Eco. Env. & Cons. 30 (May Suppl. Issue) : 2024; pp. (S27-S30)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2024.v30i03s.006

Impact of seed treatment with Biofertilizers on the growth and yield attributing parameters of linseed (*Linum usitatissimum* L)

Mannuri Shiva Kumar* and Bineeta Michael Bara[1]

Department of Genetics and Plant Breeding, SHUATS,
Sam Higginbottom University of Agriculture Technology and Sciences
Prayagraj 211 007, U.P., India

(Received 14 August, 2023; Accepted 11 October, 2023)

ABSTRACT

The present investigation was conducted during Rabi season in the year (2022-2023) at post graduate Central Research Farm, Department of Genetics and plant Breeding, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology and Sciences, PRAYAGRAJ211007 (U.P) with goal to Impact of seed treatment with Biofertilizers on the growth and yield attributing parameters of linseed (*Linum usitatissimum* L).” Replicated thrice the experiment was laid out in Randomized Block Design (RBD) with 12 +1 treatments viz, T0: absolute control, T1: Rhizobium @ 2%, T2: PSB @ 2%, T3: Azatobactor@ 2%, T4: Trichoderma @ 2%, T5: Rhizobium @ 4%, T6: PSB @ 4%, T7: Azatobactor @ 4%, T8: Trichoderma @ 4%, T9: Rhizobium @ 6%, T10: PSB@ 6%, T11: Azatobactor @ 6%, T12: Trichoderma @ 6% duration for a respective treatment is 7, 8 & 12 hrs. The results showed that methods of biofertilizer application through seed coating along with T2: PSB @ 2% treatment T2 proved its superiority over rest of treatments on growth and seed yield parameter characters. The results revealed that treatment T2: PSB @ 1% for 7 hrs seed application with recorded maximum Plant height (cm) at 90DAS, Days to 50 percent flowering, Days to Maturity, and Number of capsules per plant, Number of seeds per capsule as well as noticed, Seed yield/plot (kg), of linseed. Further, results indicated that 1000 seed weight (g) were significantly improved with the application of treatment T2. The lowest values related to all parameters were obtained in control plot treatment

Key words : *Linseed, Biofertilizers, RBD (Completely Randomized Block Design)*

Introduction

Flaxseed or Linseed (*Linum usitatissimum* L.) (2n = 30) is known as founding crop which is being evaluated as a crop platform for the production of bioindustrial and nutraceutical products. It is the sixth largest oilseed crop in the world and is one of the oldest cultivated plants. Flaxseed is grown as either oil crop or a fiber crop. Globally linseed is an important crop and its production is 21.23 lac tonnes from 21.12 lac/ha with an average yield of 1006 kg/ha. (FAOSTAT, 2022).

India ranks second in area after Canada in the world, but is at fourth place in term of production after Canada, China and U.S.A. In term of productivity India (449 kg/ha) is far below to Canada (1492 kg/ha), U.S.A (1484 kg/ha), Egypt (1465 kg/ha). (Alukedi *et al.*, (2021). Linseed is a Rabi crop in India which is a member of family Linaceae

Linseed (*Linum usitatissimum* L.) is an erect an-

(*M.Sc Scholar,[1]Assistant Professor)

nual herbaceous plant 30-120 cm, in height with slender glabrous, grayish green stem. Flowers are showy, variously shaped regular, hermaphrodite, pentamerous, hypogynous and borne in loose terminal raceme or open cyme with blue, white or pink colour. *Linum usitatissimum* L. is the only species with non- dehiscent or semi-dehiscent capsules for modern cultivation of the family Linaceae. It contains up to 10 smooth, glossy an apple pip shaped, light brown color seeds which is 4-7 mm long. Linseed is predominantly self-pollinating. Cross pollination can occur at a level of (6%) by insects. (Alemayehu *et al.,* 2019).

Seed priming has shown its effectiveness in improving seed germination, seedling growth and crop stand against the negative impacts brought about by stress in the field. Seed priming is a commercially used technique for improving seed germination and vigour. It involves imbibitions of seeds in water under controlled conditions to initiate early events of germination, followed by drying the seed back to its initial moisture content. Treatment with water, salt solution, certain hormones, organic and inorganic chemicals, and pesticides etc., are primarily practiced in seed priming. (Choudhary *et al.,* 2019).

Trichoderma species are common soil-borne filamentous fungi, with some strains capable of establishing beneficial relationships with plants (Contreras-Cornejo *et al.,* 2014). Direct plant growth promotion (Jablonka, 2013) is one of many mechanisms in which Trichoderma spp. enhance plant health, however, the molecular mechanism that underlies this is still unclear, Trichoderma spp. induce growth promotion by a fungal auxin- dependent mechanism. Using in vitro bioassay, they showed that Trichoderma virens Gv29.8 and T. atroviride IMI206040 can synthesize IAA (and some of its derivatives) and have been demonstrated to increase the production of Arabidopsis lateral roots. However, the correlation between IAA synthesis and plant growth promotion of plants in soil-based systems is less convincing, many Trichoderma strains are capable of synthesizing IAA but only a few can promote plant growth.

Rhizobium bacteria are among the most beneficial soil bacteria, which known as biological fertilizer, whose members are most notable for their ability in N2 fixation, and ability to generate plant growth promoting substances, and also because of the existence of technology having the potential to mass production of inoculants. Researches about the positive impacts of *Rhizobium* bacteria on non-leguminous plants is relatively new, and the most studies reveal that these bacteria may have beneficial effects on non-legume species including rice (Hussain *et al.,* 2009**),** wheat and canola (Shakhavat and Martensson, 2007). The positive effect on plant growth and development following inoculation with rhizobacteria in non- legume crops is related to various mechanisms other than the formation of root nodule and the biological fixation of N2 (Chi *et al.* (2005) reported that inoculation of rice (*Oryza sativa* L.) with *Rhizobium* bacteria increased plant height, weight of the root and shoot, photosynthesis rate, stomatal conductance, Irrigation water use efficiency, absorption of nutrients, and extension of leaf area compared to the control.

Materials and Methods

The present research on "Impact of seed treatment with Biofertilizers on the growth and yield attributing parameters of linseed *(Linum usitatissimum* L.*)*" was made to identify the effect of seed priming of different kinds on seed quality parameters of linseed and to find out suitable seed priming method for linseed. Inoculants of nitrogen fixing bacteria (Azotobacter) and Phosphate Solubilizing Bacteria (PSB), Trichoderma, Rhizobium was mixed with the seeds and kept in shade for 7 hours and sown immediately. The quantity of biofertilizer culture was used @ 2%, 4%, 6% of concentration taken for seed to all the treatments and Biofertilizers as per the treatments were applied at the time of land preparation. The linseeds were coated with above different biofertilizer agents in above different concentrations and intensities for a given duration. After coated linseeds were dried to initial moisture content at room temperature. After that the treated linseeds were used to grow under field conditions. Field experiment was laid out in Randomized Block Design (RBD) with three replications during Rabi 2022-23. Data were recorded for 12 characters.

Results and Discussion

The observations on of Plant Height 90 DAS of Linseed were statistically analyzed. A range of 74.70 cm to 85.28 cm of Plant Height was recorded. The maximum amount of Plant Height (85.28 cm) recorded with T10 - PSB 6% for 7 hours followed by T4 - Trichoderma 2% for 7 hours (83.79 cm) and minimum Plant Height (74.70 cm) recorded with T0 (control). The increase in plant height may be attributed to auxin production by PSB and increased supply of phosphorus by PSB and VAM. However, dual inoculation with VAM + PSB recorded more plant height compared to sole application. This could be due to synergetic effect of two organisms.

The observations on of days to 50% flowering of Linseed were statistically analyzed. A range of 66.67 to 77.00 of days to 50% flowering was recorded. The minimum number of days to 50 % flowering (66.67) recorded with T10 - PSB 6% for 7 hours followed by T9 – Rhizobium 6% for 7 hours (77.33) and maximum days to 50% Flowering (77.00) recorded with T0 - Control.

The observations on of days to maturity of Linseed were statistically analyzed. A range of 117 to 126 of days to maturity was recorded. The minimum number of days to maturity (117.00) recorded with T10 - PSB 6% for 7 hours followed by T6 – PSB 4% for 7 hours (124.00) and maximum days to maturity (126) recorded with T0 - Control.

Post - Harvest

The observations on of primary branches per plant of Linseed were statistically analyzed. A range of 4.19 to 4.96 of primary branches per plant was recorded. The maximum amount of primary branches per plant (4.96) recorded with T10 - PSB 6% for 7 hours followed by T4 - *Trichoderma* 2% for 7 hours (4.85) and minimum primary branches per plant (4.19) recorded with T0 (control). The lowest number of branches was noticed in the uninoculated control plot. Results of the present investigation are in conformity with those of Shete *et al.* (2019) who reported increased number of branches in different legume crops due to seed inoculation of Rhizobium, PGPR and PSB alone or in combination.

The observations on of number of capsules per plant of Linseed were statistically analyzed. A range of 18.07 to 25.73 of number of capsules per plant was recorded. The maximum amount of number of capsules per plant (25.73) recorded with T10 - PSB 6% for 7 hours followed by T4 - Trichoderma 2% for 7 hours (23.53) and minimum number of capsules per plant (18.07) recorded with T0 (control). This might be due to their ability to solubilize/ mineralize the native phosphorus. PSB can solubilize the fixed phosphorus to available P by the secretion of various organic acids, phosphatase 60 enzyme and growth hormones and increase the availability of phosphorus to plant in addition to lowering the pH of rhizosphere. The results are in conformity with the findings of Yousefi *et al.* (2012).

A range of 7.0 to 9.2 of number of seeds per capsules was recorded. The maximum amount of number of seeds per capsules (9.2) recorded with T10 - PSB 6% for 7 hours followed by T4 - Trichoderma 2% for 7 hours (9.0) and minimum number of seeds per capsules (7.0) recorded with T0 (control).

Table 1. Influence of biofertilizer on Plant height, Days to 50% flowering, Days to maturity.

Treatment	Plant Height	Days to 50% Flowering	Days to maturity
T0 – Control	74.71	77.00	126
T1	80.92	70.67	125
T2	83.36	68.33	**119**
T3	82.12	69.67	123
T4	83.79	67.67	**117**
T5	82.64	73.67	120
T6	81.43	75.33	124
T7	82.83	72.33	119
T8	82.80	75.33	123
T9	81.00	77.33	121
T10	85.28	66.67	**117**
T11	81.64	72.00	122
T12	80.79	75.00	120
SE m (±)	0.18	0.91	S
CD	0.54	2.66	1.652

Table 2. Influence of biofertilizer on number of capsules per plant, number of seeds per capsule, and seed yield per plot.

Treatment	Number of Capsules per plant	Number of seeds per capsule	Seed yield per plot
T0 – Control	18.07	7.0	48.02
T1	22.73	7.4	65.81
T2	25.13	8.4	79.80
T3	20.73	8.2	71.86
T4	23.53	9.0	87.31
T5	21.33	7.2	69.04
T6	23.13	7.0	58.21
T7	21.73	7.6	60.18
T8	21.13	7.5	62.95
T9	21.33	7.2	61.95
T10	25.73	9.2	89.35
T11	21.33	7.6	68.46
T12	21.13	8.0	71.61
SE (m)	0.03	0.01	0.14
CD	0.10	0.05	0.41

A range of 48.02 gm to 89.35 gm of seed yield per plot was recorded. The maximum amount of seed yield per plot (89.35 gm) recorded with T10 - PSB 6% for 7 hours followed by T4 - Trichoderma 2% for 7 hours (87.31 gm) and minimum seed yield per plot (48.02 gm) recorded with T0 (control). The increase in grain yield of maize with inoculation of P solubilizing microorganisms may be due to increase in P availability through solubilization of insoluble inorganic phosphate by organic acid, decomposition of phosphate-rich organic compounds and production of plant growth promoting substances. However, dual inoculation with VAM and PSB enhanced the grain yield. This could be attributed to the synergistic effect of two organisms which increased the P uptake. The results are in agreement with the findings of Singh *et al.* (2011) and Vahed *et al.* (2012).

Conclusion

It is conducted from the present study that the seed treatment with (Phosphate solubilizing bacteria) PSB - 2% and 6%, Trichoderma 2%, have shown significant effect on growth and yield attributing parameters of Linseed (*Linum usitatissimum L.)*, genotype EC10077. Seed treatment with PSB 6% shown best result enhancing the germination percentage, plant height, Number of primary branches per plant, Days to 50 percent flowering, Days to Maturity, Number of capsules per plant, Number of seeds per capsule, Seed yield/plot (kg), followed by Trichoderma 2% (T4) as compared to control (untreated) seeds.

Acknowledgement

The authors are thankful to all faculty members of the Department of Genetics and Plant Breeding for their encouragement and support. Thanks are also due to Dr V. P. Sahi, Head of, the Department of Genetics and Plant Breeding for providing the necessary help.

Conflict of interest: None

References

Alemayehu, Nigussie, and Gemechu Keneni, 2019. Genetic Consequences of Failure to Control Outcrossing in Breeding Often Cross-Pollinated Pulse and Oil Crops

Alukedi, Ahmed, O., Ahmed, A. Almarie, Ma Alalousi, Ss Farhan, and Alif Almehemdi, 2021. Effect of laser exposure as pre sowing seed priming in three flax cultivars (*Linum usitatissimum* L.). *Plant Cell Biotechnology and Molecular Biology*. 43-52.

Contreras-Cornejo, H. A., Macías-Rodríguez, L., Alfaro-Cuevas, R. and López- Bucio, J. 2014. Trichoderma spp. improve growth of Arabidopsis seedlings under salt stress through enhanced root development, osmolite production, and Na(+) elimination through root exudates. Mol. *Plant-Microbe Interact.* 27: 503–514. doi: 10.1094/MPMI-09-13-0265-R

Chi, F., Shen, S.H., Cheng, H.P., Jing, Y.X., Yanni, Y.G. and Dazzo, F.B. 2005. Ascending migration of endophytic rhizobia, from roots to leaves, inside rice plants and assessment of benefits to rice growth physiology. *Appl. Environ. Microbiol.* 71: 7271-7278.

Choudhary, V.K., Subhash, C., CR Chethan, and Bhumesh Kumar. 2019. Effect of seed priming on abiotic stress tolerance in plants. *In Plant Tolerance to Environmental Stress*. 29-46. CRC press.

Jablonka, E. 2013. Epigenetic inheritance and plasticity: The responsive germline. Prog. Biophys. Mol. Biol. 111, 99–107. doi: 10.1016/j.pbiomolbio.2012.08.014.

Hussain, M.B., Mehboob, I., Zahir, Z.A., Naveed, M. and Asghar, H.N. 2009. Potential of *Rhizobium spp.* for improving growth and yield of rice (*Oryza sativa* L.). *Soil. Environ.* 28: 49-55.

Shete, M.H., Murumkar, D.R., Tirmali A.M. and Landge, K.B. 2019. Formulation of culture media for growth of nitrogen fixing, phosphate solubilizing and potash mobilizing bacteria in a consortium. *J. Pl. Dis. Sci.* 14(1): 41-46.

Singh, S.R., Najar, G.R., Singh, U. and Singh, J.K. 2011. Phosphorus management in maize-onion cropping sequence under rainfed temperate conditions of inceptisol. *Journal of the Indian Society of Soil Science.* 59(4) : 355-361.

Shakhavat, M. 2007. Potential use of *Rhizobium spp.* to improve growth of non- nitrogen fixing plants. Master's Thesis, Swedish University of Agricultural Sciences, *Department of Soil Sciences P.O. Box* 7014.

Vahed, H.S., Shahinrokhsar, P. and Heydarnezhad, F. 2012. Performance of phosphate solubilizing bacteria for improving growth and yield of rice (*Oryza sativa* L.) in the presence of phosphorus fertilizer. *International Journal of Agriculture and Crop Sciences.* 4(17): 1228-1232.

Yousefi, A.A., Barzegar, A.R. and Sadeghi, M. 2012. Effects of Phosphate Solubilizing Bacteria and Arbuscular Mycorrizal Fungi on Contribution of Inorganic Phosphorus Fractions. *Advances in Environmental Biology.* 6(8): 2323-2328.