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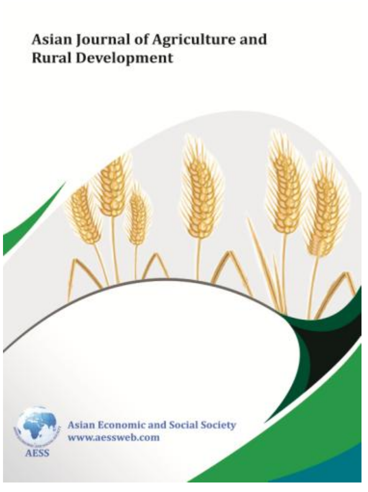

Effects of Liquid Organic Fertilizer on Time of Tasselling, Time of Silking and Grain Yield of Maize (*Zea mays*)

Enujeke, E. C. † and Ojeifo, I. M. (Department of Agronomy, Delta State University, Abraka Campus, Asaba, Nigeria)

Nnaji, G. U. (Department of soil science, University of Nigeria, Nsukka, Nigeria)

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† Corresponding author

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Effects of Liquid Organic Fertilizer on Time of Tasselling, Time of Silking and Grain Yield of Maize (*Zea mays*)

Author(s)

Enujeke, E. C. and **Ojeifo, I. M.**
Department of Agronomy, Delta State University, Abraka Campus, Asaba, Nigeria

Nnaji, G. U.
Department of soil science, University of Nigeria, Nsukka, Nigeria

Abstract

A study was carried out in the Teaching and Research Farm of Delta State University, Asaba Campus from August to December in 2005 and repeated between March and July, 2006 to evaluate the response of maize *(Zea mays)* to liquid organic fertilizer. The study was conducted using a split plot fitted into randomized complete block design. Liquid organic fertilizer was diluted at the rate of 60 ml of the product to 15 litres of water and applied to maize foliage, topsoil, foliage and topsoil at the rates of 5l/ha, 10l/ha, 151/ha, l8l/ha, 201/ha and 251/ha. The result obtained indicated a positive influence of liquid organic fertilizer on time of tasselling, time of silking and grain yield of maize. Liquid organic fertilizer significantly reduced the times of tasselling and silking, and increased grain yield of maize. Based on this study, it is recommended that 151/ha of liquid organic fertilizer which produced 5.6tha' in 2005 and 6.1tha' of dry grain yield 2006 be applied on the topsoil of maize plant with a view to maximally exploit the great economic potentials of the crop.

Keywords: Liquid organic fertilizer, Maize, Tasselling, Silking, Grain yield, Nigeria

Introduction

Maize *(Zea mays)* is the third most important cereal crop after wheat and rice (FAQ, 2002). In Nigeria, maize is consumed in a variety of ways (Agbato, 2003). In advanced countries, it is an important source of industrial products such as corn sugar, corn oil, starch, glucose, syrup, alcohol and binders in tablet production (Ihekoronve and Ngoddy, 1985). Oil obtained from the germ is used to make soaps, glycerine and vanishes. Corn sugar is used for chemicals, leather preparation, dyes and explosives (Purseglove, 1978). Maize is a major component of livestock feeds and it is acceptable to poultry, cattle and pigs as it supplies them energy. The stalk, leaves, grain and immature ears are cherished by different species of livestock. Maize is also used for silage and green fodder for feeding farm animals (Rouanet, 1992).

In spite of the increasing relevance of maize in Nigeria, yield depressions abound in farmers' fields due to declining soil fertility. Ojeniyi (2000) noted that Arabic soils of the tropics get degraded quickly in physical, chemical and biological qualities as a result of continuous cropping. This necessitates research into avenues for improving crop productivity through the application of liquid organic fertilizer, inorganic fertilizers or organic manure. Organic manure is often bulky and may not be readily available for application where large hectarage of cropland is to be applied. It also possesses unpleasant odour, harbours reptiles, and mineralizes slowly over long period of time. Inorganic fertilizers with the attendant problems of inaccessibility, difficulty in transportation and high cost of acquisition by resource poor farmers as well as the use of other chemicals lead to adverse environmental, agricultural and health consequences (Saber, 1998).

Liquid organic fertilizers are environmentally friendly fertilizers obtained from plant and animal origin. They are formulated from botanical extracts into liquids that are readily absorbed in soluble state, and are usually fortified with nutrient elements that promote healthy plants growth and development (Danbala and Green Planet, 2003). Liquid organic fertilizer gives plants added nutrients in a faster-acting form than granular fertilizer. Health-related benefits accrue from application of liquid organic fertilizer. Bockrnan *et al.* (1990) reported that a desire for quality food is part of the market acceptance of organic produce which have little or no chemical residue. Some advocates or organic farming believe that food produced with liquid organic fertilizers is more nutritious than food produced by conventional farming (Schupan, 1974). Liquid organic fertilizer is excellent for growth of many crops including maize, sorghum, rice, yam, cassava, potato, soybean, cowpea, mango, papaya and oil palm.

This study was carried out to assess the response of maize to liquid organic fertilizer. The specific objectives of this study were to: (1) determine the best rate and location for the application of liquid organic fertilizer for maize production in order to achieve optimum yield. (2) determine the response of time of tasselling and silking to liquid organic fertilizer.

Methods

Site Description: The experiment was carried out in the Teaching and Research Farm of Delta State University, Asaba Campus from August to December 2005 and repeated between March and July, 2006. Asaba is located at 06°l4N of the equator. It lies in the tropical rainforest zone and is characterized by rainy season between April and October with annual mean rainfall of 1500 to 3000mm (FOS, 1996).

Land Preparation: Land Preparation — The site was cleared using cutlass and tillage was done using plough and harrow. Soil samples were collected before the planting. The samples were analyzed in the laboratory for routine physical and chemical properties.

Pre—planting Soil Analysis: Surface sols (10 — 15cm) were sampled with a tabular sampling auger. Representative soil samples were taken and then bulked together from the replicate. The samples were air-dried at room temperature for 5 days and crushed to pass through a 2mm mesh tube. Sub—samples from the bulked soil sample were further ground to pass through 100-mesh sieve for the determination of organic matter. The rest samples were then analyzed to determine the physical and chemical properties of the soil. The analysis was done at Nigeria Institute for Oil Palm Research (NIFOR), Benin City, Edo State.

Particle Size: The analysis was done by the hydrometer method of Bouyoucos (1951) after destroying the organic matter with hydrogen peroxide and dispersing the soil with sodium hexarnetaphosphate.

pH: This was determined in distilled water and in INKCL in a 1:1 soil-to-solution suspension using a pH meter.
Organic Matter: This was determined from the result of organic carbon as follows: % organic mailer in the soil % organic carbon x 1.79. The total nitrogen (N) content of the soil then calculated from the result of the % organic matter as follows:
Total N = 5% of result organic matter content in the soil (I1TA, 1979).
Exchangeable Bases: The soil was extracted with neutral NH.OAC. K and Na in the extracts were determined by flame photometry and Mg by the atomic absorption spectrophotorneter.

Total Exchangeable Acidity: This was extracted with INKCL and estimated in the extracts by titration method (McClean. 1965).

Effective Cation Exchange Capacity (ECEC): This was taken as the sum of the exchangeable bases and exchange acidity (E.A) (Kamprath. 1970’).

Seed procurement and viability test: Hybrid maize seed (Oba super-2) was obtained from Premier Seed. Viability test was carried out.

Experimental Design: The experiment was carried out using split plot fitted into randomized complete block (RCB) design replicated three times. The main plot was occupied by method of application while the subplots were allotted the different level of liquid organic fertilizer. The main plot treatment and subplot treatments are: Method of application of liquid organic fertilizer (1) Foliar application (2) Top soil application (3) Foliar + Top soil application, while sub plot — Rate of Liquid organic fertilizer application (1 ha-1) (1) 5 (2) 10 (3) 15 (4) 18 control (Dambara and Green Planet International, 2003) (5) 20 (6) 25

Dilution Rate — The liquid organic fertilizer was diluted at the ratio of 60m I of liquid organic fertilizer to 15 litres of water (1 ml of liquid organic fertilizer to 250ml of water) (Danbara and Green Planet international, 2003)

Planting — Sixty stands of maize were sown per subplot measuring 7.88m2 at standard spacing of 75cm x 25cm giving a plant population of 5.33 plants/in2.

Application of Liquid Organic Fertilizer — Liquid organic fertilizer was applied to maize foliage, topsoil, foliage and top soil at three weeks and six weeks after sowing using hand sprayer.

Weeding —Weeding was done three times manually.

Data/sample Collection - Twenty-six middle stands served as net plot and were used as sample population to check edge effect. Days to 50% tasselling and silking were taken. After harvesting and shelling, dry weight of seeds was measured using a weighing scale.

Statistical Analysis — Data collected were subjected to analysis of variance using (SAS, 1996) and means were separated using Duncan Multiple Range Test.

Results

Physico-chemical Properties of the Experimental Site

The phvsico-chemical properties of the study area is shown in Table 1. The soil was predominantly sandy. The surface had more sand than the subsurface. Texturally, the experimental site was classified as sandy clay. The soil is generally acidic with a pH of 5.7. The organic matter and total nitrogen content were low with values of 0.12 gkg' and 0.O5gkg-1, respectively. The available P was equally low with a value of 9.3mgkg. The exchangeable cations were low in status with values of 1.86 cmol (kg for Ca and 1.42 crnolkg' for Mg. The values obtained for K (0.07 cmolkg') and ECEC (8.45 cmolkg') were low. This could be attributed to low activity clay of the study area while the low values obtained Organic C, total Nitrogen and P were as a result of erosion that is predominant in the area and subsequent leaching of the nutrient beyond the root zone.

Effect of Liquid Organic Fertilizer on Time of Tasselling of Maize

Number of days to tasselling is shown in Table 2. The table showed that liquid organic fertilizer applied at the rate of 15 l/ha on topsoil tasseled earlier than other plants, including their control counterparts in both first and second trails. During the first trail (Table 2), there were significant differences in time of tasselling. Plants that received 15 l/ha of liquid organic fertilizer tasseled first, followed by plants that received 20 l/ha, and thereafter, the plants in the control plots. Plants that received 5LJha tasselled last. Plants that received liquid organic fertilizer on topsoil tasseled first, followed by foliar + Topsoil before foliar.

The trend was the same during the second trial (Table 2). Days to 50% tasselling significantly (P=0.05) differed from plants that received various rates of fertilizer.

Effect of Liquid Organic Fertilizer on Time of Silking of Maize

The response of time of silking of maize to liquid organic fertilizer is shown in Table 2. The table showed that liquid organic fertilizer significantly differed or influenced time of silking between various rates of application. During the first trail, plants that received liquid organic fertilizer at the rate of 15 (/ha produced silk earlier than other plants. including plants in the control subplot. Plants that received lOi..ha fertilizer developed silk lastly. Plants that received fertilizer on topsoil attained 50% silking first, followed by foliar + topsoil before foliar.

The second trial followed the same trend. There were significant differences in time of silking between plants that received the different rates of fertilizer.

Effect of Liquid Organic Fertilizer on the Dry Grain Yield of Maize

The response of dry grain yield to liquid organic fertilizer are shown in Table 2. The table showed that maize plant which received liquid organic fertilizer at the rate of 15 litres/hectare on topsoil out-yielded other plants including their control counterparts. During the first trial, the yield of maize plants which received soil-applied fertilizer was superior to plants which received fertilizer through other locations. The performance of plants that obtained liquid organic fertilizer through foliar + topsoil was poorest. While 15 l/ha liquid organic fertilizer produced significant yield difference, other rates of application were statistically similar. The yield of plant that obtained 5 l/ha liquid organic fertilizer was smallest, followed by the control. The trend was the same during the second trial.

Table 1: Physico-chemical Properties of the Experimental Site

Soil properties	**Value**
Particles size distribution (%)	
Sand	66.3
Silt	26.3
Clay	7.4
Textural class sandy clay	
Soil pH (H_20)	5.7
Org. C (g Kg^{-1})	0.05
Total N (gkg^{-1})	0.12
Available P ($mgkg^{-1}$ soil)	9.3
Exchangeable cations (cmol kg^{-1})	
Ca	1.86
Mg	1.42
K	0.07
Na	0.12
ECEC (cmol kg^{-1})	8.45
Base saturation (%)	41.1

Legend: % = Percentage, H_20 = Water, Org. C = Organic carbon, gkg^{-1} = gram per kilogram, N = Nitrogen, P = Phosphorus, mgkg-1 =Milligram per kilogram, cmol kg^{-1} = centimole per kilogram, Ca = Calcium, Mg = Magnesium, K = Potassium, Na = Sodium, ECEC = Exchangeable Cation Exchange Capacity.

Table 2: Effect of Liquid Organic Fertilizer on Days to 50% Tasseling and Silking, and Dry Grain Yield (Kg/Ha) of Maize

Location of application	**Rate of LOF (l/ha^{-1})**	**Tasseling**		**Silking**		**Dry grain yield**	
		2005	**2006**	**2005**	**2006**	**2005**	**2006**
	5	57.3	60.3	71.7	69.3	2.8	3.3
Foliar	10	58.7	62.3	73.3	70.3	3.5	3.6
	15	56.0	54.0	66.0	67.7	4.2	4.5
	18	60.3	62.0	73.3	71.7	3.2	3.3
	20	62.3	56.3	68.0	74.0	3.9	3.9
	25	60.3	61.0	73.0	68.3	3.8	3.8
	Mean	**59.3**	**59.3**	**71.0**	**70.3**	**3.5**	**3.7**
	5	61.7	62.0	73.3	73.0	3.4	3.8
Top soil	10	58.0	60.3	72.0	70.0	3.5	3.7
	15	57.3	53.0	65.0	68.0	5.0	5.4
	18	58.3	56.3	67.7	70.0	4.2	4.4
	20	58.0	53.3	66.0	69.0	3.6	3.8
	25	58.0	60.7	72.3	69.3	4.0	4.3
	Mean	**58.7**	**57.7**	**69.7**	**70.0**	**3.9**	**4.2**
	5	64.0	55.7	68.0	74.7	3.6	3.6
Foliar + Top soil	10	60.3	62.3	75.0	71.7	3.4	3.5
	15	57.0	55.3	67.7	66.7	4.4	4.7
	18	57.7	64.0	75.7	66.7	2.8	3.2
	20	54.7	56.0	67.7	66.3	3.1	3.2
	25	58.3	57.0	69.3	70.3	3.2	3.3

	Mean	**58.7**	**58.3**	**70.7**	**70.0**	**3.4**	**3.6**
	CV%	6.9	4.2	5.6	3.4	22.9	15.8
	Location	7.0	2.7	7.4	2.3	0.5	0.5
LSD	Rate of LOF	3.9	2.4	3.8	2.3	0.6	0.6

Legend: LOF = Liquid Organic Fertilizer, CV% = Coefficient of variability in percent, l/ha^{-1} = Litres per hectare

Discussion

Soil Physico-chemical Properties of the Experimental Site

The sandy texture of the experimental site may be attributed to the Parent Material (PM) from which the soil was formed and the climate of the area. The soil might be formed from sandstone and quartz parent materials. These impart sandy texture to the soils. The high sand content of the soil could be attributed to high content of quartz in the material (Brady and Weils, 1999). The acidic nature of the soil of the area may be traced to the marked leaching of exchangeable bases resulting from the high rainfall associated with the environment and the dissociation of strong and functional group in the organic matter. This is in harmony with the findings of Esu (2001).

The low organic matter status of the experimental site could be attributed to the rapid decomposition of organic matter due to high solar radiation and moisture, this favours optimum microbial activities in the soil, It could also be attributed to the annual seasonal bush burning which tend to deplete organic matter accumulation in the soil (Landor, 199l).

The low level of total nitrogen could be due to high temperature. It could also be attributed to leaching of' nitrate by torrential rainfall prevalent in the environment (Brady and Weils, 1999).

The high level of' Phosphorus may be attributed to either of these reasons: (i) history of land use and cultural practices associated with the land use (that is, cropping of crops that took much P nutrient from the soil and non application of P organic fertilizers (Nnaji *et al.,* 2002). (ii) The parent material from which the soil was formed may not be too rich in P minerals (Brady and Weils, 1999). (iii) The soil may not be highly acidic as to cause high level of fixation (Brady and Weils, 1999, Isirimah *et al.,* 2003). The low values of exchangeable cations may be attributed to the leaching of bases from the solum due to high rainfall characteristics of the area. The low cation exchange capacity could be attributed to the PM from which the soil was formed, and low organic matter (OM) content of the soil. The PM from which the soil was formed may be poor in basic nutrients. FMANR (1990) noted that soils of the study area was dominated by Fe oxide and Kaolinites. These clay minerals are low in basic cations (Brady and Weils, 1999). The results, generally, are in harmony with the findings of Nnaji *et al.,* (2002) which reported that the history of land use and cultural practices affect soil conditions and crop productivity.

Effect of Liquid Organic Fertilizer on days to 50% Tasselling of Maize

Plants that received 15 1/ha liquid organic fertilizer tasseled earliest followed by plants that received 20l/ha, then 51/ha before plants on the control subplot. Plants that received 101/ha were last to tassel. The order of tasselling based on location of fertilizer was topsoil > foliar + topsoil > foliar. The earliness in time of tasselling resulting from application of liquid organic fertilizer on topsoil favours early maturity period and is similar to the report by Microsoft Corporation (2003) that liquid organic fertilizer acts as substrate for micro-organisms which help in biological stimulation of growth, improves vitality, plant vigour, and decreases crop maturity period.

Effect of Liquid Organic Fertilizer on Days to 50% Silking of Maize

Plants produced with 15 1/ha of liquid organic fertilizer developed silk earliest followed by plants that received I 81/ha fertilizer. Plants that received 51/ha fertilizer produced silk lastly. Based on location of fertilizer, plants that received fertilizer on topsoil produced silk first, followed by foliar + topsoil, before foliar (Table 2). The earliness in time of silking of maize plants that received liquid organic fertilizer on topsoil at the rate of 151/ha is similar to the findings of Galal *et al.* (2000) that liquid fertilizer promotes crop growth and healthy development. It is also in accordance with the findings of Fisinin *et al.* (1999) and Hedge *et al.* (1999) who reported positive responses of cereal crops to bio-fertilizer application.

Effect of Liquid Organic Fertilizer on Dry Grain Yield of Maize

The grain yield of plants that received 151/ha of organic fertilizer was highest; followed by plants that received 251/ha. Plants that received 101/ha had the smallest grain yield. Plants in the control treatment produced more than plants that received 51/ha and 201/ha of liquid organic fertilizer. Soil-applied fertilizer produced better result than fertilizer applied on other locations (Table 2). Apart from plants that received 151/ha fertilizer, other rates of application were statistically the same. The enhanced growth and yield of maize due to application of liquids organic fertilizer is similar to the findings of Chauhan *et al.* (1995); Mehta *et al,* (1995): Snehal *et al,* (1998) from *Brassica juncea* plants when liquid organic fertilizer was used. Also, Ramazan *et al,* (1999) showed that barley seed yield increased more than their control counterparts. It is also in accordance with the report of Buragohain (2000) who found that sugar cane cultivar COBLN 9003 yield was significantly higher in the cultivated crops with liquid organic fertilizer than other crops. The increase in yield of plants that received liquid organic fertilizer could be attributed to influence of micro-and macro-elements, which promote yield increases, contained in the fertilizer (Zodape, 2001).

Conclusion and Recommendations

The study was carried out to investigate the effects of liquid organic fertilizer on time of tasseling and silking of maize (*Zea mays*).
Days to 50% tasseling and silking of maize was known by direct counting.

Based on the results of the study, the following major findings and conclusions were made: (1) Time of tasseling and silking of maize was affected by different application rate of liquid organic fertilizer. (2) Fifteen (15) litres per hectare of liquid organic fertilizer produced the best result in terms of time of tasseling and silking of maize which suggests or indicates most favourable rate of application for maize production. (3) Soil applied fertilizer enhanced early tasseling, silking, maturity and yield of maize.

In view of the results and findings from the study, it is recommended that farmers apply liquid organic fertilizer at 15 liters per hectare through the topsoil for early tasseling, silking and increased grain yield of maize.

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