Elevating Sustainable Agriculture: Eco-Friendly Seed Treatments for Enhanced Plant Growth and Yield in Mungbean

ABSTRACT

Aims: To study the effect of chemicals, bioagents, botanical and domestically available material on plant growth, yield and yield attributing traits in mungbean var. Sweta.

Study design: The field experiment was conducted in Randomised Block Design

Place and duration of study: The study was conducted at the Student Instruction Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur U.P during *Zaid* 2021 and *Zaid* 2022.

Methodology: The seeds of mungbean var. Sweta were treated with *Rhizobium* @25g/kg (**T_1**), *Trichoderma* @10g/kg (**T_2**), Cypermethrin @3g/kg (**T_3**), Bavistin @3g/kg (**T_4**), Neem oil @5ml/kg (**T_5**) and Camphor @4g/kg (**T_6**) before sowing them in the field. At maturity, observations were recorded for plant height (cm), number of root nodules per plant, number of pods per plant, number of seeds per pod, test weight (g) and total seed yield in q/ha, to know the effect of chemicals, bioagents, botanical and domestically available material on growth and seed yield in mungbean var. Sweta.

Results: The treatment **T_5:** Neem oil @ 5ml/kg seed outperformed all the other treatments in terms of plant height (cm), number of root nodules per plant, number of pods per plant, number of seeds per pod, test weight (g) and total seed yield in q/ha. However, treatment **T_1:** *Rhizobium* @25g/kg seed, exhibited superior performance in terms of the number of root nodules per plant when compared to all other treatments.

Conclusion: The transitioning from chemical to natural seed treatment is essential, given its manifold advantages for agriculture, the environment, and human health. Neem oil has eco-friendly pest control and growth-enhancing properties which can fuel this promising shift toward a more sustainable future.

Keyword: *Natural, neem oil, Rizobium, seed treatment*

1. INTRODUCTION

Mungbean is an immensely nutrititious crop which can contribute to global food security. However, cultivated mungbean is affected by several species of fungi that cause severe yield losses and majority of them are seed-transmitted. Historically, chemical seed treatments emerged as the go-to solution for shielding seeds from pathogens thus guaranteeing a robust seed yield. However, this initial reliance on chemical seed treatments has come under scrutiny for its detrimental role in the environment and human health. Besides the negative effects on the environment and human health, one problem reported mainly is that fungicides often drastically reduce the viability of *Rhizobium* cells, decreasing nodulation and nitrogen fixation rates [1]. The urgent need is now glaringly clear: we must shift our focus from chemical to natural seed treatments for mungbean as well as other crops. In this context, instead of using chemicals, use of micro-organisms as biological control agents may represent an alternative method to control pathogenic fungi [2] [3].

Natural seed treatments offer a myriad of advantages that make them the sustainable choice for safeguarding mungbean seeds. They harness the power of beneficial microorganisms and botanical extracts, promoting a balanced and resilient ecosystem within the soil. These natural methods not only protect seeds from pests and diseases but also enhance their germination rates and overall vitality. Furthermore, they are eco-friendly, reducing the negative environmental impact associated with synthetic chemicals. Natural seed treatments also align with the growing demand for healthier, pesticide-free food products, as consumers increasingly seek safe and nutritious options. By choosing natural seed treatments, we invest in the long-term health of our agricultural systems, the well-being of our communities, and the future of our planet.

2. METHODOLOGY

The field experiment was conducted during Kharif 2021 and Kharif 2022 at Student Instruction Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur U.P. This experiment was conducted to know the effect of chemicals, bioagents, botanical and domestically available material on plant growth, yield and yield attributing traits in mungbean var. Sweta. The experiment was laid out in Randomized Block Design with three replication and six treatments. Initially, the seeds were treated with *Rhizobium* @25g/kg (**T_1),** Trichoderma @10g/kg (**T_2**), Cypermethrin @3g/kg (**T_3**), Bavistin @3g/kg (**T_4**), Neem oil @5ml/kg (**T_5**) and Camphor @4g/kg (**T_6**). The treated seeds were dried under shade for an hour and thereafter used for sowing. An untreated control (**T_0**) was also planted alongside. Standard agronomic practices and plant protection measures were taken as per schedule. At maturity, observations were recorded on ten randomly selected plants per replication for plant height (cm), number of root nodules per plant, number of pods per plant, number of seeds per pod and test weight (g). Additionally, total seed yield in q/ha was also calculated.

3. RESULTS AND DISCUSSION

The investigation was conducted during *Zaid* 2021 and *Zaid* 2022. The aggregated data from both years has been showcased in Table 1 and Figure 1, and it has been elucidated under the subsequent subheadings.

Plant height (cm): The plant height at harvest differed significantly among the treatments. Maximum plant height of 33.97 cm was recorded **T_5:** Neem oil @ 5ml/kg seed. Neem oil is known for its insecticidal and fungicidal properties. By protecting the plant from pests and diseases, neem oil can stimulate overall plant health, resulting in more robust and productive plants.

Table 1 Effect of seed treatment on agro-morophological traits in mungbean var. Sweta

Treatments	plant height (cm)	no. of root nodules/plant	no. of pods per plant	no. of seeds per pod	test weight (g)	Seed yield q/ha
T_0: Control (untreated seeds)	31.03	26.50	23.11	10.03	34.40	8.92
T_1: *Rhizobium* @25g/kg	32.38	29.89	24.50	10.50	35.60	9.26
T_2: *Trichoderma* @10g/kg	33.77	29.28	25.00	10.67	35.89	9.38
T_3: Cypermethrin @3g/kg	33.70	27.71	25.00	10.67	35.70	9.08
T_4: Bavistin @3g/kg	33.73	28.42	24.84	11.01	35.90	9.31
T_5: Neem oil @5ml/kg	33.97	28.73	25.34	11.01	36.20	9.42
T_6: Camphor @4g/kg	32.64	27.58	24.67	11.01	35.40	9.13
Mean	33.03	28.30	24.64	10.70	35.58	9.21
C.D.	0.172	0.341	0.137	0.169	0.178	0.102
SE(m) (P=0.05)	0.055	0.11	0.044	0.054	0.057	0.033

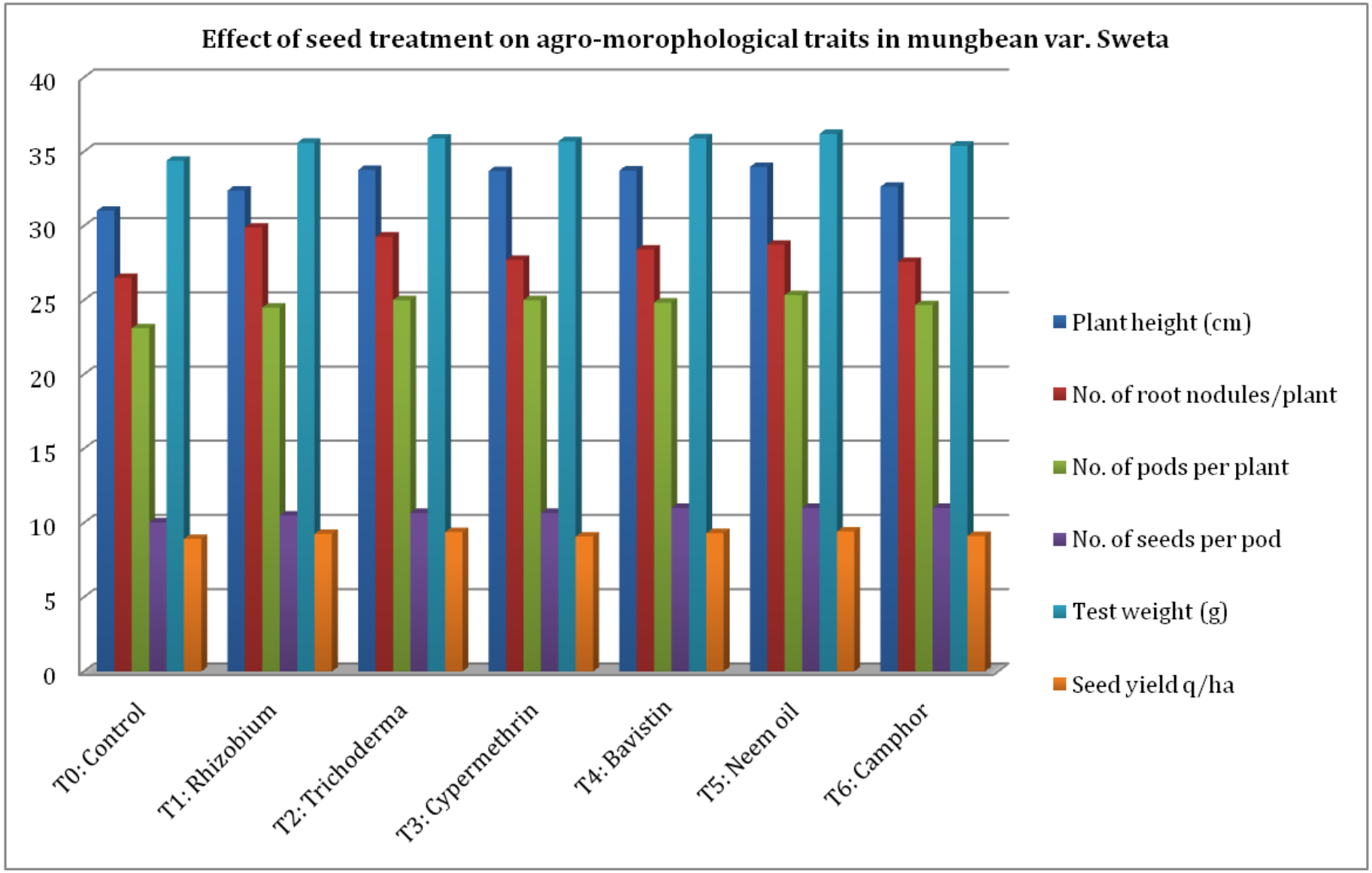
Number of root nodules per plant: the treatments differed significant among each other for number of root nodules per plant at the time of harvest. The treatment **T_1:** *Rhizobium* @25g/kg seed, exhibited the maximum number of root nodules per plant at 29.89. Similar results were reported by [4] in chickpea. Seed treatment with *Rhizobium* stimulates the formation of more root nodules per plant through a symbiotic relationship. *Rhizobium* colonize plant roots, prompting the plant to create these specialized structures for nitrogen fixation. As the bacteria thrive within the nodules, they continue to form more, increasing the overall number of root nodules on the plant's roots.

Number of pods per plant: The number of pods per plant at harvest differed significantly among the treatments. **T_5:** Neem oil @ 5ml/kg seed recorded the maximum number of pods per plant at 25.34. Neem oil does not harm beneficial insects crucial for pollination. Therefore, the use of neem oil fosters a healthier environment for pollinators, leading to enhanced pollination rates. This in turn, results in a higher production of flowers that ultimately develop into pods.

Number of seeds per pod: A significant difference in number of seeds per pod at harvest was observed among the treatments. Maximum number of seeds per pod was recorded **T_5:** Neem oil @ 5ml/kg seed (11.01) which was at par with **T_4:** Bavistin @3g/kg (11.01) and **T_6:** Camphor @4g/kg (11.01). Neem oil seed treatment may improve the ability of the plant to absorb more essential

nutrients from the soil, leading to better seed development and a higher number of seeds per pod. The results reported by [5] were parallel to the present study.

Figure 1 Effect of seed treatment on agro-morphological traits in mungbean var. Sweta.



Test weight (g): The test weight differed significantly among the treatments. Maximum test weight of 36.20 g was recorded in **T_5:** Neem oil @ 5ml/kg seed. Neem oil may influence plant hormones responsible for seed development and maturation. This regulation can lead to the production of seeds with increased weight. Besides, neem oil can improve the plant's ability to absorb nutrients from the soil. When the plant has access to a richer nutrient supply, it can allocate more resources towards seed development, resulting in larger and heavier seeds. Similar results were reported by [6] where the application of neem oil exhibited the highest test weight.

Seed yield (q/ha): Significant difference in seed yield per hectare was observed among the treatments. Highest seed yield was recorded at 9.42 q/ha in **T_5:** Neem oil @ 5ml/kg seed. The rise in seed yield can be primarily attributed to the enhancement of yield-related characteristics, such as the increased number of pods per plant, a greater number of seeds per pod, and higher test weight. Similar result was reported by [7] where seeds treated with neem oil formulations and powdered neem increased the seed yield significantly.

4. CONCLUSION

In this study, it is evident that treatment **T_5:** Neem oil @ 5ml/kg seed outperformed all the other treatments in terms of plant growth, yield and yield attributing traits in mungbean. However, it is noteworthy that **T_1:** *Rhizobium* @25g/kg seed, exhibited superior performance in terms of the number of root nodules per plant when compared to all other treatments. In essence, this research underscores the necessity of transitioning from chemical to natural seed treatments in the pursuit of sustainable agriculture. Such a shift is not merely a preference but a vital requirement, ensuring the prosperity of ecosystems and the well-being of future generations.

REFERENCES

1. Hungria M, Campo RJ, Mendes IC, Graham PH. Contribution of biological nitrogen fixation to the N nutrition of grain in the tropics, the success of soybean (*Glycine max* L. Merr.) in South America, In: Nitrogen nutrition and sustainable plant productivity. Singh, R.P. & Shankar Jaiwal, N.P.K. (eds.), Studium Press, LLC, Houston, Texas 2005. (*in press*).
2. Cubeta MA, Hartman GL, Sinclair JB. Interaction between Bacillus subtilis and fungi associated with soybean seeds. Plant Disease. 1985;69:506-509.
3. Bernal G, Illanes A, Ciampi L. Isolation and partial purification of a metabolite from a mutant strain Bacillus spp. With antibiotic activity against plant pathogenic agents. Electronic Journal of Biotechnology. 2002;5(1).
4. Verma, JP, Yadav, J, Tiwari KN. Application of *Rhizobium* sp. BHURC01 and plant growth promoting rhizobactria on nodulation, plant biomass and yields of chickpea (*Cicer arietinum* L.). *I*nternational Journal of Agricultural Research. 2010;5(3):148-156.

5. Kumar M., Kumar A., Kumar R., Yadav S.K., Yadav R. and Kumar J. Effect of seed enhancement on field performance of chickpea (*Cicer arietinum* L.). Journal of Applied and Natural Science.2015;7(2): 557-561.
6. Rani BU. and Mohan S. Efficacy of neem formulations for the control of Callosobruchus Maculatus F. infesting green gram (*Vigna radiata* L.). and their subsequent effect on germination. Agril. Sci. Digest. 2007;27(1): 53-55.5.
7. Vijaylakshmi and Majumdar V. Effect of seed treatment of chickpea with crude neem product and neem based pesticide on nematode multiplication in soil and grain yield. International Journal of Nematology. 1999;9(1):76-79.