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EFFECTS OF INORGANIC FERTILIZER AND POULTRY MANURE ON SORGHUM YIELD AT SAMARU IN THE NORTHERN GUINEA SAVANNA OF NIGERIA.

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ABSTRACT

The study investigated the effects of urea fertilizer and poultry manure singly and in various combinations on growth, yield and yield components of Sorghum (ICSV III). The trial was laid out in a Randomized Complete Block Design with three replicates. The results show that the productivity of sorghum was best when nitrogen was combined with poultry manure at the rate of 40kg N ha^{-1} + 4 t ha^{-1} of poultry manure. The results of a gross margin analysis on the treatments also indicate that the combined application (40kg N ha^{-1} + 4 t ha^{-1} of poultry manure) gave the best returns, thereby suggesting an increase in farmers' income and hence their standard of living.

KEYWORDS.Productivity, Gross Margin Analysis, Poultry Manure, and Urea

INTRODUCTION

Sorghum (*Sorghum bicolor. L*) occupies about 45-50 percent (%) of the total land area under cultivation in Nigeria, and most of it is in the savanna zone where it constitutes the major food grain and occupies about a third of the cultivated land. The total world production in 2002 was put at 5.5 million tonnes with average yield of 1280 kg ha^{-1}. In Africa production was estimated at 2.0 million tonnes with a yield of 861 kg ha^{-1}. While in Nigeria production was at 0.8 million tonnes with an average yield of 1090 kg ha^{-1}. (FAO, 2003).

Due to increasing fertility demand by improved varieties on soil nutrient resources and changing soil productivity factors, periodic revisions of fertilizer rates established for these crops is necessary. Generally, yield levels have increased along with nutrient requirement with the introduction of new and improved sorghum varieties. However, the depletion of soil nutrients as a result of intensive mixed cropping, leaching, quick mineralization etc and to some extent; improved crop management/husbandry practice, imply that there is a need for this rate to be reviewed. This is based on the fact that, fertilizer requirement of a crop is dynamic, changing with changing soil condition, crop varieties and genetic make up (Lombin, 1987). In addition, with the vast usage of organic manure among the farmers, there is need to investigate the effects of organic and inorganic fertilizers as well as their combined application on crop productivity.

Furthermore, the inadequate availability of inorganic fertilizer to poor resource farmers have resulted in the application of insufficient quantities at time of need (crop growing season), which have contributed to low yield. Organic manure is an important resource for crop production and soil sustainability, in that it is a source of all essential plant nutrients (Arunah, 2004). This manure also provides an excellent source of organic matter when added to soils, restoring some of

the organic matter depleted by many agricultural practices (Bahman and James, 1988).The problem that confronts the farmer is high handling costs of organic fertilizer when obtained in adequate quantities and the availability of the manure to meet the nutrient requirements of all the cropping lands (Probert et al., 1995). This situation is just as prevalent in the semi-arid tropics of West Africa as it is in northern guinea savannah (De Ridder and Vankeulen, 1990).

Nigerian farmers mostly practice mixed farming and as such make use of both organic and inorganic fertilizer without strictly adhering to the recommended rate of these fertilizers (Akinpelu, 1987 ; Ojomo, 1987). Studies by McCrown et al (1992) have led to the conclusion that, the best prospect for increasing productivity is a strategy of augmenting traditional soil enrichment practices with modest amount of fertilizer. Thus, this study was to determine the effect of inorganic and poultry manure application singly and in different combinations on sorghum yield and yield components. An economic analysis was also conducted to determine the gross returns for the different treatments.

MATERIALS AND METHODS

A field trial was conducted during the rainy season of 2002 at the research farm of the Institute for Agriculture Research Samaru Zaria, Nigeria (11° 11' N, 07° 38' E). Seeds of Sorghum variety ICSV III were sown at the rate of about 5 seeds per hole on 15th July 2002.Stands were later thinned to two plants per stand at three weeks after sowing (WAS). Treatment levels of applications included two levels of nitrogenous fertilizer (40 and 80kg N ha^{-1}) as urea and two levels of poultry manure (2 and 4 t ha^{-1}) as well as various combined application of nitrogen and poultry manure (40 kg N ha^{-1} +2t ha^{-1}, 40 kg N ha^{-1} +4t ha^{-1}, 80 kg N ha-1+2t ha^{-1} and 80 kg N ha^{-1} +4t ha^{-1}).A control treatment (no N and no manure) was included in each replicate. The experiment was laid out as Randomized Complete Block Design with a plot size of 6m x 4m and treatments were replicated three times. Data were collected on plant height, leaf area index (LAI), days to 50% physiological maturity, total dry matter, panicle weight, panicle length and grain yield at 4, 7, 10 and 13 WAS. Plant height in cm was measured from ground level to the longest leaf tips or panicle. Leaf area was measured using the method described by Stickler *et al* (1961).The leaf area index was determined from the ratio of leaf area per plant to the unit area of land covered by each plant as suggested by Watson(1952).

The data collected were subjected to analysis of variance and significance differences among the treatment means were separated using Duncan's multiple range test (Duncan, 1955). Gross margin analysis was used to determine the gross returns for the treatments.

RESULTS AND DISCUSSION

The results of the effects of nitrogen and poultry manure application on sorghum are presented in Table 1.A significant variation was recorded for plant height with each level of nitrogen application compared to the control .Similar results have been reported by Ibrahim (1995) and Kamoshita *et al.*, (1998).The application of poultry manure alone gave taller plant heights compared to the control and single application of nitrogen fertilizer. The combined application of 40 kg N ha^{-1} + 4t ha^{-1} of poultry manure, gave the tallest plant height and the highest LAI was obtained at 80Kg N ha^{-1} + 4t ha^{-1} of poultry manure.

During the course of the trial, water logging was experienced. This could be responsible for the non-significant effect of fertilizer application on days to 50% physiological maturity. Each level of N application gave higher yields compared to the control. The application of poultry manure significantly increased the yield compared to the control and single application of urea. This observation is similar to that made by (Fathi *et al*, 1992). This implies that nitrogen plays a central role in plant biochemistry and as a result, it positively influenced such characters as, plant height, total dry matter per plant, leaf area index and grain yield (Nyle and Ray, 1999).

The combined application of nitrogen with poultry manure showed more pronounced effects on growth parameters and grain yield. The highest grain yield was recorded at 40kg N ha^{-1} + 4 t ha^{-1} of poultry manure. Thus, poultry manure when applied alone or in combination with urea–N exerted more beneficial effects on the growth parameters and grain yield compared to single application of urea-N. This might be due to the quick release of a number of nutrients like phosphorus, sulphur and potash, in addition to supplying nitrogen (Begum *etal*, 2001).The necessary minor elements that are usually lacking in various chemical fertilizers are also supplied.

The results of the gross margin analysis on Table 2 show that application of 80 Kg N ha^{-1} gave a gross margin of N15304.19 per hectare, while the application of only poultry manure at 4t ha^{-1} gave a higher gross margin of N19002.75 per hectare .However a combined application of 40kg N ha^{-1} + 4 t ha^{-1} of poultry manure gave the highest gross margin of N25725.24per hectare. This implies that the combined application of inorganic fertilizer and organic manure apart from increasing the productivity of sorghum production, can also guarantee an increase in farmers yield, income and hence their standard of living. This therefore, could usher in a sustainable agriculture since an enhanced income could be used to obtain needed appropriate social and economic needs as well as innovations in the farming household. In addition, poultry manure may play a vital role in solving the problem of nutrient deficiency in soil and in improving soil health. Most importantly, global environmental pollution can be controlled considerably by reducing the fertilizer use and by increasing the use of manure.

CONCLUSION

From the results of this trial, the combinations of nitrogen fertilizer and poultry manure have shown to be more productive when compared to their individual effects and this is corroborated by the economic analysis . Thus, 40kg N ha^{-1} + 4 t ha^{-1} of poultry manure could be applied in sorghum production.

It is suggested that further research should focus on the possibilities of disease outbreaks as a result of the application of poultry manure. For the purpose of result validation, the study could be replicated in time and space on other sorghum varieties. To enhance the productivity and profitability of cereal crop production in Nigeria, a similar trial should be conducted on cereal crops such as maize, millet and rice.

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Table 1.Effects of Nitrogen and Poultry manure singly and in various combinations on growth, yield components and grain yield of Sorghum

Treatments	Observations						
	PHT (cm)	LAI	PM (days)	TDM (g)	PW (g)	PL (cm)	GYD ($kgha^{-1}$)
Control(0 N,0 Manure)	102.00d	2.33f	110.33	139.00d	24.58c	26.75	1050.33f
40 kg N/ha fertilizer	136.08c	3.60e	111.50	209.87c	8.75b	31.00	1516.35e
80 kg N/ha fertilizer	152.12b	4.35cd	112.50	227.70c	41.38b	32.50	2009.28cd
2t ha^{-1}manure	177.26a	3.90de	106.67	226.51c	31.17b	29.92	1830.82d
4t ha^{-1}manure	182.05	4.59c	106.67	266.68ab	44.82b	35.83	2168.92bc
40kgN+ 2t ha^{-1}manure	178.17a	4.37cd	107.33	256.39b	44.82b	35.83	2168.92bc
40kg N+4t ha^{-1}manure	188.00a	5.30ab	110.50	277.44ab	58.88a	37.50	2514.12a
80 kg N+2t ha^{-1}manure	181.01a	4.76bc	108.50	267.12ab	55.77a	36.33	2172.63bc
80 kg N+4t ha^{-1}manure	182.10a	5.43a	103.67	294.62a	58.30a	37.67	2322.605b
SE ±	5.30	0.20	3.10	9.68	2.28	3.85	64.70

Means followed by the same letter(s) in each column are not significantly different at 5% probability level using DMRT
PHT=Plant Height, LAI=Leaf Area Index,PM=Days to 50%Physiological Maturity ,TDM=Total Dry Matter ,PW=Panicle Weight,PL=Panicle Length, GYD=Grain Yield.

Table 2.Costs and Returns Analysis for Nitrogen Fertiliser and Poultry Manure application on Sorghum

Observations	Treatments								
	Control(0 N ,0 Manure)	40 kg N ha^{-1}	80 kg N ha^{-1}	2t poultry manure ha^{-1}	4t poultry manure ha^{-1}	40kgN+2t poultry manure ha^{-1}	40kgN+4t poultry manure ha^{-1}	80 kg N+2t poultry manure ha^{-1}	80 kg N +4t poultry manure ha^{-1}
GrainYield(kgha^{-1})	1050.33	1516.35	2009.28	1830.82	2046.77	2168.92	2514.12	2172.63	2322.61
Gross Returns (NAIRA) {A}	31509.9	45490.5	60278.4	54928.6	61403.4	65067.6	75423.6	65178.9	69678.3
Purchased inputs (seeds,fertiliser, poultry manure and chemicals) NAIRA{B}	9050.3	11230	15470.14	10150.45	11730.15	13509.10	16908.35	144441.32	
Labour Cost (NAIRA) {C}	18602	20800.3	29504.07	30307	30670.5	30750.5	32790.01	30852	15580.35
Total Variable cost(NAIRA){D}= (B+C)	27652.3	32030.3	44974.21	40457.45	42400.65	44259.6	49698.36	45293.32	31900
Gross Margin (NAIRA ha^{-1}) {A-D}	3857.6	13460.2	15304.19	14471.15	19002.75	20808	25725.24	19885.58	47480.35
									22197.95

Note: All figures were converted to a hectare from the plot size of $24m^2$. A Kg of Sorghum was valued at N30