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Research Article

Morphological traits and seed yield of non-branching monostem sesame VRI 5 under varied crop geometry

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Background: Prominence and demand for sesame is high, however, its production remains quite low. Scarcity of labour is one of the constraints to carry out the key operations in time, wherein delayed operations result in low productivity. The newly evolved non-branching type sesame is amenable for farm mechanization. Optimizing the crop geometry is a pre-requisite to step further for mechanizing the newly evolved monostem sesame cultivation. Keeping these aspects in view, field evaluations were conducted to evaluate the yield potential of non-branching monostem sesame VRI 5.

Methods: The newly evolved non branching monostem sesame VRI was evaluated with eight set of treatments *viz*., T_1 - 30 x 30 cm, T_2 - 30 x 15 cm, T_3 - 30 x 10 cm, T_4 - 20 x 20 cm, T_5 - 20 x 15 cm, T_6 - 20 x 10 cm, T_7 - 30 x 20 x 10 cm in paired row, T_8- 30 x 15 x 10 cm in paired row during two seasons *viz*., Summer 2021 and Summer 2022. The experiment was laid out in three replications following randomized block design.

Results: Higher plant height at harvest (88.1 cm), number of nodes per plant (14.1) and internode length (5.38 cm) were noted at a wider spacing of 30 x 30 cm. However, a higher seed yield of 770 kg/ha was recorded at a square geometry of 20 x 20 cm.

Conclusion: Based on the two consecutive years of field experiment it is ascertained that the crop geometry at a spacing of 20 x 20 cm is ascertained to be optimum in recording higher productivity of monostem sesame VRI 5.

Keywords: *monostem sesame, crop geometry, spacing, productivity*

Introduction

Sesame (*Sesamum indicum* L.) an important ancient oil seed crop belongs to the Pedaliaceae family is widely cultivated in southern temperate regions, tropical and subtropical regions and of the world. There is an inherent lacuna in sesame production, apart from physiological issues, maintenance of poor plant population reflects on the sesame seed yield. The ruling sesame plant types are profuse branching which requires more space for an individual plant and hence maintenance of population is essential, however, it is very difficult in commercial planting (Sumathi & Muralidharan, 2010). Growers have been discouraged by the low yields and difficulties encountered during the sesame harvest, which has led to reduction in the sesame growing area. With the view of these issues, the new variety VRI 5 has been released which is evolved from the parent VRI 3 x EC 370840 with the special feature of non-branching type which is best suited for mechanized cultivation. Optimizing plant population and spacing for monostem sesame is the foremost step to bring the crop for cultivation and to reap the potential yield of monostem sesame, further, it will find a solution to suit the crop for mechanisation. Varied environment, genotypes and crop management conditions impacts the plants' growth and development from germination to senescence (Agudamu et al., 2016; Pereira-Flores & Justino, 2019). Plant spacing regulates the canopy structure and has two major effects on the crop: first, it intercepts and distributes light (Harisudan et al., 2020); second, it correlates physiological development and morphological changes (Jakusko et al., 2013; Harisudan, 2020). Plant spacing varies from one plant species to another and thus must strictly be controlled to prevent over-population which in turn affects the growth and productivity of cultivated crops (Harisudan & Vincent, 2019). Widely spaced crops (35cm) produced shorter plants due to competition for growth factors. Bhardwaj et al., 2014 reported the highest yield under closer row spacing of sesame. Certainly, the recommended pattern for the branched varieties would differ from that for non-branched. However, there is limited knowledge on adequate spacing of the non-branched Sesame. Hence, this research work is proposed to determination of optimum crop geometry for higher yield and quality for non-branched Sesame.

Materials and Methods

Experimental location

Field studies to optimize the crop geometry for non-branching monostem sesame VRI 5 was conducted for two successive years Summer 2021 and Summer 2022 at Regional Research Station, Vridhachalam at 11^0 30′ N, 79^0 26′ E, and 42.67 m altitude with the objective to evaluate optimum inter and intra row spacing for mono stem sesame and further to assess suitable plant density for mono stem sesame cultivation. The field experiment soil is of sandy loam low in organic carbon (0.20 %) and with a pH of 6.5.

Experiment materials and arrangement of experiments

The field evaluation was laid out in randomized block design replicated thrice with eight set of treatments *viz*., T_1 - 30 x 30 cm, T_2 - 30 x 15 cm, T_3 - 30 x 10 cm, T_4 - 20 x 20 cm, T_5 - 20 x 15 cm, T_6 - 20 x 10 cm, T_7 - 30 x 20 x 10 cm (Paired row), T_8- 30 x 15 x 10 cm (Paired row).

Data collection

The plants were tagged to record observation. The tagged plants height were measured from the ground to the terminal of the main stem and the mean data were expressed in cm. The growth attributes data *viz*., plant height, height from the base to first node, yield attributes *viz*., height from the base to first bearing node, number of nodes/plant, and internode length were recorded. In 82 days, the crop reached maturity and was harvested. Following harvesting, the number of capsules in each of the tagged plants was determined by counting them and averaging them to determine how many capsules each plant had. Each capsule's seed content was tallied and noted. Sesame seed yield was calculated and represented in kg/ha using cleaned and sun-dried net plot area grains that had been weighed. The data recorded were subjected to statistical analyses and critical differences were analysed using the standard procedures.

Statistical analysis

The recorded data were subject to statistical procedure by Gomez & Gomez, 1984. A two-way ANOVA was used to determine the suitable spacing. For significant, critical differences were worked out at five per cent level and non-significant data were noted as N.S.

Results

Growth attributes

Field experiment to "Optimize plant population for higher productivity of mono stem sesame VRI 5" was conducted during Summer 2021 and Summer 2022. The field experiment results are presented hereunder. The varied plant geometry recorded variations on the growth attributes of monostem sesame (Figure 1). The first node emerged at low height (5.3 cm) from the base at 30 x 30 cm (T_1), whereas the first node emerged at higher height (6.9) at the paired row spacing of 30 x 15 x 10 cm (T_8). In contrary the first capsule bearing node is at low height (9.2 cm) from the base at the spacing of 30 x 15 cm (T_2), whereas the first capsule bearing node emerged at higher height (10.3) at the spacing of 20 x 10 cm (T_6). Higher plant height at 30 DAS (41.6 cm) and at harvest (88.1 cm) was reached at a wider spacing of 30 x 30 cm (T_1), low plant height at 30 DAS (34.5 cm) and at harvest (77.3 cm) was attained at a closer spacing of 20 x 10 cm (T_6). Higher number of nodes/plant (14.1) and higher internode length (5.38 cm) was observed at a wider spacing of 30 x 30 cm (T_1), less number of nodes (9.5) was observed at 20 x 10 cm spacing (T_6) and shorter internode length (4.21 cm) was noticed at 30 x 10 cm (T_3) spacing.

Figure1. Effect of plant geometry on growth attributes

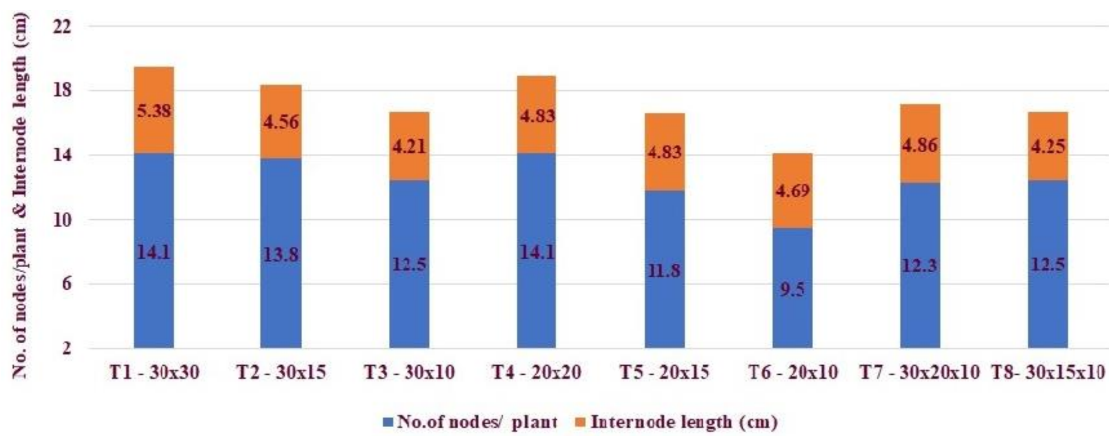

Figure 2. Effect of plant geometry on number of nodes/ plant and internode length(cm)

Yield attributes and seed yield

The varied crop geometry has noteable influence on the yield characteristics and seed yield of monostem sesame (Figure 2 and Figure 3). Wider spacing at 30 x 30 cm (T_1) has recorded higher number of capsules/node (3.98) and number of capsules/plant (56.1), whereas closer spacing of 20 x 10 cm (T_6) recorded less number of capsules/node (2.72) and number of capsules/plant (25.8). However, in terms of sesame seed yield, at square geometry of 20 x 20 cm (T_4) maximum seed yield of 770 kg/ha was obtained, whereas at wider spacing of 30 x 30 cm (T_1) low sesame yield of 300 kg/ha was recorded.

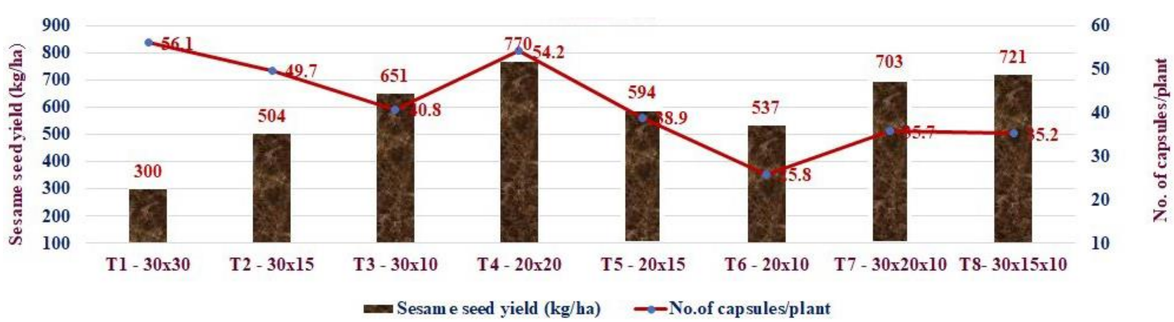

Figure 3. Effect of plant geometry on number of capsules/plant and seed yield (kg/ha)

Discussion

Numerous studies evaluated the changes in plant growth owing to varied plant spacing, which specified that decrease in the plant population produces higher growth attributes of individual plants and as a consequence more nodes (Luca & Hungría, 2014). Sesame at wider spacing receives major sunlight for the photosynthesis process, and increased photosynthesis leads to higher growth attributes (Ali et al., 2020). Wider spacing reduces the inter and intra plant competition (Jan et al., 2014) and thereby results in higher growth attributes. A similar noticeable effect of spacing on growth attribute of sesame was reported by Ali et al., 2020. Similarly, Caliskan et al. (2004) in their research work highlighted that a higher number of capsules were obtained under higher spacing at a lesser plant population. These findings are in line with further field experiments that confirmed that higher plant density reduced nodes, number of capsules/plant and seed yield (Hamza et al., 2022). Wider row spacing provides ample space for establishment and better utilization of resources per individual plant (Mohammed et al., 2019; Nadeem et al., 2015). The decrease in inter-row spacing results in decreased yield per plant however yield per hectare increases significantly (Lakew et al., 2018). Normally, as the space increases, yield also increases proportionately reaches a certain level at optimum spacing and then declines gradually. In contrary, sparsely populated fields with wider spacing could lead to uneconomic utilization of space, profuse growth of weeds and pests and reduction of yield per unit area of sesame was reported by Roy et al. (2009). The agronomic practices have a strong inherent relationship and impact on the yield traits and yield (Demeke et al., 2023).

Challenges and opportunities

Urbanization and migration of farm workers to urban areas result in scarcity of labour for agriculture. The unavailability of labour in the required time to carry out the field operations results in poor yield; hence mechanization is the only option. The traditional plant type is not suited for completed mechanization. Hence, the newly evolved monostem sesame VRI 5 has a wide scope for mechanizing sesame cultivation.

Conclusion

The evaluation of sesame potential yield is a highly intricate quantitative process that depends on various factors, the most significant of which are plant density and per plant yield. Further, the expression of morphological traits of sesame is significantly influenced by plant-to-plant competition. With the varied plant density evaluated and its impact on the yield attributes recorded, it could be determined that square crop geometry at 20 x 20 cm spacing with the dense population of 2,50,000 plants/ha is ascertained to be optimum for higher productivity of non-branching monostem sesame VRI 5.

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Author contributions

C. Harisudan wrote the entire manuscript in addition to the field experiment conducted. A. Mahalingam and T. Ezhilarasi are breeders involved in the development of monostem sesame variety. M. Paramasivan and P. Indiragandhi are involved in the data collection. R. Baskaran edited the manuscript and K. Subrahmaniyan was involved in the formulation of the experiment.

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Conflict of interest

The author declares no conflict of interest. The manuscript has not been submitted for publication in any other journal.

Ethics approval

Not applicable.

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