EVALUATION OF SYNTHETIC INSECTICIDES AGAINST *Sitophilus oryzae* (L.) ON MAIZE UNDER STORAGE CONDITION

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ABSTRACT

Nine synthetic insecticides *viz.*, dichlorvos, chlorpyriphos, deltamethrin, fenvalerate, cypermethrin, thiomethoxam, bifenthrin, endosulfan and malathion, were evaluated against *Sitophilus oryzae* (L.) on maize under storage condition during the year 2009-10. Based on adult mortality, deltamethrin found superior among the various synthetic insecticides followed by thiomethoxam, cypermethrin and fenvalerate, whereas malathion was least effective followed by dichlorvos and endosulfan. On the basis of half-life and gross persistency, deltamethrin, thiomethoxam, cypermethrin and fenvalerate were more effective, while malathion, endosulfun and dichlorvos were less effective treatments. After 6 months of storage, the per cent germination was almost equal in all the insecticides and the effect of various insecticides on germination was non-significant.

KEY WORDS: Insecticides, Maize, *S. oryzae*

INTRODUCTION

Maize (*Zea mays* L.), one of the staple food crops of India is subjected to a number of insect species in field as well as in storage condition. Among them, *Sitophilus oryzae* L., commonly known as rice weevil is one of the most noxious pests of maize under storage condition causing heavy losses both qualitatively and quantitatively. Post harvest loss was assessed from 10 to 15 per cent (Pradhan, 1964). The weight loss of 18.3 per cent in maize was recorded throughout the developmental period of *S. oryzae* grub (Adams, 1976). It has been shown beyond doubt that persistence insecticides mixed with grains can keep the grains safe from insect infestation for varying periods and is quite a potent method for storing grains meant for seed purpose. Before recommending any insecticide as seed treatment to protect against storage pest, it is also necessary to know whether it has any adverse effect on germination or not. Therefore, the present investigation was carried out to evaluate the effectiveness of various synthetic insecticides under storage condition for this important storage pest of maize.

MATERIALS AND METHODS

The cultures of *S. oryzae* collected from tribal area of Gujarat, maintained at Department of Entomology, Anand Agricultural University, Anand. The maize variety, GM 6 was used for

the study. Nine synthetic insecticides *viz.*, dichlorvos, chlorpyriphos, deltamethrin, fenvalerate, cypermethrin, thiomethoxam, bifenthrin, endosulfan and malathion, were evaluated based on adult mortality, half-life and gross persistency and its impact on germination. Required quantity of each insecticide was measured with the help of micropipette and added in standardized quantity of water. For seed treatment, maize grains (500 g) were spread on plastic sheet and well prepared insecticidal solution was uniformly applied on grains using syringe. The uniform smearing of insecticidal solution on grains were established by turning over the seeds repeatedly on plastic sheet. The seeds were then dried under fan in well aerated room for 24 hours. The bulk of these treated maize grains with various synthetic insecticides was utilized for evaluation against *S. oryzae* based on adult mortality, half-life and gross persistency following the procedure and formulae given below. Some bulk of these treated maize grains with these various synthetic insecticides was stored for 6 months in an airtight plastic bottle at room temperature and utilized for further germination study. All the experiments were carried out in Completely Randomized Design with three repetitions.

Evaluation based on adult mortality

The maize grains (50 g) were filled in plastic tube (6 cm height and 5 cm diameter) and mixed with the required quantity of insecticides. Such samples were repeated thrice. Twenty adults (5 to 10 days old) of *S. oryzae* obtained from laboratory culture were released into each of the plastic tube, which was covered with a piece of two-fold muslin cloth held in position with rubber band. The observations on number of dead adults out of total adults were made after 7 days of adult release and per cent mortality was worked out.

Evaluation based on half-life

Mortality half- life was calculated by using the formula:

$$\text{Mortality half-life } (M_{1/2}) = \log 2/K_1$$

Evaluation based on gross persistency

Gross persistency of different insecticides was worked out as per formula suggested by Pawar and Yadav (1980).

Evaluation based on germination loss

Three samples (one sample as one repetition) of maize grains (100 seeds) were drawn from 6 moths of stored sample of maize grains treated with different insecticides. The germination test was carried out on circular Whatman No.1 filter paper kept in petri-plates by using standard germination test in a seed germinator. The number of grains germinated was counted after 7 days of incubation. Based on germination counts, the percentage of germination was calculated. Based on per cent germination before seed treatment, per cent loss in germination was worked out.

RESULTS AND DISCUSSION

Evaluation based on adult mortality

Results on adult mortality of *S. oryzae* indicated that deltamethrin (91.30%) was significantly superior to other treatments (Table 1). Samson and Parker (1989) reported that deltamethrin at 4 ppm found most effective for the control of *S. oryzae* in stored maize. Duguet and Quan (1990) mentioned that deltamethrin @ 1 ppm protected rice grain against *S. oryzae*. Singh and Yadav (1994) noticed that deltamethrin was most toxic against *S. oryzae* in stored wheat. Srinivasacharayulu and Yadav (1997) reported that deltamethrin was most toxic based on LC_{50} value against *S. zeamais* in stored maize and *S. oryzae* in stored wheat. Thiomethoxam (87.60 %), cypermethrin (86.41 %), fenvalerate (85.13 %), and bifenthrin (84.73 %), were equally effective in checking the pest. Bitran *et al.* (1991) observed that deltamethrin at 0.5 ppm and 1ppm as well as cypermethrin at 1 ppm found effective against *S. zeamais* in stored maize. Arthur *et al*. (2004) reported that thiamethoxam @ 4 ppm approached 95 to 100 per cent mortality of *S. zeamais* in stored maize. The lower adult mortality was recorded in malathion (69.73%) followed by dichlorvos (77.35 %) and endosulfan (77.97 %).

Evaluation based on half-life

The highest (192.77 days) value of half-life was recorded in deltamethrin and it was at par with thiomethoxam (180.23 days). However, it was significantly higher in comparison to other treatments. The half-life values of 164.92 days and 154.07 days were recorded in cypermethrin and fenvalerate, respectively (Table 1). The lowest (91.24 days) half-life value was observed in malathion followed by endosulfan (98.18 days).

Evaluation based on gross persistency

Based on gross persistency value, deltamethrin (2372.00) was significantly superior over rest of the insecticides followed by thiomethoxam (2277.50) and cypermethrin (2181.00) (Table 1). The insecticides fenvalerate and bifenthrin were moderately persistent by recording gross persistency value of 2147.00 and 2078.00, respectively. The lowest (1616.00) gross persistency was recorded in malathion followed by endosulfan (1806.50). Samson and Parker (1989) reported that deltamethrin at 6 ppm could protect the maize grains from *S. oryzae* up to 32 weeks. Singh and Yadav (1998) observed that deltamethrin @ 3 ppm dust was most effective seed protectant against *S. oryzae* in stored wheat seed up to 9 months.

Evaluation based on germination loss

The data on per cent germination before seed treatment (Table 1) revealed that the differences among treatments was non-significant and ranged from 83.75 to 87.41 per cent, whereas after 6 months of storage too, the differences among treatments was non-significant and ranged from 73.33 to 75.08 per cent. As far as the per cent loss in germination is concerned, the difference among treatments was non-significant.

CONCLUSION

From the above results, it can be concluded that adult mortality was higher in deltamethrin followed by thiomethoxam, cypermethrin and fenvalerate, whereas malathion was least effective with respect to adult mortality. On the basis of half-life and gross persistency, deltamethrin and thiomethoxam were the most effective treatment. After 6 months of storage, the per cent germination was almost equal in all the insecticides and the effect of various insecticides on germination before and after 6 months of storage was non-significant.

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Table 1: Effectiveness of insecticides against *S. oryzae* during storage of maize

Treatments	Adult Mortality (%)	Half-life (days)	Gross Persistency	Germination (%)		Germination Loss(%)
				Before Seed Treat.	After 6 Months of Storage	
Dichlorvos 76 EC @ 4 ppm	61.58 (77.35)	109.49	1905.50	68.64 (86.73)	59.98 (74.97)	21.40 (13.31)
Chlorpyriphos 20 EC @ 4 ppm	64.77 (81.83)	115.49	1982.00	68.64 (86.73)	59.98 (74.97)	21.39 (13.30)
Deltamethrin 2.8 EC @ 4 ppm	72.85 (91.30)	192.77	2372.00	68.64 (86.73)	58.91 (73.33)	22.99 (15.25)
Fenvalerate 20 EC @ 4 ppm	67.32 (85.13)	154.07	2147.00	69.22 (87.41)	58.91 (73.33)	22.68 (14.87)
Cypermethrin 10 EC @ 4 ppm	68.37 (86.41)	164.92	2181.00	68.64 (86.73)	59.98 (74.97)	21.39 (13.30)
Thiomethoxam 25 WG @ 4ppm	69.38 (87.60)	180.23	2277.50	66.23 (83.75)	60.05 (75.08)	18.16 (9.71)
Bifenthrin 10 EC @ 4 ppm	67.00 (84.73)	138.77	2078.00	68.63 (86.72)	60.05 (75.08)	21.45 (13.37)
Endosulfan 35 EC @ 4 ppm	62.01 (77.97)	98.18	1806.50	67.19 (84.97)	60.05 (75.08)	19.64 (11.30)
Malathion 50 EC @ 10 ppm	56.62 (69.73)	91.92	1616.00	68.63 (86.72)	58.91 (73.33)	22.99 (15.25)
S. Em. ±	0.87	4.80	31.77	2.09	1.76	1.99
C.D. at 5 %	2.45	14.25	94.39	NS	NS	NS
C.V. %	7.11	6.00	2.70	5.26	5.03	16.38

Note: Figures in parentheses are retransformed values, those outside are arc sin transformed values.

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