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# Effect of integrated nitrogen management on growth parameters of sesame (*Sesamum indicum* L.) under semi-arid region, Rajasthan

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**Abstract**
The present study was conducted at Agronomy farm, S.K.N. College of Agriculture Jobner, Rajasthan in the year 2016 during kharif season. Results revealed that application of 50% RDN through urea + 50% through poultry manure + Azotobacter ($T_{12}$) recorded the significantly highest plant height at 60 DAS the maximum dry matter accumulation per metre row length at 30, 60 DAS and at harvest was also recorded in the treatment $T_{12}$. Leaf area index (LAI) and chlorophyll content at 40 DAS was the found highest in treatment $T_{12}$. The significantly higher Crop Growth Rate (CGR) at 30–60 DAS and 60 DAS- at harvest was recorded with the application of 50% RDN through urea + 50% through poultry manure + Azotobacter ($T_{12}$).

**Keywords:** sesame, *Kharif* season, growth parameters and treatments

## Introduction

Nitrogen is one of the most important major element and play vital roles in the nutrition of plant. Nitrogen promotes vegetative growth and substantial application provides leaves resistance to certain insect and fungi attacks and increase susceptibility to damage by drought and frost. It influences the vigour of plant, root growth and improves the quality of crop yield. The application of fertilizer and manures are essential for increasing crop yield and farmers income even when crops are grown without irrigation under rainfed or in dry land conditions. Sesame or gingerly *(Sesamum indicum* L.*)* commonly known as 'til' is also called as "queen of oilseeds" and has been known to be one of the earliest domesticated edible oilseed used by the mankind. Sesame is an important edible oilseed crop next to groundnut and rapeseed-mustard. The oil content in sesame generally varies from 46 to 52 per cent and protein content between 18-20 per cent. About 73 per cent of the sesame produced in the country is used for oil extraction, 14.5 per cent for domestic uses including preparation of sweet candies as condiments, culinary and confectionary purposes whereas 8.3 per cent for hydrogenization and 4.2 per cent is used for industrial purposes in manufacturing of paints, perfumed oils, pharmaceuticals and insecticides.

The productivity of sesame is low i.e 3.5-4.5 q/ha depending upon the nature of monsoon. The suffering low levels of productivity have been the chronic problem in sesame in the country. The area under the sesame in country is decreasing mainly due to switch over to relatively less risky crop and frequent crop failure due to prolonged drought/excess rainfall [5]. Lack of poor nutrient management is also a cause of its low productivity. The productivity of sesame is very low in Rajasthan as comparison to global as well as national level due to low and scanty rainfall, cultivation of crop on marginal and sub marginal lands of poor fertility, poor agronomic practices and inadequate or even no use of fertilizers. It is essential to adequately fertilize the crop. The average N, P2O5, K2O and S removal to produce a ton of sesame is 51.7, 22.9, 64.0 and 11.7 kg, respectively [9]. The integrated nutrient management in sesame improves its quantity and quality of produce and reduces the incidence of diseases, pests and cost of cultivation. Thus the concurrent application of organic manures and bio-fertilizers are frequently recommended for improving biological, physical and chemical properties of soil and to get agricultural products with good quality and free pollutants [2]. Integrated nutrient management continues to gain importance to maintain soil health for sustainable production of good quality sesame [5].

## Materials and Method

### Site location

The present experiment was conducted at Agronomy farm, S.K.N. College of Agriculture Jobner. Geographically Jobner is situated 45 km west of Jaipur at $26^0$ 05' North latitude, $75^0$ 28' East longitude and at an altitude of 427 m above mean sea level. The area falls in agro-climatic zone-IIIa (Semi-arid eastern plain zone) of Rajasthan. The climate of this region is a typically semi-arid, characterized by extremes of temperature during both summer and winter. The average annual rainfall of this tract varies from 400 mm to 450 mm. Soil of the experimental field was loamy sand in texture, alkaline in reaction, poor in organic carbon with low available nitrogen and sulphur and medium in available phosphorous and potassium content.

### Experimental details

The experiment consisting of 12 treatments was carried out in randomized block design to conduct present investigation with three replications. The treatments were randomly allocated to different plots, using random number table of Fisher and Yates (1963). Treatment details are given below:

| Treatments | Symbols |
|---|---|
| Control | $T_1$ |
| 100% RDN through urea | $T_2$ |
| 100% RDN through FYM | $T_3$ |
| 100% RDN through poultry manure | $T_4$ |
| 75% RDN through urea + 25% through FYM | $T_5$ |
| 75% RDN through urea + 25% through poultry manure | $T_6$ |
| 75% RDN through urea + 25% through FYM + *Azotobacter* | $T_7$ |
| 75% RDN through urea + 25% through poultry manure + *Azotobacter* | $T_8$ |
| 50% RDN through urea + 50% through FYM | $T_9$ |
| 50% RDN through urea + 50% through poultry manure | $T_{10}$ |
| 50% RDN through urea + 50% through FYM + *Azotobacter* | $T_{11}$ |
| 50% RDN through urea + 50% through poultry manure + *Azotobacter* | $T_{12}$ |

### Growth parameters

### Plant stand

Plant stand per metre row length was counted at 20 DAS and at harvest from five spots selected randomly from each plot and average was taken.

### Plant height

Five plants were selected randomly from each plot and tagged permanently. The height of each plant was measured from base of the plant to the tip of main shoot at 30, 60 DAS and at harvest. The mean plant height (cm) at each growth stage was worked out and recorded as plant height (cm) at respective stage.

### Dry matter production

Dry matter production was recorded at 30, 60 DAS and at harvest. For this, plants from one metre row length were uprooted from sample rows of each plot. After removal of root portion, the samples were first air dried for some days and finally dried in an electric oven at $70^0$C till constant weight. The weight was recorded and expressed as average dry matter per metre row length (g).

### Number of branches per plant

Five plants from each plot selected randomly for measurement of height were used to record the total number of branches at harvest and averaged to express as number of branches per plant.

### Chlorophyll content

Total chlorophyll content of leaves at 45 DAS was determined using the method advocated by Arnon (1949) by taking 50 mg fresh leaf material. Samples were homogenized in 80 per cent acetone and centrifuged for 10 minutes at 2000 rpm and volume of supernatant was made to 10 ml. The resultant absorbence of clear supernatant was measured by spectrophotometer at 652 nm.

$$\text{Total chlorophyll (mg/g)} = \frac{A_{(652)} \times 29 \times \text{total volume (ml)}}{\alpha \times 1000 \times \text{weight of sample (g)}}$$

### Leaf area index (LAI)

Five plants were randomly selected for leaf area at 30 and 60 DAS. The leaf area was measured with the help of portable leaf area meter at the experimental site. LAI was calculated by the following relationship (Watson, 1958).

$$\text{Leaf area index} = \frac{\text{Leaf area (cm2)}}{\text{Ground area (cm2)}}$$

### Crop growth rate (CGR)

The CGR of a plant for a time 't' is defined as the increase in dry weight of plant material from a unit area per unit of time. It was calculated with the following formula (Radford, 1967) from the crop dry matter recorded at periodic intervals.

$$\text{CGR (g/m2/day)} = \frac{W_2 - W_1}{t_2 - t_1}$$

Where, $W_1$ = Total crop dry matter at time $t_1$ (g/m2), $W_2$ = Total crop dry matter at time $t_2$ (g/$m^2$) and $t_1$ = Time at first observation (days), $t_2$ = Time at second observation (days)

## Results

The data on growth parameters recorded periodically during the course of investigation were statistically analyzed to test their significance.

### Plant stand

Data recorded on plant sand showed that application of fertilizer and manures to sesame had no significant effect on plant stand per metre row length at 20 DAS and at harvest. Thus it reveals that plant stand was almost uniform in all the plots.

### Plant height

Data presented in table 1 reveals that different treatments of integrated nitrogen management brought about significant improvement in plant height of sesame over control at 30, 60

DAS and at harvest. Application of 50% RDN through urea + 50% through poultry manure + Azotobacter ($T_{12}$) was found better for plant height (17.1 cm, 124.5 cm and 127.2 cm) followed 50% RDN through urea + 50 % through FYM + Azotobacter ($T_{11}$) respectively and minimum plant height (13.8 cm, 92.4 cm and 96.1 cm) were recorded in control ($T_1$).

**Table 1:** Effect of integrated nitrogen management on plant height of sesame.

| Treatments | Plant height (cm) | | |
|---|---|---|---|
| | 30DAS | 60 DAS | At harvest |
| $T_1$-Control | 13.8 | 92.4 | 96.1 |
| $T_2$-100% RDN through urea | 14.4 | 105.7 | 108.2 |
| $T_3$-100% RDN through FYM | 14.1 | 106.5 | 109.1 |
| $T_4$-100% RDN through PM | 14.2 | 110.2 | 114.0 |
| $T_5$-75% RDN through urea + 25% through FYM | 15.1 | 118.7 | 122.7 |
| $T_6$-75% RDN through urea + 25% through PM | 15.2 | 119.2 | 123.5 |
| $T_7$-75% RDN through urea + 25% through FYM + *Azo* | 15.8 | 120.4 | 123.6 |
| $T_8$-75% RDN through urea + 25% through PM + *Azo* | 16.1 | 120.8 | 124.5 |
| $T_9$-50% RDN through urea + 50% through FYM | 15.2 | 122.3 | 125.2 |
| $T_{10}$-50% RDN through urea + 50% through PM | 15.3 | 123.6 | 126.6 |
| $T_{11}$-50% RDN through urea + 50% through FYM + *Azo* | 16.1 | 123.1 | 126.1 |
| $T_{12}$-50% RDN through urea + 50% through PM + *Azo* | 17.1 | 124.5 | 127.2 |
| SEm $\pm$ | 0.9 | 3.9 | 4.1 |
| CD (P=0.05) | NS | 11.4 | 11.9 |
| CV (%) | 10.2 | 5.8 | 5.9 |

**Dry matter accumulation**

Data presented in table 2 reveals that different treatments of integrated nitrogen management brought about significant improvement in plant dry matter (gram/meter row length) accumulation of sesame over control at 30, 60 DAS and at harvest. Application of 50% RDN through urea + 50% through poultry manure + Azotobacter ($T_{12}$) was found better for dry matter accumulation (25.3g, 99.9 g and 127.1 g) followed 50% RDN through urea + 50 % through FYM + Azotobacter ($T_{11}$) respectively and minimum dry matter accumulation (16.2g, 72.2g and 93.4 g) were recorded in control ($T_1$).

**Table 2:** Effect of integrated nitrogen management on dry matter accumulation in sesame

| Treatments | Dry matter accumulation (g/m row length) | | |
|---|---|---|---|
| | 30 DAS | 60 DAS | At harvest |
| $T_1$-Control | 16.2 | 72.2 | 93.4 |
| $T_2$-100% RDN through urea | 19.1 | 87.2 | 111.2 |
| $T_3$-100% RDN through FYM | 18.8 | 85.6 | 109.5 |
| $T_4$-100% RDN through PM | 19.0 | 86.9 | 110.2 |
| $T_5$-75% RDN through urea + 25% through FYM | 21.9 | 95.3 | 122.4 |
| $T_6$-75% RDN through urea + 25% through PM | 22.0 | 96.4 | 124.2 |
| $T_7$-75% RDN through urea + 25% through FYM + *Azo* | 24.8 | 96.5 | 123.5 |
| $T_8$-75% RDN through urea + 25% through PM + *Azo* | 25.0 | 97.0 | 125.2 |
| $T_9$-50% RDN through urea + 50% through FYM | 22.1 | 98.6 | 124.7 |
| $T_{10}$-50% RDN through urea + 50% through PM | 22.2 | 99.2 | 125.6 |
| $T_{11}$-50% RDN through urea + 50% through FYM + *Azo* | 25.1 | 99.3 | 126.5 |
| $T_{12}$-50% RDN through urea + 50% through PM + *Azo* | 25.3 | 99.9 | 127.1 |
| SEm $\pm$ | 0.9 | 2.8 | 4.4 |
| CD (P=0.05) | 2.6 | 8.3 | 12.8 |
| CV (%) | 7.04 | 5.29 | 6.39 |

**Chlorophyll content**

An examination of data indicated that the application of different treatments of integrated nitrogen management significantly enhanced the chlorophyll content of sesame leaves. The treatment 50% RDN through urea + 50% through PM + Azotobacter ($T_{12}$) recorded best for increase in chlorophyll content and minimum was found in control treatment ($T_1$). Similar results were recorded for number of branches per plant and leaf area index.

**Crop growth rate**

It is apparent from data presented in Table 3 that different treatments of integrated nitrogen management brought significant improvement the CGR of sesame. Application of 75% RDN through urea + 25% through FYM ($T_5$), 75% RDN through urea + 25% through poultry manure ($T_6$), 75% RDN through urea + 25% through FYM + Azotobacter ($T_7$), 75% RDN through urea + 25% through poultry manure + Azotobacter ($T_8$), 50% RDN through urea + 50% through FYM ($T_9$), 50% RDN through urea + 50% through poultry manure ($T_{10}$), 50% RDN through urea + 50 % through FYM + Azotobacter ($T_{11}$). and 50% RDN through urea + 50% through PM + Azotobacter ($T_{12}$) being at par with each other recorded significantly higher crop growth rate (CGR) and represented an increase of 31.0, 32.6, 27.8, 28.3, 32.1, 33.2, 36.4 and 37.4 per cent, respectively, at 30-60 DAS and 26.8, 30.9, 26.8, 32.4, 22.5, 23.9, 28.2, and 28.2 per cent, respectively, at 60 DAS and at harvest over control. Alone application of N through urea, FYM and poultry manure significantly increased the CGR of sesame.

**Table 3:** Effect of integrated nitrogen management on CGR of sesame.

| Treatments | CGR ($g/m^2/day$) | |
|---|---|---|
| | At 30-60 DAS | 60 DAS-at harvest |
| $T_1$-Control | 1.87 | 0.71 |
| $T_2$-100% RDN through urea | 2.27 | 0.80 |
| $T_3$-100% RDN through FYM | 2.23 | 0.80 |
| $T_4$-100% RDN through PM | 2.26 | 0.78 |
| $T_5$-75% RDN through urea + 25% through FYM | 2.45 | 0.90 |
| $T_6$-75% RDN through urea + 25% through PM | 2.48 | 0.93 |
| $T_7$-75% RDN through urea + 25% through FYM + *Azo* | 2.39 | 0.90 |
| $T_8$-75% RDN through urea + 25% through PM + *Azo* | 2.40 | 0.94 |
| $T_9$-50% RDN through urea + 50% through FYM | 2.47 | 0.87 |
| $T_{10}$-50% RDN through urea + 50% through PM | 2.49 | 0.88 |
| $T_{11}$-50% RDN through urea + 50% through FYM + *Azo* | 2.55 | 0.91 |
| $T_{12}$-50% RDN through urea + 50% through PM + *Azo* | 2.57 | 0.91 |
| SEm $\pm$ | 0.07 | 0.03 |
| CD (P=0.05) | 0.20 | 0.08 |
| CV (%) | 4.98 | 5.53 |

## Discussion

Different plant growth characters like plant height, dry matter accumulation, chlorophyll content and numbers of branches per plant at harvest were affected considerably due to different integrated nitrogen management treatments (Table 1, 2 & 3). The results of the present study revealed that N through urea, FYM and poultry manure manifested statistically equivalent influence on growth parameters of sesame and recorded significantly higher values over control. The maximum values of these parameters were observed with 50% RDN through urea + 50% through poultry manure + *Azotobacter* ($T_{12}$), 50% RDN through urea + 50% through FYM + *Azotobacter* ($T_{11}$), 50% RDN through urea + 50% through poultry manure ($T_{10}$), 50% RDN through urea + 50% through FYM ($T_9$), 75% RDN through urea + 25% through poultry manure + *Azotobacter* ($T_8$), 75% RDN through urea +25% through FYM + *Azotobacter* ($T_7$), 75% RDN through urea + 25% through poultry manure ($T_6$), 75% RDN through urea + 25% through FYM ($T_5$), through organic sources of N. Majumdar and Pal (1998) also reported a significant increase in growth parameters due to application of organic manures along with minerals fertilization. Poultry manure besides supplying major nutrients (1.20% N, 2.15% $P_2O_5$ and 1.20% $K_2O$) also possessed secondary elements like Ca, Mg, and S and fairly high amount of micronutrients supplemented the supply of Cu, Mn, Fe and Mo to the plant. In the chemical properties, poultry manure lower down the soil $P_H$. This is achieved through the liberation of $CO_2$ and organic acid during decomposition and its decomposition products may give rise the natural complexing agents that solublize the nutrients already present in the soil and rendering Zn, Mn, Cu and Mo available to the plant [8]. Thus, balanced nutrition under favourable environment might have helped in production of new tissues and development of new shoots which have ultimately increased the plant height, dry matter accumulation, chlorophyll content, leaf area, number of branches per plant, LAI and CGR. These results are in agreement with who observes higher value of growth parameters due to application of fertilizer and manures in combination [4, 8, 12, 14]. In sesame, many study results also reported increased plant height, dry matter accumulation, leaf area and number of branches per plant due to increasing dose of nitrogen up to recommended level [3, 11, 14, 15].

Role of biofertilizers is well recognized in agriculture. Application of biofertilizer like *Azotobacter* provides the nitrogen to the crops. In sesame the seed inoculation with biofertilizer (*Azotobacter*) increased plant height, number of branches per plant and leaf area [7].

## Conclusion

Based on the results of one year experimentation, it is concluded that the treatments 50% RDN through urea + 50% through poultry manure + *Azotobacter* ($T_{12}$) and 50% RDN through urea + 50% through FYM + *Azotobacter* ($T_{11}$), were almost effective in increasing growth parameters of sesame. However, these results are only indicative and require further experimentation to arrive at more consistent and final conclusion.

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