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Full Length Research Article

EFFECT OF INTRA-ROW SPACING ON THE YIELD COMPONENTS AND YIELD OF SOYBEAN IN KAFANCHAN, KADUNA STATE, NIGERIA

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ABSTRACT
A field trial was carried out during the wet season of 2023 at the Research farm of the Faculty of Agriculture College of Agriculture and Environmental Sciences, Kaduna State University, Kafanchan campus to study the effect of intra-row spacing on the yield components and yield of soybean in Kafanchan, Kaduna State, Nigeria. The treatment consisted of ten (10) intra-row spacings (10, 20, 30, 40, 50, 60, 70, 80, 90, and 100cm) laid out in a randomized complete block design and replicated three times. The inter-row spacing was 50cm. Each plot consisted of three 400cm-long ridges, with an alley of 100cm between plots and 100cm between replications. The results indicated that intra-row spacing significantly affected the height, number of branches per plant, number of leaves per plant, number of pods per plant, 100-grain weight, and grain yield of soybean. The 10cm intra-row spacing had significantly higher grain yield than the other treatments, except the 40cm intra-row spacing. The 10cm intra-row spacing was recommended for farmers in the study area as it has the likely advantage of suppressing weeds and leaving more land available for cultivation.

Keywords: soybean, intra-row spacing, components, yield.

INTRODUCTION

Soybean is one of the most famous and valuable agricultural plants, being useful for human consumption, animal nutrition and industry (Sodangi *et al*., 2011; Teodor *et al.,* 2014). The rapid growth of both the poultry and food processing industries has increased demand for soybean in Nigeria. It is believed that cultivation and production will increase as more farmers become aware of the potential of the crop, not only for cash and food but also for soil fertility improvement and Striga control.

Soybean yield is a complex trait that is highly affected by the environmental conditions; hence selection based on yield solely excluding its components may hinder the progress in yield improvement (Lekota *et al.,* 2021). Components of soya-bean yield are less complex in inheritance and affected by the environmental conditions to a lesser extent (Shaahu *et al.,* 2015). For a significant yield improvement to be obtained, effective selection of yield components is imperative (Yahaya and Ankrumah, 2015).

The importance of association among yield components and also with yield itself cannot be over emphasized in soybean breeding programs. Several studies have been conducted to identify the yield components of soybean and the results vary greatly. Lekota *et al.* (2021) demonstrated that the number of branches in a plant, pods per plant, seeds in a pod and 100 seed weight influence yield potential. Ghanbari *et al.* (2018) conducted a study focusing on biological yield, harvest yield, number of pods in a plant and number of branches and found them having influence on the yield. Environmental conditions during the growing season, especially intensity and quality of solar radiation intercepted by the canopy are important determinants of yield components and photosynthesis variation in environmental resources may bring about alternation in growth patterns of crops. There is a differential response of yield components to change in the environmental conditions, for example the shading effects are more pronounced by cultural practices of intercropping and population density (Deressegn *and* Telele*,* 2017).

The market for soybean in Nigeria is growing very fast with opportunities for improving the income of farmers. Inadequate spacing has been a factor in the declining yield of soybean in the study area. The annual yield of soybeans has been on an increase for almost a decade around the world but the total yield of the crop in the study area is relatively low. This is largely due to lack of knowledge of the crop and means to increase its yield, among which is intra-row spacing (Sodangi *et al*., 2011).

The spatial distribution of plants in a crop community is an important determinant of yields. Many experiments have been conducted to determine the spacing between rows and between plants within the row, which maximizes yield. There are two general concepts frequently used to explain the relationship between row spacing, plant density, and yield. First, maximum yield could be obtained only if the plant community produced enough leaf area to provide maximum light interception during reproductive growth. Secondly, equidistant spacing between plants affected inter plant competition. Hence it will be essential to adjust the spatial distribution of the recommended population in order to have maximum yield (Deressegn and Mekibib, 2017). Studies have been conducted in several places to determine the effect of spacing between rows and between plants within the rows of several crops. This study was carried out to determine the effect of intra- row spacing on the yield components and yield of soybeans in Kafanchan.

MATERIALS AND METHODS

The field trial was carried out during the wet season of 2023 at the Research farm of the Faculty of Agriculture College of Agriculture and Environmental Sciences, Kaduna State University, Kafanchan campus. The treatment consisted of ten (10) intra-row spacings (10, 20, 30, 40, 50, 60, 70, 80, 90 and 100cm) laid out in a randomized complete block design and replicated three times. The inter-row spacing was 50cm. Each plot consisted of 3 ridges, spaced 50cm and 400cm long, with an alley of 100cm between plots and 100cm between replication.

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Soybean seeds were planted on the 28th of June 2023, at five seeds per hole and were later thinned to two seedlings per stand. Weeding was carried out three times using a hand hoe. Data were taken on plant height, number of leaves per plant, number of pods per plant, pod weight, 100 grain weight and grain yield. All data collected were subjected to analysis of variance (ANOVA) and differences between means were tested with Duncan Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

Table 1 shows the effect of intra-row spacing on the height, number of branches and number of leaves of soybean. The 10 cm intra-row spacing produced the tallest plants, which were significantly taller than all the other intra-row spacings. Several researchers (Hassan, 2015; Sevgi *et al.*, 2015; Worku and Astatkie, 2011) indicated that soybean plants grew taller in narrow plant spacing. Yimer *et al.* (2020) also indicated that as intra-row spacing becomes wider, plant height decreased significantly and the tallest plants were measured with the narrowest (5 cm) intra-row spacing while the shortest plant were obtained from the wider intra-row spacing. Under narrow intra-row spacing the competition for light, water, space and nutrients among plants becomes severe and the stems grow tall and thin.

Intra-row spacing showed significant differences on number of branches per plant. The 100 cm intra-row spacing produced plants with the highest number of branches per plant, which was statistically similar to the 70 cm and 60 cm intra-row spacing but significantly higher than all other intra-row spacings. The highest number of branches per plant was produced by the widest spacing. Also, the 100 cm intra-row spacing produced plants with the highest number of leaves per plant, which was statistically similar to the 60 cm intra-row spacing but significantly higher than all the other intra-row spacings. These variations resulted from density differences, as the soybean grown in low density utilized free plant growth resources better due to less interspecific competition compared to the denser populations. Several researchers (Yimer *et al*., 2020; Cox and Cherney, 2011; Saitoh, 2011 and Worku and Astatkie,2011) reported similar findings.

Table 1: Effect of intra-row spacing on the plant height, number of branches/plant and number of leaves per plant at 13 weeks after sowing of soybean in Kafanchan, 2023

Intra-row spacing (cm)	Plant height at harvest (cm).	Number of branches per plant at harvest	Number of leaves per plant
10	51.71^{a}	24.30^{fg}	78.00^{e}
20	43.90^{b}	19.97^{g}	52.00^{f}
30	29.00^{e}	31.73^{cd}	93.33^{bc}
40	42.00^{bc}	26.87^{ef}	84.67^{c-e}
50	32.00^{de}	34.73^{bc}	76.67^{e}
60	29.67^{e}	37.87^{ab}	104.00^{ab}
70	43.67^{b}	36.77^{ab}	91.33^{cd}
80	37.00^{cd}	31.33^{c-e}	48.33^{f}
90	35.67^{d}	29.90^{de}	80.33^{de}
100	36.80^{cd}	40.23^{a}	110.67^{a}
SE (±)	2.773	2.272	21.50

Figures in the same column followed by the same letter(s)are statistically the same at 5% level of probability according to Duncan multiple range test (DMRT).

The effect of intra-row spacing on the number of pods per plant was significant (Table 2). The 100 cm intra-row spacing supported the highest number of pods per plant, which was statistically similar to the 90 cm inter-row spacing but significantly higher than the other inter-row spacings. This finding agrees with Saitoh (2011) and Yimer *et al*. (2020) reported that narrow intra-row spacing gave fewer pods per plant than the wide intra-row spacing. The number of pods per plant is one of the most important contributing traits to yield.

Pod weight per plant was not significantly affected by intra-row spacing in this study (Table 2). All the treatments, except the 50 cm intra-row spacing had similar 100-grain weight. Grain yield decreased significantly with increasing intra-row spacing, although the pattern was not consistent (Table 2). The yield advantage with closer intra-row spacing was attributed to earlier establishment of canopy closure, greater light interception and reduction in competition for nutrients and moisture from weeds. Since narrow intra-row spacing promotes quicker soybean canopy closure, it makes the crop more competitive with weeds and prevents weeds from germinating once the canopy closes. Rapid canopy closure can also reduce soil moisture loss.

Table 2: Effect of intra-row spacing on the number of pods per plant, pod weight per plant, 100-grain weight and grain yield of soybean in Kafanchan, 2023

Intra-row spacing (cm)	Number of pods per plant	Pod weight per plant	100-grain weight	Grain yield (t/ha)
10	60.97^{c}	27.78	14.00^{ab}	3.56^{a}
20	66.23b^{c}	23.10	14.66^{a}	2.20^{bc}
30	64.33b^{c}	29.33	12.33^{ab}	1.03^{cd}
40	76.67^{b}	35.23	11.33^{ab}	2.90^{ab}
50	70.13b^{c}	32.86	10.00^{b}	0.49^{d}
60	70.43b^{c}	27.03	11.66^{ab}	0.74^{d}
70	77.40^{c}	43.90	14.33^{a}	0.53^{d}
80	64.33b^{c}	24.57	14.33^{a}	0.76^{d}
90	94.87^{a}	37.80	13.66^{ab}	0.85^{d}
100	95.67^{a}	43.37	11.33^{ab}	0.49^{d}
SE (±)	18.67	10.14	2.01	0.59

Figures in the same column followed by the same letter(s)are statistically the same at 5% level of probability according to Duncan multiple range test (DMRT).

Conclusion
In this study, the 10 cm intra-row spacing proved to be best spacing for the growing of soybean at Kafanchan as it significantly improved the crop yield. The yield advantage with closer intra-row spacing was attributed to earlier establishment of canopy closure, greater light interception and reduction in competition for nutrients and moisture from weeds. This intra-row spacing is therefore recommended for soybean farmers in Kafanchan, if grown as a monocrop.

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