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Effect of varieties and nutrient levels on seed yield, oil yield and total nutrient uptake of sesame (*Sesamum indicum* L.)

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Abstract

The experiment was conducted at Research Cum Instructional Farm of IGKV, Raipur, Chhattisgarh, The crop was sown during *Kharif* season of 2019. The soil condition of experimental field was clay in texture (vertisols). The experiment was laid out in strip plot design with treatments *viz.* vertical strips consisted three sesame varieties (V₁: TKG-22, V₂: TKG-308 and V₃: JTS-8) and horizontal strip consisted four nutrient levels (N₁: 75% RDF, N₂: 100% RDF, N₃: 125% RDF and N₄:150% RDF) with 12 treatment combinations and replicated thrice. The recommended dose of fertilizer (RDF) is 30:30:20:20 N, P₂O₅, K₂O and S kg ha⁻¹, respectively. Result revealed that among the varieties significantly maximum number of capsules plant⁻¹, seeds capsule⁻¹, test weight, seed yield, stover yield, oil content and oil yield were found in variety JTS-8, which was at par with TKG-22 with respect to seeds capsule⁻¹ and stover yield, it was also at par with TKG-308 with respect to oil content. Above parameters were found minimum(except test weight) in variety TKG-308, maximum N, P, S uptake was found in variety JTS-8 and minimum was found in variety TKG-308, while maximum K uptake was found in variety TKG-22 and minimum in JTS-8. In case of nutrient levels highest number of capsules plant⁻¹, seeds capsule⁻¹, test weight, seed yield, stover yield, oil content, oil yield and nutrient uptake (N, P, K and S) were observed with the application of 150% RDF, which was at par with 125% RDF with respect to number of seeds capsule⁻¹, seed yield, stover yield, oil yield. The data from interaction effect of varieties and nutrient levels, the maximum seed yield was obtained with the combination of JTS-8 (V₃) + 150% RDF (N₄).

Keywords: Nutrient levels, nutrient uptake, sesame, varieties, yield attributes and yield

Introduction

Sesame is one of the major oilseed crops in India. There are three known cultivars of sesame seeds like white, black and red (Jain *et al.* 2015)^[5] and it is also called queen of oilseeds and poor man's substitute for ghee. The area, production and productivity of sesame in India during 2018-19 is 1.60 million hectare, 0.76 million tonnes and 473 kg ha⁻¹, respectively and in Chhattisgarh the area, production and productivity of sesame during 2017-18 is 24.92 thousand ha, 8.37 thousand tonnes and 336 kg ha⁻¹, respectively. In India the largest producer of sesame is Gujarat, it contributes 22.3% of total production, followed by 19.2% (West Bengal), 13.5% (Karnataka), 9.8% (Rajasthan), 9.06% (M.P), and 4.7% (Tamil Nadu), 4.52% (A.P.) and 4.52% (Maharashtra) (Anonymous, 2019)^[1].

Variety plays an important role on sesame yield and quality. Variations in seed yield due to varietal potential have already been reported (Raja *et al.* 2007 and Mohsana, 2009)^[9, 8]. The seed yield of sesame crop is significantly affected by varieties or cultivars (Hazarika, 1998)^[4]. The nutritional requirement of sesame is controversial since long time (Okpara *et al.* 2007)^[6], while most research scientists trusted that sesame does not need any fertilization, some thought that the crop required fertilization. Proper nitrogen supply is beneficial to carbohydrates and protein metabolism, facilitating cell division and cell enlargement. Similarly, good phosphorus supply is normally associated with increased growth characters, therefore ensuring higher yield of seed and dry matter (Maiti and Jana 1985)^[7].

The requirement of sulphur is equal to phosphorus (Scherer 2001)^[11], If the soil contain low amount of available K, it is advised to apply 15-30 kg potassium ha⁻¹ to maintain the proper nutritional balance of sesame (Sharma 1997)^[10]. Sulphur play important role in the plant metabolism, sulphur helps flower initiation in sesame which ultimately increases the number

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of capsules plant⁻¹ and seeds capsule⁻¹, sulphur also increases the oil content of sesame crops (Hassan *et al.* 2007). Hence balance nutrition is important for any crop as well as soil health.

Materials and methods

The experiment was conducted at research cum instructional farm of IGKV, Raipur Chhattisgarh, Raipur is situated in the central Chhattisgarh plain at 21°4' N latitude and 81°35' E longitude at the height of 290.20 m above the mean sea level (MSL). The soil condition of experimental field was clayey in texture (vertisols), the soil contained low amount of nitrogen, high phosphorus, medium potassium and low amount of sulphur (225.96, 20.83, 283.24 and 10.29 kg ha⁻¹, N, P, K and S, respectively). The experiment was laid out in strip plot design *viz.* vertical strips consisted three sesame varieties (V₁: TKG-22, V₂: TKG-308 and V₃: JTS-8) and horizontal strip consisted four nutrient levels (N₁: 75% RDF, N₂: 100% RDF, N₃: 125% RDF and N₄: 150% RDF) with 12 treatment combinations and replicated thrice. The recommended dose of fertilizer (RDF) is 30:30:20:20 kg N, P₂O₅, K₂O and S ha⁻¹, respectively. The Crop was sown during *kharif* season of 2019. The Urea, single super phosphate, murate of potash and zinc sulphate was used as a source for nitrogen, phosphorus, potassium and sulphur, respectively.

After the harvesting of crop, already tagged five plants were used for counting number of capsules plant⁻¹ and their mean was calculated, at the time of threshing ten capsules randomly selected from the five sample plants from each treatment and then their seed was counted and mean was calculate. From the lot of threshed clean seeds of each plot, random seed sample was taken and one thousand seeds were counted. Then the weight of seeds of each treatment was recorded on an electronic balance.

The produce of each plot was threshed separately treatment wise and then seeds were cleaned. The weight of clean seeds obtained from each plot was recorded on weighing balance finally the seed yield was converted into yield kg ha⁻¹ by multiplying with appropriate conversion factor. Stover yield determined by subtracting the seed yield from the biological yield of each net plot under a particular treatment and harvest index was calculated as suggested by Donald 1962^[2].

$$HI (\%) = \frac{\text{Seed yield (kg ha}^{-1}\text{)}}{\text{Biological yield (kg ha}^{-1}\text{)}} \times 100$$

The oil content of seeds was estimated by using Socs plus equipment. The oil yield determined by following formula.

$$\text{Oil yield (kg ha}^{-1}\text{)} = \frac{\text{Oil\% in seed} \times \text{seed yield (kg ha}^{-1}\text{)}}{100}$$

The nutrient uptake was calculated by following formula

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \frac{\text{Nutrient concentration in plant (\%)} \times \text{yield (kg ha}^{-1}\text{)}}{100}$$

Results and Discussion

Effect of variety

The effect of varieties was found significant on yield attributes, seed yield, stover yield, oil content and oil yield of sesame. The variety JTS-8 (V₃) found significantly superior with respect to number of capsules plant⁻¹ (46.87) as compare to other varieties of sesame and minimum number of capsules plant⁻¹ (43.73) was observed in variety TKG-308 (V₂). The maximum number of seeds capsule⁻¹ (59.03) was recorded in

variety JTS-8 (V₃), which was found at par with TKG-22 (V₁) and minimum number of seeds capsule⁻¹ was recorded in variety TKG-308. Throve *et al.* (2011)^[12] also reported varietal effect on capsules plant⁻¹ and number of seeds capsule⁻¹ of sesame. The effect of varieties on test weight failed to give significant difference. The highest test weight (3.36 g) was recorded in variety JTS-8 (V₃) and lowest test weight (3.22 g) was observed in variety TKG-22 (Table 1). The highest seed yield (849.17 kg ha⁻¹), stover yield (1554.58 kg ha⁻¹) and harvest index (35.32%) was recorded in variety JTS-8 (V₃) and it was found at par with variety TKG-22 (V₁) with respect of stover yield, the lowest seed, stover yield and harvest index was observed in variety TKG-308 (V₂).

The maximum oil content (37.44%) and oil yield (318.62 kg ha⁻¹) was observed in variety JTS-8 (V₃) and it was found statistically at par with TKG-308 (V₂) with respect of oil content (36.51%) and minimum oil content (35.23%) was recorded in variety TKG-22 (V₁) and lowest oil yield found in variety TKG-308 (V₂). On the basis of these data variety JTS-8 gives 20.97, 12.77 and 23.76% more seed yield, stover yield and oil yield, respectively as compare to TKG-308. While variety TKG-22 gives 9.16, 8.15 and 5.36% more seed, stover and oil yield, respectively as compare to TKG-308. The total uptake of nitrogen differ significantly and the total uptake of phosphorus, potassium and sulphur differ non significantly due to varieties (Table 2), total uptake of N, P and S was found maximum in variety JTS-8 and the minimum total N, P and S uptake was found in variety TKG-308 (V₂), while the total K uptake (13.41 kg ha⁻¹) was found maximum in variety TKG-22 (V₁) and minimum in variety JTS-8 (V₃) (Table 2).

Effect of nutrient levels

Significant difference was found among the nutrient levels with respect of yield attributes, seed yield, stover yield, oil content, oil yield and nutrient uptake of sesame (Table 1 and 2). The application of 150% RDF (N₄) significantly produced maximum number of capsules plant⁻¹ (50.87) and number of seeds capsule⁻¹ (61.04) as compare to other nutrient levels, N₄ was at par with N₃ with respect of number of seeds capsule⁻¹ (58.51), however N₄ was also found at par with N₂ with respect of number of seeds capsule⁻¹ (56.22). While the minimum number of capsule plant⁻¹ and number of seeds capsule⁻¹ was recorded under 75% RDF (N₁). Among nutrient levels no significant difference was observed on test weight, though the highest test weight (3.31g) was observed with the application of 150% RDF (N₄) and lowest test weight (3.24 g) was observed with the application of 75% RDF (N₁). Application of 150% RDF (N₄) significantly produced maximum seed (859.56 kg ha⁻¹), stover yield (1592.89 kg ha⁻¹), oil content (38.68%) and oil yield (332.97 kg ha⁻¹), respectively and it was found statistically at par with N₃ with respect of seed (812.22 kg ha⁻¹), Stover (1550.22 kg ha⁻¹) and oil yield (297.57 kg ha⁻¹), N₄ also at par with N₂ with respect to seed yield, above parameters were found minimum under 75% RDF (N₁). The total uptake of N, P, K and S was differs significantly (except K) due to nutrient levels (Table 2). Among nutrient levels, the maximum total nitrogen uptake (37.62 kg ha⁻¹), total P uptake (24.66 kg ha⁻¹), total K uptake (14.49 kg ha⁻¹) and maximum total S uptake (9.67 kg ha⁻¹) was observed with the application of 150% RDF (N₄), which was statistically at par with N₃ with respect of total P uptake (22.64 kg ha⁻¹), while the minimum total nitrogen, phosphorus, potassium and sulphur uptake was observed with the application of 75% RDF (N₁).

Interaction effect

Significant difference on seed yield was observed due to interaction effect of varieties and nutrient levels and data are presented in table 3. The interaction indicates varieties were positively influenced with the application of different nutrient

levels. Among various treatment combinations, the maximum seed yield (914.67 kg ha⁻¹) was obtained from the treatment combination of variety JTS-8 (V₃) and 150% RDF (N₄) and the minimum seed yield (574.67 kg ha⁻¹) was obtained from treatment combination of TKG-308 and 75% RDF.

Table 1: Yield attributes and yield of sesame as influenced by varieties and nutrient levels

Treatments	No. of capsules plant ⁻¹	No. of seeds capsule ⁻¹	Test weight (g)	Seed yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Harvest index (%)	Oil content (%)	Oil yield (kg ha ⁻¹)
Varieties								
V ₁ : TKG-22	44.57	57.07	3.22	766.25	1490.83	33.94	35.23	271.23
V ₂ : TKG-308	43.73	55.28	3.25	701.92	1378.42	33.74	36.51	257.43
V ₃ : JTS -8	46.87	59.03	3.36	849.17	1554.58	35.32	37.44	318.62
S.Em ±	0.53	0.70	0.10	20.96	33.58	-	0.39	7.19
CD (P=0.05)	2.07	2.77	NS	80.97	131.86	-	1.52	28.23
Nutrient levels								
N ₁ : 75% RDF	39.56	52.73	3.24	657.33	1368.67	32.44	34.07	223.78
N ₂ : 100% RDF	43.51	56.22	3.27	760.67	1386.67	35.42	36.21	275.38
N ₃ : 125% RDF	46.29	58.51	3.28	812.22	1550.22	34.38	36.62	297.57
N ₄ : 150% RDF	50.87	61.04	3.31	859.56	1592.89	35.06	38.68	332.97
S.Em ±	0.78	1.57	0.08	31.72	51.97	-	0.43	10.83
CD (P=0.05)	2.70	5.45	NS	109.76	179.84	-	1.50	37.47
Int (VxN)								
S.Em ±	1.80	1.97	0.25	35.15	131.83	-	0.68	15.24
CD (P=0.05)	-	NS	NS	108.31	NS	-	NS	NS

Table 2: Nutrient uptake of sesame as influenced by varieties and nutrient levels

Treatments	Total Nitrogen uptake (Kg ha ⁻¹)	Total phosphorus uptake (Kg ha ⁻¹)	Total potassium uptake (Kg ha ⁻¹)	Total sulphur uptake (Kg ha ⁻¹)
Varieties				
V ₁ : TKG-22	32.66	20.36	13.41	6.79
V ₂ : TKG-308	29.73	19.68	12.79	5.59
V ₃ : JTS-8	36.87	23.80	11.69	8.00
S.Em ±	1.35	1.57	0.53	0.55
CD (P=0.05)	5.29	NS	NS	NS
Nutrient levels				
N ₁ : 75% RDF	27.91	17.17	10.97	4.11
N ₂ : 100% RDF	31.88	20.64	11.53	5.96
N ₃ : 125% RDF	34.93	22.64	13.23	7.43
N ₄ : 150% RDF	37.62	24.66	14.49	9.67
S.Em ±	0.67	0.78	0.78	0.12
CD (P=0.05)	2.33	2.70	NS	0.42
Int (VxN)				
S.Em ±	2.36	2.38	1.22	0.79
CD (P=0.05)	NS	NS	NS	NS

Table 3: Interaction between varieties and nutrient levels on seed yield (Kg ha⁻¹) of sesame

Varieties	Nutrient levels				Mean
	N ₁	N ₂	N ₃	N ₄	
V ₁	575.00	799.33	829.00	861.67	766.25
V ₂	574.67	657.00	773.67	802.33	701.92
V ₃	822.33	825.67	834.00	914.67	849.17
Mean	657.33	760.67	812.22	859.56	
S.Em±					CD (P=0.05)
Two horizontal strip at the same level of vertical strip				42.78	140.73
Two vertical strip at the same level of horizontal strip				36.77	123.07

Conclusion

On the basis of yield attributes, seed yield, stover yield, oil content and oil yield were found superior with the variety JTS-8 among all the varieties, it was found at par with TKG-22 with respect of number of seeds capsule⁻¹ and stover yield. While in case of nutrient levels the application of 150% RDF (N₄) was found superior performance in terms of yield

attributes, yield, oil content, oil yield and nutrient uptake, however it was found at par with the application of 125% RDF (N₃) in case of seeds capsule⁻¹, seed yield, Stover yield and oil yield. The combination of variety JTS-8 and 150% RDF gives highest seed yield.

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