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Managing Mungbean Seed Health: Impact of Chemical and Natural Seed Treatments on Occurrence of Diseases and insects under Ambient Storage conditions

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ABSTRACT: Preserving seed quality during storage involves controlled conditions or seed treatment, with the latter being more practical due to lower expenses. The present study was oriented towards discovering a seed treatment that can keep mungbean seeds free of disease infection and insect attacks for the longest possible time. It was conducted in the seed testing laboratory, CSA University of Agriculture and Technology, Kanpur, Uttar Pradesh, during 2021-22 to study the effect of seed coating with chemicals (T_3: Cypermethrin, T4: Bavistin), bioagents (T_1: Rhizobium, T_2: Trichoderma), botanical (T_5: Neem oil), and domestically available substances (T_6: Camphor) on disease infection and insect infestation of mungbean seeds (var. Sweta) when stored under ambient conditions. Irrespective of seed coating treatments, the seeds deteriorated with increased disease infection and insect infestation after 17 months of storage. Seeds coated with T_5: Neem oil @ 5 ml/kg recorded the lowest disease infection (2.33%) as well as insect infestation (8%) compared to T_0: Control (untreated seeds), which recorded 5% disease infection and 14.71% insect infestation at the end of 17 months of storage. Neem oil is an advantageous and environmentally friendly alternative to synthetic chemical seed treatments, which is effective against pests and diseases. The study highlights the enduring challenge of maintaining seed integrity during prolonged storage periods.

Keywords: Disease infection, insect infestation, mungbean, seed treatment.

INTRODUCTION

Green gram or golden gram, scientifically known as *Vigna radiata* L. Wilczek, is a plant species in the legume family commonly called mungbean. India is its primary center of origin, and it is mainly cultivated in East Asia, Southeast Asia, and the Indian subcontinent. Pulses are often referred to as the 'poor man's meat' since they are cheaper than meat yet provide a source of high-quality protein, carbohydrates, and other essential micronutrients. India is the major producer of green gram in the world. It is grown on approximately 40.38 lakh hectares of land with a total production of 31.5 lakh tons (Crop Outlook Report of Andhra Pradesh, 2022). It is stipulated that 80 percent of certified seed produced in India requires storage for one planting season, and 20 percent of the seed is carried over for subsequent sowing (Bal, 1976). During storage, the rate of seed deterioration can be slowed down either by storing the seeds under controlled conditions or by coating them with various seed treatments. Since controlled conditions involve a significant cost, seed treatment remains the best alternative approach to maintaining seed quality. Additionally, seed coating also helps improve the resistance of seeds towards pests and diseases. A large number of mycoflora have been reported to be associated with mungbean seeds. *Alternaria* sp, *Fusarium oxysporum*, *Fusarium solani*, *Fusarium equiseti*, *Myrothecium roridum*, *Drechslera* sp, *Aspergillus flavus*, *Aspergillus niger* and *Macrophomina phaseolina* were found in germinating seed and seedling of mungbean (Bakr and Rahaman 2001). Field fungus associated with the seed cause deterioration of seed quality, affect viability and reduces germination (Shrivastava and Gupta 1981). Besides, pathogens can spread over a long distance and uninfected field may be infected by the seeds in which different pathogens are present (Fakir et al. 2001). Therefore, the present study was undertaken to investigate the utility of seed coating with chemicals (T_3: Cypermetrin T_4: Bavistin), bioagents (T_1: *Rizobium* T_2: *Tricoderma*), Botanical (T_5: Neem oil) and domestically available substances (T_6: Camphor), on disease infection and insect infestation when stored under ambient conditions.

MATERIALS AND METHODS

The laboratory experiment was carried out during 2021-2022 in the Seed Testing Laboratory, Department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur U.P. Miungbean seeds of Sweta variety coated with seven treatments namely, T_0: Control (Untreated seeds) T_1: *Rhizobium* @25g/kg, T_2: *Trichoderma* @10g/kg, T_3: Cypermethrin @3g/kg, T_4: Bavistin @3g/kg, T_5: Neem oil @5ml/kg and T_6: Camphor @4g/kg were evaluated in completely randomized block design with four replications. The coated seeds of various treatments were packed in brown paper bags in the month of April 2021 and stored under ambient condition in Seed Testing Laboratory of Department of Seed Science and Technology, CSA UA&T, Kanpur U.P. Evaluation of fungal infection (%) and insect infestation (%) were made initially and subsequently at bimonthly intervals up to August 2022 in order to determine a worthy seed treatment which protect the seeds from the attack of diseases and pests.

Fungal infection (%): On the 8th day of the germination test, the blotter sheet was inspected for any indications of infection or pathogen growth. Subsequently, the number of seeds displaying signs of infection or pathogen growth was recorded.

$$\text{Seed Infection (\%)} = \frac{\text{Number of infected seeds}}{\text{Total number of seeds}} \times 100$$

Insect Infestation (%): To assess the seed infestation, three replications with 100 seeds per replication for each treatment were taken. Each individual seed was thoroughly inspected for any visible signs of insect damage. The seeds that exhibited evidence of insect infestation were then counted.

$$\text{Seed Infestation (\%)} = \frac{\text{Number of infested seeds}}{\text{Total number of seeds}} \times 100$$

RESULTS AND DISCUSSION

The rapid deterioration of stored seed is a serious problem, particularly, in high relative humidity areas and is associated with accelerated ageing. Since controlled condition storage involves huge cost, seed treatment is one of the best alternative approach to maintain seed quality during storage.

Significant results were obtained due to seed treatments for both the seed quality parameters evaluated in the laboratory *viz*., disease infection (%) and insect infestation (%). Irrespective of different seed treatments the disease infection (%) as well as insect infestation (%) increased gradually throughout the storage period (Fig. 1). Additionally, the different treatments applied to mungbean seeds could manage to keep them free from the attack of diseases and pests only up to 14 months of storage (Table 1 and 2).

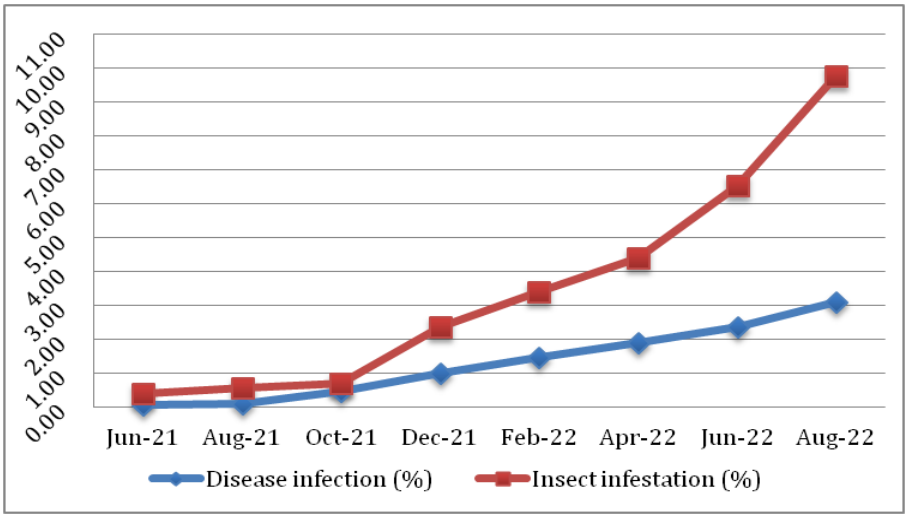

Fig. 1. Mean disease infection (%) and insect infestation (%) during 17 months of storage.

After two months of storage in June 2021, **T_0:** Control (untreated seeds) started to show signs of disease infection (0.33 %). Besides, **T_1:** *Rhizobium* @25g/kg, **T_2:** *Trichoderma* @10g/kg, **T_3:** Cypermethrin @3g/kg, **T_4:** Bavistin @3g/kg and **T_6:** Camphor @4g/kg managed to keep the seeds free of disease infection (%) up to 6 months of storage (October 2021) after which 0.67 %, 0.67 %, 0.33 %, 0.33 % and 0.33 % of seed infection was recorded in them. Furthermore, it was recorded that **T_5:** Neem oil @5ml/kg kept the seeds free of disease infection for the longest time period of 8 months (up to December 2021). At the end of storage period, significantly lowest disease infection of 2.33 % was recorded in **T_5:** Neem oil @5ml/kg and **T_4:** Bavistin @3g/kg as compared to **T_0:** Control (untreated seeds) which recorded the highest seed infection of 5 % (Table 1 and Fig. 2).

Similar results were reported by Singh *et al.* (2014); Mallaiah and Rao (2016); Adusei and Azupio (2022) on antifungal properties of neem oil which was found to be effective in reducing the growth of the pathogens in mungbean. Neem oil has excellent antibacterial, antifungal, insecticidal, pesticidal, plasticizer and antioxidant properties due to plethora of bioactive phytochemicals such as azadirachtin, salannin, nimbidin, gedunin, nimbin, isomargolonone, margolone, nimbolide, margolonone, *etc.* present in neem oil (Sadeghian *et al.*, 2007), and thus it is used for seed treatment during storage since ancient times.

Table 1: Effect of seed treatments on disease infection (%) during storage in mungbean var. Sweta.

Treatment	Months after storage							
Initial value: 00.00 %	**Jun-21 (after 2 months)**	**Aug-21 (after 4 months)**	**Oct-21 (after 6 months)**	**Dec-21 (after 8 months)**	**Feb-22 (after 10 months)**	**Apr-22 (after 12 months)**	**Jun-22 (after 14 months)**	**Aug-22 (after 16 months)**
T_0	**0.33**	0.67	1.00	1.67	2.33	3.00	4.33	5.00
T_1	0.00	0.00	**0.67**	1.00	1.67	2.00	2.33	3.66
T_2	0.00	0.00	**0.67**	1.00	1.33	2.00	2.00	2.67
T_3	0.00	0.00	**0.33**	0.67	1.00	1.67	2.00	2.67
T_4	0.00	0.00	**0.33**	1.00	1.33	1.67	2.00	2.33
T_5	0.00	0.00	0.00	**0.67**	1.33	1.33	1.67	2.33
T_6	0.00	0.00	**0.33**	1.00	1.33	1.67	2.33	3.00
Mean	**0.05**	**0.10**	**0.48**	**1.00**	**1.48**	**1.90**	**2.38**	**3.10**
SEm (±)	0.126	0.126	0.03	0.047	0.074	0.091	0.114	0.16
CD (p=0.05)	NS	0.39	0.09	0.15	0.23	0.28	0.35	0.49

T_0: Control (untreated seeds); **T_1:** *Rhizobium* @25g/kg; **T_2:** *Trichoderma* @10g/kg; **T_3:** Cypermethrin @3g/kg; **T_4:** Bavistin @3g/kg; **T_5:** Neem oil @5ml/kg; **T_6:** Camphor @4g/kg

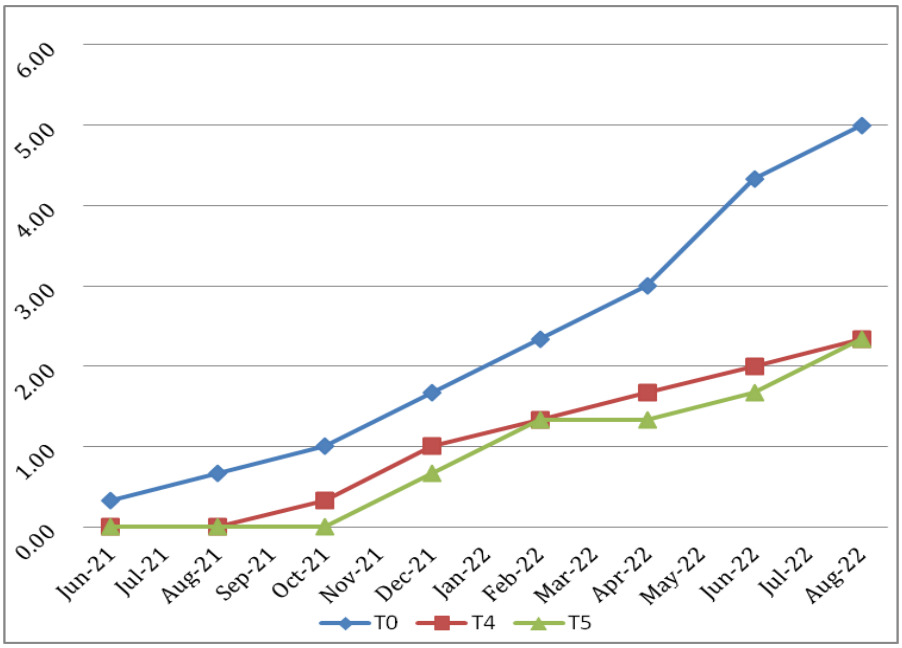

Fig. 2. Disease infection (%) in mungbean var. Sweta as affected by various seed treatments during storage.

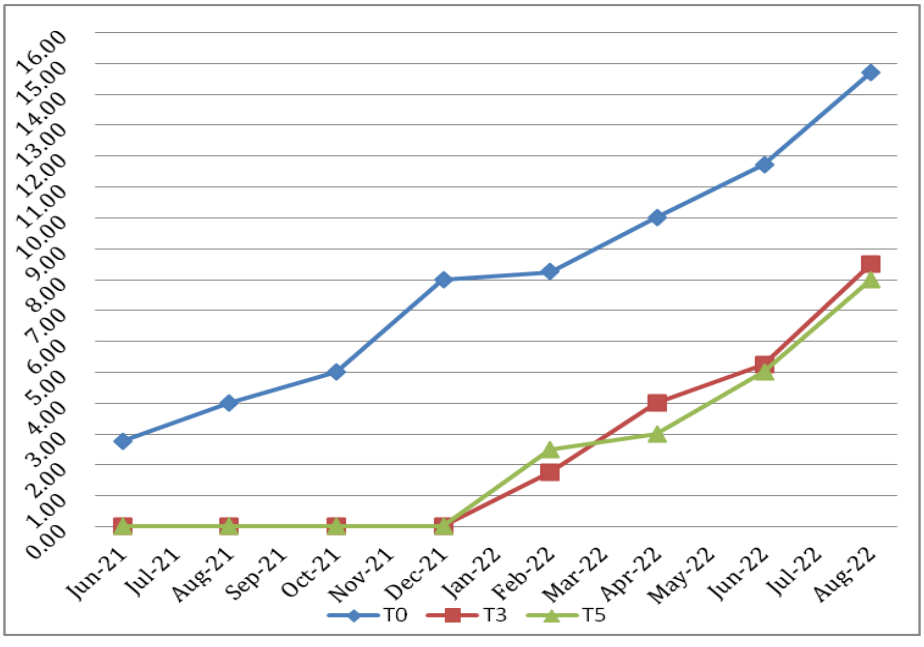

Fig. 3. Insect Infestation (%) in mungbean var. Sweta as affected by various seed treatments during storage.

Table 2: Effect of seed treatments on insect infestation (%) during storage in mungbean var. Sweta.

Treatment	Months after storage							
Initial value: 00.00 %	**Jun-21 (after 2 months)**	**Aug-21 (after 4 months)**	**Oct-21 (after 6 months)**	**Dec-21 (after 8 months)**	**Feb-22 (after 10 months)**	**Apr-22 (after 12 months)**	**Jun-22 (after 14 months)**	**Aug-22 (after 16 months)**
T_0	**2.75**	4.00	5.00	**8.00**	8.25	10.00	11.72	14.71
T_1	0.00	0.00	0.00	**2.25**	3.00	3.25	6.25	9.50
T_2	0.00	0.00	0.00	**2.50**	2.75	3.00	5.25	9.00
T_3	0.00	0.00	0.00	0.00	**1.75**	4.00	5.25	8.50
T_4	0.00	0.00	0.00	**2.25**	3.00	4.25	7.00	9.00
T_5	0.00	0.00	0.00	0.00	**2.50**	3.00	5.00	8.00
T_6	0.00	0.00	0.00	**1.50**	2.50	3.25	5.25	9.75
Mean	0.39	0.57	0.71	2.36	3.39	4.39	6.53	9.78
SEm (±)	0.109	0.065	0.109	0.132	0.144	0.173	0.17	0.261
CD (p=0.05)	0.33	0.20	0.33	0.40	0.44	0.53	0.52	0.80

T_0: Control (untreated seeds); **T_1:** *Rhizobium* @25g/kg; **T_2:** *Trichoderma* @10g/kg; **T_3:** Cypermethrin @3g/kg; **T_4:** Bavistin @3g/kg; **T_5:** Neem oil @5ml; **T_6:** Camphor @4g/kg

In June 2021after two months of storage, **T_0:** Control (untreated seeds) began to display the appearance of insect infestation (2.75 %). Further along, **T_1:** *Rhizobium* @25g/kg, **T_2:** *Trichoderma* @10g/kg, **T_4:** Bavistin @3g/kg and **T_6:** Camphor @4g/kg succeeded in keeping the seeds free of insect attack up to 8 months of storage (December 2021) after which 2.25 %, 2.50 %, 2.25 %, 2.25 % and 1.50 % of insect infestation was recorded in them. Unveiling further it was found that **T_5:** Neem oil @5ml/kg and **T_3:** Cypermethrin @3g/kg kept the seeds free of insect infestation for the longest time period of 10 months (up to February 2022). At the end of storage period in August 2022, significantly lowest insect infestation of 8 % was recorded in **T_5:** Neem oil @5ml/kg as compared to **T_0:** Control (untreated seeds) which recorded the highest insect infestation of 14.71 % (Table 2 and Fig. 3).

Similar results were reported by Haque *et al.* (2002); Raghvani and Kapadia (2003); Raja *et al.* (2012); Kumar *et al.* (2017); Adusei and Azupio (2022) on insecticidal properties of neem oil which protected the mungbean seeds kept in storage from the attack of insects. Neem oil offers immense antifeedant properties due to its efficacy in suppressing the feeding sensation in insects, at a concentrations even less than 1 parts per million (Isman *et al.,* 1991). It induces sterility in insects by preventing oviposition and interrupting sperm production in males (Chaudhary *et al.,* 2017). Seeds from the neem tree comprises 40% oil with azadirachtin as the major active ingredient, which is mainly responsible for the insecticidal activity of neem oil (Isman *et al*., 1991).

CONCLUSIONS

This research underscores the ongoing challenge of preserving seed integrity during extended storage. The study demonstrates that the seeds treated with neem oil @5ml/kg of seed, effectively safeguards mungbean seeds from diseases and insect attacks for up to 14 months in storage. Therefore, neem oil @ 5ml/kg of seeds, can be recommended for seed treatment in mungbean to ensure optimal seed health during storage under ambient conditions.

FUTURE SCOPE

On a global scale, there has been a profound transition from synthetic chemical seed treatments to the embrace of natural, organic alternatives. This shift is driven by mounting concerns about the detrimental impact of synthetic chemicals not only on the environment but also on plant life, animals, and various ecosystems. Among these eco-conscious alternatives, neem oil seed treatment shines as a highly advantageous, environmentally friendly solution, exhibiting profound effectiveness in combating insects and pests.

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Conflict of Interests. None.

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