

Efficacy of Safer and Indigenous Chemicals against *C. serratus* in Stored Groundnut

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ABSTRACT

Experiment was conducted to effect of safer and indigenous chemicals against groundnut bruchid *Caryedon serratus* in stored groundnut the results revealed that the safer chemicals followed the order Spinosad>Azadirachtin>deltamethrin> malathion. Whereas, indigenous chemicals followed the order fly ash > common salt > boric acid against oviposition and adult emergence. The per cent pod damage spinosad, Malathion, Azadirachtin 3000 ppm, deltamethrin and Azadirachtin 1000 ppm were also effective in reducing the pod damage. However the indigenous chemicals followed the order common salt > fly ash > boric acid.

Key words: Groundnut bruchid, spinosad, Malathion, Azadirachtin, Delatamethrin, Azadirachtin, Common salt, Fly ash and Boric acid.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a leguminous oilseed crop cultivated in the semi-arid and subtropical regions of the world. Globally 50 per cent of groundnut produce is used for oil extraction, 38 per cent for confectionary use and 12 per cent for seed purpose. In India, about 80 per cent is used for oil extraction, 11 per cent as seeds, 8 per cent as direct food and one per cent for export to other countries. In India, 70 per cent of the groundnut area and 75 per cent of the production are concentrated in Gujarat, Andhra Pradesh, Tamil Nadu and Karnataka.

In Andhra Pradesh, it is grown in 6.82 lakh ha during *kharif* with a production and an average yield of 5.98 lakh tonnes and 876 kg ha⁻¹, respectively. During *rabi* it is grown in 0.93 lakh ha. With a production of 2.03 lakh tonnes, with an average yield of 2190 kg ha⁻¹. Ananthapuramu district in the state with 0.74 m ha of area under cultivation is the largest producer of groundnut. Out of 100 species of insect pests attacking the stored groundnut, pod bruchid *Caryedon serratus* (Olivier) is a major cosmopolitan pest of economic importance¹.

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The groundnut bruchid, *C. serratus* is the primary storage pest of unshelled groundnuts in many parts of Asia and throughout West and Central Africa². The continuous usage of chemicals as prophylactic and curative treatment not only contaminates the produce but also leads to serious health hazards and environmental problems. Hence, use of safer insecticides and storage under air tight containers are important which are eco-friendly methods of storage pest management.

MATERIAL AND METHODS

The experiment was conducted in the laboratory of Entomology at Regional Agricultural Research Station, Nandyal, Kurnool District, The infested pods containing the pupae collected from SRTC, Hyderabad were transferred to clean plastic jars (18 × 14 × 12 cm). The jars were covered with rearing cloth and kept in the laboratory until the adults emerged. Emerging adults were transferred to again clean plastic jars (12 × 10 × 6 cm) and

TREATMENTS

Treatments	Dosage (kg ⁻¹ of pods)	Source
T1 : Common salt	10 gm	Annapurna salt
T2 : Boric Acid	10 gm	Local available
T3 : Fly ash	10 gm	Local available
T4 : Malathion	5 ml	Milthion (Insecticides India Ltd) Dahei, Gujarat
T5 : Deltamethrin	2 ml	Decis (Bayer Crop Sciences) Thane, Maharashtra
T6 : Spinosad	1 ml	Tracer (Dow AgroSciences) Mumbai, Maharashtra
T7 : Azadirachtin 1000 ppm	5 ml	Nivaar (ShriDisha Biotech, Pvt. Ltd) Hyderabad, Telangana
T8 : Azadirachtin 3000 ppm	5 ml	Nivaar (Shri Disha Biotech, Pvt. Ltd) Hyderabad, Telangana
T9 : Untreated check	-	

Spinosad is a novel insecticide, derived from a family of natural products obtained by fermentation of *Saccaropolysporas pinosa* (Actinomycetes). Spinosad is highly active, in both contact and ingestion against large number of insects. Spinosyns primarily target the binding sites on nicotinic acetylcholine receptors of insect nervous system leading to disruption of acetylcholine neurotransmission.

Azadirachtin, a component of neem oil, a complex tetranortriterpenoidlimonoid from the neem seeds, is the main component

supplied with groundnut pods for oviposition. Before offering to the adults, the groundnut pods were kept in hot air oven at 70°C for 5 minutes to get rid of any unwanted insect infestations, with regular monitoring, the culture of *C. serratus* was maintained for utilized of adults for different experiment.

Nine different test indigenous/ safer chemicals were procured from market and considered as each as treatment and replicated thrice. Each test chemical was mixed with 2 kg of groundnut pods in a cloth bag and into which five pairs of freshly emerged adults were released and the bag was tied. Destructive sampling was done on 100 g of randomly selected pods from each treatment at 15 days intervals. The data on number of eggs laid, number of adults emerged (per replication), per cent pod damage by count and weight, per cent weight loss was recorded as described in the above sections and was continued upto 6 months.

responsible for the toxic effects in insects. Azadirachtin effects growth, development, behavior, reproduction and metamorphosis.

Deltamethrin is a synthetic insecticide based structurally on natural pyrethrins, rapidly paralyze the insect nervous system giving a quick knockdown effect.

Malathion, organophosphate insecticide is well known for its contact, stomach toxicity. In addition, it is having good fumigant action and highly recommended against storage insects including *C. serratus*.

Fly ash, known as pulverized fuel ash is a coal combustion product. Fly ash particles are empty spheres filled with smaller amorphous particles and crystals. Fly ash absorbs moisture from the pods and insects body leading to unfavourable atmosphere.

Common salt absorbs moisture from the insect body leading to death. There are several reports that boric acid is highly toxic to insects. Boric acid based insecticides are used for controlling termites, carpenter ants, powder post beetles etc.

OVOPOSITION AND ADULT EMERGENCE

At every 15 days, from 100 g representative sample, the no of eggs laid on selected pods and adults emerging from different treatments were counted. Adults were removed at every time. This process was continued upto 180 days. The data on oviposition and adult emergence was pooled and subjected to statistical analysis.

POD DAMAGE

At every 15 days, from selected 100 g pods, from each treatment, the data was collected on number of damaged pods and healthy pods. Weights of both damaged and healthy pods were also recorded. The per cent damage of pods by count and weight were calculated with the help of following formulae (Lal, 1990).

Per cent pod damage (by count) =

$$\frac{\text{Number of bored pods}}{\text{Total number of pods}} \times 100$$

Per cent pod damage (by weight) =

$$\frac{\text{Weight of bored pods}}{\text{Total weight of pods}} \times 100$$

WEIGHT LOSS

Weight loss was calculated by deducting the final weight of sample at the period of termination of the experiment i.e. at 180 days after the initiation of the experiment and from initial weight taken during initiation of the experiment and the data was converted to the percentage.

$$\text{Weight loss} = \frac{W1 - W2}{W1} \times 100$$

W1 = initial weight of pods

W2 = final weight of pods

STATISTICAL ANALYSIS

The oviposition and adult emergence was subjected to square root transformation and per cent pod damage (by count and by weight), weight loss were transformed in to angular transformed values; The data was then subjected to complete randomized design analysis⁴ and then subjected to statistical analysis by SPSS, 2012 for DMRT.

RESULTS AND DISCUSSIONS

The indigenous chemicals were found to have effects on oviposition and development of the adult (Table 1). The spinosad @ 1 ml kg⁻¹ was found to be most effective with mean number of 4.04 eggs which is significantly superior over other treatments including untreated check which recorded the highest mean of 61.29 eggs. Azadirachtin 1000 ppm, 3000 ppm, deltamethrin @ 2 ml kg⁻¹ with mean number of 5.33, 5.42 and 6.04 were the next effective chemicals after Spinosad @ 1 ml kg⁻¹ and significantly superior over control treatment. The other indigenous chemicals, malathion @ 5 ml kg⁻¹, boric acid, common salt @ 10 g kg⁻¹ and fly ash @ 10 g kg⁻¹ have recorded mean numbers of 9.21, 29.63, 39.67 and 45.54 eggs respectively.

All the chemicals were found to be significantly superior in decreasing the adult emergence. Lowest adult mean emergence of 1.00 was observed when treated with spinosad @ 1 ml kg⁻¹ which is significantly superior over all other chemicals including control treatment which recorded mean adult emergence of 23.88. Azadirachtin 1000 ppm, 3000 ppm 5 ml kg⁻¹ were on par with mean adult emergence of 2.67 and 2.92 and the next effective chemicals in preventing adult emergence and significantly superior over other treatments except spinosad @ 1 ml kg⁻¹. Other chemicals deltamethrin @ 2 ml kg⁻¹, malathion @ 5 ml kg⁻¹, boric acid, fly ash @ 10 g kg⁻¹ and common salt @ 10 g kg⁻¹ recorded mean adult emergence of 3.08, 3.17, 5.46, 9.63 and 10.71 respectively.

At 180 days, spinosad @ 1 ml kg⁻¹, malathion @ 5 ml kg⁻¹, Azadirachtin 3000 ppm, deltamethrin @ 2 ml kg⁻¹ and Azadirachtin 1000 ppm @ 5 ml kg⁻¹ recorded 0.31, 1.17, 1.24, 1.94 and 2.07 per cent pod damage by count respectively which were on par and significantly superior over other treatments including untreated check which recorded 48.13 per cent. In the remaining treatments, the per cent pod damage by count ranged from 9.83 to 38.42 per cent.

Similarly the data on the per cent pod damage by weight upto 180 days showed that spinosad @ 1 ml kg⁻¹ recorded lowest pod damage by weight of 4.30 per cent which was on par with Azadirachtin 3000 ppm @ 5 ml kg⁻¹, Azadirachtin 1000 ppm @ 5 ml kg⁻¹, deltamethrin @ 2 ml kg⁻¹ and malathion @ 5 ml kg⁻¹ which recorded 5.78, 6.62, 7.48 and 8.87 per cent respectively. Whereas, boric acid, common salt @ 10 g kg⁻¹ and fly ash @ 10 g kg⁻¹ recorded per cent pod damage by weight recorded of 21.43, 34.15 and 41.78 respectively. These chemicals were significantly superior over other treatments including untreated check with no insecticide treatment and which recorded 48.25 per cent.

The efficacy of indigenous chemicals on the per cent weight loss of pods proved that spinosad @ 1 ml kg⁻¹ recorded lowest weight loss per cent of 3.91 which was on par with Azadirachtin 1000 ppm, 3000 ppm @ 5 ml kg⁻¹, deltamethrin @ 2 ml kg⁻¹, malathion @ 5 ml kg⁻¹ (3.94, 4.01, 4.47 and 4.67 per cent respectively) and significantly superior over other treatments including untreated check which recorded weight loss or per cent of 48.59. In other treatments weight loss ranged from 18.43 to 25.97 per cent.

The safer chemicals followed the order Spinosad>Azadirachtin>deltamethrin>malathion. Whereas, indigenous chemicals followed the order fly ash > common salt > boric acid against oviposition by *C. serratus*. Najitha⁵ reported that spinosad @ 5000 mg a.i./m² remained toxic upto 180 DAT against *C. serratus* and are in negation with the reports of Raghuram⁶ who reported that the effectiveness

of spinosad against *C. serratus* decreased from 90 DAT to 180 DAT.

The per cent pod damage was lowest in the treatment spinosad. Malathion, Azadirachtin 3000 ppm, deltamethrin and Azadirachtin 1000 ppm were also effective in reducing the pod damage. However, the indigenous chemicals followed the order common salt > fly ash > boric acid. Ahmed Gumaa and Abdelmanan Elzein Hassan Elamin reported that the infestation by *C. chinensis* showed highly significant differences ($P > 0.01$) in the number of holes per 100 cowpea seeds between the different treatments viz., groundnut oil, wood ash, sand, neem leaves powder, rabal leaves powder and hot pepper powder.

The present findings are in concurrence with Najitha⁵ Spinosad @ 500 mg a.i./m² remained toxic upto 180 DAT to *C. serratus* and proved to be best among three concentrations by recording 100, 91.66, 33.33, 23.33, 16.66, 13.33 and 3.33 in 24 HAT to 180 DAT at monthly interval. These results were in contrary to the results obtained by Raghuram⁶ who reported cent per cent mortality of *C. serratus* upto 90 DAT and 95 per cent from 90 to 180 DAT. Fang *et al.*¹⁰, reported 100, 60 and 25 per cent mortality of *S. oryzae*, *Oryzae philus surinamensis* (L.) and *Tribolium castaneum* adults respectively, after 14 days of exposure to wheat treated with spinosad 1.0 mg/kg of seed. Swathi Kumari also recorded 36.66, 46.66, 56.66 and 60 per cent mortality of *S. oryzae* at 1, 2, 3 and 4 DAT and the same mortality was observed upto 7 DAT (60%) due to spinosad @ 0.06 per cent.

Hasanab *et al.*⁹ reported that deltamethrin 0.02 g was effective against *C. serratus* for two months whereas 0.04 g provided protection throughout the experimental period and they also reported that spinosad at 0.5 ml and 1.0 ml was effective against *C. serratus* throughout the experimental period with zero per cent pods with egg, adult emergence for first three months after treatment. No pod damage was observed first two months and after 4 month onwards pod damage was noticed.

Toews *et al.*⁸, tested the toxicity of spinosad on four surfaces *viz.* concrete surface, galvanized floor, unwaxed floor tile and waxed floor tile and reported that spinosad deposits @ 0.05-0.1 mg/cm² gave more than 98 per cent kill of adults of eight stored product beetles exposed for 24 hrs on all surface.

Vidyashree *et al.*⁷, results revealed that spinosad 45 SC @ 100 ppm a.i. treated to

porous HDPE bags was most effective against *C. maculatus* in chickpea by recording minimum seed damage (0.67 percent) of highest germination (84.81 per cent) and least adult survival rate (0.42 no./400 seeds) at nine months after treatment imposition, closely followed by emamectinbenzoate 5 SG @ 100 ppm a.i. (1.33 no./400 seeds) with germination of 84.6 per cent.

Table 1. Efficacy of safer and indigenous chemicals with respect to oviposition, adult emergence of *C. serratus* in stored groundnut at fortnight intervals upto 6 months. The data on per cent pod damage (count and weight) and percent weight loss are presented

Treatments	Dosage (Per kg pods)	Mean No. of eggs / 180 days	Mean No. adults / 180 days	Per cent pod damage by count / 180 days	Per cent pod damage by weight / 180 days	Weight loss (%) / 180 days
T ₁ : Common salt	10 g kg ⁻¹	39.67 ^d (6.37)	10.71 ^d (3.42)	38.42 ^d (38.27)	34.15 ^d (35.72)	24.05 ^c (29.29)
T ₂ : Boric Acid	10 g kg ⁻¹	29.63 ^c (5.52)	5.46 ^{bc} (2.54)	9.83 ^b (17.37)	21.43 ^c (27.49)	18.43 ^b (25.37)
T ₃ : Fly ash	10 g kg ⁻¹	45.54 ^d (6.79)	9.63 ^{cd} (3.24)	28.89 ^c (32.49)	41.78 ^e (40.23)	25.97 ^c (30.60)
T ₄ : Malathion	5 ml kg ⁻¹	9.21 ^b (3.19)	3.17 ^{ab} (2.04)	1.17 ^a (6.16)	8.87 ^b (17.29)	4.67 ^a (12.46)
T ₅ : Deltamethrin	2 ml kg ⁻¹	6.04 ^{ab} (2.64)	3.08 ^{ab} (2.01)	1.94 ^a (7.99)	7.48 ^{ab} (15.83)	4.47 ^a (12.18)
T ₆ : Spinosad	1 ml kg ⁻¹	4.04 ^a (2.21)	1.00 ^a (1.41)	0.31 ^a (3.13)	4.30 ^a (11.82)	3.91 ^a (11.40)
T ₇ : Azadirachtin 1000 ppm	5 ml kg ⁻¹	5.33 ^{ab} (2.52)	2.67 ^{ab} (1.91)	2.07 ^a (8.25)	6.62 ^{ab} (14.89)	3.94 ^a (11.43)
T ₈ : Azadirachtin 3000 ppm	5 ml kg ⁻¹	5.42 ^{ab} (2.52)	2.92 ^{ab} (1.98)	1.24 ^a (6.07)	5.78 ^{ab} (13.85)	4.01 ^a (11.54)
T ₉ : Untreated check (Control)	-	61.29 ^e (7.89)	23.88 ^e (4.99)	48.13 ^d (43.91)	48.25 ^e (43.98)	48.59 ^d (44.17)
SE(m)±		0.24	0.12	1.68	1.28	0.92
CD (0.05)		0.73	0.36	5.02	3.83	2.74

Values in parentheses are transformed values; Means followed by same letters are not significantly different by DMRT

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