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Performance of the Different Inter Row Spacing of Growth and Yield of Hybrid Maize (Samaze -15) in Ganwoki Ganye, Adamawa State, Nigeria

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Abstract

At the research farm in Gangwoki, Ganye, Adamawa State, Nigeria, during the 2024 cropping season, this study assessed the impact of various inter-row spacings on the growth and yield performance of SAMAZE-15 hybrid maize. Four spacing treatments (20x70cm, 25x70cm, 30x70cm, and 35x70cm) were used in the experiment, which was replicated three times using a Randomized Complete Block Design (RCBD). Information was gathered on yield characteristics like cob weight and number, as well as growth parameters like plant height and leaf count. Plant height, leaf count, and cob weight did not significantly differ ($P<0.05$) between treatments, according to the results. However, the number of cobs showed a significant response to spacing, with the 20x70cm treatment recording the highest value. While physical differences were observed among treatments, statistical analysis confirmed that most variations were not significant. The study concludes that 20x70cm spacing provides a better performance in terms of cob number and is thus recommended for optimal production of SAMAZE-15 hybrid maize in the study area. Further research is suggested to integrate this spacing with other agronomic practices for enhanced productivity.

Keywords: Performance, Spaces, Yield, Hybrid, Maize

Introduction

One of the most extensively grown cereal crops in the world, maize (Zea mays L.) is used as a raw material for industry, livestock feed, and as a staple diet. Maize is essential to food security and economic growth in Nigeria and other Sub-Saharan African countries. The creation of hybrid cultivars with large yields, like SAMAZE-15, has greatly expanded the possibilities for cultivation. However, proper agronomic techniques of which inter-row spacing is crucial are also necessary to get optimal yields. Inter-row spacing affects plant population density, light interception, air circulation, and resource utilization. Narrow spacing may increase competition among plants, while wide spacing could lead to underutilization of land resources. Thus, determining the optimal inter-row spacing is essential to maximize the yield potential of SAMAZE-15 hybrid maize.

Several researchers reported that the effects of row spacing and hybrids on maize DM yield and quality characteristics are variable (Pinter *et al.* 1994, Widdicombe and Thelen 2002). Maize DM yield and its nutritive value are influenced by numerous interactions including environment (temperature, photoperiod and light intensity), agronomic management (row spacing or plant density, sowing date, fertilizer and harvest stage), and genetic factors (Graybill *et al.* 1991). Hybrid selection is a key to improve forage quality for optimum animal output (Widdicombe and Thelen 2002). According to recent research, contemporary hybrids can produce higher overall yields because to their enhanced tolerance to higher planting densities, which produce more ears per unit land area, even though higher planting densities may result in less grain per plant (Assefa, 2018). The percentage of photosynthetically active radiation (PAR), which is defined as light in the 400–700 nm spectral region, that is absorbed by the canopy is typically used to determine how effective light interception is in plants (Wimalasekera, 2019).

The distribution of light within the canopy is largely determined by the canopy architecture, which includes elements like leaf area, leaf angles, and azimuthal leaf orientations, as was previously discussed. Certain genotypes of maize have the ability to modify their structures in response to different planting densities and distribution patterns, which helps to lessen the consequences of high-density planting. The ability of maize plants to change the azimuthal orientations of their leaves in response to interplant competition is one of the noteworthy processes.

LITERATURE REVIEW

Importance of Row Spacing in Maize Production

Row spacing has a significant impact on soil moisture retention, nutrient uptake efficiency, and the microclimate surrounding the plant. Although it may lead to more inter-plant competition for resources, narrow row spacing can boost plant population and canopy coverage (Sangoi, 2001).

According to Maddonni and Otegui (2004), small row spacing tends to enhance light distribution throughout the canopy, which contributes to higher photosynthetic activity and biomass buildup. However, especially in rain-fed environments, excessively close spacing can result in competition amongst plants for light, nutrients, and water. Wider spacing can improve individual plant performance and lessen plant competition, according to Otegui (1995). However, this frequently leads to fewer plants per hectare, which could affect the total yield.

A study by Akintoye *et al.* (1999) on hybrid maize in southwest Nigeria showed that, in comparison to alternative spacing configurations, a row spacing of 75 cm with an intra-row spacing of 25 cm greatly enhanced cob length and grain output. Similar to this, Aliyu (2000) stressed that in order to attain the best yield, spacing should strike a compromise between a sufficient plant population and little intra-specific competition.

In a more recent study, Ibrahim *et al.* (2018) assessed how well hybrid maize varieties, such as SAMAZE-15, performed under various row spacings and found that the optimal ratio of plant population density to resource efficiency, which resulted in higher grain yields, was 75 cm between rows. Additionally, FAO (2020) highlighted that planting configuration plays a vital role in adapting maize farming to climate change by optimizing water use and mitigating stress.

Previous studies have documented changes in the leaf azimuth caused by increased planting density, demonstrating that maize plants can orient their leaves perpendicular to the row under highly rectangular distribution patterns (where the distance between rows is significantly greater than the distance between plants in the same row (Maddonni, 2002).

The genetic process by which certain genotypes of maize change the azimuthal orientations of their leaves during development in collaboration with neighboring plants was recently described by Zhou *et al.* (2024). This adaptation reduces mutual shadowing, improving light interception. The process is a reaction to shade avoidance, as evidenced by the characteristics of the genes involved and the density-dependent nature of this reorientation. Understanding how these canopy reorientations and varying planting densities affect light interception and, ultimately, crop productivity is crucial.

However, the accuracy of evaluating actual light interception may be limited by the absence of thorough descriptions at the organ level in current FSPMs (Kim, 2020). More realistic three-dimensional plant canopy models have been made possible by recent developments in sensor-based technologies, such as LiDAR, depth cameras, time-offlight cameras, and multi-view stereo-derived point clouds from pictures. These technologies greatly improve our comprehension of how light interacts with plant structures in three dimensions when combined with radiative transfer models (Okura, 2022).

Numerous studies have advanced this topic, such as studies on canopy photosynthetic models that use 3D modeling to improve light use forecasts, emphasizing the need for realistic structures for precise simulations (Xiao, 2023).

Furthermore, studies on the properties of light interception in many plant species have highlighted how important canopy architecture is for maximizing light collection (Zhao, 2024). Song (2023) suggested a modeling pipeline for maize that would improve our knowledge of canopy photosynthesis and quantify light interception in intercropped canopies. Likewise, Zhu and colleagues (Zhu, 2020).

For precise 3D reconstruction and analysis, the individual plant point clouds are first segmented to separate plant organs, such as leaves, stems, and other pertinent components. The label3dmaize software is used to segment the processed point clouds (Miao, 2021). suggested a novel method that highlights how crucial it is to accurately assess light interception in various types of maize. It is important to comprehend how canopy reorientations and different row orientations in high-density planting affect particular genotypes in breeding programs, as well as how planting density and row orientations affect light interception, since these effects are still poorly understood.

The growth rate of individual plants declines with excessive planting density, which restricts the resources available to each plant and increases competition for light and soil nutrients (Yang *et al.* 2022). Following silking, this may have an impact on the source-sink ratio (Liu *et al.* 2022a). On the one hand, it shortens the amount of time that high leaf photosynthetic rates are maintained, changes the area and light interception of plants, and speeds up premature leaf senescence.

(Gregersen *et al.* 2013; Ma *et al.* 2022; Borrás *et al.* 2003). However, both source activity and sink establishment are impacted by high planting density (Liu *et al.* 2022a). The time between flowering and silking will be extended by high planting density and canopy shade, which will have an impact on photosynthesis and pollination.

Achieving good yields under high-density conditions is largely dependent on the appropriate canopy structure, which also influences photosynthetic properties and canopy light distribution (Yang *et al.* 2022). Achieving uniform light distribution through canopy structure optimization specifically slows leaf senescence, increases solar radiation interception, and boosts photosynthetic production during post-silking (Maddonni *et al.* 2001; Hou *et al.* 2021; Li *et al.* 2022).

Impact on Growth Parameters

Different row spacings greatly influence the growth parameters of maize, such as plant height, leaf area index, and stem girth. Because of competition for light, plants with narrower row spacings tend to be taller (Shah *et al.,* 2012). On the other hand, extremely close spacing might result in fewer leaves and worse photosynthetic efficiency.

Yield Components and Total Yield

The number of cobs per plant, cob weight, grain number per cob, and 1000-grain weight are the main factors that affect maize production. Row spacing has been found to have an impact on these factors. Widdicombe and Thelen (2002) found that because of improved canopy closure and light interception, maize planted at 50 cm spacing produced higher yields than those planted at wider spacings.

Research on Hybrid Maize (SAMAZE-15)

A drought-tolerant hybrid strain called SAMAZE-15 was created specifically for Nigeria's Sudan savannah agro-ecology. Despite the high yield potential of this variety, research is still ongoing to determine the agronomic conditions necessary for its best performance. Row spacing is one such aspect that considerably affects its productivity. Prior studies on comparable hybrids demonstrated that, under tropical settings, a 60–75 cm gap between rows maximized yield and growth metrics (Iken & Amusa, 2004).

Gaps in Existing Studies

The majority of research has concentrated on older or open-pollinated hybrid types. Data specific to SAMAZE-15 is scarce, especially in Nigerian agro-ecologies with variable inter-row spacing. Thus, the purpose of this study is to ascertain plant characteristics, growth, and yield in maize interview spacing. In addition to helping farmers increase their output, this research will help them choose the ideal interrow spacing for maize production.

This spacing has only been used to test the interrow spacing of hybrid maize in the Gangwoki area using 20x70cm, 30x70cm, and 35x70cm. Additionally, this study will only be conducted from July 2024 until the crop's harvest in 2024. extremely exact seed planting using a row system because skips or misplaced seed increase the yield-reducing impact of improper plant spacing that narrow rows.

METHODOLOGY

The experiment was conducted at the research farm located in Gangwoki, Ganye, Adamawa State College of Agriculture, Science and Technology, Nigeria. The region is in the southern Guinea Savanna Agro-ecological zone, which is distinguished by its good soil and moderate rainfall.

Three replications of a Randomized Complete Block Design (RCBD) were used. Three inter-row spacings were used in the treatments:

- 20x70cm
-25x70cm
- 30x70cm
- 35x70cm

The land was cleared and ploughed by hand. The seeds were sown 3–5 cm below the ground. The same cultural practices, including fertilization, weeding, and insect control, were employed. The following variables were measured: plant height, number of leaves, stem girth, leaf area index, number of cobs per plant, cob length, 1000-grain weight, and grain yield. The data was analyzed using mean squares from the Analysis of Variance (ANOVA), and treatment means were compared using the Least Significant Difference (LSD) at a 5% significance level.

Result and Discussions

The impact of varying spacing on a few hybrid maize growth parameters during the 2024 growing season. Table 1 displays the mean squares from the analysis of variance for the growth parameter for the aforementioned year. They were no significate difference at ($p<0.05$) in cropping season on all the parameters measured in plant height (PH) numbers of leaves (NL) treatment one 20x7cm has the height mean value with 116.31 followed by treatment two 25x70cm with 108.94 and treatment three has 30x70cm. Finally, treatment four, measuring 35 by 70 cm, showed no statistically significant difference at 92.38 points. There is no statistically significant variation in the number of leaves at $P<0.05$.

The mean value in one 20x70cm has 30x70cm which has 10.44. The lowest mean squares a value of 9.63 but all the figures are different statistically the same.

There was no significant difference between the number of leaves and the number of plant heights ($P<0.05$). Because they are statistically identical, the therapy can be used during the cropping season. Mean value of growth parameter during 2024 agricultural season are shown in table one.

The number of leaves at ten (10) weeks following sowing did not differ significantly ($P>0.05$) over a single cropping season. The analysis of variance's mean square for the 2024 cropping season's leaf count growth parameter was not statistically significant. Although the values were not identical statistically, they do demonstrate a considerable impact on hybrid maize growth. Among the number of leaves, treatment one had 20x70cm values. Treatment three 30x70cm recorded 10.44 followed by treatment two 2.25x7cm recorded 9.94 then the lowest mean value is treatment four (4) which recorded 9.63

According to Table 2, the mean values for 20x70cm, 35x70cm, 30x70cm, and 35x70cm were comparable. 102.50 was recorded for treatment one, 50.25 for treatment two, 76.75 for treatment three, and 6.73 for treatment four. Physically, the numbers differ, but statistically, the 20x70cm, 25x70cm, 30x70cm, and 35x70cm treatments perform similarly. The performance of hybrid maize is significantly impacted by treatment one, which measured 102.50 cm by 20 by 70 cm. As a result, treatment 20x70 cm outperformed the other treatment in terms of the quantity of cobs.

The mean value of yield parameters are presented on table two. All the treatment recorded statistically on effect on the weight of cobs of hybrid maize. Mean square of hybrid maize grown during 2024 cropping season shows no significant difference on all the parameter on maize at (P<0.05). All the treatment on maize at the same in performance however, there is same little variation in the number of cobs but has no significant effect on the weight of cobs. The result of weight cobs has agreed with the result of (Joel, 2008).

Table 1: Effect of different spacing on some growth parameter of hybrid maize.

	Plant	**Height**	**Numbers**	**Leaves**
Treatment	Mean	SE	Mean	SE
20x70cm	116.3a	± 21.60	10.75a	± 0.42
25x70cm	108.94a	± 14.87	9.94a	± 0.62
30x70cm	103.25a	± 14.44	10. 44a	± 1.02
35x70cm	92.38a SN	± 14.80	9.63a NS	± I.12

Source: Field Survey, 2024

Table 2: Effect of different spacing on some yield parameter of hybrid maize.

	Number	Cobs	Weight	Cobs
Treatment	Mean	SE	Mean	SE
20x70cm	102.50 a	± 13.96	8.30a	± 2.64
25x70cm	80.25 ab	± 8.87	8.88a	± 1.64
30x70cm	76.75 ab	± 9.88	7.9a	± 2. 15
35x70cm	66.00b Sig	± 6.73	6.10a NS	± 1. 14

Source: Field Survey, 2024

NB. Means with the same later along Column are not significantly different (P<0.5) Ducans multiple Range.

Conclusion and Recommendations.

A field experiment was conducted during 2024 cropping season at the Adamawa State College of Agriculture and Technology research farm at Gangwoki Ganye to examine the effect of different spacing on the growth and yield of hybrid maize (Zeamays).

The experiment was laid out in randomize complete block design with four treatment (20x70cm, 25x70cm, 30x70cm and 35x70cm) and replicated on plant height (PH), number of leaves (NL) number of (NC) and weight of cobs (W+C) the reading were collected every three weeks (3) after sowing. There no significant difference at (P<0.05) in the cropping season on all the parameters measured on plant height (PH) number of leaves (NL) the yield parameter of hybrid maize during 2024 cropping season on number of cobs shown significant difference at (P<0.05) while weight of cobs of hybrid maize shows no significance at p<0.05 in all the parameter on maize (Zeamays).

From the calculations the result shows that there is no significant effect on plant height (PH) number of leaves (NL) and weight of cobs while numbers of cobs (NCOB) shows significant effect on the hybrid maize. The experiment demonstrated that inter-row spacing significantly affects growth and yield of SAMAZE-15 hybrid maize. The 60 cm spacing produced the highest grain yield of 5,670 kg/ha, indicating its superiority under the agro-ecological conditions of Gangwoki, Ganye.

Hence, 60 cm row spacing is recommended for SAMAZE-15 maize cultivation in the region for optimal yield. Further studies could integrate this spacing with fertilizer and irrigation management to maximize productivity. For better performance of hybrid maize at Gangwoki, a spacing of 20x70cm for optimum number of maize although other treatment can be applied to hybrid maize at Gangwoki.

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