The Influence of Manurial Sources and Levels on Nitrogen Fixation in *Vigna unguiculata* cv. Ife Brown

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Abstract

The influence of three manurial sources viZ: poultry, cowdung and household manure at 0, 2, 5 and 10 percent levels of addition (dry weight basis) on nitrogen fixation using a local cowpea variety, *Vigna unguiculata* cv. Ife brown was evaluated in a greenhouse study using the total nitrogen difference method. While poultry manure at all levels gave the highest total dry matter accumulation presumably as a result of its high nutrient content, cowdung at 10 percent gave the highest nodule dry mass as well as the highest nitrogen fixed (2.20, 1.90 and 0.60 percent for cowdung, household and poultry manure respectively). The beneficial effect of cowdung in promoting effective nodulation is probably due to its moderate nitrogen content which serves as a source of starter nitrogen for the nitrogen fixing organisms.

Introduction

Food production in Nigeria is by peasant farmers who make little or no use of inorganic fertilizers. The system depends mainly on the native organic matter contents of the soils, usually plant residues. However, recent interest of elite farmers in poultry and other livestock production has created the problem of disposal of the waste products from these sources. The soil being the universal recipient of all wastes becomes the home of the wastes. The beneficial effects of these wastes on both the physical and biochemical properties of the soil with the resultant increase in yield are clearly well established. However, the use of organic matter in legume production has not been well documented in soils in general and Nigerian soils in particular.

Masefield (1965) demonstrated that the application of farm yard manure and sawdust increased significantly the mean nodule weight and nodule number in P. sativum, P. vulgaris and V. faba. Earlier workers in Australia and Congo (Anderson and Spencer, 1948.) had observed heavy nodulation in patches of soil which were rich in charcoal from burnt vegetation. de Freitas et al (1984) using 15N labelled organic matter showed that in the presence of the organic matter, nodulated soybeans showed the highest nitrogen fixation when compared to non-nodulated isolines and sugar-cane.

In this study, it was hypothesized that nitrogen fixation could benefit from small applications of organic matter to serve as a source of starter nitrogen.

Materials and Methods

Three manurial sources viZ: cowdung, poultry manure and household wastes (garbage collected from different households at the University and dumped in a dunghill to undergo natural process of decomposition) at 0, 2, 5 and 10 percent levels (dry weight basis) were each added separately in triplicates to 5 kg air-dried, 2mm sieved, unfertilized, 0-15cm surface Alfisol soils that had carried cowpea the previous season. It was necessary to sieve the household wastes through 1cm sieve to remove broken bottles undecomposed plastics and other extraneous materials. Before the organic matter was added to the soil, some properties of the soil such as pH, organic matter particle size, CEC total N, available P and exchangeable K were determined by standard methods. Thereafter, the organic sources and levels were separately and thoroughly mixed with 5kg of the air-dried soils after which the mixed soils were placed in 10 litre plastic buckets which had been bored with two drainage holes at the bottom and the holes plugged with cotton wool. After a month of pre-incubation (Olayinka and Adebayo, 1985), two seeds of Ife brown cowpea were planted per pot. These were later thinned to one each after germination. Apart from zero addition of organic matter, maize (Zea mays Farz 7) was used as the non-nodulating control.

Watering was done with distilled, deionized water. At 40 days after planting when about 80% of the plants had flowered, the plants were carefully harvested, the roots rinsed in running water and the nodules on the individual plants were counted.

The plants in labelled paper bags were dried in the oven at 65°C

until dry Total dry matter root mass, nodule count and nodule dry mass were determined. Total nitrogen in the plants and soils was determined by Technicon auto analyser.

Results and Discussion

Although the dry matter accumulation was highest at all levels of amendment with poultry manure presumably as a result of its comparatively high nutrient content, other parameters of nitrogen fixation did not follow this trend. The dry matter accumulation was highest with 10% poultry manure addition (15.55g) and lowest at all levels of addition with household waste (Table 1). Following the trend observed with the dry matter accumulation root mass was also highest with 10% level of poultry manure addition as one would expect for reasons suggested above (Table 2). An analysis of the different sources of manure indicated that the poultry manure contained the highest total N, P_2O_5 and K_2O followed by the cowdung and the nutrients were least in household waste.

The nodule total count was significantly higher at all levels of amendment with cowdung when compared with either poultry manure or household waste (Table 3). The nodules were formed mainly on the main tap root in the cowdung treated soils whereas in the poultry manure and household treated soils the nodules were scattered throughout the whole rooting surface.

Except at 2% level of addition, there was no significant difference between total nodule count in poultry manure and household waste.

The dry mass of nodules followed the same trend as the nodule number with cowdung giving significantly higher nodule mass compared with poultry manure or household waste treated soils (Table 4).

The nodule dry mass increased as the level of amendment increased with cowdung and was significantly greater ($P = 5\%$) at all levels of addition when compared with either poultry manure or household treated soils. The decrease in nodule size in poultry manure treated soils could be as a result of the high levels of combined nitrogen which was easily mineralized thereby increasing the nitrogen pool of the soil solution. In the household waste treated soils, the nodule mass was not appreciable.

In terms of nodule functioning the highest nitrogen fixation (net nitrogen) occurred with the addition of 10% cowdung while poultry manure gave the least amount of nitrogen fixed (Fig 1). Although the addition of poultry manure to soil would support the vigorous growth of leguminous plants like any other, because the organic nitrogen is readily mineralized in the poultry manure, a substantial amount of mineral nitrogen is brought into the soil solution pool which could cause the suppression of effective nodulation.

On the other hand, it seems probable that the amount of mineral nitrogen brought into the soil solution is not enough to prevent nodulation and nodule functioning even at the high rate of 10%. Although it has not been feasible to do N partitioning with 15N, this preliminary observation indicates that nitrogen fixation in cowpea could benefit from organic matter addition especially in tropical soils which are generally low in organic matter and cation exchange capacity. Such a beneficial effect would depend on the amount of nitrogen in the organic matter which in turn depends on

the source level of addition and rate of mineralization of the organic nitrogen

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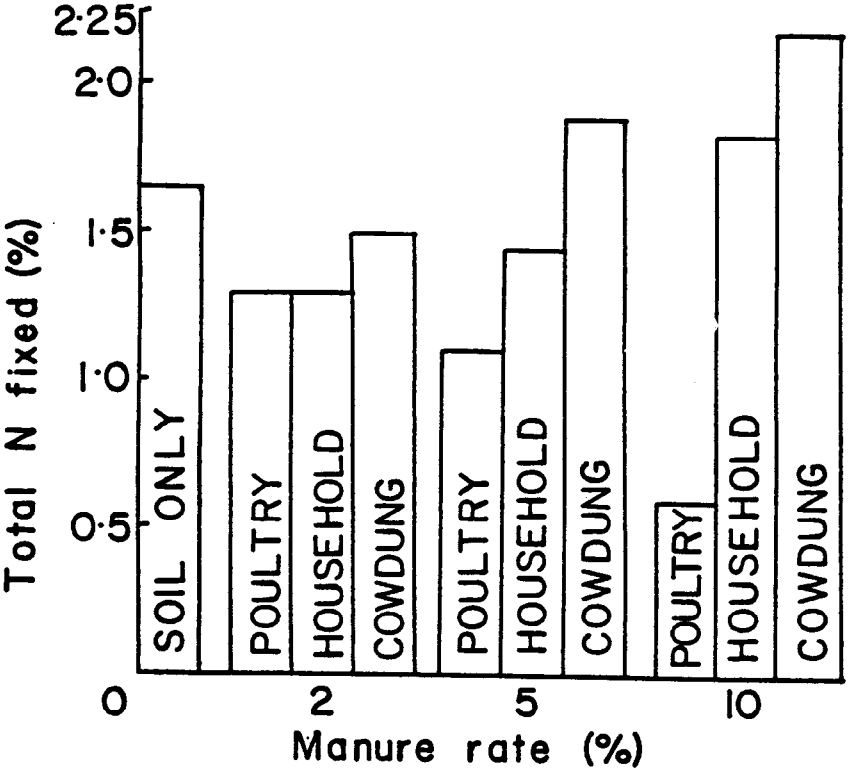
Literature Cited

1. Anderson, A. J. and D. Spencer 1948. J. Austr. Inst. Agric. Sci. 14: 39.

2. de Freitas, J. R., R. L. Victoria., A. P. Ruschel and P. B. Vose 1984. Plant and Soil 82: 257 - 261.

3. Masefield G. B. 1965. Expl. Agric. 1: 113 - 119.

4 Olayinka, A and A. Adebayo. 1985. Plant and Soil 86: 47 - 56.



Effect of different sources and varying levels of organic amendment on total Nitrogen fixed.

Table 1. The effect of different sources and varying rates of organic manure on Dry matter yield

Manure Source	Rate (%)			
	0	2	5	10
Cowdung	9.00(g)	10.50(g)	14.30(g)	13.80(g)
Poultry	9.00(g)	13.00(g)	15.15(g)	15.55(g)
Household	9.00(g)	9.60(g)	9.20(g)	10.50(g)

Table 2. The effect of different sources and varying rates of organic manure on Root mass

Manure Source	Rate (%)			
	0	2	5	10
Cowdung	0.10(g)	0.90(g)	1.02(g)	1.53(g)
Poultry	0.10(g)	1.40(g)	1.35(g)	1.65(g)
Household	0.10(g)	0.85(g)	1.00(g)	0.80(g)

Table 3. Effect of different sources and varying levels of manure on nodule count.

Manure source	Level of manure addition (%)			
	0	2	5	10
Cowdung	35[a]	84[a]	72[a]	74[a]
Poultry	33[a]	41[c]	50[b]	30[b]
Household	35[a]	68[b]	52[b]	34[b]

Table 4. Effect of different sources and varying levels of organic amendment on nodule mass (g)

Source	Manure rate (%)			
	0	2	5	10
Cowdung	0.10[a]	0.50[a]	0.56[a]	0.64[a]
Poultry	0.10[a]	0.15[b]	0.30[b]	0.20[b]
Household	0.10[a]	0.25[c]	0.15[c]	0.15[b]