

Research
Paper

Grain yield as influenced by varieties and fertilizer levels in sesamum (*Sesamum indicum* L.)

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ABSTRACT

The factorial Randomized Block Design was laid out with twelve treatment combinations, formed due to three varieties (Tapi (JLT-7), Phule Til-1 and Hawari) and four levels of fertilizer (0, 12.5 + 6, 25+12.5 and 37.5 + 18.5 N + P₂O₅ kg/ha) replicated thrice. The total dry matter accumulation per plant, straw yield, straw to grain ratio was more in Phule Til-1. The number of capsules and branches per plant, number of seeds per capsule, thousand grain weight, grain to empty capsule ratio and harvest index was significantly more in variety Tapi (JLT-7). Due to expressions of higher order for yield contributing characters, the variety Tapi (JLT-7) produced significantly more grain yield. The grain (9.93q/ha), straw (20.97 q/ha) yields obtained due to the application of 37.5 kg N+18.5kg P₂O₅/ha was the highest and significantly more than the rest of the lower levels. It was observed that with every successive increased level of fertilizer, was maximum with 37.5 kg N+18.5 kg P₂O₅ ha. The values of the yield attributes viz., number of capsules, grain weight per plant and thousand grain weight were increased.

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Key words : Sesamum, Grain yield, Varieties, Fertilizer levels

INTRODUCTION

The production statistics of sesamum crop is most discouraging at both national and state levels. The yield of this crop was low mainly due to its cultivation on marginal and sub-marginal soils with very little or no application of manure and fertilizers. The other causes of low yield was the use of low yielding varieties and non-adoption of proper and improved agronomic practices. Gaur and Trehan (1974), Deora *et al.* (1975), Maiti *et al.* (1981) and Maiti and Jana (1985) reported that the application of nitrogen and phosphorus increased the yield of sesamum seeds significantly. Sesamum is produced in Southern latitudes in developing countries as a crop of small holders. Sixty five countries in the world grow sesamum out of which 24 are in Asia, 21 in Africa, 15 in Central and South America and 5 in Europe. With this view in mind, it was felt necessary to take up an experiment at the Mahatma Phule Agricultural University, Rahuri, during *Kharif* under rainfed conditions.

MATERIALS AND METHODS

The experiment was laid out in Factorial Randomized Block Design with three replications. There were twelve treatment combinations due to 3 varieties and 4 levels of fertilizer (N+ P₂O₅). The gross plot size was 3.60 x 4.50 m² and the net plot size was 2.40 x 3.30 m². Urea (46 % N) was used as a source of nitrogen, while phosphate was applied in the form of single super phosphate containing 16 per cent P₂O₅. After the harvest of observation plants, ten capsules were selected randomly from each plant and was used for counting the number of seeds per capsule. The seed yield of five observational plants was recorded and averaged to obtain plant seed weight. Each variety was harvested at its physiological maturity and seed yield was recorded from each net plot separately and then it was converted in quintals per hectare by using hectare factor. The ratio was calculated by dividing the weight of stalk by the weight of seeds per plot as per treatments. The ratio of seed to empty capsule, weight of all three cultivars was calculated by dividing seed weight with empty capsule weight of five observational plants. Harvest index of all the varieties and fertilizer levels was calculated by the

formula:

$$HI = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

A standard method of "Analysis of Variance" was used for analysing the data (Panse and Sukhathme, 1967) standard error (S.E.) of the means was worked out for each factor and interactions. Wherever the results were significant, the critical difference (C.D.) was worked out at 5 per cent level of significance.

RESULTS AND DISCUSSION

The experimental results emerged from the trial to assess the response of sesamum varieties to varying levels of fertilizer in respect of yield and its attributes in different plant parts and total uptake at harvest as affected by different treatments, under rainfed conditions are presented below.

Grain yield per plant:

The data regarding mean grain yield per plant as influenced by varieties and fertilizer levels are presented in Table 1. The data in Table 1 indicated that the average grain yield was 5.01 g/plant.

Table 1 : Mean grain yield per plant (g), number of seeds per capsules and 1000 grain weight (g) as affected by varieties of fertilizer levels

Treatments	Grain yield per plant(g)	1000 grain weight (g)	Number of seeds per capsule
Varieties			
Tapi (JLT-7)	6.03	3.28	65.50
Phule Til-1	5.78	3.17	64.66
Hawari	3.21	2.59	64.16
'F' test	Sigt	Sigt	Sigt
S.E. \pm	0.14	0.01	0.29
C.D. (P=0.05)	0.41	0.03	0.86
Fertilier levels (N+ P₂O₅ kg/ha)			
0 + 0	3.73	2.91	58.33
12.5 + 6	4.03	3.03	63.44
25.0 + 12.5	5.54	3.09	67.33
37.5 + 18.5	6.72	3.15	70.00
'F' test	Sigt	Sigt	Sigt
S.E. \pm	0.16	0.01	0.34
C.D. (P=0.05)	0.47	0.04	0.99
Interaction			
'F' test	NS	NS	NS
S.E. \pm	0.47	0.02	0.59
General mean	5.01	3.04	64.77

Sigt.= Significant NS = Non-significant

Effect of varieties:

The mean grain yield per plant was significantly influenced due to varieties. The variety Tapi registered significantly more grain yield per plant (6.03 g) than Hawari but was at par with Phule Til-1. The variety Hawari produced the lowest grain yield per plant (3.21 g).

Effect of fertilizer levels:

The mean grain yield per plant differed significantly due to fertilizer levels. Every higher level of fertilizer produced more grain yield than the lower level. The application of 37.5 kg N+18.5 kg P₂O₅/ha was found to be significantly superior in producing grain yield per plant than rest of fertilizer levels.

Effect of interactions:

The interaction effects of the factors under study were not significant on grain yield per plant.

Thousand grain weight:

The data relating to mean thousand grain weight as influenced by varieties and fertilizer levels are presented in Table 1. The data in Table 1 indicated that the mean thousand grain weight was 3.04 g.

Effect of varieties:

The thousand grain weight significantly differed due to varieties. Variety Tapi registered significantly more thousand weight (3.28 g) than rest of varieties viz., Phule Til-1 and Hawari.

Effect of fertilizer levels:

The thousand grain weight differed significantly due to fertilizer levels. The application of 37.5 kg N+18.5 kg P₂O₅/ha registered significantly more thousand grain weight than rest of fertilizer levels. Every successive increased level of fertilizer registered corresponding increase in thousand grain weight. Control registered significantly less thousand grain weight.

Effect of interactions:

The mean thousand grain weight remained unaffected by the combined effects of the factors under study.

Number of seeds per capsule:

The data regarding number of seeds per capsule as influenced by varieties and fertilizer levels are presented in Table 1. The data in Table 1 indicated that mean number of seeds per capsule was 64.77.

Effect of varieties:

The number of seeds per capsule was significantly influenced due to varieties under study. Variety Tapi recorded significantly more number of seeds per capsule than Phule Til-1 and Hawari which were on par with each other.

Effect of fertilizer levels:

Mean number of seeds per capsule increased significantly with every successive increased level of fertilizer level of fertilizer and was the higher in the application of 37.5 kg N +18.5 kg P₂O₅/ha (70).

Effect of interactions:

The interaction effects of the factors under study on mean number of seeds per capsule were non-significant.

Yield studies:

The data pertaining to grain yield and straw yield as influenced by varieties and fertilizer levels are presented in Table 2. The data in Table 2 indicated that mean grain yield and straw yield of sesamum was 7.97 and 15.33 q/ha, respectively.

Table 2 : Mean grain, straw yield sesamum (q/ha) by varieties and fertilizer level

Treatments	Grain yield (q/ha)	Straw yield (q/ha)
Varieties		
Tapi (JLT-7)	9.55	16.61
Phule Til-1	9.13	19.32
Hawari	5.24	10.06
'F' test	Sigt	Sigt
S.E. ±	0.24	0.41
C.D. (P=0.05)	0.71	1.20
Fertilizer levels (N+ P₂O₅ . kg/ha)		
0 + 0	6.03	9.90
12.5 + 6	7.30	13.46
25.0 + 12.5	8.64	16.98
37.5 + 18.5	9.93	20.97
'F' test	Sigt	Sigt
S.E. ±	0.28	0.47
C.D. (P=0.05)	0.82	1.38
Interaction		
'F' test	NS	NS
S.E. ±	0.48	0.82
General mean	7.97	15.33

Sigt.= Significant NS = Non-significant

Grain yield:

Effect of varieties:

The per hectare grain yield differed significantly due

to varieties under study. Variety Tapi (JLT-7) produced significantly more grain yield (9.55q/ha) than Hawari (5.24q/ha) but was on par with Phule Til-1 (9.13 q/ha).

Effect of fertilizer levels:

The grain yield per hectare of sesamum was significantly affected due to fertilizer levels. The grain yield (q/ha) increased significantly with every successive increased level of fertilizer and was the highest (9.93 q/ha) with 37.5 kg N+18.5 kg P₂O₅/ha.

Effect of interactions:

The grain yield of sesamum remained unaffected due to interaction effects of varieties and fertilizer levels

Straw yield:

Effect of varieties:

The straw yield per hectare of sesamum differed significantly due to different varieties under study. Variety Phule Til-1 produced significantly more straw yield (19.32 q/ha) than varieties Tapi (16.61 q/ha) and Hawari (10.06).

Effect of fertilizer levels:

The straw yield per hectare was influenced significantly due to different fertilizer levels. Application of 37.5 kg N+18.5 kg P₂O₅/ha produced significantly more straw yield (20.97 q/ha) than rest of fertilizer levels.

Effect of interactions:

Effect of the interaction of the factors under study in mean yield were not significantly.

Straw to grain, grain to empty capsule ratios and harvest index:

The data on mean straw to grain, grain to empty capsule ratios and harvest index as influenced by sesamum varieties and fertilizer levels are presented in Table 3.

It would be seen from the data in Table 3 that the mean straw to grain, grain to empty capsule ratio and harvest index was 1.88, 1.39 and 34.94, respectively.

Straw to grain ratio:

Effect of varieties:

It would be seen from the data in Table 3 that straw to grain ratio was significantly affected by sesamum varieties. Variety Phule Til-1 registered significantly wider straw to grain ratio (2.08), while it was the lowest in Tapi, indicating that this type was capable of producing more grain per unit of total dry matter.

Table 3 : Mean straw to grain, grain to empty capsule ratio and harvest index as affected by varieties and fertilizer levels

Treatments	Straw to grain ratio	Grain to empty capsule ratio	Harvest index %
Varieties			
Tapi (JLT-7)	1.70	1.53	37.14
Phule Til-1	2.08	1.44	32.50
Hawari	1.87	1.21	34.88
'F' test	Sigt	Sigt	Sigt
S.E. \pm	0.02	0.02	0.98
C.D. at 5%	0.06	0.06	2.86
Fertilier levels (N+ P₂O₅ kg/ha)			
0 + 0	1.62	1.15	38.25
12.5 + 6	1.85	1.20	35.12
25.0 + 12.5	1.96	1.48	33.87
37.5 + 18.5	2.11	1.74	32.13
'F' test	Sigt	Sigt	Sigt
S.E. \pm	0.03	0.03	1.13
C.D. at 5%	0.08	0.07	3.31
Interaction			
'F' test	NS	NS	NS
S.E. \pm	0.04	0.04	1.96
General mean	1.88	1.39	34.84

Sigt.= Significant NS = Non-significant

Effect of fertilizer levels:

The straw to grain ratios were significantly affected by fertilizer levels. The ratios registered with every successive increased level of fertilizer as significantly widened.

Effect of interactions:

The interactions effects of the factors under study on straw to grain ratios were not significant.

Grain to empty capsule ratio:

Effect of varieties:

The grain to empty capsule ratios were significantly affected by varieties. The variety Tapi registered significantly wider (1.53) grain to empty capsule ratio, indicating that this type of capsule produced more grain per unit of total dry matter than retaining the same in empty capsule. The variety Hawari recorded the narrowest (1.21) grain to empty capsule ratio.

Effect of fertilizer levels:

Application of 37.5 kg N+18.5 kg P₂O₅/ha was found to be significantly superior over all the other fertilizer levels recording the widest grain to empty capsule respect of grain to empty capsule ratios (1.74).

Effect of interactions:

The interaction effects were not significant by respect of grain to empty capsule ratios.

Harvest index:

The data on mean harvest indices as influenced by varieties and fertilizer levels are presented in Table 3. The data in Table 3 indicated that the mean harvest index was 34.84 per cent.

Effect of varieties:

The mean indices were significantly influenced due to varieties. The harvest index was maximum and significantly more in variety Tapi (37.14) than rest of that varieties viz., Phule Til-1 and Hawari.

Effect of fertilizer levels:

The mean harvest indices differed significantly due to fertilizer levels. The mean harvest index was maximum in control (38.25) and the values of harvest indices declined with every successive increased level of fertilizer and was the lowest (32.13) in 37.5 kg N + 18.5 kg P₂O₅/ha.

Effect of interactions:

The interaction effects between varieties and fertilizer levels was not significant on mean harvest indices.

The yield contributing characters like number of capsule per plant, weight of grains per plant and 1000 grain weight of different varieties were studied. It was observed that amongst varieties, Tapi produced the highest and significantly more number of capsule (33.51) per plant at harvest, thousand grain weight (3.28 g), grain yield per plant (6.03 g) and number of seeds per capsule (65.50) than the varieties Phule Til-1 and Hawari. Consequent upon the expression of yield attributes, variety Tapi produced significantly more grain yield than other varieties. The higher yields of Tapi were associated with higher 1000 grain weight and maximum number of capsules per plant. Similar positive association of test weight and number of capsule per plant to the yield in sesamum were recorded by Thehan *et al.* (1974), Krishnamurthy *et al.* (1964), Maiti and Jana (1985), Majumdar *et al.* (1988) and Ghosh and Sen (1980).

The resultant performance of the variety can only be well judged from the yield obtained. It was observed that Tapi produced significantly more grain yield (9.55 q/ha) than rest of varieties but was at par with Phule Til-1, while straw yield produced by variety Phule Til-1 as the highest and significantly more than Tapi and Hawari. The lowest straw yield was observed in variety, Hawari, because of higher straw yield in Phule Til-1 this might be

attributed to more plant height and vegetative growth. As regards the straw to grain ratio the variety Phule Til-1 is exhibited significantly wider ratio (2.08), followed by Hawari (1.87). However, the grain to capsule ratio and harvest index was more in variety Tapi. Though, the variety Phule Til-1 produced yield at par with Tapi, it had considerable lower harvest index than Tapi and Hawari. This indicated that the cultivators Tapi and Hawari were more efficient in converting biological yield into economical yield when compared to Phule Til-1. Such variability in performance of varieties due to the differences in harvest indices amongst them were also reported by Saha and Bhargava (1980), Kharde (1981), Narayanan and Reddy, (1982) and Suryavanshi (1988).

Effect of fertilizer levels:

The number of capsules per plant significantly increased with application of 37.5 kg N+18.5 kg P₂O₅/ha than rest of fertilizers levels at all crop growth stages and it was maximum (37.58) at harvest. Similarly, Ananda Rao *et al.* (1984) and Rao *et al.* (1990) also observed that the application of nitrogen and phosphorus increased the number of capsules per plant. The application of 37.5 kg N+18.5 kg P₂O₅/ha produced significantly higher number of seeds per capsule (70), grain yield per plant (6.72g) and thousand grain weight (3.15 g) than rest of the fertilizer levels. The favourable effects of combination of nitrogen and phosphate application on expression of yield contributing characters were also observed by several earlier workers and some of them included Gaur and Trehan (1974) Ghosh and Sen (1980) Maiti and Jana (1985) and Rao *et al.* (1990).

The grain yield was considered as the important component to judge the effectiveness of fertilizers. The grain yield increased significantly with each successive increased levels of fertilizer and the application of 37.5 kg N+18.5 kg P₂O₅/ha produced significantly more and the highest grain yield (9.93 q/ha) and strew yield (20.97 q/ha) of sesamum crop. Similar favorable responses of fertilizer application on sesamum yield under rainfed conditions were also reported by various earlier workers and selected amongst them include Krishnegowda and Krishnamurty (1977), Ananda Rao and Yaseen (1980) and Anand Rao *et al.* (1984). The increase in grain yield of sesamum with fertilizer application was mainly due to increased expression of important yield components *viz.*, number of capsules per plant, test weight and weight of grains per plant at higher level of fertilizer dose. The straw to grain and grain to empty capsule ratio by weight were influenced due to different fertilizer levels. It was observed that the straw to grain and grain to empty capsule ratio

was widened with increased levels of fertilizer, However, the harvest index was reduced due to increased fertilizer levels. The maximum harvest index was observed with no fertilizer (38.25 per cent) and minimum with application of 37.5 kg N+18.5 kg P₂O₅/ha (32.13 per cent).

Effect of interactions:

The interaction effects of the factors did not reach the level of significantly in respect of growth and yield attributes. This clearly indicated that these factors behaved independently.

Conclusion:

The observations on the growth, yield contributing characters and yield were recorded to assess the treatment effects. The nitrogen and phosphorus content in stem, empty capsules and grain and total uptake of plant at harvest were worked out. Some of the important findings emerged from the investigation are summarised below.

Effect of varieties :

The yield contributing characters *viz.*, number of capsule per plant, number of branches per plant, test weight and number of seeds per capsule were higher in variety Tapi. Due to expression of these characters this variety produced significantly more grain and oil yield. Similarly, grain to empty capsule ratio, harvest index, oil and protein content were also more in variety Tapi. The values of total uptake of nutrients by different varieties indicated that the variety Phule Til-1 had maximum nitrogen and phosphorus uptake followed by Tapi.

Effect of fertilizer levels:

The comparative study on different levels of fertilizer on growth, development, yield contributing characters, yield was scrutinized. All of the characters such as yield contributing characters and capsule per plant, thousand grain weight, number of seeds of per capsule, straw to grain ratio, grain to empty capsule ratio, grain yield were significantly influenced by fertilizer levels. Every increased dose of combined nitrogen and phosphate had increased the values of these characters. Grain, straw and oil yields were more with application of 37.5 kg N+ 18.5 kg P₂O₅/ha (the highest level tried). The uptake of nitrogen and phosphorus was also increased with increased fertilizer levels and was maximum with 37.5 kg N+18.5 kg P₂O₅./ha fertilizer dose.

Effect of interaction:

Interaction effects due to different treatment combination on expression of growth, yield contributing

characters, grain and oil yield were not significant.

Conclusion:

Based on the results discussed earlier, the following conclusions could be drawn:

– Considering the expressions of yield attributes and grain yield, the application of 37.5 kg N+18.5 kg P₂O₅/ha was found to be beneficial for sesame crop under conditions.

– Based on the results, it can be concluded that amongst the varieties tried, Tapi (JLT-7) was the most suitable variety followed by Phule Til-1 under rainfed conditions.

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