EUROPEAN ACADEMIC RESEARCH
Vol. V, Issue 1/ April 2017

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Parasitism Preferences of Pupal Parasitoid *Dirhinus Gifardii* against Host Age of *Bacterocera Zonata* (Saunders)

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Abstract:

The experiment was conducted in the Bio-Control Research laboratory, Department of Entomology, Faculty of crop Protection, Sindh Agriculture University, Tandojam in 2015. Age specific parasitism by Dirhinus gifardii on the pupae of Bacterocera zonata

(saunders) was determined at 26±2 ºC and 65±5% RH. For this purpose 24, 48, 72 and 96 hours mature pupae of B. zonata were given to the adult of D. giffardii in cages by maintaining CRD with replication. The result showed that maximum parasitism and shortest emergence time was recorded as (53.33 %) within 10 days on 48 hours mature pupae. The same parasitism percentage (53.33%) was also recorded on 72 hours mature pupae but emergence time was prolonged to 12 days. Minimum parasitism percentage was recorded on 24 hours mature pupae followed by 96 hours. The female and male ratio varied significantly, it was recorded as 1:3, 1:9, 1:7 and 1:1.50 on 24, 48, 72 and 96 hours mature pupae, respectively. It is concluded that for culture development of D. giffardii 48 hours mature pupae should be utilized for better parasitism %, emergence and male female ratio.

Key words: *Dirhinus gifardii*, *Bactrocera zonata*, Pupation, Parsitism, Bio-control.

INTORDUCTION

The fruit flies are very common pests of economic importance in nearly all tropical, subtropical and various temperate regions of the world [3]. In Pakistan, *Bacterocera zonata* is one of the serious species of fruit flies, which attacks guava, mango, peaches, papaya, persimmon and citrus. Damage by this species has been reported as (25-50%) in guava, (10-15%) in mango and (40%) in persimmon [12]. Sour orange appeared to be the highest susceptible host, followed by orange and guava, whereas mandarin, apple, mango and fig were more resistant [9]. *Dirhinus giffardii* (hymenoptera: chalcididae) a pupal parasitoid of fruit flies, which was originally described from Nigeria Subsequently. This species was introduced as a biological control agent in Bolivia against medfly. It plays an important role to control many species of fruit flies and reported as an efficient bio-control agent [1]. It has been

potentially exploited as bio-control agents against different fly species in Pakistan but its parasitism on different aged pupae may be variable and needs to be determined specifically. *Bactrocera zonata* is one of the most harmful species of family Tephritidae.

Adult Fruit fly is more or less about the size of a house fly. These are pale yellow to blackish brown in color decorated with several species of brown yellow. Bodies of these are cone posteriorly and females were provided with a sharp ovipositor tip of the abdomen [15]. Most of the fruit fly species are highly polyphagous attacking several important vegetables and fruits including citrus, guava, mango, avocado, tomatoes, cucurbits and pepper etc. Female adults of the fruit flies lay eggs underside of the skin of the vegetables and fruits cause direct losses. The eggs develop into larvae that feed in the decaying flesh of the crop. Infested fruits and vegetables quickly rot and turn into inedible or drop to the ground. In additional causing direct losses in the market ability and yield which possess significant threats to quarantine security and thus to international trade in fresh vegetables and fruits world-wide [8]. Female flies deposit their eggs inside the flesh of appropriate hosts and developing maggots nourish on the fruit flesh decline large amounts of fruit and make it unfit for feeding or selling [2]. Damage to fruit result in a loss of about 7 billion rupees annually of the farmer in Pakistan, besides losses to traders, retailers and exporters. Some fruits such as guava fruit fly cause up to 100% loss of harvested fruit in Haripur and Kohat were severely damaged. [12] and 76.5% in Bannu. In Egypt *B. zonata* has caused an estimated 190 million Euros damage per year. *B. zonata* also invade many countries of the Middle East [7]. Current annual cost of damage in the Middle East is estimated at EUR 320 million and intensive control measures required to grow susceptible plants commercially.

Insect pest badly disturbing agricultural production is mostly depressed by applying large amount of hazardous chemical. Generally 30-40 percent losses are observed in the field yields at the time of pre-harvest and post-harvest was made up by common insects [11]. The indiscriminate use of pesticides creates many complications like as make the environment pollute, developing resistance to insect pests and minor pests. According to an assessment pesticides affect the health of around 400,000 to 2,000,000 people every year of these 1,000 to 40,000 die especially in the progressive countries [10]. With concentrated expression on substitute control methods are introduced as bio-control. Exact application of the bio-control active procurement, biologically and justifiable approach to pest control. Community support for the implementation of biological control as one of the preferred methods of administration of native and non-native pests mounting in many countries around the world. It caused to especially ways to increase the utilization and efficiency application of traditional and complementary biological control for the production and release of biological control agents. Flourishing biological control program mainly rely on the production of natural enemies in the most efficient and economical manner. Extensive advances in the use advanced techniques for efficient production of parasitoids and predators documented. The artificial rearing of parasitoids insects began long ago with the main goal to try to obtain an average to multiply and produce parasitoids in biological control strategies to be published. But it is also a powerful tool to perform studies on biology, physiology and behavior of the entomophagous especially endo-parasitoid species [6]. Biological control is comparatively stable, nontoxic, efficient and ecologically friendly. It can be well-defined as the achievement of parasites, parasitoids, predators and pathogens to retain pest populations at lesser mean than the level of economic damage. Consequently non-target species

are safe. Effective natural enemies frequently remain to have a deletion year disturb insect pests [4]. *Dirhinus giffardii* a pupal parasitoid of fruit fly originated in West Africa and has been presented in more than 20 countries mostly in the Central American regions and Pacific [14] ecto-parasitoid tephritid pupae of fruit flies. Female of *D. giffardii* pierce the pupae wall and deposit eggs on the host pupa. The host continues to develop until the larva emerged parasitoids when host is paralyzed and eaten by the larva [13]. Females of *D. giffardii* like to attack larger species of hosts when given a selection resulting in greater parasitoid offspring. The newly hatched wasp larvae are transparently white in color feeding on the host tissue and then they grow up in size. Then host pupa is dead only remaining outer tissue (puparium). The emergence of male wasp often takes place in the morning and it emerges 2 to 3 days earlier than female ones. The wasps mate after emergence. There is only one egg is deposited in each pupa. In the condition of 27℃ and 70 to 75 RH and adult last about 18 to 30 days. It includes 2 days of egg stage 9 to 10 days of larva stage 7 to 8 days of pupa stage and an adult can live about 10 to 15 days [13]. The significance of parasitoids in the enhanced version of bio-control lots of harmful insect reported by numerous workers [13]. It has been exploited as possible natural enemies are used against many species of fruit flies in Pakistan its attacks on diverse hosts. This suggested [5] that *D. giffardii* could already attack on *B. dorsalis* pupae and it has only a minor desired on non-parasitized pupae of fruits fly *B. correcta* and *B. dorsalis*. There were observed effect of parasitoid and pupae age and host parasitoid parasitism rates and density. The highest parasitization was observed in three days. Suggested that *D.giffardii* is a very essential bio control agent so this study was intended to assess the assessment of parasitization and progress of it's on diverse parasitoid.

MATERIAL AND METHODS

The experiment was conducted in the Bio-Control Research laboratory, Department of Entomology, Faculty of crop Protection, Sindh Agriculture University, Tandojam to evaluate the parasitism preferences of pupal parasitoid *Dirhinus gifardii* against host age of *Bacterocera zonata* (saunders) under laboratory conditions during 2015 at Temperature 26±2 and Relative humidity 65±5 %. In this experiment we determine the pupal parasitism % and age specific parasitism of *Dirhinus giffardii* on *B. zonata*.

Collection of infested fruits:

The infested guava fruits was collected from Sikandar Agriculture Farm Tandojam and Dheli Agricultural Farm, NIA, Tandojam. The infested fruits were kept in trays having sawdust. The trays were shifted in the cage, when maggots were pop out and drop themselves from infected fruits on to the sawdust for pupation. The sawdust were then sieved to collect the pupae of fruit flies.

Adult diet:

Pupal parasitid, *D. giffardii* was fed with artificial diet containing 30% honey and 70% distilled water.

Experiment design:

The experimental was laid out in a Completely Randomized Design (CRD) with three replications. The pupae of different age were placed in the cage for egg lying of the parasitoid. The treatments were T_1 (24 hours. mature pupae), T_2 (48 hours. mature pupae), T_3 (72 hours. mature pupae) and T_4 (96 hours. mature pupae). In each replication 15 pupae of *B. zonata* was kept under 5 cm layer of plant debris inside the plastic cage (1′× 1′×1) separately. Eight pairs of *D. giffardii* was released for 48

hours. in plastic cages to determine the pupal parasitism percentage and pupal age preference of the parasitoid on *B. zonata*. The collected data was subjected for statistical analysis (Zar, 1996).

RESULTS

The results presented in Table 1 indicated that 24 hours mature pupae of *B. zonata* was parasitoids with *D. giffardii*. The highest emergence of male pupal parasitoid *D. giffardii* was obtained 3.00 (20.0%) and female 1.0 (6.67%), total emergence 4.0 (26.67%) were recorded after 12 days of immature development period. The minimum emergence of male pupal parasitoid *D. giffardii* was recorded 2.33 (15.56 %) and female 1.0 (6.67%), total emergence 3.33 (22.22%) were observed after 12 days of immature development period. The parasitoid was not emerged out after 13 and 14 days of development period. It was observed that parasitoid was emerged out after 11 and 12 days of development period the highest emergence of male parasitoid was recorded and maximum parasitism percentage was seen at 12 days after completed immature development period in the 24 hours mature pupae of *B. zonata*.

The results depicted in Table 2 showed that 48 hours mature pupae of *B. zonata* was parasitoids with *D. giffardii*. The maximum emergence of male parasitoid *D. giffardii* was recorded 7.00 (46.67%) and female 1.0 (6.67%), total emergence 8.0 (53.33%) were recorded after 10 days of immature development period. Similarly, minimum emergence of male parasitoid was observed 0.33 (2.22%) and female 1.67 (11.11%), total emergence 2.0 (13.33%) were observed after 11 days of immature development period. The parasitoid was not emerged out after 12 and 13 days of development period. The findings of present results showed that parasitoid was

Table 1 **Development time, emergence and parasitism percentage after parasitization of *Dirhinus giffardii* of 24 hours mature pupae of *Bactrocera zonata.***

Development Time (Days)	Male	Male Emergence percentage	Female	Female Emergence percentage	Total	Parasitism percentage
11	2.33	15.56	1.00	6.67	3.33	22.22
12	3.00	20.00	1.00	6.67	4.00	26.67
13	0.00	0.00	0.00	0.00	0.00	0.00

Table2 **Development time, emergence and parasitism percentage after parasitization of *Dirhinus giffardii* of 48 hours mature pupae of *Bactrocera zonata.***

Development Time (Days)	Male	Male Emergence percentage	Female	Female Emergence percentage	Total	Parasitism percentage
10	7.00	46.67	1.00	6.67	8.00	53.33
11	0.33	2.22	1.67	11.11	2.00	13.33
12	0.00	0.00	1.00	6.67	1.00	6.67
13	0.00	0.00	0.00	0.00	0.00	0.00

gradually emerged after 10 and 11 days of development period. It was observed that the highest emergence of male parasitoid was obtained and parasitism percentage was recorded after 10 days development period of parasitoid in the 48 hours mature pupae of *B. zonata*.

The results presented in Table 3 displayed that 72 hours mature pupae of *B. zonata* was parasitoids by *D. giffardii*. The maximum emergence of male parasitoid *D. giffardii* was observed 6.67 (44.44%) and female 1.33 (6.67%), total emergence 8.0 (53.33%) were recorded after 12 days of development period. Whereas, after 13 days development period the highest emergence of female parasitoid was seen 3.33 (22.22%) and male 2.67 (17.78%), total emergence 6.0 (40.0%) were recorded. The results further revealed that after the 14 days of emergence the highest male emergence of parasitoids was observed 2.33 (15.56%) and female emergence was recorded 1.33 (8.89%), total emergence 3.67 (24.44%) were recorded. The parasitoid pupae was not emerged after 15 days of development period. The findings of present results indicated that the parasitoid started to emerge from 12 to 14 days after completed

their immature development period. The highest emergence of male parasitoid and parasitism percentage was recorded after 12 days of development period of parasitoid in the 72 hours mature pupae of *B. zonata*.

The results described in Table 4 indicated that 96 hours mature pupae of *B. zonata* was used for parasitism. In this study it was noted that the maximum emergence of male parasitoid *D. giffardii* was seen 4.33 (28.89%) and female 3.0 (20.0%), total emergence 7.33 (48.89%) were observed after 10 days of development

Table 3 **Development time, emergence and parasitism percentage after parasitization of *Dirhinus giffardii* of 72 hours mature pupae of *Bactrocera zonata*.**

Development Time (Days)	Male	Male Emergence percentage	Female	Female Emergence percentage	Total	Parasitism percentage
12	6.67	44.44	1.33	8.89	8.00	53.33
13	2.67	17.78	3.33	22.22	6.00	40.00
14	2.33	15.56	1.33	8.89	3.67	24.44
15	0.00	0.00	0.00	0.00	0.00	0.00

Table 4 **Development time, emergence and parasitism percentage after parasitization of *Dirhinus giffardii* of 96 hours mature pupae of *Bactrocera zonata*.**

Development Time (Days)	Male	Male Emergence %	Female	Female Emergence percentage	Total	Parasitism percentage
10	4.33	28.89	3.00	20.00	7.33	48.89
11	2.00	13.33	0.00	0.00	2	13.33
12	2.00	13.33	3.00	20.00	5.00	33.33
14	0.00	0.00	1.33	8.89	1.33	8.89

period. The result further revealed that emergence of male parasitoid was recorded 2.0 (13.33%) after 11 days of immature development period. The results further depicted that after the 12 days of development period the maximum emergence of male parasitoids was recorded 2.0 (13.33%) and female emergence was observed 3.0 (20.0 %), total emergence 5.0 (33.33%). After 13 days of immature development period only female emerged out from parasitoid pupae 1.33 (8.89%) was recorded. The findings of present results showed that parasitoid was

gradually emerged after 10 and 13 days of development period. It was observed that the highest emergence of male parasitoid was obtained and parasitism percentage was recorded after 10 days development period of parasitoid in the 96 hours mature pupae of *B. zonata*.

DISCUSSION

The results indicated that 24 hours mature pupae of *B. zonata* was parasitoids with *D. giffardii*. It was observed that parasitoid was emerged out after 11 and 12 days of development period the highest emergence of male parasitoid was recorded and maximum parasitism percentage was seen at 12 days after completed immature development period in the 24 hours mature pupae of *B. zonata*. The results further showed that parasitoid was gradually emerged after 10 and 11 days of development period. It was observed that the highest emergence of male parasitoid was obtained and parasitism percentage was recorded after 10 days development period of parasitoid in the 48 hours mature pupae of *B. zonata*.

The results indicated that the parasitoid started to emerge from 12 to 14 days after completed their immature development period. The highest emergence of male parasitoid and parasitism percentage was recorded after 12 days of development period of parasitoid in the 72 hours mature pupae of *B. zonata*. The findings of present results showed that parasitoid was gradually emerged after 10 and 13 days of development period. It was observed that the highest emergence of male parasitoid was obtained and parasitism percentage was recorded after 10 days development period of parasitoid in the 96 hours mature pupae of *B. zonata*. Our findings have more or less conformity with those of Zhao *et al*. (2013) The results showed that *P. vindemmiae* parasitized pupae of all ages and the number of high parasitism was 3-6

days mature pupae. The development time of parasitoid increased significantly in 3-6 days mature host compared to other ages groups. The host mortality rate decreased with increased host age. Male progenies developed more rapid than female and matureer host pupae produced a higher proportion of males. Adult longevity *P. vindemmiae* offspring were not affected by age enclosures. According to the results 3-6 days mature pupae *B. dorsalis* are suitable host age for *P. vindemmiae* and can be used to increase the mass culture. Naveed *et al*. (2014) reported that the maximum parasitism were observed on 3 days mature pupae and respectively detected up to the 5 to 6 days age of the pupae on both Species of flies and parasitization was not observed from 7 day onwards. These studies suggested so as to the parasitoids *D. giffardii* must be terminated after the age of 15 days for superior mass rearing. Liang *et al.* (2015) reported that the maximum parasitization was seen on host pupae of 4 and 5 days mature surveyed by 2 and 3 days mature pupae. The normal appearance period for both sexes were significantly heights in 6 to 7 days mature pupae than in the immature periods of hosts. These consequences suggest that *S. endius* and most of the tephritids are best partners for the biological control against fruit flies by releasing parasitoids. Sarwar *et al* .(2015) reported that *B. zonata* 24 hours mature host pupae were relatively more suitable for the highest parasitism and offspring production of *D. giffardii*. The completion of these results ought to help get better the mass rearing of parasitoids and the effectiveness releases of biological control agents for control of *B. zonata* in orchards plantations.

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