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Effects of Mycorrhizal Biofertilizer on Enhancing yield of *Lens culinaris*

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ABSTRACT

The present experiment investigated the effects of *Rhizobium* and mycorrhizal fungal spores on two different varieties of *Lens culinaris* (Narendra Masoor-1 and Shekhar-2). Lentil varieties were cultivated in the research field of Bipin Bihari College, Jhansi, Uttar Pradesh. Lentil seeds have been inoculated separately and in combination with *Rhizobium* and mycorrhizal spores. Plant height, weight, number of root nodules and pods, amount of chlorophyll, leaf area, and total yield were all measured after germination. The data were collected 30 days, 45 days, 60 days, 75 days, 90 days, and 120 days after seeding. These tests revealed that mycorrhiza and *Rhizobium* had a positive impact on the growth and yield of the lentil plant. The results are better when *Rhizobium* and mycorrhiza are inoculated together than when they are inoculated separately.

Figures : 15 References : 15 Table : 00

KEY WORDS : Biofertilizer, *Lens culinaris*, Mycorrhiza, *Rhizobium*.

Introduction

A large number of rhizotrophic microorganism communities exist in the rhizosphere. Rhizotrophic microorganisms and plant roots interact with each other as well as with other rhizotrophic microbe groups, which has a big impact on plant growth[10]. *Rhizobium* and mycorrhizal fungi are examples of microorganisms that colonize plant roots.

Mycorrhiza gives the host minerals like phosphorus, potassium, zinc, and other elements, whereas *Rhizobium* plays an essential role in biological nitrogen fixation[3,11,13].

Mycorrhizal fungi develop a branch-like hyphal structure within the plant cell. This structure increases plant cell surface area, helping plants absorb nutrients from soils[15].

The most commonly researched symbioses are mycorrhizal interactions between fungus and higher plant roots and nitrogen fixation between rhizobia and legumes[7].

Lentils (*Lens culinaris*) are the oldest known pulse crop, with evidence dating back 13,000 years BC found near human settlements. They are primarily cultivated in countries such as India, Pakistan, Bangladesh, Egypt, Italy, Greece, and Mediterranean nations, as well as North America[9]. The lentil plant typically grows between 6 and 8 inches tall, featuring several long ascending branches. Leaves are arranged alternately and consist of six pairs of oblong-linear, blunt, and pointed leaflets. Flowers materialize in leaf axils on a slim stalk almost as long as the leaves themselves, measuring anywhere from 2 to 4 in size and displaying pale blue hues. The pods are oblong-shaped and nearly 1.5cm in length, containing two slightly inflated seeds.

Humans consume lentil seeds in various forms such as main courses or sprouted grains in salads. With higher protein content (25%) than other legumes alongside an abundance of calories and carbohydrates lentil seeds also offer essential minerals like iron, calcium, phosphorus, and vitamin B. The byproducts of threshed plants—stalks, dried leaves, husks, pod walls—are useful for cattle feed due to their high nutrient content: 1.8% fat, 10.2% moisture, 4.4% protein, 21.4% fiber, 50% carbohydrates, and 12.2% ash. Additionally, lentil seeds provide commercial starch for the textile and printing sectors.

Materials and Methods

For this study two varieties of lentil (*Lens culinaris i.e.* Narendra Masoor-1 and Shekhar-2) were selected.

***Lens culinaris* Medik. variety- Narendra masoor-1**

Fig.1 : Control

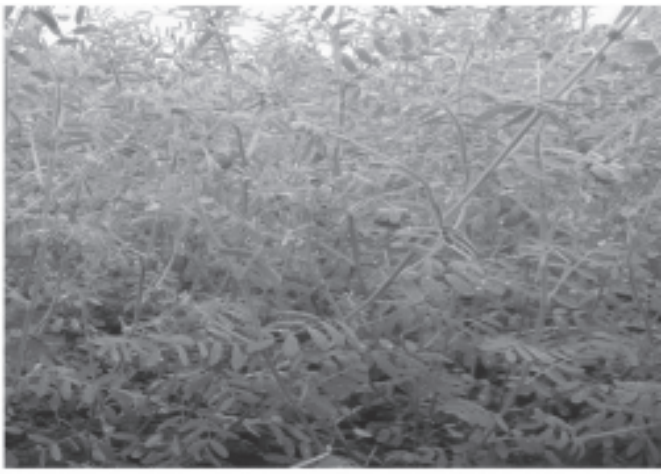

Fig. 2 : T-1 (*Rhizobium*)

Fig. 3 : T-2 (Mycorrhiza)

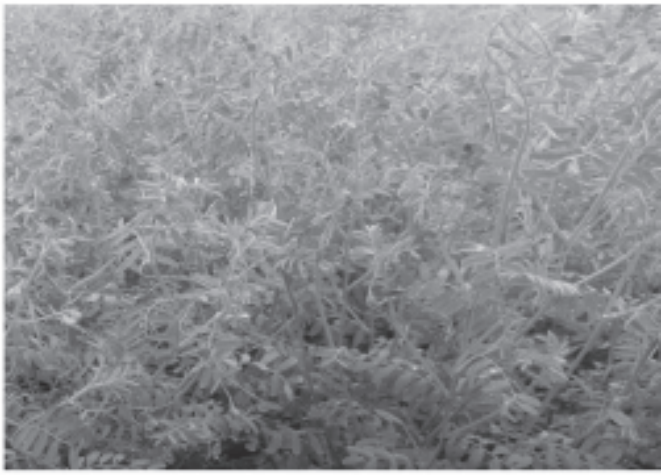

Fig. 4 : T-3 (*Rhizobium*+Mycorrhiza)

***Lens culinaris* var. Narendra masoor-1 treated with *Rhizobium*, mycorrhiza and dual inoculation of *Rhizobium* and mycorrhiza**

Seeds were purchased from Manama Beej Bhandar Jhansi. For giving treatment to seeds of lentil, Mycorrhizal fungal spores were isolated from the rhizospheric soil samples from Babina forest of Jhansi and *Rhizobium* strain were isolated from the root nodules of *Lens culinaris*.

Germination percentage of seeds: Seeds were treated with different treatments for germination percentage, including mycorrhiza, *Rhizobium*, and mycorrhiza+*Rhizobium*. The Petri plates were placed on a laboratory table at room temperature (28 C). After three days, normal, abnormal, and diseased seeds were counted. Dual inoculation with *Rhizobium*+ mycorrhiza increased seed germination in both lentil varieties more than other treatments.

Sowing of seeds: Seeds were sown in the middle of October 2019 in the research field of Bipin Bihari College, Jhansi. For each treatment 4 rows were prepared in the field. In those 4 rows seeds were sown and after 10 days of sowing, seedlings of each row were treated with different treatments such as *Rhizobium* (Figs. 02, 06), mycorrhiza (Figs. 03, 07), and dual *Rhizobium* and mycorrhiza inoculation (R+M, Figs. 04, 08).

Seedlings of one row were considered as controlled (Figs. 01, 05). Plants were observed daily and measured on 30, 45, 60, 75, 90 and 120th days after sowing. Growth parameters were plant height, plant weight, number of root nodules, number of pods, chlorophyll amount, leaf area and yield.

Results and Discussions

In this experiment the two varieties of lentil (*Lens*

***Lens culinaris* Medik. variety- Shekhar-2**

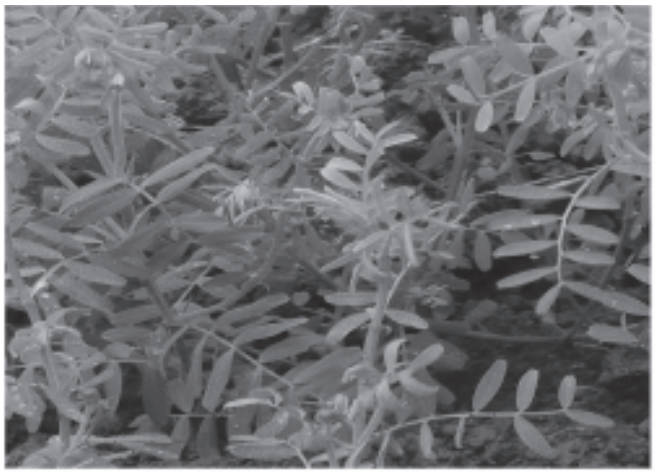

Fig.5 : Control

Fig. 6 : T-1 (*Rhizobium*)

Fig. 7 : T-2 (Mycorrhiza)

Fig. 8 : T-3 (*Rhizobium*+Mycorrhiza)

***Lens culinaris* var. Shekhar-2 treated with *Rhizobium*, mycorrhiza and dual inoculation of *Rhizobium* and mycorrhiza**

culinaris) have been used to examine the effect of seed dressing by *Rhizobium*, mycorrhizal spores separately as well as in combination for various parameters.

It has been revealed from the data presented in Fig.09 that plant height have shown significant enhancement by 1.9%, 6.9% and 11.8% in variety Narendra and 2.2%, 9.9% and 26.3% in variety Shekhar 2. The increase in plant height directly affects the plant weight in terms of fresh as well as dry weight. Data presented in Fig.10 showed that weight of the plant increased by 3.2%, 11.8% and 16.1% in variety Narendra and 2.1 %, 17.1% and 22.5% in variety Shekhar in the plants treated by *Rhizobium*, mycorrhiza and *Rhizobium*+ mycorrhizal spores as compared to controlled plants.

Treatments by spores of *Rhizobium*, mycorrhiza separately as well as in combination affects nodulation ability of *Lens culinaris* when compared with controlled plants. Results presented in Fig.11 showed that there were increase by 29.8%, 17.3% and 60.4% in variety Narendra whereas in variety Shekhar it was 36.9%, 19.6% and 68.1% in plants treated with *Rhizobium*, mycorrhiza and *Rhizobium*+ mycorrhizal suspension.

The above mentioned growth parameters have been found to affect leaf area in both the varieties and the observation have been presented in Fig.12. At the end of growth period *i.e.* 120 days, leaf area in variety Narendra have been increased by 3.8%, 12.2% and 29.8% while in variety Shekhar it is about 6.1%, 15.8% and 33.6% in various treatments of *Rhizobium*, mycorrhiza separately as well as in combination.

Treatments with spore suspension have been found to affect the amount of chlorophyll in both the varieties of *Lens culinaris*. Data presented in and Fig.13 revealed that the spore dressing of seeds enhanced

Comparative Graphs of Growth Parameters of *Lens Culinaris*

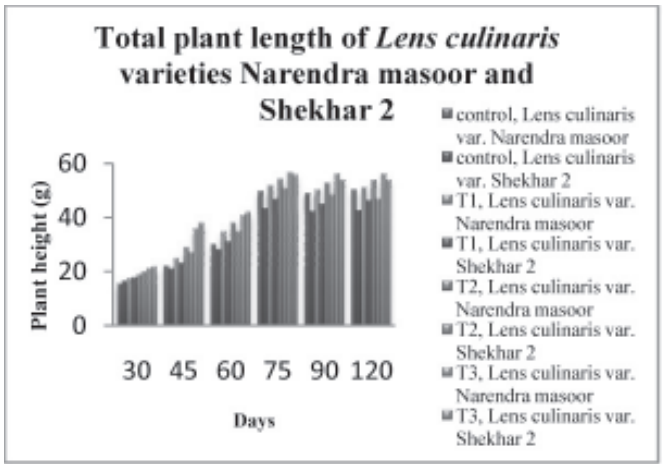

Fig.9 :

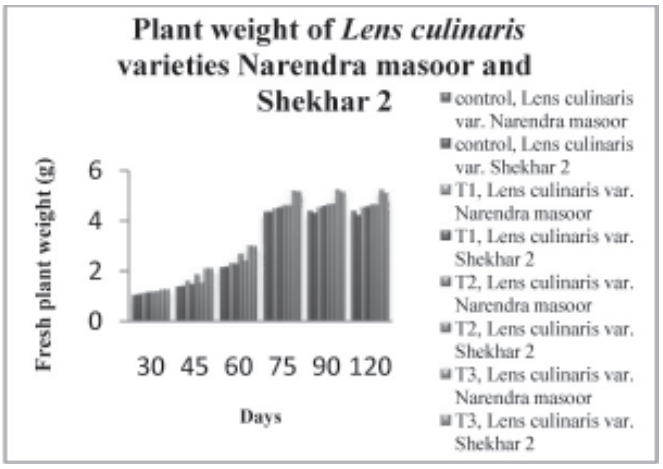

Fig. 10 :

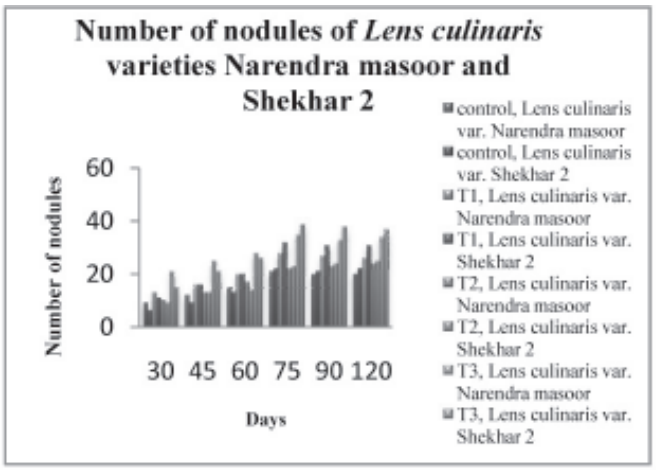

Fig. 11 :

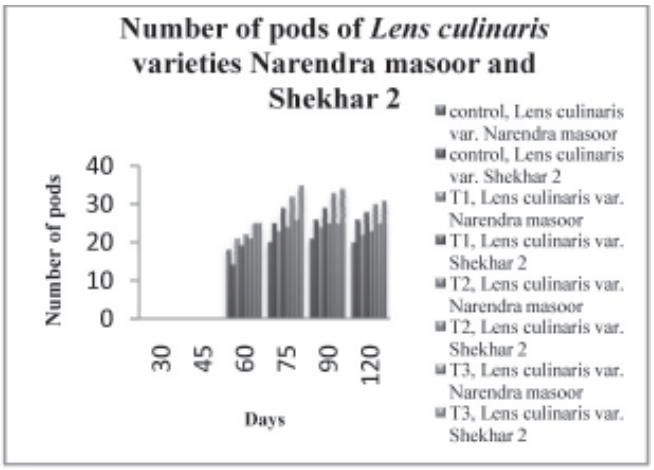

Fig. 12 :

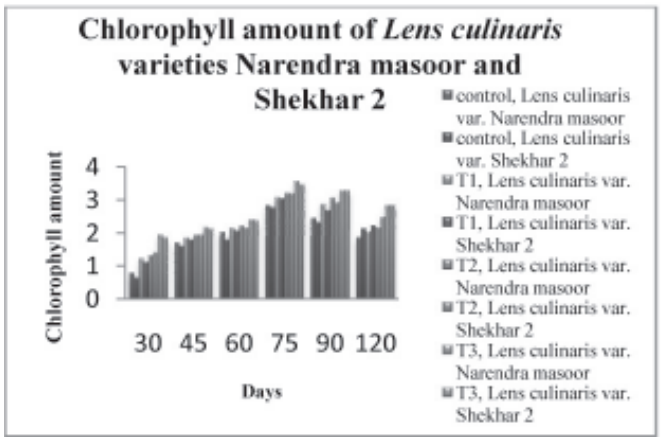

Fig. 13 :

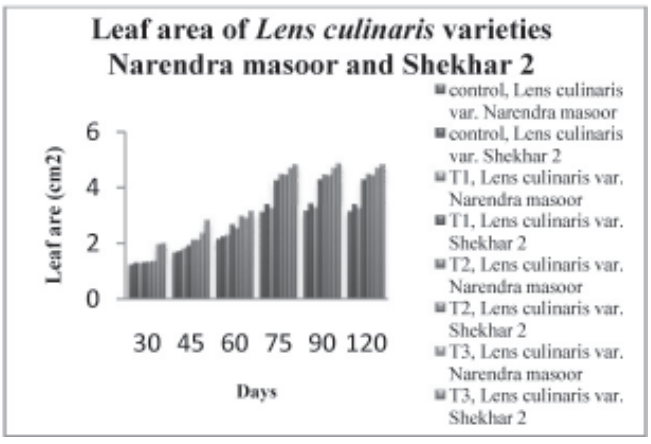

Fig. 14 :

chlorophyll amount by 10.35% and 16.8% in the treatment with *Rhizobium* and mycorrhizal spores when these two spores were mixed together and applied on seeds the chlorophyll amount were found to increased by 44.1% in variety Narendra and by 3.8%, 16.3% and 33.3% in variety Shekhar. During the study it is clear that the treatment of spores not only affects vegetative growth and biochemically chlorophyll amount but also yield of the plant. Yield has been measured in terms of number of pods and weight of seeds (100 seeds).

It is clear from the data presented in and Fig.14 that number of pods have been found in higher number as compared to controlled in both the varieties. It is about

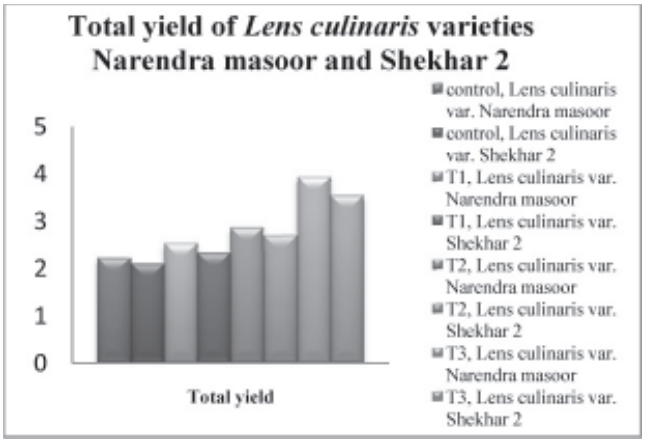

Fig.15 :

10.0%, 15.0% and 24.6% in variety Narendra and 11.3%, 19.2% and 26.8% in variety Shekhar.

The weight of seeds was also affected by treatments they were 14.2%, 21.2% and 46.8% in variety Narendra whereas 10.6%, 18.2% and 26.7% in variety Shekhar when seeds were dressed with *Rhizobium*, mycorrhiza and *Rhizobium*+ mycorrhizal spores (Fig.15). When the above results were compared with[1,4,8,12,15] findings, It has been found that both spores in mixture were more effective as compared to the effects when treated separately.

Conclusion

For this study, two varieties of lentil (*Lens culinaris* Medik.), *i.e.,* Narendra masoor-1 and Shekhar-2, were selected. Lentil seeds were treated with mycorrhizal spores, *Rhizobium,* and a dual inoculation of mycorrhizal spores and *Rhizobium*. When the effects of each treatment in various treatments were compared in both varieties, it was found that mycorrhizal spores and *Rhizobium* spores together were most effective on morphological and yield parameters.

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