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Low Cost Protection Techniques for Prevention of Pulse Bruchid, *Callosobruchus maculatus* (F.) in Stored Blackgram

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ABSTRACT

An experiment was conducted at Post Harvest Technology Centre, Bapatla, Andhra Pradesh during 2016-17 to evaluate some botanicals and indigenous techniques for controlling pulse bruchid, *Callosobruchus maculatus* (F.) infesting stored blackgram. There was no adult emergence, grain damage and loss of weight of the grain from sand layer of 3 cm over the grain surface and sesamum oil @ 2% treatments during the period of five months storage. The botanical treatments: neem seed powder, sweet flag rhizome bits and vasaka plant powder were found significantly superior with very less adult emergence (15.0, 24.17 and 32.08 no.s respectively) and grain damage (1.0, 1.33 and 2.33% respectively) compared to the untreated control with 4497.92 adults and 44.44% grain damage. In the sand layer treatment cent per cent germination was observed even after five months of storage followed by neem seed powder (99.33%) and sweet flag rhizome bits (98.67%).

Key words*: Botanicals, Indigenous techniques and Pulse bruchid.*

Blackgram (*Vigna mungo* L.) is one of the important pulse crops cultivated in India and contributes 10 per cent towards the total pulses production. In Andhra Pradesh, blackgram has been cultivated over an area of about 4.56 lakh hectares with total production of 4.11 lakh tonnes during 2015-16 under various situations and seasons (ANGRAU, 2016). One of the major constraints in storage of blackgram is the damage losses caused from the attack of pulse bruchid, *Callosobruchus maculatus* (F.). This further gives off-flavour, reduction in weight, market value of grains and making unfit for consumption. Insect control in stored products relies primarily upon the use of synthetic fumigants and insecticides, which are also responsible for ecological imbalance, pest resistance and insecticide residues in foods and feed. Due to these problems, non- chemical and environment-friendly methods of pest control are becoming increasingly important. Mixing of inert materials such as sand and ash and use of plant materials for stored grain protection from insect pests is an age old practice. With this in view, an experiment was conducted to evaluate some botanicals and indigenous techniques for controlling bruchids infesting stored blackgram.

MATERIAL AND METHODS

The experiment was conducted under laboratory conditions at Post Harvest Technology Centre, Bapatla , Guntur district, Andhra Pradesh during 2016-17. Plant products including dried neem leaves @ 5%, dried ocimum leaves @ 5%, vasaka plant powder @ 3%, neem seed powder @ 3%, sweet flag rhizome bits @ 5% and sesamum oil @ 2% and few selected indigenous techniques *viz.*, cow dung ash @ 5%, red earth @ 5% and sand as a surface layer of 3.0 cm thickness were evaluated for management of pulse beetle under no choice conditions.

Insect culture:

About 250 g of blackgram grains were taken in a plastic jar (500 ml capacity) and 50 freshly emerged adults of *C. maculatus* were released into each jar. After allowing for mating and oviposition by females for a week the adults were removed. The containers were covered with muslin cloth and kept at room temperature (27±3°C) and 75% relative humidity throughout the period of study. After 35 to 40 days, adults emerged from the culture were utilized for the experiment.

Disinfested blackgram grains (500 g) were kept in 1 kg capacity jars and treated with the above mentioned indigenous methods and botanicals along with untreated control following completely randomized block design with three replications. Ten pairs of mated adults of *C. maculatus* were released into each of the plastic jars. The number of adults emerged in each treatment including untreated control were counted at monthly interval while the dead insects were removed and live insects were again released in to the grain. Finally, they were pooled at the end of five months storage period and mentioned as total progeny development. Similarly, the data recorded on various parameters *viz.*, grain damage (%) by weight and count, weight loss (%) and germination (%) were recorded after completion of five months. The data obtained were subjected to analysis of variance (ANOVA) by completely randomized design and the treatment means were compared by Duncan's Multiple Range Test when ANOVA was significant ($p < 0.05$).

RESULTS AND DISCUSSION

Effect of botanicals and indigenous methods on progeny development: Significant differences were noticed in adult emergence in all the treatments, while sand layer and sesamum oil treatments recorded no adult emergence even after five months (Table 1). Ocimum leaves resulted in emergence of 460.0 adults only while in the neem leaves treatment, the emergence increased to 3009.17. Significantly lower numbers of adults emerged from cow dung ash (191.25) compared to red earth (4135.0) which was on par with the untreated control (4497.92). Among the other treatments neem seed powder, sweet flag rhizome bits and vasaka plant powder were found significantly superior with very less adult emergence (15.0, 24.17 and 32.08 adults respectively).

Per cent grain damage (by count):

Sand layer and sesamum oil recorded no grain damage and adult emergence which was on par with each other even after five months. After five months, the grain damage by count varied from 1.0 to 44.44% (Table 1). Neem seed powder, sweet flag rhizome bits and vasaka plant powder showed negligible grain damage with 1.0, 1.33 and 2.33% respectively. Among the leaf treatments, ocimum leaves resulted in significantly less (19.44%) grain damage compared to neem leaves (35.86%) treatment. Significantly cow dung ash recorded least (11.0%) grain damage compared to red earth (39.36%) and untreated control (44.44%).

Per cent grain damage (by weight):

The grain damage by weight from treatments varied from 0.12% to 37.62% after five months (Table 1). Neem seed powder (0.12%) treatment was found significantly on par with sweet flag rhizome bits (0.28%) and vasaka plant powder (1.07%) treatments. Ocimum leaves resulted in significantly less damage (16.42%) compared to neem leaves (27.53%). Cow dung ash was found better with significantly less damage by the bruchid compared to red earth (34.82%) which again was at par with the untreated control (37.62%).

Per cent weight loss:

After five months, the per cent weight loss caused due to bruchid infestation varied from 1.0 to 15.33 (Table 1). Among all the treatments, the weight loss was negligible in sand layer (1.0%) and sesamum oil (1.33%) treatments as there was no grain damage and adult emergence and they were at par with neem seed powder (1.67%) and sweet flag rhizome bits (3.0%). The treatments vasaka plant powder (3.67%), cow dung ash (5.33%), ocimum leaves (7.67%), neem leaves (10.33%) and red earth (12.67%) remained at par with each other treatment. There was 15.33 per cent loss in weight after five months of storage in the untreated control.

The efficacy of sand layer in reducing bruchid population, seed damage and weight loss of seeds was earlier reported in pigeonpea (Jagjeet *et al.*, 2005); in cowpea (Sunitha *et al*., 2013), in chickpea (Tabu *et al.*, 2012) and in blackgram (Swamy *et al*., 2015). Similarly, the results on the efficacy of sweet flag rhizome bits against pulse bruchid also gain support from the findings of Chiranjeevi and Sudhakar (1996); Subhadra and Kalita (2011) and Yusuf *et al*. (2011) who also reported less adult emergence and per cent seed damage with treatment of sweet flag rhizome powder; the presence of ß-asarone, an active compound in sweet flag was attributed for its bioactivity. Neem seed kernel powder provided the best protection against pulse bruchid up to three months in faba bean seed at 5% concentration (Ram *et al*., 2000) and up to three months at 2% concentration in stored chickpea (Tabu *et al.*, 2012). The results were in agreement with Swamy *et al*. (2015) and Vijayaraghavan and Kavitha (2016) who reported that neem seed powder (5%) and neem seed kernel powder (1%) respectively were effective in reducing adult emergence, per cent grain damage and per cent weight loss in blackgram.

Table 1. Effect of botanicals and indigenous methods on bruchid infestation in blackgram stored for five months.

Treatments	Dose	Progeny development (No.) *	Grain damage (%)** By count	Grain damage (%)** By weight	Weight loss (%)**	Germination (%)**
Dried neem leaves	5% (*w/w*)	3009.17 (54.727)e	35.86 (36.76)f	27.53 (31.64)f	10.33 (18.72)fg	53.0 (46.73)f
Dried ocimum leaves	5% (*w/w*)	460.0 (21.387)d	19.44 (26.17)e	16.42 (23.88)e	7.67 (15.55)ef	68.0 (55.57)e
Vasaka plant powder	3% (*w/w*)	32.08 (5.691)b	2.33 (8.75)c	0.67 (4.67)c	3.67 (11.01)cd	97.67 (81.43)c
Neem seed powder	3% (*w/w*)	15.0 (3.899)ab	1.0 (4.00)b	0.12 (1.77)ab	1.67 (7.33)ab	99.33 (86.94)ab
Sweet flag rhizome bits	5% (*w/w*)	24.17 (4.968)b	1.33 (6.53)bc	0.28 (2.92)bc	3.0 (9.88)bc	98.67 (84.41)bc
Sesamum oil	2% (*w/w*)	0.0 (0.701)f	0.0 (0.52)a	0.0 (0.52)a	1.33 (6.53)ab	66.33 (54.54)e
Cow dung ash	5% (*w/w*)	191.25 (13.837)c	11.0 (19.36)d	8.67 (17.09)d	5.33 (13.34)de	86.67 (68.61)d
Red earth	5% (*w/w*)	4135.0 (64.257)f	39.36 (38.84)f	34.82 (36.13)g	12.67 (20.80)gh	49.0 (44.43)f
Sand	Surface layer of 3.0 cm	0.0 (0.701)a	0.0 (0.52)a	0.0 (0.52)a	1.0 (5.73)a	100 (89.48)a
Untreated control	-	4497.92 (67.049)f	44.44 (41.81)g	37.62 (37.82)g	15.33 (23.05)h	0.0 (0.52)g
SEm±		1.20	0.90	0.77	1.16	1.43
CD (P=0.05)		3.54	2.66	2.27	3.427	4.22

*Figures in parentheses are square root transformed values
** Figures in parentheses are angular transformed values

Seed germinability:

There were significant differences among the treatments in germination percent, while the seeds in untreated control completely lost their viability after five months. In the sand layer treatment cent per cent germination was observed even after five months of storage. Neem seed powder (99.33%), sweet flag rhizome bits (98.67%) and vasaka plant powder (97.67%) treatments closely followed and found significantly superior to the other treatments. Cow dung ash recorded 86.67 per cent germination. Sesamum oil, ocimum leaves, neem leaves and red earth recorded 66.33, 68.0, 53.0 and 49.0 per cent germination respectively.

As in this case, the superior performance of vegetable oils including sesamum as grain protectant against the pulse beetle was also reported by several researchers at the concentrations ranging from 2 ml/kg (Prakash *et al.*, 2014) to 15 ml/kg (Srikanth *et al.*, 2011) in various pulses. However, Gupta and Apte (2015) found that sesamum oil at 0.5 per cent was effective against C. *maculatus* without deleterious influence on the seed viability of blackgram seeds till one year. The results with cow dung ash corroborates with that of Girma *et al.* (2015) who reported that cow dung cake ash was less effective against Angoumois grain moth in stored maize at lower rate of application. Whereas, Hampanna *et al.* (2006) reported that cow dung ash (2%) was effective in reducing the population build up of pulse beetle which resulted in 71.0 per cent germination in chickpea.

As the sand layer of 3 cm over grain surface did not allow *C. maculatus* beetles to access the blackgram grain, there was no progeny buildup and grain damage due to bruchid infestation during the study. The germination was also preserved hundred per cent up to 150 days of treatment. Sweet flag rhizome bits @ 5% recorded minimum emergence of adults (24.17 no.), grain damage (1.33%), weight loss (3.0%) with better germination (98.67%) and found effective in preventing pulse bruchid. Thus, indigenous techniques of using locally available (river) sand and botanicals neem seed powder and sweet flag rhizomes gave good protection of blackgram during storage against the damage inflicted by bruchid. Therefore, these inexpensive and eco-friendly pest control methods can be suggested to small scale and resource poor farmers for domestic storage of pulses.

LITERATURE CITED

ANGRAU 2016 Acharya N. G. Ranga Agricultural University Research and Extension Highlights 2015-16 (Eds. Naidu *et al*.), 67.

Chiranjeevi C and Sudhakar T R 1996 Effect of indigenous plant materials on the fecundity, adult emergence and development of pulse beetle in blackgram. *Journal of Research ANGRAU*, 24: 57-61.

Girma D, Swaminathan R and Ameta O P 2015 Efficacy of inert dusts against angoumois grain moth in stored maize. *Indian Journal of Entomology*, 77(3): 255- 261.

Gupta S and Apte S D 2015 Effect of botanicals (oils) on green gram (*Vigna radiata* L.Wilczek) against *Callosobruchus maculatus* (Fab.). *European Journal of Experimental Biology*, 5 (8): 31- 33.

Hampanna A Y L, Naganagoud and Patil B V 2006 Evaluation of animal origin inert materials against rice weevil and pulse beetle in stored sorghum and chickpea. *Karnataka Journal of Agricultural Science*, 19(1): 54- 57.

Jagjeet S, Chillar B S and Kashyap R K 2005 Effectiveness of various seed protectants on adult mortality of pulse beetle, *Callosobruchus maculatus* infesting pigeonpea seeds. *Annals of Applied Biology*, 21(1): 65-67.

Prakash N M, Subhag S R, Anurag M K and Chandramani 2014 Efficacy of indigenous oils on growth and development of *Callosobruchus chinensis* infesting Black gram. *Annals of Plant Protection Sciences*, 22(2): 283- 286.

Ram B, Panerul P and Gopal P S 2000 Use of botanicals for the management of pulse beetle (*Callosobruchus maculatus* Fabricius) in lentil. *Nepal Agricultural Research Journal*, 4: 67-78.

Srikanth M, Venugopala R N and Sudhakar T R 2011 Efficacy of plant products and vegetable oils against pulse beetle, *Callosobruchus chinensis* in rajma beans, *Phaseolus vulgaris*. *Indian Journal of Plant Protection*, 39(1): 4- 7.

Subhadra D W and Kalita J 2011 Efficacy of plant materials against *Callosobruchus chinensis* in green gram. *Indian Journal of Entomology*, 73(1): 56-58.

Sunitha B H, Viswanatha K P, Channakeshava B C, Devendrappa J, Ambika D S and Dinesh H B 2013 Assessment of relative efficacy of seed treatments in controlling bruchids (*Callosobruchus chinensis*) during storage in cowpea [*Vigna unguiculata* (L.)]. *International Journal of Agricultural Sciences*, 9(1): 39-43.

Swamy S V S G, Lakshmipathy R and Bhaskara Rao D 2015 Biorational approaches for the management of pulse beetle, *Calloso bruchus chinensis* in blackgram. *Journal of Insect Science*, 28(2): 217-220.

Tabu D, Selvaraj T, Singh S K and Mulugeta N 2012 Management of adzuki bean beetle (*Callosobruchus chinensis* Linnaeus) using some botanicals, inert materials and edible oils in stored chickpea. *Journal of Agricultural Technology*, 8: 881-902.

Vijayaraghavan C and Kavitha Z 2016 Evaluation of botanical powders and oils on pulse beetle, *Callosobruchus maculatus* in black gram. *Annals of Plant Protection Sciences*, 24(2): 307-311.

Yusuf A U, Dike M C, Adebitan S A and Ahmad B J 2011 Comparative efficacy of seven plant powders on the cowpea bruchid, *Callosobruchus maculatus* (Fab.) development and damage. *Journal of Biopesticides*, 4: 15-26.

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