The Pharma Innovation Journal 2022; SP-11(6): 2009-2012

www.ThePharmaJournal.com

The Pharma Innovation

**ISSN (E): 2277-7695**
**ISSN (P): 2349-8242**
**NAAS Rating: 5.23**
TPI 2022; SP-11(6): 2009-2012

www.thepharmajournal.com
Received: 23-04-2022
Accepted: 26-05-2022

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# Growth and production efficiency of sesame (*Sesamum indicum* L.) under different row ratio and nutrient management practices in Kymore Plateau of Madhya Pradesh

**Vinod Kumar Tiwari, HS Kushwaha, Anjni Mastkar and Arun Kumar Shukla**

**Abstract**
A field experiment was conducted during *kharif* season of 2016-17 and 2017-18 at Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.) to select out the suitable row ratio and find out the appropriate nutrient requirement for higher growth and production efficiency of sesame. Growth characters of sesame *viz.* plant height, number of leaves and dry weight/plant were found numerically higher in pigeonpea + sesame 2:2 and 4:2 paired row planting. However, grain yield, straw yield and production efficiency of sesame was recorded significantly higher in pigeonpea + sesame 2:2 paired row ratio. Addition of 100% RDF to main crop (20:60:30 kg NPK/ha) + PSB and 75% RDF to main crop + FYM 5 t/ha produced significantly higher growth parameter *viz.* plant height, number of leaves and dry weight/plant of sesame. However significantly higher grain, and straw yield and production efficiency of sesame were obtained under 100% RDF to main crop + PSB. Application of 100% RDF to main crop + PSB and 75% RDF to main crop + FYM 5 t/ha gave 65% and 58% higher production efficiency over FYM 10 t/ha (control) treatment.

**Keywords:** Growth parameters, nutrient management, pigeonpea, production efficiency, row ratio, sesame and yield

## Introduction
Sesame (*Sesamum indicum* L.) is the oldest ancient oilseed crop with longest history of cultivation in India. It is a crucial oilseed crop, next only to groundnut and rapeseed mustard. India contributed about for 27 per cent of world's sesame area with 23 per cent of world's production and with a productivity of 322 kg/ha annually, making India ranks first in the field of production in the world. It is grown in an area of 15.26 lakh hectares with production of 7.50 lakh tonnes and productivity of 491 kg/ha (Anonymous, 2021) [2]. Sesame is generally grown as sole cropping but it is also cultivated as an intercrop with cereal and pulse crops. Pigeonpea and sesame differ morphologically and physiologically in growth habits. However, the space between the pigeonpea row could be effective utilized by growing a short duration sesame crop, which may generate an additional income without adversely affecting the yield of pigeonpea (Jat and Ahlawat, 2010) [4]. The row spacing of pigeonpea can be enhanced by modified the wider crop geometry (paired planting) which may adjust different rows of sesame under intercropping system.
Continuous use of inorganic fertilizers in exhaustive cropping system has disturbed the balance of nutrients in the soil, which has an unfavourable effect on soil health and also on crop yields (Sharma *et al.*, 2010) [8]. Balanced and systematic fertilizer application, combining inorganic and organic and biofertilizers are essential in registering the higher yield and bring down cost of production. Sesame crops are grown without any fertilizers or the fertilizers are being applied only for the main crop and that too in small quantity. These are very mearge information are available regarding row ratio and nutrient management in pigeonpea + sesame system. Keeping these facts, in view the study was undertaken to select out suitable row ratio and optimize the nutrient requirement of sesame under for pigeonpea + sesame intercropping system in prevailing climate condition of Kymore Plateau of Madhya Pradesh.

## Materials and Methods
A field experiment was conducted during *kharif* season of 2016-17 and 2017-18 at Agriculture

farm of Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot, Satna (M.P.) located at the $25^{0}10'$ N latitude and $80^{0}32'$ E longitude and about 190-210 meter above mean sea level. The soil was sandy loam in texture with low organic carbon (0.29% and 0.24%) and nitrogen (193.43 and 201.6 kg N/ha), medium in phosphorous (16.72 and 20.11 kg P/ha) and potassium (207.28 and 201.5 kg K/ha). The soil was neutral in reaction with 7.44 to 7.46 pH. Electrical conductivity of the soil was 0.30 to 0.32 $dsm^{-1}$. The average rainfall of Chitrakoot is 950 mm while, it was received 870 and 820 mm rainfall during two respective years.

The experiment was consisted of three intercropping system viz. $I_1$: pigeonpea + sesame (1:1), $I_2$: pigeonpea+ sesame (2:2) and $I_3$: pigeonpea + sesame (4:2) and five nutrient management treatment viz. $F_1$**:** FYM @ 10 t/ha, $F_2$**:** 50% RDF to main crop + FYM@ 10 t/ha, $F_3$**:** 75% RDF to main crop + FYM@5 t/ha, $F_4$**:** 100% RDF to main crop (20:60:30 kg NPK/ha), $F_5$**:**100% RDF to main crop + PSB. For comparison of intercropping effect, two additional treatment of sole pigeonpea and sesame were included. The experiment was laid down in a strip plot design with three replication. Pigeonpea cv. UPAS 120 and sesame cv. T-4 were sown with row spacing of 60 cm (normal) and 30 cm respectively and 30/90 cm and 120/90 cm in paired row planting of sesame was done between the pairs of pigeonpea row by reducing row spacing between two rows of a pair up to 30 cm instead of normal spacing of 60 cm however, in 1:1 row ratio of pigeonpea+ sesame, one of sesame was adjusted in between two row of pigeonpea under normal sowing. The seeds were drilled manually in the furrow. Seed rate of pigeonpea was 20 kg/ha and for sesame was 5 kg/ha. Thinning was done at 20 days after sowing to keep plant-to-plant spacing of 15 cm for pigeonpea and 10 cm for sesame. Irrigation was applied as per need of crop. Crops were kept weed free by two hand weeding at 20 and 40 DAS. The data on growth and yield were recorded as per the standard procedure. The production efficiency was estimated as per following formula

**Production efficiency =** Grain Yield (kg/ha)/duration of crop (days)

Data generated were subjected to analysis of variance (Anova) and critical difference (CD) at 5% probability level was obtained (Gomez and Gomez, 1984) [3].

## Results and Discussion

### Growth parameters

The pigeonpea + sesame (2:2) intercropping system recorded markedly higher growth parameters of sesame *viz.* plant height, number of leaves, dry weight/plant in both years of experiment However, pigeonpea + sesame (4:2) gave intermediate order of growth parameters of sesame *viz.* plant height, number of leaves, dry weight during two years of study. It might be owing to over competition of sesame plants with pigeonpea in 1:1 and 4:2 row ratio of intercropping. However, 2:2 row ratio pigeonpea + sesame provided better spaces, reduces competition and better utilization of natural resource which leads to better plant growth of sesame. Similar result was reported by Valiki *et al.* (2015) [12].

In nutrient management treatment, application of 100% RDF to main crop + PSB ($F_5$) recorded significantly higher plant height, number of leaves, dry weight/plant of sesame over rest of treatment except $F_3$: 75% RDF to main crop + FYM 5 t/ha which was statistically at par. It might be due to adequate supply of nutrient with different peak demand of element in pigeonpea and sesame helps the sesame crop in maximum uptake of nutrients which resulted into highest plant height, leaves and dry weight/plant. The results were in conformity with findings of Yadav *et al.* (1997) [13], Subrahmaniyan and Arulmozhi (1999) [10] and Meena *et al.* (2009) [7].

The pure cropping system of sesame registered highest plant height, number of leaves and dry matter/plant than those of rest of inter cropping treatment mean during two years. It might be because of more space avail by sole crop while intercrop plant faced some degree of competition with comparative lower spacing which has reduced growth parameters of sesame crop.

### Yield

The grain yield and straw yield of sesame was recorded in intercropping pigeonpea + sesame (2:2) followed by pigeonpea+ sesame (4:2) in two years of study. It might be owing to better growth and superior yield attributes of sesame with pigeonpea inter cropping system. Similar variations in yield of sesame due to different planting pattern in maize + legume intercropping were also presented by Alhaji (2008) [1] and Kumar *et al*. (2021) [6]

In nutrient management treatment, application of 100% RDF to main crop + PSB ($F_5$) produced significantly higher grain yield and statistically at par to $F_3$ (75% RDF to main crop + FYM 5 t/ha) during two consecutive years. However, straw yield of sesame was observed significantly superior in 100% RDF to main crop + PSB ($F_5$) over $F_1$: FYM 10 t/ha and remained treatment statistically at par. This might be due to incorporation of organic and inorganic source along with biofertilizer which have significant increase the uptake of N, P and K by plant and facilitated the allocation and transfer of nutrient into grain and straw formation and resulted in greater grain and straw yield. (Kumar *et al.*, 2013 and Singh *et al*., 2017) [5, 9]. Sesame yields could also be ascribed due to better growth and yield attributes under above mentioned treatments. Other research workers like Subrahmaniyan and Arulmozhi (1999) [10] and Meena *et al.* (2009) [7] also reported almost similar effect of nutrients on sesame yield.

The sole sesame produced markedly more grain and straw yield compared to rest of treatment mean. This might be due to some of competition faced by intercrop of sesame which reduced the requirement for these resources in this system because of peak demand of nutrient and water is differed in sesame and pigeonpea intercropping system, these results are corroborated to finding of Tomar *et al*. (2017) [11] and Kumar *et al*. (2021) [6].

### Production efficiency

The production efficiency was assessed conspicuously higher under pigeonpea + sesame (2:2) followed by pigeonpea + sesame (4:2) in two years of study. This might be due to superior grain yield of sesame under aforesaid treatment as obtained in same duration of crop.

In nutrient management treatment, $F_5$ 100% RDF to main crop + PSB obtained significantly greater production efficiency which was statistically at par with $F_3$ (75% RDF to main crop + FYM 5 t/ha) during 2016 and 2017. This might be attributed to more grain yield of sesame under respective treatment. Higher sesame yield could also be attributed to better growth and yield attributes under above mentioned treatments.

**Table 1:** Effect of intercropping system and nutrient management on growth parameters of sesame

| Treatments | Plant height (cm) | | No. of leaves per plant | | Dry matter/plant (g) | |
|---|---|---|---|---|---|---|
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| **Intercropping systems** | | | | | | |
| $I_1$: Pigeonpea+ sesame (1:1) | 99.88 | 102.34 | 17.21 | 17.27 | 18.81 | 19.99 |
| $I_2$: Pigeonpea+ sesame (2:2) | 101.35 | 103.93 | 17.60 | 17.82 | 19.11 | 21.40 |
| $I_3$: Pigeonpea+ sesame (4:2) | 100.19 | 103.04 | 17.48 | 17.58 | 18.90 | 20.95 |
| SEm ± | 1.67 | 1.49 | 0.29 | 0.19 | 0.22 | 0.30 |
| CD at (P = 0.05) | NS | NS | NS | NS | NS | NS |
| **Nutrient Management Practices** | | | | | | |
| $F_1$: FYM 10t/ha | 91.68 | 96.69 | 15.24 | 15.37 | 14.84 | 15.78 |
| $F_2$: 50% RDF to main crop+ FYM 10 t/ha | 97.11 | 100.27 | 16.95 | 17.02 | 18.74 | 20.53 |
| $F_3$: 75% RDF to main crop+ FYM 5 t/ha | 104.76 | 106.20 | 17.97 | 18.13 | 20.48 | 22.69 |
| $F_4$: 100% RDF to main crop | 100.44 | 102.67 | 17.84 | 17.98 | 19.53 | 21.09 |
| $F_5$: 100% RDF to main crop + PSB | 108.38 | 109.70 | 19.15 | 19.29 | 21.10 | 23.80 |
| S.Em ± | 1.72 | 1.74 | 0.44 | 0.40 | 0.35 | 0.41 |
| CD at (P = 0.05) | 4.90 | 4.96 | 1.27 | 1.21 | 1.01 | 1.18 |
| **Sole Vs Rest** | | | | | | |
| Sole sesame | 108.40 | 110.10 | 18.20 | 18.42 | 20.30 | 22.50 |
| Treatment mean | 100.47 | 103.10 | 17.43 | 17.57 | 18.94 | 20.78 |
| SEm ± | 2.80 | 2.72 | 0.65 | 0.44 | 0.51 | 0.62 |
| CD at (P = 0.05) | NS | NS | NS | NS | NS | NS |

**Table 2:** Effect of intercropping and nutrient management on seed yield, straw yield and production efficiency of sesame

| Treatments | Grain yield (q/ha) | | Straw yield (q/ha) | | Production efficiency (kg/day) | |
|---|---|---|---|---|---|---|
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| **Intercropping systems** | | | | | | |
| $I_1$: Pigeonpea+ sesame (1:1) | 5.42 | 5.48 | 17.08 | 17.22 | 6.02 | 6.09 |
| $I_2$: Pigeonpea+ sesame (2:2) | 5.74 | 5.87 | 17.15 | 17.44 | 6.38 | 6.52 |
| $I_3$: Pigeonpea+ sesame (4:2) | 5.45 | 5.74 | 17.10 | 17.41 | 6.06 | 6.38 |
| SEm ± | 0.06 | 0.11 | 0.29 | 0.25 | 0.47 | 0.59 |
| CD at (P = 0.05) | NS | NS | NS | NS | NS | NS |
| **Nutrient Management Practices** | | | | | | |
| $F_1$: FYM 10t/ha | 3.81 | 3.97 | 14.25 | 14.73 | 4.23 | 4.41 |
| $F_2$: 50% RDF to main crop+ FYM 10 t/ha | 5.72 | 5.77 | 17.62 | 17.66 | 6.36 | 6.41 |
| $F_3$: 75% RDF to main crop+ FYM 5 t/ha | 6.09 | 6.17 | 17.86 | 18.00 | 6.77 | 6.86 |
| $F_4$: 100% RDF to main crop | 5.83 | 5.96 | 17.83 | 17.98 | 6.48 | 6.62 |
| $F_5$: 100% RDF to main crop + PSB | 6.22 | 6.62 | 18.01 | 18.42 | 6.91 | 7.36 |
| S.Em ± | 0.12 | 0.16 | 0.39 | 0.31 | 0.61 | 0.60 |
| CD at (P = 0.05) | 0.33 | 0.46 | 1.11 | 0.88 | 1.73 | 1.71 |
| **Sole Vs Rest** | | | | | | |
| Sole sesame | 6.05 | 6.20 | 18.21 | 18.45 | 6.72 | 6.89 |
| Treatment mean | 5.53 | 5.70 | 17.11 | 17.36 | 6.14 | 6.33 |
| SEm ± | 0.17 | 0.23 | 0.59 | 0.48 | 0.92 | 0.98 |
| CD at (P = 0.05) | NS | NS | NS | NS | NS | NS |

## Conclusion

Thus it can be concluded that sesame grown with pigeonpea in 2:2 row ratio combined with 100% RDF to main crop pigeonpea + PSB was found most appropriate treatment for Kymore Plateau region of Madhya Pradesh

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