Yield and Nitrogen Fixation of Cowpea as Affected by Tillage and Cropping Systems in the Northern Savanna Zone of Ghana

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Abstract

Published information on the response of crops in mixed cropping systems to tillage systems in the northern savanna zone of Ghana is scanty. A field experiment to assess the yield and nitrogen (N) fixation of cowpea (*Vigna unguiculata* (L.) Walp) intercropped with maize (*Zea mays* L.) on four tillage practices was conducted in 2000 and 2001 at Nyankpala (9° 25' N, 1° 0' W at 183 m above sea level). The experiment was laid in a split-plot design with four replications. The major factor was tillage systems made up of conventional (Con), bullock plough (BP), hand hoe (HH) and zero tillage (ZT). The sub-factors were cropping systems (CRPSYT) comprising of sole maize, sole cowpea, maize/cowpea inter-row cropping system and bare fallow in 2000, which was replaced by maize/cowpea intra-row cropping system in 2001. The results revealed that Con and BP, which had tillage depth of more than 10 cm, led to a significant ($P < 0.05$) reduction of soil bulk density. The leaf area index (LAI), plant shoot height, dry matter and the subsequent grain yields of maize and cowpea were also higher on Con and BP than HH and ZT practices. Phosphorus (P) and potassium (K) contents of both crops, nodule number, nodule weight and N_2 fixation of cowpea were not affected by tillage systems but N contents in maize on Con and BP practices were similar but were 29% higher than on HH and ZT which were also not different. Cropping systems had no effects on LAI, nodule weight, nodule number and the subsequent N fixed by cowpea. The semi-erect cowpea (*Sul-518-2*) in the mixed cropping systems became viny and climbed the maize associated with it due to shading. This led to a reduction in the dry matter content of maize by 26%. Maize/cowpea intercropping is more productive than the sole (LER > 1) but no significant difference in yields was obtained between the inter- and the intra-row cropping systems.

Introduction

Nitrogen and phosphorus deficiencies in the savanna soils of northern Ghana have been widely reported (FAO, 1967; Acquaye, 1973, Tiessen, 1988). Some of the causes of this situation include the fact that most soils in Ghana are developed on well-weathered parent materials that have been leached over a long period of time (Halm and Asiamah, 1992). The annual burning of crop residues or their removal for various uses such as for fuel, animal feed and for building purposes also prevents the build up of organic matter in this ecological zone. The soil is exposed to long dry season where erosion by wind and also by water in wet season occur which further reduces the available soil nutrients. Also, the long bush fallow periods of about 15 years, which were previously used by peasant farmers to replenish soil fertility have been reduced to about 3 years in some parts of the Northern Region of Ghana due to population pressure on the land.

The use of inorganic fertilizers for soil fertility maintenance is also becoming