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Biology and feeding efficacy of *Micraspis discolor*, a potential biological control agent of whitefly, *Dialeuropora decempuncta*

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Abstract

Whitefly, *Dialeuropora decempuncta* Quaintance & Baker manifests chlorosis, dryness, curling of leaves and sooty mould disease in mulberry causing a leaf yield loss of 1630 kg/ha/season. It was reported that a number of whitefly species have developed resistance to chemical insecticides. The hazards of residual toxicity on silkworm are also well known. In view of the above, continuous efforts were made to find its effective natural enemies in mulberry fields of West Bengal. Continuous screening of whitefly infested leaves has led to the discovery of a native predator, *Micraspis discolor* Mulsant (Coleoptera : Coccinellidae). To explore possibilities of using this predator as a bio-control agent, its biology and feeding efficacy were studied. The life span of the egg, grub, pre-pupal and pupal stages of this predator was 5, 2.8, 3.27, 3.6, 4.5, 1.27 and 5.6 respectively, when reared on whitefly life stages. Biometrical studies provided the measurement of various stages, viz., egg (0.9x0.55 mm), grub (2.74 x 1.24; 4.2 x 2.02; 4.94 x 3.1, 6.0 x 3.98 mm), pre-pupa (5.36 x 11.7 mm), pupa (4.86 x 13.2 mm), male (8.5 x 6.8 mm) and female (9.6 x 7.63 mm). Longevity of male and female predators was 64.6 and 82.6 days respectively. Copulation period was 4.20 – 18.6 minutes. The fecundity was 42-58. The feeding efficacy studies revealed that fourth instar grub is voracious feeder and female consumed more life stages of *D. decempuncta* than male.

Keywords: whitefly, biological control, native predator, biology, feeding efficacy

1. Introduction

The whitefly, *Dialeuropora decempuncta* (Quaintance & Baker) (Homoptera: Aleyrodidae) is very destructive and started to infest mulberry since 1994 [1] with an Economic Threshold Level of 20/leaf [2]. This homopteran insect damages mulberry leaf by extracting large quantities of leaf juices from the lower surface of tender leaves. The initial symptoms appear on young leaves in the form of mild scattered yellow specks or spots. In severe cases, dryness of leaves, leaf curl and sooty mould disease were observed resulting in huge leaf yield loss of 1650 kg/ha/season [3]. The polyphagous nature of the pest is also contributing towards the intensity of the damage. Whitefly infested leaves show significant reduction in leaf moisture percent, carbohydrate, sugar, protein contents of the leaves. Feeding these leaves to silkworm affect the effective rate of rearing, economic parameters of the cocoons. Unlike other agricultural pests, rainfall aggravates the whitefly population [4]. Spray of chemical insecticides are forcing development of resistance, secondary pest outbreak, hazardous effects on silkworm rearing, killing of beneficial insects like parasitoids and predators. Use of botanical pesticides still has to cross so many hurdles of involving more private sector participation and other neem, no other botanical was commercially exploited for large scale production. All these factors have driven us to find out the possible means of control measures without disturbing the ecological balance. As biological control has already proven as living weapon in controlling mealy bug by *Cryptolaemus montrouzieri* Mulsant (Coleoptera: Coccinellidae) in southern peninsula in grapevine [5] and mulberry gardens, efforts were made to find out the natural enemies of whitefly in three traditional sericultural districts of West Bengal. The continuous screening of whitefly infested mulberry leaves has led to the discovery of *Micraspis discolor* Mulsant (Coleoptera: Coccinellidae), a native predator of whitefly. This report is first of its kind to state that this is a predator of whitefly. The natural population in the field is unable to suppress the pest population in the field. The inundative population is a prime requisite in biological pest suppression. But, this can be feasible once the basic information on its life cycle, fecundity and feeding efficacy on the host life stages is

made available. Hence, the present study has been carried out to study the biology of the predator on its host, *D. decempuncta*.

2. Materials and methods

Adult males and females of *M. discolor* were collected from whitefly infested mulberry leaves and taken to the laboratory for studying its biology under the controlled temperature and Relative Humidity at 25-28° C and 65-70% R.H. respectively. Each pair of adult beetles was kept in a glass beaker (10 x 5 cm) and provided with nymphs infested leaves for oviposition. On laying, 20 eggs of predator were kept individually in petri dishes (90 x 50 cm). Thus 20 replications were maintained and incubation period was recorded. After hatching, the grubs were supplied daily with fresh nymphs infested leaves collected from mulberry fields until pupation. Developmental periods of grub, pre-pupal, pupal, adult longevity, mating and oviposition behaviours were studied^[5, 6]. For studying the feeding efficacy, each predatory grub was kept in petri dish (90 x 50 mm) and provided with known number of eggs and nymphs of whitefly infested leaves. Observations were made on the number of preys eaten at every 24 hours. Surviving preys were counted and removed. Fresh preys were offered to the predatory grub every day until pupation. Number of preys consumed by the predatory grub in each instar and also the total number consumed by a grub and an adult were calculated. The feeding potential studies were conducted with 10 predatory grubs, adult males and adult females where each individual was considered as one replicate^[5, 7]. The collected data in the form of replications were pooled and mean data with standard deviations are presented in Table- 1 & 2.

3. Results and discussion

3.1 Egg: Eggs were elliptical in shape and laid in clusters (13-18) amongst the eggs and nymphs of whitefly on the ventral surface of mulberry leaves. The eggs were brownish yellow, elliptical in shape with blunt basal portion that possess glue for the attachment with mulberry leaves. The egg measured 0.90 mm and 0.55 mm in length and breadth respectively

(Table 1). Incubation period was 5 days. This was at variance with the observation made earlier in *C. montrouzieri*, *Scymnus coccivora* Ayyar and *Nephus spp.* (Coleoptera: Coccinelliae) where the incubation periods were respectively 4.25, 4.13 and 4.14 days^[5, 7, 8].

3.2 Grub: Newly hatched grubs were black coloured with white specks on the dorsal surface measured 2.74 mm in length and 1.24 mm in breadth. The duration of first instar grub was 2.82 days (Table 1). Second instar grub measured 4.2 mm in length and 2.02 mm in breadth and developmental period was 3.27 days (Table 1). The duration of third instar was 3.64 days, the fourth instar grub measured 6 mm in length and 0.98 mm in breadth. Its developmental period was 4.55 days. The total grub period was 14.17 days. This was shorter than *C. montrouzieri*^[5] and longer than *Nephus sp.* (13 days)^[8] and *S. coccivora* (11.75 days)^[7].

3.3 Pre-pupa: The slow moving and non-feeding pre-pupal stage measured 5.36 mm in length and 11.7 mm in breadth (Table 1). The pre-pupal stage lasted for 1.27 days, whereas in other Coccinellid predators, viz., *S. coccivora*, it was 1.25 days, *Nephus sp.* 1.20 days and *C. montrouzieri* 2.10 days^[5, 7, 8].

3.4 Pupa: Pupa was clump like, oval in shape with red colour measured 4.86 in length and 13.2 mm in breadth (Table 1). The pupal period was 5.64 days as against 8.70, 5.60 and 6.40 days in *C. montrouzieri*, *S. coccivora* and *Nephus sp.* Respectively^[5, 7, 8].

3.5 Adult: Adults showed distinct sexual dimorphism. Males (8.5 x 6.8 mm) were smaller, brownish red in colour. The females were larger (9.6 x 7.63 mm) and red in colour with mid-dorsal black longitudinal line (Table 1). Male to female sex ratio of *M. discolor* was 1:1. This was in agreement with the observations made in *C. montrouzieri* and *Nephus sp.*^[5, 8]. Longevity of female was higher (82.6 days) than male (64.6 days).

Table 1: Biological and Biometrical parameters of different stages of *M. discolor*.

Stage of life cycle	Length (mm)	Breadth (mm)	Duration / Longevity (days)
Egg	0.90 ± 0.04 (0.84 - 0.92)	0.55 ± 0.04 (0.46-0.56)	5 ± 0.60 (4 - 6)
Grub			
I instar	2.74 ± 0.16 (2.60 - 3.0)	1.24 ± 0.17 (1 - 1.6)	2.82 ± 0.39 (2 - 3)
II instar	4.2 ± 0.20 (4 - 4.6)	2.02 ± 0.13 (1.8 - 2.2)	3.27 ± 0.45 (3 - 4)
III instar	4.94 ± 0.16 (4.8 - 5.2)	8.10 ± 0.04 (8 - 9)	3.64 ± 0.48 (3 - 4)
IV instar	6 ± 0.15 (5.8- 6.2)	9.8 ± 0.04 (9 - 10)	4.55 ± 0.50 (4 - 5)
Pre-pupa	5.36 ± 0.11 (5.2 - 5.4)	11.7 ± 0.46 (11 - 12)	1.27 ± 0.45 (1 - 2)
Pupa	4.86 ± 0.08 (4.8 - 5)	13.2 ± 0.98 (12 - 14)	5.64 ± 0.64 (5 - 6)
Adult			
Male	8.5 ± 0.49 (8 - 9.6)	6.8 ± 0.53 (6 - 8)	64.6 ± 3.47 (62 - 72)
Female	9.6 ± 0.25 (9 - 10)	7.63 ± 0.30 (7.36 - 8)	82.6 ± 4.10 (78 - 90)

3.6 Mating: The pre-mating, mating and post-mating periods were 5.2, 50.5 and 31.3 days respectively (Table 2). But, the pre-mating period in *S. coccivora* and *Nephus sp.* was 4 and 2.25 days respectively^[7, 8]. The coitus lasted for 15.56 minutes and was longer than *Nephus sp.* (7.14 minutes)^[8]. It was observed that adults were promiscuous in mating behaviour.

3.7 Oviposition: Pre-ovipositional, ovipositional and post-ovipositional periods were recorded as 10.2, 59.2 and 24.1 days respectively (Table 2). Whereas in *Nephus sp.* these periods were 11.20, 54.25 and 11.05 days respectively. Fecundity of *M. discolor* was 50.5 (Table 2) found to be higher than that of *C. montrouzieri* and *S. coccivora*^[5, 7].

Table 2: Mating and ovipositional behaviour of *M. discolor*.

Parameter	Duration (days)
Pre-mating period Range	5.2 ± 1.78 (3 – 9)
Mating period Range:	50.5 ± 4.67 (42 – 58)
Coitus Range:	15.56 ± 1.96 minutes (12.20-18.6)
Post –mating period Range:	31.3 ± 9 (17 – 45)
Pre-ovipositional period Range:	10.2 ± 2.56 (5 – 14)
Ovipositional period Range:	59.2 ± 4.90 (48-65)
Fecundity	50.5 ± 5.46
Post-ovipositional period	24.1 ± 6.98 (17 – 31)

3.8 Feeding efficacy: Consumption of whitefly, *D. decempuncta* life stages by the adults and grubs of *M. discolor* revealed that the grub has consumed 711.21 or 179.96 eggs and nymphs respectively. Amongst the larval instars, 4th instar grub was voracious by devouring highest number of whitefly eggs. The grub of *Brumoides suturalis* fed on 1014.5 eggs of whitefly, *Aleuroclava pentatuberculata* (Sundarraaj & David) (Homoptera: Aleyrodidae) and 380 nymphal stages [8]. The larva of *B. suturalis* devoured 622 eggs or 218 nymphs of whitefly, *Dialeuropora decempuncta* (Quaintance & Baker) [9]. The grub of *Nephus* sp. consumed 106.1 eggs or 6.39 nymphs or 1.4 adults of *M. hirsutus* per day [10]. The grub of *Scymnus nubilus* Mulsant (Coleoptera: Coccinellidae) consumed 1320 eggs or 208.2 nymphs or 27.8 adults of *M. hirsutus* [11].

The studies on the feeding efficacy of adults revealed that, a female beetle of *M. discolor* consumed 2124.8 ± 201.52 eggs or 1444.8 ± 88.09 nymphs of whitefly. A female beetle of *B. suturalis* consumed 4462 eggs or 1835 nymphs of *D. decempuncta* [10]. In the present study, a male beetle of *M. discolor* consumed 1734 ± 159.4 eggs or 925.6 ± 51.4 nymphs of whitefly during its adult stage. In *B. suturalis*, a male beetle consumed 2488 eggs or 667 nymphs of whitefly, *D. decempuncta* [10]. A female beetle of *Nephus* sp. consumed 3,441.1 eggs or 533.3 nymphs or 112.5 adults of mealy bug, *M. hirsutus*, where as a male beetle consumed 2,067.2 eggs or 409.7 nymphs or 66.4 adults [11]. A male beetle of *S. nubilus* consumed 1622 eggs or 212.6 nymphs or 42.5 adults of *M. hirsutus*, whereas a female beetle devoured 2302 eggs or 326.1 nymphs or 74.9 adults [12]. In confirmation to the above studies, the present study also found that the female beetle has consumed more life stages of the host than that of the male.

4. Conclusion

The predator, *M. discolor* was found to complete its life cycle in 26.19 days. Where as its host, *D. decempuncta* requires 39.62 for completing its life cycle [13]. In a biological control programme, it is always desirable for a predator to possess shorter life cycle than the pest. Due to this, the predator can multiply at faster rate than the pest, resulting in effective suppression of pest population. Moreover, the grub and adults of the predator are effectively fed on eggs and nymphal stages of whitefly. Due to these features, the present predator, *M. discolor* can be effectively used as a potent tool for the eco-friendly management of whitefly, *D. decempuncta* in the mulberry ecosystem.

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6. References

1. Bandyopadhyay UK, Raina SK, Chakraborty N, Santha Kumar MV, Sen SK, Saratchandra B. New record of a homopteran pest on mulberry (*Morus alba*). *Sericologia*. 1999; 39(2):319-321.
2. Bandyopadhyay UK, Santha Kumar MV, Das KK, Saratchandra B. Determination of Economic Threshold Level for whitefly, *Dialeuropora decempuncta* (Quaintance & Baker) infesting mulberry. *International Journal of Industrial Entomology*. 2002; 4(2):133-136.
3. Bandyopadhyay UK, Santha Kumar MV, Das KK, Saratchandra B. Yield loss in mulberry due to sucking pest whitefly, *Dialeuropora decempuncta* Quaintance & Baker (Homoptera: Aleyrodidae). *International Journal of Industrial Entomology*. 2001; 2(1):75-78.
4. Bandyopadhyay UK, Sahu PK, Raina SK, Santha Kumar MV, Chakraborty N, Sen SK. Studies on the seasonal incidence of the whitefly (*Dialeuropora decempuncta* Quaintance and Baker) causing leaf curl on mulberry in relation to abiotic factors. *International Journal of Industrial Entomology*. 2000; 1(1):65-71.
5. Mani M, Thontadarya TS. Development and feeding potential of Coccinellid predator, *Cryptolaemus montrouzieri* Mulsant on the grape mealy bug (Green). *Journal of Biological Control*. 1987a; 1(1):19-22.
6. Santha Kumar MV. Behavioural studies of some hymenopteran parasitoids on lepidopterous pests of chick pea and pigeon pea in relation to reproduction. Ph.D. thesis, Shivaji University, Kolhapur, Maharashtra. 1989.
7. Mani M, Thontadarya TS. Biological studies on the grape mealy bug predator, *Scymnus coccivora* Ayyar (Coccinellidae: Coleoptera). *Journal of Biological Control*. 1987b; 1(2):89-92.
8. Santha Kumar MV, Chakraborty N, Sahakundu AK. Biology of *Nephus* sp. (Coleoptera: Coccinellidae), the native predator of pink mealy bug, *Maconellicoccus hirsutus* (Green) (Hemiptera: Pseudococcidae). *Biological Control of Insect Pests*. 1994, 91-95.
9. Santha Kumar MV, Datta P, Chakraborty S, Das NK, Mukhopadhyay SK, Saha AK *et al.* Biology and feeding efficacy of *Brumoides suturalis*, a native predator of whitefly, *Aleuroclava pentatuberculata*. *Proceedings of the UGC sponsored State Level Seminar on Advancement of Biological Science towards Sustainable Development held during 29th & 30th, 2012, 32-42.*
10. Bandyopadhyay UK, Santha Kumar MV, Mukhopadhyay SK, Mitra P, Bajpai AK. Biological control studies on whitefly, *Dialeuropora decempuncta* (Quaintance and Baker) (Homoptera: Aleyrodidae) through native predator, *Burmoides suturalis* (Fabricius) on mulberry in West Bengal. *Journal of Sericulture & Technology*. 2010; 1(1):66-69.
11. Chakraborty N, Santha Kumar MV, Sen SK. Studies on the feeding potential of a Coccinellid predator, *Nephus*

- sp.* on pink mealy bug, *Maconellicoccus hirsutus* (Green). *Sericologia*. 1999; 39(2):193-199.
12. Santha Kumar MV, Chakraborty N, Prasad BC, Gupta SK. Feeding efficacy of *Scymnus nubilus* Mulsant, a native predator of pink mealy bug, *Maconellicoccus hirsutus* (Green). *IPM& Sustainable Agriculture – an Entomological approach*. 1996; 6:139-142.
 13. Bandyopadhyay UK, Santha Kumar MV. Studies on biology of whitefly, *Dialeuropora decempuncta* on mulberry. *Annals of Plant Protection Sciences*. 2008; 16(2):498-500.
 14. Gupta MP, Sharma K, Khan BU, Kapoor BC, Bajpai PK, Kumar A *et al.* Tissue specific esterase isozyme variation in *Clarias batrachus* and *C. gariepinus*. *Global Journal of Pharmacology*. 2009; 3(1):1-5.
 15. For Books and other monograph Format: Author AB, Author BB, Author CC. Title of Book. Ed, Vol, Publisher, City, year, page numbers.
 16. Nadkarni KM. *Indian Materia Medica*. Edn 3, Vol. I, Popular Prakashan, Mumbai, 2000, 242-246.
 17. For Patent Reference: Gupta PK, Garg M. Submicron emulsions as ocular drug delivery vehicles, U.S. Patent US 5496811, 1996.
 18. For Website Reference: Quick dissolving tablets. <http://www.biospace.com>. 27 May, 2001.