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EFFECT OF ORGANIC MANURE SOURCE AND TIME OF APPLICATION ON THE FIELD PERFORMANCE AND NUTRIENT N UPTAKE OF GINGER IN THE GUINEA SAVANNA

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ABSTRACT

The influence of organic manure from different sources applied at different time intervals before planting on the rhizome yield and nutrient N uptake of ginger was evaluated in 2009 and 2010 cropping seasons at the National Root crops Research Institute, Umudike. Treatments consisted of organic manure from three sources (Poultry manure, Rice mill waste and Cow dung manure) factorially combined with five manure application times (during planting, 1, 2, 3, and 4 weeks before planting) in a Randomized Complete Block Design with 3 replications. Results showed that both organic manure source and time of application significantly ($P \leq 0.05$) affected fresh rhizome yield of ginger in the Guinea Savanna. Highest mean rhizome yields of 8.40 t/ha and 8.30 t/ha were obtained from poultry manure amendment while rice mill waste amendment produced the least yield. Compared with either the control or other manure application time treatments, mean rhizome yields were relatively lower when ginger was planted earlier than 2 weeks after manure amendment. Highest N uptake was observed in poultry manure treatment and when manure was applied 2 weeks before planting of ginger.

INTRODUCTION

Organic manures differ markedly in their effect on soil properties and crop yield due to differences in their chemical characteristics. Land application of organic manures for crop production has increased in recent years due to the high cost of inorganic fertilizers and increase in livestock production (Yadav *et al*., 2000). High quality organic inputs (high % N, low % lignin and polyphenols) are known to behave as fertilizers through fast mineralization of their tissue N while low quality organic resources (low % N, high lignin and polyphenols) have a slow release pattern of their mineralizable N resulting in a net N nutrient immobilization phase (TSBF, 2002). Depending on whether this immobilization phase lasts or not, decreased or enhanced crop yields may be the result. In the case of long-term immobilization, residual effects may be more relevant rather than immediate N supply to the crop.

The release of nutrients from decomposing organic residues can be synchronized with plant growth demand. The main way to promote synchrony is with the management of the timing, placement and quality of organic residues. The fertilizer value of organic materials is increased if nutrient release through their decomposition and mineralization coincides with crop's nutrient requirement curve. While nutrient N released

from organic amendments for crop uptake depends on the quality, the rate of application, the nutrient release pattern and the environmental conditions (Murwira and Kirchmann, 1993), how much of the total N content of an organic manure that is utilized by a crop is influenced by rate and time of manure application (TSBF, 2002). Proper timing of organic manure application has been reported to control the nutrient release and uptake efficiency of crops generally (Woomer *et al*., 1994). Information is however, very sketchy on the effect of time of manure application before planting on the N nutrient release characteristics of most organic resources and how these release characteristics can impact on the N uptake of ginger in tropical agriculture. This study aims at:

(i) Establishing a synchrony between the time course of organic manure N mineralization and uptake as a basis for determining the most suitable time interval for crop planting after organic manure application in order to achieve optimum ginger production in the Guinea Savanna.

(ii) Determining the most suitable organic manure source for optimum ginger field performance in the Guinea Savanna.

MATERIALS AND METHODS

The study was conducted at the research farm of the National Root Crops Research Institute sub-Station located at Maro, Kaduna in Kaduna State.

Treatments were organic manure from three sources (Poultry manure, Rice mill waste and Cow dung Manure) each applied at an agronomic rate and in factorial combination with five manure application times {during planting, one week before planting (WBP), two weeks before planting, three and four weeks before planting}. A plot containing optimum NPK fertilizer recommendation for ginger in the zone but having no organic manure was also included as a control. Poultry and cow dung manures used for the study were procured from the Livestock Unit of Michael Okpara University of Agriculture, Umudike while the rice mill waste was collected from rice milling industry located at Bende Local Government Headquarters, Bende, Abia State.

The treatments were laid out on 2m x 3m bed prepared using tractor and arranged in a Randomized Complete Block Design with three replications. The plots were fertilized during planting with recommended agronomic quantities of NPK 15 :15 : 15 fertilizer after giving consideration to the nutrient N contents of the manure materials. Manure application was by incorporation using spade during land preparation.

The analysis values of the manures used for the study are shown in Table 1 below. The plots were planted up with UG1 ginger variety and were mulched with local shrub called "Doka" 2 days after planting. Data collected on fresh rhizome yield and N uptake were analyzed using analysis of variance (ANOVA). Treatment means with significant effect were separated using LSD (0.05).

RESULTS AND DISCUSSION

Effect of Treatment on Fresh Rhizome Yield

Both organic manure source and time of application significantly ($P \leq 0.05$) affected fresh rhizome yield of ginger in the Guinea Savanna. Among the manure sources evaluated, highest mean rhizome yields of 8.40 t/ha (2009) and 8.30 t/ha (2010) were obtained from poultry manure amendment across all manure application times investigated. These mean yield values were 40 and 26 % higher than those obtained from plots amended with rice mill waste for the two years (Table 2). Poultry manure out-yielded the absolute control by 18 % (2009) and 11 % (2010).

Higher yield responses observed in plots amended with poultry manure relative to rice mill waste and cowdung manure is attributed to higher chemical quality of the manure material, especially total N which was higher in Poultry manure than in the other manure sources (Table 1). Ano and Emehute (2004), reported increased rhizome yield with

complementary application of poultry and inorganic fertilizer. No significant difference was however, observed in the yield response between rice mill waste and cow dung manure treatments in both years. Yield from optimum NPK fertilizer treatment was significantly higher than mean yield values recorded in three manure sources across all application times.

Compared with either the control or other manure application time treatments, mean rhizome yields were relatively lower when ginger was planted earlier than 2 weeks after manure amendment. This result indicated that a minimum of 2 weeks interval must be allowed after manure incorporation into the soil before ginger is planted in order to enable nutrient mineralization for plant uptake to commence. Planting ginger earlier than 2 weeks after soil manure amendment caused nutrient immobilization (especially N which is needed by the crop for physiological functions) and this affected negatively not only the growth and yield of ginger but also, its N uptake response. It therefore, becomes imperative that mineral N is needed to overcome the demand for N by the microbial decomposer community and to supply N to the crop if ginger must be planted earlier than 2 weeks after soil incorporation of manure in agricultural systems. Planting ginger immediately after manure amendment (0 WAP) gave the least mean rhizome yield response across the three manure sources tested for the two years. Similarly, planting ginger 2 weeks after manure addition to the soil gave the highest yield response irrespective of manure source (Table 3).

Table 1: Selected Chemical Properties of the Organic Manures used for the Study

Manure Source	Total N (%)	Total P (%)	Total K (%)
Poultry Manure	1.21	0.81	0.67
Rice Mill Waste	0.86	0.64	0.81
Cow Dung Manure	0.87	1.20	0.66

Table 2: Selected physico-chemical properties of the soil of the study area before commencement of trial.

	N (%)	P (mg/kg)	K (cmol/kg)	Ca	Mg	pH	OM (%)	BD (g/cm^3)	Texture
2009	0.14	11.3	0.11	0.8	0.40	5.5	2.50	1.36	Sandy loam
2010	0.10	12.1	0.10	0.6	0.20	5.3	2.20	1.32	Sandy loam

Table 3. Effect of Organic Manure Source and Time of Application on the Fresh Rhizome Yield Response of Ginger in the Guinea Savanna, Nigeria.

Appl. Time	2009 Fresh Rhizome Yield (t/ha) Manure Source				2010 Fresh Rhizome Yield (t/ha) Manure Source			
	PM	PMW	CDM	Mean	PM	PMW	CDM	Mean
0 WAP	6.4	5.4	5.7	5.8	6.8	4.8	5.7	5.8
1 WBP	7.2	5.6	5.2	6.0	7.3	6.4	6.8	6.8
2 WBP	11.6	8.2	9.0	9.6	10.2	7.9	8.8	9.0
3 WBP	9.4	4.8	8.2	7.5	8.7	6.8	7.4	7.6
4 WBP	7.6	6.1	7.5	7.7	8.4	7.1	5.7	7.1
Abs.Cont	-	-	-	7.1	-	-	-	7.5
Opt. NPK Fert	-	-	-	9.2	-	-	-	10.1
Mean	8.4	6.0	7.1	-	8.3	6.6	6.9	-
	LSD (0.05):				LSD (0.05):			
	Manure = 1.22				Manure = 1.04			
	Time = 1.88				Time = 1.62			
	Manure X Time = NS				Manure X Time = NS			

Effect on N uptake

Generally, manure application (irrespective of source) tended to increase N nutrient uptake efficiency of ginger relative to the control (especially at 4 and 6 months after planting (MAP). Highest N uptake was observed when manure was applied 2 weeks before planting. N uptake was highest in poultry manure and least in rice mill waste at 2 and 6 MAP. Across the 4 manure application times evaluated, N uptake was highest when ginger was planted 2 weeks after manure amendment. Highest N uptake was recorded at 4 MAP. This coincides with the period of tuber initiation in ginger and a lot of nutrient is therefore required to sustain physiological activities of the crop at this time. At 4 MAP, mean N-uptake was relatively higher in all manure-treated plots than the control across the various application times except at 4 WBP.

Table 4. Effect of Organic Manure Source and Time of Application on the N Uptake of Ginger in the Guinea Savanna Zone of Nigeria (Average of 2009 and 2010 croppings).

Appl. Time	2 MAP N Uptake (Kg/ha) Manure Source				4 MAP N Uptake (Kg/ha) Manure Source				6 MAP N Uptake (Kg/ha) Manure Source			
	PM	**RMW**	**CDM**	**Mean**	**PM**	**RMW**	**CDM**	**Mean**	**PM**	**RMW**	**CDM**	**Mean**
0 WAP	2.6	1.2	2.0	2.0	2.6	2.1	2.4	2.4	2.3	1.0	1.2	1.5
1 WAP	2.4	1.9	1.9	2.1	2.9	3.5	2.2	2.9	2.3	2.3	2.9	2.5
2 WAP	3.5	1.5	2.3	2.4	3.7	2.5	3.3	3.2	3.9	2.2	3.3	3.1
3 WAP	2.5	1.4	1.8	1.9	2.2	3.9	2.5	2.9	1.6	2.6	1.9	2.1
4 WAP	1.4	1.5	0.9	1.2	1.8	1.3	0.9	1.3	1.2	1.3	0.7	1.1
Abs. Cont	-	-	-	2.3	-	-	-	2.2	-	-	-	1.9
Opt. NPK	2.5	1.5	1.8	3.2	2.6	2.3	2.3	-	2.3	1.9	2.0	-
Mean LSD(0.05)	Manure = 0.56 Time = 0.87 Manure X Time = NS				Manure = NS Time = 1.02 Manure X Time = NS				Manure = NS Time = 1.32 Manure X Time = NS			

CONCLUSION

Organic manure application 2 weeks before planting gives a better N-uptake and rhizome yield response for ginger in the Guinea Savanna zone of Nigeria. Higher yield result is achieved in the zone using poultry manure than rice mill waste and cow dung manure because of its better nutrient quality.

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