Vol. 51, No. 1, pp 36-40, 2023
Indian Journal of Soil Conservation
https://www.iaswc.com/ijsc.html

Effect of different nitrogen levels and row spacings on yield of *Sesamum indicum* L. (sesame) under *Agele marmelous* L. (beal) based agri-horti system

Kuwar Yeshvir Arya[1,*], V.K . Srivastava[1] and S.K. Verma[2]

[1]Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh; [2]Department of Agroforestry College of Horticulture and Forestry Acharya Narendra Deva University of Agriculture and Technology Kumarganj, Ayodhya, Uttar Pradesh.

*Corresponding author:
E-mail: kuwaryeshvirarya076@gmail.com (Kuwar Yeshvir Arya)

ARTICLE INFO

DOI : 10.59797/ijsc.v51.i1.147

Article history:
Received : March, 2022
Revised : March, 2023
Accepted : March, 2023

Key words:
Nitrogen
Row Spacings
Sesame
Oil content
Yield attributes

ABSTRACT

A field study was conducted during *kharif*, season 2019-20 at Agricultural Research Farm, Rajiv Gandhi South Campus Banaras Hindu University, Barkachha, Mirzapur, (Uttar Pradesh) to study the response of four Nitrogen (N) levels (0 kg N ha^{-1}, 20 kg N ha^{-1}, 40 kg N ha^{-1} and 60 kg N ha^{-1}) and two-row spacings (30 cm and 45 cm) under rainfed condition. The design of experiment was Factorial Randomized with 8 treatments and 3 replications. Results revealed that row spacing 45 cm recorded more number of branches, capsules, dry matter plant^{-1}, 1000 grain weight and higher grain yield than the row spacing 30 cm. The application of 40 kg N ha^{-1} produced significantly maximum grain yield along with the higher values of plant height, branches plant^{-1}, dry matter plant^{-1} was with 60 kg N ha^{-1}. Increasing N levels up to 40 kg N ha^{-1} resulted in significantly higher grain yield and yield attributes. Through increased the levels of nitrogen up to 60 kg N ha^{-1} increased the maximum oil content (41.84%) in 45 cm but not up to the level of 40 kg N ha^{-1}, whereas, 40 kg N ha^{-1} (39.70%) and 20 kg N ha^{-1} (39.05) produced, respectively. Although highest nitrogen levels were found superior to medium and lowest Nitrogen levels and produced maximum gross returns, net returns and benefit-cost ratio (BCR).

1. INTRODUCTION

Sesame (*Sesamum indicum* L.) is an important oilseed crop cultivated especially in developing countries as a rich source of oil protein, calcium, and phosphorus. Sesame (*Sesamum indicum* L.) belongs to the family *Padaliaceace*. Seasme is known as the king of oil seeds due to the high oil content (50-60%) of its seed (Nadeem *et al.,* 2015). The crop is grown on a wide range of soils provided they should be well-drained but it thrives better on sandy loam with adequate soil moisture, very sandy, acidic soil is not suitable for its cultivation. The crop grows well in soils having a pH reaction in the range of 5.5 to 8.0. Sesame is the main source of foreign currency in the agricultural commodities next to coffee. Oilseed cultivation is becoming increasingly unattractive due to low and unstable yields. The price of edible oils is decreasing due to trade liberalization. Sesame (*Sesamum indicum* L.) locally known as "til" is probably the most ancient oilseed known and being used by man. Sesame (*Sesamum indicum* L.) is an ancient oilseed crop of the world. It is accepted by various names like gingely, til, simsim, gergelim and biniseed, etc. In India, it is mainly cultivated in Uttar Pradesh, Maharashtra, Madhya Pradesh, Tamil Nadu, Orissa, Rajasthan, and Karnataka states. The oil offers low cholesterol and a high proportion of polyunsaturated fat (about 80% unsaturated fatty acids), and sesame proteins are rich in the essential sulfur-containing amino acids methionine and tryptophan. In 2014 the total world production was about 5.46 million tonnes (M t) that were grown on 10.56 m ha. In Uttar Pradesh sesame occupied an area of about 0.387 m ha and production of about 0.91 lakh tons with 215 kg ha^{-1} productivity.

Agroforestry is the collective name for land-use systems involving trees combined with arable crops and / or animals on the same unit of land. In another form, Agroforestry is the science of designing and developing an integrated self-sustainable land management system, which involves the introduction or retention of woody components such as trees, shrubs along with crops including pasture / animals and forest plants and sequentially on the same piece of land and applied management practices are compatible with the cultural practices of the local population. In an agroforestry system, there are ecological and economical interactions between the different components (Raintree *et al.,* 1986). Farmer realizes the problem of low economic profit in the initial stage of fruit tree orchard till the tree started bearing fruits. Land with low nutritional status may be exploited for establishing orchards and making the agriculture system economically viable. Hence an attempt can be made to increase the productivity of agricultural land by advocating agroforestry as one of the most practical ways of meeting the needs for food, fruit, fodder, and fuel.

Agri-horti system along with arable crops / fodder is ideal for controlling land degradation. An improved cropping system in which maximum utilization of natural resources increases the return per unit area per unit time. A large variety of fruits cover nearly 7% of the cropped area in India. Hence, it is necessary to identify trees with low water requirements. In this system, we can increase the total output from the land by growing mainly short duration crops within the alleys of such fruit crops. Agri-horticulture land use is an important component of agroforestry there is ample scope to utilize the introduction of the fruit tree during the initial 5 to 6 years by growing arable crops (Rajpoot *et al.*, 2014).

Bael (*Aegle marmelos* L.) is commonly distributed throughout the tropics**.** *Aegle marmelos* are commonly known as Bael, belonging to the family Rutaceae. This is a moderate-sized, slender, aromatic, and indigenous tree of India. Different parts (leaves, roots, barks, seeds and fruits) of the plant have been used in the formulation of enthno-medicine to exploit its therapeutic properties (Singh *et al*., 2019a). The other important features of these fruit trees are it is wider adaptability to soil and climatic condition and freedom from pests and disease. Due to their escape from animal damage and hardy nature, they have become naturalized in many tropic and sub-tropic parts of the world and are popular among the local farmers of eastern Uttar Pradesh. Nitrogen is the essential nutrient required by the plant for its vigour and growth. Some important varieties are Thar Divya, NB-7, NB-9, NB-16, CISH-B-1, CISH-B-2, Pant Aparna, Pant Urvashi and Pant Shivani. Presently, Goma Yashi is being preferred owing to its dwarf stature, suitability for high-density planting and excellent fruit quality (Singh *et al*., 2021).

An adequate supply of nitrogen is essential for desirable yield and vegetative growth (Shilpi *et al*., 2012), It also provides healthy and green colour to stem and leaves and enables efficient photosynthesis. Excessive nitrogen application cause physiological disorder of nitrogen also plays an important role in the photosynthesis of amino and chlorophyll acid which contributes to the building units of protein and the growth of plants. Row to row and plant to plant spacing is one of the important components of agro-forestry and an intensive farming system that could bring a positive increase in yield. The main role of spacing in plant growth is that plants can receive sufficient water, sunlight, and other necessary nutrients from the soil which enhances the yield of sesame. In the Sesame crop, different levels of spacing depend on the growth and habit of the variety.

2. MATERIALAND METHODS

The present investigation entitled "Effect of different nitrogen levels and row spacings on yield of *Sesamum indicum* L. (Sesame) under *Agle marmelous* L. (Baal) based agri-horti system" was carried out during *kharif* season of 2019-20 at Agricultural Research Form, Rajiv Gandhi South Campus (Banaras Hindu University), Barkachha, Mirzapur, Uttar Pradesh (India). A detailed account of the materials used, experimental procedure and methods adopted during the course of field research are described in this chapter.

The research farm is situated at a distance of nearly 11 km in the south-east from Mirzapur-Robertsganj road, Rajiv Gandhi Campus Agricultural Research Farm Barkachha (BHU) tis situated in Vindhyan reason (25°10" latitudes, 82°37 longitudes varying from 365 to 427 meters above sea level). The experiment was placed fairly uniform structure and well drain soil which had poor fertility status.

The climate of Barkachha Mirzapur is typically semi-arid, sub-humid characterized by extremes of temperature both in summer and winter with low rainfall and moderate humidity. The maximum temperature in summer is as high as 36.4.0˚C (July) and the minimum temperature in winter falls below 6.1˚C (January). The annual rainfall of the locality was 270.66 mm in 2019 of which nearly 90% is contributed by the south-west monsoon between June to September. The rainfall during the experimental period The fertilizer application was done according to the treatment requirement. The source of NPK was from Urea, DAP, and MOP. Sowing was completed as per treatments. The fertilizer RDF dose of 30:20:20 NPK kg ha^{-1} was applied after sowing. The package of recommended practices was adopted to maintain the crop.

Soil samples were taken from the experiment field before the experiment from a depth of 0-20 cm taking all possible precautions for soil sampling. The samples of soil were collected to the laboratory crushed and, air-dried soil to pass through a 2.0 mm mesh sieve. The samples were subjected to appropriate mechanical and chemical analysis. The experimental trial was conducted during *kharif* season of 2019-2020 on sesame grown in alleys of bael trees in a factorial randomize block design with a plot size of 5.0 by 3.0-meter agri-horicultural system. The experiment was conducted with three replications each replication was divided into 8 equal plots and treatments were randomly allocated within the blocks for replication.

The significance of the treatment effect was evaluated with the help of the 'F' test (Variance ratio). The mean treatment difference was tested at a 5% probability level using the critical difference (CD) (Gomez and Gomez, 1976). If the (F test) variance ratio was found to be significant at a meaning level of (5%) the standard mean error (SEm±) and critical difference (CD) were calculated for further comparison.

S.Em± = (Error sum of squares / n)½

Where, n = number of observation; CD at 5% = SEm± x (2) 1/2 T value at 5% of error d.f.; The results were presented in tabular form as in the figure where needed.

3. RESULTS AND DISCUSSION

Tree Performance

Tree performance on growth The results shown in (Table 1) indicated that the height, dbh and canopy width of bael after 12 years of plantation found a significant difference among the different treatments (T_1 - control, T_2 - Nitrogen (20 kg ha^{-1}), T_3 - Nitrogen (40 kg ha^{-1}) and T_4 - Nitrogen (60 kg ha^{-1}) and spacings of sesame crop 30 ×10 and 60 × 10 cm. The bael tree height at maturity time is 8.10 (feet), canopy diameter 20.12 (feet) and stem girth 10.76 (feet).

Yield Attributing Characters

Yield attributes *viz.,* number of length of the capsule (cm), No of capsule plant^{-1}, No. of grains capsule^{-1}, Test weight (g) (1000-grains) as influenced by nitrogen levels and row spacings are presented in Table 3. Application of 60 kg N ha^{-1} recorded the maximum capsule length No. No of capsule plant^{-1}, No. of Grains capsule^{-1}, length of the capsule (cm) and Test weight (g) (1000-grains) which was at par with 40 kg N ha^{-1} but significantly superior over rest of the treatments at all the growth stages. Row spacing of 45 (cm) recorded the maximum Grains (45.48) capsule^{-1} which was higher than 30 cm (45.31) capsule^{-1} but not up to the level of significance.

The finding of the data indicated that growth attributes of crops such as plant height, number of primary and secondary branches plant^{-1} and dry matter accumulation plant^{-1} had marked variation under different N levels. It was noted that plant height increased rapidly between 30 and 60 DAS signifying that, this period is the active vegetative growth period of sesame. ttentive Analysis of plant height at 30, 60 and harvest revealed that the plant height of sesame

Table: 1
Details of treatment combination

Treatment	Combination	Treatment detail
T_1	N_0 S_1	Control
T_2	N_1 S_1	3 0 × 10 cm + 20 kg N ha^{-1}
T_3	N_2 S_1	30 × 10 cm + 40 kg N ha^{-1}
T_4	N_3 S_1	30 × 10 cm +60 kg N ha^{-1}
T_5	N_0 S_2	Control
T_6	N_1 S_2	45 × 10 cm + 20 kg N ha^{-1}
T_7	N_2 S_2	45 × 10 cm + 40 kg N ha^{-1}
T_8	N_3 S_2	45 × 10 cm + 60 kg N ha^{-1}

Table: 2
Growth parameters of 12 year old Baal tree species at various crop growth stages in bael based agri-horti system

Parameters	25 DAS	50 DAS	Maturity
Plant height (feet)	7.25	7.93	8.10
Canopy diameter (feet)	18.85	19.97	20.12
Stem girth (inch)	15.38	10.54	10.76
Shading area			
Length (feet)	13.25	13.55	13.85
Width (feet)	6.85	7.48	7.86

Table: 3
Average number of capsule plant^{-1}, no. of Grains capsule^{-1}, length of capsule (cm) and test weight (g) effect by various nitrogen and spacings levels

Treatment	Yield attributes			
	No. of capsule plant^{-1}	No. of Grains capsule^{-1}	Length of capsule (cm)	Test weight (g) (1000-grains)
Nirogen levels (4)				
(N_0) 0 kg N ha^{-1}	37.45	39.85	1.35	1.94
(N_1) 20 kg N ha^{-1}	42.8	43.56	1.51	2.03
(N_2) 40 kg N ha^{-1}	45.34	47.98	1.77	2.21
(N_3) 60 kg ha^{-1}	48.00	50.21	1.83	2.34
SEm±	1.30	0.76	0.09	0.08
CD (P=0.05)	3.95	2.31	0.27	0.26
Row spacing (2)				
S_1 (30 cm)	42.97	45.31	1.61	2.10
S_2 (45 cm)	43.87	45.48	1.62	2.16
SEm±	0.92	0.54	0.06	0.06
CD (P=0.05)	2.79	1.63	0.19	0.18
Interaction	NS	NS	NS	NS

increased progressively with the improvement of growth stages. An increasing level of nitrogen application up to @ 60 kg N ha^{-1} recorded significantly higher plant height, during the crop growth period. Ahmed *et al.* (2018) and Badshah *et al*. (2017) also obtained increased height and number of capsules due to adequate nitrogen supply, maximum nutrient content and NPK was obitand in case of *Sesamum indicum* L. under Bael based agri-horti system. When applied 45 kg sulphur ha^{-1} and 75 kg N ha^{-1} (Kushawaha *et al.,* 2022). Mankar *et al.* (1995) and Nookra *et al.* (2011) also reported that nitrogen fertilizer has positive effect on the growth as well as yield of Sesame parameters .

Economics

The results of The present study result indicated that the different levels of N significantly influenced the economics of sesame. The cost of cultivation varied due to the application of different N levels which incurred a different amounts of production cost. However, the maximum cost of cultivation was recorded with the highest level of nutrient application *i.e.* 60 kg N kg ha^{-1} followed by 40 kg N ha^{-1}. The increasing levels of N application significantly improved the net returns and BCR only up to 40 kg N ha^{-1}. This could be attributed due to the increase in economic yield with each increment of the N level. Haruna *et al.* (2011) and Patel *et al.* (2014) also reported similar results in the experiment.

4. CONCLUSIONS

The data collected during experimentation were subjected to statistical analysis to draw a valid conclusion. Finally, the different treatments were analyzed for their gross return, net return and B:C ratio. The yield attributes *viz.,* capsule plant^{-1} and test weight were recorded maximum with the application of 60 N kg ha^{-1} and higher values over 40 kg N ha^{-1}. However, for the number of seed capsule^{-1}, the difference was significant only between the highest and medium nitrogen levels. Whereas, the length of the capsule couldn't touch the level of significance. In sesame crop row spacing of 45 cm produced a maximum number of capsule plant^{-1} (43.87), number of seed capsule^{-1} (45.48) and test weight (2.16 g) over 30 cm spacing but both remained at par.

Table: 4
Economics of sesame as influenced by nitrogen levels and row spacings

Treatment	Economics			
	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio
Nitrogen levels (4)				
(N_0) 0 kg N ha^{-1}	20675	25569.67	4894.67	1.23
(N_1) 20 kg N ha^{-1}	23209	31875.28	8666.28	1.37
(N_2) 40 kg N ha^{-1}	23600	37729.92	14123.92	1.59
(N_3) 60 kg ha^{-1}	23990	37428.28	13438.28	1.56
SEm±	-	4256.84	-	0.07
CD (P=0.05)	-	12911.68	-	0.22
Row spacings (2)				
S_1 (30 cm)	20675	33868.77	13194.77	1.63
S_2 (45 cm)	20675	32412.79	11737.79	1.50
Sem±	-	3010.04	-	0.18
CD (P=0.05)	-	9129	-	0.19
Interaction		NS	NS	NS

Table: 4
Net return (₹ ha^{-1}) and B:C ratio as influenced by various nitrogen levels and spacings in sesame under Bael based agri-horti system

S.No.	Treatment	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})				Net return (₹ ha^{-1})	B:C ratio
			Grain	Straw	Bael (Fruit)	Total		
1.	N_0S_1	20675	26783.50	2000.00	4000	32783.50	12108.50	1.50
2.	N_1S_1	23209	29843.17	2232.00	4000	36075.17	12866.00	1.55
3.	N_2S_1	23600	37401.00	2934.00	4000	44335.00	20735.00	1.87
4.	N_3S_1	23990	32994.17	2629.33	4000	39623.50	15633.50	1.65
5.	N_0S_2	20675	22445.17	1910.66	4000	28355.83	7680.83	1.37
6.	N_1S_2	23209	31441.40	2386.00	4000	37827.40	14618.40	1.62
7.	N_2S_2	23600	35460.17	2598.66	4000	42058.83	18458.83	1.78
8.	N_3S_2	23990	36579.00	2654.00	4000	43233.00	19243.00	1.80

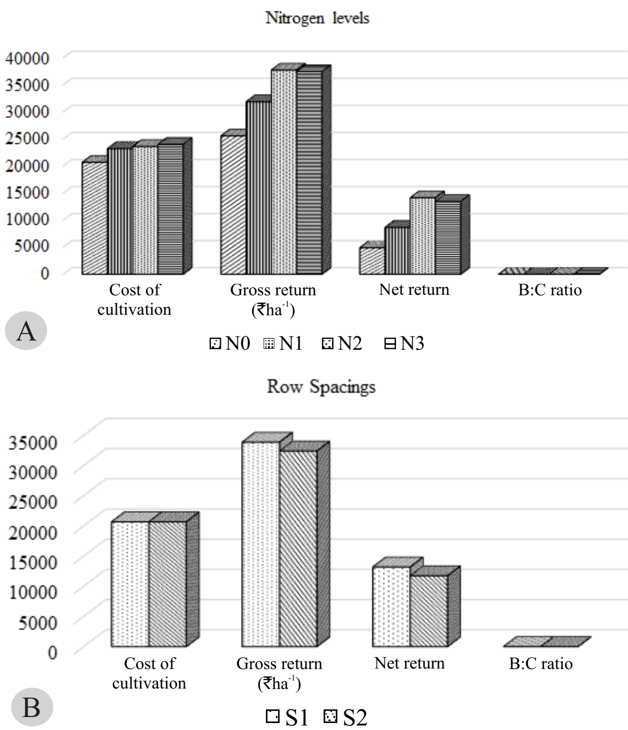

Fig. 1. Economics of sesame as influenced by nitrogen levels and row spacings

REFERENCES

Ahmad, J., Ahmad, F., Iqbal, S., Shah, S.M.A., Ali, M., Abbas, M.W., Nawaz, H., Mehmood, Z., Ali, B. and Ali, S. 2018. Growth and oil yield of sesame as influenced by sulphur and nitrogen. *Open Access J. Agric. Res.,* 2474-8846.

Adak, T., Pandey, G., Kumar, K. and Shukla, S.K. 2020. Appraisal of integrated nutrient management on soil properties and guava productivity. *Soil Water Cons. Bull.,* 32p.

Badshah, S., Khalil, S.K., Jalal, F., Baseer, A., Suleman, M., Khan, H. and Zaheer, S. 2017. Influence of nitrogen and row spacing on Sesame (*Sesamum indicum* L.) growth and yield attributes. *Pure Appl. Bio.,* 6(1): 116.

Haruna, I.M. 2011. Growth and yield of sesame (*Sesamum indicum* L.) as influenced by nitrogen and intra row spacing in Lafia, Nasarawa state of Nigeria. *Elixir Agric.*, 41: 5685-5688.

Kala, S., Parandiyal, A.K., Kumar, A., Meena, H.R., Meena, G.L., Mina, B. L. and Singh, R.K. 2020. Ideal design and management of Karanj (*Pongammia pinnata*) based silvipastoral system for productive utilization of Chambal ravines. *Soil Water Cons. Bull.,* 66p.

Kushwaha, S., Singh, A.K. and Singh, B.K. 2022. Effect of different levels of sulfur and nitrogen on growth yield and quality of sesame (*sesamum indcum* L.) under Bael based agri-horti system. *Eco. Env. Cons.,* 28(3): 1404-1410.

Mankar, D.D., Satao, R.N., Solanke, V.M. and Ingole, P.G. 1995. Effect of nitrogen and phosphorous on quality, uptake and yield of sesamum. *Res. J. Punjabrao Krishi Vidyapeeth,* 19: 69-70.

Nadeem, A., Kashani, S., Ahmed, N., Buriro, M., Saeed, Z., Mohammad, F. and Ahmed, S. 2015. Growth and yield of sesame (*Sesamum indicum* L.) under the influence of planting geometry and irrigation regimes. *Am. J. Plant Sci.,* 6(07): 980.

Noorka, I.R., Hafiz, S.I. and E.L. Bramawy, M.A.S. 2011. Response of sesame to population densities andnitrogen fertilization on newly reclaimed sandysoils. *Pak. J. Bot*., 43(4): 1953-1958.

Obreza, T.A. and Vavrina, C.S. 1993. Production of chinese cabbage in relation to nitrogen source, rate, and leaf nutrient concentration. *Comm. Soil Sci. Plant Anal.,* 24(13-14): 1465-1479.

Patel, H.K., Patel, R.M., Desai, C.K. and Patel, H.B. 2014. Response of summer sesamum (*Sesamum indicum* L.) to different spacings and levels of nitrogen under north Gujarat condition. *Int. J. Agric. Sci.,* 10(1): 336-343.

Raintree, J.B. 1986. Agroforestry pathways: land tenure, shifting cultivation and sustainable agriculture. *Unasylva*, 38(4): 2-15.

Rajput, B.S., Maurya, S.K., Singh, R.N., Sen, A. and Singh, R.K. 2014. Effect of different types of mulch on maize under Guava (*Psidium guajava*) based agri-horti System. *Online Int. Interdiscip. Res. J.,* 4(3): 122-130.

Shilpi, S., Islam, M.N., Sutradhar, G.N.C., Husna, A. and Akter, F. 2012. Effect of nitrogen and sulfur on the growth and yield of sesame. *Int. J. Bio-resource Stress Manage.,* 3(2): 177-182.

Singh, A.K., Singh, S., Saroj, P.L. and Singh, G.P. 2021. Improvement and production technology of Bael (*Aegle marmelos*) in India - a review. *Curr. Hortic.,* 9(1): 3-14.