Research Paper :

Bio-efficacy of certain grain protectants against groundnut bruchid, *Caryedon serratus* (Olivier)

HASANAB A. NADAF, S.R.K. RAO, N.R.G. VERMA AND V.R.K. MURTHY

International Journal of Plant Protection (April, 2010), Vol. 3 No. 1 : 60-64

See end of the article for authors' affiliations

Correspondence to :
S.R.K. RAO
Department of Entomology, College of Agriculture, Acharya N.G. Ranga Agricultural University, HYDERABAD (A.P.) INDIA

SUMMARY

Effect of certain grain protectants against groundnut bruchid *Caryedon serratus* was studied in the laboratory. It indicated that the treatment with sweet flag rhizome powder (10 g/kg) was found to be effective in disrupting the bruchid development by recording pods with no eggs, no pod damage and no adult emergence for the first two months. The pods treated with neem seed kernel powder (10 g/kg) protected the pods effectively against *C. serratus* for the first two months by recording 1.69 and 2.06% pod damage. Spinosad and deltamethrin proved their merit throughout experimental period by achieving zero per cent pods with egg, pod damage for first two months and adult emergence for first three months after treatment.

Key words : Neem, Sweet flag, Spinosad, Deltamethrine, *Caryedon serratus*

Accepted :* *January, 2010

Groundnut (*Arachis hypogaea* L.) is an important oilseed crop in many parts of the tropics, particularly in semi-arid areas. It is the world's fourth most important source of edible oil and third most important source of vegetable protein. The high oil (50 per cent) and protein (35 per cent) contents of groundnut serve the world's need for food, energy and industrial uses and is rich source of minerals (calcium, magnesium etc.) and vitamins (E, K and B group). It is highly difficult to store the oilseeds as they suffer a great damage during storage due to insect pests and micro-organisms. It is truly said that' a grain saved is a grain produced". At present, the only solution for stabilizing per capita availability is to reduce storage losses. Groundnut is stored as both pods and kernels and, both of these are susceptible to insects, fungi and mites in storage. One hundred insect species are reported to attack the stored groundnuts (Redlinger and Davis, 1982). Of these, eight insect species are of major importance and six are of minor importance. Among them, the groundnut borer/ groundnut bruchid, *Caryedon serratus* (Olivier) is a well known pest of economic importance. It has been reported as a pest of international importance in stored groundnut and is wide spread in various groundnut growing areas of the world (Davey, 1958).

C.serratus causes heavy loss in quality and quantity of stored groundnut. The extent of damage of bruchid was recorded as 77 per cent in pods by Kumari *et al*. (2002) and 50 to 70 per cent by Devi and Rao (2000). Indiscriminate use of toxic pesticides for preventing storage losses in groundnut may lead to human and animal health problems due to residual hazards. Therefore, usage of botanicals and less residual insecticides is of great importance.

MATERIALS AND METHODS

Studies on the management of groundnut bruchid, *C. serratus* was conducted in the Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad during November, 2007 to June, 2008. Twenty five pairs of freshly emerged adult beetles were released into glass jar (20 x 10 cm) containing 250 g of groundnut pods. The mouth of the jar was covered with muslin cloth and held tight with rubber bands. Ten such jars were maintained for mass culturing of the bruchids. The adult beetles were removed after ten days and the jars were kept undisturbed till the emergence of adults. The freshly emerged adults were used in the experiment (Sandeep, 2005). The potential efficacy of grain protectants *viz.*, neem seed kernel powder, sweet flag rhizome powder, deltamethrin and spinosad was evaluated against groundnut

bruchid under laboratory conditions.

One kilogram of groundnut pods (TMV-2) were used in each replication and three replications were maintained for each treatment and stored in gunny bags. The thoroughly dried groundnut pods were treated with the test chemicals and shade dried for an hour before they were transferred to gunny bags. The insecticide solution of 100 ml was found sufficient for complete wetting of one kilogram groundnut pods. An untreated check was also maintained.From each replication of each treatment fifty grams of groundnut pods were transferred to different glass jars at monthly interval for four months and five pairs of freshly emerged adults were released into each jar and the jars were covered with muslin cloth secured with rubber bands. Subsequently, the data were collected on adult mortality and pods with eggs at ten days after release, adult emergence and pods damaged after cease of adult emergence for estimating the relative performance of the individual grain protectant.

RESULTS AND DISCUSSION

The treatment of groundnut pods with sweet flag rhizome powder (10 g) was found to be effective in disrupting the bruchid development by recording pods with no eggs, no pod damage and no adult emergence (Table 2 and 3) for the first two months. Sandeep (2005) reported that the sweet flag rhizome powder at 1% was found to be the most effective grain protectant in preventing oviposition and pod damage by *C. serratus*. Deleterious effects of sweet flag rhizome powder were reported on *C. chinensis* by Ghosh *et al.* (1981), on *S. oryzae* by Ramarao and Sarangi (1998) and Hanumanthrao (2003). The antifeedant, insecticidal and antigonodal properties of sweet flag rhizome powder might have influenced C. *serratus* development These findings are in conformity with the present results.

The pods treated with neem seed kernel powder (10 g) protected the pods effectively against *C. serratus* damage for the first two months by recording 1.69 and 2.06% pod damage when compared with the control (Table 2), wherein 14.11 and 17.79% pods damage was noticed during first and second month, respectively. The present results are in conformity with Mathur *et al.* (1985) and Rani and Mohan (2007) who found the neem seed kernel powder was most effective in reducing the infestation of *C. chinensis* and *C. maculatus* on black gram and green gram, respectively. However, half the dose of neem seed kernel powder (5 g) was ineffective against *C. serratus* and recorded 15.30, 51.70, 31.20, and 83.5% mortality, pods with eggs, pod damage and adult emergence, respectively (Table 3 and 4).

Groundnut pods treated with deltamethrin (0.02 and 0.04 g) and spinosad (0.5 and 1.0 ml) were effective in controlling bruchid infestation by recording 57.40, 64.16,

Table 1 : Effect of grain protectants on the mortality of adult *C. serratus* (Olivier) in groundnut pods

Treatments	Dose/kg	Corrected mortality (%)			
		First month	Second month	Third month	Fourth month
T_1 –Neem seed kernel powder	5 g	37.26^{b}	23.63^{c}	16.90^{b}	15.30^{d}
		(37.58)	(28.31)	(24.04)	(20.11)
T_2 –Neem seed kernel powder	10 g	50.80^{b}	33.83^{b}	20.20^{b}	16.90^{c}
		(45.46)	(35.25)	(22.26)	(24.62)
T_3 –Sweet flag rhizome powder	5 g	54.16^{b}	37.26^{b}	27.00^{b}	23.68^{c}
		(47.49)	(37.30)	(30.52)	(28.98)
T_4 –Sweet flag rhizome powder	10 g	77.90^{c}	67.86^{ab}	67.73^{a}	43.86^{b}
		(62.59)	(55.80)	(55.65)	(41.39)
T_5 –Deltamethrin	0.02 g	81.30^{c}	74.53^{a}	64.23^{a}	57.40^{ab}
		(64.90)	(64.65)	(53.72)	(49.36)
T_6 –Deltamethrin	0.04 g	84.70^{c}	77.96^{a}	74.40^{a}	64.16^{a}
		(67.21)	(66.64)	(60.77)	(53.27)
T_7 –Spinosad	0.5 ml	84.70^{c}	81.50^{a}	71.03^{a}	60.80^{ab}
		(67.21)	(65.90)	(57.96)	(51.32)
T_8 –Spinosad	1.00 ml	84.70^{c}	77.96^{a}	77.76^{a}	70.93^{a}
		(67.21)	(66.64)	(63.50)	(57.60)
S.E. $\pm$		3.52	9.09	6.98	4.13
C.D. (P = 0.05)		10.46	27.00	20.74	12.30

The values in the parenthesis are angular transformed values
In each column the values having same superscripts are not significant

Table 2: Effect of grain protectants on pod damage by *C.serratus* (Olivier) in groundnut pods

Treatments	Dose/kg	Pod damage (%)			
		First month	Second month	Third month	Fourth month
T_1 – Neem seed kernel powder	5 g	3.05^{b}	3.01^{b}	22.38^{c}	31.20^{c}
		(1.84)	(1.84)	(4.76)	(5.62)
T_2 – Neem seed kernel powder	10 g	1.69^{ab}	2.06^{b}	24.82^{cd}	29.74^{c}
		(1.38)	(1.58)	(5.00)	(5.49)
T_3 – Sweet flag rhizome powder	5 g	2.66^{b}	4.49^{c}	6.93^{b}	12.88^{b}
		(1.75)	(2.21)	(2.71)	(3.65)
T_4 – Sweet flag rhizome powder	10 g	0.00^{a}	0.00^{a}	1.08^{a}	2.68^{a}
		(0.70)	(0.70)	(1.20)	(1.64)
T_5 – Deltamethrin	0.02 g	0.00^{a}	0.00^{a}	0.98^{a}	2.06^{a}
		(0.70)	(0.70)	(1.17)	(1.47)
T_6 – Deltamethrin	0.04 g	0.00^{a}	0.00^{a}	0.59^{a}	1.39^{a}
		(0.70)	(0.70)	(0.97)	(1.29)
T_7 – Spinosad	0.5 ml	0.00^{a}	0.00^{a}	0.53^{a}	1.00^{a}
		(0.70)	(0.70)	(0.95)	(1.18)
T_8 – Spinosad	1.00 ml	0.00^{a}	0.00^{a}	0.00^{a}	0.900^{a}
		(0.70)	(0.70)	(0.70)	(1.06)
T_9 – Control	-	14.11^{b}	17.79^{d}	31.53^{d}	51.24^{d}
		(3.75)	(4.24)	(5.62)	(7.17)
S.E. $\pm$		0.23	0.16	0.27	0.32
C.D. (P = 0.05)		0.70	0.48	0.82	0.95

The values in the parenthesis are angular transformed values
In each column the values having same superscripts are not significant

Table 3: Effect of grain protectants on egg laying of C. *serratus* (Olivier) in groundnut pods

Treatments	Dose/kg	Pods with eggs (%)			
		First month	Second month	Third month	Fourth month
T_1 – Neem seed kernel powder	5 g	8.46^{c}	13.62^{c}	38.12^{c}	51.70^{c}
		(16.91)	(21.64)	(38.02)	(45.99)
T_2 – Neem seed kernel powder	10 g	7.19^{c}	13.40^{c}	41.98^{c}	58.82^{c}
		(15.51)	(21.45)	(40.36)	(50.08)
T_3 – Sweet flag rhizome powder	5 g	2.63^{b}	3.40^{b}	3.42^{ab}	10.62^{b}
		(9.16)	(10.28)	(10.34)	(18.44)
T_4 – Sweet flag rhizome powder	10 g	0.46^{a}	0.89^{a}	2.09^{ab}	7.37^{b}
		(2.24)	(4.42)	(8.17)	(15.32)
T_5 – Deltamethrin	0.02 g	1.63^{ab}	0.60^{a}	1.87^{ab}	2.63^{ab}
		(4.26)	(2.57)	(7.78)	(9.21)
T_6 – Deltamethrin	0.04 g	0.00^{a}	0.00^{a}	1.19^{ab}	1.85^{a}
		(0.00)	(0.00)	(3.63)	(7.69)
T_7 – Spinosad	0.5 ml	0.00^{a}	0.00^{a}	0.53^{a}	2.01^{ab}
		(0.00)	(0.00)	(2.42)	(8.04)
T_8 – Spinosad	1.00 ml	0.00^{a}	0.00^{a}	0.49^{a}	0.90^{a}
		(0.00)	(0.00)	(2.32)	(3.15)
T_9 – Control	-	9.72^{c}	17.14^{c}	43.24^{c}	71.65^{d}
		(18.15)	(24.38)	(41.00)	(57.98)
S.E. $\pm$		1.70	1.44	2.45	2.38
C.D. (P = 0.05)		5.05	4.29	7.29	7.08

The values in the parenthesis are angular transformed values
In each column the values having same superscripts are not significant

Table 4 : Effect of grain protectants on the adult emergence of *C.serratus* (Olivier) in groundnut pods

Treatments	Dose/kg	Emergence of adults over control (%)			
		First month	Second Month	Third month	Fourth month
T_1 – Neem seed kernel powder	5 g	47.77[c]	36.78[c]	86.45[d]	83.51[d]
		(6.59)	(6.09)	(9.30)	(9.45)
T_2 – Neem seed kernel powder	10 g	23.33[bc]	16.66[b]	77.16[d]	77.46[d]
		(4.19)	(4.08)	(8.79)	(8.80)
T_3 – Sweet flag rhizome powder	5 g	10.00[a]	15.27[b]	7.59[c]	14.43[c]
		(2.82)	(3.87)	(2.80)	(3.76)
T_4 – Sweet flag rhizome powder	10 g	0.00[a]	0.00[a]	3.75[bc]	6.75[bc]
		(0.70)	(0.70)	(1.86)	(2.40)
T_5 – Deltamethrin	0.02 g	0.00[a]	0.00[a]	2.64[b]	3.07[b]
		(0.70)	(0.70)	(1.64)	(1.71)
T_6 – Deltamethrin	0.04 g	0.00[a]	0.00[a]	1.45[b]	3.15[b]
		(0.70)	(0.70)	(1.20)	(1.72)
T_7 – Spinosad	0.5 ml	0.00[a]	0.00[a]	0.00[a]	2.81[b]
		(0.70)	(0.70)	(0.70)	(1.81)
T_8 – Spinosad	1.00 ml	0.00[a]	0.00[a]	0.00[a]	2.29[b]
		(0.70)	(0.70)	(0.70)	(1.37)
S.E. ±		0.86	0.27	0.37	0.52
C.D. (P = 0.05)		2.56	0.81	1.12	1.56

The values in the parenthesis are angular transformed values
In each column the values having same superscripts are not significant

Table 5 : Effect of grain protectants on the germination and oil content in groundnut

Treatments	Dose/ Kg	Germination (%)	Oil content (%)
T_1 – Neem seed kernel powder	5 g	90.00[b] (71.62)	48.33[a] (44.04)
T_2 – Neem seed kernel powder	10 g	91.33[ab] (72.95)	48.00[a] (43.85)
T_3 – Sweet flag rhizome powder	5 g	92.00[ab] (73.76)	48.33[a] (44.04)
T_4 – Sweet flag rhizome powder	10 g	83.3[c] (65.91)	48.00[a] (43.85)
T_5 – Deltamethrin	0.02 g	80.66[c] (63.92)	48.00[a] (43.85)
T_6 – Deltamethrin	0.04 g	81.66[c] (63.92)	47.00[a] (43.27)
T_7 – Spinosad	0.5 ml	81.66[c] (69.65)	47.66[a] (43.66)
T_8 – Spinosad	1.00ml	80.33[c] (63.67)	46.66[a] (43.08)
T_9 – Control	-	93.00[a] (74.68)	47.00[a] (43.27)
S.E. ±		6.864	0.472
C.D. (P = 0.05)		2.56	1.40

The values in the parenthesis are angular transformed values
In each column the values having same superscripts are not significant

60.80 and 70.93% mortality (Table 1) of adult bruchid in fourth month observation, respectively. The treatment *viz.*, spinosad and deltamethrin proved their merit throught experimental period by achieving zero per cent pods with egg, pod damage for first two months and adult emergence for first three months. Subramanyam *et al*. (2007) found that the single application of spinosad at 1 mg (*a.i.*)/kg was effective for managing common stored – grain insects of hard winter wheat including *R. dominica*, for at least six months. Even though, sweet flag rhizome powder (10 g) and deltamethrin (0.02 g) continued to be effective for the first two months by recording zero per cent pods with eggs, pod damage and adult emergence in the latter months these treatments were less effective than deltamethrin (0.04 g) and both the concentrations of spinosad. Azam *et al*. (1994) recorded 88.89 per cent mortality in case of *T. castaneem*, 68.75 per cent in case of *S. oryzae* and 55.56 per cent in case of *C. maculatus* at 4 hrs after treatment of deltamethrin. Hundred per cent mortality was recorded in *T. castaneum* @ 0.1 and 0.05 per cent concentration of deltamethrin (Kumar and Parikh, 1996). Toews *et al*. (2003) found that spinosad had excellent contact activity against eight species of adults of stored product insects. Nayak *et al*. (2005) reported spinosad as a potential protectant against *Rhizopertha dominica* and *Liposcelis entomophila* in stored wheat grain. Single application of spinosad at 1 mg (a.i.) / kg

was effective for managing common stored grain insects of hard winter wheat including *Rhizopertha dominica* for at least 6 months.

Effect of grain protectants on the germination and oil content was studied after completion of the experiment. It was found that germination was more than 80 per cent, while oil content was not significantly differed in all the treatments including spinosad and deltamethrin (Table 5). The present results in relation to the germination are similar to the findings of Krishnappa *et al.* (1998), who reported that pods treated with insecticide were not lost the viability up to one year.

Therefore, spinosad (0.5 and 1.0 ml) and deltamethrin (0.04 g) can be recommended for use as pre storage grain protectants.

Authors' affiliations:
HASANA B A. NADAF, N.R.G. VERMA AND V.R.K. MURTHY, Department of Entomology, College of Agriculture, Acharya N.G. Ranga Agricultural University, Rajendranagar, HYDERABAD (A.P.) INDIA

REFERENCES

Azam, K.M., Shaika, A.L., Harthy, Razvi, S.A. and Al-Racesi, A. (1994). A relative toxicity of certain insecticides against *Tribolium castaneum* (H), *Sitophilus oryzae* (L.) and *Callosobruchus maculatus* (F.). *Pestol.*, **18**(2) : 10-13.

Davey, P.M. (1958). The groundnut bruchid, *Caryedon gonagra*. *Bull. Entomological Res.*, **49** : 385-404..

Devi, D.R. and Rao, N.V. (2000). A note on reaction of groundnut varieties to the bruchid *Caryedon serratus* (Olivier). *J. Res. ANGRAU*, **28** : 41-43.

Devi, D.R. and Rao, N.V. (2005). Some observations on the biology of groundnut seed beetle, *Caryedon serratus* (Olivier) (Coleoptera : Bruchidae). *Legume Res.*, **28**(3) : 229-230.

Gosh, S.K., Verma, G.D. and Lall, B.S. (1981). Pesticidal efficacy of some indigenous plant products against pulse beetle *Callosobruchus chinensis* L. *Bull. Grain Technol.*, **19**(2): 96-98.

Hanumanthrao, P. (2003). Studies on biology and management of *Sitophilus zeamais* (Motschulsky) infesting maize in storage. M.Sc. (Ag.) Thesis, Andhra Pradesh Agricultural University, Hyderabad (A.P.).

Krishnappa, N., Narayanaswamy, S. and Sreerama, R. (1998). Effect of packaging material on seed quality of groundnut (*Arachis hypogaea L.*) cultivars. *Current Res. Univ. of Agric. Sci. Bengaluru*, **27**(11-12):205

Kumar, D. and Parikh, S. (1996). Efficacy of deltamethrin on inactive developmental stages of *Tribolium castaneum*. *Indian J. Entomol.*, **58**(3) : 260-263.

Kumari, D.A., Sudheer Reddy, V. and Singh, Y. (2002). Feeding potential, qualitative and quantitative losses caused by groundnut bruchid *Caryedon serratus* (Olivier) in groundnut. *J. Insect Sci.*, **15**:9(1-2) 72-74

Mathur, Y.K., Kripa Shankar and Salik Ram (1985). Evaluation of some grain protectants against *Callosobruchus chinensis* L. on blackgram. *Bull. Grain Technol.*, **23**(3) : 253-259.

Nayak, M.K., Daglish, G.J. and Byrne, V.S. (2005). Effectiveness of spinosad as a grain protectant against resistant beetle and Psocid pests of stored grain in Australia. *J. Stored Product Res.*, **41**(4) : 455-467.

Ramarao, C.V. and Sarangi, P.K. (1998). Control of *Sitophilus oryzae* through certain plant products. *Indian J. Entomol.*, **26**(2) : 183-185.

Rani, B.U. and Mohan, S. (2007). Efficacy of neem formulations for the control of *Callosobruchus maculatus* (F.) infesting green gram and their subsequent effect on germination. *Agric. Sci. Digest*, **27**(1):53-55

Redlinger, L.M. and Davis, R. (1982). *Insect control in post harvest peanuts*. Peanut Science and Technology Yoakum Texas, USA. American Peanut Research and Education Society, pp. 520-571.

Sandeep, R.S. (2005). Biology and management of groundnut pod borer, *Caryedon serratus* (Olivier.) in groundnut pods. M.Sc. (Ag.) Thesis, Acharya N.G. Ranga Agricultural University, Hyderabad (A.P.).

Subramanyam, B., Toews, M.D., Ileleji, K.E., Maier, D.E., Thompson, G.D. and Pitts, T.J. (2007). Evaluation of spinosad as a grain protectant on three Kansas farms. *Crop Protec.*, **26**(7) : 1021-1030.

Toews, M.D.,Subramanym, B. and Rowan, J.M. (2003). Knockdown and mortality of adults of eight species of stored product beetles exposed to four surfaces treated with spinosad. *J. Eco. Entomol.*, **96**(6):1967-1973

****