

Phosphorus utilization in mixed cropping systems with legumes

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The application of mixed cropping systems can contribute to an efficient, complementary utilization of growing factors. This in turn leads to increased efficiency of water and nutrient use and to more stable yields. Mixed cropping systems with legumes are of special interest due to the potential of additional nitrogen fixation in the soil.

The research project at Rostock University has been investigating the performance of different sole and mixed cropping systems under controlled and semi-controlled conditions as well as in a field experiment. The latter was established in 1998 to investigate the effects of different phosphorus (P) fertilizer strategies. Since 2012, the following crops have been cultivated: maize (*Zea mays*) and sorghum (*Sorghum bicolor*) alone, as well as combinations of monocots and legumes in which maize or sorghum were combined with runner bean (*Phaseolus coccineus*), blue lupin (*Lupinus angustifolius*), Andean lupin (*Lupinus mutabilis*), broad bean (*Vicia faba*) or soybean (*Glycine max*).

Differences in yields between sole and mixed cropping were found depending on the level of P supply. Under optimal P supply, the single cultivated maize and sorghum showed the highest biomass yields. However, under P deficiency, the respective combinations with legumes resulted in comparable or even higher yields. In addition, the mixed cropping systems exhibited higher yield stability and were less affected by differences in fertilizer or water supply. Enzyme activity in the soil also differed between sole and mixed cropping systems: higher activities of enzymes such as acid phosphatase were usually found in mixed cropping treatments. Bio-available P concentrations were also higher in soils of mixed crops.

The results of the present study indicate an increased mobilization of less available P sources in cropping systems combining different crop species. Monocots appear to profit directly from legumes. Furthermore, the combination of crops with legumes reduces the demand for nitrogen fertilizer.