GROWTH PERFORMANCE OF POP CORN AS INFLUENCED BY NITROGEN FERTILIZER RATE AND INTRA-ROW SPACING AT BADEGGI, NIGERIA

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Abstract

Two field trials were conducted in 2016 and 2017 rainy season in Research Farm of National Agricultural Extension and Research Liaison Services Ahmadu Bello University, (NAERLS/ABU), North Central Zone, Badeggi, Niger State, Nigeria (9°45 N, 7°31 E) to test the effect of Nitrogen Fertilizer rate and Intra-row spacing on Growth and Development of Popcorn (Zea Mays Averta) var Samm II. The treatment were made up of three Intra-row spacing (20, 25 and 30cm) and for nitrogen fertilizer rate (0kg N/ha, 60kg N/ha, 120kg N/ha and 180kg N/ha). Increase in nitrogen fertilizer rate significantly increased plant height at 8 and 12 weeks after sowing (WAS) in 2016 and 2017 rainy seasons respectively. The highest rate of 180kg N/ha produced taller plant than lower rate of 60kg N/ha. Total Dry Matter (TDM) was significantly affected by N fertilizer only at 12 WAS in 22016 and at all stage in 2017. Leaf Area Index LAI was significantly affected by nitrogen application through out the season except at 4 WAS in 2016 season. Intra-row spacing had no significant effect on plant height except at 8 WAS in 2017 rainy season. TDM was significantly affected by intra-row spacing only at 12 WAS in 2016 and at intra-row spacing only at 12 WAS in 2016 and at all stages in 2017 rainy season wehre spacing at 30cm produced highest TDM plant

Keyword; Nitrogen, Intra-row spacing, Pop corn (Sam 11)

Introduction

Pop corn is a popular snack, an important part of diet of many people in most region of the world. The rapid increase in the use of Pop corn as snacks at amusement parks, theafters or around family television has greatly increased the demand for Pop corn.

The demand has out-run the supply each year, hence, Pop corn production has turned out to be a very valuable income earning, FAO (2011). The need to increase or boost popcorn production through agronomic research cannot be over-emphasized.

One of the problems of Pop corn production is poor yield. The poor performance of Pop corn in Nigeria has been attributed to low-input crop production practices, severe crop environmental stresses, and the use of low yielding varieties. There are several crop production practices that could influence growth and performance of crops. These practices include land preparation, spacing, fertilization, time of planting and time of harvesting etc. Optimum plant spacing and nitrogen fertilizer appear to have significant roles in determining yield capacity of Pop corn.

Plant population is another important factor that determine the yield capacity of crops per unit area

of land. Plant population is determined by plant spacing. The current practice among the peasant farmers producing Pop corn in the study area is to plant at a spacing of 60cm by 60cm, this spacing might not guarantee optimum yield per unit area. In view of the response of Popcorn to nitrogen fertilization and plant population especially the improved varieties this experiment was conceived to determine the best intra-row spacing and optimum N rate for maximum growth and yield of Pop corn variety Sam 11.

Material and Methods

Experiment were conducted in 2016 and 2017 rainy season at the Research Farm of National Agricultural Extension and Research Liaison Service, Ahmadu Bello University, Zaria (NAERLS/ABU), North Central Zone, Badeggi (9°45'N, 7°31'E) within the Southern Guinea Savannah ecological Zone of Nigeria. The treatment consisted of three intra-row spacing (20, 25 and 30cm) combined with four nitrogen levels (0, 60, 90 and 120 kg N/ha). Split plot design was used with three replications.

The variety Samaru II was obtained from the Institute of Agricultural Research, Ahmadu Bello University, Zaria (IAR/ABU) was used as a test crop. The land was prepared by harrowing and ridges 75cm apart were made. The gross and net plots were 19.93 and 17.5m respectively. Seeds were sown at intra-row spacing dictated by the treatment combination.

Planting was done on 7th June, 2016 and 11th June, 2017 rainy seasons. Three seeds were sown per hole at intra-row spacing 75cm apart and intra-row spacing of 20, 25 and 30cm respectively and thinned to one plant. Weed were controlled with pre-emergence herbicide gly-weed with CP4 knapsack sprayer immediately after planting followed by manually weed control using hoe at 4 and 9 Weeks after sowing in the Experimental plots. Soil sample were collected from the field at 0-30cm depth and analysed for physic-chemical properties using standard procedures. Basal fertilizer application of compound NPK 15:15:15 grade was first half dose applied at 2 WAS respectively with appropriate additional nitrogen fertilizer treatment using Urea (46%N) as source to balance nitrogen level of (0, 60, 120 and 180 kg N/ha).

Data on plant height, Total Dry Matter and Leaf Area Index were collected from five randomly tagged plant plot at 4, 8 and 12 weeks after sowing (WAS). The data collected were subjected to analysis of variance as described by Snedecor and Cochrah (1967). The treatment means were compared using Duncan Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results

Effect of Nitrogen Fertilizer Rate and Intra-row Spacing of Pop Corn on Plant Height

The result of the soil analysis varied as shown in Table 1. The soil chemical properties was generally low in organic carbon, total nitrogen. The Electrical Conductivity (EC) value of the soil (0.08 and 0.09ds/m^2) indicated that the soil were not salt affected. From the result (Table 1), the soil texture class at the experimental site was sandy loam. The soil was slightly acid tending to alkaline (5.40 to 6.0) condition in water indicating moderate soil condition for pop corn production Kamprath (2009).

Table 2 show the influence of Nitrogen Fertilizer rate and intra-row spacing of pop corn on plant height at 4, 8 and 12 WAS during 2016 and 2017 rainy seaons. In 2016 season, Nitrogen rate only had significant effect at 12 WAS where application

at 180kg N/ha resulted in taller plant than application at 120kg N/ha of N rates. Intra-row spacing had no significant effect on plant height during the period of growth. None of the treatment interactions on plant height was found to be significant. While in 2017 rainy season Nitrogen fertilizer rate had no any significant effect on plant height through-out the stages of growth. Also intra-row spacing had no any significant influence on plant height during all stages of growth.

Table 3

Effect of Nitrogen Fertilizer and Intra-row spacing of Pop corn on Total Dry Matter (TDM).

The effect of nitrogen fertilizer rate and intra-row spacing of pop-corn on Total Dry Matter per plant at 4, 8 and 12 WAS in 2016 and 2017 rainy seasons is shown in Table 3. In 2016 at 4 and 8 WAS the application of nitrogen fertilizer on Total Dry Matter (TDM) was not significant. However, at 12 WAS application 180kg N/ha significantly produced higher TDM plant than application of 60kg N/ha. At 4 and 8 WAS intra-row spacing on TDM was not significant. However, at 12 WAS, 30cm intra-row spacing produced highest dry matter only than at 25cm.

In 2017 rainy season, however, each increase in nitrogen fertilizer rate significantly increased TDM of Pop corn at both 4 and 8 WAS. At 12 WAS however, there were no significant difference on TDM between 120kg N/ha and 60kg N/ha. Application of 180kg N/ha produced higher TDM than 120kg N/ha.

When intra-row spacing was considered, it was found that at both 4 and 12 WAS each increase in intra-row spacing significantly increased TDM. However, at 8 WAS there was no significant difference in the TDM at 5 and 30cm intra-row spacing both of which were statistically higher than 20cm intra-row spacing.

Table 4

Effect of Nitrogen Fertilizer Rate and Intra-row Spacing of Pop Corn on Leaf Area Index (LAI).

Leaf Area Index (LAI) as affected by application of Nitrogen fertilizer rate and intra-row spacing at 4, 8 and 12 WAS in 2016 and 2017 rainy seasons are presented in Table 4. In 2016 rainy season at 4 WAS, nitrogen fertilizer rate had no significant effect on leaf area index. However, at both 8 and 12 WAS application of 180kg N/ha resulted in significant increase in Leaf Area Index than 120kg N/ha and 60kg N/ha which were at par.

In 2017, nitrogen fertilizer significantly influenced leaf area index. Each increase in nitrogen fertilizer rate resulted in significant increase in leaf area index at all sampling stages except at 8 WAS when there was no significant difference between 180kg N/ha and 120kg N/ha. Intra-row spacing of 5 and 30cm resulted in similar leaf area index but significantly higher than 20cm intra-row spacing at both 4 and 12 WAS. Intra-row spacing had no significant effect on leaf area index at 8 WAS.

Discussion

The no significant values obtained for most of the growth parameters at early stage of the crop growth indicates low nutrient demands during the initial stage of crop growth and development, thus the soil might have satisfied all the crops need. However, the positive response to applied nitrogen fertilizer at later stages for some of the growth parameters could be due to the fact that at this stage available nutrients in the soil could no more meet the crop requirements without the use of fertilizer. This confirms the observation made by Abayomi et al., (2013) who reported that Maize growth expressed in terms of plant height, stem girth, crop growth

rate, relative growth rate CGR, RGR, NAR showed a positive response to applied fertilizer up to the highest rate of 120kg N/ha. However, Jaliya *et al* (2013) reported that 150kg N/ha significantly produced taller plants, more number of leaves and higher dry matter level.

The non-significant response of most of the growth attributes of pop corn to varying intra-row spacing could be attributed to the fact that the variety Sam 1 used has genetically small morphological structure and so there was moderate competition for light. This mean that adequate growth factors were equally provided to the crop at this spacing, thereby minimising interplant competition. This might have provided similar amount of assimilates that make up these important parameters under the ranges of plant population used. Similarly, the crop being a C_4 plant has maximum photosynthetic rates due to low CO_2 compensation point.

The significant interaction recorded between nitrogen fertilizer and intra-row spacing on LAI indicated the complementary role played between these factors on vegetative growth of Pop corn. Significant interaction between intra-row spacing and nitrogen was observed at 12 WAS in 2016 trial only. Application of 180kg N/ha and 30cm intra-row spacing gave significantly higher plant height than all other treatments combination except 120kg N/ha and 25cm intra-row spacing (Table 5). Significant interaction was also observed on Pop corn grain yield in 2016 trial and that the highest grain yield was obtained with application of either 120kg N/ha or 180kg N/ha and 30cm intra-row spacing (Table 6).The yield increase with higher nitrogen rate of wider spacing could be due to maximum dry matter production for grain filling that was made possible as a result of taller plants that intercepted most of the photosynthetically active radiation, more number of leaves per plant that provided more surfaces for photosynthesis and assimilates production.

This result agreed with that of Tatero and Ojuma (2003). Considering the main effect and the interaction, wider spacing seem to favour the growth and yield of Pop corn. On the other and 120kg N/ha was found to be adequate for good growth and yield of popcorn at Badeggi. The interaction effect have shown that 30cm intra-row spacing and 120kg N/ha gave a higher growth, total dry matter and leaf area index that was comparable to 25cm and 180kg N/ha combination. For economic reason 30cm intra-row spacing and 120kg N/ha could be recommended for Pop corn production in Badeggi.

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