NITROGEN FIXATION BY GROUNDNUT (*ARACHIS HYPOGAEA*) IN INTERCROPPED AND ROTATIONAL SYSTEMS

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Summary

This paper examines the nodulation and nitrogen fixation of groundnut when grown in pure culture or in association with pearl millet, maize or sorghum. In all cases, association of groundnut with a cereal resulted in reduced nodulation and nitrogen fixation. This was ascribed to shading of the groundnut, leading to reduced photosynthesis. When grain millet was planted in rotation with groundnut or maize supplied 20 kg N/ha, yield following groundnut were 524 kg/ha greater than obtained in the millet/maize rotation.

INTRODUCTION

Legumes play a key role in many rotational and intercropping systems. In rotations part of the nitrogen (N_2) fixed by the legume can become available to subsequent crops; in intercropping systems, especially under small farm conditions, the ability of the legume to grow without N fertilization permits better allocation of limited resources, and lowers risk of total crop failure.

Surprisingly, there are few studies of the effects of intercropping on nodulation and N_2 fixation in legumes. Interplant competition has been shown to influence nodule function in *Phaseolus vulgaris* (Graham & Rosas, 1978a), *Trifolium subterraneum* (Phillips & Bennett, 1978) and *Vicia faba* (Sprent & Bradford, 1977). Interspecies competion between maize and beans did not affect the nodulation and N_2 fixation of a climbing cultivar of *Phaseolus vulgaris* (Graham & Rosas, 1978b), while in a soybean/sorghum intercrop, N_2 fixation by the soybean was markedly affected by association with tall, but not with dwarf, sorghum varieties (Wahua & Miller, 1978).

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Groundnut (*Arachis hypogaea* L.) is grown in semiarid tropical regions, both as an intercrop and in rotations. In this paper we examine some effects of cropping pattern on N_2 fixation in groundnut and subsequent crop yield.

MATERIALS AND METHODS

In the three intercropping experiments reported here, we compare the nodulation and N_2 fixation of groundnut when grown in monoculture, and:

When associated with maize at four different levels of applied N;
When associated with sorghum partially defoliated to simulate different degrees of competition for light; and
When associated with pearl millet.

In each case, the cereal and groundnut were grown in separate rows, with optimum sole crop plant-to-plant spacings, using ratios of 1 row millet:3 rows groundnut; 1 row sorghum:2 rows groundnut; and 1 row maize:2 rows groundnut. Both crops were sown at the same time, and received recommended fertilization, save for N. The sorghum/groundnut experiments were conducted during the post-rainy season; the others during the rainy season.

In the experiment with maize, 0, 50, 100, 150 kg N/ha was applied to the maize at planting, while in the experiment with sorghum, a range of groundnut cultivars were tested and in half the treatments alternate leaves of the sorghum were defoliated to enhance light penetration. In all experiments nodulation and N_2 fixation were measured throughout the growing season.

Two experiments to determine the benefit from groundnut to subsequent crops were also carried out. The first compared the yield of grain millet grown after groundnut, unfertilized maize, or maize supplied 20 kg N/ha; the second, also with grain millet, compared yield after groundnut, millet, or fallow.

RESULTS AND DISCUSSION

In all three crop combinations studied, intercropping reduced nodulation and N_2 fixation by the groundnut. With millet this inhibition occurred both with and without applied fertilizer N (see Figures 1 & 2). In the maize experiment N fertilization of the maize further reduced nodulation and N_2 fixation by the groundnut (see Table 1). However, nodule formation was less affected than nodule weight or nitrogenase activity, presumably because most nodules were formed before the cereal provided any substantial competition for light. The reduction in nitrogenase activity was most closely related to the reduction in nodule weight, with an 80% reduction in activity at the highest N fertilizer level (150 kg N/ha). Final yield per plant was also decreased at the high N levels. Our results suggest that N fertilizer effects are