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Research Article

Effect of nitrogen and sulfur on yield and yield components of sesame (*Sesamum indicum* L.) in calcareous soil

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Abstract

The study was carried out on sesame in North West of Pakistan. The experiment was laid out in RCBD having 3 replications. Four N and three S rates were applied in two splits one at sowing and second split with first irrigation. No of pods plant^{-1} and grain yield (kg ha^{-1}) were affected significantly by N, S and control vs rest. No of grains pod^{-1} and 1000-seeds weight were affected significantly affected by nitrogen not sulfur. Mean values for nitrogen exhibited that highest grain yield (799.4) were obtained at 70 kg N ha^{-1} ,while minimum grain yield (637) were recorded at 0 kg N ha^{-1}. Mean values for sulfur revealed that highest grain yield (807.1) were recorded at 30 kg S ha^{-1}, while minimum grain yield (628.6) were recorded at 10 kg S ha^{-1}. Nitrogen and sulfur interaction showed that optimum grain yield (1030 kg ha^{-1}) was noted at 70:30 kg N:S ha^{-1}, while minimum grain yield (516.10 kg ha^{-1}) was noted at 150:10 kg N:S ha^{-1}. It is concluded that nitrogen and sulfur applied at the rate of 70:30 kg N:S ha^{-1} perform better as compared to other treatment applied and thus recommended for attaining high yield.

Key words: Nitrogen; Sulfur: Sesame: Yield

Introduction

Sesame (*Sesamum indicum* L.) belongs to Pedaliaceae family. Till is its local name in Urdu and Punjabi, in Sindhi it is called tir, Konzala in Pashto and in Balochi it is called Kunjit. It is an oilseed crop. It is annual minor kharif short-day plant, and it flowers normally in 42-45 days [1]. Its stem is erect and branched. The roots develop more profusely in sandy soil than in clay soil which imparts drought resistance to sesame. Flowers on short peduncles are borne singly in the axils of leaves of the upper portion of the stem and branches. The fruit of sesame is called capsule and it varies from 2.5 to 8.0 cm in length and 0.5 to 2.0 cm in diameter. Capsules starts maturing form bottom to top, allowing shattering of the lower ones by the time the uppermost capsules are mature. Seeds of sesame are small, ovate and are of two types due to its color differentiation, one is cream-colored and other type is black. Most people like Cream-colored seeds for use in sweet dishes and other foods. Sesame

is grown in tropical zones as well as in temperate zones. In Asia and Africa it is cultivated from centuries. The world production of sesame seed was 3,976,968 tons in 2009 and the major production area was Asia (2,489,518 tons) and Africa (1,316,690 tons), constituting about 62.6% and 33.1% of the total world production [2]. The sesame seed contains all necessary fatty acids and amino acids. It is a best source of vitamins and minerals. The seed cakes of sesame are also used as nutritious feed for livestock [3]. Sesame is considered as a drought tolerant crop [4]. In Pakistan, sesame was cultivated on an area of 90.7 ha with an annual production of 41 tones and an average yield of 452 kg ha^{-1} in Pakistan whereas in Khyber Pakhtunkhwa its average yield was 500 kg ha^{-1}[5]. Nitrogen is most important nutrient for enlargement of leaf and expansion of roots. Due to these reasons, nitrogen increased crop yield and quality [6]. Seed oil contents were increased by N application except at the highest rate (90 kg N ha^{-1}) which slowly reduced oil content compared with the control(zero)[7]. Sulfur is also famous as one of the essential elements for plant growth particularly for oilseed crops. Sulfur is a constituent of three amino acids commonly found in plants such as cysteine and methionine, which are essential components of proteins. Sulfur gives pungency to oil as it forms di sulphide linkages and also increases oil content. Oilseed crops require more sulfur than cereals as their oil storage organs are mostly proteins, rich in S. Sulfur deficiency delay N metabolism in plants as well as synthesis of S-containing amino acids and thus exerts adverse effects on both seed and oil yield.

Soil and climatic conditions of Pakistan are highly encouraging for sesame production. Among the various factors of crop production proper sowing dates, nitrogen levels, sulfur levels and improved sesame cultivars play a key role in enhancing its production. Keeping in view the above limitations this research was conducted to check out the impact of nitrogen and sulfur levels on the yield and yield components of sesame at the agro-climatic condition of Northwestern Pakistan.

Materials and methods

Site description

The field experiment was studied at The Agronomy Research Farm, The University of Agriculture Peshawar, during kharif 2013. The experiment was laid out in RCBD with three replications. A subplot size of 2.7 m x 3 m was used. Each sub plot was consisted of 6 rows having 45 cm row-to-row distance. Local black variety of sesame was sown on June 29, 2013.During the entire crop season four irrigations were applied and two time manual weeding was done. Phosphorus was applied at the recommended rate of 60 kg ha^{-1}. Seed rate was kept 4 kg ha^{-1} and all other agronomic practices were carried out consistently for all the experimental units throughout the growing season. The crop was harvested on October 24, 2013.

Treatments of the experiment

	N: S(kg ha^{-1})
T1 =	30:10
T2 =	30:20
T3 =	30:30
T4 =	70:10
T5 =	70:20
T6 =	70:30
T7 =	110:10
T8 =	110:20
T9 =	110:30
T10 =	150:10
T11 =	150:20
T12 =	150:30
T13 =	0:0(Control)

Statistical Analysis:

Data was subjected to analysis of variance (ANOVA) according to the methods described by Steel and Torrie (1980) and mean difference b/w treatments was

compared by least significance difference at 5% level of probability.

Results and discussion

Number of pods plant^{-1}

Number of pods plant^{-1} were affected positively by different levels of nitrogen, sulfur, control vs. rest and their interaction (N x S). In (Table 1) mean values for nitrogen proved that more number of pods plant^{-1} (174.9) were recorded at 110 kg N ha^{-1}, while less number of pods plant^{-1} (138) were recorded at 0 kg N ha^{-1}. In case of sulfur (Table 3) more number of pods plant^{-1} (196.1) were recorded at 30 kg S ha^{-1}, While less number of pods plant^{-1} (138) were recorded at 0 kg S ha^{-1}. In case of Interaction N×S (Table 4) more number of seeds pod^{-1} (220.7) were recorded at 70 kg N and 30 kg S ha^{-1}, while less number of seeds pod^{-1} (109.3) were recorded at 70 kg N and 10 kg S ha^{-1}. The number of pods were significantly influenced by application of N fertilizer [8]. N fertilizer application at 75 and 112.5 kg N ha^{-1} did not differ significantly from each other but differ with 37.5 and 0 kg N ha^{-1} rates with higher values. The effect of different sulfur applications were statistically significant on number of capsules per plant [9]. Capsules per plant were increased by each increment of nitrogen fertilizer [10]. Application of sulfur at 40 kg ha^{-1} produced higher pods plant^{-1}[11]

Table 1. Impact of nitrogen and sulfur on control vs. rest of sesame.

Cont vs. Rest	No of pods plant^{-1}	No of seeds pod^{-1}	1000 grains wt (g)	Grain yield(kg ha^{-1})
Control	138b	63b	5b	637b
Rest	170a	73b	6a	714a

Number of seeds pod^{-1}

Number of seeds pod^{-1} were affected significantly by nitrogen and control vs. rest, while non-significantly affected by sulfur and the interaction of nitrogen and sulfur. In (Table 2) mean values for nitrogen mediated that more number of seeds pod^{-1} (73.9) were obtained at 150 kg N ha^{-1} ,while less number of seeds pod^{-1} (63) were attained at 0 kg N ha^{-1}. In case of sulfur (Table 3) more number of seeds pod^{-1} (72.3) were achieved at 20 kg S ha^{-1}, while less number of seeds pod^{-1} (63) were recorded at control. In case of interaction (N×S) (Table 4) more number of seeds pod^{-1} (76.3) were recorded at 110 kg N and 30 kg S ha^{-1}, while less number of seeds pod^{-1} (68) were recorded at 30 kg N and 10 kg S ha^{-1}. The higher significance difference among nitrogen levels for number of seeds capsule^{-1} was recorded [3]. More number of seeds capsule^{-1} (62.83) were produced when nitrogen was applied at the rate of 80 kg ha^{-1}. Also more number of seeds per capsule were recorded by increasing sulfur levels [12].

Table 2. Impact of Nitrogen on yield and yield components of sesame.

N (kg ha^{-1})	No of pods plant^{-1}	No of seeds pod^{-1}	1000 grains wt. (g)	Grain yield(kg ha^{-1})
30	169.9ab	70.7b	5.6b	668.1c
70	165.6b	72.9a	6.9a	799.4a
110	174.9a	73.4a	5.4b	733.9b
150	169.1b	73.9a	5.9ab	653.3c
LSD(0.05)	5.32	2.08	1.02	49.30

1000-seeds weight

1000-seeds weight of sesame was positively affected by nitrogen, while affected non-significantly by control vs. rest, sulfur and interaction between nitrogen and sulfur. In (Table 2) mean values for nitrogen showed

that maximum 1000-seeds weight (6.9) were noted at 70 kg N ha^{-1} ,while minimum 1000-seeds weight (5) were produced at 0 kg N ha^{-1}. In case of sulfur (Table 3) maximum 1000-seeds weight (6.2) were produced at 30 kg S ha^{-1}, while minimum 1000-seeds weight (5) were obtained at 0 kg S ha^{-1}. In case of interaction (N×S) (Table 4) maximum 1000-seeds weight (7.3) were recorded at 70 kg N and 20 kg S hac^{-1}, while minimum 1000-grain weight were recorded at 150 kg N and 10 kg S hac^{-1}. 1000-seed weight was significantly affected by nitrogen levels [3]. The maximum 1000-seed weight (3.42 g) was obtained in N_2 (80 kg ha^{-1}) treatment, followed by N_1 (40 kg ha^{-1}) treatment that resulted in 3.22 g weight of 1000-kernals.

Table 3. Impact of Sulfur on yield and yield components of sesame

S (kg ha^{-1})	No of pods $plant^{-1}$	No of seeds pod^{-1}	1000 grains wt. (g)	Grain yield(kg ha^{-1})
10	139.0c	71.9b	5.6a	628.6c
20	174.5b	72.3ab	6.1a	705.4b
30	196.1a	74.0a	6.2a	807.1a
LSD(0.05)	4.60	Ns	Ns	42.69

Table 4. Impact of Nitrogen and Sulfur interaction on yield and yield components of sesame

N Level	S Level	No of pods $plant^{-1}$	No of seeds pod^{-1}	1000 grains wt. (g)	Grain yield (kg ha^{-1})
30	**10**	154.3	68.0	5.3	696.0
	20	167.0	71.3	5.3	583.3
	30	188.3	72.7	6.0	725.0
70	**10**	109.3	73.0	6.3	585.0
	20	166.7	73.0	7.3	783.3
	30	220.7	72.7	7.0	1030.0
110	**10**	137.7	71.3	5.7	716.7
	20	200.7	72.7	5.0	711.7
	30	186.3	76.3	5.7	773.3
150	**10**	154.7	75.3	5.0	516.7
	20	163.7	72.0	6.7	743.3
	30	189.0	74.3	6.0	700.0
LSD(0.05)		**	Ns	Ns	**

Grain yield (Kg ha^{-1})

Grain yield of sesame was significantly affected by nitrogen, sulfur, control vs rest and interaction between nitrogen and sulfur. In (Table 2) mean values for nitrogen indicated that maximum grain yield (799.4) were produced at 70 kg N ha^{-1} ,while minimum grain yield (637) were obtained at 0 kg N ha^{-1}. In case of sulfur (Table 3) maximum grain yield (807.1) were recorded at 30 kg S ha^{-1}, while minimum grain yield (628.6) were recorded at 10 kg S ha^{-1}. In case of interaction (N×S) (Table 4) maximum grain yield (1030) were produced at 70 kg N and 30 kg S hac^{-1}, while minimum grain yield (516.7) were recorded at 150 kg N and 10 kg S ha^{-1}. The application of 60 kg N ha^{-1} produced significantly higher grain yield as compared with other levels of N application [13]. Yield was reduced by increasing N rate from 60 to 120 kg N ha^{-1}.The application of S increased TDM and seed yield in oil seed crops [11]. The application of S increased the grain yield of sesame and the capsule number $plant^{-1}$ [9]. Also seed yield was increased by 39% as compared to control [14].

Conclusion

From the results we concluded that nitrogen application at 70 kg ha^{-1} gave maximum 1000-seeds weight and grain yield and sulfur application at 30 kg ha^{-1} gave maximum no of pods $plant^{-1}$, number of grains pod^{-1}, 1000-seeds weight and grain yield. 70 kg N ha^{-1} and 30 kg S ha^{-1} were proper nutrients combinations for improved growth yield characters of sesame viz. increases 1000-seeds weight and grain yield.

Authors' contributions

Designed the experiments: N Khan & SK Khalil, Performed the experiments: N Khan, A Ali & Z Ullah, Analyzed the data: N Khan A Ullah & SK Khalil, Contributed reagents/materials/analysis tools: M Ali & A Ali, Wrote the paper: N Khan.

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