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Potentiality of *Anisopteromalus calandrae* (Howard) and *Choetospila elegans* (Westwood) against the rice weevil, *Sitophilus oryzae* (Linnaeus)

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ABSTRACT: An attempt was made to evaluate the potentiality of the parasitoids, *Anisopteromalus calandrae* (Howard) and *Choetospila elegans* (Westwood) in reducing the population of *Sitophilus oryzae* (L.) in wheat stored in six different types of bags (heavy jute, light jute, polythene, polypropylene, markin and nylon). Both *A. calandrae* and *C. elegans* suppressed the populations of *S. oryzae* in the above bags. Different types of bags showed significant effects ($P<0.01$) on suppression for *A. calandrae* and *C. elegans* as well as on parasitizaiton of *S. oryzae*. The highest percentage of host suppression was recorded in light jute and markin bags in case of *A. calandrae* and *C. elegans*, respectively. The percentage of parasitism higher in light jute followed by markin bags for both *A. calandrae* and *C. elegans*.

KEY WORDS: *Anisopteromalus calandrae*, *Choetospila elegans*, potentiality, *Sitophilus oryzae*

INTRODUCTION

Sitophilus oryzae (Linnaeus) is a major pest of rice, wheat and cereals throughout the world especially in temperate and tropical regions (Alam, 1971; Hill, 1983; Bhuiyah *et al.*, 1990). It consumes almost the entire endosperm and protein of the embryo and causes not only a great loss of food but also the economic loss of the farmers, storekeepers and of a country in fact. *S. oryzae* is parasitized in its larval-pupal stages by the pteromalid parasitoids, *Anisopteromalus calandrae* (Howard) and *Choetospila elagans* Westwood (Islam *et al.*, 1985; Smith, 1992).

The release of insect parasitoids and predators into warehouse situations to suppress or eliminate residual or active populations of various stored product insect pests has been studied (Brower and Press, 1992; Doury and Rojas-Rousse, 1994; Flinn *et al.*, 1994, 1996; Ahmed and Kabir, 1995; Islam and Kabir, 1995; Ahmed and Khatun, 1996).

Some work has been done on the control potential of *A. calandrae* on different hosts (Cline *et al.*, 1985; Islam and Nargis, 1994) but there has not been any such work on *C. elegans* parasitizing *S. oryzae* contained in different types of bag. The present study was taken up to evaluate the potentiality of the parasitoids, *A. calandrae* and *C. elegans* in reducing or eliminating *S. oryzae* populations in wheat stored in various type of bags.

MATERIALS AND METHODS

To get a large number of infested wheat seeds (18-20 days-old), adults of *S. oryzae* were placed in a large covered plastic tray (45x30cm) containing sufficient amount of uninfested wheat. *Sitophilus oryzae* infested wheat seeds parasitized by *A. calandrae* and *C. elegans* were collected from the culture just before the adult emergence and placed in a small beaker separately covered with a piece of muslin each. Subsequently, mating was observed after the adult emergence within 24 hours.

Two rooms (7.87 cubic meter each) were used for the experiment, one for *A. calandrae* and the other for *C. elegans*. The doors and windows of the rooms were closed completely to prohibit insects from entering and exiting. Small bags were made from pieces of heavy jute, light jute, polythene, polypropylene, markin and nylon. The bags were sewn on two sides to form a pouch. Each bag had a capacity of 300g of wheat.

Infested wheat seeds with *S. oryzae* (18-20 days-old) reared previously were taken. The number of 2250 infested seeds was separated. The seeds were then divided into three equal lots to ensure that an equal number (c 750) of *S. oryzae* infested seeds (18-20 days-old) was present in each grain mass. One of the lots was placed in a glass-container and incubated to determine the number of *S. oryzae* emerged in the absence of the parasitoids. The other lots, separately, were mixed thoroughly with enough uninfested seeds to make a total grain mass of 7500g each.

Five bags of each type were previously prepared for the parasitoid species, *A. calandrae* and the seeds were divided equally and placed into the bags. Each bag contained 250g of wheat seeds. The bags were placed in the test room. A single introduction of 50 pairs of newly emerged mated females of *A. calandrae* was released into the center of the test room. The room was kept tightly closed. The bags were collected seven days later, lightly brushed to remove any insect, placed in jars, and incubated for 15 days. The emergence of the parasitoid was recorded from all the bags. The suppressive effect of *A. calandrae* was determined by comparing the number of *S. oryzae* emerging from the different type of bags with those emerging from the control. The percentage of parasitism in each treatment was measured as suggested by (Islam and Kabir, (1995). In this experiment five replicates were carried out.

Similar procedure was applied in case of *C. elegans* with the remaining lot of infested wheat at the same time using the other test room and analyzed comparing with the *S. oryzae* emerged in the control used for *A. calandrae*. As there was no temperature and relative humidity control system, the experiments were conducted in different periods (May-June and July-August).

RESULTS AND DISCUSSION

Anisopteromalus calandrae parasitized in all types of bags containing infested seeds of *S. oryzae*. The emergence of *S. oryzae* and *A. calandrae* from six types of bag was significantly different ($P<0.01$) (Table 1). Large number of *A. calandrae* emerged from light jute, markin and heavy jute bag than others.

Choetospila elegans also parasitized in all types of bag tested containing infested seeds of *S. oryzae* and significant difference ($P<0.01$) was noticed for the emergence of *S. oryzae* and *C. elegans* in different types of bag (Table 1). Higher number of *C. elegans*, emerged from light jute followed by marking and heavy jute bag.

The pest suppression in six different types of bags in two periods has been shown in Table 2. The highest pest suppression was found in light jute (90.99% in May-June and 88.87% in July-August) followed by markin (81.68% and 84.19%) and heavy jute (73.33% and 74.03%) in the respective periods in case of *A. calandrae*. In case of *C. elegans*, the highest pest suppression was found in light jute (75.57%) followed by markin (73.65%) and heavy jute (68.83%) in May-June period whereas the highest pest suppression was found in markin (82.26%) followed by light jute (81.45%) and heavy jute (76.45%) in July-August period. The pest suppression was significantly

Table 1. Number of *S.* oryzae, *A. calandrae* and *C. elegans* emerged from different types of bags

Bag	*S. oryzae*		*A. calandrae*		*S. oryzae*		*C. elegans*	
	May-June	July-August	May-June	July-August	May-June	July-August	May-June	July-August
Heavy	33.2d	32.2d	87.4c	87.8c	38.8d	29.2d	81.8b	81.6b
Light Jute	11.2f	13.8f	107.8a	105.6a	30.4e	23.0e	88.8a	88.2a
Polythene	114.6a	113.6a	4.6f	3.8f	116.6a	111.4a	2.6e	3.2e
Polypropylene	76.6b	76.2b	43.0e	43.4e	66.0c	68.4c	53.6c	52.6c
Markin	22.8e	29.6e	96.2b	96.0b	31.4e	22.0e	87.6a	86.8a
Nylon	69.4c	69.0c	52.0d	52.4d	73.2b	71.2b	48.2d	47.8d

Figures followed by the same letters were not significant at P<0.05 by the DMRT.

different (P<0.01) for *A. calandrae* and *C. elegans* in different type of bags. In case of *C. elegans*, periods significantly affected (P<0.01) pest suppression.

Parasitism occurred in all the bags containing infested wheat of *S. oryzae* (Table 2). The highest percentage of parasitism was observed in light jute (90.63) followed by markin (80.86) and heavy jute (73.08) in May-June and these figures were 88.47, 83.05 and 73.27, respectively in July-August in *A. calandrae*. The lowest parasitism was observed in polythene bags in both periods. In case of *C. elegans*, in May-June the highest percentage of parasitism was found in light jute, markin and heavy jute (75.05, 73.65 and 67.84) and in July-August that was found in markin cloth (75.12) followed by light jute and heavy jute (73.9 and 68.01). The percentage of parasitism of *A. calandrae* and *C. elegans* were significantly different (P<0.01) in different types of bag.

Table 2. Per cent suppression and parasitization of *S. oryzae* in bags by *A. calandrae* and *C. elegans*

Bag Type	Suppression (%)				Parasitism (%)			
	A. calandrae		*C. elegans*		*A. calandrae*		*C. elegans*	
	May-June	July-August	May-June	July-August	May-June	July-August	May-June	July-August
Heavy jute	73.33c	74.03c	68.83b	76.45b	73.08c	73.27c	67.84b	68.01b
Light jute	90.99a	88.87a	75.57a	81.45a	90.63a	88.47a	75.05a	73.90a
Polythene	7.92c	8.42f	6.32e	10.16d	3.94f	3.24f	2.14e	2.68e
Polypropylene	38.46e	38.55e	46.97c	44.83c	35.94e	36.29e	44.82c	44.03c
Markin	81.68b	84.19b	73.66a	82.26a	80.86b	83.05b	73.65a	75.12a
Nylon	44.24d	44.36d	41.19d	42.58c	42.92d	43.24d	39.71d	39.39d

Figures followed by the same letters were not significant at P<0.05 by the DMRT.

The present study demonstrated that the number of the parasitoids, (*A. calandrae* and *C. elegans*) as well as the number of host (*S. oryzae*) emerged from the six different types of bag in May-June and July-August was significantly different. This indicated that the parasitoids did not penetrate all the bags equally. This result supports the result of Islam and Kabir (1995) who reported that the mean number of *Callosobruchus chinensis* and *Dinarmus basalis* recovered from three types of bag (amemian, polypropylene and jute) in April-May and July-August periods was significantly different. They also mentioned that *D. basalis* did not penetrate all the bags equally. However, Cline *et al.* (1985) found that average number of insects (host plus parasitoid) recovered from all types of fabric bags (cotton, burlap and polypropylene) were not significantly different when *A. calandrae* was released against *S. oryzae*. Verma (1990) observed *D. basalis* to be able to penetrate a 10-inch bed of bruchid-infested seeds readily and found 74.92 percent mortality of the host *C. analis*. From the present investigation it can be noted that very little number of parasitoids penetrated the weave of the polythene bag containing infested wheat, as evidenced by the fact that very little number of *S. oryzae* were parasitized. Cline *et al.* (1985) found no parasitization in the cotton bag containing *S. oryzae*-infested wheat by the parasitoid *A. calandrae*.

It is evident from the present study that the highest percentage of parasitism occurred by *A. calandrae* was found in light jute bag (89%) and lowest in polythene bag (3%). In case of *C. elegans*, the highest percentage of parasitism was found in light jute (74%) and markin bags (74%) and lowest in polythene bag (2%). Only 30.0 - 47.0 per cent of parasitism was observed in burlap bag and polypropylene bag (Cline *et al.*, 1985).

The highest pest suppression occurred in light jute bags by *A. calandrae* and *C. elegans* in the present experiment. Significant differences were found in six different types of bag in host suppression for both the parasitoid species. The periods did not show any significant effect on host suppression by *A. calandrae*. But significant effect of periods was found in host suppression for *C. elegans* and the highest host suppression occurred in July-August period. The present result also agree with the observation of Islam and Kabir (1995) who mentioned more than 86 per cent of pest suppression occurred in amemian bag. A single release of 50 pairs of *A. calandrae* suppressed 95.3 per cent of residual populations of *S. oryzae* in wheat (Press *et al.*, 1984) but 32.8 per cent and 34.3 per cent of *S. oryzae* and *Rhyzopertha dominica*, respectively (Ahmed and Kabir, 1995). *C. elegans* was very effective for suppressing *R. dominica* populations with augmentative release (Flinn *et al.*, 1994, 1996). Flinn *et al.* (1996) found 98 per cent and 91 per cent suppression of *R. dominica* compared with the control by *C. elegans* in 1993 and 1994, respectively. They also worked on *Cryptolestes ferrugineus* parasitized by *Cephalonomia waterstoni* and found that *C. waterstoni* suppressed 50 per cent of *C. ferrugineus* population growth.

It can be concluded that both *A. calandrae* and *C. elegans* have potential for controlling *S. oryzae* in both grain storage and warehouse where processed commodities are stored, and between these two parasitoids *A. calandrae* was found to be more effective. For suppression of *S. oryzae* in wheat contained in six different types of bag light jute, markin cloth and heavy jute bags can be suggested.

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