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(RESEARCH ARTICLE)

Performance of maize (*Zea mays*) as influenced by intra-row spacing and weeding regime in Anyigba, Kogi State, Nigeria

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Abstract

In the 2017 and 2018 wet seasons, field trials were conducted at the Teaching and Research Farm of Kogi State University, Anyigba to examine the performance of maize (*Zea mays*) as influenced by intra-row spacing and five weeding regimes. The experimental design was a slit-plot in a randomized complete block design replicated three times with intra-row spacing allocated to the main plots and weeding regimes allocated to the sub plots. The treatments were three intra-row spacings (20, 25 and 30cm) and five weeding regimes (one hoe-weeding at 3WAS, two hoe-weeding at 3 and 6 WAS, one hoe-weeding at 6 WAS, regular weeding up to 8 WAS and the weedy check).Results indicated that intra-row spacing had no significant effect on days to 50% tasseling and on plant height at maturity. Grain yields were impressive in plots hoe-weeded twice at 3 and 6 WAS as well as those subjected to regular weeding up to 8 WAS. The effect of regular weeding on the growth and yield of maize was negligible compared to that in plots subjected to two hoe-weeding at 3 and 6 WAS. This showed that regular weeding up to 8 WAS in maize production was superfluous. As revealed in this study, maize grain yield increased with wider intra-row spacing in the order of 30 cm > 25 cm > 20 cm.

Keywords: Performance; Weeding regime; Intra-row; Plant population; Grain yield

1. Introduction

Maize is a major cereal crop third in world production after wheat and rice [1]. Maize production in Nigeria was initially restricted mainly to the forest zone but the production has now expanded to the savanna where it accounts for over 70% of the production in the country [2]. It is a cereal crop widely consumed [3]. It is used as staple food in the developing countries as feed for livestock in the temperate and advanced countries and finally as raw materials for many products [4]

The various food types made from maize are available in different parts of Nigeria [5]. It is a major cereal crop of great importance for food, feed and industrial processing in sub-sahara Africa [6]. Maize is fast replacing other cereals such as millet, sorghum and rice in Nigeria [7].

It is a staple food among the people of Kogi State most especially the Igala ethnic group that constitutes the bulk of the state human population.

There are numerous factors that militate against the economic production of maize among which is weed infestation. In Nigeria, losses of up to 80% in the potential grain yield of maize have been attributed to unchecked weed growth throughout the crop lifecycle [8]. Plant population on the field which depends on both intra and inter-row spacing influences crop performances [9]. Reports from researches also indicate that yields of arable crops such as maize,

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cowpea, and soybean are increased through the use of appropriate plant population [9, 10, 11]. This study was therefore undertaken to assess the effect of intra-row spacing and period of weed interference on the productivity of maize.

2. Material and methods

Field experiments were carried out at the Teaching and Research Farm of the faculty of agriculture, Kogi state university, Anyigba (7^0 29^1 N: 7^0 11^1E) in the derived guinea savanna zone of Nigeria in 2017 and 2018 cropping seasons. The soil type of the experimental field was a sandy loam high in organic matter and the physio-chemical properties of the soil are presented in Table 1.

Table 1 Physio-chemical properties of the soil (0-20 cm) at the experimental site, Kogi State University Anyigba

Soil property	
Ph	6
Coarse sand (%)	18
Fine sand	41
Clay (%)	10
Silt (%)	35
Organic carbon (%)	0.93
Total Nitrogen (%)	0.06
Available P (ppm)	5.40
Exchangeable K (ppm)	43.46
Ca (ppm)	365.21
Mg (ppm)	80.0
Mn (ppm)	50.2
Fe (ppm)	126.73
Zn (ppm)	1.83
Na (ppm)	13.10
Cu (ppm)	1.43

The treatments were arranged in a split-plot using a randomized complete block design (RCBD) with intra-row spacing allocated to the main plots and weeding treatments allocated to the sub-plots and replicated three times. The treatments consisted of three intra-row spacings (20, 25 and 30cm) and five weed interference treatments. The three intra-row spacing of 20, 25 and 30cm x 75cm (common intra-row spacing) translated to 66,666, 53,333 and 44,444 plants/ha respectively.

Weeds were controlled as stipulated in the weeding treatments by the use of hand hoe. On clearing the field manually, ploughing was done followed by harrowing two weeks later. Ridges were spaced 75cm apart. Sowing of maize seeds was carried out a day after ridging at a depth of 4.0cm. The maize variety planted was DMR-LSR-W obtained from Kogi state Agricultural Development Project (ADP). Two seeds were sown per hole and thinned down to one plant/hole two weeks after sowing. Compound fertilizer applied was NPK 20: 10: 10 at 400kg/ha at 5 weeks after sowing (WAS). Weeding was carried out manually using a hand hoe. There was no further weeding after 6 WAS except plots that were subjected to regular weeding up to 8 WAS. Observations taken included days to 50% flowering, plant height at maturity, stem girth, cob length, cob diameter, 100-seed weight and grain yield/ha. All data were subjected to analysis of variance (ANOVA) and the Duncan's multiple range test (DMRT) was used to compare treatment means at 5% level of probability.

3. Results

Tables2 and 3 show the effects of intra-row spacing and weeding regimes on maize growth and yield components. Intra-row spacing did not show significant ($P < 0.05$) effect on number of days to 50% tasseling. Equally, there were no significant ($P< 0.05$) differences in plant height across the intra-row spacing and weeding regimes evaluated in both years. Weeding once 6 WAS had similar effects as keeping plots weedy (un-weeded) in respect to plant height. It was also observed that keeping plots weedy and weeding once 6 WAS tended to enhance plant height. Intra-row spacing had significant ($P<0.05$) effects on stem girth, cob length, cob diameter, cob dry weight and 100- seed. The improved growth and development of plants subjected to two hoe-weeding treatments at 3 and 6 WAS or regularly weeded up to 8 WAS transformed into significantly higher grain yield than plants in plots hoe-weeded once at 3 or 6 WAS as well as the weedy check. Considering the combined analysis over the two years, weeding once 3 or 6 WAS or leaving the plots weedy throughout the crop life cycle resulted in grain yield losses of 35, 62 and 75% respectively in comparison to two hoe-weeding treatments at 3 and 6 WAS and regular weeding up to 8 WAS. It is to be noted that the two years of study revealed that there was no grain yield advantage of plants subjected to regular weeding up to 8 WAS over those in plots weeded twice at 3 and 6 WAS.

Table 2 Effect of intra-row spacing and weeding regime on the growth on the growth and yield components of maize in Anyigba in 2017

Intra-row spacing (cm)	Weeding regime	Days to 50% tasseling	Plant height at maturity (cm)	Stem girth (cm)	Cob length (mm)	Cob diameter (cm)	Cob dry weight (g)	100-seed weight (g)	Grain yield
75cm x 20cm	One hoe-weeding at 3 WAS	66^{a}	145.3^{a}	4.3^{b}	14.6^{b}	43.6^{b}	50.2^{b}	11.6^{b}	1237.4^{b}
	Two hoe- weeding at 3 and 6 WAS	68^{a}	144.0^{a}	6.4^{ab}	18.3^{a}	47.4^{a}	61.2^{a}	14.6^{a}	1429.8^{a}
	One hoe weeding at 6 WAS	69^{a}	147.6^{a}	4.6^{b}	11.3^{c}	42.0^{b}	47.0^{b}	9.3^{b}	1201.9^{b}
	Regular weeding up to 8 WAS	66^{a}	145.3^{a}	7.2^{a}	19.4^{a}	47.0^{a}	63.0^{a}	15.7^{a}	1486.7^{a}
	Weedy check	68^{a}	148.0^{a}	2.9^{c}	8.4^{d}	24.6^{c}	25.3^{c}	5.4^{c}	410.0^{c}
75cm x 25cm	One hoe-weeding at 3 WAS	67^{a}	145.0^{a}	4.5^{b}	14.8^{b}	51.3^{b}	58.5^{b}	12.0^{b}	1677.2^{b}
	Two hoe-weeding at 3 and 6 WAS	69^{a}	144.6^{a}	9.0^{a}	24.3^{a}	64.7^{a}	97.3^{a}	19.6^{a}	2158.4^{a}
	One hoe-weeding at 6 WAS	68^{a}	148.4^{a}	4.4^{b}	12.0^{c}	45.2^{c}	54.8^{b}	10.7^{b}	1596.7^{b}
	Regular weeding up to 8 WAS	67^{a}	145.2^{a}	9.2^{a}	24.0^{a}	64.2^{a}	98.4^{a}	20.1^{a}	2160.0^{a}
	Weedy check	67^{a}	148.7^{a}	3.0^{b}	9.0^{d}	30.4^{d}	30.2^{c}	9.6^{bc}	514.2^{c}
75cm x 30cm	One hoe-weeing at 3 WAS	67^{a}	144.7^{a}	5.0^{b}	14.2^{b}	49.4^{b}	56.4^{b}	13.7^{b}	1761.0^{b}
	Two hoe-weeding at 3 and 6 WAS	69^{a}	143.8^{a}	9.6^{a}	23.9^{a}	64.3^{a}	98.8^{a}	22.3^{a}	2275.5^{a}
	One hoe-weeding at 6 WAS	69^{a}	147.5^{a}	4.0^{b}	11.7^{c}	47.3^{b}	51.7^{b}	11.8^{b}	1696.4^{b}
	Regular weeding up to 8 WAS	68^{a}	146.0^{a}	9.4^{a}	24.7^{a}	64.8^{a}	99.4^{a}	22.5^{a}	2277.0^{a}
	Weedy check	67^{a}	148.6^{a}	2.8^{c}	8.6^{d}	27.6^{c}	27.0^{c}	9.9^{bc}	572.0^{c}
	S.E $\pm$	3.11	5.43	0.10	0.26	2.10	2.12	0.14	12.65

WAS = Weeks After Sowing; Means in a column followed by the same letter are not significantly different at 5% level of probability according to Duncan's Multiple Range Text (DMRT).

In fact, grain yields obtained from plots regularly weeded were not significantly higher than that got from plants in plots subjected to twice weeding at 3 and 6 WAS. In the two years study, it was found out that the productivity of maize significantly increased with wider intra-row spacing as 1634.41, 1525.40 and 1049.60kg/ha grain yields were obtained from 30, 25 and 20cm intra-row spacing respectively. Irrespective of the intra-row spacing evaluated in the two years of study, the weedy plots recorded the least grain yield.

Table 3 Effect of Intra-Row Spacing and Weeding Regime on the Growth and Yield Components of Maize in Anyigba in 2018.

Intra-row spacing (cm)	Weeding regime	Days to 50% tasseling	Plant height at maturity (cm)	Stem girth (cm)	Cob length (cm)	Cob diameter (mm)	Cob dry weight (g)	100-seed weight (g)	Grain yield (kg/ha)
75cm x 20cm	One hoe-weeding at 3 WAS	66^{a}	144.9 ^{a}	4.0^{b}	12.9^{b}	41.4^{b}	47.5^{b}	9.8^{b}	1021.6^{b}
	Two hoe-weeding at 3 and 6 WAS	68 ^{a}	144.2 ^{a}	5.1^{a}	16.1^{a}	45.1^{a}	69.0^{a}	12.4^{a}	1204.3^{a}
	One hoe weeding at 6 WAS	68 ^{a}	146.1 ^{a}	4.2^{b}	10.4^{b}	44.3^{a}	45.3^{b}	9.0^{b}	983.7^{b}
	Regular weeding up to 8 WAS	67 ^{a}	145.2 ^{a}	6.8^{a}	16.8^{a}	45.4^{a}	69.4^{a}	13.0^{a}	1214.1^{a}
	Weedy check	67 ^{a}	148.0 ^{a}	2.4^{c}	4.7^{c}	21.6^{c}	22.4^{c}	5.0^{c}	306.7^{c}
75cm x 25cm	One hoe-weeding at 3 WAS	68 ^{a}	144.4 ^{a}	4.4^{b}	13.6^{b}	48.7^{b}	56.8^{b}	10.4^{b}	1393.7^{b}
	Two hoe-weeding at 3 and 6 WAS	68 ^{a}	144.2 ^{a}	8.9^{a}	24.0^{a}	65.0^{a}	95.7^{a}	18.9^{a}	2109.6^{a}
	One hoe-weeding at 6 WAS	67 ^{a}	145.7 ^{a}	4.5^{b}	12.0^{b}	43.6^{b}	53.2^{b}	9.3^{b}	1082.0^{c}
	Regular weeding up to 8 WAS	67 ^{a}	144.2 ^{a}	9.3^{a}	24.4^{a}	62.5^{a}	96.6^{a}	19.8^{a}	2114.2^{a}
	Weedy check	68 ^{a}	148.6 ^{a}	2.8^{c}	7.4^{c}	24.8^{c}	27.2^{c}	6.8^{c}	448.0^{d}
75cm x 30cm	One hoe-weeing at 3 WAS	68 ^{a}	145.3 ^{a}	4.8^{b}	13.5^{b}	48.9^{b}	60.1^{b}	11.8^{b}	1632.4^{b}
	Two hoe-weeding at 3 and 6 WAS	67 ^{a}	144.6 ^{a}	9.4^{a}	25.0^{a}	66.0^{a}	96.9^{a}	20.7^{a}	2168.3^{a}
	One hoe-weeding at 6 WAS	67 ^{a}	147.6 ^{a}	4.3^{b}	11.9^{b}	44.8^{b}	53.6^{c}	9.9^{b}	1386.7^{c}
	Regular weeding up to 8 WAS	68 ^{a}	146.4 ^{a}	9.5^{a}	25.0^{a}	62.7^{a}	98.6^{a}	20.9^{a}	2179.0^{a}
	Weedy check	68 ^{a}	148.3 ^{a}	2.6^{c}	6.7^{c}	24.4^{c}	25.4^{d}	6.5^{c}	395.8^{d}
	S.E $\pm$	3.10	5.43	0.06	0.07	2.41	2.52	0.13	13.8

WAS = Weeks After Sowing; Means in a column followed by the same letter are not significantly different at 5% level of probability according to Duncan's Multiple Range Text (DMRT)

4. Discussion

The similar growth of maize in relation to days to 50% tasseling and height across the three intra-row spacing examined could be due to the fact that only one variety of maize was used and thereby having the same genetic constitution.

This is corroborated by [12] who observed a non-significant difference in the height of soybean (Var. TGX 1440 – 1E) based on the same genetic make-up. Comparatively taller plants were recorded in plots kept weedy throughout as well as weeding once at 6 WAS. This could be due to competition between the crop and weeds for the above ground resources, which may bring about etiolation in maize plants. Delaying weeding till 6 WAS was actually detrimental to maize growth and yield as they could not sufficiently recover from weed infestation and consequently resulting to poor grain yield. This result is in agreement with the findings of [13] that optimum yield of maize was achieved when the crop was kept weed-free for three to five weeks after sowing. Irrespective of the intra-row spacing, two hoe-weeding treatments at 3 and 6 WAS resulted in similar growth and grain yield of maize in comparison to regular weeding. Since the grain yields obtained from plots weeded at 3 and 6 WAS and that subjected to regular weeding up to 8 WAS were similar, it is advisable to adopt two hoe-weeding treatments at 3 and 6 WAS in order to cut down labour costs. [14] had suggested two hoe-weeding operations as against weed-free treatment in order to minimize costs in maize production.

5. Conclusion

Based on the results obtained from this study, it is evident that delaying weeding up to 6 WAS brings about poor growth and development of maize. In addition higher grain yield is achieved by lowering plant population through wider intra-row spacing (30cm). However, caution should be exercised against arbitrary increase in intra-row spacing as this could result in abysmally low plant population resulting in marked reduction in maize grain yield.

Compliance with ethical standards

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Disclosure of conflict of interest

The trial is completely devoid of conflict of interest.

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