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Performance of Two Varieties of Maize as Influnced by Plant Spacing In Bali Local Government Area of Taraba State-Nigeria

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Abstract: *Field experiment was conducted at the orchard of the Department of Crop Production Technology, Federal Polytechnic, Bali; to determine the performance of two varietiesof maize (Evat/99/SRT-W and SAMMAZ-15) as influenced by plant spacing. Bali Local Government Area is locatedwithin Guinea Savanna ecological zone of Nigeria. The study area is located within latitudes 7° 12´ N to 9° 00´ N of the equator and longitude 10° 00´ E to12° 00´ E of the Meridian and lies within Guinea Savanna ecological zone of Nigeria (Rajab et al., 2014). The annual rainfall ranges from 75cm to 110cm and the temperature ranges between 22° C – 35° C, while the soil is dominantly of ferruginous tropical type that lies on sandy parent materials (Dada et al., 2006).Randomized Complete Block Design (RCBD) was used, where the main treatments were five levels of spacing: viz. 55cm x 25cm, 65 cm x 35 cm, 75 cm x 45 cm, 85 cm x 55 cm, and 95cm x 65cm. The sub-treatments were the maize varieties.Parameters measured were germination count, plant population at fifth week after sowing (5 WAS), leaf count at 5 WAS, plant height at 6 WAS, plant height at maturity, leaf count at maturity, number of rows per cob, number of seeds per cob, cob weight and 1000 grain weight.The results showed significant differences among the parameters measured.Treatment 5 (95cm x 65cm) recorded the highest mean values for all the yield parameters, such as number of rows per cob (15.6), cob weight (207.96), total number of seeds per cob (603.6) and one thousand grains weight (333.3) all at p = 0.05. The results for sub-treatment (variety) indicated significant differences in the performance of the varieties at p = 0.001.SAMMAZ-15 showed superiority over Evat/99/SRT-W for growth and yield parameters. Therefore, the results of this study indicated that there were differences in the performance of the varieties in response to plant spacing and other agronomic practices under rain fed condition in Bali Local Government Area of Taraba State. Treatment 5 (95cm x 65cm) having highest yield performance and variety 'B' (SAMMAZ-15) which has superior qualities are being recommended to farmers in this agro-ecological zone.*

Keywords: *maize variety, performance, spacing, influence, ecological zone.*

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I. Introduction

Maize (*Zea mays* L.) is an annual crop which belongs to the family Poaceae/Gramineae and Genus Zea. It grows to a height of 1-3 meters. Maize grain contains about 10% protein, 4% oil, 70% carbohydrate, 2.3% crude fibre, 10.4% albuminoidal, 1.4% ash and other vitamins and minerals (3G e-learning, 2014).

Maize requires adequate moisture and warmth from germination to flowering especially a well distributed rainfall of 50cm –75cm for proper growth; and it thrives well on sandy loam to silty loam soils of *p*H range 5.5-7.5, with the optimum temperature for both germination and growth at 21° C and 32° C respectively (Singh *et al*., 2010).

Nigeria is the leading producer of maize in Africa with approximately 8 million tons of maize production, and it is the main staple food crop, the demand of which does not only depend on human and animal consumption, but extends to industries for flour mills, breweries and confectionaries (Sabo *et al*., 2016). Sabo *et al*., (2016) reported Food and Agriculture Organisation (FAO) of the United Nations reported that Nigeria produced 7.1 and 7.8 million tons of maize in 2006 and 2007 respectively and the pattern would potentially rise to 14 million tons.

Reddy, (2013) reported that seedrate and spacing greatly influenced the growth rate and yield output of maize and the former vary from 20-22kg/ha (sometimes 50kg/ha) and 25cm to 100cm respectively, depending on the variety and availability of moisture in the soil. Great differences in grain yield were also observed in different cultivars due to variations in crop management, climatic/edaphic factors and germplasm (Reddy, 2013).

Research in Nebraska showed increase in maize yield under rain-fed condition, when narrow row spacing and high seedrate were adopted (Barr, *et al*., 2013). Similarly, when row spacing narrower than the conventional one was adopted in areas with extended period of rainfall in Southern Brazil, it improved maize grain yield especially those sown early in the growing season (Sangoi *et al*., 2001). However, in a research conducted under dry land conditions in Zimbabwe, Fanadzo *et al*., (2007) observed that narrow row spacing with high maize densities reduced maize grain yield but suppress weeds considerably. Therefore, this research was conducted to determine the best spacing for optimum output on the growth and yield of two varieties of maize (Evat/99/SRT-W and SAMMAZ-15) commonly cultivated in Bali Local Government Area (L.G.A.).

Research Hypotheses

Ho_1= row spacing has no influence on maize grain yield

Ho_2 = variety does not affect the growth and yield of maize at the given spacing

II. Materials And Methods

Field experiment was carried out at the orchard of the Department of Crop Production Technology, Federal Polytechnic, Bali; to determine the performance of two hybrid varieties (Evat/99/SRT-W, as variety 'A' and SAMMAZ-15, as variety 'B') of maize as influenced by plant spacing in Bali L.G.A. The study area is located within latitudes 7° 12´ N to 9° 00´ N of the equator and longitude 10° 00´ E to12° 00´ E of the Meridian and lies within Guinea Savanna ecological zone of Nigeria (Rajab *et al*., 2014). The annual rainfall ranges from 75cm to 110cm and the temperature ranges between 22° C – 35° C, while the soil is dominantly of ferruginous tropical type that lies on sandy parent materials (Dada *et al*., 2006).

Planting was done in the second week of June, when rain had fully established. The field was ploughed using tractor and harrowed using hoe to give fine tilth. The experimental field was marked out into 10 main plots of 5m x 20m each and the subplots were 5 m x 5 m each. Walk ways of 0.5 m was created between the subplots. The experiment was replicated five times.This gave a total experimental field of 28 m x 53m, which accommodate 25 beds for each variety.

Randomized Complete Block Design was adopted, where the main treatments were five levels of spacing: viz. 55cm x 25 cm, 65cm x 35cm, 75 cm x 45 cm, 85cm x 55cm, and 95cm x 65cm, while the sub-treatment was the maize varieties. Three seeds were drilled at the given spacing and later thinned to two seedlings per stand. NPK 20:10:10 was applied once at the rates of 120 kg/ha N, 45kg/ha P_2 O_5 and 40 kg/ha K_2O but N was applied in two splits with the first N application at sowing, as recommended by FAO, (2000). The plots were weeded twice, before fertilizing at three weeks after sowing and at two weeks before tasselling.

Parameters assessed were germination count, plant population at fifth week after sowing (5WAS), leaf count at 5WAS, plant height at 6WAS, plant height at maturity, leaf count at maturity, number of seed rows per cob, number of seeds per cob, cob weight and 1000 grain weight. An average of ten representative samples (in each sub-plot) was used for parameter estimate.

Analysis of Variance (ANOVA) was used to analyse the data generated with the help of 'R' statistical package. Diagnostic plots were used to explore the assumptions of ANOVA and as a result of which, two of the parameters which did not conform to the assumption of the ANOVA were log-transformed. Interactions between the main treatment (spacing) and sub-treatment (variety) were also observed.

III. Results and Discussions

On one hand, treatment 1 (55cm x 25cm) shows the highest mean values for both germination count (89.3) and plant population at 5 WAS (73.4) at p<0.001, while on the other hand,treatment 5 (95cm x 65cm) shows the highest mean values for all the yield parameters, such as number of rows per cob (15.6), cob weight (207.96), total number of seeds per cob (603.6) and one thousand grains weight(333.3) all at p = 0.05 (Table 1). Similarly, treatment 2 shows highest mean values for plant height at maturity (2.20), leaf count at maturity (13.1) and number of rows per cob (15.6). However, treatment 3 shows highest mean values only for leaf count at 5 WAS (11.8), while treatment 4 shows the highest mean values for plant height at 6 WAS (103.8) and leaf count at maturity (13.1) as seen in Table 1 and Figure 1. In a nut shell the general patterns of low yield parameters displayed by treatment 1 (with narrow spacing of 55cm x 25cm) could be explained by the research conducted by Fanadzo *et al*., (2007) where it was observed that under dry land conditions, narrow rows and high maize densities decrease maize grain yield even though it suppressed weeds population.In the same vein, the results contradict the finding of Sangoi *et al*., (2001) and Barr *et al*., (2013) in Brazil and Nebraska respectively, where narrow row spacing and high seed ratesincreased maize grain yield. This could be probably due to higher amount and extended period of rainfall received in those localities because maize, besides being high feeder is also a moisture loving crop.

The results for sub-treatment (variety) indicated that variety 'B' showed superiority over variety 'A' for 70% of growth and yield parameters at p = 0.001 as displayed by their mean values in Table 1. However, only few of the parameters showed significant interactions between main treatment (spacing) and sub-treatment (variety) as seen in Tables 1 and 2. This could be due to variations in the germplasms of the crop varieties as observed by Reddy, (2013) who explained that beside seed rates and spacing, other factors such as soil moisture regime, edaphic factors, crop management and germplasm have significant influence on growth and yield of a crop.

Table 2 shows the mean squares, probabilities of ‘F’, Multiple R-squared, Residual Standard Error (RSE) at 40 degrees of freedom, F-statistic at 9 and 40 df, *p* values and Standard Error for Differences (SED) in means obtained from ANOVA outputs. The mean squares in Table 2 shows that both main and sub-treatments have significant effects at $p < 0.05$ for parameters such as germination count, plant population at 5 WAS, leaf count at maturity and number of rows per cob.

IV. Conclusion And Recommendations

Conclusively, the results show that the null hypothesis (Ho_1) which says row spacing has no influence on maize grain yield should be rejected due to significant variations observed among the five levels of spacing used in the experiment. Similarly, the null hypothesis (Ho_2) which says variety does not affect the growth and yield of maize should also be rejected because of the variations observed between the two varieties on growth and yield parameters.

Therefore, it is recommended that farmers within Bali L.G.A. and its environs should adopt the widest spacing of 95 cm x 65 cm and also opts for variety ‘B’ (SAMMAZ-15) for better grain yield. It is also recommended that further research should be carried out for three consecutive years to ascertain these assertions.

Table1: Mean performance of growth and yield parameters of the two maize varieties

Treatment	GC	PH6W	PP5W	LC5W	PHM	LCM	R/C	CW	S/C	TGWg
a. Main Treatment (spacing in cm)										
T1 (55x25)	89.3	100.5	73.4	10.6	2.03	12.5	14.8	181.32	509.4	238.2
T2 (65x35)	66.8	98.5	71.3	10.9	2.20	13.1	15.6	183.81	599.1	318.1
T3 (75x45)	49.1	101.9	51.2	11.8	2.13	12.8	15.4	199.38	590.2	317.3
T4 (85x55)	35.5	103.8	43.9	10.5	2.06	13.1	14.5	190.80	551.1	309.1
T5 (95x65)	28.1	95.6	31.7	10.9	2.03	12.7	15.6	207.96	603.6	333.3
Mean	53.76	100.06	54.3	10.94	2.09	12.84	15.18	192.65	570.68	321.2
Prob. of F	4.19e-10***	0.757	1.23e-07***	0.212	0.0835.	0.660	0.046*	0.220	0.117	0.733
SED	0.13785	6.509	0.12016	0.5865	0.0700	0.4733	0.6943	12.77	40.28	19.08
b. Sub-Treatment (variety)										
variety A	48.00	97.44	47.16	10.80	2.116	13.00	14.68	191.5	557.0	329.5
variety B	59.52	102.68	61.44	11.08	2.064	12.68	15.68	193.8	584.4	312.9
Mean	53.76	100.06	54.3	10.94	2.09	12.84	15.18	192.7	570.7	321.2
Prob. Of F	0.0566.	0.210	0.00347**	0.455	0.0471	0.291	0.028*	0.785	0.288	0.178
SED	0.08718	6.509	0.07599	0.3709	0.0443	0.2993	0.439	8.077	25.47	12.07
a x b		NS		NS		NS		NS	NS	NS

SOURCE: Field Experiment

KEY: significance codes = 0 (***), 0.001 (**), 0.01 (*), 0.05 (.), NS (Not significant), T1= Treatment 1, GC= germination count, PH6W = plant height at 6^{th} week after sowing, PP5W = plant population at 5^{th} week, LC5W = leaf count at 5^{th} week, PHM = Plant height at maturity, LCM = Leaf count at maturity, R/C = number of row per cob, CW = Cob weight, S/C = Number of seed per cob, TGWg = thousand grain weight in grams, SED = standard error for difference in means, a x b = interaction between main and sub-treatment, prob. = probability.

Table 2: Mean squares and interactions between main and sub-treatment from analysis of variance for all parameters of the two varieties

Treatment	DF	GC	PH6W	PP5W	LC5W	PHM	LCM	R/C	CW	S/C	TGW g
1. Main treatment (spacing)											
Mean square	4	2.2528	99.7	1.0965	2.63	0.0545	0.68	2.52	1224.1	16028	917
Prob. Of F	4	4.19e-10***	0.757	1.23e-07***	0.212	0.0835.	0.660	0.3959	0.220	0.117	0.733
Mult. R-sqr.		0.715	0.1416	0.6731	0.1693	0.3025	0.1813	0.2311	0.1594	0.2303	0.1771
RSE	40	0.3082	14.55	0.2687	1.311	0.1565	1.058	1.552	28.56	90.06	42.67
F – statistic	9 &40	11.15	0.7331	9.15	0.9057	1.927	0.9841	1.336	0.8428	1.33	0.9566
p- value		1.842e-08	0.6763	2.354e-07	0.5297	0.07558	0.4678	0.2497	0.5819	0.2527	0.4891
SED		0.13785	6.509	0.12016	0.5865	0.07000	0.4733	0.6943	12.771	40.28	19.08
2. Sub-treatment (variety)											
Mean square	4	0.3660	343.2	0.6969	0.98	0.0338	1.28	12.50	61.6	9412	4228
Prob. Of F	1	0.0566.	0.210	0.00347**	0.455	0.2471	0.291	0.0282*	0.785	0.288	0.178
SED		0.08718	4.117	0.07599	0.3709	0.04427	0.2993	0.4391	8.077	25.47	12.07
3. Interactions (Treatment x Variety)											
Mean square	4	0.0391	163.9	0.2154	0.63	0.0433	1.48	1.60	306.9	5889	2146
Prob. Of F	4	0.7993	0.549	0.03019*	0.831	0.1545	0.279	0.6208	0.824	0.579	0.335
SED		0.19495	9.205	0.16993	0.8295	0.09899	0.6693	0.9818	18.061	56.96	26.99

SOURCE: Field Experiment

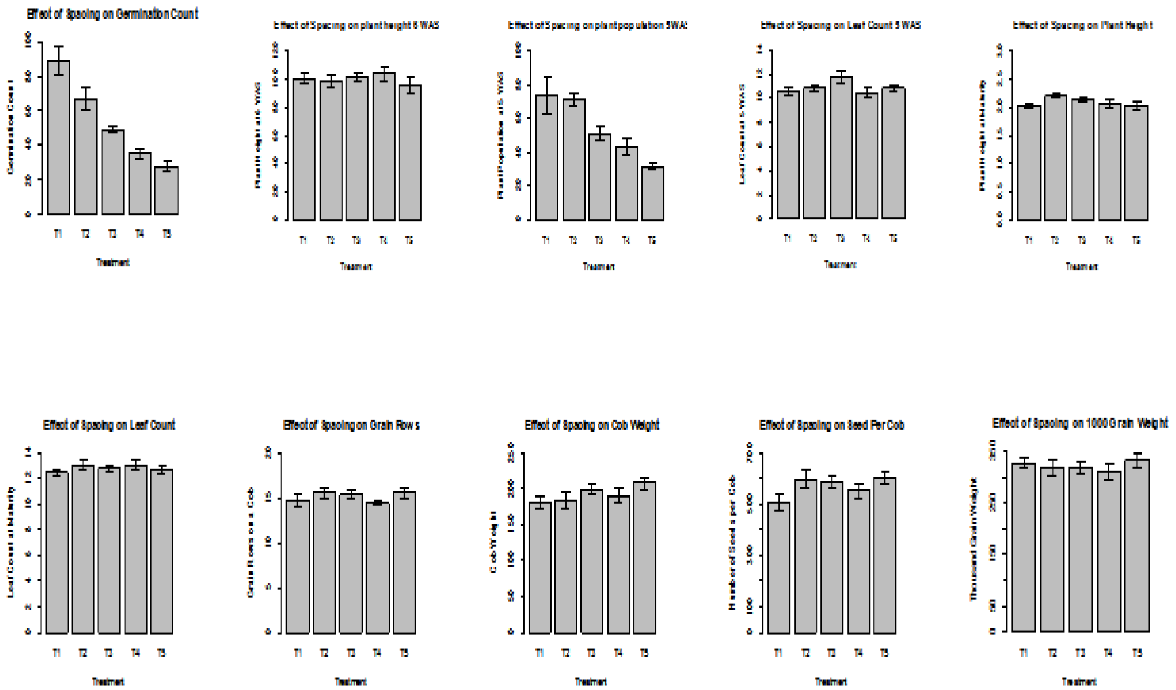

Figure 1: Effects of the Five Levels of Spacing (main treatment) on the Various Maize Growth and Yield Parameters

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