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P-dynamics in slash and mulch system in south-east Sulawesi, Indonesia : Impact of different age of fallow vegetation

Luki Abdullah[1], Ronald F. Kühne[1] and Paul L.G. Vlek[2]

[1]University of Göttingen, Institute of Agronomy and Animal Production in the Tropics, Department of Agronomy in the Tropics, Grisebachstraße 6, D-37077 Göttingen, e-mail: labdull@gwdg.de
[2]Centre for Development Research (ZEF), Walter-Flex-Straße 3, D-53113 Bonn, Germany

Abstract

Different age of fallow regrowth, species composition, total biomass production as well as P concentration of secondary vegetation are suspected to be key factors affecting soil-P availability in the slash and mulch systems of south-east Sulawesi.

To test this hypothesis an on-farm field experiment in south-east Sulawesi, Indonesia involving secondary vegetation residue originated from three and seven years old fallow was conducted. Our objectives were to assess the effects of differential age of fallow regrowth and amount of mulch application on the soil microbial biomass P, soil P mineralization dynamics and P uptake by maize as a test crop.

The experiment was carried out on a three years fallow which had been cleared from vegetation (roots were retained) at the end of the dry season. The fallow-vegetation was slashed, chopped (3-5 cm) and broadcasted as mulch. Within fallow vegetation as main plots, three levels of mulch consisting of: control (no mulch = M_0), mulch application equal to the fallow biomass production per ha (M_1) and $M_2 = 2M_1$ were set up as split-plots. M_1 and M_2 for 3 years fallow were 8.8 and 16.2 kg plot^{-1}, respectively, while M_1 and M_2 for 7 years fallow were 37 and 74 kg plot^{-1}. Each treatment was replicated three times. Mulching was carried out a week before seeding of maize. Maize Hybrid CP1 was grown on 2 m x 2 m plots (50 plant plot^{-1}) without soil tillage. The soil was fertilized at rates of 150 kg N ha^{-1} and 60 kg K ha^{-1}, but no mineral P was applied. To recognize the effect of the presence of maize roots on soil parameters, plots without maize were included. Surface soil (0-10 cm) was sampled at 0, 2.5, 5 and 10 weeks after planting with a soil auger. Maize above-ground biomass was harvested at 10 weeks after seeding and analyzed for dry matter and P content with standard methods.

The results showed that mulch application increased significantly (P<0.05) the shoot dry weight (SDW) of maize over control by 59% (M_1) and 127% (M_2) for three years fallow vegetation (F3) and 24% (M_1) and 101% (M_2) for seven years fallow vegetation (F7). The younger fallow (F3) resulted in a higher level of SDW than amendment from F7. Total P-uptake increased over control by about 230% (M_1) and 570% (M_2) for F3, and 52% (M_1) and 260% (M_2) for F7. The application of younger material (F3), from F3 doubled P-uptake of maize as compared to the older one (F7). Application of 3-years-old fallow vegetation increased Bray P of unplanted plots over control particularly after 5 weeks and resulted in a higher Bray P than that of older fallow. However, the 7-years-old fallow vegetation did not increase significantly (p>0.05) Bray P concentration in the soil. Microbial biomass P (P_{mic}) was increased by mulch application. Furthermore, P_{mic} was higher in unplanted plots than in planted plots. P_{mic} of plots amended with F3 was higher than those of plots amended with F7.

The 3 years fallow vegetation resulted in the highest soil P availability, biomass production and P uptake by maize. This was because high leaf fraction, which is high in decomposability and P concentration.

Key words : microbial biomass P, available P, P uptake, fallow age