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Optimization of Spacing and Fertilizer Levels on Growth of Sesame (*Sesamum indicum* L.)

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A field experiment was conducted during *kharif* season of 2014-15 at Oilseeds Research Station, Latur, to study the response of sesame to different spicing and fertilizer levels. The experiment was laid out in a split plot design consisting six spacing and three fertilizer levels with two replications. The results indicated that growth and yield attributing characters of sesame viz. plant height, number of functional leaves, leaf area, number of capsule, number of branches, total dry matter, capsule yield per plant and test weight were appreciably improved with the spacing of 60 cm x 15 (S_6) cm the spacing of 45 cm x 10 cm (S_1) was found to be significantly effective in producing higher seed yield (kg ha^{-1}), oil yield (kg ha^{-1}), gross monetary returns, net monetary returns and B: C ratio which was at a par with the spacing of 30 cm x 15 cm (S_2) and significantly superior over rest of the spacing. Among different fertilizer levels, the application of 125 % RDF (F_3) produced significantly higher growth and yield attributing characters, higher seed yield (kg ha^{-1}), oil yield (kg ha^{-1}), gross monetary returns, net monetary returns and B:C ratio as compared to 75 % RDF (F_1) and it was at par with 100% RDF (F_2).

Introduction

Sesame (*Sesamum indicum* L.) which is known variously as til, gingelly, simsim, gergelim etc. Sesame is one of the world's oldest cultivated oilseed crops. Sesame is a self-pollinated crop, which belongs to family *Pedaliaceae* and better known as "Queen of oilseeds" by virtue of its quality edible oil and protein content, as it contains 50 percent oil and 18-20 percent protein. Sesame oil has long shelf life and rich in linoleic acid. Its protein is rich in sulphur containing amino acid (Methionine). Yield potential of sesame can be exploited by the use of agronomic techniques. Among the standardized agronomic practices required for a realizing yield potential of *kharif* sesame, plant geometry and nutrition are the most important factors in determining yield. The planting geometry helps in altering canopy architecture affecting light interception and CO_2 assimilation which further affect the productivity. Plant nutrition is key input to increase the productivity. Fertilizer is an important option that should be adopted in order to improve crop yields. Nitrogen is a structural component of chlorophyll and protein therefore adequate supply of nitrogen is beneficial for both carbohydrates and protein metabolism. Similarly, phosphorus is an important plant nutrient which help in growth and development of a plant and ultimately improved crop yield. Supply of nutrients and water to the growing plant parts, resulting in increased growth and yield traits, thereby ensuring more seed and dry matter yield (Maiti and Jana, 1985). It significantly increases seeds capsule^{-1}, capsule plant^{-1}, seed yield, oil and protein content of sesame cultivar. Understanding the dynamic of these nutrients in terms of their uptake, translocation and distribution in sesame plant with an important aspect of its nutrition that will help in taking decision to improve its production and management. It will also help in adaptation of proper package and practices for sesame crop and reduce the cost of fertilization. In view of above consideration the present investigation entitled "Optimization of spacing and fertilizer level in sesame (*Sesamum indicum* L.)"

Materials and Methods

A field experiment was conducted during *kharif* season of 2014-15 at Oilseeds Research Station, Latur, to study the response of sesame to different spacing's and fertilizer levels. The soil was clayey in texture, low in available nitrogen (141 kg ha^{-1}), medium in phosphorus (17.1 kg ha^{-1}), high in potassium (576 kg ha^{-1}) and slightly alkaline in reaction (7.8 P^{H}). The total rainfall received during crop growth period was 421 mm and distributed over 29 rainy days. The experiment was laid out in a split plot design consisting six spacing's viz. 45 cm x 10 cm (S_1), 30 cm x 15 cm (S_2), 45 cm x 15 cm (S_3), 30 cm x 22.5 cm (S_4), 60 cm x 10 cm (S_5) and 60 cm x 15 cm (S_6) as main plot treatment and three fertilizer levels viz. 75 % RDF (F_1), 100 % RDF (F_2) and 125 % RDF (F_3) as sub plot treatment replicated twice. The recommended dose of fertilizer (RDF) was 50: 25: 00 NPK kg ha^{-1}. The gross and net plot size of expérimental unit was 5.4 x 3.6 m and 4.5/4.8/4.2 x 3.0 m respectively. Sowing was done by dibbling method on 12th July 2014. The recommended cultural practices and plant protection measures were under taken as per recommandation. Data on various variables were analyse by analysis of variance (Panse and Sukhatme, 1967)

Results and Discussion

The data pertaining to growth parameters have been presented in table 1. The important growth parameters plant height (cm), number of branches per plant, leaf area (dm^2), number of functional leaves plant^{-1}, and total dry matter (g). were influanced significantlly by various treatment.

Among the various spacing's the spacing of 60 cm x 15 cm (S_6) produced significantly highest plant height at all growth stages of crop growth except 15 DAS and spacing of 30 cm x 15 cm (S_2) produced lowest plant height through crop growth period except at 15 DAS. The wider row and plant spacing might have provided sufficient rooting and moisture extraction pattern to the plant which in turn would have helped better absorption of water and nutrient from the soil resulting in tallest plant. This is in agreement with the findings Sivagamy and Rammohan (2013), Shinde *et al.,* (2011) and Caliskan *et al.,* (2004).

The plant spacing of 60 cm x 15 cm (S_6) recorded significantly higher mean number of functional leaves per plant as compared to all other spacings. The spacing of 45 cm x 10 cm (S_1) and 30 cm x 15 cm (S_2).

Availability of sufficient light and moisture to every plant at higher plant spacing leading to enhanced plant growth might have led to better functional leaves per plant Basavraj *et al.,* (1993). Mean leaf area per plant was increased up to 60 DAS. The significant differences in leaf area were observed among different spacing at all growth stages.

Table.1 Data pertaining to growth parameters

Treatment	Plant height (cm)	Number of functional leaves	Mean leaf area (dm^2)	Number of branches plant-1	Total dry matter (g)	Yield (kg ha^{-1})
Spacings (cm)						
S_1 - 45 x 10	88.4	17.10	15.66	4.12	22.08	658
S_2 - 30 x 15	83.6	11.18	16.17	3.90	24.19	597
S_3 - 45 x 15	85.4	10.03	22.13	3.97	21.87	543
S_4 - 30 x 22.5	88.7	13.82	21.26	4.03	25.30	486
S_5 - 60 x 10	94.9	7.96	22.25	4.03	22.38	576
S_6 - 60 x 15	98.7	20.28	27.44	4.17	35.93	545
S.E. ±	2.3	0.41	1.16	0.03	0.84	17
C.D. at 5 %	8.4	1.50	4.22	0.11	3.05	63
Fertilizer levels						
F_1 - 75 % RDF	86.9	10.38	17.83	3.89	22.47	535
F_2 - 100 % RDF	89.7	14.27	21.27	4.07	25.64	576
F_3 - 125 % RDF	93.2	15.53	23.36	4.15	27.76	592
S.E. ±	1.4	0.40	0.70	0.04	0.76	13
C.D. at 5 %	4.2	1.24	2.17	0.12	2.35	41
Interaction (S x F)						
S.E. ±	3.36	0.98	1.72	0.10	1.8	32
C.D. at 5 %	NS	NS	NS	NS	NS	NS
General Mean	**89.96**	**13.39**	**20.81**	**4.03**	**25.29**	**568**

Among the spacing the spacing of 60 cm x 15 cm (S_6) was significantly higher leaf area per plant which was at par with 60 cm x 10 cm (S_5), 30 cm x 22.5 cm (S_4), 45 cm x 15 cm (S_3) at different growth stages spacing of 60 cm x 15 cm (S_6) produced significantly higher leaf area per plant over rest of the spacings. Similar result was also obtained by Sarkar and Pal (2005).

The spacing of 60 cm x 15 cm (S_6) produced significantly higher mean number of branches per plant which was at par with 45 cm x 10 cm (S_1) found significantly superior over rest of the spacings at different growth stages. The wider plant spacing 60 cm x 15 cm (S_6) enhanced mean number of branches over remaining spacing owing to better geometric arrangement resulting in better absorption of moisture and nutrient due to lesser competition for growth factors between plant. Similar finding were also observed by Sivagamy and Rammohan (2013) and Jukusko and Usman (2013). The spacing of 60 cm x 15 cm (S_6) recorded significantly higher mean total dry matter per plant over rest of the spacing. The extent of increases in the dry matter per plant due to decreases in plant density tended to increases growth advanced. Thus the increased total dry matter per plant at wider plant spacing which usually associated with increased leaf area per plant has led to greater accumulation of photosynthesis. Similar findings reported by Ngala *et al.,* (2013) and Haruna (2011).

Seed yield (kg ha^{-1}) was influenced significantly due to different spacing. The spacing of 45 cm x 10 cm (S_1) produced significantly highest seed yield (kg ha^{-1}) which was at par with 30 cm x 15 cm (S_2) and significantly superior over rest of spacings. It might be due to higher plant population in closer spaced plant. Hence higher plant population lead to higher seed yield per unit area. Similarly yield reduction with decreasing plant population in sesame reported by Prasanna *et al.,* (2014).

From the result it may be inferred that the plant spacing of 60 cm x 15 cm (S_6) was recorded with higher plant height (cm), Number of functional leaves, mean leaf area (dm^2), number of branches $plant^{-1}$, total dry matter (g) and highest yield kg ha^{-1} was recorded with closer plant spacing (S_1) - 45 x 10 cm that was (658 kg ha^{-1}) over the other plant spacing.

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