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Research Paper

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

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ABSTRACT

The factorial randomized black design was laid out with twelve treatment combinations, formed due to three varieties (Tapi (JLT-7), Phule Til-1and Hawari) and four levels of fertilizer (0, 12.5 + 6, 25+12.5 and 37.5 + 18.5 N + p_2O_5 kg/ha) replicated three times. The total dry matter accumulation per plant, straw yield, straw to grain ratio were 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 were 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 P_2O_5/ha were the highest and significantly more than the rest of the lower levels. It is observed that with every successive increased level of fertilizer maximum with 37.5 kg N+18.5 kg P_2O_5 ha, the values of the yield attributes *viz.,* number of seeds per capsule, grain weight per plant and thousand grain weight were increased.

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Key words : Varieties, Fertilizer level, *Sesamum indicum* L., Yield attributes

INTRODUCTION

The production statistics of Sesamum crop is most discouraging at both national and state levels. The yield of this crop is low mainly due to its cultivation on marginal and sub-marginal soils with very little or no application of mannure and fertilizers. The other causes of low yield are 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 Randomised Block Design with three replications. There were twelve treatment combinations due to 3 varieties and 4 levels of fertilizer (N+ P_2O_5). The gross plot size was 3.60 x 4.50 m^2 and the net plot size was 2.40 x 3.30 $m^{2.}$ 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 P_2O_5. After the harvest of observational of plants, ten capsules were selected at random from each plant and used for counting the number of seeds per capsule. The seed yield of five observational plants was recorded and averaged to obtain seed weight per plant. 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. 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 were 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 interaction. 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 in this chapter.

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.

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 P_2O_5 /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.

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. ±	0.14	0.01	0.29
C.D. (P=0.05)	0.41	0.03	0.86
Fertilier levels (N+ P_2O_5 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. ±	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. ±	0.47	0.02	0.59
General mean	5.01	3.04	64.77

Sigt.= Significant NS = Non-significant

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:

Thousand grain weight differed significantly due to fertilizer levels. The application of 37.5 kg N+18.5 kg P_2O_5/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 at par with each other.

Effect of fertilizer levels:

Mean number of seeds per capsule increased significantly with every successive increased level of fertilizer and was the higher in the application of 37.5 kg N +18.5 kg P_2O_5/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 and straw yield of 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
Fertilier levels (N+ P_2O_5 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 hactare 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 at 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 P_2O_5/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 q/ha).

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 P_2O_5 /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 was not significant.

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 can 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 can be seen from the data in Table 3 that straw to grain ratio was significantly affected by sesamum varieties.

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. ±	0.02	0.02	0.98
C.D. P=0.05)	0.06	0.06	2.86
Fertilier levels (N+ P_2O_5 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. ±	0.03	0.03	1.13
C.D. P=0.05)	0.08	0.07	3.31
Interaction			
'F' test	NS	NS	NS
S.E. ±	0.04	0.04	1.96
General mean	1.88	1.39	34.84

Sigt.= significant, NS = Non-significant

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 in producing more grain per unit of total dry matter.

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 were 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. 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 P_2O_5/ha was found to be significantly superior over all the other fertilizer levels recording the widest grain to empty capsule in respect of grain to empty capsule ratios (1.74).

Effect of interactions

The interaction effect was not significant in respect of grain to empty capsule ratios.

Harvest index:

The data on men 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 P_2O_5/ha.

Effect of interactions:

The interaction effect 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 then 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 were the highest and significantly more than Tapi and Hawari. The lowest straw yield was observed in variety Hawari, cause of higher straw yield in Phule Til-1 might be attributed to more plant height and vegetative growth. As regards the straw to grain ratio the variety Phule Til-1 exhibited significantly wider ratio (2.08), followed by Hawari (1.87). However, the grain to capsule ratio and harvest index were 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), Narayan 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 P_2O_5//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 (1990) also observed that the application of nitrogen land phosphorus increased the number of capsules per plant. The application of 37.5 kg N+18.5 kg P_2O_5/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 serveral learlier workers (Gaur and Treahan, 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 P_2O_5/ha produced significantly more and the highest grain yield (9.93 q/ha) and straw yield (20.97 q/ha) of sesamum crop. Similar favourable responses of fertilizer application on sesamum yield under rainfed conditions were also reported by various earlier workers (Krishnegowda and Krishnamurthy, 1977, 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 ratioes by weight were influenced due to different fertilizer levels. It was observed that the straw to grain and grain to empty capsule ratios were 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 P_2O_5/ha (32.13 per cent).

Effect of interactions:

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

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 P_2O_5/ha was found to be beneficial for sesamum 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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