Academic Journal of Plant Sciences 5 (3): 90-93, 2012
ISSN 1995-8986

DOI: 10.5829/idosi.ajps.2012.5.3.322

Response of Maize to Combined Application of Nitrogen and Phosphorus Fertilizer Under Different Weeding Regimes in Makurdi in the Southern Guinea Savanna Zone of Nigeria

P.I. Agber and A. Ali

Department of Soil Science, College of Agronomy, University of Agriculture, Makurdi

Abstract: The effect of combined different levels of nitrogen with different levels of phosphorus and weeding regimes was examined at the Teaching and Research Farm of the Federal University of Agriculture, Makurdi. Different levels of nitrogen were combined with different levels of phosphorus to give a single inorganic fertilizer treatment, namely control (no application), 20KgN + 10KgP/ha, 30KgN + 20KgP/ha, 20KgP/ha, 40KgN + 30KP/ha and 50KgN + 40KgP)/ha. These were combined with weeding regimes as follows: W_1 (no weeding), W_2 (weeding once, 3WAP), W_3 (weeding twice, 3 and 6 WAP) and W_4 (weeding thrice, 3 and 6 and 9 WAP) to give a total treatment combination of twenty treatments. Results indicated significant differences among parameters and seed yield upon application of combined levels of Nitrogen and Phosphorus. Similarly, weeding regimes significantly increased growth parameters and maize seed yield. Weeding thrice (3, 6 and 9 WAP) gave higher grain yield than all other treatments. Treatment combination was also significant. Treatment combination of 50KgN + 40KgP/ha + weeding thrice (3, 6 and 9 WAP) produced the highest maize yield in both years. It is recommended that 50KgN + 40KgP/ha and thrice weeding regimes be adopted to high yield of maize in the study area.

Key words: Nitrogen · Phosphorus · Weeding regime · Performance

INTRODUCTION

Maize (*Zea Mays L*) belongs to the family graminae. It is an important grain crop of the world and perhaps the most completely domesticated. In the Southern Guinea Savanna Zone of Nigeria, maize is progressively and increasingly becoming and important component of the diet of the people and the hectarage under the crop is rapidly expanding. Maize production currently is however, largely dependent on the use of scarce and expensive N and P fertilizers; this is because the soils are often deficient in organic matter, N and P.

Maize requires relatively high soil fertility, particularly, N and P for high yield [1, 2, 3]. Significant responses of maize to N fertilizer application have been reported [3, 4]. Phosphorus deficiency in the Southern Guinea Savanna soil is considered one of the single most important yield limiting factors. Economic optimum rate combinations of N with P are therefore necessary for higher yield of maize. Maize is also sensitive to weed interference. Akobundu and Agyakwa [5] and Lutz [6] all reported 40-60% grain yield reduction due to weed interference.

Since it is known that maize needs large amount of N and P and it is sensitive to weed interference; adequate fertilization practices combined with adequate weeding periods have to be employed. In view of the increasing demand for maize, there is need to fashion out better fertilizer management practices combined with adequate weeding regimes to improve the performance of maize. The objective of the study therefore is to evaluate the effect of combined levels of N with P and weeding regimes on the growth and yield of maize in the Southern Savanna Guinea ecological zone of Nigeria.

MATERIALS AND METHODS

The experiment was conducted at the Teaching and Research Farm of the University of Agriculture, Makurdi, Nigeria during the 2007 and 2008 cropping seasons. The soil of the study site was sandy loam broadly classified as an Alfisols [7].

Corresponding Author: P.I. Agber, Department of Soil Science, College of Agronomy, University of Agriculture, Makurdi.

Table 1: The physical and chemical composition of soil (0.15cm) before planting

Parameters	Value
Sand (%)	85.00
Clay (%)	11.70
Silt (%)	3.30
Total N (%)	0.10
Organic Carbon (%)	1.66
Available P (mg/kg)	7.00
Exchangeable bales (Cmol kg^{-1})	
Ca	8.60
K	0.87
Mg	1.69
Na	0.22
$H^{+}Al$ (Cmol kg^{-1})	2.09
CEC	14.60

Top soil (10-15cm depths) samples were taken before planting. Sampling was done across the experimental site. The soil samples were air dried, crushed and sieve with a 2mm sieve. Particle size distribution was done using the hydrometer method and pH measured using he glass-electrode pH meter at 1:1 soil to water ration. The organic carbon content was determined by dichromate wet oxidation method and total N by macro kjeldahl method. Available P was determined by Bray P-1 extracted [8] while the exchangeable cations were determined by extracting with neutral normal NH_4 OAC. The K and Na were measured using the flame photometer while Mg and Ca were determined using atomic absorption spectrophotometer (AAS). Exchangeable acidity was extracted with 1.0 M KCl and determined by titration with NaOH solution. Cation exchange capacity (CEC) was determined by the sub neutral 1m NH_4OA Ac saturation method.

Table 1 shows the physical and chemical properties of the soil at the study site before cropping. The soil is sandy loam with organic carbon and total nitrogen of 1.66% and 0.103% respectively. The pH was 6.50. The available phosphorus was 7,00mg/kg. The values of exchangeable bases, K, Ca, Mg and Na were 0.87, 8.60, 1.69 and 0.22cmol kg^{-1} respectively. Exchangeable acidity and effective cation exchange capacity were 0.040 and 14.60cmol kg^{-1} respectively.

The treatments were a combination of inorganic fertilizer (Nitrogen plus phosphorus) and weeding regimes. The fertilizer treatments comprised of varying N levels with P levels constituted the main-plot treatment, which were: control, T_1, (no application), T_2, (20 kgN/ha and 10 kgP/ha), T_3, (30 kgN/ha and 20 kgP/ha), T_4, (40 kgN/ha and 30 kgP/ha) and T_5, (50 kgN/ha and 40 kgP/ha). Weeding regimes was the sub-plot. The weeding regime include: control, W_1 (no weeding). W_2 (weeding once, 3 WAP), W_3 (weeding twice, 3 and 6 WAP) W4, (weeding thrice 3, 6 and 9 WAP).

The treatment was laid out in a randomized complete block design and replicated four times. Three maize seeds were planted per hole and later thinned to one seeding per stand. The source of N was urea while P was derived from Ammonium phosphorus. The gross plot size was 5 m X 5 m. Data collected were plant height, leaf area, stem growth, days to 50% tasselling and seed yield. Data were analyzed using analysis of variance procedure (ANOVA) LSD (5%).

RESULTS AND DISCUSSION

The effect of varying nitrogen levels combined with different phosphorus levels and weeding regimes on plant height, leaf area, stem diameter, days to 50% tasseling and seed yield are presented in Tables 2, 3, 4, 5 and 6 respectively.

The results presented in Table 2 showed significant increase in plant height with increase in nitrogen and phosphorus levels. The percentage increased over the control in 2008 was 25.74%, 35.38%, 56.32% and 61.75% doe 20N + 10P, 30N + 20P, 40N + 30P and 50N + 40P kg/ha respectively. The same trend was observed in 2007. Weeding regimes significantly increased plant height from 81.90cm for control to 106.70cm for weeding thrice in 2008. However, no significant difference was observed in plant height between weeding twice and thrice in 2007 and 2008. Nitrogen levels combined with phosphorus levels significantly interacted with weeding intervals in maize height.

Table 3 shows the effects of varying nitrogen levels combined with phosphorus levels and weeding regimes on maize leaf area. The results of both seasons showed that application of combined nitrogen with phosphorus at different levels significantly increased maize leaf area from 469.250 cm^2 for control to 492.250, 497.000, 512.250 and 533.000 cm^2 for 20N + 10P, 30N + 20P, 40N + 30P and 50KgN + 30KgP/ha respectively in 2008. Similarly, weeding regimes increased maize leaf area from 486.10 cm^2 and, 497.30 cm^2, to 509.30 cm^2 and 510.30 cm^2 for control and weeding once, twice and thrice respectively. Different nitrogen levels combined with different phosphorus levels and weeding regimes significantly increased maize leaf area.

Table 2: Effects of combined nitrogen levels with phosphorus levels and weeding regimes on Maize height

Treatments	Plant height (cm)	
Nitrogen + Phosphorus levels	2007	2008
Control	67.380	69.250
20N + 10P	84.380	86.380
30N + 20P	91.750	93.750
40N + 30P	106.250	108.250
50N + 40P	129.000	131.000
LSD	1.200	1.219
Weeding Regimes		
Control	80.100	81.900
Once	94.400	96.500
Twice	103.800	105.500
Thrice	104.700	106.700
LSD	1.074	1.090

Table 3: Effects of combined Nitrogen levels with phosphorus levels and weeding regimes on maize leaf area

Treatments	Leaf Area (Cm^2)	
Nitrogen + Phosphorus levels	2007	2008
Control	464.1300	469.250
20N + 10P	487.0000	492.250
30N + 20P	491.7500	497.000
40N + 30P	507.2500	512.250
LSD	0.2000	0.183
Weeding Regimes		
Control	481.1000	486.100
Once	492.2000	497.300
Twice	504.1000	509.300
Thrice	505.1000	510.300
LSD	0.1789	0.164

Table 4: Effects of combined Nitrogen levels with phosphorus levels and weeding regimes on maize stem growth

Treatments	Stem growth (cm)	
Nitrogen + Phosphorus levels	2007	2008
Control	15.00	16.44
20N + 10P	17.85	19.35
30N + 20P	18.00	19.50
40N + 30P	19.26	20.82
50N + 40P	22.56	24.06
LSD	0.019	0.019
Weeding Regimes		
Control	16.26	15.90
Once	17.88	19.35
Twice	19.35	20.04
Thrice	21.45	21.54
LSD	0.017	0.017

Table 5: Effect of combined Nitrogen and Phosphorus levels and weeding regimes on number of days to 50 % tasselling

Treatment	Days to 50% tasselling	
(Nitrogen + Phosphorus levels)	2007	2008
Control	69.50	71.50
20N + 10P	70.00	72.00
30N + 20P	67.00	69.00
40N + 30P	67.25	66.75
50N + 40P	63.00	65.00
LSD	NS	NS
Weeding Regimes		
Control	71.30	71.30
Once	67.50	69.50
Twice	66.70	67.70
Thrice	64.90	66.90
LSD	NS	NS

Table 6: Effect of combined Nitrogen and Phosphorus levels and weeding regimes on seed yield of maize

Treatments	Grain yield (t/ha)	
Nitrogen + Phosphorus levels	2007	2008
Control	0.860	0.910
20N + 10P	1.900	1.960
30N + 20P	2.230	2.280
40N + 30P	2.480	2.540
50N + 40P	3.330	3.380
LSD	0.009	0.004
Weeding Intervals		
Control	1.610	1.660
Once	2.230	2.280
Twice	2.480	2.540
Thrice	2.450	2.500
LSD	0.008	0.004

Table 4 shows the effects of varying nitrogen levels combined with phosphorus levels and weeding regimes on stem diameter. Application of nitrogen levels combined with phosphorus levels and weeding intervals significantly increased stem girth from 15.00 cm for control to 22.56 cm for 50 KgN + 40 Kg P/ha. Similar results were obtained in 2008. Weeding regimes significantly increased maize stem growth from 16.26 cm for control to 21.45 cm for weeding thrice in 2007. Similar results were also obtained in 2008. Nitrogen levels combined with phosphorus levels also significantly interacted with weeding regimes in maize stem growth.

The effects of varying nitrogen levels combined with phosphorus levels and weeding regimes on number of days to 50% tasselling and seed yield are presented in Table 5 and 6 respectively. They were no significant difference between the combined fertilizers levels and weeding intervals on days to 50% tasselling. Significant differences however exist between the combined fertilizers levels and weeding regimes on maize gain yield. The mean effects of nitrogen levels combined with phosphorus levels on grain yield were 0.87 t/ha for control to 3.33 t/ha for 50KgN + 40KgP/ha in 2007. The percentage increase in grain yield over the control in 2007 were 119.36%, 158.09%, 263.25% and 285.26% for 20N + 10P, 30N + 20P, 40N + 30P and 50KgN + 40KgP/ha respectively.

The significant increases in plant height, leaf area, stem diameter growth and maize grain yield with increasing nitrogen levels combined with phosphorus levels are in agreement with the findings of Aitu [2], Caitt [4] and Veen [3]; who reported significant increases in the same maize growth and grain yield with increasing N levels. The non significant influence of combined levels of N and P on days to 50% tasseling also is in agreement with that reported by Makinde *et al*. [9]. The result was however different from that earlier obtained by Aitu [2], Cait [4] and Veen [3]. The significant increases in the growth parameters in the growth parameters and grain yield of maize associated with increasing N and P combined with P levels clearly confirm the indispensability of N and P in the nutrition of maize.

Nitrogen is an active constituent of protoplasm, enzyme and chlorophyll and also plays a role of catalytic agent in various physiological processes. It also accelerates cell division and speeds up photo assimilation process, which in turn, boosts up growth with resultant high yield. Phosphorus on the other hand plays an important role in breathing and in the energy supply. It promotes the development of roots in ground plants. It also has a positive effect on the number of grains per spike and the grain weight, hence higher levels of P result into significant increase in grain yield [2]. The best performance of maize in terms of growth parameters and grain yield consistently observed in weeding thrice (3, 6 and 9 WAP) clearly points to the superiority of keeping the field free of weed. This also showed that early Weeding (3 WAP) and subsequent weeding at 6 and 9 incidence of weed - maize competition for growth resources. Thus, weeding early at 3 WAP and subsequent weeding at 6 and 9 WAP provided an initial and continuous weed-free environment for proper establishment and growth of maize and hence higher competitive advantage over the weeds which they actually suppressed. Again, early weeding especially at 3 WAP promotes early flowering in maize. From the findings, weeding thrice (3, 6 and 9) proved superior to no weeding, weeding once (at 3 WAP) and weeding twice (at 3 and 6 WAP). This implies that maize is sensitive to weed and therefore would do better if it is kept weed free. The significant interactions between combined N levels with P levels and weeding regimes imply that the magnitude of the differences observed in the growth and yield of maize among the various levels Of combined N with P was affected by weeding treatments.

CONCLUSIONS

The result of this study revealed that increasing N levels with P levels significantly increased the growth and grain yield of maize. Keeping maize weed-free i.e. weeding thrice at (3, 6 and 9 WAP) significantly increased the growth and grain yield of maize much more than no Weeding, weeding once (3 WAP) and weeding twice (3 and 6WAP).

REFERENCES

1. Osundaire, B., 2001. Effects of Fertilizer Types and different companion crops on the performance of Cassava. PhD Thesis, University of Ibadan, Nigeria, pp: 199.
2. Aitu, B.O., 2004. The effects of tillage practices and NPK Fertilization on the Growth, yield and yield Quality of Cereals. Crop Sci., 4(1): 205-209.
5. Akobunde, U.J. and C.W. Agyakwa, 1987. Handbook of West African weeds. IITA Publication, pp: 350.
3. Veen, R.J., 2007. Influence of Organic and Chemical fertilizers on the growth, yield and yield components of maize. Journal of Crop Science Res., 7(6): 751-756.
4. Caitt, B.E., 2005. The growth and yield parameter of maize as influenced by varying plant densities and NPK fertilization. Journal of Applied Sci., 3: 18-24.
6. Lutz, C.A., 2007. Effects of different weeding regimes and fertilizer types on the performance of Maize. Weed Science Research, 8(3): 333-338.
7. United States Department of Agriculture (USDA), 1975. Agricultural Handbook, No. 436 SCA/USA. Washington D.C., USDA, pp: 200.
9. Makinde, F.A. A.A. Agboola and F.I. Oluwatoyinbo, 2001. The effects of organic and inorganic Fertilizers on the growth and yield of maize in a maize/melon intercrop. Moor Journal of Agricultural Res., 2: 15-20.
8. Mclean, E.O., 1982. Soil pH and Lime requirement. In: Methods of Soil Analysis Part 2. A.L. Page, (ed). Am. Soc. Agronomy. Madison 101 USA, pp: 199-234.