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MULTILOCATIONAL TRIAL ON SAMMAZ MAIZE (*Zea mays* L) VARIETY ON YIELD PERFORMANCE IN THE NORTHERN GUINEA SAVANNAH ZONE, NIGERIA.

BY

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ABSTRACT

The multilocational field experiment were conducted at Yola and Mubi locations to study the performance of five (5) SAMMAZ Varieties of maize Viz: SAMMAZ 11, SAMMAZ 14, SAMMAZ 15, SAMMAZ 16, and SAMMAZ 17 in the northern guinea savannah zone of Nigeria, during the 2011 cropping season. The experiment was laid in a split plot design with maize varieties as the main plot treatments, while plant population, (53,333, 63,333, 80,000 and 106,666) as the sub-plot treatments. The treatment were replicated three (3) times. Characters measured included plant height, number of leaves per plant, number of days to 50% tasseling, number of day to 50 % silking, days to 95% maturity, stem diameter, length of ear, diameter of ear, number of grains per ear, 100 grain weight, Yield per plot and total grain yield per hectare. The result of the experiments showed that there was significant difference due to varietal effect in plant height at 3 WAS in Yola and at 7 WAS and 9 WAS in Mubi. Variety also affects days to 50% tasseling, days to 50% silking and days to 95% maturity at both locations. Interaction of variety and population affected harvest index in Mubi. Population significantly affected yield per plant, yield per plot, total grain yield per hectare in both locations. Combined analysis result showed highly significant effect due to location on plant height at 3 and 5 WAS and also due to variety, was highly significant at 3 and 5 WAS. Varieties affected number of leaves per plant significantly at 5 and 9 WAS and highly significant at 11 WAS. Location and varieties affected days to 50% tasseling, days to 50 % silking and days to 95% maturity highly significantly while population only affected days to 50% silking significantly. Diameter of ear and harvest index was highly significantly affected by location and significantly on number of grains per row. Varieties affected length of ear significantly. Location affected straw weight per plant highly significantly. SAMMAZ 15 which gave a plant population of 106,666 $ha^{-1}$is recommended at the two locations.

Key words: Varieties, Maize, SAMMAZ, tasseling, silking.

INTRODUCTION:

Maize is a versatile crop and ranks third following wheat and rice in world production as reported by Food and Agricultural Organization (FAO, 2002). It is a source of food and livelihood for millions of people in many countries of the world. It is produced extensively in Nigeria, where it is consumed roasted, baked, friend, pounded or fermented (Agbato, 2003). The Northern Guinea Savanna alone took about 92% of the total area grown to maize in Nigeria. Maize is also widely believed to have the greatest potential among food crops for attaining the technological breakthrough that will improve food production in the region (Kamara and Sanginga, 2010).In advanced countries, it is an important source of many industrial products such as corn sugar, corn oil, corn flour, starch Syrup, brewer's grit and alcohol (Dutt, 2005). Corn oil is used for salad, soap-making and lubrication. Maize is a major component of livestock feed and it is palatable to poultry, cattle and pigs as it supplies them energy (Iken*et al*., 2001) the stalk, leaves grain and immature ears are cherished by different species of livestock (Dutt, 2005).

Basically maize is a tropical plant but at present it is being cultivated with equal success in temperate, tropical and sub-tropical crop and is grown twice in a year. Small scale farmers before use to plant maize mostly for subsistence as part of agricultural systems that features several crops in the tropics and sub-tropics but recently due to high yield potential, short growing period, high value for food forage and feed for livestock, poultry and a chippers source of raw materials for agro-based industries, it is increasingly gaining more importance in the cropping system. Inspite of the increasing relevance and high demand for maize in Nigeria, yield across the country continues to decrease with an average yield of about 1tonne ha^{-1} which is the lowest African yield recorded (Fayenisin, 1993) as compared to other maize growing countries like Italy (9530 Kg ha^{-1}), Canada (6630kgha^{-1}), China (4570kg/ha^{-1}) and Argentina producing average maize of 560kg/ha^{-1} (Tahir *et al.*, 2009).

Growing maize at appropriate spacing is one of the bases for higher yield, whereas intra-row spacing at sub. Optimum is a major constrain to attaining the yield potential of the crop (Alofe*et al.,* 1988) intra-row spacing for maximum grain yield in maize varies from 20 to 45cm (Olson and Sanders, 1988). There is no single recommendation for all environments and all maize types and varieties because optimum spacing for optimum maize yield could vary depending on climatic factors such factors as soil fertility, variety and type, planting date and planting pattern among others (Luis, 2001). The intra-row spacing used by local formers for open-pollination extra-early maize was found to be the same as for hybrid, medium and late maturing varieties. Thus could be reasons for the low yield obtained by farmers (Elemo, 1997).

In the present era, the practice of planting maize crop on narrow –row spacing is gaining popularity, particularly among the farmers who know the role of plant population in enhancement of maize yield. Some advantages of reducing plant spacing include the more efficient use of environmental resources, better weed control and higher grain yield particularly maize hybrids that tolerate higher plant density than hybrids used in the past (Duvick and Cassaman 1999; Tollenarrand Lee. 2002; and Sangoi*et al*., 2002). Yield of maize increases with higher plant population up to an optimum number, beyond which it decreases (Tianu*et al.,* 1983). Thus maximum yield can only be obtained by having the optimum plant population density per hectare. Maize is the agronomic grass species that is most sensitive to variations in plant density. For each production, there is a population that maximize grain yield. Maize maximum economic grain yield is obtained from 30,000 to over 90,000 plants per hectare depending on water availability, fertility, maturity rating, planting date and row spacing (Olson and Sanders 1988)..

Population is an important agronomic attribute since it is believed to have effects on light interception during which photosynthesis takes place which is the energy manufacturing medium using green parts of the plant. Also it affects the photosphere and rhizhosphere exploitation by the plant especially when spacing gives the right plant density or population which is the number of plant allowed on a given unit area of land for optimum yield (Obi 1991). The photosynthetically active solar radiation intercepted (PARINT) by the canopy is one of the main requirements to obtain high yield in the absence of water shortage (Melges*et al*., 1989).

The standard population of maize has been used since time immemorial and the recommendations are blanket. Since we have different environmental condition, the population in other nations like the United States of American (USA) should not be the same as that which is obtained in say here in Nigeria. Yields in USA are higher than yields in Nigeria. Although a lot of factors may be responsible, but increased in plant populations through reduced plant spacing is one of them. It is against this background of understanding that this study was conceived in order to explore increased maize plant population through reduced spacing as an economically viable ecologically non – degrading and socially acceptable cultural practice that can enhance yield of maize per unit area, there by leading to increased food self-sufficiency, food security, employment, industrial raw materials and possibly increased foreign exchange earnings. Moreover, the effect of rapid population growth and the enormous expansion of industrial and other socio economic activities brought about by modernization in the recent years which has resulted in reduction of cultivable land resource as a result of competitive demand for land by the non – agricultural sectors of the economy calls for the need to study and come up with techniques and strategies to increase the yield of crops per unit area so as to maximize and use our little available land more economically.

Effect of Plant Population on Growth, Yield Components and Yield of Maize.

Plant population affect most growth parameters of maize even under optimal growth conditions and therefore it is considered a major factor determining the degree of competition between plant (Singh*et al.,* 2004). Increased plant population could lead to increase yields under optimal climatic and management conditions due to greater numbers of smaller cobs per unit area (Bavec and Bavec, 2002). Porter *et al.,* (1997) reported that the maximum corn grain yield was recorded at 82,000 to 89,000 plants ha^{-1} and decreasing raw spacing from 0.76 to 0.51m resulted in 4% more grain yield. Bavec and Bavec (2002). Reported increase plant population from 4.5 to 13.5 plants/m^{-2} significantly changed the following cob characteristic, weight of 1,000 kernels, cob length, number of kernel rows and number of kernels per row. Narrowing row spacing increases light interception by the crop, particularly in the early growing season, there by leading to increased crop growth rates and earlier canopy closure Dally (2004). Ear length decreased with increasing plant density (Kemuel*et al*., 1983). Singh and Srivastava (1991) reported that decreasing plant density increased the number of grains cob^{-1}. Tianu*et al*. (1983) reported that

1000 grain weight decreased with increasing plant density. Narayanaswamy*et al.* (1994) reported higher grain yield was obtained at higher plant population density. Reports of Al-Rudha and Al-Youmis (1998) that maize sown at 15cm had maximum plant height compared with their counterparts sown at wider intra-row spacing. Maize plant sown on 15cm spacing had higher number of leaves than their counterparts which were sown at wider spacing possibly because of increased growth rate in search for space, sunlight and other environmental resources. (Al –Rudha and Al- Youmis 1998) and Ali *et al.* (2003).

Saberali, (2007) reported that even distribution of rainfall enhanced early uniform emergence, good growth, increase yield and grain quality of maize. Previous research findings indicated that in high maize density, leaf area index, total dry weight and crop growth rate increased than low maize density throughout crop growth season (Saberali, 2007) Results from experiments conducted by Sikander *et al*, (2000) found out that minimum plant spacing resulted in maximum emergence m^{-2} while minimum emergence m^{-2} was recorded from maximum plant spacing maximum. Maximum Plant height was recorded from minimum spacing while minimum plant height was recorded from maximum spacing. Roy and Biswas (1992) reported that number of cobs per m^2 increased with increasing plant density, also maximum number of grains cob^{-1} was recorded from wide spacing and minimum number of grains cob^{-1} was recorded from closer spacing. Maximum cob length was recorded at wider plant spacing while minim value was recorded from minimum or closer spacing (Al-Rudha and Al-Youmis (1978) Similarly maximum plant spacing resulted in maximum cob weight.

Sharma and Adamu (1984) reported that number of cobs, weight of cobs and grain weight per cob were highest at lower plant population. Al-Rudh and Al-Youmis (1978) reported that maximum thousand grain weight was recorded at wider row spacing while minimum value was recorded at lower plant spacing. Ghuman and Gill (1969) reported that closer plant spacing gave progressively higher grain yield than wider plant spacing. Roy and Biswas (1992) reported that fodder yield increased with increasing plant density. Cox and Crasta (1993) Reported that plant density recommendations for more modern maize hybrids have increased. Currently grown maize hybrids have more erect leaves often withstand environmental stressed better and are grown at high plant populations in an attempt to intercept more solar radiation (Tollenaar, 1999).

Effect of Variety on Growth, Yield Components and Yield of Maize.

Dingkuhu*et al*, (1991) reports that the longer a crop is able to grow in the particular site in a season, the greater is its biomass production in that site. Thus, increase in Biomass production with longer duration growth reflects, not only the opportunity for more prolonged interception of photosyntically active radiation by the crop, but also the greater opportunity for uptake of nitrogen and other nutrients especially in low input conditions (Yoshida, 1993). It is however, noted that for grain crops, grain yield will often increase with duration up to a certain point but what happens beyond that point depends on environmental and agronomic conditions (Evans, 1993) from this experiments, it was observed that hybrids yellow and white maize yielded significantly higher than local yellow and while maize under the same conditions. According to Standhill (1981), crop physiologist, have established that the increased solar interception achieved by the large and larger living crop canopies can largely explain the high yield levels in modern cultivars came into play as the more genetically improved one performed better in total grain yield than the yet to be improved local maize cultivars. It was also observed that hybrids maize were significantly smaller in height then local ones.

The yield of a crop is a function of a number of factors and process such as high intercepted by the canopy, metabolic efficiency of plant, translocation efficiency of photosynthates from leaves to economic parts and sink capacity or sink strength amongst other (Doku 1977) and the genetic makeup of the crops. Because of the improved nature of the hybrid culture they are genetically more advanced and enhanced to take up plant nutrients from the soil faster than the local ones coupled with high densities, which always give room for competition for light energy.

Maximum crop production can be achieved by development of improved crop varieties and suitable growing environment and soil with optimum plant population ha^{-1} (Trenton et al., 2006). Maize cultivars had significant difference in days to 50% silking and tasslling as a result of difference in genetic makeup of these varieties (Hassan 1987). Difference in growth indices of crop varieties have been attributed to differences in genetic characteristic of the individual varieties (Ibrahim *et al.,* 2000) it was also observed by Dalley*et al*. (2006) in their experiment that maize sown at narrow space showed increased growth rates as compared with their counterparts sown at wider intra-row spacing probably due to earlier canopy closure for increased light interception as well as increased availability of soil moisture because of equidistance distribution of crop plants.

Effect of Interaction between Plant Population and Variety on Growth, YieldComponents and Yield of Maize.

Plant population and their interaction with varieties were non-significant (Penuar&Sirrbie 1989). Interaction between varieties and plant population had significantly affected biological yield of maize (Khan *et al.,* 1993) Stover yield was significantly affected by plant population, varieties and their interaction where 65,000 plants ha^{-1} gave the highest while 45,000 plants ha^{-1} gave the lowest with Sarhad white variety (Plensicar&Kustori, 2005). Interaction between Sarhad white maize variety with higher plant density produced higher harvest index as compared to lowest plant population (Park *et al*., 1989).

Ali *et al*. (2003) reported that competition between maize plants for light, soil fertility and other environmental factors were markedly increased with highest population but decrease with lower plant population and type of variety Sajjan *et al.* (2002) reported that growth characters of crops varied because of differences in their genetic make – up maize plant sown on 15cm spacing had higher number of leaves than the counterpart which were sown at wider spacing possible because of increased growth rate in search for space, sunlight and other environmental resources. GwizdekS. (1989) attributed the differences between the leaf area and other growth characters of maize genotypes to difference in photosynthetic activity of leaves, leaf arrangement, chlorophyll contents, stomatal conductance value and activity of photosynthetic enzymes. Udoh (2005) reported that some hybrid maize varieties have yield advantage over other maize varieties because they possess such special qualities as high yield, disease resistance early maturity, uniformity in flowering ear placement and ease of harvesting using combined harvester.

MATERIALS AND METHODS

Experimental Sites: A Field experiment was conducted at two locations during the 2011 cropping season. One at the Teaching and Research Farm of the Department of Crop Production and Horticulture, Modibbo Adama University of Technology (MAUTECH), Yola and the other one at the former College of Agriculture Teaching and Research Farm Mubi. Yola is located in Northern Guinea Savanna Zone at latitude 9^{o}14' North and longitude 12^{o}38' East and altitude of 158m above sea level (Kowal and Knabe, 1972) and Mubi is located in Northern Guinea Savanna Zone at latitude 10^{o}3' North and Longitude 13^{o}07' East and altitude of 400 metres above sea level (Adebayo and Tukur, 1999), Yola has an annual average minimum and maximum temperatures of 20.2^{o}C and 43.5^{o}C'. respectively (AD, ADP, 2001); Adabayo A. A. and A. L. Tukur, (1999). While Mubi has 24.1^{o}C' and 34.2^{o}C' minimum and maximum temperatures respectively (AD,ADP, 2001). Maximum rainfall in Yola is around August (292.8mm/mouth^{-1}) while Mubi, maximum rain fall is also around (August (440.2 mm/month^{-1}) and minimum is 103.3mm/month^{-1} around October (AD, ADP 2001). The textural class of soils in the two sites is clay loam.

Land Preparation: The fields at both the experimental sites (Mubi and Yola) were ploughed with tractor. Hand hoe was used to further clear the remaining weeds and debris out of the farm and also to break down big lumps of soils in order to get good leveling flat site.

Treatments and Experimental Design: The treatments for both locations consist of five maize varieties (SAMMAZ 11, SAMMAZ 14, SAMMAZ 15, SAMMAZ 16 and SAMMAZ 17) which were obtained from Institute for Agricultural Research (IAR) Ahmadu Bello University (ABU) Zaria and are all late maturing (mature in more than 90days) and four plant populations (53,333, 63,333, 80,000 and 106,666 plants/ha^{-1}) which were laid out in a split-plot design. The maize varieties were assigned to the main plots and the plant populations to the sub-plots. These treatments were replicated 3 times. The inter-row spacing however remained at 75cm and two plants per hill were maintained till maturity. The total experimental area for the 3 replication was 1,024m^2 (64mx16 m) which comprised of 60 sub-plots with a net area of 12.0m^2 (4mx3m). Each main plot and replicates were separated by 1 and 2m respectively.

Agronomic Practices: After ploughing and levelling of the experimental areas, the field was marked out according to the design. Maize seeds were treated with seed dressing chemical Apron Plus at the rate of 50 g to 6kg of seed in order to protect it from soil borne diseases and pest. When the rains were fully established, the seed were sown at Mubi location on 18^{th} July 2011 while that of Yola location was on 24^{th} July 2011. Three (3) seeds were sown per hole and later thinned to two(2) plants per stand at two weeks after sowing. Weeding was done manually at 3, 6 and 9 weeks after sowing using hand hoe. Fertilizers were applied at the rates of 120:80:80, 160;80;80, 180:80:80: and 240:80:80kg NPK per hectare for the 53,333, 63,333, 80,000 and 106,666 plants/ha^{-1} respectively (Table 1). All the phosphorus and potassium fertilizers required were applied at planting while the nitrogen required was split into two, half at planting and the remaining half was further split into 3 equal doses (at 3, 6 and 8 weeks after sowing) using urea as the source of nitrogen.

Collected on Growth and Yield of Maize: Data were collected on the following Characters in both location (Yola and Mubi)

Plant height: Plant height was measured from the soil surface to the base of the last flag leaf at 3, 5, 7, 9 and 11 weeks after sowing (WAS). Ten plants from the two middle rows were used for the measurement using a graduated (cm) meter ruler. The mean of the ten plants was calculated and recorded as plant height (cm).

Number of leaves per plan: Ten (10) plants, from the two middle rows were randomly selected and the average number of their leaves were used as the number of leaves per plant at 3, 5, 7, 9 and 11 weeks after sowing. Tagging was done to take care of senescence.

Number of days to 50% tasseling: The number of days from sowing to when 50% of the plants in a plot tasseled was recorded as the number of days to 50% tasseling.

Number of days to 50% silking: The number of day taken by half of the plants to silk in each plot was recorded and regarded as number of days to 50% silking.

Number of days to 95% maturity: The number of days it took 95% of the ears of the maize plant to reach maturity from sowing date in each plot was recorded and regarded as number of days to 95% maturity.

Diameter of ear: Ten (10) unshelled maize ears from each plot were measured using Vernier caliper. The mean of the ten measured ears was recorded as diameter of ear (cm).

Length of ear: Ten maize ears from the middle two rows of each plot were selected and their length measured using graduated rule. Mean of the ten measured length of ears were recorded as length of ear (cm).

Number of rows per ear: Ten maize ears were selected from each plot and their number of rows counted. The mean numbers of rows on the ten selected maize ears from each plot were recorded as number of rows per ear.

Number of grains per ear: Mean number of grains per ear from ten selected maize ears from each plot were counted and the mean recorded as number of grain per ear.

Stover yield per plant: After ear harvest, ten plants were randomly selected from each plot and weighed. The mean average of the ten plants was taken as Stover yield per plant (g).

Number of ear per plant: The number of ears from ten (10) selected maize plants from each plot was, counted and the mean recorded as number of ears per plant.

Weight of 100 grains: The weight of 100 grains from each plot was determined using Triple Beam Balance700/800 series by Ohans

Grain yield per plant: The ear from the ten selected maize plant from each plot were shelled and weighed using Triple Beam Balance.700/800 series by Ohans in the laboratory and the mean weight recorded as grain yield per plant.

Grain yield per plot: Dried maize ears were shelled manually and yield was recorded on per plot basis in order to get grain yield per plot.

Grain yield per hectare: Grain yield per hectare for each plot was computed as follows?

$$\frac{\text{Grain yield per plot (kg)}}{\text{Net plot size (m2)}} \times 10{,}000\text{m}^2$$

Harvest index:

Harvest index for each plot was computed using the formula as follows?

$$\text{Harvest index (HI)} \quad \frac{\text{mean grain in weight per plant (g)}}{\text{Mean weight of grain per plant + Stover yield per plant (g)}}$$

Statistical Analysis: Data collected were analyzed statistically using the generalized linear mode (GLM) procedure of SAS (statistical analysis system v6. 12, 1994). Means that were statistically different were separated using least significant difference (LSD) at $p < 0.05$.

RESULTS AND DISCUSSIONS:

Plant Height: Maize plant height at 3, 5, 7, 9 and 11 weeks after sowing (WAS) as affected by variety and population in Yola. There was no significant difference in plant height due to variety, population or their interaction in all the stages measured except at 5 WAS when plant height was significantly affected by variety. SAMMAZ 17 gave the highest plant height (23.20cm) followed by SAMMAZ 14(20.06cm) and the least was SAMMAZ 16 with 15.51cm.

In Mubi highly significant difference in plant height due to variety was observed at 3 and 5 WAS. The varietal performance at 3 WAS showed that SAMMAZ 15 gave the highest plant height (15.23cm) followed by SAMMAZ 11 (14.83cm) and the least was SAMMAZ 16 (12.71cm). At 5 WAS, SAMMAZ 17 gave the highest plant height (29.35cm) followed by SAMMAZ 11. (27.19cm) and the least was SAMMAZ 16(22.91cm).

Result from the combined analysis shows that location and variety had highly significant effect on plant height at 3 and 5 WAS (Table 1). Mubi location gave the highest plant height at 3WAS (14.45cm) and also at 5 WAS (26.10cm) as against Yola location which have 8.38cm at 3 WAS and 19.03cm at 5WAS. Varietal effects shows that SAMMAZ 17 had the tallest plants (12.15cm) At 3 WAS followed by SAMMAZ 14 (11.70cm and the least value of 10.04cm came from SAMMAZ 16. At 5 WAS, SAMMAZ 17 also recorded the tallest plants with 26.32cm followed by SAMMAZ 14 (22.87cm) and the shortest plants (19.21cm) were recorded from SAMMAZ 16. Plant height was not significantly affected by population or interaction between Local and population, location and Variety, Variety and Population and Location, Variety, and Population as can be seen in Table 1.

Table 1: Maize Plant Height (cm) and Ear Height (cm) as Affected by Location, Variety and Population in the Combined Analysis in 2011 Rainy Season.

Treatments	Week after sowing					Ear height
	3	5	7	9	11	
Location (L)						
Yola	8.38	19.03	70.49	111.55	113.71	54.97
Mubi	14.45	26.10	49.42	118.02	112.25	57.83
Mean	11.42	22.56	59.95	114.78	117.9	56.40
P<F	0.0001**	0.0001**	0.151NS	0.098NS	0.051NS	0.104NS
LSD	0.695	1.958	28.93	7.718	8.56	3.469
Varieties (V)						
SAMMAZ 11	11.64	22.08	51.89	116.65	123.45	57.04
SAMMAZ 14	11.70	22.87	65.19	117.22	108.76	57.66
SAMMAZ 15	11.57	22.32	49.48	109.56	115.34	53.38
SAMMAZ 16	10.04	19.21	49.32	112.64	116.94	54.47
SAMMAZ 17	12.15	26.32	92.88	117.84	125.27	59.45
Mean	11.42	22.56	59.95	114.78	117.9	56.40
P<F	0.003**	0.0008**	0.27NS	0.612NS	0.117NS	0.184NS
LSD	1.099	3.097	45.75	12.19	13.55	5.48
Population (Plant ha^{-1})						
53,333	11.28	22.06	52.29	114.99	120.32	56.02
63,333	11.30	22.07	52.95	116.02	114.62	56.55
80,000	11.38	24.20	82.51	116.56	121.36	56.42
106,666	11.30	21.93	51.07	111.57	115.56	56.61
Mean	11.42	22.56	59.95	114.78	117.90	56.40
P<F	0.691NS	0.30NS	0.36NS	0.801NS	0.608NS	0.995NS
LSD	0.983	2.777	40.91	10.90	12.11	4.906
Interaction (VxP)	NS	NS	NS	NS	NS	NS

NS = not significant at P = 0.05
* = significant at P = 0.05
** = highly Significant at P = 0.01

Phenological Traits: Days to 50% tasseling: There were highly significant difference in the number of days to 50% tasseling due to varieties while population and the interaction between variety and population had no significant effect, on the number of days to 50% tasseling in Yola (Table 2). Mean performance of varieties showed that SAMMAZ 11 and 16 recorded higher number of days to 50% tasseling (63 days) each followed by SAMMAZ 17 (60 days) while the least was SAMMAZ 14 (57 days) in Yola (Table 8). Days to 50% Tasseling: Days to 50% tasseling was significantly affected by varieties in both locations. This showed that varieties responds differently at different location due to their different genetic makeup. Combined result also indicates similar trend. Population did not affects days to 50% tasseling significantly. This is in line with the reports by Hassan. (1987) who reported that maize cultivator had significant difference in days to 50% tasseling as a result of differences in genetic method of these varieties.

Table 2: Days to 50% Tasseling, days to 50% Silking and Days to 95% Maturity of Maize Varieties at Different Population in Yola in 2011 Rainy Season.

Treatments	Days to 50% tasseling	Days to 50% silking	Days to 95% maturity
Varieties (V)			
SAMMAZ 11	63	67	90
SAMMAZ 14	57	61	87
SAMMAZ 15	62	66	90
SAMMAZ 16	63	67	88
SAMMAZ 17	60	64	90
Mean	61	64	89
P<F	0.002**	0.001**	0.007**
LSD	3.024	2.866	1.968
Population (Plant ha^{-1})			

53,333	61	66	89
63,333	62	66	89
80,000	60	64	89
106,666	60	64	89
Mean	61	64	78
P<F	0.319NS	0.231NS	0.961NS
LSD	2.705	2.56	1.960
Interaction (VxP)	NS	NS	NS

NS = not significant at P = 0.05

** = Highly significant at P = 0.01

In Mubi, similar trends was observed with highly significant effect due to variety and non-significant effect as a result of either population or interaction on number of days to 50% tasseling (Table 3). Mean performance of varieties shows that SAMMAZ 16 had the highest number (67 days) followed by SAMMAZ 11, 15 and 17 having 64days each and the least value was recorded from SAMMAZ 16 with 63 days as can be seen in Table 3.

Result from the combined analysis indicates highly significant effects on number of day to 50% tasseling as a result of location where Mubi produce the highest number (64 days) as against Yola location which had 61 days (Table 4).

Variety also affects days to 50% tasseling significantly. SAMMAZ 16 seen to produce the highest number of days to 50% tasseling in both locations (65 days) followed by SAMMAZ 11 and 15 having 63 days each and the least value of 60 days was obtained from SAMMAZ 14 (Table 4). There were no significant effect on days to 50% teasel ling as a result of population and interaction between location and population, location and variety, variety and population and location, variety and population.

Days to 50% silking: In Yola Mean performance of varieties shows that SAMMAZ 11 and SAMMAZ 16 had the highest number of days to 50% silking (67 days) followed by SAMMAZ

15 with 66 days and the least is SAMMAZ 14 having 61 days.Data on number of days to 50% silking showed similar results to that of number of days to 50% tasseling. This can be supported by similar result from Hassan (1987). Who reported difference in days to 50% silking as a result of differences in this genetic methods of this varieties

Table 3: Combined Days to 50% Tasseling, Days to 50% Silking and Days to 95% maturity of Maize Varieties at Different Population in Yola and Mubi during 2011 Rainy Season.

Treatments	Days to 50% Tasseling	Days to 50% Silking	Days to 95% Maturity
Location (L)			
Yola	61	65	89
Mubi	64	70	91
Mean	63	67	90
P<F	0.0001**	0.001**	0.0001**
LSD	1.123	1.008	0.825
Varieties (V)			
SAMMAZ 11	63	68	91
SAMMAZ 14	60	65	89
SAMMAZ 15	63	68	91
SAMMAZ 16	65	69	89
SAMMAZ 17	62	67	91
Mean	63	67	90
P<F	0.0001**	0.0001**	0.002**
LSD	1.77	1.59	1.305
Population (Plant/ha^{-1})			
53,333	63	68	90
63,333	63	68	91
80,000	62	66	90
106,666	62	66	90
Mean	63	67	90

P<F	0.186NS	0.047*	0.717NS
LSD	1.588	1.426	1.167
Interaction (LxP)	NS	NS	NS
Interaction (LxV)	NS	NS	NS
Interaction (VxP)	NS	NS	NS
Interaction (L x V x P)	NS	NS	NS

NS = not significant at P = 0.05
* = significant at P = 0.05
** = Highly significant at P = 0.01

In combined analysis, number of days to 50% silking followed similar trend to that of tasseling were highly significant effects was observed as a result of location and varieties. In addition, population affects days to 50% silking significantly. Mubi location produced the highest number of days to 50% silking (70 day) while Yola location had 65 days. SAMMAZ 16 had the highest number of days to 50% silking and was closely followed by SAMMAZ 11 and 15 having 68 days each while the least was SAMMAZ 14 which had 65 days. Population of 53,333 plants/ha^{-1} and 63,333 plants/ha^{-1} produced the highest number of days to 50% silking (68 days each) then followed by 80,000 plants/ha^{-1} and 106,666 plants/ha^{-1} having 66days each. Interactions has no significant effect on number of days to 50% silking.

Results from the combined analysis shows that location and variety affects days to 95% maturity. Mubi had the highest number of days to 95% maturity (91 days) then Yola (89 days).

Varietal effects shows that SAMMAZ 11, 15 and 17 produced the highest number of days to 95% maturity (91 days) followed by SAMMAZ 11 and 16 having with 89 days each in combined analysis.

Yield Components:

Ear length (cm): Result of ear length in Yola indicates that there were significant difference among varieties but not in population or interaction between varieties and population (Table 4). The data showed that only varieties affect length of ear significantly in both locations. This indicates that different varieties shows different response to length of ear at different location. This is in conformity with results of Udoh (2005) who reported that some hybrids maize varieties have yield advantage over other maize varieties because they possess such special qualities as high yield, high ear length, placement and uniform flowering.

Table 4: Length of Ear, Diameter of Ear, Number of Rows/Ear, Number of Grains per Row and Harvest Index Maize Varieties at Different Population in Yola in 2011 Rainy Season

Treatments	length of Ear	Diameter of Ear	No. of rows/ear	No. of Grains/rows	Harvest Index
Varieties (V)					
SAMMAZ 11	14.37	3.64	14	31	0.4949
SAMMAZ 14	14.89	3.54	13	30	0.5598
SAMMAZ 15	14.34	3.76	14	28	0.5349
SAMMAZ 16	13.87	3.57	14	28	0.5440
SAMMAZ 17	14.40	3.72	14	29	0.4959
Mean	14.63	3.60	14	29	0.5259
P<F	0.018*	0.35NS	0.983NS	0.484NS	0.0210*
LSD	0.878	0.246	1.050	3.215	0.0462
Population (Plant/ha $^{-1}$)					
53,333	14.6	3.70	14	29	0.5029
63,333	14.8	3.70	14	29	0.5510
80,000	14.9	3.60	13	30	0.5322
106,666	14.1	3.60	14	29	0.5174
Mean	14.63	3.60	14	29	0.5259
P<F	0.210NS	0.949NS	0.716NS	0.910NS	0.1251NS
LSD	0.785	0.221	0.939	2.875	0.0413

Interaction (VxP)	NS	NS	NS	NS	NS

NS = not significant at P = 0.05
* = significant at P = 0.05

mean performance of varieties showed that SAMMAZ 11 had the longest ear length (15.37cm), this was followed by SAMMAZ 14 while the lowest was recorded by SAMMAZ 16 with 13.87cm.

Similar result was obtained in Mubi with only varieties showing significant effect on length of ear while population and interaction had no significant effect on length of ear, Table 5. Performance of varieties with regard to length of ear showed that SAMMAZ 17 had the highest length of ear (15.01cm) followed by SAMMAZ 15 (14.75cm) and the least was SAMMAZ 14 (13.24cm).

Ear diameter cm: Results from both locations shows no significant difference in diameter of ear due to varieties, population or their interaction (Table 4).Result from the two locations shows that variety and population did not affects diameter of ear significantly. Combined analysis indicates that location affects diameter of ear significantly which indicate location effects on different varieties.

Harvest index: Result indicates significant difference in harvest index due to varieties effect while population and interaction between varieties and population showed no significant difference in Yola. Varietal performance shows that SAMMAZ 14 had the highest harvest index (0.5598) followed by SAMMAZ 16 (0.5440) and the least was SAMMAZ 11 (0.4949). In Yola significant effect due to variety on harvest index was observed but plant population and interaction between varieties and population had no significant effect. Mubi location showed no significant effect due to varieties, population or interaction between varieties and population. Result from combined analysis showed that location affect harvest index highly significantly. This result is similar to the work of Evans 1993 who reported that Biomass production depends on environmental and agronomic conditions of an area.

From combined analysis ear diameter was not affected significantly due to variety, population or their interaction between location and population, location and variety, variety and population and location, variety and population, Table 6.

Table 5: Length of Ear, Diameter of Ear, Number of Rows/Ear, Number of Grains Per Row and Harvest Index of Maize Varieties at Different Populations in Mubi in 2011 Rainy Season.

Treatments	Length of Ear	Diameter of Ear	No. of rows/ear	No. of Grains/rows	Harvest Index
Varieties (V)					
SAMMAZ 11	14.31	3.81	14	26	0.4568
SAMMAZ 14	13.24	3.83	14	29	0.4574
SAMMAZ 15	14.75	3.78	14	29	0.4899
SAMMAZ 16	14.06	3.92	14	27	0.4800
SAMMAZ 17	15.01	3.93	14	28	0.4376
Mean	15.01	3.85	14	28	0.4643
P<F	0.270NS	0.989NS	0.554NS	0.372NS	0.2508NS
LSD	1.069	0.381	0.711	3.58	0.05
Population (Plant/ha^{-1})					
53,333	13.86	3.83	14	28	0.4749
63,333	14.80	3.95	14	28	0.4856
80,000	14.35	3.83	14	27	0.4548
106,666	14.09	3.80	14	27	0.4380
Mean	14.27	3.85	14	28	0.4643
P<F	0.244NS	0.831NS	0.841	0.901NS	0.1344NS
LSD	0.95	0.341	0.63	3.21	0.0447
Interaction (VxP)	NS	NS	NS	NS	NS

NS = not significant at P = 0.05

Table 6: Combined Mean Performance of Length of Ear (cm), Diameter of Ear (cm), Number of Rows/Ear, Number of Grains Per Row and Harvest Index on Location, Variety and Population (Mubi and Yola) in 2011 Rainy Season

Treatments	Ear length	Ear Diameter	No. of rows/ear	No. of Grains/rows	Harvest Index
Location (L)					
Yola	14.63	3.65	14	29	0.5259
Mubi	14.27	3.85	14	28	0.4643
Mean	14.45	3.75	14	28	0.4643
P<F	0.102ns	0.005*	0.148ns	0.030*	0.0001**
LSD	0.435	0.140	0.393	1.482	0.0234
Varieties (V)					
SAMMAZ 11	14.85	3.72	14	28	0.4758
SAMMAZ 14	13.06	3.68	14	30	0.5086
SAMMAZ 15	14.55	3.77	14	28	0.5024
SAMMAZ 16	13.96	3.75	14	27	0.5120
SAMMAZ 17	14.85	3.82	14	29	0.4667
Mean	14.45	3.75	14	28	0.4643
P<F	0.023*	0.79NS	0.521NS	0.521NS	0.032NS
LSD	0.688	0.222	2.344	2.344	0.0372
Population (Plant/ha^{-1})					
53,333	14.26	3.75	14	29	0.4949
63,333	14.81	3.81	14	29	0.5183
80,000	14.63	3.73	14	28	0.4935
106,666	14.12	3.71	14	28	0.4777
Mean	14.45	3.75	14	28	0.4643
P<F	0.103ns	0.809NS	14	0.936NS	0.113NS
LSD	0.616	0.199	14	2.097	0.0333
Interaction (LxP)	NS	NS	NS	NS	NS
Interaction (LxV)	NS	NS	NS	NS	NS
Interaction (VxP)	NS	NS	NS	NS	NS

Interaction (L x V x P)	NS	NS	NS	NS	NS

NS = Not significant at P = 0.05
* = significant at P = 0.05
** = Highly significant at P = 0.01

In Mubi, there was no significant effect on harvest index due to either variety, population or interaction between varieties and population.

Grain Yield:

Grain yield per plant (g): Significant difference was observed in grain yield per plant due to population while variety and interaction between variety and population did not significantly affect this character in Yola. Population of 63,333 plants/ha^{-1} gave the highest grain yield per plant (63.9g) followed by 53,333 plants/ha^{-1} population which gave 59.3g/plant while the least value of 48.5g/plant was obtained from the population of 106,666 plant/ha^{-1} at Yola (Table 7).Grain yield per plant was not affected significantly due to variety, but population showed significantly difference from the two locations. This is in line with the report of Trenton *et al,* (2006) who reported that maximum crop production can be achieve with improved crop varieties, suitable growing environment and optimum plant population.

Result from Mubi location follows the same trend with that of Yola showing significant differences on grain yield per plant the different plant populations while variety and the interaction between variety and population had no significant effect. Mean performance indicates that population of 63,333 plants/ha^{-1} had the highest grain yield/plant (68.17g). This was closely followed by 53,333 plant/ha^{-1} (62.22 g) and the least is from 106.666 plants/ha^{-1} (51.68).

Result from combined analysis shows that varieties and population affects grain yield plant^{-1} significantly. Based on varietal performance, SAMMAZ 15 produced the highest grain yield plant (62.17 g) from both locations followed by SAMMAZ 16 (60.62 g) and the least was SAMMAZ 11 with 52.15g (Table 16) plant population of 63,333plants/ha^{-1} produced the highest grain yield per plant^{-1} (66.06 g) followed by 53,333 plant/ha^{-1} (60.77 g) and the least value of 50.10g was obtained from the population of 106,666 plants/ha^{-1} (Table 16). The interaction between location and population, location and variety, variety and population and location, variety and population had no significant effect on grain yield plant from combined analysis as presented in Table 7

Grain yield per plot (Kg): Result from Yola shows that grain weight/plot^{-1} was not affected significantly by variety. Population affected weight of grain/plot^{-1} significantly where 106,666 plant/ha^{-1} gave the highest yield (6.21kg). followed by 80,000 plants/ha^{-1} (5.12kg) and the least was from 53,333 plants/ha (3.79kg). The interaction between variety and population had no significant effect on grain weight/plot^{-1}.Data from the two locations on grain yield per plot followed similar trend with that of grain yield per plant where only plant population affects grains yield per plot while varieties and interaction did not show any significant difference. This is also similar with result of Trenton *et al*, (2006).Results from Mubi also shows that variety had no significant effect on weight of grain/plot^{-1} while population affects weight yield per plot^{-1} highly significantly where 106,666 plants/ha^{-1} gave the highest grain yield per plot^{-1} (6.6114kg) this was followed by 80,000 plant/ha^{-1} (5.1214kg) and the least was from 53,333 plants/ha^{-1} (3.97kg) as seen on table 15. The interaction between variety and population had no significant effect on grain weight/plot^{-1}.

From combined analysis, yield/plot^{-1} was not affected by location, but highly significant difference was observed due to variety and population. On variety, SAMMAZ 15 gave the highest grain yield/plot^{-1}(5.56kg) followed by SAMMAZ 14 with 5.44kg and the least was SAMMAZ 11 with 4.54kg. On population, 106,666 plant ha^{-1} gave the highest grain weight/plot^{-1} of 6.41kg which was followed by plant population of 80,000 plants ha $^{-1}$ and the least value of 3.88kg came from plant population of 53,333 plant ha^{-1}.

Weight of 100 grain (g): In Yola result showed no significant difference either due to variety, population or their interaction between varieties and population. Analysis from Mubi indicate significant difference in weight of 100 grain due to varietal effect while population and interaction between variety and population had no significant effect. Mean performance shows that SAMMAZ 17 had the highest weight of 100 grain (23.68g) followed by SAMMAZ 15 (20.36g) and the least value of 17.80g was obtained from SAMMAZ 11.(Table 7). However,weight of 100 grain was not affected by variety, population or their interaction which shows that varieties where able to express their grain formation even at high population in Yola. However, at Mubi, weight of 100 grain was affected significantly due to varieties but not due to population or their interactions. This indicates difference in weight of grain across location effect. Combined analysis showed highly significant difference due to variety and population but not affect by location or any of their interaction. This is supported by the work of Udoh (2005) who reported that some hybrid maize varieties have yield advantage over other maize varieties due to special qualities like high yield, disease resistance, early maturity.

In combined analysis, weight of 100 grain was highly significantly affected by varieties and significantly by population. Varietal performance shows that SAMMAZ 17 gave the highest 100 grain weight (22.03 g) which is closely followed by SAMMAZ 15 (20.16 g) and the least was SAMMAZ 14 which have 18.23g (Table 8) the effect of plant population shows that 63,333 plants/ha^{-1} gave the highest weight of 100 grain (21.35g), followed by 53,333 plants/ha^{-1} (19.77 g) and the least value of 19.74 g was recorded from 106,666 plants/ha-1. Location and interaction between location and

Table 7: Mean Performance of Grain Yield Per Plant, Grain Weight Per Plot, Number of Ear Per plant, Grain Yield Per Hectare and Straw Weight on Variety and Population in Yola in 2011 Rainy Season

Treatments	Grain yield per plant(g)	Grain yield per plant(g)	100 Grain weight	No. of ear per plant	Grain yield per hectare (kg/ha^{-1})	Grain yield per straw
Varieties (V)						
SAMMAZ 11	50.4	4.39	19.87	1.00	343.14	52.0
SAMMAZ 14	58.6	5.27	17.91	1.00	4398.45	4.6
SAMMAZ 15	60.2	5.38	19.97	1.00	4488.53	52.18
SAMMAZ 16	58.7	5.23	18.40	1.00	43.60.99	47.48
SAMMAZ 17	53.4	4.75	20.38	1.00	3962.44	55.28
Mean	56.2	5.01	19.31	1.00	4128.51	50.33
P<F	0.261NS	0.128NS	0.184NS	0.798NS	0.0342*	0.09NS
LSD	10.28	0.869	2.422	0.0262	736.25	8.207
Population (Plant/ha $^{-1}$)						

53,333	59.3	3.79	19.7	19.7	3164.11	57.84
63,333	63.9	4.91	20.2	20.2	40.99.50	41.48
80,000	53.2	5.12	19.3	19.3	4169.36	47.12
106,666	48.5	6.21	17.9	17.9	5081.07	44.86
Mean	56.2	5.01	19.13	19.13	4128.51	50.33
P<F	0.009**	0.0001**	0.202ns	0.202NS	0.0001**	0.005**
LSD	9.914	0.777	2.166	2.166	658.52	7.341
Interaction (VxP)	NS	NS	NS	NS	NS	NS

NS = not significant at P = 0.05

* = significant at P = 0.05

** = Highly Significant at P = 0.01

population, location and variety, variety and population and location, variety and population showed no significant effect.

Total grain yield per hectare: Results from Yola shows that there were significant differences in total grain weight per hectare^{-1} due to varietal effect and highly significant differences due to population. Interaction between variety and population had no significant effect on grain yield/ha^{-1} (Table 7). Mean performance of varieties in Yola shows that SAMMAZ 15 gave the highest grain yield (4,488.53kg/ha^{-1}) which was closely followed by SAMMAZ 14 (4,398.45kg/ha^{-1}) and the least was recorded from SAMMAZ 11 (3,432.14kg/ha^{-1}). Mean performance due to population in Yola shows that 106,666 plants/ha^{-1} gave the highest grain yield (5,081.07kg/ha^{-1}) followed by 80,000 plants/ha^{-1} (4,169.36kg/ha) and the least (3,164.11kg/ha) was obtained from 53,333 plants/ha^{-1}.In Yola there was significant difference due to varieties and highly significant differences due to population but not significant due to interaction. In Mubi highly significant difference was observed only due to population on grain yield. Combined analysis showed highly significant difference due to varieties and populations on grain yield but no effect due to location or interactions.This is inline with the work of Bavec and Bavec (2002) Narayaswamy*et al,* (1994) Sharma and Adamu (1984) Dalley*et al*., (2006) and Udoh (2005) who all recorded higher yield at higher plant population.

In Mubi location, highly significant difference was observed in grain yield per hectare^{-1} due to population but there were no difference significantly either due to variety or interaction between variety and population (Table 8). Mean performance on population shows that 106,666 plants/ha^{-1} produce the highest grain yield/ha^{-1} (5,512.59kg/ha^{-1}) followed by 80,000 plants/ha^{-1} (4,580.73kg/ha-1) and the least value (3,270.40kg/ha) was obtained from 53,333 plants/ha. From combined analysis, grain yield was highly significantly affected by varietal and populations. Varietal performance shows that SAMMAZ 15 produced the highest grain yield (4,637.50kg/ha) followed by SAMMAZ 14 (4,507.80 kg/ha) and the least (3,667.50 kg/ha) was recorded from SAMMAZ 11. Performance in terms of population, reveals that 106,666 plants/ha produced the highest grain yield (5,296.83 kg/ha) followed by 80,000 plants/ha^{-1} (4,375 kg/ha^{-1}) and least was obtained from 53,333 plants/ha^{-1}(321.26kg/ha^{-1}). There was no significant effect either due to location or interaction between location and population, location and variety, variety and population and location, variety and population .

Result from combined analysis showed highly significant difference on straw weight per plant due to location and population effect. This can be as a result of less competition for available resource thus plant had enough nutrients to be utilized for higher growth and weight.

Combined analysis shows that location and population affects straw weight significant while variety and interaction between location and variety, location and population, variety and population and location, variety and population had no significant effect. Mean performance from combined analysis is shows that Mubi had higher straw weight (67.70g) than Yola (50,33g) while in terms of population, 53,333 plants/ha^{-1} produce the highest straw weight value (64.17g) followed by 63,333 plants/ha^{-1} (60.91g) and the least value (53.68g) was obtained from 106,666 plants/ha^{-1} (Table 8).

Table 8: Combined Mean Performance of Yield per Plant (g), Yield per Plot (kg), 100 Grain Weight (g), Number of Ear Per Plant, Total Grain Yield (kg ha^{-1}) and Straw Weight(g) on Location Variety and Population in 2011 Rainy Season

Treatments	Yield per	Yield per	100	Number of	Total	Straw

	plant (g)	plot (kg)	grain weight (g)	ear per plant	grain yield (kg ha^{-1})	Weight (g)
Varieties (V)						
Yola	56.25	5.01	19.30	1.00	4128.50	50.33
Mubi	59.72	5.32	20.16	1.00	4422.80	67.70
Mean	57.98	5.16	19.74	1.00	4422.80	59.02
P<F	0.14NS	0.114NS	0.18NS	0.121	0.090NS	0.001**
LSD	4.634	0.390	1.262	0.121	349.98	3.77
Varieties (V)						
SAMMAZ 11	52.15	4.54	18.84	1.00	3667.50	60.17
SAMMAZ 14	60.37	5.44	18.73	1.00	4507.80	58,32
SAMMAZ 15	62.17	5.56	20.16	1.00	4637.50	58.78
SAMMAZ 16	60.62	5.40	18.91	1.00	4501.77	57.78
SAMMAZ 17	54.61	4.88	22.03	1.00	4063.58	60.47
Mean	57.98	5.16	19.74	1.00	4422.80	59.02
P<F	0.031*	0.005**	0.005**	0.157NS	0.003**	0.674NS
LSD	7.327	0.617	1.996	0.033	553.37	5.96
Population (Plant/ha $^{-1}$)						
53,333	60.77	3.88	19.77	1	321.26	64.17
63,333	60.06	5.07	21.35	1	4213.51	60.91
80,000	55.01	5.29	18.97	1	4375.04	57.28
106,666	50.10	6.41	18.84	1	5296.83	53.68
Mean	57.98	5.16	19.74	1	4422.80	59.02
P<F	0.0001**	0.001**	0.024*	0.461NS	0.001**	0.001**
LSD	6.55	0.557	1.786	0.030	494.94	5.33
Interaction (LxP)	NS	NS	NS	NS	NS	NS
Interaction (LxV)	NS	NS	NS	NS	NS	NS
Interaction (VxP)	NS	NS	NS	NS	NS	NS
Interaction (L x V x P)	NS	NS	NS	NS	NS	NS

NS = not significant at P = 0.05

* = significant at P = 0.05

** = highly significantly at P = 0.01

DISCUSSION

Summary:A field experiment were conducted at multilocational areas to study the effects of increased plant population of five(5) varieties of maize Viz SAMMAZ 11, SAMMAZ 14, SAMMAZ 15, SAMMAZ 16, and SAMMAZ 17 on yield and yield component during the 2011 cropping season. The experimental design was a split plot design with maize varieties as the main plot treatments, while plant population, (53,333, 63,333, 80,000 and 106,666 plants/ha^{-1}) as the sub-plot treatments. The treatment were replicated three (3) times and characters measured included plant height, number of leaves per plant, number of days to 50% tasseling, number of day to 50 % silking, day to 95% maturity, number of ear per plant, stem diameter, length of ear, diameter of ear, number of grains per ear, 100 grain weight, Yield per plot and total grain yield per hectare.

The result of the experiments showed that there were significant difference due to varietal effect in plant height at 3 WAS in Yola and at 7 WAS and 9 WAS in Mubi. Variety also affects days to 50% tasseling, days to 50% silking and days to 95% maturity at both locations. Variety also affects ear length at both locations. Interaction of variety and population affected harvest index in Mubi. Population significantly affected yield per plant, yield per plot, total grain yield per hectare in both locations.

Combined analysis result showed highly significant effect due to location on plant height at 3 and 5 WAS and also due to variety highly significantly at 3 and 5 WAS. Location also affected number of leaves per plant significantly at 3WAS and highly significantly at 5, 7, 9 and 11 WAS. Varieties affected number of leaves per plant significantly at 5 and 9 WAS and highly significantly at 11 WAS.

Location and varieties affected days to 50% tasseling, days to 50 % silking and days to 95% maturity highly significantly while population only affected days to 50% silking significantly. Diameter of ear and harvest index was highly significantly affected by location and significantly on number of grains per row. Varieties affected length of ear significantly. Local affected straw

weight per plant highly significantly. Varieties affected yield per plant significantly and yield per plot, weight of 100 grain yield, total grain yield per hectare was highly significantly affected. Population affected yield per plant, yield per plot, Straw weight and total grain yield highly significantly and weight of 100 grain significantly.

Conclusion: From the experiment, it can be concluded that varieties showed different responses to growth characters at different locations. SAMMAZ 17 shows higher growth rate early in the season, showed more number of leave per plant at Mubi. SAMMAZ 16 and SAMMAZ 11 showed higher number of days to 50 % tasseling and 50 % silking at both location. SAMMAZ 11 showed higher ear length value at Yola while SAMMA 11 was the highest in Mubi.

It can be concluded that SAMMAZ 15 gave higher values in terms of yield and yield component as compared to other varieties in both locations. In terms of plant population 106,666 plants/ha^{-1} produced the highest grain yield in both locations.

Recommendations: From the result of the experiment, it is recommended that SAMMAZ 15 and 106,666 plants/ha^{-1} be used in both Yola and Mubi locations for maximum grain yield and meeting up with the increasing population explosion..

COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration amongall authors. All authors read and approved the final manuscript.

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