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# Feeding Potential of Coccinella Spp (Coleoptera: Coccinellidae) on Natural Diet under the Laboratory Conditions.

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***Abstract:*** *Highest mean number of hatching / egg survival was recorded in Artificial diet (86.50±2.90) followed by Aphids feeding (75.25±2.28). Highest mean number of larval survival/ no.of pupae was observed in Artificial diet (73.00±2.48) followed by Aphids feeding with larval survival/ no.of pupae for parent (67.00±3.93). Maximum pupal weight was observed in Artificial diet (0.07±1.79) followed by Aphids feeding with pupal weight (0.06±2.06). Highest pupal survival rate was observed in Artificial diet (75.25±1.49) followed by Aphids feeding with pual survival rate (65.50±2.39). Highest male sex ratio was recorded in Artificial diet (25.00±0.70) followed by Aphids feeding with male sex ratio (21.50±0.95). Maximum female sex ratio was observed in Artificial diet (48.50±3.17) followed by Aphids feeding with female sex ratio (37.75±0.85). Longest incubation period was noted in Aphids feeding having incubation period (4.00±0.40), while shortest incubation period was recorded in Artificial diet (3.25±0.25). Longest larval period (in days) in Aphids feeding was (8.00±0.40), although shortest larval period was recorded in Artificial diet (7.00±0.25). Longest papal period was recorded in Aphids feeding was (5.25±0.47) whereas, shortest pupal period was recorded in Artificial diet (4.25±0.25). More egg laying rate was noted for Artificial diet (2006.30±64.91) followed by Aphids feeding with egg laying rate (1830.00±32.40)..*

**Keywords:** Feeding Potential of Coccinella under laboratory condition.

**INTRODUCTION**:

The common Lady bird beetle, Coccinella spp(Stephens) is an important predator; it belongs to order 'Coleoptera'. Their agricultural significance lie in their carnivorous habits the larvae are all predators; some are terrestrial, feeding on jassids, psyllids, aphids, coccids, mites etc., and others are aquatic. It is unusual in the tropics to locate a great colony of aphids known as Aphis lion. One larva may eat as many as 500 aphids in its life and there is no uncertainty that they participate a significant part in the natural control of many small homopterous pests (Legaspi et al., 1994; Michaud, 2001). Worldwide, they also position as some of the majority frequently used and locally accessible natural enemies.

Coccinellid spp Stephens (Neurotera: Coccinellidae) is one of the most important generalist predators. The larval stages are active in suppressing pests, while it is free living in adult stages. Larvae of Coccinellid spp are voracious predators of soft bodied arthropods such as aphids, whitefly, thrips, American bollworms, mites, army worms, small larvae of beetles, and eggs of lepidopetrous insects etc. (Carrillo et al., 2004). It has received much attention from researchers as well as farmers as a potential biological control agent (Gautam et al., 2007; Alasady et al., 2010; Saljoqi et al., 2013). Interest in utilizing this useful predator as one of the most important components of integrated pest management (IPM) programs for field and horticultural crops has recently increased as growers found alternatives to pesticides for managing insect pests. Since lady bird beetles are generalists, the effective and proper use of these predators is essential for a positive effect in the IPM programs.

Functional response studies have received much attention in the ecological literature. Functional response is the change in the number of prey consumed by each predator in response to the change in density of prey within a specific time (Holling, 1959). Functional response of predators is one of the major factors in regulating the population dynamics of the predator prey system. Functional response can be defined as an increase in the number of prey attacked by predators in

per unit time as the density of prey increases. It characterizes the relationship between the predator attack rate and its prey. Insects, diseases, weeds and nutritional factors are major constraints acting against the quality and quantity of crops yield. Out of many insect pests, aphids and mites are the most important and serious insect pests of crops (E.D., 2013). The aphids are one that damages the various crops in which they habitat. They damages crops by sucking sap from plant and transferring viral diseases to healthy plants. Aphids infest wide range of several agricultural crops in horticulture, cereal crops, oilseed crops etc. Farmers are using more than one pesticide in alternating manner to suppress insect pest in their field (E.D., 2013).

The negative impacts of chemical pesticides on human health and environment, have led to realize the need for alternative method, which is environmentally friendly, economically viable and sustainable method of insect pest management. It can be reduced or minimized through the development, dissemination and promotion of alternative method such as botanical pesticides (Akter, 2015; Kafle, 2015), biological pest control (Pinstrup-Andersen and Hazell, 1985) and IPM approach (Neupane, 2010). It is important to reduce the pesticides application on crops by using or conserving the biologically derived predator in the field such as Lady bird beetle, Coccinellid spp(Stephens) (Sarwar, 2014). The common lady bird beetle is an important generalist predator (Sarwar, 2014) is best known as biocontrol agent (Memon et al., 2015). After knowing the importance of Coccinellid spp in agricultural systems, it is important to develop efficient pest management strategies that are simple, economical, sustainable and bio-friendly based on biological control.

## REVIEW OF LITERATURE:
## BIOLOGY & MASS REARING OF C. SPP:

Coccinellid spp (Stephens) is important predator, available commercially in many countries of the world for augmentative release in agro ecosystem for population management of many insect pests. Biology of Coccinellid spp depends upon many factors biotic as well as a biotic. Biotic factors such as host species, its stage of development to be consumed as prey and the host plant on which Coccinellid spp host is feeding. There is a huge amount of literature available on biology of Coccinellid spp, here some of the selected references are reviewed on biology. Obrycki et al. (1989) observed that, development of Coccinellid spp required 20.5, 21.6 and 24.9 days at 27˚C with a photoperiod of 16: 8 (L: D), when fed Ostrinia nubilalis (Hubner) eggs, Agrotis ipsilon (Hufnagel) eggs, and A. ipsilon neonates, respectively. The influence of different aphid foods on larval development, juvenile mortality, weight of cocoons and adult fecundity of Coccinellid spp was investigated. Myzus persicae (Sulzer) and Acyrthosiphon pisum (Harris), were much more suitable than other aphid species studied. Aphis fabae (Scop.) was the most unsuitable prey type for Coccinellid spp as high juvenile mortality occurred to larvae fed on this species. Larvae fed on this aphid 9 produced small cocoons and fecundity was much reduced compared to M. persicae. Macrosiphum albifrons (Essig) delayed development and affected the fecundity of adult females but caused less juvenile mortality (Osman and Selman, 1993). McEven (1996) studied a relationship between the quantity of larval food and the rate of larval development and survival from eclosion to pupation in Coccinellid spp. McEwan et al., (1996) studied the influence of an artificial food supplement on larval and adult performance of Coccinellid spp. The adult diet comprised of yeast autolysate, sugar and water in the ratio of 4: 7: 10. Different numbers of live prey eggs of Anagasta kuehniella (Zeller), on larval development and survival and on adult weight and survival of Coccinellid spp. Given the same number of prey eggs, predator larvae receiving artificial food supplement reached the pupal stage more rapidly than those given water. Mishra et al., (1996) studied the biology and feeding potential of Chrysopa scelestes (Banks) on the eggs of the sugarcane pest Pyrilla perpusilla (Walker) in the laboratory. The egg, larval and pupal periods lasted 3.69±0.77, 10.05±1.63 and 9.55±1.23 days, respectively. Adult longevity was 24.75±3.14 days for males and 31.70±2.95 days for females. The larval diet of Coccinellid spp exerted a significant effect on the rate of its development, survival, cocoon weight and the fecundity of the adult females (Osman and Selman, 1996). Mannan et al. (1997) studied the biology of Coccinellid spp on Aphis gossypii (Glover) and Myzus persicae (Sulzer). The pre-oviposition, oviposition and postoviposition period were 6.55, 21.10 and 7.95 days on A. gossypii and 9.25, 21.85 and 11.20 days on M. persicae, respectively. The mean fecundity of Coccinellid spp was about 84.70 and 103 eggs; the incubation periods were 2.25 and 3.68 days. The duration of development of 10 first, second and third instar larvae were 2.60, 2.25, 2.38 and 3.75, 2.78 and 3.35 days when reared on A. gossypii and M. persicae, respectively. The pupal period was 9.43 and11.40 days on A. gossypii and M. persicae, respectively. The females lived longer (35. 70 and 38.80 days) than males (32.20 and 35.80 days) on two respective hosts. The preoviposition, oviposition and post-oviposition recorded on two hosts were: 6.55 and 9.25, 21.10 and 21.85 and 7.95 and 11.20 days, respectively, when larvae were reared on A. gossypii and M. persicae, respectively. Saminathan et al., (1999) studied the biology and predatory potential of Coccinellid spp on eggs of Corcyra cephalonica (Stainton), Earias vitella (Fabricius) and Helicoverpa armigera (Hubner), neonate larvae of E. vitella and H. armigera and A. gossypii (Glover) collected from cotton (Gossypium hirsutum L.), okra (Hibiscus esculentus L.) and guava (Psidium guajava L.) and Aphis carccivora (Coch.) collected from cowpea [Vigna unguiculata (L.) Walp.] and groundnut (Arachis hypogaea L.). The egg, grub and pupal period of Coccinellid spp were minimum on A. craccivora collected from groundnut and maximum on H. armigera neonate larvae. The total developmental period of

Coccinellid spp on different insect hosts ranged from 18.59 [A. craccivora (groundnut)] to 22.74 days (H. armigera neonate larvae). Coccinellid spp adult laid a maximum of 318.40 eggs when reared on A. craccivora. Geethalakshmi et al. (2000) studied the biology and feeding of Coccinellid sppon Corcyra cephalonica (Stainton) eggs. Total development period from egg to adult emergence was completed in 22.2 days. Larval and pupal period was 10.3 and 8.4 days, respectively. Progeny had a sex ratio of 1: 0.95 (female: male) an average of 640 eggs were laid per female. Males survived for 26.5 days and females for 39.0 days. A single larva fed an average of 30.3 eggs of C. cephalonica, 33.4 eggs of Helicoverpa arnigera, 0.54 egg masses of Spodoptera litura, 5.9 and 7.9 first instar larvae of H. armigera and S. litura and 33.3 and 24.6 Aphis gossypii and Planococcus citri, respectively, in a single day. Venkatesan et al., (2000) reared Coccinellid spp for 10 successive generations on a larval semi-synthetic diet containing soybean hydrolysed powder (1.3%), egg yolk (32.3%), honey (16.1%), yeast extract (1.3%), water (38.7%), petroleum jelly (0.7%) and paraffin wax (9.6%). Larval developmental period was longer on semisynthetic diet than on Corcyra cephalonica eggs. Mean adult emergence of Coccinellid spp reared on semi-synthetic and on C. cephalonica eggs was 56.7 and 82.5%, respectively. Food consumption increased as Coccinellid spp developed. The first larval stage of Coccinellid spp fed heavily on Aphis gossypii nymphs (54.05), sterilized eggs of C. cephalonica (53.90) and H. armigera (43.05). Coccinellid spp larvae consumed more A. gossypii than Uroleucon compositae (Thomas) nymphs (Bansod et al., 2001). Liu and Chen (2001) determined the effects of three aphid species (fourth instars only), Aphis gossypii Glover; Myzus persicae (Sulzer) and Lipaphis erysimi (Kaltenbach) on immature development, survival and predation of Coccinellid spp in the laboratory. Survival rates of Coccinellid spp from first stadium to adult emergence were significantly different among larvae fed different aphid species. When larvae were fed A. gosypii and M. persicae, 94.4±3.3% (mean ± SE) and 87.6±5.1% of individuals developed to adults, respectively; whereas only 14.9±3.4% of individuals developed to adults when fed L. erysimi. The developmental durations of Coccinellid spp larvae were also significantly different among larvae fed the three aphid species. The developmental duration from first stadium to adult emergence was shortest when larvae were fed A. gosypii (19.8±0.4 d), followed by M. persicae (22.8±0.2, d), and then L. erysimi (25.5±0.4, d). The total number of fourth stadium aphids consumed by Coccinellid spp larvae differed significantly among individuals fed different aphid species. Coccinellid spp consumed more A. gossypii (292.4) and M. persicae (272.6) than L. erysimi (146.4). Although total numbers of aphids consumed by the three Coccinellid spp larval stadia differed significantly, the proportions of aphids consumed by each larval stadium to the total number of aphids consumed were similar, 3.9-7.1% by the first stadium, 12.0-16.8% by the second stadium and 78.1-83.0% by the third stadium.

**EFFECTS OF DIFFERENT DIETS ON FECUNDITY:**

Ulhaq *et al* (2006) conducted the experiment at the Entomology Division of Nuclear Institute for Food and Agriculture (NIFA), Peshawar, Pakistan. Experiment was designed in Randomized Complete Block Design (RCBD) with three replications each having five pairs of adult Coccinellid spp. The results showed that the mean number of eggs laid by female Coccinellid spp fed on diets containing egg yolk, egg white and mixed egg were 168.30±0.98, 114.40±0.44 and 99.40±0.36 respectively, as compared to the standard diet where the mean number of eggs were 131.10±0.59. It is obvious that fecundity was not significantly higher for the females fed on diet containing egg yolk (168.30±0.98) from standard diet (131.10±0.59) but it was significantly higher than the other diets containing egg white (99.40±0.36) and mixed egg (114.40±0.44). Whereas fecundity was not significantly different for the diets containing egg white, mixed egg and standard diet. So in the present experiment the diet containing egg yolk, milk and honey in the ratio of 5ml: 10ml: 5ml proved to be the best resulting in significantly higher egg laying by the female Coccinellid spp as compared to the other diets under the same laboratory conditions. This diet consists of three components and each component has the promoting effect on egg production. As reported by Hill (1989), sugar is a very important component in adult diet for the insects that has pronounced effect on the egg production. Similarly McEwen and Kidd (1995) had recommended yeast and sugar for maximum egg production. Honey is also a very important component regarding fecundity, McEven and Kidd (1995) and Kubota and Shiga (1995) analyzed that a mixture of honey and yeast autolysate is a suitable adult diet for production of fertile eggs. Last but not the least component is yolk that is the most important one. Milevoj (1999) reared adults of Coccinellid spp on adult diet consisting of milk, eggs, fruits sugars and yeast and found a favourable effect on fecundity. Higher fecundity observed in diet containing egg yolk is because as egg yolk is rich in protein (amino acids). There are 15.5% amino acids as compared to egg white and mixed egg which contain 9.8% and 11.95% respectively (Norioka et al., 1984). Vitamin A, niacin, riboflavin B12, pantothenic acid, thiamin, pyridoxine, folic acid, Vitamin E and D are present in greater quantity in egg yolk than in egg white and mixed egg. Similarly folic acid, which is particularly more important for egg productions is much higher (117 µ g) in egg yolk than in mixed egg (73 µ g) and an egg white (3 µ g). Egg yolk also has higher amount of saturated, mono unsaturated, polyunsaturated oils and lipids than mixed eggs, whereas egg white has no lipids at all. Also the egg yolk has greater caloric value (303 calories per 100 g) than mixed egg (148 calories per 100 g) and egg white (117 calories per 100 g). The cholesterol level is particularly very high (1075 mg) in egg yolk as against (432 mg) in

mixed egg and no cholesterol in egg white (Rolfes et al., 1978

**MATERIALS AND METHODS:**

The rearing of the host insect and predator was started under the room temperature for knowing the feeding potential of predator on different species of aphids. The initial culture was obtained from Lasbela University of Agriculture, Water and Marine Science, Uthal, Balochistan which was further multiplied on the standard laboratory host, the *eggs* of *Sitrotoga cerealella.*The aphids viz:, *Aphis craccivora, Aphis gossypii*and *Rhopalosiphum maidis, Aphis Fabae* and *Myzus persicae* was collected from the surrounding orchards of Quetta.

The lacewing adults were confined in a glass chimney (6 cm dia. X 8 cm dia). Adults were supplied with standard artificial diet consisting of yeast, sucrose, honey, casein and water. The mixture forms slurry was provided to adults and cotton soaked in distilled water was also supplied to maintain moisture. The plexi glass strips were drilled at three points to make pits for holding drops of diet slurry. The upper portion of glass chimney was covered with black muslin cloth as a substrate of egg deposition. The adult diet was changed each after 2 days. Eggs laid by female on muslin cloth will be harvested with sharp razor.

Second instars of all aphid species were provided with the help of camel hair brush as adlibitum of 50, 100 and 150 to the first, second and third instars of lady bird beetle larvae, respectively. Total 05 larvae of each instar was used for the experiment and newly moulted (less than 2 hours old) larval stages were studied on each host for the developmental parameters of *Coccinellid spp.* Different parameters such as egg hatching, larval duration (days), larval survival, pre-pupation period (days), pupation period days) total developmental period (days, from egg hatching to adult formation) and total survival was recorded on daily basis. For the study of reproductive traits of *Coccinellid spp*, 10 pairs of adults were obtained to observe the reproductive parameters such as pre-oviposition period (days), oviposition period (days), total eggs laid per female, life span of female and male (days).

Each larval instar of *Coccinellid spp* was fed separately in the 9cm Petri dish. Each treatment was replicated three times. In each Petri dish, a single egg of *C. carne* with known age was transferred. After hatching, the individual larva was provided with known number o feach freh host every day. The number of prey consumed and non-cnsumed was recorded as daily feeding potential.

**Statistical analysis:**

The data was then subjected to one way analysis of varinance (ANOVA) under Completely Randomized Design (CRD) and Least Significant Difference (LSD) test at 5% probability level was used to test the difference among treatment means.

**RESULTS:**

**1. Hatching / egg survival:**

The analysis of variance (Appendix-I) demonstrated significant ($P<0.05$) difference for mean number of hatching / egg survival. The data (Table-1) indicates that highest mean number of hatching / egg survival was recorded in Artificial diet (86.50±2.90) followed by Aphids feeding (75.25±2.28). This indicates that *Coccinellid spp*produced more hatching when fed on artificial diet compared to aphid feeding.

**Table-1. Effect of different feeding regimes on the hatching / egg survival of *Coccinellid spp***

| Treatments | Hatching / egg survival |
|---|---|
| Aphids feeding | 75.25±2.28 b |
| Artificial diet | 86.50±2.90 a |
| SE± | 3.7561 |
| LSD @ 0.05 | 8.0060 |

**2. Larval survival / no of pupae.**

The analysis of variance (Appendix-II) demonstrated significant ($P<0.05$) difference for larval survival/ no.of pupae. The data (Table-2) indicates that the highest mean number of larval survival/ no.of pupae was observed in Artificial diet (73.00±2.48) followed by Aphids feeding with larval survival/ no.of pupae for parent (67.00±3.93).

**Table-2. Effect of different feeding regimes on the number of larval survival / no. of pupae of *Coccinella spp***

| Treatments | Number larval survival / no. of pupae |
|---|---|
| Aphids feeding | 67.00±3.93 a |

| | |
|---|---|
| Artificial diet | 73.00±2.48 a |
| SE± | 5.3603 |
| LSD @ 0.05 | 11.425 |

**3. Pupal weight**

The analysis of variance (Appendix-III) demonstrated significant (P<0.05) difference for pupal. The data (Table-3) indicates that maximum pupal weight was observed in Artificial diet (0.07±1.79) followed by Aphids feeding with pupal weight (0.06±2.06).

**Table-3. Effect of different feeding regimes on the pupal weight of *Coccinella spp***

| Treatments | Pupal weight (grams) |
|---|---|
| Aphids feeding | 0.06±2.06 b |
| Artificial diet | 0.07±1.79 a |
| SE± | 1.4803 |
| LSD @ 0.05 | 3.1563 |

**4. Pupal survival/no.of adult emergence**

The analysis of variance (Appendix-IV) demonstrated significant (P<0.05) difference for pupal survival/ no.of adult emergence among the treatments. The data (Table-4) resulted that highest pupal survival rate was observed in Artificial diet (75.25±1.49) followed by Aphids feeding with pual survival rate (65.50±2.39).

**Table-4. Effect of different feeding regimes on the pupal survival / no. of adult emergence of *Coccinella spp***

| Treatments | Pupal survival / no. of adult emergence |
|---|---|
| Aphids feeding | 65.50±2.39 b |
| Artificial diet | 75.75±1.49 a |
| SE± | 2.7218 |
| LSD @ 0.05 | 5.8014 |

**5. Male sex ratio**

The analysis of variance (Appendix-V) demonstrated significant (P<0.05) difference for male sex ratio among the feeding regimes. The data (Table-5) indicates that highest male sex ratio was recorded in Artificial diet (25.00±0.70) followed by Aphids feeding with male sex ratio (21.50±0.95).

**Table-5. Effect of different feeding regimes on the male sex ratio of *Coccinella spp***

| Treatments | Male sex ratio |
|---|---|
| Aphids feeding | 21.50±0.95 b |
| Artificial diet | 25.00±0.70 a |
| SE± | 0.9747 |
| LSD @ 0.05 | 2.0775 |

**6. Female sex ratio**

The analysis of variance (Appendix-VI) determined the significant (P<0.05) difference in female sex ratio among the treatments. The data (Table-6) indicates that maximum female sex ratio was observed in Artificial diet (48.50±3.17) followed by Aphids feeding with female sex ratio (37.75±0.85).

**Table-6. Effect of different feeding regimes on the female sex ratio of *Coccinella spp***

| Treatments | Female sex ratio |
|---|---|
| Aphids feeding | 37.75±0.85 b |

| | |
|---|---|
| Artificial diet | 48.50±3.17 a |
| SE± | 2.6724 |
| LSD @ 0.05 | 5.6961 |

**7. Incubation period (in days)**

The analysis of variance (Appendix-VII) showed non-significant (P>0.05) difference of incubation period in days between the treatments. The results in (Table-7) revealed that longest incubation period was noted in Aphids feeding having incubation period (4.00±0.40), while shortest incubation period was recorded in Artificial diet (3.25±0.25).

**Table-7. Effect of different feeding regimes on the incubation period of *Coccinella spp***

| Treatments | Incubation period in days |
|---|---|
| Aphids feeding | 4.00±0.40 ab |
| Artificial diet | 3.25±0.25 b |
| SE± | 0.6708 |
| LSD @ 0.05 | 1.4298 |

**8. Larval period in days**

The analysis of variance (Appendix-VIII) demonstrated significant (P<0.05) difference for larval period (in days) between treatments. The results of (Table-8) showed the longest larval period (in days) in Aphids feeding was (8.00±0.40), although shortest larval period was recorded in Artificial diet (7.00±0.25).

**Table-8. Effect of different feeding regimes on the larval period of *Coccinella spp***

| Treatments | Larval period ( in days) |
|---|---|
| Aphids feeding | 8.00±0.40 b |
| Artificial diet | 7.00±0.25 b |
| SE± | 0.7246 |
| LSD @ 0.05 | 1.5444 |

**9. Pupal period in days**

The analysis of variance (Appendix-IX) showed significant (P<0.05) difference for pupal period in days between the treatments. The results of (Table-9) revealed that longest papal period was recorded in Aphids feeding was (5.25±0.47) whereas, shortest pupal period was recorded in Artificial diet (4.25±0.25).

**Table-9. Effect of different feeding regimes on the pupal period of *Coccinella spp***

| Treatments | Pupal period (in days) |
|---|---|
| Aphids feeding | 5.25±0.47 bc |
| Artificial diet | 4.25±0.25 c |
| SE± | 0.4916 |
| LSD @ 0.05 | 1.0478 |

**10. Egg laying**

The analysis of variance (Appendix-IX) significant (P<0.05) difference for egg laying rate between the treatments. The data (Table-10) indicates that more egg laying rate was noted for Artificial diet (2006.30±64.91) followed by Aphids feeding with egg laying rate (1830.00±32.40).

**Table-10. Effect of different feeding regimes on the egg laying (no. of adults emerged) of *Coccinella spp***

| Treatments | Egg laying |
|---|---|
| Aphids feeding | 1830.00±32.40 b |

| | |
|---|---|
| Artificial diet | 2006.30±64.91 a |
| SE± | 63.174 |
| LSD @ 0.05 | 134.65 |

**Discussion:**

In the current study average mean number of hatching / egg survival , larval survival / no. of pupae, pupal weight, pupal survival/ no. of adult emergence, male sex ratio, female sex ratio and egg laying percentage were higher in Artificial diet followed by Aphids feeding. While, incubation period, larval period and pupal period were equally longer in Aphids feeding and shortest values for these traits were examined in Artificial diet. The

results are in accordance with the findings of Sattar *et al.*, (2011) they reported that larval food significantly affected the length of larval period. The shortest larval period was recorded on *S. cerealella* eggs, while longest on *H. armigera* eggs. Balasubramani and Swamiappan (1994) studied development of *Coccinellid spp* on different hosts in laboratory and found that larval development was rapid on eggs of *Corcyra cephalonica* (8.20 days) and longest on neonates of *H. armigera* (11.10 days). Mannan *et al.* (1997) studied biology of *Coccinellid spp* on *A. gossypii* and *M. persicae* and observed that larval duration was long when fed on *M. persicae*. Saminathan *et al.* (1999) and Bansod and Sarode (2000) studied biology and feeding potential of *Coccinellid spp* on different hosts and noted developmental period of *Coccinellid spp* ranged from 18.6 days on *Aphis cracivora* to 22.7 days on *H. armigera* neonate larvae. Giles *et al.* (2000) studied nutritional interactions among alfalfa, *Medicago sativa* and faba bean, *Vicia faba*, as host plants, pea aphid, *Acyrthosipnon pisum* an herbivore and *Coccinellid spp* a predator. *Coccinellid spp* larvae developed faster on pea aphid reared on alfalfa than on pea aphid raised on faba bean. Chemical analysis showed that aphids reared on faba bean had 6.3 times more levels of myristic acid. The duration of development of *Coccinellid spp* was significantly different on three aphid species. It was shortest when larvae were fed *A. gossypii* followed by *M. persicae* and *Lipaphis erysimi* (Liu and Chen, 2001). Ballal and Singh (1999) and Bartlett (1984) studied the host plant-mediated orientational and ovipositional behaviour of three species of chrysopids and found that *Coccinellid spp* females had significantly higher preference for sunflower and cotton, while pigeon pea was less preferred. On cotton, *Coccinellid spp* preferred to lay more eggs on underside of leaves than on buds. Flint *et al.* (1979) reported that damaged cotton plants release the terpenoid β caryophyllene which attracts *Coccinellid spp*. Selman (1993) investigated the influence of different aphid species on larval development and fecundity of *Coccinellid spp*. *M. persicae* and *A. pisum* were suitable, while *A. fabae* was most unsuitable prey causing high juvenile mortality. *Coccinellid spp* larvae fed on this aphid and *Macrosiphum albifrons* had reduced fecundity. The survival of larvae of *Coccinellid spp* feeding on *A. cracivora*, *Drosophila melanogaster* and *C. cephalonica* were 51.8, 80.9 and 86.7%, respectively. While *Coccinellid spp* laid 1079, 582 and 172.8 eggs/female when reared on *C. cephalonica*, *D. melanogaster* and *A. cracivora*, respectively (Tesfaye and Gautam, 2002). When Obrycki *et al.* (1989) fed *Coccinellid spp* larvae on *Ostrinia nubilalis* and *Agrotis ipsilon* eggs, 26-40% larvae died and when reared on *A. ipsilon* neonates, 65%, while all larvae died when fed *O. nubilalis* neonates, which was due to entanglement in silk produced by these larvae. Liu and Chen (2001) determined the development, survival and predation of *Coccinellid spp* on three aphid species, *A. gossypii*, *M. persicae* and *L. erysimi*. Survival was significantly different on aphid species; when larvae were fed on *A. gossypii* and *M. persicae*, 94.4 and 87.6% individuals developed to adult stage, respectively; whereas, only 14.9% when fed *L. erysimi*. Duration of development was significantly short (19.8 d) when fed *A. gossypii* followed by *M. persicae* (22.8 d) and *L. erysimi* (25.5 d). Similarly, *Coccinellid spp* consumed more *A. gossypii* (292.4) and *M. persicae* (272.6) than *L. erysimi* (166.4). Zheng *et al.* (1993) found a highly significant positive correlation between prey consumed during larval stage and adult body weight of *Coccinellid spp*.

**Conclusion**

On the basis of this study findings it could be concluded that average mean number of hatching/egg survival, larval survival/ no.of pupae, pupal weight, pupal survival/no. of adult emergence, male sex ratio, female sex ratio and egg laying percentage was higher in Artificial diet followed by

Aphids feeding. Similarly longer, incubation period, larval period and pupal period was recorded in Aphids feeding although, shortest incubation period, larval period and pupal period were examined in Artificial diet.

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