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Biological Control Potential of *Anisopteromalus calandrae* against *Callosobruchus maculates* in Brown Lentils under Controlled Environmental Conditions

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THIS research was conducted to assess the parasitic potential of *Anisopteromalus calandrae* (Howard) against a larval parasitoid ofpulse beetle (*Callosobruchus maculates*). Different pairs of host insects (pulse beetle) (5, 15, and 30) were released in to jars of 100g and 150g of brown lentils with constant pairs of *A. calandrae* for each group. The statistical data showed that when the population of *C. maculatus* was much higher even than its parasitoid showed a significant effect as in case of 30 pairs of *C. maculatus* and 2 pairs of *A. calandrae* (32-38% parasitism) in different situations (100g and 150g brown lentils). The parasitic potential increased with increase in the parasitoid population as in case of 15 pairs of insect pest and 5 pairs of parasitoid 80-84% parasitism), 10 pairs of pest and 5 pairs of parasitoid (88-94% parasitism) and 10 pairs of pest insect and 10 pairs of parasitoid (94-98% parasitism). Comparison of the data showed that *A. calandrae* is most effective in 3:1 in both approaches.

Keywords: *Anisopteromalus calandrae*; *Callosobruchus maculates*; Brown lentils; Biological control.

Introduction

In Pakistan, insects cause a great loss in different types of stored products within different types of storage systems [1-2]. There are about twenty species of insects including *Callosobruchus maculates, C.chinensis, P. ainterpunctella, C. cephalonica, R. dominica, S.oryzae, T. granarium, S. cerealella, C. ferrugenius, S. granarius, S. zeamais, T. castaneum* and *O. surinamensis* that frequently attack the pulses, cereals, and their products when these products are stored [3].

C. maculatus is considered as primary insect pest of stored pulses[4]. It attacks on whole seed of pulses and causes infestation in new grains. Eggs of *Callosobruchus sp.* hatch within 5 days [3]. In optimum temperature (26^{0}C) *C. maculatus* completes its life cycle in 35 days and produce 5 generations during storage period. This means that pest population increases within no time and cause serious damage to economy. *Callosobruchus sp.* attack on differentvarieties of stored legumes including white pea (*P.sativum),* cowpea (*V.guiculate*), lentil (*L. culinaris)* and other important crops. It is called holometabolic insect because its eggs and adults are always present on the upper side of grains and the larvae and pupa stages lives inside the grains. The larvae dig a whole into the grains and consume the endosperms present in

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the grains. Consequently,such grains not only become unfit for human consumption but also unfit for replanting or sprouting.

Insecticides and fumigants are being used for a long period to control insect pests of stored grains [5]. No doubt that the use of chemical insecticide helps greatly to control insect pests quickly but on the other hand it is seriously damaging other biotic organisms like beneficial and valuable insects[6, 9]. With its toxic residual effects, it is damaging soil and the crops growing on that soil also disturbing biodiversity of that area [7]. Some of these pesticides have adverse effects on soil and on human life. So, there is a need to find out alternatives of these pesticides and control by natural enemy is one of the best options [8].

In controlling the stored-grain insect pests, parasitoids have more benefits as compared to old chemical methods. In biological control there is no hazardous residual effects. The most important advantage of biological control are (i) that they reproduce themselves until their host survive and after elimination of host they also get eliminated because of their shorter life span (ii) No need to spread them over wider area like chemical pesticides because a single location is enough for them and they find their host and spread by their own. Population of adult parasitoids has been successfully recognized in the stored products like wheat and maize [10]. Some parasitoids like *A. calandrae* even find their host inside the grain and feed on them [11].

It is observed that the progeny and sex ratio in *A. calandrae* is regulated by its host size. It deposits female eggs on larger hosts and male eggs on small size hosts. Female parasitoid uses specific cues and clues to identify the location of host beetle larvae that is being developed inside the seed. It may catch the odors from host or may be the sound produced by larvae during feeding that catches the attention of wasp towards it the reason is still not clear. But once the host larvae are detected, female parasitoid uses its ovipositor to paralyze the host larvae and lays eggs on it. A female wasp may lay more than 400 eggs in his life as one egg per host [12].

This study was aimed to determine the parasitic potential of *A. calandrae* against major primary pest of stored grains*C. maculatus* which causes serious damage to important crops like cereals and pulses in Asia. So that better strategies to use the biological control agent *A. calandrae*may be developed for sustainable management of the pulse beetles.

Material and Methods

Collection of Pulse Beetles and Their Parasitoids

In this research the damaged grains were collected from storages of farmers, food department, and grain market of Faisalabad (Pakistan),with the eggs and adult population of *C. maculatus*, a small parasitic wasp *A. calandrae* was also found. This parasitic wasp is found naturally with its hosts. This parasitoid attacks on the larvae and pupa of *C. maculatus* and thus can be used as its natural control.

Rearing of Host Pests

Half kilogram (kg) of cereals was taken in 2 plastic jars, 30 individuals of pulse beetles were released in each jar. After 5-7 days adults of pulse beetle were sieved out and grains having eggs of *Callosobruchus maculatus* were again put into jars. Jars were labeled properly and covered with fine muslin cloth and then placed into the incubator at optimum growth conditions i.e. 27 ^{0}C-30 ^{0}C with 65-70% R.H [13]for rearing of homogenous culture. After 2 weeks of incubation, the adults were seen in jars [14]. Late larval instars were used in these experiments as these are preferred by the parasitoid [15]. This culture was used in further experiments of biological control.

Rearing of Anisopteromalus calandrae

Anisopteromalus calandrae, a cosmopolitan wasp were collected from infested grains from storages and grain market of Faisalabad and reared in laboratory according to the described methods [16]. Thirty adult *C. maculatus* were releasing on sterilized grains in separate jars. After 5-7 days adult insects were sieved out from jars and grains having eggs were placing in incubator at optimum growth conditions. After 15 days 20 parasitoids were released in jars. Female parasitoid laid eggs on emerging larvae and pupa of insect pests. Cotton swabs dipped in honey solution were placed in jars for wasp feeding because if *A. calandrae* is given honey it may live an average life of 49.8 days on the other hand its life become shorter with an average of 10.4 days only if honey is replaced with sugarcane solution [17].

Experiment

In this experiment, 100g and 150g of brown lentils were taken in separate jars. These grains were sterilized properly before the start of experiment. 12 jars were taken each having 100gm of brown lentils and 12 jars containing

150g brown lentils. 30 individuals of pulse beetle were released in each jar and removed after 5-7 days to get homogenous population in each jar. Eggs hatched in 7-10 days and then *A. calandrae* released in these jars in pairs of 2, 5 and 10 respectively each except in control jar and 3 replications were made for each trail. After 30 days data were collected from these jars. The results was analyzed using Complete Randomized Design (CRD).

The parasitism (%) of *Anisopteromalus calandrae* against *Callosobruchus maculatus* on brown lentilswas determine using the following formula [18].

%age parasitism =

$$\frac{\text{Total No. of emerged } \textit{Anisopteromalus calandrae}}{\text{No. of emerged host + No. of emerged } \textit{A. calandrae}} \times 100$$

Results and Discussion

The results were analyzed regarding pest emergence, parasitoid emergence and percentage parasitism of *A. calandrae* against*C. maculates*using brown lentils.

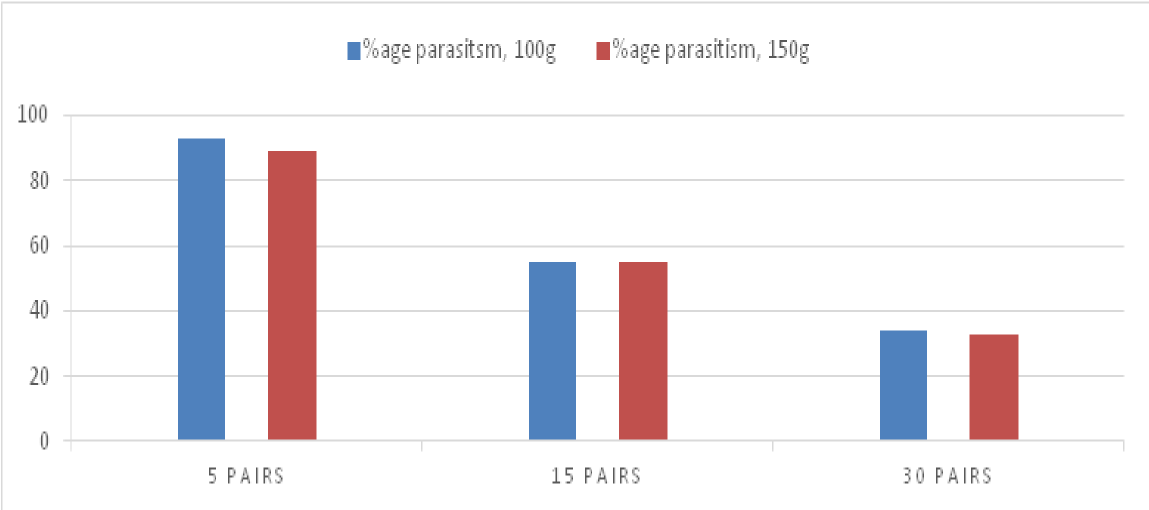

Fig. 1. % age parasitism in 100g vs. 150g brown lentils when parasitoid population is constant (2 pairs) and host population is variable (5 pairs, 15 pairs and 30 pairs).

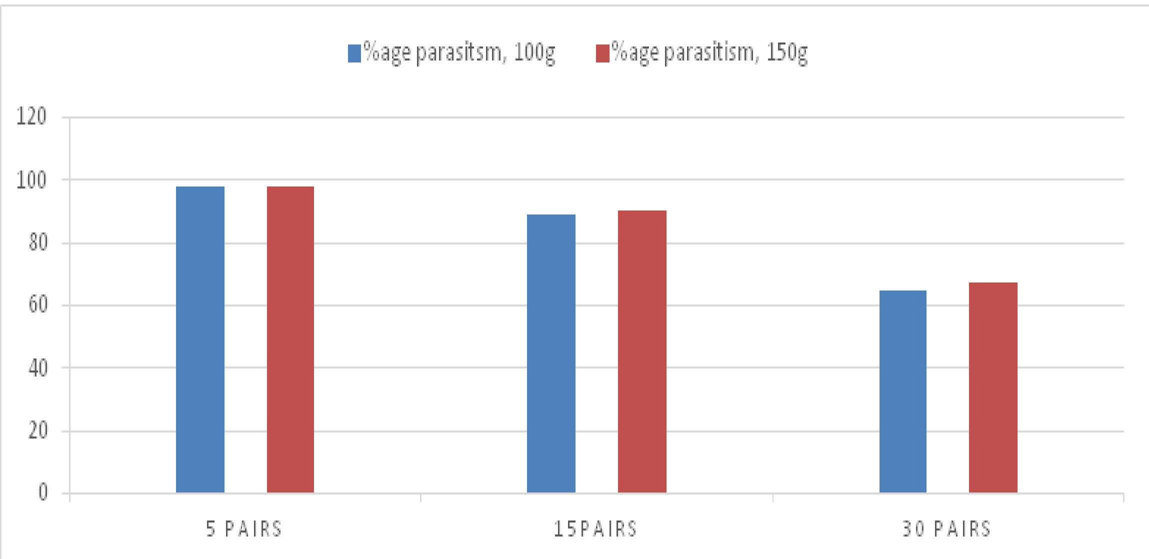

Fig. 2. % age parasitism in 100g vs. 150g brown lentils when parasitoid population is constant (5 pairs) and host population is variable (5 pairs, 15 pairs and 30 pairs).

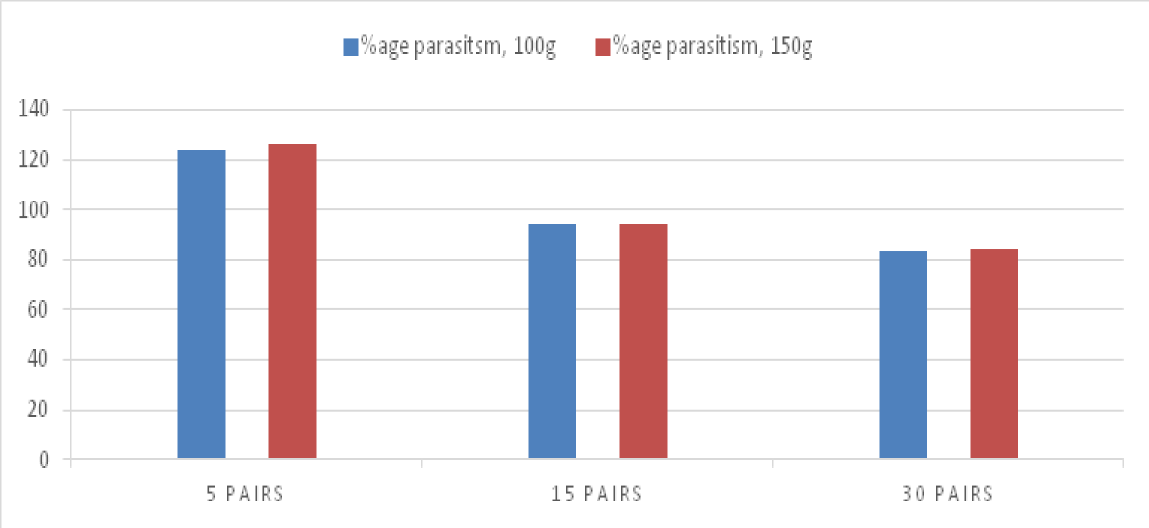

Fig. 3. %age parasitism in 100g vs. 150g brown lentils when parasitoid population is constant (10 pairs) and host population is variable (5 pairs, 15 pairs and 30 pairs).

The present study was conducted to evaluate the development of host and activities of parasitoid and to find out the percentage parasitic potential of *A.calandrae*using different quantities of brown lentils (100gm, 150gm). The statistical data showed that the population of *C. maculatus* can be easily controlled by its natural predator *A. calandrae.* The results of these experiments evaluated that the population of pulse beetle can be suppress with its host, these finding were quite similar to those of Perez-Mendoza [19]. The statistical data also showed that when the population of *C. maculatus* was much higher than its parasitoid population, the parasitoid still showed a significant effect on pest population as in case of 30 pairs of *C. maculatus* and 2 pairs of *A. calandrae* (32-38% parasitism) in both situations (100g and 150g brown lentils). The parasitic potential increased with increase the parasitoid population as in case of 15 pairs of pest insect and 5 pairs of parasitoid (80-84% parasitism), 10 pairs of pest insect and 5 pairs of parasitoid (88-94% parasitism) or 10 pairs of pest insect and 10 pairs of parasitoid (94-98% parasitism) the results was similar to as reported by Lucas and Riudavets [3, 20].The results evaluated that, the best parasitic potential was obtained when used in 3:1 (3 pest and 1 parasitoid). Although 2:1 and 1:1 showed very impressive results but these practices cannot be used for a longer period of time (6 months or more) because they showed almost 100% parasitism this means the parasitoid will not have host population to lay eggs and so its population will decline and get vanished in a smaller period of time but in case of 3:1 ratio, the pest population was under control and parasitoid lived for a longer period of time. Mahal [20, 21] performed similar experiments on *A. calandrae*to observe the effects of different introduction rate released in different densities (5, 10, 20, 30, 40, and 50) introduced in population of *R. dominica* in stored wheat.

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