Effect of different sources and rates of nitrogen fertilizer on growth and yield of sweet corn.

Olaniyan A.B[1], Akintoye H.A[2], Balogun M.A[1]

[1]University of Ibadan, Department of Agronomy, Nigeria.
[2]National Horticultural Research Institute, Vegetable Production, Nigeria.

ABSTRACT

Rapid nitrate leaching due to current nitrogen management practices under the humid tropical environmental condition of the south western Nigeria, may contaminate fresh and salt water resources. It is becoming a major public concern because underground water is the sole source of fresh water especially in the south western part of Nigeria. Field studies were carried during the cropping seasons at Ibadan south western Nigeria to examine the effect of different sources and rates of nitrogen fertilizer on growth and yield of sweet corn. The main objectives of the study were to examine the use of organo-mineral fertilizer as a possible management alternative for reducing nitrate leaching due to nitrogen fertilizer applications as a result of applied inorganic fertilizer while also providing sufficient nitrogen for crop growth.

The effect of organo-mineral fertilizer and availability of nitrogen at rates up to 120kgN/ha was also evaluated in the trial.
The result favoured production of sweet corn at 120kg N/ha. Highest total dry matter was obtained at 120kg N/ha.
The fresh cob weight of 13.97 tonnes and 17.35 tonnes/ha were obtained from 80kg and 120kg N/ha respectively.

The result suggests that the application of organo-mineral fertilizer may be a useful management practice to reduce nitrate leaching losses, improve soil structure and also reduce production cost by reducing the use of expensive inorganic fertilizer with the additional advantage of cleaning environment through the use of organic waste.

INTRODUCTION

Nitrogen has been found to be most important nutrient for maize production. However, most Nigerian soils have low nitrogen level. In view of this low N status in the soil, N is usually supplemented with chemical N fertilizer and the importance of this source has increased over the years. However, the problem with this supplementary N is that while it can lead to high crop yield, it also results to pollution of groundwater after crop harvest (Roth and Fox 1990, Gordon *et al*., 1993). Recent studies in Nigeria had shown that organic based fertilizers are less leached into the groundwater than the chemical fertilizer (Sridhar and Adeoye 2003). In view of this fact, the use of organic based fertilizer has found favour in boosting crop production in Nigeria because it is cheap and less likely to pollute the groundwater as much as chemical fertilizers. As part of efforts to avoid use of inorganic fertilizer, organo-mineral fertilizer, which is a mixture of inorganic and organic fertilizer, had been successfully used to obtain optimum yield in other maize cultivars (Sridhar and Adeoye 2003).

However, organo-mineral fertilizer is yet to be used for the production of sweet corn. The present study therefore compares the use of organo-mineral fertilizer with other sources of nitrogen fertilizer on the growth and yield of sweet corn in Southwestern part of Nigeria.

MATERIALS AND METHODS

Field experiments were conducted during 2003 growing season on the experimental field of the National Horticultural Research Institute (NIHORT), Ibadan (3^0 52'E and 7^0 25'N) Nigeria. The soil of the experimental site was sandy loam and classified as Alfisol (Herpstead, 1973). The experimental field was cleared; ploughed and harrowed and divided into plots. Before planting, a representative soil sample was taken at different parts of the field and was thoroughly mixed together to form a composite sample, which

was air-dried and made to pass through a 2mm, and 0.5mm sieve for soil texture and chemical analysis. The soil sample was later analyzed for a total N, available P, and exchangeable Ca.

The experimental design was a split plot factorial fitted to randomized complete block. The treatments included three N sources (Organo-mineral, Poultry manure, NPK, Chemical Fertilizer) as main plot and four N rates (0, 40, 80 and 120 kg N ha^{-1}) as sub plot. The sweet corn was planted at the spacing of 75 cm between rows and 25 cm within row to give population density of 53,333 plants/ha. The variety of sweet corn used for the experiment was sweet comp. white. Weeds were manually controlled. Recommended practices for disease and insect control were followed.

One half of the nitrogen was applied at sowing for the chemical fertilizer treated plots while the remaining half was top dressed 4 weeks later. The organo-mineral fertilizer was applied once at sowing while poultry manure was applied one week before sowing.

After final harvest sweet corn cob were harvested fresh, and weighed. The grain on the cob was equally weighed fresh. Total dry matter was determined by oven dried at 75^0C until constant weight was attained.

All data collected were analyzed using analysis of variance procedures (ANOVA) using SAS-GLM procedures (SAS Institute, 1990). The means were separated by the least significant difference (LSD $P<0.05$).

RESULTS

The result of the nutrient status of the experimental site showed that the soil was low in major nutrients such as total N (0.14g/kg), available P (7.63 mg/kg), exchangeable K (0.09 cmol/kg). The N content of organo-mineral used was 4.2% while the N content of poultry manure was 1.94%.

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The highest level of fertilizer source (120kgN/ha) produced the highest amount of dry matter and the least dry matter was produced by the control. The dry matter production at

120 kg N/ha was higher than the production at 80,40,0 kg N/ha by 11.0%, 14.9% and 48.6% respectively (table 1).

The effect of sources of nitrogen and levels on fresh cob yield and grain yield followed the same trend (tables 2 and 3). As found out in total dry matter yield, NPK fertilizer produced significantly higher fresh cob and grain yield than the other sources. The least values for the two were produced by poultry manure. For cob yield, plants under NPK out yield the plants under organo-mineral and poultry manure by 20.9 and 28.3% respectively.

With regard to the levels of N, application at 120 kg N/ha gave the highest values for both cob yield and grain yield while lowest values were obtained at O kg/ha (Control). There were significant differences between the values obtained by these treatments. For fresh cob yield, production at 0,40,and 80kg on average 28.6%, 57.0% 80.0 %of the production at 120kg N/ha.

DISCUSSION

The importance of nitrogen in the production of maize had been well documented all over the world (Mengel and Kirkby, 1978). In Nigerian agriculture, the importance of nitrogen for optimum maize production has also long engaged the attention of many workers (Fayemi 1966, Agboola 1968, Jones 1973 and Lucas 1986). However, in recent time, concerned have been raised on the unbridled use of chemicals source of N because of its polluting effect with nitrate – N on the groundwater. The use of organo-mineral fertilizer with less N content has been suggested for production of maize (Sridhar and Adeoye, 2003).

This study has showed conclusively that NPK fertilizer was superior to organo-mineral and poultry manure for optimum production of total dry matter, fresh cob yield and grain yield in sweet corn. However, although organo-mineral fertilizer produced 21% less cob yield and grain yield than NPK, this may not be too much of concern if its use will not

lead to high level pollution of ground water compared with use of NPK. Another added advantage of organo-mineral like organic manures is their slow nutrient release and residual effect on subsequent crop yields. This has been well documented in Nigeria by Titiloye, Lucas and Agboola 1985. In their study the authors found that residual effect of poultry manure led to 33% yield increase in maize over that of NPK fertilizer. This aspect on residual effect of organo-mineral is now being studied in a follow up experiment.

With regard to the level of N needed for maize production the result obtained in the study confirmed previous result of Lucas (1986) that yield response of maize to N fertilizers could be obtained up to 150 kg N/ha. This study therefore shows that yield response of sweet corn to nitrogen follows the same trend.

CONCLUSION

The preliminary trend that can be deduced from the study is that if well packaged, organo-mineral fertilizer may be a useful management practice to minimize nitrate leaching losses, improve soil structure and also reduce production cost by reducing the use of expensive inorganic fertilizer with the additional advantage of cleaning environment through the use of organic waste.

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Table 1: **Effect of Different Sources of N fertilizer Applied at Different Rates on Total dry matter t/ha at Final Harvest of Sweet Corn**

	N Levels				
N sources	**0**	**40**	**80**	**120**	**Mean**
NPK (Chemical)	5.62	9.07	9.17	10.59	**8.61**
Organo-mineral	3.82	6.29	6.83	7.5	**6.11**
Poultry	3.81	6.61	6.99	8.06	**6.37**
Mean	**4.42**	**7.32**	**7.66**	**8.60**	
LSD 5% (levels)	**1.30**				
LSD (Sources)	**0.9**				
LxS	**NS**				

Table 2: **Effect of Different Sources of N Fertilizer Applied at Different Rates on Fresh cob Yield (t/ha)**

	N Levels				
N sources	**0**	**40**	**80**	**120**	**Mean**
NPK (Chemical)	5.84	12.19	15.45	21.72	**13.80**
Organo-mineral	5.03	8.86	12.60	17.19	**10.92**
Poultry	4.04	8.54	13.85	13.15	**9.90**
Mean	**4.97**	**9.87**	**13.97**	**17.35**	
LSD 5% (levels)	**2.55**				
LSD (Sources)	**1.71**				
LxS	**NS**				

Table 3: **Effect of Different Sources of N Fertilizer Applied at Different rates on Grain Yield.**

	N Levels				
sources	**0**	**40**	**80**	**120**	**Mean**
NPK (Chemical)	4.96	10.36	13.13	18.46	**11.73**
Organo-mineral	4.28	7.53	10.71	14.61	**9.28**
Poultry	3.43	7.23	11.77	11.18	**8.40**
Mean	**4.20**	**8.37**	**11.87**	**14.75**	
LSD 5% (levels)	**2.17**				
LSD (Sources)	**1.45**				
LxS	**NS**				