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Effect of organic and inorganic seed treatments on seed health of French bean (*Phaseolus vulgaris* L.)

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ABSTRACT

A laboratory experiment was conducted on French beans (*Phaseolus vulgaris* L.) to investigate the effect of organic and inorganic seed treatments on seed health. The seeds of French bean were subjected to different seed treatments viz., T₀: Control (untreated), T₁: Neem leaf powder @5g/kg of seed, T₂: neem oil @5ml/kg of seed, T₃: Castor oil @5ml/kg of seed, T₄: karanj oil @5ml/kg of seed, T₅: vekhand powder @10g/kg of seed, T₆: Turmeric powder @5g/kg of seed, T₇: Citronella oil @5ml/kg of seed, T₈: Ash @5g/kg of seeds, T₉: Deltamethrin @0.04ml/kg of seed. Seed health was tested for different parameters viz., pulse beetle infestation, seed weight loss, egg-laying, adult emergence, percent mortality, dead insects and live insects. The bio-efficacy test was undertaken to find out the effect of chemicals and different botanicals against pulse beetle in French bean seed.

Results revealed that seeds treated with Deltamethrin @0.04ml/kg of seed significantly recorded the lowest pulse beetle infestation (1.33%), lower number of egg-laying (11.00), lowest number of adult emergence (1.67), lowest seed weight loss (4.67%), highest mortality (87.8%), higher dead insect (15.00) and lower live insect (5.00) at the end of storage period. Among the botanicals, seed treated with neem oil @5 ml/kg of seed showed higher seed quality and health parameters. From the present investigation, the seed treated with organic and inorganic components protected the seed health while, the control seed deteriorated at the end of the storage period.

Keywords: Seed Health, Deltamethrin, *Aspergillus* spp. And Mortality.

INTRODUCTION

Pulses occupy a very important position in the Indian diet. They are an important source of protein and calories. On average, pulses contain 22 to 24 percent protein as against 8 to 10 percent in cereals. A good amount of lysine is present in the pulses. They also maintain soil fertility and adapt themselves to the large variation in climatic conditions; they are useful in different cropping systems and also provide nutritive fodder to the farm animals. Among the pulses grown in India, the French bean is considered an important pulse crop.

French bean (*Phaseolus vulgaris* L.) belongs to the family Leguminosae and it is native to South America. The nutritive value of 100 g of green pod contains 1.7 g protein, 0.1 g fat, 4.5 g carbohydrate, 1.8 g fibre and is also rich in minerals and vitamins. It has some medicinal properties in the control of diabetes, cardiac problems, and natural cure for bladder burn. It has both carminative and reparative properties against constipation and diarrhoea respectively ^[1].

Storage of seeds till the next sowing season is an essential part of the seed industry. In general, pulses are more susceptible to storage pests and the French bean is no exception. Amongst the stored grain pests of pulses, the pulse beetle (*Clonorchis chinensis*) is an economic effective pest ^[2], and causes considerable damage to the seed and deteriorates the quality of seed in the storage. Apart from this, fungi associated with stored seeds are also responsible for the deterioration of seed quality. To prevent the qualitative and quantitative losses due to storage pests and disease, several methods such as storage in safe conditions and containers with safe moisture levels and seed treatment with suitable chemicals or plant products, etc, are being adopted.

In storage, viability and vigoro of the seeds are regulated by many Physic-chemical factors like moisture content of the seed, atmospheric relative humidity, temperature, initial seed quality, the physical and chemical composition of seed, gaseous exchange, storage structure, storage insects, and packaging materials. Hence, storage of seeds till the next planting time assumes prime importance for a successful seed production program.

Botanicals have been used for a very long time by many farmers in the world for decades to control

stored insect pests [3]. Many scientists revealed that the use of botanicals as pre-storage seed treatment is effective in the management of storage pests and thus helps in improving the quality of seed. So, in the present investigation botanicals viz., neem leaf powder, neem oil, karanj oil, castor oil, vekhand powder, citronella oil, turmeric powder, and ash were used to check the seed health of French bean

MATERIALS AND METHODS

A comprehensive laboratory study on “Effect of organic and inorganic seed treatments on seed health of French bean (*Phaseolus vulgaris*)” was undertaken at Seed Technology Research Unit, Mahatma Phule Krishi Vidyapeeth, Rahuria. Dist. Ahmednagar (MS) from May 2019 to Feb 2020. Experimental material consists of freshly harvested seeds of French bean variety Varun, obtained from Botany Farm, College of Agriculture, Pune. The experiment was laid out in Completely Randomized Design (CRD) with three replications. Seeds were subjected to different treatments and health was tested for different parameters viz., pulse beetle infestation, seed weight loss, egg-laying, adult emergence, percent mortality, dead insects and live insects. The bio-efficacy test was undertaken to find out the effect of chemicals and different botanicals against pulse beetle in French bean seed. The seeds of French bean were treated with deltamethrin @ 0.04 ml/kg of seed and various botanicals viz. neem leaf powder @ 5 g/kg of seed, neem oil @ 5 ml/kg of seed, castor oil @ 5 ml/kg of seed, karanj oil @ 5 ml/kg of seed, vekhand powder @ 10 g/kg of seed, turmeric powder @ 5 g/kg of seed, citronella oil @ 5 ml/kg of seed and ash @ 5 g/kg of seed. From treated seeds 100-gram seed was taken out from each replication and kept in a 200 ml capacity plastic jar and 10 pairs of pulse beetle were released in each set and the observations were recorded on pulse beetle infestation, percent seed weight loss, a number of eggs laid, adult emergence, percent mortality, dead insects and live insects. Percent, seed infestation was recorded on the 3rd, 6th, and 9th months after storage period. The data generated the ford said aspects was statistically analysed as per the procedure [4,5], adopting “Fishers ‘analysis of variance techniques”.

RESULT AND DISCUSSION

The present investigation was carried out to study the effect of organic and inorganic seed treatments on the health of French bean seeds during the storage period. Seeds were subjected to different seed health treatments and observations were recorded on the following aspects

Seed microflora (%): The results on seed microflora as influenced by seed treatments during the storage period are presented in Table 1. It was noticed that seed microflora increased with the advancement of the storage period irrespective of seed treatment.

Initially, higher seed microflora (10.67) was recorded in seeds treated with vekhand powder (T5) followed by karanj oil (T3), and lower seed microflora (8.33) was recorded in control (T0). At the end of 300 days storage period, lower seed microflora (29.67) was recorded in deltamethrin (T9) treated seeds followed by neem oil (T2) while, the highest seed microflora (48.00) was recorded in the untreated control (T0). During the study, the different microflora observed were *Fusarium oxysporum*, *Aspergillus Niger*, *Aspergillus flavus*. Among the microflora observed during the storage of French bean seeds, *Aspergillus* spp. occupied the major percentage.

Bio efficacy Test: French bean seeds were subjected to different treatments and health was tested for different parameters viz., pulse beetle infestation, seed weight loss, egg-laying, adult emergence, percent mortality, dead insects and live insects. Significant differences were observed in all the seed health parameters for all seed treatments in all the storage periods.

1. **Pulse beetle infestation (%):** At three months of storage period, lowest pulse beetle infestation (0.00%) was recorded in the seed treated with deltamethrin @ 0.04 ml/kg of seed, neem leaf powder @ 5 g/kg of seed, neem oil @ 5 ml/kg of seed, castor oil @ 5 ml/kg of seed, karanj oil @ 5 ml/kg of seed and highest pulse beetle infestation was recorded in the control (3.67%). Likewise, the lowest pulse beetle infestation (0.00 and 0.67%) was observed for seed treated with deltamethrin @ 0.04 ml/kg of seed, while the highest pulse beetle infestation was recorded in the control (10.00 and 24.67%) respectively, at 6 and 9 months of storage period (Table 2). Similar findings were observed in pigeon pea [6,7], and in chickpea [8], and in black gram [9].

2. **Seed weight loss (%):** All the treatment was significantly superior over untreated control in minimizing percent weight loss due to pulse beetle damage (Table 2). At three months of the storage period, the per cent weight loss was prevented in the seed treated with deltamethrin @ 0.04 ml/kg of seed, neem leaf powder @ 5 g/kg of seed, neem oil @ 5 ml/kg of seed, castor oil @ 5 ml/kg of seed, karanj oil @ 5 ml/kg of seed. Significantly maximum (3.56%) seed weight loss was recorded in the untreated control.

At the sixth and ninth months of the storage period the percent weight loss was significantly superior in seed treated with deltamethrin @ 0.04 ml/kg of seed (0.00 and 0.33%), which were found statistically at par with neem oil @ 5 ml/kg of seed (0.34 and 1.85%), castor oil @ 5 ml/kg of seed (0.81 and 5.25%), karanj oil @ 5 ml/kg of seed (0.88 and 5.62%), respectively. Significantly maximum (8.55 and 14.50%) seed weight loss was recorded in untreated control for the sixth and ninth months of storage period. A similar finding was observed in chickpea [8], and in black gram [9].

3. **Number of eggs /100 seeds:** After three months of storage minimum number of eggs (0.00%) was laid by the beetles in seed treated with deltamethrin @0.04 ml/kg of seed, neem oil @ 5 ml/kg of seed, neem leaf powder @ 5 g/kg of seed. Significantly maximum (17.67) egg-laying was recorded in the untreated control.

At the sixth and ninth month of the storage period the number of an egg laid was significantly superior in seed treated with deltamethrin @ 0.04 ml/kg of seed (0.00 and 2.67%), which were found statistically at par with neem oil @ 5 ml/kg of seed (2.33 and 8.67%), neem leaf powder @ 5 g/kg of seed (7.33 and 13.67), karanj oil @ 5 ml/kg of seed (17.00 and 26.00), castor oil @ 5 ml/kg of seed (17.33 and 30.67), respectively. Significantly maximum (34.33 and 53.33) eggs laid were recorded in untreated control for the sixth and ninth months of storage period (Table 2). Similar findings were observed in black gram [9], and in red gram [10].

4. **Number of adult emergences:** All the treatments were found significantly superior over control and proved effective in bringing about significantly lower adult emergence of pulse beetle as compared to untreated control (Table 3). After three months of storage no any adult emergence was recorded in seed treated with deltamethrin @ 0.04 ml/kg of seed (0.00), neem leaf powder @ 5 g/kg of seed (0.00), neem oil @ 5 ml/kg of seed (0.00), castor oil @ 5 ml/kg of seed (0.00), karanj oil @ 5 ml/kg of seed (0.00). Significantly maximum (7.00) adult emergence was recorded in the untreated control.

At the sixth and ninth months of the storage period the effect of treatment on a number of adult emergences was significantly superior in seed treated with deltamethrin @ 0.04 ml/kg of seed (0.00 and 1.00), which was found statistically at par with neem oil @ 5 ml/kg of seed (1.00 and 3.67), castor oil @ 5 ml/kg of seed (3.67 and 7.33), karanj oil @ 5 ml/kg of seed (4.33 and 9.00), respectively. Significantly maximum (18.33 and 36.33) adult emergence were recorded in untreated control at the sixth and ninth month of the storage period.

The present investigation recorded that prevention of adult emergence was found in seed treated with deltamethrin @0.04 ml/kg of seed

followed by neem oil @ 5 ml/kg of seed, castor oil @ 5 ml/kg of seed, karanj oil @ 5 ml/kg of seed while control seed has high adult emergence about 36.33 at the end of storage period. Similar findings were observed in pigeon pea [7], in black gram [9], and in red gram [10].

5. Mortality (%): At six months of storage maximum per cent mortality was recorded in seed treated with deltamethrin @ 0.04 ml/kg of seed (94.00%), which is statistically at par with neem oil @ 5 ml/kg of seed (85.22 %), castor oil @ 5 ml/kg of seed (80.00%), karanj oil @ 5 ml/kg of seed (77.67%), while untreated control has 0.00 per cent mortality.

At nine months of storage maximum per cent mortality was recorded in seed treated with deltamethrin @ 0.04 ml/kg of seed (74.48%) which is statistically at par with neem oil @ 5 ml/kg of seed (57.56%), castor oil @ 5 ml/kg of seed (53.22%), while untreated control had 0.00 per cent mortality (Table 3). It was found that per cent mortality was decreasing with storage period as its efficacy decreases. From results it is revealed that seeds of treatment maintained up to end of the storage period with slightly reduction. Similar findings were observed in black gram [9], and in red gram [10].

6. Dead insect: After three and six months of storage highest dead insect were recorded in the seed treated with deltamethrin @ 0.04 ml/kg of seed (20.00 and 18.78), followed by neem oil @ 5 ml/kg of seed (19.67 and 17.00), castor oil @ 5 ml/kg of seed (19.33 and 16.11) respectively. Significantly lowest i.e., 0.00 dead insect was recorded in untreated control at both storage period.

At the end of storage period (9 month) the effect of treatment on number of dead insects was significant superior in seed treated with deltamethrin @ 0.04 ml/kg of seed (15.00), which was found

statistically at par with neem oil @ 5 ml/kg of seed (11.56), neem leaf powder @ 5 g/kg of seed (10.67). Significantly lowest number of dead insect (0.00) was recorded in untreated control.

The present investigation recorded that highest number of dead insects was found in seed treated with deltamethrin @ 0.04 ml/kg of seed followed by neem oil @ 5 ml/kg of seed, while control seed has found no any dead insect up to end of the storage period. So, from result it indicates that higher the number of dead insects, higher the efficacy of chemical and botanicals.

7. Live insect: After three months of storage period, lowest live insect was recorded in the seed with deltamethrin @ 0.04 ml/kg of seed (0.00) followed by neem oil @ 5 ml/kg of seed (0.33), castor oil @ 5 ml/kg of seed (0.67). Significantly highest live insect (20.00) was recorded in untreated control.

At sixth and ninth month of storage period the effect of treatment on number of live insects were significantly superior in seed treated with deltamethrin @ 0.04 ml/kg of seed (1.22 and 5.00), which were found statistically at par with neem oil @ 5 ml/kg of seed (3.00 and 8.44), castor oil @ 5 ml/kg of seed (3.89 and 9.33) respectively. However, significant highest number of live insect (20.00) was recorded in untreated control at both storage period.

The present investigation recorded that lowest number of live insects was found in seed treated with deltamethrin @ 0.04 ml/kg of seed followed by neem oil @ 5 ml/kg of seed, castor oil @ 5 ml/kg of seed, while control seed has recorded highest number of live insects up to end of the storage period. So, from results it indicates that the lower the number of live insects, higher the efficacy of chemicals and botanicals.

Table 1: Effect of seed treatment on seed microflora (%) in French bean

Treatments	Storage Period (days)									
	Initial	60	90	120	150	180	210	240	270	300
T ₀	8.33	9.00	14.00	17.67	25.33	27.67	32.67	37.00	42.67	48.00
T ₁	9.00	9.33	12.33	13.67	17.67	22.33	28.33	31.67	33.67	37.00
T ₂	8.67	8.67	10.00	12.67	14.00	18.00	22.33	25.67	28.00	32.00
T ₃	10.00	10.00	12.00	14.33	16.67	21.00	27.33	30.33	32.67	36.33
T ₄	9.67	10.33	11.33	14.33	17.00	21.33	27.67	32.00	34.00	38.33
T ₅	10.67	10.67	12.00	16.33	20.00	23.00	30.00	34.33	38.00	41.67
T ₆	9.00	10.33	10.67	13.67	16.33	22.00	28.67	31.33	33.67	39.00
T ₇	8.67	9.33	11.33	13.00	16.00	22.33	26.67	30.00	32.33	36.33
T ₈	9.67	9.67	11.67	15.00	17.67	22.67	26.67	30.33	30.67	35.00
T ₉	8.67	9.33	9.67	12.00	13.00	16.67	21.67	23.00	25.00	29.67
SE±	0.6	1.07	0.67	0.64	0.51	0.72	0.61	0.71	0.50	0.75
CD at 5%	(NS) 1.80	(NS) 3.17	1.99	1.89	1.52	2.13	1.80	2.09	1.48	2.22

T₀: Control T₁: Neem leaf powder T₂: Neem oil T₃: Castor oil
 T₄: Karanj oil T₅: Vekhand powder T₆: Turmeric powder T₇: Citronella oil
 T₈: Ash T₉: Deltamethrin

Table 2: Effect of seed treatment on pulse beetle infestation, seed weight loss and number of eggs /100 seeds in French bean

Treatments	Storage Period (Months)								
	Pulse beetle infestation (%)			Seed weight loss			Number of eggs /100 seeds		
	3	6	9	3	6	9	3	6	9
T ₀	3.67	10.00	24.67	3.56	8.55	14.50	17.67	34.33	53.33
T ₁	0.00	1.67	8.67	0.00	0.92	2.87	0.00	7.33	13.67

T ₂	0.00	0.67	4.00	0.00	0.34	1.85	0.00	2.33	8.67
T ₃	0.00	1.33	7.67	0.00	0.81	5.25	0.33	17.33	30.67
T ₄	0.00	1.33	8.00	0.00	0.88	5.62	0.67	17.00	26.00
T ₅	1.33	5.67	16.33	0.83	3.10	8.43	3.67	21.33	38.00
T ₆	4.00	5.00	15.33	2.31	4.01	10.34	12.00	18.33	34.33
T ₇	2.67	4.00	11.33	1.79	3.36	8.16	6.67	14.33	31.00
T ₈	3.67	6.67	15.33	1.27	5.22	10.18	7.33	18.67	34.33
T ₉	0.00	0.00	0.67	0.00	0.00	0.33	0.00	0.00	2.67
SE±	0.39	0.60	0.59	0.08	0.10	0.08	0.31	0.47	0.71
CD at 5%	1.16	1.79	1.74	0.25	0.31	0.26	0.93	1.39	2.10

T₀: Control T₁: Neem leaf powder T₂: Neem oil T₃: Castor oil
 T₄: Karanj oil T₅: Vekhand powder T₆: Turmeric powder T₇: Citronella oil
 T₈: Ash T₉: Deltamethrin

Table 3: Effect of seed treatment on Number of adult emergences, Mortality (%), number of dead insects and number of live insects in French bean

Treatments	Storage Period (Months)											
	Number of adult emergences			Mortality (%)			Number of dead insects			Number of live insects		
	3	6	9	3	6	9	3	6	9	3	6	9
T ₀	7.00	18.33	36.33	0.00	0.00	0.00	0.00	0.00	0.00	20.00	20.00	20.00
T ₁	0.00	5.00	8.00	95.32	77.33	52.78	19.11	15.44	10.67	0.89	4.56	9.33
T ₂	0.00	1.00	3.67	98.22	85.22	57.56	19.67	17.00	11.56	0.33	3.00	8.44
T ₃	0.00	3.67	7.33	96.33	80.00	53.22	19.33	16.11	10.67	0.67	3.89	9.33
T ₄	0.33	4.33	9.00	95.78	77.67	52.11	19.11	15.56	10.55	0.89	4.44	9.45
T ₅	2.33	7.67	13.33	78.55	69.11	39.11	15.78	13.78	7.89	4.22	6.22	12.11
T ₆	3.00	8.33	13.33	72.00	58.22	43.89	14.44	11.67	8.78	5.56	8.33	11.22
T ₇	1.67	5.67	10.67	75.22	56.89	45.11	15.00	11.33	9.11	5.00	8.67	10.89
T ₈	2.67	9.33	12.67	69.11	55.33	36.00	13.78	11.11	7.22	6.22	8.89	12.78
T ₉	0.00	0.00	1.00	100.00	94.00	74.78	20.00	18.78	15.00	0.00	1.22	5.00
SE±	0.27	0.38	0.52									
CD at 5%	0.82	1.12	1.55									

T₀: Control T₁: Neem leaf powder T₂: Neem oil T₃: Castor oil
 T₄: Karanj oil T₅: Vekhand powder T₆: Turmeric powder T₇: Citronella oil
 T₈: Ash T₉: Deltamethrin

CONCLUSION

- Among all treatments, deltamethrin (T₉) @ 0.04 ml/kg of seed found to be superior over rest of treatments, which recorded highest per cent mortality, lower pulse beetle infestation, lowest egg laying, adult emergences, highest dead insects and lowest live insects when seed treated with chemicals.
- Among all the botanicals treatments, neem oil (T₂) @ 5ml kg⁻¹ of seed found to be superior over rest of treatments which recorded highest per cent mortality, lower pulse beetle infestation, egg laying, adult emergences, higher dead insects and lower live insects.

The above conclusions are based on one season experimentation and therefore, needs further detailed investigations to confirm benefits due to botanicals and chemical in French bean for maintaining seed health of French bean.

Conflict of Interest

None declared.

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