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AGRONOMIC EVALUATION OF SPACING AND NITROGEN MANAGEMENT PRACTICES ON GROWTH AND YIELD OF SESAME (*Sesamum indicum* L.)

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Abstract – The present investigation was conducted to evaluate the spacing and nitrogen management practices on growth and yield of sesame. The field experiment was carried out at Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology, and sciences, Prayagraj during *Kharif* 2020. The soil of the experimental plot was sandy loam in texture, neutral in soil reaction (pH 7.3), low organic carbon (0.57 %), available P (32.10 kg/ha), EC (0.29 ds/m), available K (346 kg/ha). Two experimental factors were taken, with spacing as one factor i.e.,30 cm x 10 cm, 45 cm x 10 cm, 60 cm x 10 cm, while levels of nitrogen management practices as the 2nd factor i.e., 100% RDN (*Recommended dose of Nitrogen*), 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation, 50% RDN + 50% N through Bokashi + *Azotobacter* inoculation. Both factors are structured as 9 treatment combinations which are laid in Randomized block design by replicating thrice. The results revealed that the treatment T_5 (Spacing 45cm × 10cm + 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation) was recorded higher growth parameters *viz*. plant height (92.65 cm), Dry weight (17.92 g/plant), No. of leaves/ plant (39.87) and higher yield attributes *viz*. Number of capsules/plant (42.00), Number of seeds/capsule (52.67) and consequently higher Grain yield (1256.67 kg/ha), and Stover yield (2112.67 kg/ha).

INTRODUCTION

Sesame (*Sesamum indicum* L.) is amongst the oldest spices and oilseed crops in the world. India ranks first in area (29%), production (26%), and export (40%) of sesame in the world. Domestic demands made by the large population make an impact as the production of oilseeds in our country along with sesame is not up to the required level. Sesame seed value adds to its exceptional food, diet, health care, edible oil, and biomedicine. Sesame is an antique oil crop supplying seeds for confectionery purposes, edible oil, paste, and cake (Weiss, 1983). It is known with different names in various Indian languages. Sesame seeds is known as *'Til'* in Hindi, *'Nuvvulu'* in Telugu, *'Ellu'* (Tamil, Malayalam, Kannada), *'Teel'* in Marathi, and *'Til'* in Bengali. Sesame belongs to the family of Pedaliaceae. Its seed contains approximately 50% oil and 25% protein (Burden, 2005). Sesame oil has a long shelf life and rich in linoleic acid. Its protein is rich in sulphur-containing amino acids (Methionine) (Unde *et al.*, 2017). In the summer season, the crop is astonishingly superior to the yield of Kharif season as the crop is frequently affected by the monsoons at maturity consequential in discoloured grains due to mold prevalence, which fails to fetch the better price at the export market (Sanjay *et al.*, 2020). The various physiological processes that occur in a plant that manifests the yield of sesame that can be altered by the various management practices viz., plant geometry, fertilization, etc. makes an impact in influential the yield. Plant geometry has a diverse consequence on the growth attributes viz., plant height and number of branches/plant as well as on yield and yield attributes *viz.,* number of capsules/ plant and number of seeds/capsule. To fully exploit the yield potential of sesame, it is vital to uphold optimal plant population. Plant geometry plays has its role in the better interception of sunlight to each strata of leaves, thus promoting the pace of photosynthesis and consequently the hike in dry matter production. As a C_3 plant, sesame will be thwacked by photorespiration. Better plant geometry influences by minimizing the photorespiration which ultimately escalates the crop yield. As per modern technology, spacing has a connotation in relation to plant population, which usually depends upon the soil fertility eminence and moisture level of the field. Plant geometry improves the light interception and CO_2 assimilation by revising the canopy structure and also increasing productivity (Brar *et al.,* 1998). Proper nutrient management improves the growth and yield of crops. Nowadays excess use of chemical fertilizer has been a huge threat to the environment and also agricultural produce quality, to deal with the present crisis the promising interpretation to by employment of natural biological nitrogen-fixing system through different organic sources like bio fertilizers, organic manures in addition with chemical fertilizers is essential. Hence, efficient administration of nitrogen is key for escalating the growth and productivity of crops. Bokashi is a soil fertility technology amendment that can be applied to ameliorate the soil properties for better plant growth and production (Iriti *et al.,* 2019). Many positive aspects of the application of bokashi have been reported such as improving soil fertility and plant growth as well as reducing the use of inorganic fertilizers (Wijayanto *et al.,* 2016). It has revealed to augment plant nutrient uptake, growth, and yield via diverse fundamental mechanisms such as changes in soil structure, nutrient solubility, root growth and morphology, plant physiology, and symbiotic relationships (Pandit *et al.,* 2019).

In view of the above consideration the present investigation entitled "Agronomic Evaluation of Spacing and Nitrogen Management practices on Growth and Yield of Sesame (*Sesamum indicum* L.)" was carried out.

MATERIALS AND METHODS

A field experiment was conducted during the *Kharif* season of 2020 to study the effect of plant geometry and nitrogen management practices on the growth and yield of sesame (*Sesamum indicum* L.)., at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh, India which is located at $25^0 39' 42''$ N latitude, $81^0 67' 56''$ E longitude and 98 m altitude above the mean sea level. The soil of the experimental plot was sandy loam. The experiment was carried out in Randomized Block Design (RBD) consisting of 9 treatments which are replicated thrice. Two experimental factors were chosen, one with spacing *i.e.,* 30 cm x 10 cm, 45 cm x 10 cm, 60 cm x 10 cm, while the other factor is levels of nitrogen management practices, i.e., 100% RDN (Recommended dose of Nitrogen), 75% RDN + 25% N through bokashi + *Azotobacter* inoculation, 50% RDN + 50% N through bokashi + *Azotobacter* inoculation. The factors are designed to structure the 9 treatment combinations that as shown in Tables 1 and 2. The recommended dose of fertilizer (RDF) was 50:40:30 NPK kg/ha. Nitrogen requirement was fulfilled by applying urea and bokashi as per treatment combination. Half the dose of urea was given as a basal dose and the rest half was applied as two doses at 30 DAS and at the flowering stage respectively by splitting them equally. Based on the N content in bokashi it is given as a basal dose. At the time of sowing as a basal dose P and K fertilizers are applied. At the rate of 200 ml/ha azotobacter seed treatment was done on the shekhar variety of seed. An appropriate sampling technique was adopted in order to generate scientific and reliable data for statistical analysis. Five plants were selected from each plot leaving the first 2 border rows and taking the 3rd plant from the edges and 1 from the center of the 3rd row and were tagged. Pre-harvest observations like Plant height (cm), No. of leaves/plant, Dry weight (g/plant), were recorded from the tagged plants, after which the final data was subjected to statistical analysis. Net plot area of 1 m^2 was harvested from each plot and dried and threshing and winnowed manually. Weighed the grain per net plot value, the grain yield per hectare was computed and expressed in kilograms per hectare. Yield attributing character viz. No. of capsules/plant, No. of seeds/ capsule, Test weight and harvest index (%) were reorded. The data were computed and analyzed by following the statistical method of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Effect on the growth of sesame

The statistical data regarding growth parameters were presented in Table 1.

Plant height (cm)

Significantly higher plant height (92.65 cm) was recorded by the treatment T_5 (Spacing 45cm × 10cm + 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation). Whereas, treatment T_6 (Spacing 45 cm × 10 cm + 50% RDN + 50% N through Bokashi + *Azotobacter* inoculation) was found statistically at par with maximum i.e., T_5. The spacing 45 cm x 10 cm might be the optimum plant height for sesame because competition for resources has hindered the plant height which was in close conformity with Yadav *et al.,* (2007). High availability of nitrogen by the treatments might have enhanced the activities of meristematic tissues of plant, consequently, increase in number and size of cells, and ultimately increased plant height. Ghosh and Sen (1980), and Rao *et al.,* (1990) found similar results. Due to the improved biological activities by the seed treatment by azotobacter might have hiked the plant height Ghosh (2000).

Dry weight (g/plant)

Maximum plant dry weight (17.92 g) was recorded by the treatment T_5 (Spacing 45 cm × 10 cm + 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation. However, treatment T_6 (Spacing 45cm × 10cm + 50% RDN + 50% N through Bokashi + *Azotobacter* inoculation) has shared the statistical parity with the Treatment T_5.

Adequate nutrients, moisture and, solar radiation being nitrogen a vital constituent of chlorophyll which has boosted the photosynthetic activity in plants and synthesis of photosynthate subsequently the dry weight in accord with Patra and Mishra (2000). Due to the increased accessibility nitrogen levels by plant improved dry weight**,** Ogundare *et al.,* (2015).

No. of leaves/plant

Due to the senescence of leaves at the harvesting stage which is a natural process, the leaves per plant have dipped in all treatment combinations. The highest no. of leaves (39.87) was observed in T_5 (Spacing 45 cm × 10cm + 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation), whereas, treatment T_4 (Spacing 45 cm × 10 cm + 100% RDN) and treatment T_6 (Spacing 45 cm x 10 cm + 50% RDN + 50% N through Bokashi + *Azotobacter*

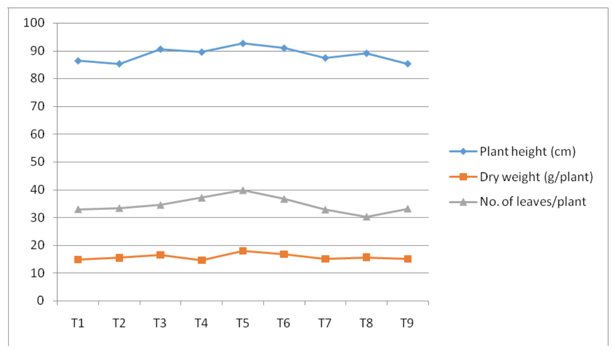

Fig. 1. Graph depicting the plant height, dry matter, and no. of leaves/plant.

Table 1. Effect of spacing and nitrogen management practices on growth parameters of sesame

S. No.	T. no	Treatment combination	Plant height (cm)	Dry weight (g/plant)	No. of leaves/ plant
1	T_1	Spacing 30 cm × 10 cm + 100% RDN	86.41	14.92	33.00
2	T_2	Spacing 30 cm × 10 cm + 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation	85.35	15.49	33.40
3	T_3	Spacing 30cm × 10 cm + 50% RDN + 50% N through Bokashi + *Azotobacter* inoculation	90.60	16.50	34.53
4	T_4	Spacing 45 cm × 10 cm + 100% RDN	89.55	14.68	37.13
5	T_5	Spacing 45 cm × 10 cm + 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation	92.65	17.92	39.87
6	T_6	Spacing 45 cm × 10 cm + 50% RDN + 50% N through Bokashi + *Azotobacter* inoculation	90.98	16.77	36.73
7	T_7	Spacing 60 cm × 10 cm + 100% RDN	87.45	15.13	32.87
8	T_8	Spacing 60 cm × 10 cm + 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation)	89.11	15.68	30.27
9	T_9	Spacing 60 cm × 10 cm + 50% RDN + 50% N through Bokashi + *Azotobacter* inoculation	85.37	15.04	33.20
		SEm (±)	0.64	0.42	1.08
		CD (P=0.05)	1.92	1.27	3.25

inoculation) were found statistically at par with highest treatment T_5. To a certain level, better nitrogen levels in soil and optimum level of competition between plants by wide spacing might have resulted in the improvement in no. of leaves/ plant Fagam *et al.,* (2016) and Patra (2001).

Effect on the yield and yield attributes of sesame

The statistical data regarding yield and yield attributes were presented in Table 2.

The highest number of capsules/plants was recorded by T_5(42.00) and treatments T_3 and T_7 were found at par to the T_5. However, T_1 has recorded less number of capsules/plant (33.20). Maximum number of seeds/capsule was recorded by T_5 (52.67) and treatment T_3 was found statistically at par to maximum, whereas T_1 (42.73) has recorded the least number of seeds/capsule. The graph for number of capsules/plant and number of seeds/capsule is represented in Fig. 2. The non-significant result was observed in Test weight, whereas T_7 and T_1 recorded maximum (3.22 g) and minimum (2.54 g) respectively. The highest harvest index (37.30%) and lowest harvest index (31.30%) were recorded with the treatments T_5 and T_4 respectively.

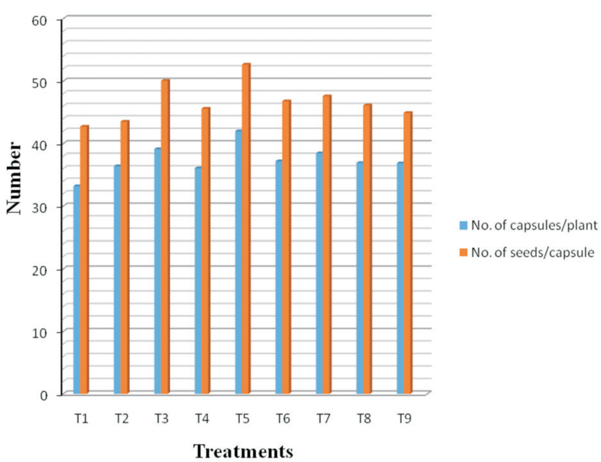

Fig. 2. Graph depicting the no. of capsules/plant and no. of seeds/capsule

Highest grain yield (1256.67 kg/ha) was obtained by treatment T_5 (Spacing 45 cm × 10 cm + 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation). The treatment T3 (Spacing 30cm × 10cm + 50% RDN + 50% N through Bokashi + *Azotobacter* inoculation), has shared the statistical parity with treatment T_5 (Spacing 45 cm × 10 cm + 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation). Maximum stover yield (2112.67 kg/ha) was obtained

Table 2. Effect of spacing and nitrogen management practices on yield and yield attributes of sesame

S. No	T. no	Treatment combination	No. of Capsules/ plant	No. of Seeds/ capsules	Test weight (g)	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Harvest Index (%)
1	T_1	Spacing 30 cm × 10 cm + 100% RDN	33.20	42.73	2.54	846.67	1690.33	32.05
2	T_2	Spacing 30 cm × 10 cm + 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation	36.40	43.53	2.60	940.00	1784.67	36.17
3	T_3	Spacing 30 cm × 10 cm + 50% RDN + 50% N through Bokashi + *Azotobacter* inoculation	39.14	50.07	2.76	1133.33	1960.00	36.41
4	T_4	Spacing 45 cm × 10 cm + 100% RDN	36.07	45.60	2.77	863.33	1870.67	31.31
5	T_5	Spacing 45 cm × 10 cm + 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation	42.00	52.67	2.79	1256.67	2112.67	37.30
6	T_6	Spacing 45 cm × 10 cm + 50% RDN + 50% N through Bokashi + *Azotobacter* inoculation	37.20	46.80	2.69	976.67	1753.33	35.75
7	T_7	Spacing 60 cm × 10 cm + 100% RDN	38.47	47.60	3.22	990.00	1892.67	34.51
8	T_8	Spacing 60 cm × 10 cm + 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation	36.93	46.13	2.84	976.67	1792.00	35.14
9	T_9	Spacing 60 cm × 10 cm + 50% RDN + 50% N through Bokashi + *Azotobacter* inoculation	36.87	44.93	2.74	973.33	1757.33	35.67
		SEm (±)	1.47	1.36	0.21	75.00	78.74	2.44
		CD (P=0.05)	4.40	4.07	NS	224.84	236.07	NS

by treatment T_5 (Spacing 45 cm × 10 cm + 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation), the treatments T_3 (Spacing 30 cm × 10 cm + 50% RDN + 50% N through Bokashi + *Azotobacter* inoculation), and treatment T_7 (Spacing 60cm × 10 cm + 100% RDN) were at par with highest treatment T_5.

The competition for the available resources in 30 cm x10 cm spacing and lower plant population by 60 cm x 10 cm spacing might have hindered the yield of sesame. Enhanced exploitation of resources viz., solar radiation, nutrients, and water etc may have favoured 45 cm x10 cm spacing in obtaining the maximum grain and stover yield. The finding was in agreement with Shinde *et al.*, (2011) and Yadav *et al.*, (2007).

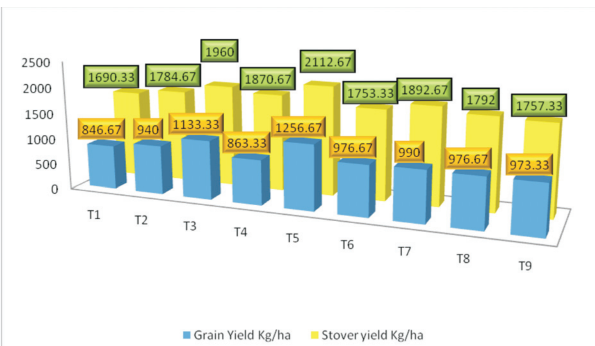

Fig. 3. Graph depicting the grain and stover yield of sesame.

This statement is in close accord with the findings of Preeti (2010) and Nayek *et al.*, (2015) escalated nitrogen supply by the clubbed use of both inorganic and organic i.e., bokashi and azotobacter might have bestowed the vegetative and reproductive growth in succession tweaked the yield, yield attributes and dry matter accumulation to raise the stover yield. Due to significant improvement in growth and yield attributes resulting in obtaining the highest grain and stover yield of seasame. These results are in conformity with observations of Nayek *et al.*, (2014).

CONCLUSION

Being performed exceptionally the treatment, T_5 spacing 45 cm × 10 cm + 75% RDN + 25% N through Bokashi + *Azotobacter* inoculation in all growth and yield parameters. It is recommended for the farmers.

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