots yield was about 96 and 89 ton/ha for different NPK treatments under deep and shallow ploughing, respectively. The corresponding values were 26 and 21 ton/ha without any addition of fertilizers. Whereas mean values of the sucrose percentage were found to be 16.5 and 15.1% at different treatments of NPK under shallow and deep ploughing, respectively. The corresponding values were 12 and 11% without any addition of fertilizers. That means, deep ploughing may be encouraged the roots of sugar beet to penetrate and move through the soil and getting the best of their nutritive needs from the soil.

### **N, P and K concentration in shoots of sugar beet plant:**

Table (2) indicated that N concentration was increased in shoots of sugar beet plant under deep ploughing compared with shallow one, where N concentration was 2.98% and 2.24% without any addition of fertilizers, respectively. Application of N increased N concentration in shoots of sugar beet up to 5.32% under deep ploughing and 216 kg N/ha. Addition of P fertilizer encouraged nitrogen uptake by sugar beet plants, where the highest value of N concentration was obtained under the second level of P (72 kg P<sub>2</sub>O<sub>5</sub>/ha). This may be due to that, the deep ploughing facilitated the root distribution, and consequently increased the absorption area of plants to nutrients. On the other hand, data showed that increasing of added potassium had no effect on concentration of N in shoots, where the highest value of N concentration was obtained at N<sub>216</sub> P<sub>72</sub> K<sub>0</sub> for both shallow and deep ploughing.

The results showed that, also phosphorus content in sugar beet was higher under deep ploughing than shallow one. The highest value of P concentration was 5.75 mg P/g dry matter of plant under deep ploughing and  $N_{144}P_{72}K_{72}$  treatment. This result indicated that, higher dose of added-N (216 kg N/ha) may be increasing the vegetative growth and decreasing phosphorus absorption by plants. On the other hand, potassium absorption by sugar beet plants was increased with increasing added K up to 108 kg  $K_2O$ /ha under different treatments of other nutrients (N and P), but the concentration of K in plant shoots was higher under deep ploughing than its under shallow one. Maximum concentration of K in the shoots was obtained at  $N_{72}P_{36}K_{108}$  of added fertilizers under deep ploughing. These results indicated that deep ploughing lowered fertilizer requirements and gave the best uptake at balanced fertilization. This was in agreement with the studies of Bajpai and Joshi (1992) and Hamissa (1995).

**Table (2): Concentration of N, P and K in sugar beet plant (shoots) as affected by soil ploughing depth and increment rates of NPK fertilizers.**

Fertilizer treatments	Shallow ploughing at 15 cm			Deep ploughing at 30 cm			
	N %	P mg/g plant	K mg/g plant	N %	P mg/g plant	K mg/g plant	
$N_0P_0K_0$	2.24	2.12	21.45	2.98	2.87	36.27	
$N_{72}P_{36}$	$K_0$	2.24	2.20	36.27	3.40	2.97	42.12
	$K_{36}$	3.19	2.29	37.05	4.05	4.16	65.52
	$K_{72}$	2.87	2.94	42.12	4.69	3.77	72.15
	$K_{108}$	3.62	2.47	44.85	3.83	3.30	76.05
Mean	2.98	2.48	40.07	3.99	3.54	63.96	
$N_{144}P_{36}$	$K_0$	2.66	2.88	38.22	3.51	3.48	42.90
	$K_{36}$	3.30	2.14	40.17	3.51	3.22	50.70
	$K_{72}$	3.41	3.10	50.70	3.73	4.60	58.50
	$K_{108}$	3.09	2.87	57.72	3.41	3.43	59.67
Mean	3.12	2.75	46.70	3.54	3.68	52.94	
$N_{216}P_{36}$	$K_0$	4.04	3.27	40.95	4.36	3.72	49.92
	$K_{36}$	4.15	2.21	42.90	4.26	3.43	53.82
	$K_{72}$	3.30	2.67	47.97	3.73	3.60	68.25
	$K_{108}$	2.34	2.53	66.30	4.05	3.02	70.20
Mean	3.46	2.67	49.53	4.10	3.44	60.55	
$N_{72}P_{72}$	$K_0$	2.56	2.34	37.05	4.15	4.06	48.75
	$K_{36}$	3.09	2.46	47.97	3.51	4.80	51.87
	$K_{72}$	3.19	4.04	53.82	4.15	5.48	60.45
	$K_{108}$	2.56	3.87	54.60	3.83	4.13	64.35
Mean	2.85	3.30	48.36	3.91	4.62	56.36	
$N_{144}P_{72}$	$K_0$	2.77	3.64	40.17	4.26	4.36	49.92
	$K_{36}$	2.98	2.20	42.12	3.64	5.07	56.55
	$K_{72}$	2.98	3.80	44.07	4.26	5.75	63.57
	$K_{108}$	3.09	4.12	62.40	3.73	3.79	68.25
Mean	2.97	3.44	47.19	4.05	4.74	59.57	
$N_{216}P_{72}$	$K_0$	4.90	3.95	44.85	5.32	5.02	53.82
	$K_{36}$	3.30	4.35	44.85	3.73	4.50	55.77
	$K_{72}$	3.73	4.55	52.82	4.15	4.70	64.35
	$K_{108}$	3.62	3.69	62.40	4.68	4.39	68.25
Mean	3.89	4.14	51.48	4.47	4.65	60.55	
General mean	3.21	3.13	47.22	4.01	4.11	60.49	

### Effect of soil ploughing depth and NPK treatments on soil pH and EC:

Data presented in Table (3) show the mean values of soil pH and EC in the soil solution of surface layer (0-15 cm) after harvesting sugar beet crop. The results showed that soil pH and EC were decreased under deep ploughing (30 cm) compared to the shallow one (15 cm) without any addition of fertilizers, where soil pH was 8.87 and 8.70 while EC was 2.11 and 0.83 dS/m under shallow and deep ploughing, respectively. Decrease of soil pH under deep ploughing may be due to that the deep ploughing buried the organic matter deeper in the soil, where decomposition of organic matter in soil produced organic acids which led to decrease soil pH (Ali and Abo Habaga, 1995). On the other side, EC decreasing of soil solution may be due to increasing penetration of water under deep ploughing which led to leaching the salts through the soil profile.

**Table (3): Mean values of soil pH and EC (dS/m) as affected by increment rates of NPK fertilizers after harvesting sugar beet crop.**

NK treatments		Shallow ploughing (15 cm)				Deep ploughing (30 cm)			
N kg/ha	K kg K <sub>2</sub> O/ha	P <sub>1</sub> (36 kg P <sub>2</sub> O <sub>5</sub> /ha)		P <sub>2</sub> (72 kg P <sub>2</sub> O <sub>5</sub> /ha)		P <sub>1</sub> (36 kg P <sub>2</sub> O <sub>5</sub> /ha)		P <sub>2</sub> (72 kg P <sub>2</sub> O <sub>5</sub> /ha)	
		pH	EC	pH	EC	pH	EC	pH	EC
72	0	8.80	0.77	8.57	1.21	8.55	0.58	8.51	0.81
72	36	8.66	1.03	8.96	0.93	8.52	0.67	8.56	0.55
72	72	8.68	1.18	8.40	1.45	8.60	0.80	8.26	0.64
72	108	8.66	0.89	8.62	0.91	8.53	0.68	8.59	0.86
Mean		8.70	0.97	8.64	1.13	8.55	0.68	8.48	0.72
144	0	8.71	1.21	8.60	0.73	8.41	0.68	8.58	0.63
144	36	8.77	0.85	8.83	0.98	8.66	0.53	8.50	0.85
144	72	8.78	0.62	8.80	0.99	8.25	0.55	8.44	0.62
144	108	8.79	1.33	8.63	1.14	8.44	0.88	8.58	0.80
Mean		8.76	1.00	8.72	0.96	8.44	0.66	8.53	0.73
216	0	8.61	0.96	8.60	1.18	8.57	0.56	8.58	1.03
216	36	8.53	0.84	8.70	0.76	8.50	0.68	8.59	0.58
216	72	8.86	0.63	8.80	0.68	8.57	0.60	8.57	0.67
216	108	8.82	0.75	8.60	0.86	8.66	0.62	8.55	0.67
Mean		8.71	0.80	8.68	0.87	8.58	0.62	8.60	0.74
General mean		8.72	0.92	8.68	0.99	8.52	0.65	8.53	0.73

Significance for	Parameters						
	D	P	T	D X P	T X D	T X P	T X D X P
Soil pH	*	*	ns	*	ns	**	ns
EC	*	**	**	**	ns	**	**

D = Ploughing depth

T = NK treatments

P = P-treatments

\*, \*\* = significant and highly significant at 5% and 1%, respectively.

Application of NK fertilizers to the soil haven't significant decrease on soil pH but superphosphate fertilizer had a significant effect on decreasing soil pH in the surface soil layer (0-15 cm). This is because the acidity effect of superphosphate which dissolve to give a solution with pH value of about 1.48 (Lindsay, 1979). Statistical analysis showed that the interactions between P and NK fertilizers had highly significant effect on soil pH and also between ploughing operation and P only. The lowest value of soil pH was 8.25 under deep ploughing and 144 kg N/ha + 72 kg K<sub>2</sub>O/ha + 36 kg P<sub>2</sub>O<sub>5</sub>/ha of added fertilizers. It can be concluded that, decreasing soil pH was considered an important goal for many agriculture practices in our soils which increases availability of most nutrients. Therefore, addition of acidic fertilizers such as superphosphate is an important goal not only to its acidulation effect but also to balanced fertilization with N and K fertilizers.

Statistical analysis in Table (3) showed that the relationships between NPK fertilizers and ploughing depths were highly significant in decreasing EC of soil solution.

The lowest value of soil EC (0.53 dS/m) was obtained at 144 kg N/ha + 36 kg P<sub>2</sub>O<sub>5</sub>/ha + 36 kg K<sub>2</sub>O/ha treatment under deep ploughing at 30 cm. Heavy clay soil from Nile delta needs to deep ploughing to reduce the water table of ground water and hence decreasing the total soluble salts of soil solution. Decreasing the total soluble salts in the soil solution after harvesting the sugar beet crop, may be related to plant healthy growing and better uptake of nutrients.

### Effect of soil ploughing depth and NPK treatments on soluble Ca<sup>++</sup>, Mg<sup>++</sup> and Na<sup>+</sup>:

Data in Table (4) showed that the soil solution after harvesting of sugar beet plant contained higher amounts of soluble Ca<sup>++</sup>, Mg<sup>++</sup> and Na<sup>+</sup> under shallow ploughing (15 cm) than its value under deep ploughing (30 cm) without any addition of fertilizers (N<sub>0</sub>P<sub>0</sub>K<sub>0</sub> treatment). Soluble Ca<sup>++</sup> was 4.60 and 4.2; soluble Mg<sup>++</sup> was 6.10 and 3.80; soluble Na<sup>+</sup> was 11.00 and 6.25 meq/L under shallow and deep ploughing, respectively. This decrease in soluble cations under deep ploughing may be attributed to improving soil permeability and hydraulic conductivity which increase the movement of soluble cations through the soil profile. These results were confirmed by those obtained by Agboola (1981) and Rezk *et al.* (1982).

Addition of different fertilizers at different rates led to decreasing soluble cations in the soil solution. That is clear from difference values between control treatment (N<sub>0</sub>P<sub>0</sub>K<sub>0</sub>) and general mean (Table 4). This may be attributed to good plant growth and hence more absorption of cations from soil solution and/or insoluble compounds precipitation such as Ca and Mg phosphates. Values of general means for soluble cations indicated that the order of decreasing was Mg<sup>++</sup> > Ca<sup>++</sup> > Na<sup>+</sup> (see Table 4).

The interaction between different fertilizer treatments and soil ploughing depths showed highly significant relationships in decreasing the amounts of soluble Ca<sup>++</sup>, Mg<sup>++</sup> and Na<sup>+</sup> with one exception for Mg<sup>++</sup> ion under ploughing depth and NK treatment.

**Table (4): Effect of soil ploughing depth and different rates of NPK fertilizers on soluble Ca<sup>++</sup>, Mg<sup>++</sup> and Na<sup>+</sup> (meq/L) in soil after harvesting sugar beet crop.**

NK treatments		Shallow ploughing (15 cm)						Deep ploughing (30 cm)					
N kg/ha	K kg K <sub>2</sub> O/ha	P <sub>1</sub> (36 kg P <sub>2</sub> O <sub>5</sub> /ha)			P <sub>2</sub> (72 kg P <sub>2</sub> O <sub>5</sub> /ha)			P <sub>1</sub> (36 kg P <sub>2</sub> O <sub>5</sub> /ha)			P <sub>2</sub> (72 kg P <sub>2</sub> O <sub>5</sub> /ha)		
		Ca <sup>++</sup>	Mg <sup>++</sup>	Na <sup>+</sup>	Ca <sup>++</sup>	Mg <sup>++</sup>	Na <sup>+</sup>	Ca <sup>++</sup>	Mg <sup>++</sup>	Na <sup>+</sup>	Ca <sup>++</sup>	Mg <sup>++</sup>	Na <sup>+</sup>
72	0	2.20	0.90	5.20	3.20	2.90	7.17	1.50	0.80	5.00	3.10	1.20	5.85
72	36	2.40	2.50	5.80	3.80	2.80	6.15	2.20	1.10	5.50	2.80	2.40	3.65
72	72	2.25	3.10	8.20	3.70	4.00	9.50	1.70	3.00	5.35	2.30	1.10	4.65
72	108	2.70	1.00	6.20	3.50	2.70	5.95	1.60	0.90	5.85	3.30	2.20	5.45
Mean		2.39	1.88	6.35	3.55	3.10	7.19	1.75	1.45	5.43	2.88	1.73	4.90
144	0	2.40	1.90	7.90	3.30	2.10	5.11	1.60	0.90	5.00	3.10	2.00	4.17
144	36	2.90	2.20	7.50	4.00	2.70	5.47	2.60	2.10	6.50	1.90	2.20	5.38
144	72	1.40	1.20	4.60	2.90	1.70	4.45	1.40	1.10	4.30	2.30	0.80	4.40
144	108	3.00	2.60	9.00	3.00	2.60	6.25	2.40	1.20	8.18	2.80	1.90	5.25
Mean		2.43	1.98	7.25	3.30	2.28	5.32	2.00	1.33	6.00	2.53	1.60	4.80
216	0	1.60	1.90	7.00	4.20	2.00	7.00	1.30	1.30	6.25	4.20	1.90	6.50
216	36	3.60	1.90	6.75	3.30	1.80	5.25	2.40	0.50	6.60	2.00	1.60	4.35
216	72	2.70	1.90	5.00	3.10	1.00	4.75	2.50	0.90	4.50	2.50	1.00	4.00
216	108	1.40	2.10	6.10	2.80	2.70	6.50	1.30	1.30	5.75	2.20	2.30	4.85
Mean		2.33	1.95	6.21	3.35	1.88	5.88	1.88	1.33	5.78	2.73	1.70	4.93
General mean		2.38	1.93	6.60	3.40	2.42	6.13	1.88	1.26	5.73	2.71	1.68	4.88

Significance for	Parameters						
	D	P	T	D X P	T X D	T X P	T X D X P
Ca <sup>++</sup>	**	**	**	**	*	**	**
Mg <sup>++</sup>	**	**	**	**	ns	**	**
Na <sup>+</sup>	**	*	**	**	**	**	**

D = Ploughing depth

T = NK treatments

P = P-treatments

\*, \*\* = significant and highly significant at 5% and 1%, respectively.

### Calculated SAR and ESP after harvesting sugar beet crop:

The calculated values of SAR and hence ESP were decreased in the soil surface (0-15 cm) under deep ploughing at 30 cm compared to shallow ploughing at 15 cm (Table 5). This reflects the higher amounts of soluble  $\text{Na}^+$  at shallow ploughing compared to deep ploughing (Table 4). The values of SAR were 4.76 and 3.14 without any addition of fertilizers ( $\text{N}_0\text{P}_0\text{K}_0$ ) under shallow and deep ploughing, respectively. The corresponding values for ESP were 7.66 and 5.62%, respectively. That means, deep ploughing was succeeded in decreasing soil salinity and alkalinity compared to shallow one (Table 1).

Data showed that under the same treatments of P and soil ploughing depth, addition of NK fertilizers had higher significant effect on the calculated SAR and ESP. The lowest value of SAR (2.27) and ESP (4.44%) were obtained under deep ploughing and addition of 72 kg N/ha + 72 kg  $\text{P}_2\text{O}_5$ /ha + 36 kg  $\text{K}_2\text{O}$ /ha. On the other hand, P application had highly significant effect on SAR and ESP, where increasing P addition decreased calculated SAR and ESP (Table 5). Conformation of soluble phosphate compounds such as Na-Phosphates almost led to leaching more  $\text{Na}^+$  ions and hence decreasing SAR and ESP. Statistical analysis showed that all interactions between NPK treatment and soil ploughing depth had highly significant effect on the calculated SAR and ESP.

**Table (5): Calculated sodium adsorption ratio (SAR) and exchangeable sodium percentage (ESP%) as affected by soil ploughing depth and different rates of NPK fertilizers after harvesting sugar beet crop.**

NK rates		Shallow ploughing (15 cm)				Deep ploughing (30 cm)			
N kg/ha	K kg $\text{K}_2\text{O}$ /ha	$\text{P}_1$ (36 kg $\text{P}_2\text{O}_5$ /ha)		$\text{P}_2$ (72 kg $\text{P}_2\text{O}_5$ /ha)		$\text{P}_1$ (36 kg $\text{P}_2\text{O}_5$ /ha)		$\text{P}_2$ (72 kg $\text{P}_2\text{O}_5$ /ha)	
		SAR	ESP	SAR	ESP	SAR	ESP	SAR	ESP
72	0	4.23	6.97	4.09	6.80	4.70	7.62	4.01	6.71
72	36	3.71	6.36	3.40	5.92	4.30	7.06	2.27	4.44
72	72	5.02	8.00	4.86	7.79	3.52	6.10	3.58	6.14
72	108	4.58	7.67	3.38	5.88	5.27	8.30	3.31	5.79
Mean		3.46	7.25	3.93	6.60	4.45	7.27	3.29	5.77
144	0	5.43	8.46	3.12	6.87	4.54	7.39	2.60	4.89
144	36	5.69	7.58	2.99	5.39	4.25	7.02	3.82	6.49
144	72	4.12	6.83	2.93	5.30	3.84	6.49	3.59	6.18
144	108	5.38	8.43	3.73	6.37	5.87	9.01	3.62	6.23
Mean		4.91	7.83	3.19	5.98	4.63	7.48	3.41	5.95
216	0	5.30	8.38	3.99	6.67	5.47	6.83	3.73	6.37
216	36	4.08	6.81	3.29	5.79	5.49	8.55	3.25	5.71
216	72	3.30	5.79	3.31	5.84	3.48	6.01	3.10	5.52
216	108	4.63	4.49	3.93	6.63	5.04	8.05	3.23	5.70
Mean		4.33	7.12	3.63	6.23	4.87	7.36	3.33	5.83
General mean		4.54	7.40	3.59	6.27	4.65	7.37	3.34	5.85

Significance for	Parameters						
	D	P	T	D X P	T X D	T X P	T X D X P
SAR	**	**	**	**	**	**	**
ESP	**	**	**	**	*	**	**

D = Ploughing depth

T = NK treatments

P = P-treatments

\*, \*\* = significant and highly significant at 5% and 1%, respectively.

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## Depth and Quality of the Groundwater in North Delta Soils

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### **Abstract**

Water table levels had been recorded daily on 227 locations in North Delta under different soil, land use and drainage conditions. The measurements were made in observation wells (perforated plastic tubes 38 mm diameter and 2 m deep). The measurements were started in November 1999 and will continue through the next two growing seasons. Ground water samples were collected (twice until now) from the observation wells. Salt content, concentration of the essential cations and anions, and the concentration of some heavy metals and microelements were determined.

The preliminary results for the first six months are presented here and the final results will be published after the end of the investigations. The obtained data revealed that the lands of the North Nile Delta region are characterized by a high water table. The mean water table level ranged between 33-150 cm with overall mean of 78 cm. Water table levels reach a maximum after irrigation and gradually decrease reaching a minimum before the next irrigation. Such trend was observed in all studied locations. The quality of ground water was influenced by the land use and drainage conditions, and also by the levels of the water table. Negative correlation was obtained between groundwater depth and quality of such water. The correlation coefficients between mean water table level and mean values of EC, Na, Ca+Mg, HCO<sub>3</sub>, Mn, Fe, and Pb of the groundwater were 0.319, 0.296, 0.323, 0.359, 0.378, 0.244, and 0.069 respectively. The data of depth and quality of the ground water will be used to justify identifying the ground water as a resource to cover a part of the water requirements of the different field crops.

### **Introduction**

In arid and semi-arid regions usually shallow water table is the decisive factor of salinization and alkalization. The limiting depth of groundwater table that might be considered of practical importance would vary with the nature of the soil and quality of groundwater, land use, irrigation and drainage conditions (Kovda, 1961 and Elgabaly, 1972). Most lands of North Delta region are clay textured soils, mainly under flood irrigation system and increased cropping intensity. Groundwater table level of 60–90 cm for sandy soils and of 100–150 cm for clay soils were considered suitable for most field crops (Benetin, 1983). The sub-irrigation from groundwater may greatly contribute in the water requirements of the plants. Ground water may be considered as a water supply source for crops and may reduce irrigation demand (Ragab and Amer, 1989; Ibrahim, 1999).

Specially in North Delta region, where water supplies become scarce, evaluation of the depth and quality of groundwater is necessary for effective water use and management. Therefore the objectives of this investigation are to: (1) evaluate the fluctuation of water table levels for 227 locations in North Delta, representing wide variations in land use, drainage conditions, and hence groundwater depth; (2) determine the quantitative relations between depth and quality of ground water.

## **Material and Methods**

Water table levels had been recorded daily on 227 sites in Kafr El-Sheikh governorate, north Nile Delta, Egypt. The study sites were chosen to represent a wide variation in locations, land use, irrigation and drainage conditions. The measurements were made in observation wells (perforated plastic tubes 38 mm diameter and 2 m deep), which were installed at the half distance between two tiles (or open field drains). The measurements were started first November 1999 and will continue for at least one year. The data presented here cover the first six months. (November 1999 – April 2000). Ground water samples were collected from the observation wells at the beginning of December 1999 and at the end of April 2000. Salt content (EC value) and the concentrations of essential cations and anions were determined as the methods described by Richards (1954). Fe, Mn, Zn, Cu, Pb, Ni, Co, and Cd were determined by Atomic Absorption spectrophotometer. Statistical analyses were calculated for the relation between ground water depth and quality of such water. Correlation coefficients were calculated according to the method given by Snedecor and Cochran (1967).

## **Results and Discussion**

Ground water depth varies from 5 cm to 191 cm according to the location, cultivated crop and drainage conditions. The average values of water table depths for the studied sites from beginning November 1999 until end April 2000 are presented in Fig. (1)<sup>9</sup>. These values ranged between 33 cm and 150 cm with overall mean value of 78 cm. The lands of studied locations were characterized by a high water table.

**Table 1: Mean water table depth (M.W.T) and chemical analysis of such water in the main studied regions**

Location	M.W.T (cm)	EC dS/m	Na <sup>+</sup> Meq/L	Ca <sup>++</sup> + Mg <sup>++</sup>	HCO <sub>3</sub> Meq/L	Mn (mg/L)	Fe (mg/L)	Pb (mg/L)
Dakalt	(89) 65-127	(2.6) 1.2-9.8	1.7-58	4.7-36	3.2-29	0.11-4.8	0.1-1.6	0.2-1.8
Kom Elwahal	(65) 33-83	(4.0) 1-8.8	6.9-57	2.5-27	2.6-30	0.1 – 4	0.17-2.5	0.1-2.2
El Ragama	(63) 42-123	(4.8) 1.6-13	10-72	5.1-47	7.5-30	0.1-2.9	0.26-1.3	0.1-2
Abo Moustafa	(67) 47-93	(7.0) 1.4-22	11-138	6.5-83	6-49	0.29-6.4	0.27-2	0.1-3.7
El Daba	(93) 44-144	(3.5) 1.3-8	8-48	5.9-31	4-28	0.1-3.9	0.1-1.3	0.1-3.1
GarbMansour	(96) 84-105	(6.7) 3-12	17-79	11.5-47	11-30	0.5-2.4	0.3-1.3	0.6-4.6
Aruamon	(79) 62-101	(2.6) 1-8.6	6.2-50	4.2-50	4.9-23	0.1-4.9	0.1-3.4	0.2-3.5
El Manifa	(82) 56-137	(1.7) 1.3-3.6	8-23	4.2-13	5.7-15	0.1-3.9	0.1-6.1	0.2-3.6
Ibto	(82) 40-150	(4.3) 1.3-16	8-93	5-38	5.6-30	0.21-3.5	0.25-2.2	0.1-2.7
El Taufa	(73) 45-144	(2.3) 1.3-3.7	7-22	4.8-13	5.3-13	0.1-2.8	0.13-2.9	0.2-3.4
Nosra	(86) 76-99	(1.9) 1.5-2.7	9-17	5.2-9	6.5-9	0.43-2.4	0.15-1.1	0.1-1.4
Sakha	(87) 80-96	(2.7) 1.9-4.2	11-24	6.8-14	6.7-16	0.5-0.9	0.2-1.1	3-3.8

<sup>9</sup> Figures 1-4 are only available in the print copy (Beihefte zu Der Tropenlandwirt Nr. 71)

The daily fluctuations of water table depth for some chosen sites are illustrated in figures (2) and (3). The depth of water table reached the deepest level of 90-150 cm before irrigation, it came close to soil surface upon irrigation and decreased gradually in between irrigations. Such trend was observed in all studied locations. The highest and lowest water table depth and drawdown rate of water table level varied according to cultivated crop, soil, irrigation and drainage conditions.

The 227 studied sites were regional divided into twelve main regions. Mean water table and chemical analysis of ground water in the main studied regions presented in Table (1) showed that water table depth and quality varied between these regions according to soil and drainage conditions as well as quality of irrigation water. High water levels of 63-67 cm with high salt content (mean EC value of 4-7 dS/m) were recorded in some regions such as Kom-Elwahal, El Ragama and Abo-Moustafa due to excessive use of bad irrigation water and not conserved drainage system. The studied locations in Garb-Mansour had newly reclaimed soil irrigated with mixed irrigation, but they had an adequate tile drainage system. The other studied regions had old alluvial soils irrigated with Nile water, and had mean water table level varied between 73-89cm with not bad quality (mean EC values of 1.7-4.3 dS/m). Groundwater analysis showed also that Na is the dominant cation. The Na exceeds the sum of Ca+Mg in all the studied locations. Groundwater is free of residual sodium carbonate (RSC) in some locations and contains different levels of RSC in other ones.

Negative significant relation between mean water table depth and EC values of such water was found ( $r = 0.320$ , and  $R\text{-squared} = 0.102$ ) as illustrated in Fig. (4). Table (2) showed the data of regression analyses among mean water table level and chemical analysis of such water. The quality parameters of ground water were negatively correlated with the depth of such water. The correlation was found to be significant or high significant except for Pb. The correlation coefficients were 0.320, 0.296, 0.323, 0.359, 0.244, and 0.069 for EC, Na, Ca+Mg,  $\text{HCO}_3$ , Mn, Fe, and Pb respectively. The obtained low R-squared values mean that variations of groundwater quality can not be considered due to the depth of such water only. But it affected by many other factors such as soil, land use, irrigation and drainage conditions. In this concern, Oosterbaan (1988) concluded that if the water table becomes shallow the salt leaching can no longer occur and the salts accumulate in the soil and consequently in the ground water.

**Table (2): Correlation of mean water table depth with quality parameters of such water.**

Quality Parameter	Range	Average	Standard deviation	Correlation Coefficient	R-squared
EC	1.1-12.7	3.7	2.6	-0.320**	0.102
Na	6.7-77.8	23	15.6	-0.296**	0.088
Ca+Mg	3.9-47	13.2	9.2	-0.323**	0.104
$\text{HCO}_3$	3.2-33	12.2	6.7	-0.359**	0.129
Mn	0.01-4.7	1.3	0.96	-0.378**	0.143
Fe	0.01-2.5	0.79	0.46	-0.244*	0.059
Pb	0.01-4.6	1.07	0.89	-0.069 n.s.	0.005

\*\* Significant at 1% level, \* significant at 5%, n.s Non-significant.

Recent research has indicated that most crops have higher salt tolerance values than previously thought (Rhoades et al. 1989) which means that many drainage and ground waters are suitable for supplemental irrigation purposes. Water supply from

groundwater can be evaluated as potential sources of irrigation water. Many researchers (Kruse et al. 1985; Ayars and Schoneman 1986; Ayars 1996) have shown that field crops will extract significant quantities of water from the shallow groundwater. Preliminary data of the present study revealed that groundwater quality in many of the studied regions is not bad. Results of this study strongly support the argument that groundwater may contribute on water requirements of field crops. This will be discussed in detail in a following study.

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