Journal of
Plant Sciences

ISSN 1816-4951

Academic
Journals Inc.

www.academicjournals.com

Journal of Plant Sciences 2 (4): 475-479, 2007
ISSN 1816-4951

Evaluation of Organic Manures and Plant Densities on Podrot, Nodulation and Seed Weight of Groundnut in an Ultisols

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Abstract: Two field experiments were carried out during the early seasons of 2000 and 2001, to examine the effect of organic manure applied as zero manure, green manure and fowl droppings respectively and plant densities of 1,000,000; 250,000; 111,111 and 62,500 plants ha^{-1}, respectively in 2000 and 2001, respectively on pod rot, nodulation and 1000-seed weight of groundnut. The result showed that manure and plant density were highly significant ($p<0.01$) on pod rot, nodulation and 1000-seed weight in 2000 and 2001, respectively. Organic manure significantly reduced pod rot 4.31 and 4.47 in 2000 and 2001, respectively. Fowl dropping reduced severity of pod rot 3.10; 3.02 in comparison with green manure 4.72; 4.86 when zero manure (no-treatment) 5.10; 5.54 in 2000 and 2001, respectively were high. Two hundred and fifty thousand plants ha^{-1} recorded least severity of pod rot 3.00; 2.77 while 1,000,000 plants ha^{-1} 4.95; 4.50 were high in 2000 and 2001, respectively. Organic manure were highly significant on nodulation 9.60; 9.48 in 2000 and 2001, respectively with fowl dropping 15.10; 14.75 recording highest, when zero-manure (control) 10.84; 11.16 nodulation per plant were low in 2000 and 2001, respectively. Organic manure and plant density were highly significant ($p<0.01$) on 1000-seed weight with organic manure 641.1; 642.9 and plant density 812.2; 799.2 in 2000 and 2001, respectively. Fowl dropping recorded highest 1000-seed weight 672.5; 680.0 as well as 250,000 plants ha^{-1} 895.5; 863.4 while 1,000,000 plants ha^{-1} recorded the lowest 1000-seed weight 752.0; 785.0 in 2000 and 2001, respectively.

Key words: Evaluation, organic manures, plant-population, podrot, nodulation, seedwieght, ground nut

INTRODUCTION

Groundnut or peanut (*Arachis hypogeae* L., Family Leguminoseae) is a short-lived annual crop. It is cultivated particularly for its edible oil and protein-rich seeds borne in fruits (pods) which develop below the soil surface. It is used as food and feed for the tropics (Obasi and Ezedinma, 1991). It is mostly cultivated in temperate environments Allen (1983) with little cultivation here in the forest south. The little cultivated in this part of the country are often of very low yield as a result of insect attack which often result to total crop failure in extreme cases. They predispose the pods to dis-integration of it's tissues, hence pod rot, or act as vectors of fungal and other plant pathogens.

In Nigeria and other parts of Africa, organic waste materials are used for soil fertility improvement. They supply water, essential nutrients, buffering capacity, good growth and development of crops. Most cultivars are tolerant to a wide range of soil conditions, and grow well in most fertile soils that are well supplied with organic materials and essential nutrients Tindall (1983). Most annual crops respond well to organic manure application unlike equivalent amount of NPK fertilizer (Maynard, 1983). The superiority (richness and concentration) of poultry manure over other manures has been confirmed in many experiments. Follelt *et al.* (1981) and it is highly valuable to many

agronomic plants (Cooke, 1980). Groundnut form a symbiotic relationship with a specific soil bacterium, *Rhizobium spp* and simple compounds in groundnut root exudates may attract these bacteria and aid in their rhizosphere accumulation (Hunter and Fabring, 1980).

Estimates of about 240 kg ha^{-1} N fixed by groundnut have been reported, giving 80% of total plant's uptake of nitrogen Dart and Krantz (1977). Chemical control is very expensive and requires a lot of expertise, coupled with its hazardous effects on non-target plants and animals, as well as the environment. More so, use of low input technology affordable by our resource poor farmers, to reduce severity of diseases such as pod rot and improve yield are needed in our agricultural sector.

Hence the objective of the research is to determine the effect of organic manure and plant density on the severity of pod rot, nodulation and seed weight.

MATERIALS AND METHODS

Two seasons experiments were conducted in the school of Agriculture and Agricultural Technology, teaching and farm research of Federal University of Technology (FUTO) in 2000 and 2001, respectively, using an erect (early-maturing cultivar) of groundnut (*Arachis hypogeae* L). Forty-eight plots were marked out and prepared based on four (4) planting densities (10×10) cm; (20×20) cm, (30×30) cm and (40×40) cm giving 1,000,000; 250,000; 111,111 and 62,500 plants ha^{-1}, respectively, on (3) types of organic manures; zero manure (control); fowl droppings and green manure respectively and the experiments were replicated (4) times in a randomized complete block design. Soil samples were collected randomly at 0-15 and 15-30 cm, respectively to determine the nutrient status of the soil.

Data were collected on the pod rot, nodulation and 1000-seed weight.

Pod Rot

Pod rot were obtained by counting the number of rotten pods at harvest and expressed as percentage of the total pods formed. This was recorded per sampled plants from the replicated plots per treatment levels in 2000 and 2001, respectively.

Nodulation

Nodules numbers were obtained per sampled plants from the replicated plots per treatment level.

While 1000-seed weight was obtained by counting one thousand (1000) seeds from the pods of sampled plants, which was then weighed on a precision weighing balance.

Soil samples were collected randomly at 0-15 and 15-30 cm, respectively and analyzed in the laboratory to determine the nutrient status of the research plots. The data were subjected to statistical analysis as described by Steels and Torrie (1981).

RESULTS

Result obtained from the two seasons investigated showed that organic manure and plant density are highly significant ($p<0.01$) on pod rot nodulation and 1000-seed weight of groundnut. Organic manure influenced pod rot 4.31; 4.47 while plant density recorded 4.06; 3.77 rotten pods in 2000 and 2001, respectively (Table 1). Fowl dropping recorded lowest 3.10; 3.02 rotten pods followed by green manure 4.72; 4.86 when zero-manure (control) 5.10; 5.54 were high in 2000 and 2001, respectively. 250,000 plants ha^{-1} recorded lowest severity of pod rot 3.00; 2.77 followed by 111,111 plants ha^{-1} 4.06; 3.80, then 62,500 plants ha^{-1} 4.22; 4.00 when 1,000,000 plants ha^{-1} 4.95; 4.50 rotten pods were highest in 2000 and 2001, respectively.

Table 1: Effects of organic manure and plant density on pod rot in 2000 and 2001

Treatments	2000	2001
Organic manure	4.210	4.470
Zero manure	5.100	5.540
Green manure	4.720	4.860
Fowl droppings	3.100	3.020
$LSD_{0.01}$	0.525	0.588
Plant density	4.060	3.770
1000,000	4.950	4.500
250,000	3.000	2.770
111,111	4.060	3.800
62,500	4.220	4.000
$LSD_{0.01}$	0.596	0.615

Table 2: Effects of organic manure and plant density on Nodulation of Groundnut

Treatments	2000	2001
Organic manure	9.600	9.480
Zero manure	10.840	11.160
Green manure	12.440	12.020
Fowl droppings	15.100	14.750
$LSD_{0.01}$	0.275	0.233
Plant density	12.830	12.800
1000,000	11.080	11.650
250,000	14.900	14.460
111,111	12.820	12.780
62,500	12.500	12.320
$LSD_{0.01}$	2.862	2.940

Table 3: Effects of organic manure and plant density on 1000 seed weight

Treatments	2000	2001
Organic manure	641.10	642.90
Zero manure	615.20	608.50
Green manure	635.50	640.10
Fowl droppings	672.50	680.00
$LSD_{0.01}$	14.65	15.22
Plant density	812.20	799.20
1000,000	752.00	785.00
250,000	895.50	863.40
111,111	791.20	766.00
62,500	810.00	782.30
$LSD_{0.01}$	4.43	4.86

Table 4: Soil characterization of study site in 2000 and 2001

	Soil pH (water)		OM (%)		TN (%)		CEC (me/100 g soil)	
Treatment	2000	2001	2000	2001	2000	2001	2000	2001
O-Manures	4.0	4.0	1.28	1.25	0.069	0.063	3.71	3.60
Green manure	4.3	4.5	1.40	1.43	0.112	0.105	6.55	6.08
Fowl dropping	4.6	4.8	2.04	2.16	0.113	0.196	7.90	7.69

Organic manure significantly influenced nodulation of groundnut 9.60; 9.48 as well as plant density 12.83; 12.80 nodules per plant in 2000 and 2001, respectively. Fowl droppings recorded highest nodulation 15.10; 14.75 in comparison with 111,111 plants ha^{-1} 12.82; 12.78 when 1,000,000 plants ha^{-1} 11.08; 11.65 were lowest in 2000 and 2001, respectively Table 2. Organic manure and plant density significantly influence 1000-seed weight ($p<0.01$). Organic manure recorded 641.1; 642.9 while plant density obtained 812.2; 799.2 in 2000 and 2001, respectively (Table 3). Fowl dropping recorded highest 1000-seed weight 672.5; 680.0 in comparison with green manure 635.5; 640.1 when zero manure (control) 615.2; 608.5 were low in 2000 and 2001, respectively. 250,000 plants ha^{-1} recorded highest 1000-seed weight 895.5; 863.4; 111,111 plants ha^{-1} had 791.1; 799.0; 62,500 plants ha^{-1} recorded 810.0; 782.3 while 1,000,000 plants ha^{-1} recorded lowest 752.0; 785.0; 1000-seed weight in 2000 and 2001, respectively. The result of the soil analysis indicated that the plot is acidic. It also showed variable percentages of soil nutrients (Table 4).

DISCUSSION

The low severity of pod rot but high nodulation and 1000-seed weight recorded by fowl droppings may be attributed to the availability of nutrient elements in the droppings. Thereby ensuring adequate absorption of the required nutrient for biochemical and physiological activities of the plant. Thus, providing a healthy situation for the plants and barrier against disease incidence, penetration and symptom manifestation, as well as disintegration of the pod tissues hence pod rot. Pod rot is hastened by penetration of soil micro-organism, in line with Sbrahmanyan *et al*. (1980) and Gajiri *et al*. (1994). High severity of pod rot and low nodulation and 1000-seed weight recorded by zero-manure (control) may be attributed to insufficient nutrient supplied to crops under this treatment.

This is true since in availability of nutrient make the crop plant to have a weak development due to nutrient deficiency and as such have quick reactions to disease penetration and symptom manifestation. The lowest record of severity of pod rot in all the seasons investigated by plant density 250,000 i.e., (20×20) cm, may be as a result of ideal plant spacing that provides favourable crop competition, thereby withstanding the effect of pathogenic attack. Lower pathogenic attack favour plants of this density, resulting to their high nodulation and 1000-seed weight. This is due the fact that plant densities have large influence on yield in line with Deutsch (1977). The difference in nodulation might be due to intrinsic characteristics as a result of plant densities, nutrient composition brought about by types of organic manure for mode of infection and nodulation, in agreement with Dart (2001). Highest record of pod rot and low yield by plant population 1000,000 plants ha^{-1}, may be attributed to over crowdedness and very high competition for available soil nutrient, thereby creating a nutrient deficiency situation and made the crops prone to disease infestation resulting to low yield. The bushy like nature of this density provide hide out for insect pests, which act as vectors of plant pathogen in line with Ihejirika and Nwufo (2001).

The result of soil analysis showed that the soil is acidic. This may be as a result of soil nutrient loss due to erosion, leaching, burning, removal of plant debris after harvest and deforestation. This can be improved by any form of erosion control; mulching, planting of cover crops, use of organic and inorganic manure (esp. non-acid inducing type). Some Scholars have predicted soil properties under forest conditions and contended that bulk density, total porosity and carbon-nitrogen ratio related closely to organic matter (Schmidt *et al*., 1996; Prevost, 2004).

In conclusion, organic manure and plant density significantly lower the severity of pod rot and improve nodulation and 1000-seed weight of groundnut with fowl dropping performing better than green manure when zero manure (0-fertilizer) was the lowest.

Two hundred fifty thousand plants ha^{-1} recorded lowest severity of pod rot but highest nodulation and 1000-seed weight while 1,000,000 plants ha^{-1} recorded highest pod rot but lowest nodulation and 1000-seed weight in 2000 and 2001, respectively.

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