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Accessibility of the efficacy of seed protectants on quality of mung bean seed against bruchids

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Abstract
The seed qualities are deteriorated by different biotic and abiotic factor during ambient storage. Pulse beetle play important role to deterioration of quality of seed of pulse crop. Use of protectants as seed treatment is rapid and effective method for destroying life of insects during seed storage. The maximum germination was recorded in Emamectin benzoate (procliam 5 SG) @ 40 mg/kg seed with 86.66 per cent germination followed by Novaluron (Rimon 10 EC) @ 0.05 ml/kg seed and Spinosad (Tracer 45 SC) @ 3.5 mg/kg seed with 83 per cent. The highest seed vigour index was recorded in Emamectin benzoate (procliam 5 SG) @ 40 mg/kg seed with 2623.86 followed by Deltamethrin (Decis 2.8 EC) @ 0.04 ml/kg seed with 2173.31, Novaluron (Rimon 10 EC) @ 0.05 ml/kg seed with 2147.20. However, Deltamethrin (Decis 2.8 EC) @ 0.04 ml/kg seed was at par with Emamectin benzoate (procliam 5 SG) @ 40 mg/kg seed in respect to germination and vigour.

Keywords: Mung bean, seed protectant, bruchids, germination, vigour index

Introduction
Mung bean is the most important short duration pulse crop, which is grown on more than 6 million ha worldwide (about 8.5% of global pulse area) of which about 90% is confined to Asia. India is the largest producer of mung bean having about 3.83 million ha cultivated land with the total production of 2.01 million tonnes of grain with an average productivity of 418 kg/ ha and 7.96% share in total production (Anonymous, 2019) [2, 3]. Uttar Pradesh covering an area of 0.72 lakh hectare with a total production of 0.40 lakh tonnes and the average productivity of 555.56 kg/ha (Anonymous, 2019) [2, 3]. The important mung bean growing states are Rajasthan, Maharashtra, Madhya Pradesh, Tamil Nadu, Andhra Pradesh, Karnataka, Odisha and Bihar. Mung bean is used in several food products, both as a whole seed and in processed form (Myers, 2000) [9]. In a country like India where a large population is vegetarian, pulses are the cheapest and best source of total dietary protein (Swaminathan, 1937) [10]. Pulse beetles, *Callosobruchus chinensis* a common stored insect pest belonging to the family bruchidae, targeting many different species of stored legume and it is distributed across the tropical and subtropical regions of the world (Thembhare, 2007) [12].
Bruchids are the most notorious among the insects of chick pea and cause 50 per cent damage during storage in three to four months (Caswell, 1981) [4]. Although the infestation starts in the field and continues in storage. After a period of six months the loss has been estimated to be around 30-40 per cent, sometimes even in the severe cases of infestation the damage can reach even up to 100 per cent (Lal and Raj, 2012) [7]. Insecticides are one of the most effective weapons for disinfesting and protecting stored products from infestation. However, resistance of many storage pests against traditional insecticides stressed upon the need to use some substitute insecticides which are potent and safe.

Materials and Methods
In experiment to assess the efficacy of seed protectants (newer insecticides) on quality of mung bean (*Vigna radiate* L.) seed variety IPM-2-3 was acquired from of Acharya Narendra Deva University of Agriculture & Technology, Ayodhya. Seed of mung bean for experiments was fumigated with aluminium phosphide (3g Tab each) @ 1 Tab/ 3q seed with seven days of exposure periods to disinfested the agaist bruchid before start the experiments under ambient storage condition. Total eight treatments were evaluated. The experiment was carried out with three replications under CRD in seed entomology lab. In each replication of each treatment 500 g. mung bean seed were taken. The seed was mixed with seed protectants as per technical programme. The seed protectants used were as follows:

Table: The seed protectants used were as follows

Treatment	Name of seed protectant	Trade name	Dose (mg or ml/ kg Seed)
T_1	Emamectin benzoate	Procliam (5 SG)	40 mg
T_2	Spinosad	Tracer (45 SC)	3.5 mg
T_3	Indoxacarb	Avaunt (14.5SC)	13.8mg
T_4	Malathion	Malathion (5% Dust)	2.5mg
T_5	Novaluron	Rimon (10 EC)	0.05 ml
T_6	Nimbecidine	Nimbecidine(0.03%EC)	1.5 ml
T_7	Deltamethrin	Decis (2.8 EC)	0.04ml
T_8	Control	Untreated	Untreated

Thus treated mung bean seed packed in 1kg capacity gunny (jute) bags and kept them on racks in lab under ambient storage condition for further observations.

To obtained the germination per cent of mung bean seed by the between paper (BP) method (ISTA, 1976). One hundred randomly selected seed for each replication from each treatment placed on water soaked germination paper, which were rolled after covering them with another water soaked germination paper. The rolled germination papers were covered with butter paper and kept in seed germinator at 27.5 ^{0}C and 75% RH. After 7th days the germination per cent were recorded on the basis of normal seed ling emergence. The germination was recorded at 0, 3 & 6 months after treatment with seed protectants. Seed vigour index was calculated by adopting formula as suggested by Abdul-Baki and Anderson (1973).

Vigour Index = germination (%) X Seedling length (cm)

To work out efficacy of seed protectant against bruchids hundred seed will be randomly selected from each replication and short out healthy and unhealthy seed with the help of magnifying lens (10x). The observation will be recorded at 0, 3 and 6 month after treatment. Thus the data obtained will be used for calculating insect infestation per cent by using given formula (Mohan and Sundar babu, 1999) [8].

$$\text{Per cent seed damage(bored seed)} = \frac{\text{No. of bored seed in sample}}{\text{Total number of seed in sample}} \text{ x } 100$$

Results

Efficacy of seed protectants (newer insecticides) against bruchids in mung bean seed

The insect infestation (%) at different storage period showed variation in mung bean seed. All the Seed protectants after 3 and 6 months of storage were significantly superior over control. After 3 months of storage period the seed insect infestation per cent with in the seed protectants was ranged between 0.00 – 2.66 per cent. The maximum seed insect infestation per cent in treatments was observed in Nimbecidine (Nimbecidine 0.03% EC) @1.5ml/kg seed with 2.66 per cent followed by Malathion (Malathion 5% Dust) @ 2.5 mg/kg seed with 2.33 per cent, Indoxacarb (Avaunt 14.5 SC) @ 13.8 mg/kg seed with 1.66 per cent and Spinosad (Tracer 45 SC) @ 3.5 mg/kg seed with 1 per cent seed damage.

Table 1: Efficacy of seed protectants (newer insecticides) against bruchids in mung bean seed

Treatment	Seed protectant	Dose (mg or ml/ kg Seed)	Storage Months After Treatment (Insect Damage %)	
			3	6
T_1	Emamectin benzoate (procliam 5 SG)	40 mg	0.00 (0.00)	0.33 (1.91)
T_2	Spinosad (Tracer 45 SC)	3.5 mg	1.00 (5.73)	1.66 (7.33)
T_3	Indoxacarb (Avaunt 14.5 SC)	13.8 mg	1.66 (7.33)	2.66 (9.35)
T_4	Malathion (Malathion 5% Dust)	2.5 mg	2.33 (8.74)	4.33 (11.93)
T_5	Novaluron (Rimon 10 EC)	0.05 ml	0.66 (3.82)	1.33 (6.53)
T_6	Nimbecidine (Nimbecidine 0.03% EC)	1.5 ml	2.66 (9.35)	5.66 (13.75)
T_7	Deltamethrin (Decis 2.8 EC)	0.04 ml	0.33 (1.91)	1.00 (4.62)
T_8	Control	Untreated	4.66 (12.45)	9.33 (17.75)
S.E(m)±			1.05	1.26
C.D. (5%)			3.19	3.81

After 6 months of storage the per cent seed infestation ranged from 0.33 – 5.66%. The maximum insect infestation per cent was recorded in Nimbecidine (0.03% EC) @ 1.5ml/kg seed with 5.66 per cent followed by Malathion (Malathion 5% Dust) @ 2.5 mg/kg seed with 4.33 per cent, Indoxacarb (Avaunt 14.5 SC) @ 13.8 mg/kg seed with 2.66 per cent and Spinosad (Tracer 45 SC) @ 3.5 mg/kg seed with 1.66 per cent seed damage.

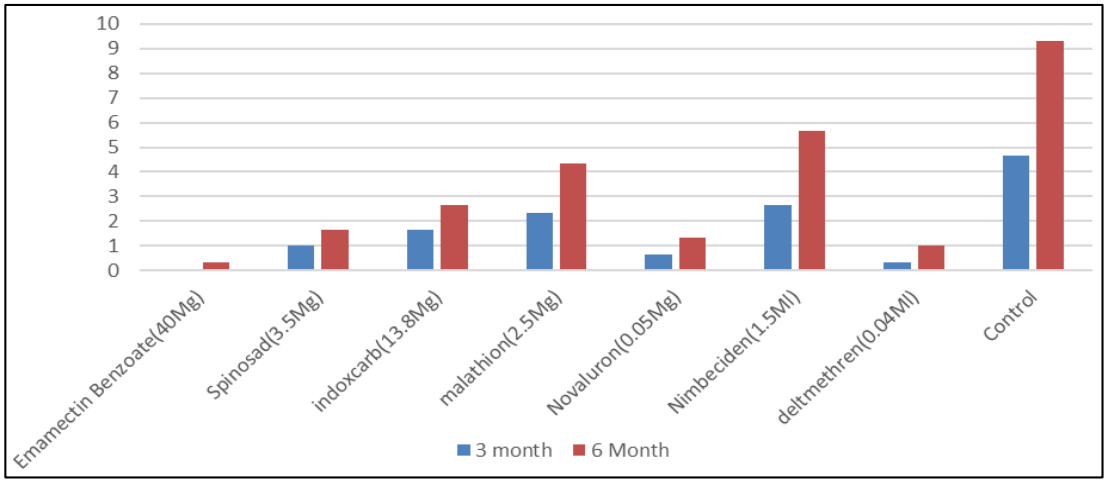

Fig 1: Efficacy of seed protectants (newer insecticides) against bruchids in mung bean seed

The minimum insect infestation 0.33% was recorded in Emamectin benzoate (procliam 5 SG) @ 40 mg/kg seed followed by Deltamethrin (Decis 2.8 EC) @ 0.04 ml/kg seed with 1.0 per cent and Novaluron (Rimon 10 EC) @ 0.05 ml/kg seed with 1.33 per cent damage. The maximum insect infestation (4.66%) at 3 month and (9.33%) at 6 months of storage period under untreated control. Seed infestation increased significantly as storage period increased.

Efficacy of seed protectants (newer insecticides) on Mung bean seed germination (%) at different storage period

After 3 months of storage, the seed germination ranged between different treatments ranged from 78 - 86.66 per cent. The maximum germination was recorded in Emamectin benzoate (procliam 5 SG) @ 40 mg/kg seed and Deltamethrin (Decis 2.8 EC) @ 0.04 ml/kg seed with 86.66 per cent germination followed by Novaluron (Rimon 10 EC) @ 0.05 ml/kg seed and Spinosad (Tracer 45 SC) @ 3.5 mg/kg seed with 83 per cent, and Indoxacarb (Avaunt 14.5 SC) @ 13.8 mg/kg seed with 81 per cent germination. The minimum seed germination were observed in Malathion (Malathion 5% Dust) @ 2.5mg/kg seed with 80 per cent followed by Nimbecidine (Nimbecidine 0.03% EC) @1.5ml/kg seed with 81 per cent germination. All the treatment showed higher germination than control 78 per cent.

Table 2: Efficacy of seed protectants (newer insecticides) on Mung bean seed germination (%) at different storage period

Treatment	Seed protectant	Dose (mg or ml/ kg Seed)	Storage Months After Treatment (Germination %)	
			3	6
T_1	Emamectin benzoate (procliam 5 SG)	40 mg	86.66 (68.568)	83.33 (65.893)
T_2	Spinosad (Tracer 45 SC)	3.5 mg	83.00 (65.647)	78.66 (62.601)
T_3	Indoxacarb (Avaunt 14.5 SC)	13.8 mg	81.00 (64.168)	78.33 (62.243)
T_4	Malathion (Malathion 5% Dust)	2.5 mg	80.00 (63.427)	76.00 (60.682)
T_5	Novaluron (Rimon 10 EC)	0.05 ml	83.00 (65.664)	79.66 (63.191)
T_6	Nimbecidine (Nimbecidine 0.03% EC)	1.5 ml	81.00 (64.137)	75.33 (60.198)
T_7	Deltamethrin (Decis 2.8 EC)	0.04 ml	86.66 (68.576)	82.66 (65.396)
T_8	Control	Untreated	78.00 (62.028)	69.66 (56.563)
S.E(m)±			0.88	1.11
C.D. (5%)			2.66	3.38

After 6 months of storage the seed germination between different seed protectants ranged from 69.66 - 83.33 per cent. The maximum germination was recorded in Emamectin benzoate (procliam 5 SG) @ 40 mg/kg seed with 83.33 per cent germination followed by Deltamethrin (Decis 2.8 EC) @ 0.04 ml/kg seed with 82.66 per cent, Novaluron (Rimon 10 EC) @ 0.05 ml/kg seed with 79.66 per cent, Spinosad (Tracer 45 SC) @ 3.5 mg/kg seed with 78.66 per cent and Indoxacarb (Avaunt 14.5 SC) @ 13.8 mg/kg seed with 78.33 per cent.

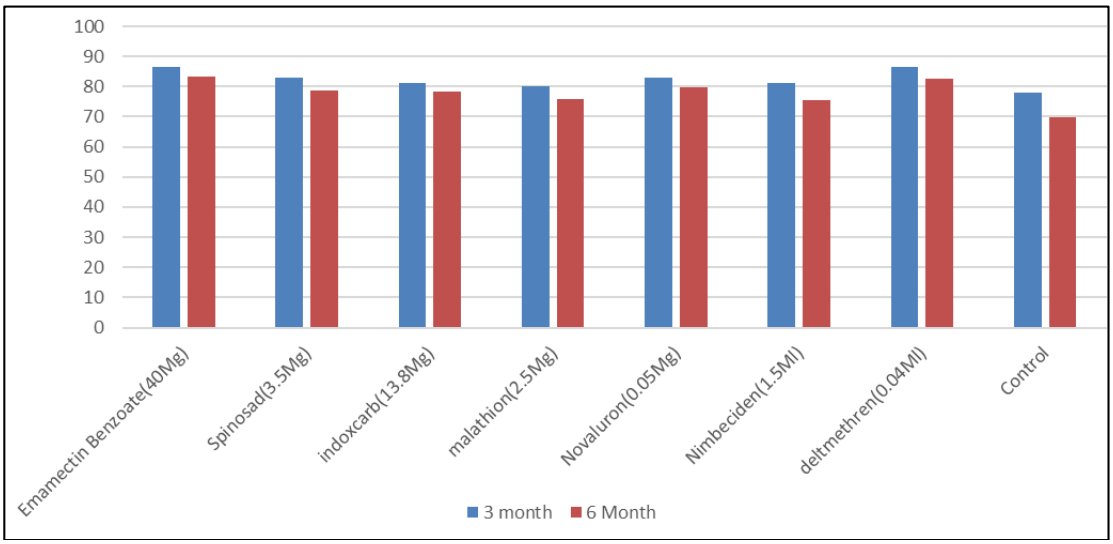

Fig 2: Efficacy of seed protectants (newer insecticides) on Mung bean seed germination (%) at different storage period

The minimum seed germination was in Nimbecidine (Nimbecidine 0.03% EC) @1.5ml /kg seed with 75.33 followed by Malathion (Malathion 5% Dust) @ 2.5mg /kg seed with 76 per cent germination and significantly good in compared to control 69.66 per cent germination.

Efficacy of seed protectants (newer insecticides) on Mung bean seed Vigour Index at different storage period:

After 3 months of storage the seed vigour index ranged 1367.53 - 2623.86. The highest seed vigour index was recorded in Emamectin benzoate (procliam 5 SG) @ 40 mg/kg seed with 2623.86 followed by Deltamethrin (Decis 2.8 EC) @ 0.04 ml/kg seed with 2173.31, Novaluron (Rimon 10 EC) @ 0.05 ml/kg seed with 2147.20, and Spinosad (Tracer 45 SC) @ 3.5 mg/kg seed with 2089.50. The minimum seed vigour index was recorded in Nimbecidine (Nimbecidine 0.03% EC) @1.5ml/kg seed with 1948.86 followed by Malathion (Malathion 5% Dust) @ 2.5mg/kg seed with 2055.53 and Indoxacarb (Avaunt 14.5 SC) @ 13.8 mg/kg seed with 2088.0 vigour index. The lowest vigour index was obtained in control with 1367.53.

Table 3: Efficacy of seed protectants (newer insecticides) on Mung bean seed Vigour Index at different storage period

Treatment	Seed protectant	Dose (mg or ml/ kg Seed)	Storage Months After Treatment (Vigour index)	
			3	6
T_1	Emamectin benzoate (procliam 5 SG)	40 mg	2623.86	2158.13
T_2	Spinosad (Tracer 45 SC)	3.5 mg	2089.50	1896.10
T_3	Indoxacarb (Avaunt 14.5 SC)	13.8 mg	2088.00	1763.16
T_4	Malathion (Malathion 5% Dust)	2.5 mg	2055.53	1622.30
T_5	Novaluron (Rimon 10 EC)	0.05 ml	2147.20	1919.13
T_6	Nimbecidine (Nimbecidine 0.03% EC)	1.5 ml	1948.86	1179.33
T_7	Deltamethrin (Decis 2.8 EC)	0.04 ml	2173.31	2063.96
T_8	Control	untreated	1367.53	979.23
S.E(m)±			61.15	63.28
C.D. (5%)			184.90	191.36

After 6 months of storage the seed vigour index ranged from 979.23 - 2158.13 and the higher vigour was recorded in Emamectin benzoate (procliam 5 SG) @ 40 mg/kg seed with 2158.13 followed by Deltamethrin (Decis 2.8 EC) @ 0.04 ml/kg seed with 2063.96, Novaluron (Rimon 10 EC) @ 0.05 ml/kg seed with 1919.13, and Spinosad (Tracer 45 SC) @ 3.5 mg/kg seed with 1896.10 seed vigour index.

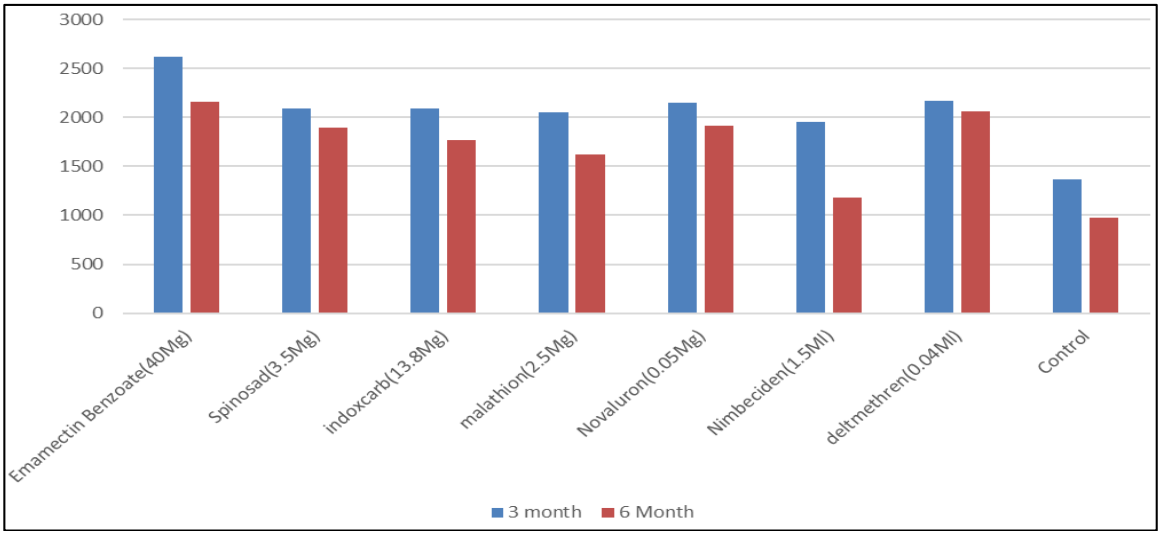

Fig 3: Efficacy of seed protectants (newer insecticides) on Mung bean seed Vigour Index at different storage period

The minimum seed vigour index was observed in Nimbecidine (Nimbecidine 0.03% EC) @1.5ml/kg seed with 1179.33 followed by Malathion (Malathion 5% Dust) @ 2.5mg/kg seed with 1622.30 and Indoxacarb (Avaunt 14.5 SC) @ 13.8 mg/kg seed with 1763.16 seed vigour index. The vigour index in control was 979.23 that were very low in compared to all treatments.

Discussion

All the evaluated seed protectants were able to protect the seed above Indian minimum seed certification standard upto 6 months of storage and were superior over control. Among all evaluated seed protectants, the Emamectin Benzoate (Procliam 5 SG) @ 40mg/kg seed followed by Deltamethrin (Decis 2.8 EC) @ 0.04ml/kg seed and Novaluron (Rimon 10 EC) @ 0.05 ml/kg seed was found more effective due to minimum insect infestation per cent. These results were also supported by Kumari *et al.* (2014) [6] and Kadam *et al.* (2013) [5]. Germination per cent was found significantly above the IMSCS level up to 6 months of storage when seed was treated with Emamectin benzoate (Procliam 5 SG) @ 40 mg/kg seed with 83.33% followed by Deltamethrin (Decis 2.8 EC) @ 0.04ml/kg seed and Novaluron (Rimon 10 EC) @ 0.05 ml/kg seed at 3 to 6 months of ambient storage. Similar results were also found by Anonymous (2015) [1] and Sushma *et al.* (2014) [11]. Seed vigour index was found significantly higher when seed was treated with Emamectin benzoate (Procliam 5 SG) @ 40 mg/kg seed with 2158.13 followed by Deltamethrin (Decis 2.8 EC) @ 0.04 ml/kg seed with 2063.96 and Novaluron (Rimon 10 EC) @ 0.05 ml/kg seed with 1919.13 up to 6 months of storage. These results were also supported by Sushma *et al.* (2014) [11] and Babu *et al.*, (2008).

Conclusion

Thus present investigation showed that seed protectants *viz.*, Emamectin benzoate (Procliam 5SG) @ 40 mg/kg seed followed by Deltamethrin (Decis 2.8 EC) @ 0.04 ml/kg seed and Novaluron (Rimon 10 EC) @ 0.05 ml/kg seed may be used as suitable seed protectants for storing seed of mung bean under ambient storage condition in order to maintain the Indian Minimum Seed Certification Standards for at least 6 months.

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