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# Effect of nitrogen and potassium on growth, yield and nutrient uptake of sesame (*Sesamum indicum* L.) under loamy sand soil of Rajasthan

**Anju Bijarnia, OP Sharma, Rajesh Kumar, Roshan Kumawat and Ramesh Choudhary**

**Abstract**
A field experiment was conducted at Agronomy farm, S. K. N. College of Agriculture, Jobner (Rajasthan) during *Kharif* 2016, on loamy sand soil. The experiment comprising of four levels of Nitrogen (0, 20, 40, 60 kg N/ha) and four levels of Potassium (0, 10, 20, 30 kg $K_2O$/ha), thereby making 16 treatment combination was laid out in randomized block design and replicated thric. Results indicated that progressive increase in level of nitrogen up to 40 kg/ha significantly increased the plant height and dry matter accumulation/plant at all the growth stages, number of branches/plant, leaf area index, and chlorophyll content over preceding levels. Yield and total N, P and K uptake also increase significantly with nitrogen at 40 kg/ha and further increase in nitrogen level to 60 kg/ha could not enhance the above parameters significantly. Results further revealed that progressive increase in level of potassium upto 20 kg/ha significantly increased the growth and yield determining characters of sesame *viz*., plant height, dry matter accumulation/plant at most of the stages, leaf area index, number of branches/plant, seed and stalk yield of sesame over 10 kg $K_2O$/ha and control. The above treatment remained at par with 30 kg $K_2O$/ha. Total N, P and K uptake also increase in the same manner.

**Keywords:** Growth, quality, sesame, nitrogen, potassium

## Introduction
Sesame (*Sesamum indicum* L.) commonly known as *til* also called as" queen of oilseeds" has been known to be one of the earliest domesticated edible oilseeds used by the mankind. The crop is grown in wide range of environments extending from semi-arid tropics and sub-tropics to temperate regions. Sesame is an edible oilseed crop next to groundnut and rapeseed-mustard. Its oil content generally varies from 46 to 52 per cent and protein content from18-20 per cent. In India, sesame is cultivated on 15.98 lakh hectares with annual production of 8.20 lakh tones (Anonymous, 2016-17) [1].

Despite of being such an important sesame growing state, the average productivity is very low in comparison to global as well as national level. Cultivation of crop on marginal and sub-marginal lands of poor fertility under rainfed condition, low and scanty rainfall, poor agronomic practices and inadequate or even no use of fertilizers are the major factors responsible for low productivity of the crop.

Poor nourishment especially of nitrogen, is another factor of low productivity of sesame. Nitrogen is university deficient plant nutrient in most of the Indian soils, particularly the light textured ones where most of sesame growing areas are confined (Chhonkar and Rattan, 2000) [4].

Besides nitrogen, potassium is an essential macronutrient that is taken up by plants from soil in relatively large amounts. Currently nitrogenous and phosphatic fertilizer application is several times higher than that of K (6.8:2.8:1.0). This NPK use ratio when compared from a generally proclaimed ideal ratio of 4:2:1 is typically unfavourable to potassium (Katyal, 2001) [7]. Potassium plays a key role in many metabolic processes in plants. Inspite of the enormous role of potassium in plant physiological and metabolic processes as well as activation of many enzymatic systems, its application to field crops is being ignored with the understanding that our soils are not deficient in potassium. Considering the above facts in view, the present investigation was conducted during *kharif*, 2016.

## Material and Methods
A field experiment was conducted during the *kharif* seasons of 2016 at SKN College of Agriculture, Sri Karan Narendra Agricultural University, Jobner. Geographically, jobner is situated 45 km west of Jaipur at $26^0$ 05' North latitude, $75^o$ 28 East longitude and at an altitude

of 427 meters above mean sea level. The average annual rainfall of this tract varies from 400 mm to 500 mm and is mostly received during the months of July to September. Soils are loamy sand with 0.21% organic carbon, 126.3 kg ha-1 N, 19.23 kg/ha $P_2O_5$ and 150.26 kg/ha $K_2O$. Experiment was laid out in a radnomized block design with three replications comprising 16 treatment combination. The recommended dose of 25 kg $P_2O_5$/ha through SSP was drilled as basal 10 cm deep and N and $K_2O$ were applied as per treatment through urea and MOP, respectively. The dose of sulphur @ 20 kg/ha was applied through sulphur dust. Different growth attributes studied viz., plant height and dry matter accumulation/plant at all the growth stages, number of branches/plant, leaf area index, chlorophyll content were counted in five randomly selected one meter row length in each plot at physiological maturity of the sesame. The sesame RT-346 was sown at 30 cm row spacing on 16 JULY 2016 and harvested 20 october 2016.

The uptake of nitrogen by crop was calculated by following formula (Snell and Snell, 1949) [11]:

$$\text{N uptake (kg/ha)} = \frac{\text{Per cent N in seed x Seed yield (kg/ha) + Per cent N in stalk/straw x stover/straw yield (kg/ha)}}{100}$$

The uptake of phosphorus by crop was calculated by following formula (Jackson, 1967):

$$\text{P uptake (kg/ha)} = \frac{\text{Per cent P in seed x Seed yield (kg/ha) + Per cent P in stalk/straw x stover/straw yield (kg/ha)}}{100}$$

$$\text{Total uptake (kg/ha)} = \frac{\text{Nutrient conc. in seed (\%) x Seed yield (kg/ha) + Nutrient conc. in stalk/straw (\%) x stover/straw yield (kg/ha)}}{100}$$

## Result and Discussion

### Effect of Nitrogen

#### Growth and yield

A perusal of data presented in table 1&2 (Fig. 1 & 2) revealed that application of 40 kg N had favourable effect on growth and yield. All the growth parameters and yields *viz*., plant height, dry matter accumulation per plant, branches per plant, LAI, chlorophyll content, seed and stalk yield increased linearly with the corresponding increase in levels of N. This increment was, by and large, statistically significant over control and 20 kg N/ha and found at par with 60 kg N/ha. Results of the present investigation are in conformity with those of Chaubey *et al.* (2003) [3], Tripathi and Rajput (2007) [13] in sesame.

#### Nutrient uptake

Increasing levels of N significantly increased N concentration in both seed and stalk and total N, P and K uptake (Table 3 and Fig. 3) by sesame but increase in P and K concentration was nonsignificant. Higher N, P and K uptake might be due to improved nutritional environment in the rhizosphere as well as in the plant system leading to enhanced translocation of N, P and K in plant parts. Since the nutrient uptake is a function of its content in crop plant and seed and stalk yield of the crop. The increase in these parameters due to N led to an increased uptake of nutrients in the present study. Another reason for higher nitrogen content might be due to increased activity of nitrate reductase enzyme. These results are in close conformity with the findings of Mondal *et al*. (2001) [8], Sujathamma *et al*. (2003) [12] and Shehu *et al*. (2010) [10] in sesame.

### Effect of Potassium

#### Growth and yield

The sesame crop responded favourably to potassium fertilization in terms of plant height, number of branches/plant, crop dry matter accumulation/plant at all the stages of observation. Significant response to applied K was noted upto 20 kg/ha in respect of these growth determining characters (Table 1 & 2 and Fig. 1 & 2). Yield also increased in the same manner. However, it showed statistical equivalence with 30 kg/ha, wherein, the maximum values of most of the growth attributes were recorded. The result of this study were in close conformity as observed by Sarkar and Pal (2005) [9], and Deshmukh *et al.* (2010) [5] on sesame.

#### Nutrient uptake

Increasing in the level potassium increase the N and P concentration in seed and stalk non significantly but the application of potassium exerted significant variation in K concentration and total N, P and K uptake (Table 3 and Fig. 3) in seed and stalk. The increase in nitrogen uptake in seed and stalk might be due to cumulative effect of increased seed and stalk yields as well as favourable effect on availability of nitrogen at the higher level of potassium. Increase in uptake of the nitrogen with potassium application might be due to increase in seed and stalk yield of sesame (Jadav *et al*., 2010) [6]. Brar *et al.* (2010) [2] and Vaghani *et al.* (2010) [14] also reported that the uptake of N, P and K in seed and stalk were significantly increased with increasing levels of potassium.

**Application of research/ Future perspective:** Based on the one year of study itis recommended that 40N kg/ha and Potassium at 30 kg $K_2O$ should be applied for better nutrient management in *kharif* season respectively, for obtaining higher growth in Sesame.

**Table 1:** Effect of Nitrogen and Potassium on growth parameters at different stages

| Treatments | Plant stand/meter row length | | Plant height (cm) | | | Leaf area index | Chlorophyll content (mg/g) |
|---|---|---|---|---|---|---|---|
| | 20 DAS | At harvest | 30 DAS | 60 DAS | At harvest | | |
| **Nitrogen(N kg/ha)** | | | | | | | |
| 0 | 9.78 | 8.56 | 28.2 | 107.5 | 130.9 | 3.21 | 1.21 |
| 20 | 9.80 | 8.65 | 34.3 | 118.5 | 143.5 | 3.80 | 1.29 |
| 40 | 9.88 | 8.67 | 40.2 | 125.8 | 151.7 | 4.13 | 1.38 |
| 60 | 9.92 | 8.72 | 40.8 | 127.8 | 153.2 | 4.22 | 1.43 |
| SEm± | 0.20 | 0.16 | 1.03 | 2.14 | 2.51 | 0.09 | 0.02 |
| CD (P=0.05) | NS | NS | 2.96 | 6.16 | 7.22 | 0.26 | 0.07 |
| **Potassium ($K_2O$ kg/ha)** | | | | | | | |
| 0 | 9.78 | 8.59 | 33.5 | 111.3 | 134.8 | 3.47 | 1.29 |
| 20 | 9.83 | 8.63 | 35.9 | 118.1 | 143.0 | 3.77 | 1.31 |
| 30 | 9.87 | 8.67 | 36.5 | 124.3 | 150.4 | 4.00 | 1.33 |
| 40 | 9.89 | 8.71 | 37.5 | 125.9 | 151.2 | 4.12 | 1.36 |
| SEm± | 0.20 | 0.16 | 1.03 | 2.14 | 2.51 | 0.09 | 0.02 |
| CD (P=0.05) | NS | NS | 2.96 | 6.16 | 7.22 | 0.26 | NS |

NS= Non- significant, DAS= Days after sowing, N= Nitrogen, $K_2O$= Potassium

**Table 2:** Effect of Nitrogen and potassium on No of branches dry matter accumulation and yield

| Treatments | No of branches/plant | | Dry matter accumulation (g) | | | Yield (kg/ha) | |
|---|---|---|---|---|---|---|---|
| | 30 DAS | At harvest | 30 DAS | 60 DAS | At harvest | Seed yield | Stalk yield |
| **Nitrogen(N kg/ha)** | | | | | | | |
| 0 | 3.02 | 3.14 | 1.54 | 9.83 | 10.28 | 642 | 1812 |
| 20 | 3.37 | 3.49 | 1.68 | 10.75 | 11.18 | 881 | 2470 |
| 40 | 3.64 | 3.78 | 1.82 | 11.63 | 12.04 | 983 | 2821 |
| 60 | 3.75 | 3.87 | 1.87 | 11.90 | 12.44 | 1020 | 2893 |
| SEm± | 0.08 | 0.09 | 0.04 | 0.24 | 0.27 | 24 | 65 |
| CD (P=0.05) | 0.24 | 0.25 | 0.11 | 0.69 | 0.78 | 69 | 186 |
| **Potassium ($K_2O$ kg/ha)** | | | | | | | |
| 0 | 3.11 | 3.22 | 1.62 | 10.02 | 10.38 | 711 | 2009 |
| 20 | 3.38 | 3.50 | 1.74 | 10.83 | 11.26 | 877 | 2477 |
| 30 | 3.63 | 3.77 | 1.76 | 11.60 | 12.10 | 958 | 2727 |
| 40 | 3.66 | 3.80 | 1.79 | 11.66 | 12.20 | 980 | 2783 |
| SEm± | 0.08 | 0.09 | 0.04 | 0.24 | 0.27 | 24 | 65 |
| CD (P=0.05) | 0.24 | 0.25 | 0.11 | 0.69 | 0.78 | 69 | 186 |

NS= Non- significant, DAS= Days after sowing, N= Nitrogen, $K_2O$= Potassium

**Table 3:** Effect of Nitrogen and Potassium on N, P and K concentration and uptake

| Treatments | N concentration (%) | | Total N uptake (kg/ha) | P concentration (%) | | Total P uptake | K concentration (%) | | Total K uptake |
|---|---|---|---|---|---|---|---|---|---|
| | Seed | Stalk | | Seed | Stalk | | Seed | Stalk | |
| **Nitrogen(N kg/ha)** | | | | | | | | | |
| 0 | 3.01 | 1.08 | 38.8 | 0.654 | 0.184 | 7.6 | 0.807 | 0.461 | 13.6 |
| 20 | 3.23 | 1.20 | 58.3 | 0.670 | 0.194 | 10.7 | 0.851 | 0.474 | 19.3 |
| 40 | 3.43 | 1.28 | 70.1 | 0.679 | 0.196 | 12.2 | 0.858 | 0.486 | 22.3 |
| 60 | 3.45 | 1.31 | 73.0 | 0.686 | 0.202 | 12.8 | 0.861 | 0.491 | 23.1 |
| SEm± | 0.07 | 0.03 | 1.6 | 0.016 | 0.005 | 0.3 | 0.021 | 0.011 | 0.5 |
| CD (P=0.05) | 0.21 | 0.08 | 4.5 | NS | NS | 1.0 | NS | NS | 1.6 |
| **Potassium ($K_2O$ kg/ha)** | | | | | | | | | |
| 0 | 3.24 | 1.18 | 47.0 | 0.660 | 0.190 | 8.6 | 0.792 | 0.442 | 14.5 |
| 20 | 3.28 | 1.21 | 58.9 | 0.667 | 0.194 | 10.7 | 0.802 | 0.467 | 18.6 |
| 30 | 3.29 | 1.23 | 66.2 | 0.674 | 0.195 | 11.8 | 0.887 | 0.494 | 22.1 |
| 40 | 3.31 | 1.25 | 68.0 | 0.687 | 0.197 | 12.3 | 0.898 | 0.510 | 23.1 |
| SEm± | 0.07 | 0.03 | 1.6 | 0.016 | 0.005 | 0.3 | 0.021 | 0.011 | 0.5 |
| CD (P=0.05) | 0.21 | 0.08 | 4.5 | NS | NS | 1.0 | 0.061 | 0.031 | 1.6 |

NS= Non- significant, N= Nitrogen, $K_2O$= Potassium

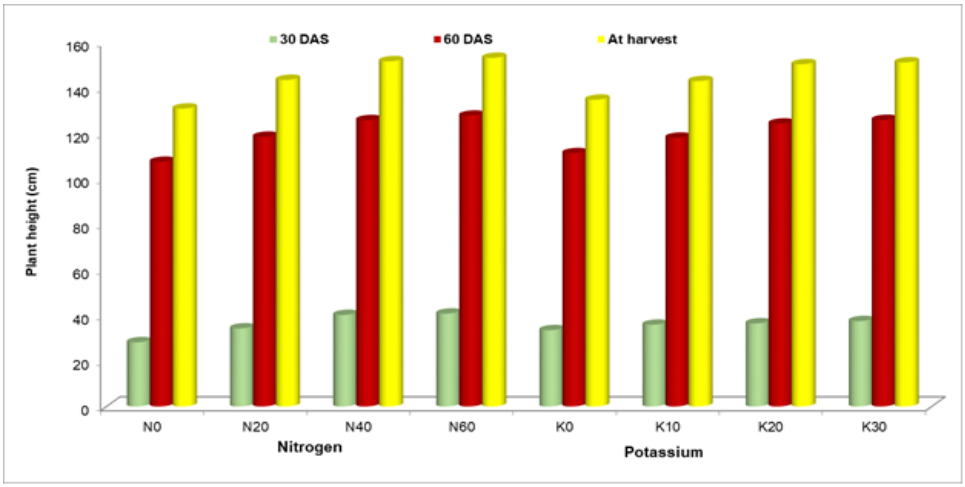


**Fig 1:** Effect of nitrogen and potassium on plant height at different growth stages

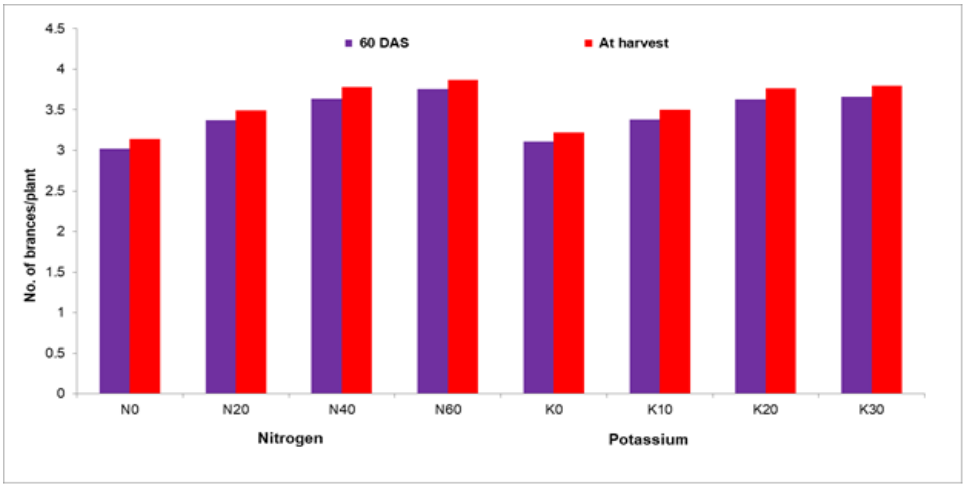


**Fig 2:** Effect of nitrogen and potassium on branches per plant

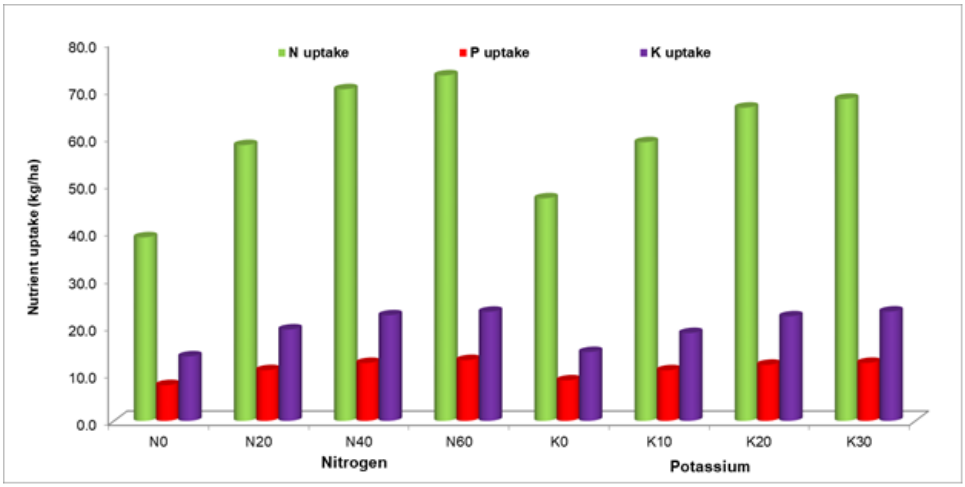


**Fig 3:** Effect of nitrogen and potassium on N, P and K uptake

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