ABSTRACT

Crop species differ in their P efficiency, i. e. their ability to grow well in low P supplying soils. To test this hypothesis, field experiments were carried out in a low P soil to study P efficiency of wheat (Triticum aestium L.), maize (Zea mays L.) and groundnut (Arachis hypogaea L.) during the whole growing season and the possible reasons of variation in P efficiency of these crop species. Treatments replicated four times consisted of P-0 (no P), P-50 (50 mg P kg^{-1} soil) and P-400 (400 mg P kg^{-1} soil). Four harvests were made to cover whole growing season of all the crop species. At each harvest, different soil and plant parameters were determined. Plot size varied from 10 m^2 for the first three harvests and 16 m^2 for the last harvest (at maturity). Taking the relative yield as measure of P efficiency (expressed by the yield at P-0 relative to the yield at P-400), maize was most efficient, yielding more than 80%, followed by groundnut, 75%, and wheat, 65% of their maximum yields. Total P uptake of maize was twice to those of wheat and groundnut. The variation in uptake efficiency was not related to size of root systems but mainly to the P influx. At P-0, although the root system of groundnut was only 50% of that of wheat, P uptake was the same; and maize had the same root length as wheat but P uptake was twice. The efficiency changed during the growing season. Wheat was of intermediate P efficiency during the whole growing season while maize was inefficient in early growth stages and very efficient later. In contrast, groundnut was very efficient at the beginning and less efficient later. The efficiency of wheat was mainly based on its root system whereas maize and groundnut relied on a large P influx. In this experiment, P influx was the major factor determining differences in P efficiency among the species as well as for the same species during the growing season under field conditions. In order to separate the influence of root and soil properties, model

calculation of P influx were carried out by employing the nutrient uptake model. The measured influx was much higher than the calculated influx at low P level. At higher P levels, the calculated influx became much closer to the measured values. Sensitivity analysis shows that at low P level the C_{Ll} (initial soil solutions P concentration) was the most sensitive parameter for all the three crops. Among the physiological parameters I_{max} and K_m was found to play negligible role in P uptake at low P level. But at higher P level (P-400) I_{max} was the most sensitive parameters followed by r_0 for P uptake of three crop species. The higher measured than calculated influx indicated that plant possesses mechanisms that enhance P transport to the root from soil. Possible reason for this enhanced transport may be through root exudates that increase P solubility in the rhizosphere or mycorrhyzae symbiosis.

Key words: *Influx, groundnut, maize, wheat, P uptake, P efficiency, root morphology*