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Insecticidal seed treatment in redgram storage

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Abstract
A Laboratory experiment was carried out to know the efficacy of new insecticidal molecules as seed treatment on storage insect pests and seed viability during storage under ambient conditions on redgram from July 2024 to June 2025. Among the insecticides, seed treated with broflanilide @3 ppm recorded nil seed damage upto nine months after storage. At twelve months after storage 70 percent mortality of pulse beetle adults was recorded in seed treated with broflanilide @3 ppm.

Keywords: Redgram, pulse beetle, broflanilide, dinotefuran, residual toxicity

Introduction

Redgram is commonly known as Tur or Arhar is the second important pulse crop in the country. The ability of redgram to produce high economic yields under soil moisture deficit makes it an important crop in rainfed and dry land agriculture. Area under redgram reported during 2024-25 was 41.99 lakh ha and production (42.2 lakh tonnes) in India (Anonymous 2025) [1].

After harvest, storage of seeds until the next cropping season without reducing their quality is crucial for successful seed production. Effective seed storage ensures that seeds remain viable, maintaining their germination potential and vigour. The challenge lies in preserving quality of seeds over time, which can be affected by various factors such as moisture, temperature and insect pests. Post-harvest damages by insect pests have been an increasingly important constraint to food legume supplies worldwide. Insects pose a significant threat to stored seeds, often leading to substantial losses.

The most important storage pest of redgram is the weevil called *Callosobruchus chinensis* (Order: Coleoptera). Its infestation starts either in the field on the maturing pod and is carried to the stores with the harvested crops or it originates in the storage itself. Severe infestation can lead to total grain loss in storage. It is a field-to-store pest; adult beetles lay eggs on pods (in the field) or seeds (in storage). It is known to be prolific and rapid in breeding and can swiftly cause a significant quantitative drop as well as diminish the nutritional value of stored grains. Insecticides with various mode of action must be rotated often to maintain effective management of pest population. Emamectin benzoate, deltamethrin, spinosad and other regularly used insecticides are crucial in the management of pests. Insect pests are developing resistance to these insecticides after two or three years of their application. Therefore, it is necessary to assess newer and safer chemical molecules (Patil *et al*, 2025) [3].

Seed treatment is one of the important management practices to protect the seed from insect pests during storage. In view of the safety to human beings as well as protection against these insect pests, there is a need to evaluate insecticides of new origin.

Synthetic insecticides of organic as well as inorganic nature are in use for the management of stored grain pests which are proved to be safe from the view of application as well as consumers. Broflanilide is a new meta-diamide insecticide with a novel mode of action without known cross-resistance that delivers excellent efficacy in controlling problematic chewing insect pests, including Lepidopterans, coleopteran and thysanopteran pests. Broflanilide acts as an allosteric modulator of the GABA receptor disrupting insect neurotransmission and leading to paralysis and death. Dinotefuran is furanicotinyl insecticide which belongs to the third generation of neonicotinoids with a broad spectrum and systemic insecticidal activity. Dinotefuran provides a tetrahydrofuran (THF) moiety distinct from other neonicotinoids with a chloropyridine or chlorothiazole ring, which is considered to be an essential structural element for the neonicotinoid action. The unique chemical and excellent biological properties and favourable toxicological profile make dinotefuran available for pest management in wide range of crops with a variety of application methods

Therefore, to manage the insect pests of redgram during storage, new molecules with a novel mode of action are needed. Due to the significant vulnerability of seeds to deterioration caused by insect pest infestation, new molecules like broflanilide and dinotefuran are used along with check. Taking into consideration the need for the management of storage insect pest infestation and increase the storage life of seeds, present investigations were made to study the effect of new molecules as seed treatment against storage insect pests, seed quality and storability in redgram.

Materials and Methods

One kg of freshly harvested certified seed with very high percentage of germination and low moisture content (<10%) was taken for each treatment per replication. Required quantity of insecticides were diluted in water to make total volume of 5 ml for treating one kg of seed for proper coating (if required). After drying in shade, seeds were packed and kept in room under ambient temperature.

Residual toxicity was studied by taking out 100 g of treated seed and releasing 10 adult insects *Callosobruchus chinensis* and mortality recorded after 3, 7 and 15 days and thereafter, every three months for a total period of 12 months. Observations recorded were

- Seed germination, seed moisture
- Insect infestation (% kernel damage)
- Presence / Absence of insects (live and dead)

Experiment was conducted in completely randomized design with nine treatments and three replications in Seed Research Technology Centre, Rajendranagar, Hyderabad.

1. Broflanilide @ 1 ppm (300 SC @3.33 mg /kg seed)
2. Broflanilide @ 2 ppm (300 SC @6.66 mg/kg seed)
3. Broflanilide @ 3 ppm (300 SC @9.99 mg /kg seed)
4. Dinotefuran @ 1 ppm (20SG @5 mg/kg seed)
5. Dinotefuran @ 2 ppm (20SG @10 mg/kg seed)
6. Dinotefuran @ 3 ppm (20SG @20 mg/kg seed)
7. Emamectin benzoate @2ppm (5SG @40.0 mg/kg seed)
8. Deltamethrin @ 1.0 ppm (Deltamethrin 2.8EC@ 0.04 ml/kg seed)
9. Untreated control

Results

No seed damage was observed in redgram seeds treated with Broflanilide @ 3 ppm (T_3) upto nine months of storage. After one year 2.63% damage was recorded in seeds treated with Broflanilide @ 3 ppm (T_3).Significant difference in seed damage was noticed among treatments at different storage intervals. Highest damage of 1.25% was recorded in control at three months while it increased to 8.87% at twelve months.

Moisture content decreased with storage duration. No significant difference occurred among treatments. At three and six months of storage, germination in control was high compared to treatments. But at nine months there was no difference among treatments and control. At 12 months germination varied between 61-71%. Yadav and Singh, 2020 [6] recorded 85.67 percent germination in redgram after nine months storage with emamectin benzoate 5SG@40mg/kg, Deltamethrin 2.8 EC @ 0.04 ml/kg of seed was found effective for control of pulse beetle in stored pigeon pea seed and maintained germination above MSCS (87.66%) upto 6 months of storage(Rathod *et al*, 2018) [4].

Mortality recorded at three days after release of pulse beetle immediately after seed treatment was 100% in seeds treated with Broflanilide @ 3 ppm(T_3) while no mortality was recorded in control. T_7(Emamectin benzoate @2ppm) was the second best treatment. At 15 days after release of insects, T_1 (Broflanilide @ 1 ppm), T_2(Broflanilide @ 2 ppm) and T_8 (Deltamethrin @ 1.0 ppm) also resulted in 100% mortality.

At three months, three days after release 100% mortality was observed in seeds treated with Broflanilide @ 3 ppm(T_3) and Emamectin benzoate @2ppm (T_7). Broflanilide @ 2 ppm(T_2) and T_8 were on par with the best treatment. After six months of storage 73.3% mortality was recorded in T_3 while 26.7% in control at three days after release of pulse beetle.

Nine months after storage, mortality of released insects was 100% in T_3 at 7 days and it was on par with T_7. At 15 days after release, T_2(Broflanilide @ 2 ppm) and T_8 (Deltamethrin @ 1.0 ppm) also gave 100% mortality. Maximum of 70% mortality was noticed at 3 days after release in T_3 after one year of storage.

The present results are in concurrence with that of Patil *et al* 2025 [3] in cowpea. Thirumala Raju and Jyothi, 2016 [5] reported 0.83 % insect damage in cowpea nine months after storage. Deshpande *et al*, 2024 [2] reported that seed treatment in Greengram with emamectin benzoate 5 SG (4 ppm/kg of seed) was most effective in controlling pulse beetle infestation recording the highest adult mortality (87.75%) and lowest seed damage (3.67%).

A successful seed storage management strategy that kept seed quality of redgram for up to one year was the broflanilide @3 ppm (300 SC @ 9.99 mg/kg seed) treatment.

Table 1: Effect of treatments on seed germination (%), Seed damage% and moisture content (%) in Redgram

	Germination%				Seed Damage %				Moisture content (%)			
Treatments	3M	6M	9M	12M	3M	6M	9M	12M	3M	6M	9M	12M
T_1: Broflanilide @ 1 ppm (300 SC @3.33 mg /kg seed)	78.33 (62.26)	80 (63.4)	75.33 (60.2)	61.67 (51.7)	0.63 (4.56)	0.84 (5.25)	0.99 (5.71)	4.66 (12.42)	11.93 (20.19)	9.53 (17.97)	7.53 (15.92)	8.0 (16.42)
T_2: Broflanilide @ 2 ppm (300 SC @6.66 mg/kg seed)	86.33 (68.37)	90 (71.53)	85.67 (67.73)	71.67 (57.84)	0.34 (3.35)	0.19 (2.51)	0.07 (1.2)	3.45 (10.66)	11.80 (20.07)	10.13 (18.53)	7.80 (16.21)	7.73 (16.13)
T_3: Broflanilide @ 3 ppm (300 SC @9.99 mg /kg seed)	76.67 (61.12)	79.33 (62.94)	76.00 (60.65)	61.67 (51.7)	0.00 (0)	0.00 (0)	0.00 (0)	2.63 (9.23)	11.57 (19.86)	9.70 (18.13)	7.87 (16.28)	7.70 (16.1)
T_4: Dinotefuran @ 1 ppm (20SG @5 mg/kg seed)	76.00 (60.65)	79.00 (62.7)	74.67 (59.75)	65.00 (53.71)	0.93 (5.54)	1.21 (6.32)	1.53 (7.09)	4.18 (11.74)	11.13 (19.43)	9.80 (18.23)	7.40 (15.77)	7.90 (16.31)
T_5: Dinotefuran @ 2 ppm (20SG @10 mg/kg seed)	77.00 (61.32)	78.33 (62.23)	73.67 (59.1)	65.67 (54.11)	0.83 (5.23)	0.97 (5.64)	1.11 (6.03)	4.02 (11.5)	11.33 (19.65)	9.80 (18.23)	7.60 (15.99)	7.93 (16.35)

T_6: Dinotefuran @ 3 ppm (20SG @20 mg/kg seed)	75.00 (59.97)	78.33 (62.23)	73.67 (59.1)	62.33 (52.13)	0.68 (4.72)	0.81 (5.17)	0.96 (5.62)	3.63 (10.9)	11.10 (19.41)	9.67 (18.1)	7.47 (15.84)	7.93 (16.35)
T_7: Emamectin benzoate @2ppm 5SG @40.0 mg/kg seed)	76.33 (60.87)	77.00 (61.32)	76.33 (60.87)	63.67 (52.9)	0.29 (3.1)	0.00 (0)	0.00 (0)	2.96 (9.89)	10.83 (19.2)	9.70 (18.13)	7.20 (15.54)	7.90 (16.31)
T_8:Deltamethrin @ 1ppm (2.8EC @0.04 ml/kg of seed)	73.33 (58.89)	76.33 (60.87)	77.00 (61.32)	64.00 (53.11)	0.44 (3.8)	0.07 (1.26)	0.00 (0)	2.80 (9.53)	12.83 (20.97)	9.97 (18.39)	7.03 (15.36)	7.53 (15.92)
T_9: Untreated control	91.33 (72.89)	92.33 (73.9)	74.67 (59.75)	70.67 (57.18)	1.25 (6.42)	2.43 (8.95)	2.95 (9.89)	8.87 (17.16)	11.43 (19.75)	9.57 (18)	7.50 (15.88)	7.73 (16.13)
CD (P=0.05)	2.75	1.19	1.63	2.48	0.17	0.64	0.6	2.79	NS	NS	NS	NS

Figures in () are arcsin transformed values

Table 2: Percent Mortality of *Pulse* beetle released to 100 g treated seeds at different storage interval in Redgram

	Immediately after seed treatment			3 months after storage			6 months after storage			9 months after storage			12 months after storage		
Treatments	3 DAR	7DAR	15DAR	3 DAR	7DAR	15DAR	3 DAR	7DAR	15DAR	3 DAR	7DAR	15DAR	3 DAR	7DAR	15DAR
T_1	56.67 (48.82)	78.33 (62.26)	100.00 (90)	88.33 (70.08)	100 (90)	100 (90)	51.7 (45.93)	81.7 (64.78)	100 (90)	46.7 (43.06)	86.7 (68.82)	96.7 (83.84)	46.7 (43.06)	100 (90)	100 (90)
T_2	73.33 (58.9)	88.33 (70.08)	100.00 (90)	98.33 (85.68)	100 (90)	100 (90)	60.0 (50.74)	86.7 (68.82)	100 (90)	61.7 (51.73)	93.3 (77.69)	100.0 (90)	50.0 (44.98)	100 (90)	100 (90)
T_3	100 (90)	100.00 (90)	100.00 (90)	100.00 (90)	100 (90)	100 (90)	73.3 (58.9)	96.7 (83.84)	100 (90)	80.0 (63.4)	100.0 (90)	100 (90)	70.0 (56.76)	100 (90)	100 (90)
T_4	31.67 (34.21)	35.00 (36.22)	54.33 (47.47)	33.33 (35.2)	51.67 (45.93)	65 (53.74)	23.3 (28.76)	60.7 (51.3)	76.7 (61.12)	26.7 (30.98)	43.3 (41.13)	53.3 (46.9)	53.3 (46.9)	100 (90)	100 (90)
T_5	45.00 (42.1)	51.67 (45.93)	67.67 (55.33)	43.33 (41.13)	68.33 (55.74)	76.67 (61.19)	32.7 (34.81)	69.3 (56.35)	86.7 (68.56)	38.3 (38.22)	56.7 (48.82)	66.7 (54.76)	56.7 (48.82)	100 (90)	100 (90)
T_6	51.67 (45.93)	71.67 (57.83)	76.00 (60.65)	66.67 (54.76)	76.67 (61.12)	83.33 (66.11)	46.0 (42.68)	77.0 (61.32)	89.3 (70.92)	51.7 (45.93)	68.3 (55.74)	70.0 (56.76)	63.3 (52.75)	100 (90)	100 (90)
T_7	81.67 (64.66)	100.00 (90)	100.00 (90)	100.00 (90)	100.00 (90)	100 (90)	68.3 (55.74)	100.0 (90)	100.0 (90)	78.3 (62.26)	98.3 (85.68)	100.0 (90)	66.7 (54.76)	100 (90)	100 (90)
T_8	53.33 (46.9)	87.67 (69.47)	100.00 (90)	96.67 (83.84)	100.00 (90)	100 (90)	58.3 (49.78)	83.3 (65.92)	100 (90)	53.3 (46.9)	86.7 (68.82)	100 (90)	63.3 (52.75)	100 (90)	100 (90)
T_9	0.00 (0)	31.67 (34.21)	46.00 (42.68)	26.67 (30.98)	36.67 (37.21)	56.67 (48.82)	26.7 (34.98)	43.3 (41.3)	56.7 (48.82)	23.3 (28.76)	36.7 (37.21)	55.0 (47.86)	40.0 (39.21)	100 (90)	100 (90)
CD (P=0.05)	6.44	3.32	1.83	8.65	2.69	4.34	4.08	7.53	2.38	4.61	9.12	6.94	4.8	NS	NS

Figures in () are arcsin transformed values

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