BIOLOGY OF *COCCINELLA TRANSVERSALIS* FAB. ON *APHIS NERII* UNDER LABORATORY CONDITIONS

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ABSTRACT: *A laboratory study was conducted on determine the effect of Aphis nerii on the biology of C. transversalis (Fab.) under laboratory conditions at Department of Plant Protection, SAU, Tandojam Sindh, Pakistan during 2013-14, to determined most suitable natural diets (aphid) for mass rearing of C. transversalis three natural diets i.e. T_1 (fresh), T_2 (frozen) and T_3 (dried) akk aphid, Aphis nerii were tested. The minimum pre-oviposition (3.2 ± 0.33 days), oviposition (32.5 ± 1.24 days) and post-oviposition (3.0 ± 0.26 days) period was obtained on fresh aphid followed by frozen and dried aphid of A. nerii. The highest fecundity (310.2 ± 11.98) was recorded on fresh aphid followed by frozen and dried aphid of A. nerii. The minimum egg incubation period (3.3 ± 0.37 days), total larval duration (8.5 ± 0.40 days) and pupal (3.2 ± 0.33 days) development period was recorded on fresh aphid followed by frozen and dried aphid of A. nerii. The longest survivor of adults was observed on dried aphid followed by frozen and fresh aphid of A. nerii, respectively. The highest egg hatching (68.0 ± 2.29 %), pupation (71.33 ± 2.34%) and minimum larval cannibalism (28.67 ± 2.34 %) was observed on fresh aphid followed by frozen and dried aphid of A. nerii, respectively. The analysis of variance showed that there was significant difference among the all biological parameters on three different diets (P<0.05).*

Key words: Biology, development period, *Coccinella transversalis, Aphis nerii.*

INTRODUCTION

The arthropod insect pests attacked on different crops, which fade the quality and quantity of crops and reduce yield as well in the economy of farmers. Farmers used agrochemicals for the protection of crops by the attack of insect pests, which increase crop production. Pesticides adversely affected ecofriendly environmental factors. Among alternative management practice, biological control is found to be safe, economical and permanent. This described as the introduction of natural enemies that cause reduction in insect pest population to keep them below economic threshold level. Effective natural enemies continuously feed on insect pests round the year [1]. In Pakistan many species of lady bird beetle are very effective in managing the many arthropod insect pests, particularly small and soft bodied insects. Approximately 4000 species of coccinellids are present all over the world [2] and 71 species of Coccinellid predators are documented in pests of different crops in Pakistan [3]. Among these predators Transverse beetle, *Coccinella transversalis* belonging to the Subfamily Coccinellinae, Order Coleoptera is important predators of many aphid species. Its adult is oval domed in shape, range in length from body length from 3 to 5mm. Females in general are a little larger than males. Most Ladybird Beetles are brightly colored. It has complete metamorphosis. Females lay clusters of 10 to 50 yellow spindle eggs. The larvae have long sharp mandibles and feed on small insects like their adults. The larvae are elongate and slightly oblong in shape. They are usually patterned with colours similar to their parents, and many are adorned with spines. The pupae are usually brightly patterned and can be found attached to the leaves and stems of plants where larvae have fed and developed [4]. The indiscriminate use of agro chemicals have developed resistance in insect pests and resulted in the environmental pollution on large scale, which is too dangerous for human & animal health, so there is a great need to work on coccinellid predators to find out the solution of farmers community and public health and to make the environment safe. The present research work was conducted to evaluate the natural diets on the biology of *Coccinella transversalis* Fab. under laboratory conditions. The findings of present research will greatly be helpful for integrated pest management strategy of many insect pests of different crops.

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MATERIALS AND METHODS

The experiment was conducted on to determine the effect natural diets (*Aphis nerii*) on the biology of *Coccinella transversalis* Fab. under laboratory conditions at 26 ± 2ºC temperature and 65 ± 5 % relative humidity and (11 L: 13 D) photoperiod in the Plant Protection Department, Sindh Agriculture University, Tando Jam during 2013-14. For this purpose adult transverse beetles were collected from field crops and reared on their prey (host) species in the laboratory for stock culture. In this experiment akk aphid, *Aphis nerii* was used as natural diets into three forms i.e. $T_{1=}$ Fresh, $T_{2=}$ Frozen and $T_{3=}$ Dried. Live akk aphid, *Aphis nerii* was collected from respective host plants. The collected aphid was transformed into two ways (i) Frozen aphid and (ii) Dried aphid.

Frozen aphid

Aphids were collected from respective host plants with the help of suction pump brought in the laboratory and placed into freezer at temperature 0ºC in plastic container (20×8 cm) for 24 hrs. When it became completely frozen, the dead aphids were taken and keeping into small container at same temperature. The frozen aphids were provided to predator to determine the biological parameters.

Dried aphid

The collected aphids were killed by keeping them into ice box for 24 hrs. After that same aphids were placed into oven at 50ºC for 3-4 hrs. The dried aphids were stored by keeping them in a plastic container and kept at 20ºC in the refrigerator till the experimentation

Table 1. Biology of Transverse beetle, *Coccinella transvarsalis* Fabricius reared on Akk aphid, *Aphis nerii* under laboratory conditions.

Biological parameter	(Fresh)	(Frozen)	(Dried)
Fecundity per female	310.2 ± 11.98 a	218.4 ± 7.47 b	92.2 ± 2.14 c
Pre-oviposition period	3.2 ± 0. 33 c	5.9 ± 0. 31 b	7.4 ± 0.37 a
Oviposition period	32.5 ± 1.24 c	36.7 ± 1.04 b	41.1 ± 1.50 a
Post-oviposition period	3.0 ± 0.26 c	6.4 ± 0.40 b	9.6 ± 0.40 a
Egg incubation period	3.3±0.37c	5.7±0.37b	8.6±0.16a
Hatching % (n=40)	68.0±2.29a	52.25±1.95b	40.25±1.56c
Mortality % (n=40)	32.0±2.29c	47.75±1.95b	59.75±1.56a
Pupation % & Larval cannibalism %			
Pupation % (n=40)	71.33±2034a	63.0±2.08b	55.67±2.58c
Larval cannibalism %(n=40)	28.67±2.34a	37.84±1.97b	44.33±2.58a
Adult emergence rate (%)			
Male	38.98±1.36a	37.84±1.72ab	34.43±1.42b
Female	52.98±1.44a	48.67±2.19a	50.66±2.23a
Different letters within a row indicate significant difference (Fisher's Protected LSD test: $P< 0.05$)			

Table 2, Developmental period of *Coccinella transvarsalis* Fabricius reared on Akk aphid, *phis nerii* under laboratory conditions.

Life stages	Developmental period (days)		
	(Fresh)	(Frozen)	(Dried)
1st instar	2.1 ± 0.18 c	3.1 ± 0.31 b	4.2 ± 0.42 a
2nd instar	2.2 ± 0.20 c	3.0 ± 0.30 b	3.8 ± 0. 29 a
3rd instar	1.9 ± 0.23 b	2.8 ± 0.29 b	3.8 ± 0.33 a
4th instar	2.3 ± 0.21 b	4.0 ± 0.45 a	3.4 ± 0.27 a
Total larval duration	8.5 ± 0.40 c	12.9 ± 0.82 c	15.2 ± 0.59 b
Pre Pupal Period	1.3 ± 0.15 a	1.7 ± 0.21a	1.8 ± 0.25 a
Pupal Period	3.2 ± 0.33 b	4.6 ± 0.54 a	5.1 ± 0.35 a
Adult longevity			
Male	35.8 ± 0.99 b	39.2 ± 1.36 b	57.0 ± 2.86 a
Female	42.5 ± 1.01 c	50.7 ± 2.34 b	64.3 ± 1.80 a
Different letters within a row indicate significant difference (Fisher's Protected LSD test: $P< 0.05$)			

The experimental design was complete randomized design (CRD) with five replications. When eggs become hatched the grubs were transfer into Petri dishes for experiment. The adults and larva was fed with natural diets. The fecundity, egg incubation, hatching percent and longevity, developmental period of larva, pupal percent emergence and sex ratio was recorded. The collected data was subjected for statistical analysis and statistical differences existed between data sets ($P<0.05$), Fisher's Least Significant Differences (LSD) were used to separate the differing means [5].

RESULTS

The result given in the Table 1 indicated that maximum fecundity was obtained by adult female 310. ± 11.98 on fresh aphid followed by frozen and dried aphids were 218.4 ± 7.47 and 92.2 ± 2.14, respectively. The result further revealed that the maximum pre-oviposition period was varied significantly ($P<0.05$) in the female 3.2 ± 0.33 days fed on fresh aphid followed by frozen and dried aphids were 5.9 ± 0.31 and 7.4 ± 0.37, respectively (Table 1). The results depicted that the oviposition period varied significantly in the female on given diets. The maximum period was observed 41.1 ± 1.50 days, when fed on dried aphids. Whereas, the minimum oviposition period were recorded 36.7 ± 1.04 and 32.5 ± 1.24 days fed on frozen and fresh aphids, respectively. The longest oviposition period was recorded on dried aphid followed by frozen and fresh as compared to rest of diets given to predator. The result showed post-oviposition period lasted by female 3.0 ± 0.26 days reared on fresh aphids, followed by frozen and dried aphids 6.4 ± 0.40 and 9.6 ± 0.40 days reared on frozen and dried aphids, respectively. The result further revealed that the minimum egg incubation period was recorded 3.3 ± 0.37 days on fresh aphids followed by frozen and dried aphids were lasted 5.7 ± 0.37 and 8.6 ± 0.16 days, respectively. The results indicated that the highest egg hatching % was seen on fresh aphids. The highest egg hatching % was recorded 68.0 ± 2.29 fed on fresh aphid followed by frozen and dried aphids were 52.25 ± 1.95 and 40.25 ± 1.56 %, respectively. Similarly, the highest egg mortality was seen 59.75 ± 1.56 % on dried aphid and lowest was 32.0 ± 2.29 % on fresh aphid. The data prescribed in Table 1 showed that the highest pupation % was obtained 71.33 ± 2.34 fed on fresh aphid and lowest was recoded 55.67 ± 2.58, when fed on dried aphid. However, the lowest larval mortality % was recorded 28.67 ± 2.34 fed on fresh aphids followed 37.84 ± 1.97 and 44.33 ± 2.58 on frozen and dried aphids, respectively. The data indicated that the maximum adult emergence of male and female was obtained 38.98 ± 1.36 and 52.98 ± 1.44 % fed on fresh aphid, respectively. The adult male and female emergence rate was recorded 37.84 ± 1.72; 48.67 ± 2.19 and 34.43 ± 1.42; 50.66 ± 2.23 on frozen and dries aphids, respectively. It was observed that the female

emergence rate (%) was more than males. The analysis of variance showed that there was significant difference among the all biological parameters on three different diets (*P<0.05*).

The result given in Table 2 indicated that the 1st instar lived 2.1 ± 0.18, 2nd instar 2.2 ± 0.20, 3rd instar 1.9 ± 0.23 and 4th instars 2.3 ± 0.21 with total larval duration of 8.5 ± 0.45 days reared on fresh aphid. The result further revealed that the larvae fed on frozen aphid the development period (days) were recorded 3.1 ± 0.31, 3.0 ± 0.30, 2.8 ± 0.29 and 4.0 ± 0.45 in 1st, 2nd , 3rd and 4th instars respectively. Total larval duration was 12.9 ± 0.82 days reared on frozen aphid. The data indicated that the mean larval development period (days) was recorded in 1st instar 4.2 ± 0.42, 2nd instar 3.8 ± 0.29, 3rd instar 3.8 ± 0.33 and 4th instars 3.4 ± 0.27. The total larval duration of 15.2 ± 0.59 days fed on dried aphid. The result indicated that the maximum pre-pupal and pupal period was obtained 1.3 ± 0.15 and 3.2 ± 0.33 reared on fresh aphid followed by frozen and dried aphids 1.7 ± 0.21 ; 4.6 ± 0.54 and 1.8 ± 0.25 and 5.1 ± 0.35 days, respectively. The result further revealed that the adult longevity was observed on fresh, frozen and dried aphids in the laboratory. The adult male was lasted 35.8 ± 0.99 days on fresh aphid followed by frozen and dried aphid 39.2 ± 1.36 and 57.0 ± 2.86 days, respectively. Similarly, the adult female was lived 42.5 ± 1.01 days fed on fresh aphid followed by frozen and dried aphid 50.7 ± 2.34 and 64.3 ± 1.80 days, respectively. The shortest survivor recorded on fresh aphid followed by frozen and dried aphid, respectively. The female lived longer than male when reared on three diets. There is highly significant difference in the developmental period of different life stages of *C. transversalis* on different diets (*P*<0.05).

DISCUSSION

Our findings have more or less conformity with those of [6] who reported that pre-oviposition period of up to 5 days was observed, most of this time being spent in mating, and the eggs were laid 24 h later on the lower surface of the mustard leaves, at a rate of 100-120/female in the laboratory; in the field, fecundity was higher. The larvae hatched after 7-10 days, and the total larval stage lasted 21-22 days, during which an average of 90 aphids was consumed by each larva. The pupal stage lasted 7-10 days, and the adults lived for 20-30 days. [7] reported the Developmental period of *C. septempunctata* and *C. transversalis* varied from 16.5 to 21.4 and 15.2 to 18.0 days, respectively. *C. sexmaculata* predated voraciously and bred well on all these hosts including *U. compositae*, indicating its wide host range. But, it developed faster on *A. nerii* (12.2 days) than other hosts and was more fecund on *A. craccivora* and *A. nerii*. *A. craccivora* was the most preferred host for all the coccinellids.The results of the present studies have the partial agreement with the reports of [8] evaluated six aphid species, viz. *Aphis craccivora, Aphis gossypii, Aphis nerii, Myzus persicae, Lipaphis erysimi* and *Uroleucon compositae* as prey to the feeding stages of *Coccinella transversalis* (Fabricius). Significant effect of prey quality was observed on pre-imaginal developmental periods, wet weights and adult longevity. The complete development was shortest on *A. gossypii* (13.01±0.18 days) and longest on *A. nerii* (20.51±0.25 days). The total prey consumption by larva, adult male and female in their lifetime was maximum (665.30±5.75, 4831.10 ± 123.54 and 5412.30 ± 94.51, respectively) on *A. gossypii* and minimum (434.80 ± 4.03, 802.80 ± 34.37 and 905.20 ± 52.48, respectively) on *A. nerii*. Immature survival, growth index and adult emergence of *C. transversalis* was maximum (68.33, 7.82 and 88.21%, respectively) when larval instars consumed *A. gossypii* and minimum (37.75, 2.18 and 60.69%, respectively) after feeding on *A. nerii*. Female reproduction was also prey quality dependent showing maximum reproductive performance in terms of fecundity and percentage viability, with a highest reproductive period and lowest non-reproductive period on *A. gossypii*, followed by *A. craccivora, L. erysimi, M. persicae, U. compositae* and *A. nerii*.

CONCLUSION

The minimum pre-oviposition, oviposition and post-oviposition period was obtained on fresh aphid followed by frozen and dry aphid of *Aphis nerii.* The highest fecundity, egg hatching percentage, pupal, adult emergence and minimum egg incubation period, larval and pupal development was recorded on fresh aphid followed by frozen and dry aphid of *Aphis nerii.* The longest survivor of adults was observed on dried aphid followed by frozen and fresh aphid of *Aphis nerii.*

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