

## EFFECT OF POULTRY LITTER ON THE YIELD OF TWO MAIZE VARIETIES IN THE NORTHERN GUINEA SAVANNA

Udom, G. N\*, and Bello, H. M.

Crop Production Programme, School of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University, P.MB.0248, Bauchi, Nigeria,

\*Current Address: Department of Crop Science, University of Uyo, Uyo, Nigeria

### ABSTRACT

*Field experiments were conducted at the Bauchi State Agricultural Programme Research Farm, Bauchi during the 2002 and 2003 wet seasons to study the response of two maize varieties to different levels of poultry litter. Two varieties [Obatampa, quality protein maize (QPM) and Downy mildew Resistant (DMR)] and five levels of poultry litter (0,2,4,6 and 8 tonnes / ha) were laid out in a randomized complete block design with three replications. The results showed that varietal effect was not significant on the yield and yield components of maize during both years of experimentation. Poultry litter significantly affected the cob length, cob weight, shelling percentage and grain yield of maize during all the years. Application of 2t/ha of poultry litter significantly increased the maize grain yield and further increase of poultry litter beyond (2t/ha) did not significantly increase the grain yield. Therefore, application of poultry litter at the rate of 2t/ha was recommended for growing these two maize varieties in the Nigerian savanna.*

**Keywords:** Maize, Poultry manure, *Zea mays*, Quality Protein Maize.

### INTRODUCTION

Maize (*Zea mays L*) is an important crop in Nigeria mainly as an energy giving food. Based on cropped land and quantity produced, maize is Nigeria's third most important cereal crop after sorghum and millet (FAO, 1997) and also ranks third in the current world cereal production output (FAO, 1997). Maize production in the sub saharan Africa was reported to have an increasing trend of between 2% to 3% annually (Boxall, 2000), and current rate of its production may not reach the growing demand of the ever increasing human population, hence repeated calls on more efforts for improve maize production.

The performance of agricultural sector has over the decade remained far from expectations in terms of efficient crop production. Some of the factors hompering crop production border on poor scientific and technological applications including the use of manures and fertilizers. The use of fertilizer has witnessed a declining trend in recent years, mainly due to its negative effects on soil resulting on limitation of crop yield and mining

of crops. This has also led to the degradation of already fragile soils (Ali, 2005).

Maize, like any cereal crop is high nutrient demanding (especially for N) and these nutrients are limiting in the savanna soils due to intensive cropping and inadequate vegetation cover. The introduction of conventional inorganic fertilizer has drastically reduced the use of organic manures. Organic manure is mainly composed of wastes and residues from plants and animals. They contain relatively small amount of plant food. Organic manures supply nutrient to the plants, improve soil structure, aeration and encourage good root growth. Also, it is understandable that all the essential nutrients required by plants are supplied by organic manures, although in small amounts. Poultry manure was reported to contain more plants nutrients than all other organic manures. (Ali, 2005).

The actual amount of nutrients to be released to the soil by organic fertilizer depends on the quantity and availability of the nutrient elements of that particular organic material (Nnadi *et al.*, 1981, Feedmix, 1995). Soil

fertility improvement by inorganic fertilizer is currently out of the reach of the majority of peasant farmers due to high cost. This situation has forced most of the farmers to grow and produce maize with litter or no fertilizer which reduces yield and quantity of maize produced (Onwueme and Sinha, 1991). In this situation, the use of poultry litter which is readily available and can supply minimum amount of nutrients for maize production is advisable. Various researches have been conducted on organic fertilizer, but there is dearth of information on the use of poultry litter as a complement or substitute for inorganic fertilizer for soil fertility management. In view of the above therefore, the objective of this experiment was to study the response of two maize varieties to poultry litter application.

## MATERIALS AND METHOD

The field experiments were located at the Bauchi State Agricultural Development Programme Research Farm, Bauchi (Lat 10° 22'N; 9° 47'E and 609m above sea level) in the northern Guinea savanna ecological zone of Nigeria, during the 2002 and 2003 wet seasons. The site received an average annual rainfall of 1424mm and 943mm in 2002 and 2003 wet seasons, respectively. The soil is moderately deep, well drained sandy loam.

The treatments included in the experiments were two maize varieties (Obatampa) Quality Protein Maize (QPM) and Downy Mildew Resistant varieties (DMR) and five levels of poultry litter (0, 2, 4, 6 and 8 tonnes/ha). This were laid out in a randomized complete block design with three replications. The experimental plots were ploughed, ridged and two seeds each of the maize varieties were sown at 75 cm inter-row and 50cm intra-row spacing with two plants per stand giving a plant population 53,333 plants/ha. Poultry litter was applied as basal application during land preparation as per treatments.

The poultry litter used in the treatments was analyzed to determine the three basic nutrient elements (N P and K) and other secondary elements (Ca, Mg and S). The results showed that in 2002, the poultry litter contained 1.95% total N; 2.41% P and 1.61% K. The secondary elements were 1.79% Ca; 0.38% Mg and 0.34% S, while in 2003, the content were 2% total N; 2% P; 1.50% K; 2.34% Ca; 0.25% Mg and 0.25% S. The equivalent N content in the poultry litter treatments were, 0, 39, 78, 117

and 156 KgN/ha in 2002 and 0, 40, 80; 120 and 160 KgN/ha during the 2003 wet seasons corresponding to 0, 2, 4, 6 and 8 tonnes/ha of poultry litter, respectively. Uniform N rates of 46KgN/ha as urea was applied to the maize plants at 5 weeks after sowing. The experimental sites were kept weed free throughout the period of the experiments. The net and gross sizes of the plots were 11.25m<sup>2</sup> and 18.75m<sup>2</sup>, respectively.

The maize varieties were harvested at maturity and the data collected included number of cobs, cob length, grain yield, shelling percentage and 1000 grain weight.

All the data collected were subjected to analysis of variance as described by Snedecor and Cochran (1967). Duncan multiple range test (Duncan 1955) was used to demarcate significant differences in the means of the treatments.

## RESULTS AND DISCUSSION

Tables 1 and 2 show the effect of variety and poultry litter on the yield components of maize during the 2002 and 2003 wet seasons, respectively. Differences between means of maize varieties were found to be statistically similar on all the yield components in all the two years. Even though the variety QPM appeared to have produced higher yield components than DMR variety in both years.

The differences between the means of poultry litter were found to be significant ( $P < 0.05$ ) on cob length and cob weight in both years of experimentation. (Table 1) Also poultry litter had significant effect on 1000-grain weight only in 2003 wet season (Table 2). However, number of cobs and shelling percentage were not significantly affected by poultry litter in both years.

Cob length was significantly ( $P < 0.05$ ) increased with the addition of poultry litter from 0 to 2 tonnes per hectare. Further increase in poultry litter upto 8t/ha, however, did not produce any significant increase in cob length in both years. However, the differences between the means at 0, 2, and 4 tonnes per hectare were statistically the same during the 2003 wet season (Table 2). All levels of applied poultry litter produced similar cob weights which were significantly ( $P < 0.05$ ) higher than control, however, the difference between 0 and 2 tonnes per hectare of poultry litter was not significant (Table 2). Also, all levels of applied poultry litter produced similar 1000-grain weights which were significantly ( $P < 0.05$ ) higher than control.

Udom, G. N, and Bello, H. M.

**Table 1 Effect of variety and poultry litter on the yield components of maize during the 2002 wet season.**

Yield components					
Treatments	Number of Cobs/ha	Cob Length (cm)	Cob Weight (g)	Shelling %	1000-grain Weight (g)
<b>Variety</b>					
QPM	20225.0	15.21	3.01	57.74	230.67
DMR	19666.0	14.65	2.91	64.12	214.47
LS	NS	NS	NS	NS	NS
SE±	1809.12	0.809	0.26	3.37	7.23
<b>Poultry Litter (t/ha)</b>					
0	15389	12.00b	1.43c	48.15	186.33b
2	19259	15.52a	2.72b	69.17	218.67ab
4	18963	15.12a	2.75b	61.67	229.67a
6	21526	15.80a	3.27b	62.13	236.17a
8	24593	16.20a	4.63a	63.50	242.00a
LSD	NS	*	*	NS	*
SE±	2860.4	0.80	0.41	5.34	11.43

QPM =Quality Protein maize; DMR= Downy mildew Resistant; LS = Level of significance. Means followed by the same letter(s) within a treatment group are not statistically significant using Duncan multiple range Test (DMRT). \* = Significant at P=0.05

**Table 2: Effect of variety and poultry litter on the yield components of maize during the 2003 wet season**

Yield components					
Treatments	Number of Cobs/ha	Cob length (cm)	Cob weight (g)	Shelling %	1000-grain Weight (g)
<b>Variety</b>					
QPM	34254	14.87	4.69	67.81	235.00
DMR	33422	14.34	4.14	63.13	218.00
LS	NS	NS	NS	NS	NS
SE±	2259.11	0.45	0.33	2.08	6.62
<b>Poultry Litter (t/ha)</b>					
0	31407	12.53b	2.58b	60.95	204.83
2	30667	14.52ab	3.90ab	65.62	223.17
4	30375	15.20ab	4.95a	66.12	238.83
6	38518	15.60a	5.48a	67.90	237.33
8	38222	15.43a	5.17a	66.77	231.17
LSD	NS	*	*	NS	NS
SE±	3572.0	0.45	0.52	3.29	10.48

QPM =Quality Protein maize; DMR= Downy mildew Resistant; LS = Level of significance. Means followed by the same letter(s) within a treatment group are not statistically significant using Duncan multiple range Test (DMRT). \* = Significant at P=0.05.

The significant increase in the cob length and cob weight with the addition of poultry litter during both years of experimentation may be due to the supply of essential nutrients especially N,P,K and S by the poultry litter which are important in the determination of yield components (Jones, 1993). Similar observations were also reported by several researchers including Falaki, *et al.* (1995), Jama *et al.* (2000) and Smaling *et al.* (2002) who reported significant increases in the maize yield components with the addition of organic manure. Application of 2 tonnes of poultry litter significantly increased 1000- grain weight, but increasing poultry litter beyond 2 t/ha was not economical. Similar increases were also reported by Sobulo (1988) and Stella *et al.* (2001) where cob length, cob weight and 1000-grain weights were significantly increased with

addition of poultry manure. Also Silva, *et al.* (2003) reported that the increase in the yield components might be connected with the release of essential nutrient elements by the poultry litter.

Table 3 shows the effect of variety and poultry litter on the maize grain yield in 2002 and 2003 wet seasons. The two maize varieties did not significantly differ in their grain yield. Although, application of poultry litter significantly increased maize grain yield in both years, during the 2002 wet season, application of 8 t/ha of poultry litter produced the highest grain yield. All other levels of applied poultry litter produced similar grain yield which were significantly higher than control (Table 3). In 2003 wet season, all levels of applied poultry litter produced similar grain yield except 2 tonnes per hectare which was similar to the control.

**Table 3: Effect of variety and poultry litter on maize grain yield (t/ha) in 2002 and 2003 wet seasons.**

Treatments	Yield (t/ha)	
	2002	2003
<b>Variety</b>		
QPM	1.72	3.13
DAR	1.94	2.67
LSD	NS	NS
SE±	0.16	0.23
<b>Poultry Litter(t/ha)</b>		
0	0.72c	1.63b
2	1.87b	2.58ab
4	1.67b	3.08a
6	2.00b	3.75a
8	2.90a	3.47a
LSD	*	*
SE±	0.265	0.377

QPM =Quality Protein maize; DMR= Downy mildew Resistant; LS = Level of significance. Means followed by the same letter(s) within a treatment group are not statistically significant using Duncan multiple range Test (DMRT). \* = Significant at P<sub>0.05</sub>

The application of poultry litter significantly increased grain yield, however, application of poultry litter beyond 2 t/ha in both years did not significantly increase the maize grain yield to warrant the use of higher level of poultry litter. The increase in grain yield may be due to the supply of nutrients especially N by the poultry litter which is known to be the most spectacular in plant growth and development. Similar observations were reported by several researchers including Silva *et al.* (2003) and Zublena *et al.* (1993). The increase in grain yield may also be connected with the positive increase associated with poultry litter on the yield components. The slight difference in the yields obtained in 2002 and 2003 seasons could be due to the residual effect of poultry litter during the 2003 wet season.

The slight response of maize grain yield beyond 2 t/ha of poultry litter in the 2003 season seems to suggest that 2t/ha might be the optimum rate of poultry litter for the best performance of these maize varieties.

## CONCLUSION

Based on the results of these experiments, therefore, it could be concluded that the uses of poultry litter at the rate of 2t/ha was recommended for these two maize varieties in the Nigerian savanna considering its availability, sourcing and the labour of incorporating it into the soil as against the use of poultry litter at the rate of 4t/ha.

## REFERENCES

- Ali, G.A (2005).Uses of manure and fertilizer as soil management Technique for sustainable crop production: paper presented at workshop organized by Taraba State Local Government Service Commission on 8 and 9, December, 2005. p. 5.
- Oxall, R.A. (2005). Post-harvest Technology of quality protein maize: Storage and Processing. Choosing the right technology. Final report.Chatham U.K. NRI. P. 44.

- Duncan, D.B. (1955). Multiple Ranges and Multiple F. Test. Biometrics: II: 1– 42. FAO, (1996). Quarterly Bulletin of Statistics. Food and Agricultural Organization of the United Nations: Rome, Italy p. 8.
- FAO, (1997). Quarterly Bulletin of Statistics Food and Agricultural Organization of the United Nation Rome Italy. Vol. 10 .pp. 13-34.
- Falaki, A. M., Mike, S. and Abubakar, I.U. (1995). Fertilizer use, practice under irrigation. An invited paper presented at the 3<sup>rd</sup>National fertilizer workshop, Nigeria. Ibadan, 22-24 April. 1992. pp. 12.
- Feedmix, (1995). Nutritional value of poultry litter. *The International Journal on feed Nutrition and Technology* 1 (3): 26-39.
- Jama, B; Swinkels, R.A and Bunish, R. J. (2000) Agronomic and economic evaluation of organic fertilizer. Mimeo. Ministry of Agriculture. Agric Section Development Strategies, Nairobi, Kenya.
- Jones, H.K. (1993). A survey of the availability of tissue nitrogen and phosphorus concentration in maize and grain sorghum. *Field Crop Research* 6: 133 – 137.
- Nnade; L.A, Singh, L. and Bala Subramanian V (1981) Effect of grain legumes and sorghum on soil nitrogen status and the yield of subsequent maize crop sorghum. *Journal of Agricultural Research* 1:183-190.
- Onwueme, I.C and Sinha, T. D. (1991) Field Crop Production in tropical Africa. CTA wageninagan Nether Lands, P. 450
- Silva S.A, Woods, E.I. and Colemann, W.C (2003) The Use of composted poultry manure as a fertilizer. University of Hawaii; p. 53.
- Smaling, E.M.A., Nandwa, S.W., Prestele H; Roetler, R and Muchena, F. N. (2002). Yield response of maize to fertilizers and Manures under different agro-ecological condition in Kenya. Dordrecht. The Netherland. Elsevier, Publishers. Pp233.
- Snedecor; C.W. And Cochran; W.C. (1967). Statistical methods. Sixth edition, New Delhi. Oxford and IBL. pp. 33 – 80.
- Sobulo, R.A. (1988), Complementary use of organic and chemical fertilizer for maize production in the tropics. Wiley and Sons. New York. pp. 235 – 245.
- Stella, M., Kimani, S., Mwangi, W., Verkuji H. and Nusember, F (2001). Determinant of fertilizer and manure use in maize production in Kiamba District, Kenya. Mexico DP international maize and wheat improvement centre (CIMMYT) and Kenya Agricultural Research institute. (KARI). p.12
- Zublena, J. P., Barker, J.C. and Corter, T.A. (1993). Poultry manure as a fertilizer source. Soil facts. North Carolina. Coop. Ext. Series. Raleigh.North Carolina. p. 32.