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Influence of Fertilizer Types and Weeding Regimes on Improved Maize Variety

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ABSTRACT
Field experiment was carried out at the Crop Production Research Farm of the Federal University of Agriculture, Abeokuta, Nigeria (70 15'N 3º25'E), during the period of July 2014 to September 2014 to determine the effect of fertilizer types and weeding regime on improved variety of maize. The experiment was laid out in a split-plot arrangement fitted in a Randomized Complete Block Design in three replicates. The main plot consisted of two types of fertilizers (Organomineral and Inorganic) applied at the rate of 2.5 t/ha and 120 kg N/ha respectively, and no fertilizer. The sub -plot consisted of four weeding regimes namely weeding once at three weeks after planting (WAP), weeding twice at 3 and 5 WAP, weeding at 3, 5 and 7 WAP and weeding at 3, 5, 7 and 9 WAP. Data collected include plant height, leaf area per plant, stem girth, cob length, cob girth, grain yield, weed occurrence and density, The study showed that inorganic and organomineral fertilizers play a significant role in enhancing the growth and yield of maize. The application of inorganic fertilizer and weeding at 3, 5 and 7 WAP (weeding 3 times) significantly enhanced maize grain yield. Weed control was better improved using organomineral at 2.5 t/ha than inorganic fertilizer at 120 kgN. Based on the result of this study, inorganic fertilizer at 120 kgN/ha and weeding three times at 3, 5 and 7 WAP could be recommended for optimum yield of improved maize variety
Keywords: Fertilizer, weeding , organominerals, inorganic, density

INTRODUCTION
Maize was introduced into Africa in the 1500s and has since become one of Africa's dominant food crops. Like many other regions, it is consumed as a vegetable although it is a grain crop. The grains are rich in vitamins A, C and E, carbohydrates, and essential minerals, and contain 9% protein. They are also rich in dietary fiber and calories which are a good source of energy (Mashingaidze, 2004; IITA, 2012). Maize is not only an important human nutrient, but also a basic element of animal feed and raw material for many manufacturing industries. Nigeria was ranked the 10th largest producer of maize in the world, and the largest maize producer in Africa, followed by South Africa (IITA, 2012)
The constraints of small scale farmers in increasing crop yield in Nigeria include, small farm size, inadequate fertilizer supply and weed infestation. Weeds have been a problem to man ever since he began cultivating crops about 10,000 BC. Weeds can deprive the crop of 30-50% of the applied nutrients and 20-40% of the soil moisture. Yield losses due to weeds in maize range between 20-100% in the

Philippines, Brazil, America, Gambia, Sierra Leone and Nigeria (Ibrahim and Hamma, 2012). Variation in crop and weed responses to soil fertility regimes indicate the need for better understanding of interactions between management practices and species specific physiological and morphological characteristics. The timing of nutrient availability relative to crop and weed demands upon nutrient supplies appears to be very important for determining the outcome of competitive interactions. All crops and weeds have the basic nutrient requirement. Interactions between soil amendments and time of weed removal could affect the growth and yield response of maize crop.

Nigerian farmers' access to fertilizer is limited by fund scarcity and late distributions. It is therefore necessary to source for locally available, cheap and environmental friendly materials that can be used solely. Organic materials have advantages of being environmentally friendly
and capable of promoting crop growth and increasing yield by improving soil physical, chemical and biological properties. A significant increase of agricultural production depends on the adoption of modern technologies, especially much greater use of mineral fertilizers and improved crop management techniques that can increase yields while protecting the integrity of the resource base (Julio and Carlos 1999).

Organomineral fertilizer also known as humic fertilizers are fertilizers that consist of organic matter and mineral compounds bound to it either chemically or by adsorption. Organomineral fertilizer is a low input technology of improving the nutrient status of tropical soils for sustainable crop production. They combine the attributes of both organic and inorganic fertilizers (Ayeni, 2008). The recent interest in organomineral fertilizers arose from high cost and scarcity of inorganic fertilizers and the bulky nature of organic fertilizers required by crop (Makinde *et al.,* 2010). Organomineral fertilizer is also a type of fertilizer comprising of composite organic wastes and inorganic materials. It is produced commercially through fortification or blending of composite organic wastes, such as cow dung, poultry droppings, market refuse, household refuse and plant residues with inorganic materials, such as urea and rock phosphate for sustainable agricultural production

Nweke *et al* (2013), investigated the Effect of organomineral fertilizer on growth and yield of maize at Igbariam, Southeastern, Nigeria and reported that the application of organomineral fertilizer significantly ($P \leq 0.05$) increased plant height, leaf area index at 90 Days after sowing, number of maize cobs, maize ear length and maize grain yield over other treatments.

Similarly, proper timing of weed removal and improvement of soil fertility through soil amendments can enhance the growth performance of maize and its competitive advantage over weeds thus boosting the yield of the crop. There are scanty research information on the interaction between organomineral fertilizer and weeding frequency in maize production. The objective of this study therefore was to assess the growth and yield performance of early maturing maize variety as affected by inorganic fertilizer, organomineral fertilizer and weeding regime.

MATERIALS AND METHODS

An experiment was conducted at the Teaching and Research Farms, Federal University of Agriculture, Abeokuta Ogun State, located at 07º 20'N; 023 E; 76 m above sea level in the Southern Derived Savanna Agro-ecological zone of South Western part of Nigeria. Samples of soil and organomineral fertilizer were collected for analysis to determine their physical and chemical properties. The trial was laid out in split-plot arrangement fitted in Randomized Complete Block Design with three replicates**.** The main plot (fertilizer types) consisted of no soil amendment, application of 120kg N of inorganic fertilizer at 2 and 6 weeks after planting (WAP) and application of 2.5 t/ha of Organomineral fertilizer at 2 WAP.

The subplot (weeding regime) consisted of weeding at 3 WAP, weeding at 3, 5 WAP, weeding at 3, 5, and 7 WAP and weeding at 3, 5, 7 and 9 WAP. Field was laid out, subsequent to ploughing and harrowing with each plot measuring 2.5m X 3m.

Maize variety, Oba Super 2 were sown at a spacing of 75 cm by 25 cm between and within rows .120 kgN/ha of inorganic fertilizer was applied in two splits at 2 and 6 weeks after planting (WAP) using NPK

15-15-15 and Urea respectively while 2.5 tons ha^{-1} of Organomineral fertilizer was applied at 2 WAP. Hoe weeding was done four (4) times according to treatments at 3, 5, 7 and 9 WAP.
Data were collected on Plant height, Stem girth, Leaf area (cm^2), Cob weight (g), Cob length (cm), Cob girth (mm), Grain yield (tones /ha). Weeds Samples were collected using a 0.5 m x 0.5 m quadrat and sorted out into Broad Leaves, Sedges and Grasses and counted to determine the weed density.
All Data collected from the study was subjected to Analysis of Variance using GenStat Discovery 12th Edition while the means were separated using Least Significant Differences (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

Physical and chemical properties of soil samples and organomineral fertilizer

The result presented in Table1 showed that the soil is sandy loam. The sandy loam texture of the experimental site may be attributed to the parent material from which the soil was formed and the climate of the area is attributed to high content of quartz in the material (Brady and Weils, 1999). Soil pH (H_20) was 6.0 (USDA, 1998). Total N, K and available P in the soil were 0.12, 0.42 and 35.72. The total nitrogen obtained from the soil was lower than the critical value of 0.15.

Weed occurrence at Experimental Site

The list of weeds, their family, community form and their level of occurrence throughout the experimental period are presented in table 2 below. *Tridax procumbens* Linn. occurred most among the broad leaf weeds while *Euphorbia hirta* L. had the least level of occurrence . *Bracharia deflexa* Schumach., recorded the highest number of occurrence among the grasses while *Imperata cylindrical* (L.) P.Beauv., had the least level of occurrence. For sedges, *Kyllinga erecta* Schumach occurred most while *Cyperus rotundus* Linn had the least level of occurrence.

Plant Height (cm)

Table 3 shows that there were no significant differences among the plant height in maize as influenced by fertilizer types between 3 to 7 WAP while significant differences were observed at 9 WAP. Inorganic fertilizer gave the highest plant height at 9 WAP while the least plant height was recorded from plants not fertilized. The plant height generally increased in all the plots irrespective of the fertilizer types applied.
Weeding regime had significant effect on plant height between 3 to 7 WAP. Weeding at 3, 5 and 7 WAP had the highest plant height at 5 and 9 WAP . Similarly, weeding at 3, 5 and 7 WAP had the highest plant height at 3 and 7 WAP. However no significant differences were observed among plant height at 9 WAP as influenced by weeding regime. This higher plant height obtained with weeding 3 times could be attributed to reduced weed competition with maize and
better resource sharing among the crop stands.

Stem Girth

Table 4 shows that there are significant differences among the stem girths of maize as influenced by fertilizer types between 5 to 9 WAP, however there was no significant effect at 3 WAP. Inorganic fertilizer had the highest stem girth at 7 WAP while the lowest was recorded in plots with no fertilizer application at 9 WAP. Generally stem girth increase with time from 5 to 7 WAP and later decrease at 9 WAP irrespective of fertilizer types applied.
The effects of weeding regimes on stem girth were significant ($P \leq 0.05$) between 3 and 9 WAP. The least stem girth was recorded from plot weeded at 3, 5, 7 and 9 WAP throughout the period of experimentation. The highest stem girth was recorded from plots weeded three times at 3, 5 and 7 WAP.
There was no significant interaction between the fertilizer types and weeding regime on the stem girth.

Leaf Area (cm^2)

Except at 9 WAP, there were no significant differences among the maize plants with regards to leaf area throughout the period of observation (table 5). The leaf area varied significantly ($P \leq 0.05$) throughout the experimental period with weeding at 3 and 5 WAP giving the highest leaf area of 636.29cm² at 9 WAP. The least leaf area was recorded at 9 WAP from plot weeded at 3, 5, 7 and 9 WAP. Weeding at 3, 5, 7 and 9 WAP had the least leaf area at 3 WAP. No significant interaction was observed between the fertilizer types and weeding regime on leaf area.

Effects of Fertilizer Types and Weeding Regimes on yield parameters of improved maize variety

It was observed that application of inorganic fertilizer and organomineral do not have any significant effect on cob weight, cob girth and cob length whereas significant differences were observed in the maize grain yield. Organomineral applied at 2.5 t/ha out yielded the other treatments with 3.66 t/ha of grain yield (Table 6).

The effect of weeding regime on the maize cob weight, cob girth and cob length were not significant. However, weeding frequency affected grain yield of maize significantly ($P \leq 0.05$).Weed removal three times at 3, 5 and 7 WAP gave the highest cob weight and grain yield of 84.30g/plant and 3.75t/ha respectively (Table 6). Weeding three times at 3, 5 and 7 WAP significantly increased growth and yield parameters in improved maize variety. This could be as a result of keeping the field free of weeds for proper establishment and growth of maize and hence higher competitive advantage over the weeds which they actually suppressed. This implies that maize is sensitive to weed and therefore would do better if it is kept weed free (Agber and Ali, 2012). The early stage of a maize plant (first three weeks) is very sensitive to weed competition. If maize growth is affected by weeds in its early stages of growth it may not recover fully, even when weeds are controlled subsequently.

There was no significant interaction between fertilizer types and weeding regime on cob weight, cob length, cob girth and grain yield (Table 6).

Weed Density

Table 7 shows that weed density was not significantly affected by fertilizer types at 3, 5, 7 and 9 WAP. The weed density generally decreased from 3 to 9 WAP except organomineral fertilizer where weed density increased from 7 to 9 WAP.

Weeding regime generally significantly ($P \leq 0.05$) affected the weed density at 3 and 5 WAP with weed removal three times at 3, 5 and 7 WAP and weed removal at 3 and 5 WAP giving the highest weed density respectively. The least weed densities were recorded from plot weeded 3, 5, 7 and 9 WAP and maize weeded at 3, 5 and 7 WAP at 3 and 5 WAP respectively.

There was no significant interaction between fertilizer types and weeding regime on weed density.

CONCLUSION

The study has shown that inorganic and organomineral fertilizers are very important for growth and yield of maize. The results obtained indicated significant differences were observed in plant height, stem girth, leaf area, and grain yield of maize when fertilized with inorganic fertilizer at 120kg N/ha. The application of inorganic fertilizer and weeding at 3, 5 and 7 WAP (weeding 3 times) significantly enhanced maize grain yield. Weed control was better enhanced using organomineral at 2.5 t/ha than inorganic fertilizer at 120kgN.

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Table 1: Physical and chemical properties of soil and organomineral fertilizer before planting

Properties	**Soil**	**Organomineral**
Ph	6.05	5.28
N (%)	0.12	0.56
Organic carbon (%)	1.92	0.64
Available P (mg/kg)	35.72	0.32
Fe (ppm)	8.75	-
Mn (ppm)	3.14	-
Zn (ppm)	6.8	-
Cu (ppm)	2.85	-
Na (centimol/kg)	0.68	0.38
K (cmol/kg)	0.42	0.38
Ca (cmol/kg)	1.24	0.19
Mg (cmol/kg)	0.96	6.81
Sand (%)	73.8	-
Clay (%)	13.35	-
Silt (%)	12.78	-
Textural class	Sandy loam	-

Table 2: Weed occurrence at the Experimental Site

Weed types	Family	Community form	Level of occurrence
Broad leaves			
Chochorus olitorius	*Malvaceae*	Annual herb	51
Passiflora spp	*Passifloraceae*	Annual herb	115
Tridax procumbens Linn.	*Asteraceae*	Annual herb	762
Euphobia heterophylla Linn.	*Euphorbiaceae*	Annual herb	19
Euphorbia hirta L.	*Euphorbiaceae*	Annual herb	1
Cleome viscosa L.	*Cleomaceae*	Annual herb	12
Spigelia anthelmia Linn.	*Logamiaceae*	Annual herb	8
*Ph*ysalis *angulata* Linn.	*Solanaceae*	Annual herb	4
Synedrella nodiflora (L.) Gaertn.	*Asteraceae*	Annual herb	2
Commelina benghalensis L.	*Commelinaceae*	Perennial herb	34
Ageratum conyzoides Linn	*Asteraceae*	Annual herb	2
Grasses			
Rottboellia cochichinensis Lour.	*Poaceae*	Annual grass	182
Bracharia deflexa Schumach.	*Poaceae*	Annual grass	1444
Imperata cylindrical (L.) P.Beauv.	*Poaceae*	Perennial grass	3
Sedges			
Cyperus rotundus Linn.	*Cyperaceae*	Perennial	1

Table 3: Effects of fertilizer types and weeding regime on plant height (cm) of improved maize variety

	Plant Height (cm)			
	3 WAP	5 WAP	7 WAP	9 WAP
Fertilizer (F)				
No fertilizer	56.01	108.10	126.70	172.50
Inorganic Fertilizer at 120kgN/ha	53.02	122.40	132.80	188.20
Organomineral at 2.5t/ha	54.17	111.50	124.10	183.30
LSD (0.05)	ns	Ns	Ns	11.72*
Weeding Regime (WR)				
Weeding at 3 WAP	52.50	106.30	112.20	177.50
Weeding at 3 and 5 WAP	61.28	129.60	154.30	185.50
Weeding at 3,5and 7 WAP	57.67	129.80	144.00	188.70
Weeding at 3,5,7 and 9 WAP	46.17	90.30	101.00	173.70
LSD (0.05)	5.85***	9.06***	27.84**	Ns
F × WR	ns	Ns	Ns	Ns

WAP –Weeks After Planting, ns- Not Significant, * =significant at 0.05, **=significant at 0.01, ***=significant at 0.00

Table 4: Effects of fertilizer types and weeding regime on Stem girth (mm) of improved maize variety

	Stem Girth (cm)			
	3 WAP	5 WAP	7 WAP	9 WAP
Fertilizer (F)				
No fertilizer	9.48	19.01	20.68	18.84
Inorganic Fertilizer at 120kgN/ha	9.61	21.36	23.54	21.99
Organomineral at 2.5t/ha	8.19	20.35	23.12	20.19
LSD (0.05)	Ns	1.60*	1.46**	1.36***
Weeding Regime (WR)				
Weeding at 3 WAP	8.13	18.78	21.74	19.67
Weeding at 3 and 5 WAP	10.21	22.74	23.59	21.67
Weeding at 3,5and 7 WAP	10.30	22.13	24.79	21.34
Weeding at 3,5,7 and 9 WAP	7.72	17.32	19.67	18.68
LSD (0.05)	1.79**	1.85***	1.69***	1.57**
F × WR	Ns	ns	ns	Ns

WAP –Weeks After Planting, ns- Not Significant, * =significant at 0.05, **=significant at 0.01, ***=significant at 0.001.

Table 5: Effects of fertilizer types and weeding regime on Leaf Area of improved maize variety

	Leaf Area (cm²)			
	3 WAP	5 WAP	7 WAP	9 WAP
Fertilizer (F)				
No fertilizer	131.56	413.91	498.33	543.05
Inorganic Fertilizer at 120kgN/ha	130.80	466.52	558.04	634.62
Organomineral at 2.5t/ha	132.64	425.51	549.48	599.01
LSD (0.05)	ns	ns	ns	51.83**
Weeding Regime (WR)				
Weeding at 3 WAP	114.56	396.89	498.72	581.93
Weeding at 3 and 5 WAP	169.88	493.29	587.71	636.29
Weeding at 3,5and 7 WAP	152.07	495.64	586.67	630.57
Weeding at 3,5,7 and 9 WAP	90.15	355.44	468.04	520.11
LSD (0.05)	24.98***	28.77***	75.07**	59.85**
F × WR	ns	ns	ns	Ns

WAP –Weeks After Planting, ns- Not Significant, * =significant at 0.05, **=significant at 0.01, ***=significant at 0.001

Table 6: Effects of fertilizer types and weeding regime on Cob weight (g), Cob Length (cm), Cob girth (mm) and grain yield of improved maize variety

	Cob weight (g)	**Cob girth (cm)**	**Cob length (cm)**	**Grain yield (t/ha)**
FERTILIZER (F)				
No fertilizer	66.20	4.91	27.69	3.10
Inorganic Fertilizer at 120kgN/ha	72.60	5.14	28.91	3.66
Organomineral at 2.5t/ha	75.90	5.29	27.99	3.26
LSD (0.05)	Ns	Ns	ns	0.45*
WEEDING REGIME (WR)				
Weeding at 3 WAP	59.10	4.92	27.82	3.06
Weeding at 3 and 5 WAP	79.30	5.10	28.50	3.58
Weeding at 3,5and 7 WAP	84.30	5.18	28.74	3.75
Weeding at 3,5,7 and 9 WAP	63.60	5.26	27.72	2.98
LSD (0.05)	15.01*	Ns	ns	0.52*
F × WR	Ns	Ns	ns	Ns

WAP=Weeks After Planting, ns= Not Significant, * =significant at 0.05.

Table 7: Effects of Fertilizer Type and Weeding Regime on Weed Density

	Weed Density			
	3 WAP	5 WAP	7 WAP	9 WAP
Fertilizer (F)				
No fertilizer	82.30	21.30	12.30	10.60
Inorganic Fertilizer at 120kgN/ha	79.90	17.60	17.20	8.70
Organomineral at 2.5t/ha	73.70	16.80	12.80	13.10
LSD (0.05)	ns	Ns	ns	Ns
Weeding Regime (WR)				
Weeding at 3 WAP	61.30	19.40	17.20	15.20
Weeding at 3 and 5 WAP	97.20	24.30	13.80	11.00
Weeding at 3,5and 7 WAP	99.60	14.10	10.00	6.70
Weeding at 3,5,7 and 9 WAP	56.40	16.30	15.30	10.20
LSD (0.05)	33.27*	6.10*	ns	Ns
F × WR	ns	Ns	ns	Ns

WAP –Weeks After Planting, ns- Not Significant, * =Significant at 0.05