Efficacy of some biopesticides and ecofriendly practices for the management of fig moth, *Ephestia cautella* (Walker) (Lepidoptera: Phyticidae) in stored sunflower

K. M. Kumaranag, K. S. Jagadish* and Y. G. Shadakshari

ABSTRACT

The fig moth, *Ephestia cautella* (Walker) is a major storage of stored sunflower. Different biopesticides and eco-friendly practices were evaluated for their bioefficacy against this pest. Sunflower seeds treated with neem seed kernel powder and malathion + thiram showed higher mortality of 50.39 per cent and 100 per cent, respectively, after 24 hrs after the first larval release, while the remaining larvae showed symptoms of dying, lack of movement and responded very weakly to pricking. A gradual increase in the level of mortality was observed in all the treatments with the time lapse of 72 hrs after first release, when seeds that were subjected to malathion + thiram, sanitation and neem seed kernel powder showed 100, 93.34 and 91.67 per cent mortality, respectively. The loss in the weight of sunflower seeds was highest in case of extended sun drying. Maximum adult emergence after first larval release was noticed in case of extended sun drying. After the second larval release, made at 45 days after treatment, maximum mortality was recorded in case of seeds treated with malathion + thiram (95.25 %) and sand layer (46.67%), but at the end of 72 hrs, 100 and 91.67 per cent mortality was recorded in case of malathion + thiram and sanitation, respectively .However, after the second larval release, maximum weight loss of seeds was recorded in case of extended sun drying (1.34%), with an adult emergence of 31.67 per cent . At 72 hrs after the third release of the larvae at 90 days after treatment, sanitation recorded 91.67 per cent mortality, which was on par with that of malathion + thiram (100%), while the pest mortalities that was observed both in case of seeds treated with sand layer and neem kernel powder was 81.67 per cent. The maximum weight loss was observed in case of extended sun drying (1.50%) with 20 per cent adult emergence.

Key words: *Helianthus annuus, Ephestia cautella,* eco-friendly management practices, stored seeds

INTRODUCTION

Reports indicated that losses due to insect pests in major crops vary from five per cent in oilseeds to thirty per cent in pulses, which in monetary terms amounts to more than Rs. 29,240 crores annually (Rabindra, 2003). In order to meet the increasing demand for edible oils and oil meals, prevention of post-harvest losses in oilseeds by adopting effective preservation methods was emphasized (Rajendran and Devi, 2004).

Sunflower (*Helianthus annuus* L.), which is one of the major edible oilseeds of India, is often infested by insect pests in storage, the fig moth, *Ephestia cautella* (Walker) and the rice moth, *Corcyra cephalonica* Stainton among Lepidopterans and the red rust flour beetle, *Tribolium castaneum* (Herbst.) among Coleopteran pests, are economically important. Of these the fig moth, *Ephestia cautella* is a regular and important pest. Larvae of both *E. cautella* and *C. cephalonica* caused intensive webbing of the seeds, which results in the deterioration in the quality and shelf life of the seeds. Whenever the sunflower seeds are stored with high moisture, in untidy bins or gunny bags for longer periods, enormous loss due to insect pests can be expected. The predominant insect pests of stored sunflower include saw toothed beetle, *Oryzaephilus surinamensis* (L.), red rust flour beetle *Tribolium castaneum* (Herbst) and the rice moth *Corcyra cephalonica* Stainton causes severe damage to the stored sunflower (Mc Bride, 1981). Besides, the other storage pests *viz., Lasioderma serricorne* (F.) and *Plodia interpunctella* have also been reported (Beratlief and Iliescu, 1990). Therefore, the present investigation was conducted with the objective of evaluating ecofriendly management practices against *E. cautella* in stored sunflower *viz.*, sanitation practice, extended sun drying, sand layer method and use of botanicals like neem seed kernel powder, neem leaf powder in comparison with chemical control.

MATERIALS AND METHODS

Two physical methods, one cultural method, two botanicals and insecticide (malathion) and fungicide (thiram) dusts were evaluated for their relative efficacy as

grain protectants against the infestation by *E. cautella*. The details of different treatments imposed and their respective dosages are as furnished here under.

Test Materials

Healthy neem leaves were obtained and brought to the laboratory, washed with clean tap water and moisture was removed with the help of blotting paper and leaves were oven dried at 70°C for 48 hrs, they were then powdered and passed through the sieve of 60 mesh size. For preparing the neem seed kernel extract, the neem seeds were purchased from the market and the kernels were separated and dried at 40°C in an oven and ground to powder and then passed through sieve of 60 mesh size. In sand layer method, the sand that was procured was passed through the sieve of 60 mesh size and washed with water and then sun dried before using for the treatment. One inch layer of sand was spread evenly on newspaper spread above the seeds stored in the container. The sunflower seeds were dried continuously for three days (between 9.00AM - 5.00PM) and then the seeds were stored in plastic containers. Sanitation involved cleaning the seeds thorou ghly and making it free from foreign material before subjec ting them to storage. Besides, the recommended insecticide (malathion@0.001%) and fungicide (thiram@0.001%) dusts were included in the experiment as standard checks.

Bioassay

Sunflower seeds (100g each) were subjected to the above treatments by taking them in 500ml containers. Further, 20 second instar larvae of *E. cautella* were released into each sets of treatment separately. Three replications were maintained for each treatment. The mouth of the containers were covered with double layered muslin cloth and then fastened with rubber band. The test insects were released into three sets of containers at periodical intervals *viz.*, 1 day after treatment (I set, first release), 45 days after treatment (II set, second release) and 90 days after treatment (III set, third release). The observation on the larval mortality of *E. cautella* was recorded at 24hr, 48hr and 72 hr after larval release. The observations on the per cent weight loss and per cent adult emergence of the pest were recorded on 30th, 60th, 90th days after the release of the pest. The data was tabulated and statistically analyzed by ANOVA for further interpretation.

RESULTS AND DISCUSSION

The results of the studies on the evaluation of efficacy of sanitation, extended sun drying, sand layer method and grain protectants (neem leaf powder and neem seed kernel (NSK) powder) in comparison with the chemical control malathion + thiram as std. check) indicated that, seeds treated with

Table 1. Efficacy of different management practices against *E. cautella* mortality (in %) after first release of larvae at one day after treatment

Treatments	Larval mortality			Per cent weight loss of seeds	Per cent adult emergence
	24	48	72		
Sanitation	21.67^{c}	63.34^{c}	93.34^{b}	0.16^{c}	0.00^{d}
Extended sun drying	11.67^{d}	21.67^{d}	31.67^{e}	1.34^{b}	11.67^{b}
Sandlayer method	46.67^{b}	60.00^{c}	75.00^{d}	0.00^{d}	5.00^{c}
Neem leaf powder	23.34^{c}	55.00^{c}	81.67^{c}	0.53^{c}	0.00^{d}
NSK powder	50.39 ^{b}	73.34^{b}	91.67^{b}	0.00^{d}	0.00^{d}
Malathion + Thiram	96.67^{a}	100.00^{a}	100.00^{a}	0.00^{d}	0.00^{d}
Untreated control	6.67^{d}	10.05^{e}	10.50^{f}	2.74^{a}	61.67^{a}
F-test	*	*	*	*	*
SEM±	0.714	1.368	0.63	0.048	0.982
CD (P=0.01)	2.12	4.03	1.87	0.41	2.91

neem kernel powder and those treated with malathion + thiram showed higher mortality of 50.39 per cent and 96.67 per cent, after 24 hrs after the first larval release, while the remaining larvae showed symptoms of dying, lack of movement and responded very weakly to pricking. A gradual increase in the level of mortality was observed in all the treatments with the time lapse of 72 hrs. after first release (Table 1), when seeds that were subjected to malathion + thiram, sanitation and neem seed kernel powder showed 100, 93.34 and 91.67 per cent mortality, respectively.The loss in the weight of sunflower seeds was highest in case of extended sun drying. Maximum

Table 2. Efficacy of different management practices against *E. cautella* mortality (in %)after second release of larvae at 45 days after treatment

Treatments	Larval mortality (hrs. after larval release)			Per cent weight loss of seeds	Per cent adult emergence
	24	48	72		
Sanitation	18.34^{c}	48.34^{c}	91.67^{b}	0.00^{c}	0.00^{d}
Extended sun drying	6.66^{d}	15.69^{d}	28.34^{e}	1.34^{b}	31.67^{b}
Sandlayer method	46.67^{b}	61.67^{b}	80.05^{c}	0.17^{c}	13.33^{c}
Neem leaf powder	21.67^{c}	45.39^{c}	61.67^{d}	0.37^{c}	13.33^{c}
NSK powder	35.25^{b}	65.23 ^{b}	86.67 ^{b}	0.34^{c}	6.67^{d}
Malathion + Thiram	95.25^{a}	100.00a	100.00a	0.00^{c}	0.00^{e}
Untreated control	1.67^{d}	8.34^{e}	10.01^{f}	3.30^{a}	68.34^{a}
F-test	*	*	*	*	*
SEM±	0.891	0.825	1.26	0.054	0.825
CD (P=0.01)	2.64	2.45	3.74	0.16	2.45

Table 3. Efficacy of different management practices against *E.cautella* mortality (in %) after third release at 90 days after treatment

Treatments	Larval mortality (hrs. after larval release)			Per cent weight loss	Per cent adult emergence
	24	48	72		
Sanitation	11.67[d]	30.00[c]	91.67[a]	0.00 [c]	0.00[d]
Extended sun drying	6.67[d]	21.67[d]	26.67[d]	1.50 [b]	20.00[b]
Sandlayer method	46.67[b]	65.00[a]	81.67[b]	0.23 [c]	13.33[b]
Neem leaf powder	20.25[c]	35.25[b]	68.34[c]	0.67[c]	21.67[b]
NSK powder	26.67[c]	56.67[b]	81.67[b]	0.44[c]	11.67[c]
Malathion + Thiram	90.25[a]	95.25[a]	100.0[a]	0.00c	0.00[d]
Untreated control	1.67[e]	3.34[e]	6.67[e]	3.53[a]	75.25[a]
F-test	*	*	*	*	*
SEM±	0.982	1.304	1.456	0.905	1.01
CD (P=0.01)	2.91	3.80	4.32	2.68	3.00

adult emergence after first larval release was noticed in case of extended sun drying.

After the second larval release, made at 45 days after treatment (Table 2), at 24 hrs. after release, maximum pest mortality was recorded in case of seeds treated with malathion + thiram and sand layer, but at the end of 72 hrs, 100 and 91.67 per cent mortality was recorded in case of malathion + thiram and sanitation, respectively. However, after the second larval release, maximum weight loss of seeds was recorded in case of extended sun drying with an adult emergence of 31.67 per cent. At 72 hrs after the third release of the larvae at 90 days after treatment (Table 3), sanitation recorded 91.67 per cent mortality, which was on par with that of malathion + thiram (100%), while the pest mortalities that was observed, both in case of seeds treated with sand layer and that with neem kernel powder was 81.67 per cent. The maximum weight loss was observed in case of extended sun drying with 20 per cent adult emergence. Thus sanitation practice and chemical check (malathion + thiram) proved their superiority against *E. cautella*, even upto 90 days after treatment. However, malathion + thiram was significantly superior than sanitation practice. The seeds treated with the neem seed kernel powder and neem leaf powder proved their efficacy in controlling the pest only upto 45 days after treatment. There afterwards the efficacy of these neem formulations was reduced.

In the present study, sanitation, followed by neem seed kernel powder were significantly superior among the bio-pesticides and eco-friendly measures evaluated for the suppression of *E. cautella*, which almost agrees with the findings of McBride (1981), who suggested that sanitation is a good pest control practice for prolonged storage of sunflower seeds. Kumar *et al.* (1982) observed that the efficacy of malathion reduced after 110 days after application, which is similar to the findings of the present study. Similarly, Jadhav and Shekarappa (2009) obtained 86.6 per cent mortality of *Sitophilus oryzae* in sorghum treated with neem seed kernel powder (5%), with 8.11 per cent grain damage and 2.2 per cent weight loss.

However, in our study, extended sun drying and sand layer method failed to give good control of the pest. On the contrary, Kalasagond (1999) and Kittur (1990) observed higher mortality of the *Callosobruchus chinensis* in case of sand layer method and they reported that extended sun drying is helpful in removing the field infestation of *C. chinensis*. The findings of the present study are contradictory to theirs, probably because of the changes in the seed material used and different target pests involved.

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K. M. Kumaranag, K. S. Jagadish* and Y. G. Shadakshari
All India Co-ordinated Research Project (Sunflower), University of Agricultural Sciences, GKVK, Bangalore-560 065, India, *Phone: 09341960569, E-mail: jagsan_san@yahoo.co.in