Effect of Boron and Bio-fertilizers on growth and yield of Sesame (*Sesamum indicum.L*)

ABSTRACT

A field experiment was conducted during *kharif* 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The experimental soil used in this ~~of~~ experiment~~al~~ ~~plot~~ was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36 %), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out in Randomized Block Design with ten treatments each replicated three times~~thrice~~ on the basis of one year experimentation. The treatments which were~~are~~ Control (RDF), 2.5 kg B/ha + PSB, 2.5 kg B/ha + *Azotobacter*, 2.5 kg B/ha + PSB + *Azotobacter*, 5.0 kg B/ha + PSB, 5.0 kg B/ha + *Azotobacter*, 5.0 kg B/ha + PSB + *Azotobacter*, 7.5 kg B/ha + PSB, 7.5 kg B/ha + *Azotobacter* and 7.5 kg B/ha + PSB + *Azotobacter* are used. The results showed that application of 7.5 kg B/ha + PSB + *Azotobacter* showed ~~was~~ a ~~recorded~~ significantly higher plant height (85.36 cm), No. of Branches/plant (6.57), Plant dry weight (19.53 g/plant), Crop growth rate (20.89 g/m^2/day), capsules/plant (52.57), Seeds/capsule (62.60), Test weight (3.38 g), Seed yield (1.1635 t/ha), Stover yield (3.3819 t/ha), Biological yield (4.5556 t/ha),gross returns (Rs.79723.65/ha), net return (Rs.52849.25/ha) and benefit cost ratio (1.96) as compared to other treatments.

Key words: Sesame, Boron, Azotobacter, PSB, Growth, yield and economics

1. INTRODUCTION

Among the oilseed crops, sesame (*Sesamum indicum L.)* is one of the world most important and oldest known oil seed crops (Abou Gharbia *et al*., 1997). Sesame is a member of the padaliaceae plant family. Its cultivation has started since 1500 BC in the Middle East, Asia & Africa **(Ali *et al.,* 2007).** India is the major producer of sesame (*Sesamum indicum L*.) and ranks first in both area (1.78 M ha) and production (0.81 Mt) with average productivity of 455 kg ha-1 . Odisha produces 0.09 million tonnes sesame seeds annually with average productivity of 403 kg ha-1 **(Anonymous 2012-13).**. Higher nutritional, medicine and cooking quality has recognized it as 'the queen of oilseeds'. There is a decline in productivity in sesame due to its cultivation in marginal and sub-marginal lands and moreoverpoor crop management practice.

The sesame seed has been considered as 'Queen of Oilseed' for its high oilseed content and quality and traditionally categorized as a health food in China, Japan and Asian countries. It is considered to have both nutritional and medicinal value. Moreover, seed is a rich source of edible oil (48-55%) and protein (20-28%) with anti-oxidants lignans such as sesamolin and sesamin which prevents rancidity and gives sesame oil a shelf life. Sesame oil is called 'poor man's ghee'. The lignin content has useful physiological effect in human and animal health **(Mane 2019).** The seeds are very rich in iron, magnesium, manganese, copper and calcium and contain vitamin E, A, B and B1. The seed contain phytosterols associate with reducing the level of blood cholesterol and also phytoestrogens with anti- oxidants an anticancer property.

Among the micronutrient deficiency, boron deficiency is the second most dominant problem globally. Among the micronutrients, boron deficiency is one of the most widespread micronutrient deficiency in India. Plants require boron for a number of growth processes like development of meristematic tissue, proper pollination and seed set, translocation of sugars, starches. It has been reported that boron is required for pollen germination and pollen tube growth **(Dugger, 1983)**. Boron deficiency can affect pollen viability and abortion of stamen and pistils which contribute to low seed set reported by (**Chitralekha and Nirmala 2000).**

Biofertilizers like Azotobacter and phosphate solubilizing bacteria play a vital role in the nutrition of plants. Indian soils are mostly deficient in microorganisms and nutrients. So application of biofertilizers and inorganic fertilizers are necessary to increase the crop productivity **(Patel *et al.,* 2017)**. Application of Azotobacter and Azospirillum incubated withFYM with 50 per cent moisture in

soil resulting 13 and 14 times increase in population respectively, as compare to initial microbial population and increase in yield by 46 per cent inokra **(Pattanayak *et al.,* 2001)**.

2. MATERIALS AND METHODS

The present examination was carried out during *Kharif* 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, UP, which is located at 25.28^{o}N latitude, 81.54^{o}E longitude and 98 m altitude above the mean sea level. The experiment was laid out in Randomized Block Design which consisting of nine treatments with Control (RDF), 2.5 kg B/ha + PSB, 2.5 kg B/ha + *Azotobacter*, 2.5 kg B/ha + PSB + *Azotobacter*, 5.0 kg B/ha + PSB, 5.0kg B/ha + *Azotobacter*, 5.0 kg B/ha + PSB + *Azotobacter*, 7.5 kg B/ha + PSB, 7.5 kg B/ha + *Azotobacter* and 7.5 kg B/ha + PSB + *Azotobacter* are used. The experimental site was uniform in topography and sandy loam in texture, nearly neutral in soil reaction (P^{H} 7.1), low in Organic carbon (0.38%), medium available N (225 kg ha^{-1}), higher available P (19.50 kg ha^{-1}) and medium available K (213.7 kg ha^{-1}). In the period from germination to harvest several plant growth parameters were recorded at frequent intervals along with it after harvest several yield parameters were recorded those parameters are growth parameters, plant height, no. of branches/plant and plant dry weight are recorded. The yield parameters like No. of capsules/plant, No. of seeds/capsules, Test weight (g), seed yield, stover yield and harvest index were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design (Gomez and Gomez 1984).

3. RESULT AND DISCUSSION

Growth Parameters

Plant height

At harvest, significantly highest plant height (85.36 cm) was recorded in the treatment 7.5 kg B/ha + PSB + *Azotobacter* over all the other treatments. However, the treatments with application of 5.0 kg B/ha + PSB + *Azotobacter* (85.13 cm) and 7.5 kg B/ha + *Azotobacter* (85.27 cm) which were found to be at par with treatment 7.5 kg B/ha + PSB + *Azotobacter* as compared to all the treatments.The increase in plant height might be due to the involvement of Boron in different physiological processes like enzymes activation, electron transport, chlorophyll formation, stomatal regulation, etc. which gradually increased plant height. The results were found in accordance with **Choudhary *et al.* (2000).**The increase in plant height due to the application of PSB might be due to the presence of plant growth harmones i.e. IAA, cytokinin, gibberellins, and phosphorus availability to the plant similar results were found by **Dutta and Singh (2002)**

Number of branches/plant

At harvest, maximum Number of Branches/plant (6.57) was observed in the treatmentwith 7.5 kg B/ha + PSB + *Azotobacter*. However, treatment with 5.0 kg B/ha + *Azotobacter* (6.52) and 7.5 kg B/ha + PSB (6.41) which was found to be statistically at par with 7.5 kg B/ha + PSB + *Azotobacter*. The higher levels of boron attributed to best results because boron might attributed to the favorable influence of them on plant metabolism and biological process activity and their stimulating effect on photosynthetic pigments and enzyme activity which in turn encouraged vegetative growth. The results were found similar with **Ravi and Chandra *et al.* (2015).**

Plant dry weight (g/plant)

At harvest, treatment with 7.5 kg B/ha + PSB + *Azotobacter* was recorded with significantly maximum dry weight (19.53 g/plant) over all the treatments. However, the treatments 7.5 kg B/ha + PSB (19.48 g/plant) and 5.0 kg B/ha + PSB + *Azotobacter* (19.42 g/plant) were found to be statistically at par with 7.5 kg B/ha + PSB + *Azotobacter*.

The application of boron generally influences cell division and nitrogen absorbtion from soil might enhanced plant growth reflects in terms of plant dry weight. The findings were in harmony with **Mamatha *et al* (2016).** Inoculation of PSB solubilization of inorganic insoluble phosphates by microorganisms to the production of organic acids, chelating oxoacids from sugars, andexchange reactions in growth environment, the results were found to similar with **Kumar *et al.* (2016).**

Table 1 Effect of boron and bio- fertilizers on growth of cowpea

Treatments	At harvest			30-45 DAS	
	Plant height (cm)	Number of branches/plant	Dry weight (g)	CGR ($g/m^2/day$)	RGR (g/g/day)
Control (RDF)	83.78	5.65	18.26	20.49	0.061
2.5 kg B/ha + PSB	83.83	5.31	18.26	19.82	0.057
2.5 kg B/ha + *Azotobacter*	84.05	6.15	18.31	19.60	0.057
2.5 kg B/ha + PSB + *Azotobacter*	84.49	5.45	18.35	20.02	0.056
5.0 kg B/ha + PSB	84.63	5.43	18.37	20.56	0.058
5.0 kg B/ha + *Azotobacter*	84.43	6.52	18.62	19.78	0.056
5.0 kg B/ha + PSB + *Azotobacter*	85.13	5.27	19.42	20.00	0.054
7.5 kg B/ha + PSB	85.27	6.41	19.48	19.82	0.052
7.5 kg B/ha + *Azotobacter*	84.89	6.29	19.32	20.24	0.057
7.5 kg B/ha + PSB + *Azotobacter*	85.36	6.57	19.53	20.89	0.052
F test	S	S	S	S	NS
Sem±	0.13	0.16	0.06	0.21	0.00
CD (P=0.05)	0.39	0.56	0.17	0.62	-

Yield Parameters

Number of Capsules/plant

Significantly Maximum Number of capsules/plant (52.57) was recorded with the treatment of application of 7.5 kg B/ha + PSB + *Azotobacter* over all the treatments.However, the treatments 5.0 kg B/ha + PSB + *Azotobacter* (51.96) and 7.5 kg B/ha + PSB (52.25) which were found to be statistically at par with 7.5 kg B/ha + PSB + *Azotobacter***.**

Significant increase in number of capsules/plant is due to increase in the availability of Nitrogen and Phosphorous through bio fertilizer inoculation by which more spikelets are produced due to increased rates of spikelets primordial production, similar results were found Hadiyal *et al.* (2017).

Number of Seeds/capsules

Significantly Maximum Number of Seeds/capsule (62.60) was recorded with the treatment of application of 7.5 kg B/ha + PSB + *Azotobacter* over all the treatments.However, the treatments 5.0 kg B/ha + PSB + *Azotobacter* (61.87) and 7.5 kg B/ha + PSB (62.22) which were found to be statistically at par with 7.5 kg B/ha + PSB + *Azotobacter***.**

The application of boron to sesame generally improves capsule growth by synthesizing tryptophan and auxin. The enhancement effect on capsules/plant, seeds per capsule attributed to the favorable influence of boron application to crops on nutrient metabolism, biological activity and growth parameters which in turn influenced higher enzyme activity which in turn encouraged more capsules/plant and seeds/capsule. Similar findings were observed by **Yadav *et al* (2016).**

Test weight (g)

Significantly highest Test weight (3.38 g) was recorded with the treatment of application of 7.5 kg B/ha + PSB + *Azotobacter* over all the treatments. However, the treatments 5.0 kg B/ha + PSB + *Azotobacter* (3.29 g) and 7.5 kg B/ha + PSB (3.35 g) which were found to be statistically at par with 7.5 kg B/ha + PSB + *Azotobacter.*

Seed yield (t/ha)

Significantly highest sSeed yield (1.1635 t/ha) was recorded with the treatment (application of 7.5 kg B/ha + PSB + *Azotobacter*) over all the treatments. However, the treatments with (1.1141 kg/ha) in 5.0 kg B/ha + PSB + *Azotobacter* and with (1.1447kg/ha) in 7.5 kg B/ha + PSB which were

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found to be statistically at par with 7.5 kg B/ha + PSB + *Azotobacter.*

Boron plays the vital role in increasing because it takes place in many physiological process of plant such as chlorophyll formation, stomatal regulation, starch utilization which enhanced seed yield, **Mallik and Raj (2015).**

Stover yield (t/ha)

Significantly high sest Stover yield (3.3819 t/ha) was recorded with the treatmentapplication of 7.5 kg B/ha + PSB + *Azotobacter* over all the treatments. However, the treatments with (3.2999 t/ha) in 5.0 kg B/ha + PSB + *Azotobacter* and 7.5 kg B/ha + PSB (3.3443 kg/ha) which were found to be statistically at par with 7.5 kg B/ha + PSB +*Azotobacter*.

Increase in yield and stover yield through bio-fertilizer might be attributed to supply of more plant hormones (auxin, cytokinin, gibberellin etc.) by the microorganisms inoculatedor by the root resulting from reaction to microbial population and more availability of phosphorous and nitrogen. Similar results were obtained by Kalita *et al.* (2019) .

Harvest Index (%)

Significantly highest hHarvest index (26.1%) was recorded with the treatment (application of 2.5 kg B/ha + PSB + *Azotobacter*) over all the treatments. However, the treatments with (25.7%) in 5.0 kg B/ha + PSB + *Azotobacter* and 7.5 kg B/ha + *Azotobacter* (26.0%) which were found to be statistically at par with 7.5 kg B/ha + PSB + *Azotobacter.*

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Table 2 Effect of boron and bio - fertilizers on yield of Sesame

Treatments	At Harvest						
	Number of capsules/plant	Number of seeds/capsules	Test weight (g)	Seed yield(t/ha)	Stover yield (t/ha)	Biological Yield (t/ha)	Harvest index (%)
Control (RDF)	47.5	54.6	2.89	0.75	2.23	2.99	24.7
2.5 kg B/ha + PSB	48.2	56.3	3.05	0.84	2.58	3.42	24.5
2.5 kg B/ha + *Azotobacter*	47.8	55.0	3.01	0.78	2.34	3.14	24.9
2.5 kg B/ha + PSB + *Azotobacter*	48.9	57.7	3.08	0.99	2.81	3.79	26.1
5.0 kg B/ha + PSB	50.3	58.2	3.19	1.05	3.03	4.06	25.7
5.0 kg B/ha + *Azotobacter*	48.5	57.1	3.01	0.91	2.73	3.64	24.8
5.0kg B/ha + PSB + *Azotobacter*	52.0	61.9	3.28	1.12	3.29	4.46	25.0
7.5 kg B/ha + PSB	52.3	62.2	3.35	1.15	3.35	4.52	25.3
7.5 kg B/ha + *Azotobacter*	51.2	60.5	3.23	1.09	3.11	4.18	26.0
7.5 kg B/ha + PSB + *Azotobacter*	52.6	62.6	3.38	1.17	3.39	4.56	25.5
F test	S	S	S	S	S	S	S
Sem±	0.22	0.32	0.04	0.02	0.16	0.16	0.12
CD (P=0.05)	0.66	0.94	0.13	0.06	0.49	0.49	0.33

4. CONCLUSION

It is concluded that application of treatment 7.5 kg PSB + *Azotobacter (*T10*)* was recorded higher production and economics as compared to other treatments. Since, the findings based on the research done in one season, further trails are needed to confirm the results.

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