J. Soils and Crops 33 (2) 258-261, December 2023

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

OPTIMIZATION AND SPLIT APPLICATION OF NITROGEN AND POTASSIUM FOR THE YIELD ENHANCEMENT IN SESAME

S.Gobika[1] and D.Rajkumar[2]

ABSTRACT

The field trial was conducted at RVS Farm Unit IV during the year 2021-2022 to study the dynamics of the nutrients for determining the optimum level of fertilizers and an effect of split application of nitrogen and potassium fertilizer in sesame (variety-TMV 7). The field experiment was laid out in the factorial randomized block design with two factors having four levels and replicated thrice. The relative performance in terms of plant height, number of branches, leaf area index, crop growth rate, seed and stalk yield and economics was examined. The results showed that the application of 125% RDF of N and K with the split application as 50% at basal, 25% at 15 DAS and 25% at 30 DAS recorded the higher growth parameters, yield, net income with higher B:C ratio (2.49) .

(Key words: Sesame, nitrogen, potassium, split application, yield)

INTRODUCTION

Sesame an activistic oilseed crop in the world and is grown as vegetable oil seed crop in India. Its edible oil content ranges between 46-52 per cent and protein content ranges between 18-20 per cent with high biological value. The seed contains carbohydrate, fats, fiber, vitamins, minerals and all the essential amino acids especially sulphur containing amino acid methionine, which is scarce in other plant protein. The country has been achieving the self sufficiency in food grain production but the vegetable oil is being imported from other countries (Nayek *et al.,* 2014). Though the country is being a leading producer of gingelly, the requirement of vegetable oil gets imbalanced due to lower productivity. In India, the productivity has been gradually increasing but it is 25% lesser to the average productivity of the world. This situation makes a reorientation in agriculture to achieve the rapid increase in productivity of sesame. The productivity can be achieved by improving agronomic practices which becomes immense with a special concern on nutrient management in sesame.

In sesame, low yielding varieties, poor agronomic packages, non synchronized flowering, damage through pests and diseases, unrealized genetic potential and lack of mechanization for cultivation are responsible for low yield of the crop (Singh *et al.,*2018). The inadequate and improper nourishment of nutrients is an important limiting factor for expressing the full potential yield of sesame.

Nitrogen is the most important dynamic nutrient that enhances the leaf area and chlorophyll content, thereby increases the yield and sustains the soil N content, fertility and productivity (Dongarkar *et al.,* 2005). Most of the occasion, the applied N fertilizers are lost through leaching, denitrification and volatilization. Potassium activates enzymes, assist translocation and storage of assimilates, favors the energy balance and helps in resistance to drought. Keeping these facts in view, the present investigation had been premeditated to study the optimum recommendation of fertilizers and an effect of split application of fertilizer nutrient to exert out the maximum potential yield.

MATERIALS AND METHODS

The trial was conducted in the sandy clay loam soil with available soil NPK of 245:18:330 kg ha^{-1}. The sesame variety TMV 7 used as test crop. The treated seeds were sown at 30 cm x 30 cm spacing and the recommended dose of fertilizers 35 kg N:23 kg P_2O_5:23 kg K_2O ha^{-1} with the micronutrient application of $MnSO_4$ 5 kg ha^{-1} for irrigated sesame and full dose of P applied as basal. N and K were applied based on the treatment schedule. The STCR recommendation for the targeted yield of 1.2 t ha^{-1} was 18:13:13 kg ha^{-1} NPK along with FYM at the rate of 12.5 t ha^{-1}.

The trial was fitted out in the statistical design FRBD with two factors having four levels and replicated thrice. Factor 1: Nutrient levels were M_1- 75% RDF of N and K, M_2- 100% RDF of N and K, M_3- 125% RDF of N and K and M_4- Soil Test Crop Response (STCR) based N and K nutrient management. Factor 2: Spilt application of N and K were S_1- 100 % RDF as basal, S_2- 50% as basal and 50% at 15 DAS, S_3- 50% as basal, 25% at 15 DAS, 25% at 30 DAS and S_4- 25% as basal, 50% at 15 DAS, 25% at 30 DAS.(Note: RDF- Recommended Dose of Fertilizers)

1. Asstt. Professor, Dept. of Agriculture Engineering, RVS Technical Campus Coimbatore, Coimbatore-641 402
2. Professor and Head, Dept. of Agriculture Engineering, RVS Technical Campus Coimbatore, Coimbatore-641 402 (Corresponding author)

The observations recorded on plant height, number of branches, leaf area index, crop growth rate, seed yield and stalk yield were statistically analyzed by the Fisher's method of ANOVA, (1984) and results were discussed.

RESULTS AND DISCUSSION

Plant height and number of branches

The data on plant height and number of branches at 60 DAS were depicted in Table 1. The examined data reveals that 125% RDF of N and K (M_3) produced the taller plants (124.48 cm) and the higher number of branches (9.78) and the shorter plants (115.87 cm) in STCR based recommendation of N and K and lesser number of branches (8.28) in 75% RDF of N and K. Progressive effect of nitrogen and potassium may be due to the role of nitrogen in boosting the vegetative growth by enhancing the meristematic cell activity at the growing tip and potassium had a positive role in enzymatic and metabolic activity. The results are in compliance with Akhtar *et al.* (2017). Application of 75 kg of nitrogen in mustard significantly increased the plant height, number of branches and dry matter production (Dongarkar *et al.,* 2005).

Among the split doses of N and K, S_3-50% at basal, 25% at 15 DAS and 25% at 30 DAS (N and K) had taller plants (124.40 cm) with higher number of branches (10.10) and it was comparable with 25% at basal, 50% at 15 DAS and 25% at 30 DAS (N and K) in plant height and had an significant difference in number of branches. The shorter plants (114.81 cm) and lesser number of branches were observed in 100% basal application of N and K.The split application adds the availability of nutrients in the rhizosphere pool may had a greater effect on growth parameters. Gebremariam (2015) reported that fertilizer at two equal splits (one at planting and other at branching) produced the taller plants in sesame. Shirazy *et al.* (2017) also reported that the split application of nitrogen as 50% at basal and 50% at 20 DAS with different nitrogen rates increased the plant height.

Leaf Area Index (LAI)

Data pertains on LAI are shown in Table 1. The leaf area index had a significant difference by the different nutrient level and split application of nutrients N and K. The higher LAI (5.00) at 60 DAS was in accounted in 125 % RDF of N and K and it is equivalent to 100% RDF of N and K (4.82) and lesser value (4.37) was obtained in STCR based nutrient recommendation. According to split application LAI was higher in 50% at basal, 25% at 15 DAS and 25% at 30 DAS (N and K) and was at par with 25% at basal, 50% at 15 DAS and 25% at 30 DAS (N and K). Haruna (2011) reported that increase in N application produced the larger leaves and higher chlorophyll content. More the LAI, greater the photosynthetic leaf area which aids in light interception to trap the photosynthetically active radiation and the higher CO_2 exchange and these has been provoked by the efficient utilization of nutrients.The larger leaf area was an aid to intercept the sunlight which helps in more assimilate production (Umar *et al.,* 2012).

Crop Growth Rate (CGR)

The higher CGR was found in 125% RDF of N and K between 45-60 DAS (6.86) and it is equivalent with 100% RDF of N and K (6.09). The reduced CGR was seen in STCR based recommendation of N and K between 45-60 DAS (4.97). With regards to split application of nitrogen and potassium 50% at basal, 25% at 15 DAS and 25% at 30 DAS found superior between 45-60 DAS (6.65) statistically on par with 25% at basal, 50% at 15 DAS and 25% at 30 DAS (Table 1). This might be due the increased chlorophyll content enhances the photosynthesis thereby the new tissue has been developed.

Seed and stalk yield

An appraisal of data in Table 1 revealed that different levels of nitrogen and potassium differed conspicuously for seed and stalk yield. The seed (870.6 kg ha^{-1}) and stalk yield (3192.8 kg ha^{-1}) resulted higher in 125% RDF of N and K followed by 804.4 and 3011.3 kg ha^{-1} in 100% RDF of N and K and the lesser seed and stalk yield was noticed in STCR based recommendation. The increase in plant height and physiological parameters by the augmented nitrogen levels promotes the vegetative growth thereby enhances biological yield. Thentu *et al.* (2014) reported that the maximum number of capsules were obtained by the application of 150% RDF thus in turn increased the yield of sesame. The seed yield with different levels of nitrogen was due to the difference in the photosynthetic activity and total sink activity (Ram *et al.,* 2022). Babajide and Oyeleke (2014) stated that application of increased level of nitrogen fertilizers enhanced yield by the enlarged leaf area for better photosynthesis, carboxylases activity and chlorophyll content. The potassium has a positive impact on yields due to part in photosynthesis, carbohydrate synthesis and cell elongation (Jadav *et al.,* 2010). The nitrogen helps in vegetative growth and produces stronger source-sink and potassium helps in movement of assimilates to reproductive part by an ionic balance and the enzymatic activity thereby to improve the yield. Regarding the split application of N and K, 50% at basal, 25% at 15 DAS and 25% at 30 DAS recorded higher seed and stalk yield (857.1 and 3164.0 kg ha^{-1}) and the lesser yield (686.1 and 2575.3 kg ha^{-1}) was accounted under 100 % basal application. There is noteworthy effect of spilt application on yield of sesame by increasing the nutrient use efficiency and thereby reducing the nutrient losses and improving the yield. The results evidenced by Sharma *et al.* (2018) that the maximum number of capsules $plant^{-1}$ was recorded with treatment 70:40:0 (S) *i.e.* 64.7, which was 62% higher than the control. Bikrem *et al.* (2013) also reported that two equal splits *viz.*, 50% as basal +50% at 30 days after sowing (DAS) resulted in higher yield. Shehu *et al.* (2010) also reported significant interaction effect of nitrogen and potassium for seed yield in sesame.

Table 1. Fertilizer level and split application of N and K on plant height, number of branches, Leaf Area Index, Crop Growth Rate at 60 DAS and seed yield, stalk yield and Economics of sesame

Treatments	Plant height at 60 DAS (cm)	Number of branches	Leaf Area Index	Crop Growth Rate) (45-60 DAS ($gm^2 day^{-1}$)	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Net income (₹ ha^{-1})	B:C ratio
M_1	117.3	8.28	4.48	5.50	722.9	2752.9	22875	2.11
M_2	122.5	8.93	4.82	6.09	804.4	3011.3	27488	2.32
M_3	s124.5	9.78	5.00	6.86	870.6	3192.8	31280	2.49
M_4	115.8	8.32	4.37	4.97	710.1	2633.2	22301	2.10
SEd	**3.19**	**0.29**	**0.15**	**0.26**	**15.11**	**71.26**	*	*
CD (p=0.05)	**6.44**	**0.59**	**0.31**	**0.53**	**30.82**	**145.37**		
S_1	114.8	7.24	3.85	4.93	686.1	2575.3	21512	2.09
S_2	120.4	8.92	4.69	5.64	721.3	2711.5	22729	2.10
S_3	124.4	10.1	5.21	6.65	857.1	3164.0	30228	2.42
S_4	120.6	9.06	4.93	6.19	843.5	3139.4	29446	2.39
SEd	**3.19**	**0.29**	**0.15**	**0.26**	**15.11**	**71.26**	*	*
CD (p=0.05)	**6.44**	**0.59**	**0.31**	**0.53**	**30.82**	**145.37**	*	*

*Stastically not analysed

Economics

The higher net income (₹ 31280 ha^{-1}) and the B:C (2.49) ratio recorded in 125% RDF of N and K followed by 100% RDF of N and K. With regards to split application of nitrogen and potassium as 50% at basal, 25% at 15 DAS and 25% at 30 DAS accounted the higher net income of ₹ 30228 ha^{-1} with the B:C ratio of 2.42. The higher B:C results to reduce risk management of farmers in terms of chemical fertilizers. Sharma *et al.* (2018) also reported that the treatment of 70:40:0 (S) gave the maximum net return (Rs. 42,545 ha^{-1}) and higher B:C ratio of 3.34.

REFERENCES

Ali, Akhtar, Nangial Khan, Rayyan Khan, Zia Ullah, Murad Ali, Muhammad Junaid, Malik Owais Ullah Awan, Irshad Ahmad, Anis Ur Rehman Khalil, and Adeel Liaqat, 2017. Growth of sesame *(Sesamum indicum* L.*)* as affected by nitrogen and sulfur under semiarid climate. Pure Appl. Biol.**6** (1):40.

Babajide, P. A. and O. R. Oyeleke, 2014. Evaluation of sesame (*Sesamum indicum*) for optimum nitrogen requirement under usual farmers' practice of basal organic manuring in the Savanna ecoregion of Nigeria.Evaluation.**4** (17):122-132.

Bikram, Singh, Singh Satyavir, Kumar Vinod, and Kumar Yogender, 2013. Nitrogen and nipping schedule for higher productivity of sesame (*Sesamum indicum* L.) on aridisols of South-Western Haryana.Haryana J. Agron.**29** (1/2):1-5.

Dongarkar, K. P., W. S. Pawar, V. S. Khawale, N. G.Khutate and N. N. Gudadhe, 2005. Effect of nitrogen and sulphur on growth and yield of mustard (*Brassica juncea* L.). J. Soils and Crops, **15**(1): 163-167.

Gebremariam, Gebrelibanos, 2015. Growth, yield and yield component of sesame (*Sesamum indicum* L.) as affected by timing of nitrogen application. J.Biol.Agriculture and Healthcare, **5**(5):165-169.

Haruna, I.M., 2011. Dry matter partitioning and grain yield potential in sesame (*Sesamum indicum* L.) as influenced by poultry manure, nitrogen and phosphorus at Samaru, Nigeria.J. Agric. Technol. **7** (6):1571-1577.

Jadav, D.P., D.R. Padamani, K.B. Polara, K.B. Parmar and N.B. Babaria, 2010. Interaction effect of sulphur and potassium on yield and nutrients uptake by sesame (*Sesamum indicum* L.). Asian J. Soil Sci.**5** (1):144-147.

Kushahwah, Raj Singh, Kumar Rupendra, U.C. Sharma, N.S. Bhadauria, N.K. Kushwaha and Kumar Chandan, 2018. Impact of frontline demonstration technologies on sesame crop yield in Bhind district (MP). Indian Res. J. Exten.Edu.**18** (2):97-100.

Nayek, Snehangshu Sekhar, Koushik Brahmachari and M.D. Riton Chowdhury, 2014. Integrated approach in nutrient management of sesame with special reference to its yield, quality and nutrient uptake.The Bioscan, **9** (1):101-105.

Ram, K. V., A. D. Raj and P. M. Sankhla, 2022. Effect of nitrogen, phosphorus and potassium on growth, yield and economics of hybrid maize (*Zea mays* L.). J. Soils and Crops,**32**(1):80-86.

Sharma, Vivek, M.J. Singh, Vijay Kumar, and Anil Khokhar, 2018. Response of integrated nutrient management on growth, seed yield and economics of sesame (*Sesamum indicum* L.) under rainfed conditions in sub montane region of Punjab. Indian J. Dryland Agric. Res. Dev.**33** (1):45-48.

Shehu, H.E., Joshua D Kwari and M. K. Sandabe, 2010. Effects of N, P and K fertilizers on yield, content and uptake of N, P and K by sesame (Sesamum indicum). Int. J. Agric. Biol.**12** (6):845-850.

Shilpi, Sonia, M.D. Nuruzzaman, Fahmina Akhter, M.N. Islam and G.N.C. Sutradher, 2014. Response of nitrogen and sulfur on the oil content of sesame and nutrient status of soil. Int. J. Bio-resour. Stress Manag. **5** (1):041-046.

Shirazy, Bir Jahangir, M.M. Mahbub, T.A. Somee and S. Islam, 2017. Effect of Nitrogen Rates and Foliar Spray of Micronutrients on Growth and Yield of Sesame (*Sesamum indicum* L.). Am. J. Plant Biol.**3** (1):1-21.

Thentu, T.L., S.M. Nawlakhe, D.D. Mankar, M. Shrinivasrao and G.V. Bhonde, 2014. Growth, yield and quality of summer sesame as influenced by the fertilizer and sulphur levels. J. Soil and Crops, **24**(1):143-147.

Umar, U.A., M. Mahmud, S.U. Abubakar, B.A. Babaji and U.D. Idris, 2012. Performance of sesame (*Sesamun indicum* L.) varieties as influenced by nitrogen fertilizer level and intra row spacing. Asia-Pac. J. Sci. Technol. **13** (2):364-369.

Rec. on 17.11.2022 & Acc. on 11.01.2023