



PERFORMANCE OF EXTRA EARLY MAIZE (*Zea mays* L.) INFLUENCED BY
WEED CONTROL METHODS AND PLANTING PATTERN

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ABSTRACT

A field trial was conducted during the 2014 rainy season at the research farm of the Institute for Agricultural Research, Samaru (11° 11' N; 07° 38' E) 686m above sea level in the Northern Guinea Savanna ecological zone of Nigeria to study the effects of weed control and planting pattern on productivity of extra early maize. The trial consisted of factorial combination of five weed control treatments which include application of atrazine at 1.0 and 1.5 kg a.i/ha, one hoe weeding at 3 weeks after sowing, two hoe weeding at 3 and 6 weeks after sowing and a weedy check with two planting patterns Single and double rows. The treatments were laid out in a Randomized Complete Block Design with three replicates. Application of Atrazine at 1.5kg a.i/ha produced the least weed cover and weed dry weight. Double row planting also recorded lower weed cover and weed dry weight. Application of Atrazine at 1.5kg a.i/ha and two hoe weeding at 3 and 6 WAS produced the most vigorous and taller plants. Double row planting also produced the most vigorous plants. Application of atrazine at 1.5 kg a.i/ha produced plants with more leaves and also increased days to 50% tasseling while all other weed control treatments with the exception of the weedy check increased days to 50% silking. Application of atrazine at 1.5 kg a.i/ha and the two hoe weedings significantly produced longer, wider and heavier cobs. Single row planting also produced longer wider and heavier cobs. The highest grain yield was obtained in plots treated with atrazine at 1.5 kg a.i/ha while double row planting recorded the highest grain yield. Based on the result of this study it can be concluded that application of Atrazine at 1.5kg a.i/ha with double row planting reduced weed infestation and increased grain yield of extra early maize.

Keywords: Control, Density, Herbicide, Plant and Weed

INTRODUCTION

Maize (*Zea mays* L.) is a cornerstone of global food security, ranking as one of the world's most produced cereals alongside wheat and rice. In Nigeria, it is a vital staple crop for human consumption, a key component in livestock feed, and a raw material for various industries (IITA, 2020). Despite its high yield potential, particularly in the savanna agro-ecology which accounts for the bulk of national production, the average yield in farmers' fields remains significantly below the crop's genetic potential (Kamara *et al.*, 2021).

Two critical agronomic factors constraining maize productivity are inadequate weed management and sub-optimal plant population densities. Maize is highly susceptible to weed competition, especially during the critical growth period of 3 to 6 weeks after sowing (WAS). Uncontrolled weed growth during this phase can lead to severe competition for light, nutrients, and water, resulting in yield losses that can exceed 50% (Oerke, 2020). Effective weed control is therefore essential to unlock the crop's yield potential.



Furthermore, achieving the appropriate plant population through an optimal planting pattern is crucial. Planting at low densities fails to utilize available resources efficiently and can exacerbate weed infestation by allowing lighter to reach the soil surface, thereby stimulating weed germination (Tofa *et al.*, 2020). Conversely, excessively high populations intensify intra-specific competition for resources, potentially reducing yield per plant. The use of improved, compact varieties such as extra-early maize, which have a shorter stature and faster maturity, may necessitate a re-evaluation of planting patterns to maximize their yield potential through better light interception and canopy architecture (Adnan *et al.*, 2017).

While herbicides like atrazine are widely used for weed control in maize, there is a need to evaluate their efficacy in conjunction with modified planting patterns for new varieties. Similarly, the effectiveness of manual weeding, a common practice among smallholder farmers, must be assessed under different spatial arrangements. The specific objectives of the study were to:

- i. determine the productivity of extra early maize under different weed control methods.
- ii. determine the productivity of extra early maize under varying planting patterns.

MATERIAL AND METHODS

The Study Area

A field trial was conducted during the rainy season of 2014 at the Research farm of the Institute for Agricultural Research, Samaru (11° 11'N 07° 38'E and 686 meters above sea level) in the Northern guinea savannah ecological zone of Nigeria.

The trial consisted of factorial combination of five weed control treatments which include application of Atrazine at 1.0 and 1.5 kg a.i/ha, one hoe weeding at 3 Weeks after sowing, two hoe weeding at 3 and 6 weeks after sowing and a weedy check with two planting patterns in single and double rows. The treatments were laid out in a Randomized Complete Block Design with four replicates. The gross and net plot sizes were 18m² and 12m² respectively. The maize variety used was (SAMMAZ 29). It was obtained from the Institute for Agricultural Research, Ahmadu Bello University, Samaru, Zaria. It is found appropriate for Sudan savanna and low land ecologies because of its earliness to maturity and drought tolerance.

Prior to land preparation, glyphosate was applied at the rate of 1.44 kg a.i ha⁻¹ in the experimental site. After 14 days of application, the site was harrowed to a fine tilt thereafter ridges were made at 75cm apart and the field divided into plots and replications according to the experimental layout.

Two seeds were sown manually per hole at an intra and inter row spacing of 25 and 75cm respectively. The plants were later thinned to one plant per stand at two weeks after sowing (WAS). The pre-emergence herbicides were applied immediately after sowing. The equipment used was CP3 knapsack sprayer fitted with a green deflector polyjet nozzle and set at a pressure of 2.1 kg-m² to give a spray volume of 250 L/ha. The spraying was done in the morning when the weather was calm to avoid wind drift. The herbicides were applied on treatment basis. Hoe weeding was carried out on treatment basis.

Fertilizer was applied by side dressing at the rate of 90 kg N, 45 kg P and 45 kg K to supply the recommended inorganic fertilizer treatment. The N was applied in two split doses at 3 and 6 WAS while the P and K were applied at 3 WAS. There were no incidence of pest and diseases observed during the period of the experiment and no control measures were employed. The maize cobs were harvested when the crop attained physiological maturity i.e. when attachment of seeds



to the cob was blackened and the husk had turned brownish. The harvesting was done manually using hand.

Data were collected on weed cover score, weed dry weight (g), stand count, crop vigor score, plant height (cm), number of days to 50% tasseling, number of days to 50% silking, number of ears per plant, cob length (cm), cob diameter (cm), cob weight per plant (g), 100-seed weight (g). Data collected were subjected to analysis of variance as described by Snedecor and Cochran (1967). The treatment means were separated using Duncan's Multiple Range test (Duncan, 1955).

RESULTS AND DISCUSSION

Effect of Weed Control on Weeds

All the weed control treatments significantly reduced the weed cover score (Table 1) and weed dry weight (Table 2) compared to the weedy check which significantly increased the weed cover score and weed dry weight. The reduction of weed infestation by these treatments was as a result of effective weed control which drastically depressed weed growth eventually resulting to lower weed cover scores and weed dry matter. This is in line with earlier reports by Adeosun (1995) and Atangs (1997) who reported that hoe weeding at 3 and 6 WAS has resulted in reduction of weed cover. Also, Mahadi (2011) reported a significant decrease in weed cover and weed dry weight with the application of different herbicides at varying doses and weeding twice at 3 and 6 weeks after sowing as compared to the weedy check.

The weedy check significantly increased weed cover and weed dry weight presumably due to no form of weed control carried out throughout the crops life circle which has resulted in high weed cover score and dry weight. This is in conformity with the findings of Adeosun (1995) Atangs (1997) and Mahadi (2011) who earlier reported that the weedy check produced significantly higher weed cover score than all the other weed control treatments in their various trials.

Effect of Weed Control on Crop Growth and Yield

The growth of extra-early maize as reflected in crop vigour score, plant height and number of leaves (Table 1) were significantly increased by the weed control treatments. The increase in crop growth and yield by these weed control treatments was as a result of effective weed control which had reduced the level of competition for growth resources in the maize crop thereby making them available to the plants and consequently resulting in vigorous crop growth. The weedy check significantly recorded the least crop vigour score throughout the seasons and at all sampling stages. This was due to unchecked weed competition for resources, which resulted in lower crop vigour, shorter plants with a smaller number of leaves, smaller and lighter cobs which ultimately produced smaller grain yield. Similar observations were made by Singh *et al.* (1986) and Mahadi (2011). Crops are known to attain better canopy with higher number of leaves per plant in a less weed competitive situation than in a weedy environment which was reflected in most of the weed control treatments. This was due to growth factors such as nutrients, light, water and space being more available to crops in weed free situation which ensures good leaf formation both in number and size. This observation was in line with the finding of Ndarubu (1997), who reported more leaves in sesame resulting from application of Metolachlor plus Metobromuron at 1.5 and 2.0kg a.i/ha. Similarly, the weed control treatments increased crop yield (Table 2) over that of the weedy check, the increase in yield of this crop by the treatments was due to the effective reduction of weeds which eventually reduced competition for resources. yield increased because the crop was free



from weed during the critical interference period which after emergence in maize, there is a negative correlation between grain yield and field wildness (Pamplous 1988).

Effect of Plant Population on Crop Growth and Yield

The growth and yield of extra-early maize was significantly enhanced by the number of plants per stand within the treatments. The increase in these parameters with increase in plant population agrees with the report by Delgado and Yermanos (1995) and Gupta (1984) in which increase in yield with increasing plant population up to certain level was reported.

The result indicated that there was an increase in seed yield when plant population was increased whereas decrease in seed yield was observed when the population of weed was not managed and this could be attributed to the competition between the weeds and maize plants for resource such as water, light, nutrients, etc. Double row sowing produced the highest grain yield due to higher number of cobs per unit area as compared to single sowing.



Table 1: Effect of weed control treatment and planting pattern on crop vigour score, number of leaves, weed cover score and plant height of extra early maize at Samaru during 2014 rainy season

Treatment		Crop Vigour Score			Number of Leaves			Weed Cover Score			Plant Height (cm)			
		3 WAS	6 WAS	9 WAS	3 WAS	6 WAS	9 WAS	3 WAS	6 WAS	9 WAS	3 WAS	6 WAS	9 WAS	Harvest
Weed control														
	Rate kg a.i/ha													
Atrazine	1.0	7.0ab	6.7b	6.3b	4.6b	6.8bc	12.0ab		3.3b	4.3b	17.8ab	76.7b	123.8b	138.5b
Atrazine	1.5	7.7a	7.8a	7.8a	4.8b	7.6a	12.2a	1.3c	2.0c	2.5d	18.2a	82.0a	123.0a	152.3a
One hoe weeding at 3 WAS		7.0ab	4.7c	3.5c	5.1ab	6.3c	8.8c	6.2a	4.1b	5.2b	16.2ab	62.3c	91.5c	103.1c
Two hoe weeding at 3 & 6 WAS		6.8b	7.1b	7.0a	5.8a	7.5ab	11.1b	3.8c	6.5a	3.8b	17.5ab	78.1ab	130.8a	148.7a
Weedy check		6.3ab	2.8d	1.6d	5.1ab	7.0abc	6.7d	6.5a	7.6a	8.8a	16.2b	38.8d	57.5d	72.7d
SE +		0.26	0.23	0.28	0.21	0.26	0.37	0.32	0.34	0.22	0.55	1.66	1.15	1.64
Planting pattern														
Single row		6.9b	5.7	5.0b	5.1	6.9	10.2	4.7	4.8a	5.5a	17.4	66.3	107.6	123.3
Double row		7.4a	6.0	5.6a	5.1	7.2	10.1	4.9	4.0b	4.3b	17.2	68.9	106.7	122.8
SE +		0.16	0.14	0.17	0.17	0.14	0.24	0.20	0.22	0.14	0.35	1.06	0.73	1.05
Interaction WxP		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a treatment group are statistically similar at 5% level of probability using DMRT

WAS-weeks after sowing

NS not significant



Table 2: Effect of weed control treatment and planting pattern on days to 50% tasseling/silking, cob length/diameter/dry weight, 100 grain weight, grain

Treatment		Days to 50% Tasselling	Days to 50% Silking	Cob length (cm)	Cob diameter (mm)	Cob dry weight (g)	100 grain weight (g)	Grain yield (kg/ha)	Stand Count		Weed dry weight (g)	
									3WAS	Harvest	6WAS	12WAS
Weed control	Rate kg a.i/ha											
Atrazine	1.0	58.1ab	61.8a	11.6b	57.7b	78.1a	16.8c	2240.6b	59.5	57.6a	23.2b	41.3c
Atrazine	1.5	58.6a	62.5a	12.7a	62.0a	80.2a	18.5b	2465.2a	60.7	58.6a	15.6e	35.2d
One hoe weeding at 3 WAS		56.7b	61.6a	10.3c	51.8c	53.0b	12.0d	860.7c	58.7	56.5a	38.5b	51.5b
Two hoe weeding at 3 & 6 WAS		57.6ab	63.0a	18.0a	60.8a	80.7a	21.1a	2126.7b	59.0	56.8a	30.3c	42.6c
Weedy check		50.6c	53.1b	8.0d	36.7d	36.1c	12.0d	346.1d	59.5	52.0b	67.2a	173.0a
SE +		0.56	0.48	0.35	0.72	1.99	0.56	41.33	1.05	0.93	1.57	1.89
Planting pattern												
Single row		56.3	60.4	12.1a	56.2a	68.8a	18.7a	1560.6b	39.4b	36.3b	38.8a	71.9a
Double row		56.4	60.4	10.1b	52.7b	62.5b	19.4d	1655.1a	79.6a	76.3a	31.2b	65.5b
SE +		0.35	0.31	0.22	0.46	1.27	0.35	26.30	0.67	0.59	0.99	1.20
Interaction WxP		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

yield, stand count and weed dry weight of extra early maize at Samaru during 2014 rainy season

Means followed by the same letter(s) within a treatment group are statistically similar at 5% level of probability using DMRT
WAS-weeks after sowing
NS not significant



CONCLUSION AND RECOMMENDATIONS

Based on the factual evidence from this study, it is concluded that effective weed control is paramount for achieving optimal growth and yield of extra-early maize in the Northern Guinea Savanna. The application of Atrazine at 1.5 kg a.i./ha was the most effective treatment, resulting in significantly lower weed biomass, superior crop vigor, and the highest grain yield, which was statistically comparable to the two hoe-weeding treatment. This demonstrates the efficacy of chemical control in suppressing weeds throughout the critical growth periods. Furthermore, the double row planting pattern proved advantageous, contributing to reduced weed infestation and a higher grain yield, likely due to a more efficient plant arrangement that enhanced resource use and weed suppression.

Recommendations

1. For farmers in the Northern Guinea Savanna of Nigeria, the adoption of Atrazine at 1.5 kg a.i./ha, combined with a double row planting pattern, is recommended to maximize grain yield in extra-early maize cultivation.
2. For resource-constrained farmers who rely on manual weeding, two timely hoe-weedings at 3 and 6 Weeks After Sowing (WAS) are a viable and effective alternative, especially when implemented with the double row system.

Remaining Gaps in Knowledge

While this study clearly establishes the superiority of specific treatments, it also points to areas requiring further investigation:

1. **Long-Term Herbicide Impact:** The study was conducted for a single season. The long-term effects of repeated Atrazine application on soil health, microbial activity, and environmental safety in this agro-ecology remain to be evaluated.
2. **Integrated Weed Management (IWM):** The research tested herbicide and manual weeding in isolation. There is a gap in knowledge regarding the potential of an IWM strategy that combines lower herbicide rates with a single manual weeding or the use of cover crops for sustainable and cost-effective weed control.
3. **Socio-Economic Analysis:** The recommendations would be strengthened by a complementary socio-economic study comparing the cost-benefit ratio of the herbicide option versus manual weeding to determine the most economically viable option for smallholder farmers.

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