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Effect of Levels of Nutrients (NPKS) on Growth and Yield of Sesame (*Sesamum indicum* L.)

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ABSTRACT

A field experiment was conducted during the *kharif* season of 2017 to sytudy the growth and yield of sesame under different levels of NPKS and to find the suitable nutrient levels (NPKS) for sesame. The experiment was laid out in Randomized Block Design (RBD) with three replications and seven treatments viz ; T_1 (control), T_2 (10 : 5 : 5 : 10 NPKS kg ha^{-1}), T_3 (20 : 10 : 10 : 20 NPKS kg ha^{-1}), T_4 (30 : 15 : 15 : 30 NPKS kg ha^{-1}), T_5 (40 : 20 : 20 : 40 NPKS kg ha^{-1}), T_6 (50 : 25 : 25 : 50 NPKS kg ha^{-1}) and T_7 (60 : 30 : 30 : 60 NPKS kg ha^{-1}). There were significant variations among different treatments on the growth and yield attributes of sesame. Among the treatments, application of 60-30-30-60 kg NPKS ha $^{-1}$ recorded the highest plant height (cm), leaf area index (LAI), total dry matter plant^{-1}, number of capsules plant^{-1}, number of seeds capsule^{-1} test weight, seed yield and stover yield which was statistically at par with application of 50 : 25 : 25 : 50 NPKS kg ha$^{-1.}$ However, from the benefit cost ratio, it was found that application of 50 : 25 : 25 :50 kg ha^{-1}is more economic than application of 60-30-30-60 kg NPKS ha^{-1}.

Keywords Sesame, Seed yield, Stover yield, Benefit-cost ratio.

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INTRODUCTION

Sesame (*Sesamum indicum* L.) belongs to the family Pedaliaceae, and is one of the most ancient crops and oilseeds known and used by mankind. In India sesame is grown in about 2-3 million hectares with a total production of nearly 81 lakh tones (FAOSTAT 2015). In North-Eastern states, the growing area and production found to be highest in Nagaland state but in terms of productivity it is highest in Manipur state (Debnath et al. 2015). In Nagaland, sesame has been adopted well for cultivation in almost all the districts at different elevation up to 1874 MSL. According to the recent report 2011-12, Dimapur district recorded highest in area (630 ha) and production (400 metric tonnes) followed by Mokokchung district with area of 450 ha and production of 260 metric tonnes. Total production during the year 2011-12 was 2100 metric tonnes from an area of 3500 ha (Walling 2015).

The average yield of sesame in india is very low (274 kg ha^{-1}) . The lower productivity may be attributed due to use of sub-optimal rate of fertilizer, poor management and cultivation of sesame in marginal and sub-marginal lands where deficiency of macronutrients such as NPK and micronutrient is predominant. This indicates the scope and need to increase the productivity of sesame through optimization of nutrients as nutrient imbalance is an important factor limiting the full expression of sesame yield potential. On the other hand sesame nutrition remained very controversial for long time (Okpara et al. 2007). While many researches were of the opinion that sesame does not require any fertilization, some of the opinion that the crop needed to be fertilized. Fertilizer is an important option that should be adopted in order to improve crop yields.

Researches on the nutrition of sesame in the tropics have shown significant yield increase due to nitrogen, phosphorus and potassium in India. Detailed fertilizer studies have indicated the application of Nitrogen, Phosphorus and Potassium (NPK) fertilizer to sesame gives reasonable chance of increase economic returns (Jakusko and Usman 2013). Adequate supply of nitrogen is beneficial for carbohydrates and protein metabolism, promoting cell division and cell enlargement. Similarly, good supply of phosphorus is usually associated with increased in root density and proliferation, which aid in extensive exploration and supply nutrients and water to the growing plant part, resulting in increased growth traits thereby ensuring more seed and dry matter yield. Analysis of mature sesame plants usually shows high potassium content especially in the capsules. Sesame being an oilseed crop, sulfur plays a remarkable role in protein metabolism. It is required for the synthesis of proteins, vitamins and chlorophyl and also S containing amino acids such as cystine, cysteine and methionine which are essential components of proteins. Lack of sulfur causes retardation of terminal growth and root development. Application of sulfur in sesame has resulted in improved plant parameters and yield of sesame (Kumar et al. 2017). Understanding the dynamics of these nutrients in term of their uptake, translocation and distribution in sesame plant is an important aspect that will help in taking decision for improving its production and management (Shenu et al. 2010).

MATERIALS AND METHODS

The field experiment was conducted in the Experimental Research Farm of School and Agricultural Sciences and Rural Development (SASRD), Nagaland University, Medziphema Campus, during July—October, 2017 to evaluate the effect of different levels of nutrients (NPKS) on growth and yield of sesame. Randomized Block Design (RBD) was used in the experiment with seven treatments and three replications. The treatment consisted of T_1 (control), T_2 (10 : 5 : 5 : 10 NPKS kg ha^{-1}), T_3 (20: 10 :10 : 20 NPKS kg ha^{-1}) T_4 (30 : 15 : 15 : 30 NPKS kg ha^{-1}), T_5 (40 : 20 : 20 : 40 NPKS kg ha^{-1}) T_6 (50 : 25 : 25 : 50 NPKS kg ha^{-1}) and T_7 (60 : 30 : 30 : 60 NPKS kg ha^{-1}) which were applied after the land preparation and a day before sowing of the crop. Half dose of nitrogen and full dose of phosphorus, potassium and sulfur were given before sowing while the remaining half dose of nitrogen was given at flowering stage. Sesame variety savitri was taken for the experiment. The experiment was conducted on well drained loam soil having pH 4.42, organic carbon 0.34%, available nitrogen 214 kg ha^{-1}, available phosphorus 16.8 kg ha^{-1}, available potassium 163.8 kg ha^{-1} and sulfur 11.03 kg ha^{-1}. The data were analyzed statistically by applying the techniques of variance and the significant of different source of variation was tested by F test (Cochran and Cox 1957).

RESULTS AND DISCUSSION

Application of T_7 (60 : 30 : 30 : 60 NPKS kg ha^{-1}) recorded the maximum plant height (88.13 cm) which was at par with T_6 (86.20 cm). However, the lowest

Table 1. Effect of levels of NPKS on plant height (cm) , leaf area index (at 50 DAS), plant dry matter at harvest.

Treatment	Plant height	Leaf area index	Plant dry matter
T_1 (control)	62.53	0.22	6.41
T_2 (10 : 5 : 5 : 10)	71.27	0.25	8.19
T_3 (20 : 10 : 10 20)	75.73	0.28	9.43
T_4 (30 : 15 : 15 : 30)	76.60	0.28	10.64
T_5 (40 : 20 : 20 : 40)	82.53	0.32	11.06
T_6 (50 : 25 : 25 : 50)	86.20	0.34	12.01
T_7 (60 : 30 : 30 : 60)	88.13	0.35	15.21
SEm ±	0.77	0.007	0.33
CD (p=0.05)	2.39	0.02	1.01

Table 2. Effect of levels of NPKS on no.of capsules plant^{-1} , no.of seeds capsule-1 , test weight, seed yield (kg ha^{-1}) and stover yield (kg ha^{-1}).

Treatment	No. of capsules plant^{-1}	No. of seeds capsule^{-1}	Test weight (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1 (control)	48.00	16.92	1.56	221.33	876.11
T_2 (10:5:5:10)	49.27	19.48	1.42	260.92	1395.55
T_3 (20:10:10:20)	51.47	23.44	1.97	270.66	1473.99
T_4 (30:15:15:30)	57.87	26.67	1.92	271.01	1632.75
T_5 (40:20:20:40)	61.93	28.53	2.03	331.81	1760.12
T_6 (50:25:25:50)	65.27	31.70	2.22	398.86	1831.81
T_7 (60:30:30:60)	67.13	32.49	2.61	419.37	1942.00
SEm ±	0.66	0.56	1.37	24.94	98.62
CD (p=0.05)	0.06	1.75	NS	76.85	303.86

height (62.53 cm) was recorded by T_1 (control). The increase in the application of nutrients might have resulted in the increased plant height. Similar result was obtained by Pagal et al. (2017) (Table 1).

The deta of the leaf area index indicated that there was significant variation in different treatments . The treatment T_7 (60 : 30 : 30 : 60 NPKS kg ha^{-1}) showed the highest LAI which was statistically at par with T_6. The lowest LAI was recorded inT_1 (control). This might be due to the low availability of nutrients since no chemical nutrients were applied. This was in close conformity with the findings of Shilpi et al. (2012). Highest dry matter accumulation was recorded in T_7. The application of nutrients in highest amountsmight have resulted in the highest accumulation of dry matter in treatment T_7 . In the case of yield attributes, T_7 recorded the highest number of capsules plant^{-1} (67.13), number of seeds capsule^{-1} (32.49) and were statistically at par with T_6. The variation in the different levels of application of NPKS did not give any significant effect on test weight of sesame.

From, Table 2, it was revealed that T_7 (60 : 30 : 30 : 60 NPKS kg ha^{-1}) recorded the highest yield (419.37 kg ha^{-1}) which was statistically at par with T_6 (398.86 kg ha^{-1}).T_1 (control) recorded the lowest yield with (221.33 kg ha-1). It can be clearly observed that application of different levels of NPKS gave significanly higher yield than control. The application of nutrients in different treatments has resulted in higher yields compared to control where no nutrients were applied. Increase in the application of nutrients has resulted in higher yields. The findings are in conformity with Umata etal. 2017 and Parmar et al. (2018). T_7 (60:30:30:60 NPKS kg ha^{-1}) also recorded the highest stover yield (1942.00 kg ha^{-1}) which was statistically at par with T_6 (1831.81 kg ha^{-1}) and T_5 (1760.12 kg ha^{-1}). The lowest stover yield was recorded in T_1 (control) with 876.11 kg ha^{-1}.

As per the data presented in Table 3, the highest gross return (Rs 32,400) and net return (Rs 16348.35) was recorded from T_7 (60 : 30 : 30 : 60 NPKS kg ha^{-1}) followed by T_6 (50 : 25 : 25 : 50 NPKS kg ha^{-1}). However, the highest benefit cost ratio was obtained in T_6 with 1.06 followed by T_4 with 0.95. T_7 recorded benefit cost ratio of 0.94. Lowest benefit-cost ratio was obtained in T_5 (0.90). The higher input in T_7 has increased the cost of cultivation which has resulted in lower profit even if it gave the highest yield from the treatment.

Table 3. Economics as influenced by various treatments.

Treatment	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B : C ratio
T_1 (control)	18160	8630	0.91
T_2 (10 :5 : 5 : 10)	20560	9837.67	0.92
T_3 (20 : 10 : 10 : 20)	23120	11205.34	0.94
T_4 (30 : 15 : 15 : 30)	25520	12413.01	0.95
T_5 (40 : 20 : 20 : 40)	27200	12900.68	0.90
T_6 (50 : 25 : 25 : 50)	31840	16348.35	1.06
T_7 (60 : 30 : 30 : 60)	32400	15716.02	0.94

CONCLUSION

From the above result it can be concluded that application of (60 : 30 : 30 : 60 NPKS kg ha^{-1}) resulted in highest yield of sesame however considering the benefit cost ratio, application of (50 : 25 : 25 : 50 NPKS kg ha^{-1}) is more economical for maximizing the production of sesame under Nagaland condition.

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