OnLine Journal of Biological Sciences 2 (9): 630-632, 2002
ISSN 1608-4127

# Potentiality of *Micraspis discolor* (F.) as a Biocontrol Agent of *Nilaparvata lugens* (Stal)

Mahfuj Ara Begum, [1]Mahbuba Jahan, M.N. Bari, M. Mofazzel Hossain and N. Afsana
Entomology Division, Bangladesh Rice Research Institute, Gazipur, Bangladesh
[1]Department of Entomology, Bangladesh Agricultural University, Mymensingh, Bangladesh

**Abstract**: Life cycle of *Micraspis discolor* (Fabricious), a predator of brown plant hopper (BPH), *Nilaparvata lugens* (Stal) was studied in the laboratory and its potentiality in biological control was investigated. A female *M. discolor* laid an average of 117.7 eggs in 25.1 days of oviposition period. Preoviposition period ranged from 5-10 days with an average of 6.6 days. The eggs hatched in 2-3 days with 83.7% hatching success. Predator had 4 larval instars requiring a total period of 12-15 days. Mean developmental period of the predator was 20.2 days. Male and female beetles lived for 27.4 and 32.4 days respectively. A predator larva consumed an average of 47.6 third instar brown plant hopper, while an adult beetle consumed an average of 112.6 BPH during 30 days after emergence. Predator, *M. discolor* both in larval and adult stage showed preference for second and third instar brown plant hopper.

**Key words:** *Micraspis discolor*, biological control, *Nilaparvata lugens*

## Introduction

The brown plant hopper, *Nilaparvata lugens* (Homoptera: Delphacidae) is a key pest of aman and boro rice in Bangladesh and has become a major problem for rice production in several parts of the country (Alam *et al.*, 1980; Kamal, 1998a). Both adult and nymph cause damage to rice crop by sucking plant sap. Low infestation causes reduced plant height, crop vigour and tiller production, while heavy infestation turns the plants yellow leading to the development of the symptom hopper burn (Reissig *et al.*, 1985). Chemical control of BPH is less effective (Heinrichs, 1979). Moreover, frequent applications are required which sometimes cause resurgence. Many of the recent outbreaks of BPH might occur due to resurgence (Hirao, 1972; Cheliah and Heinrichs, 1980; Tanaka *et al.*, 2000). Biological control is a vital component of integrated management of brown plant hopper. *Micraspis discolor* a coccinellid beetle is reported to predate on nymphs and adults of brown plant hopper (Samal and Misra, 1985; Kamal, 1998b). *Micraspis* sp. can survive and develop successfully on BPH (Shepard and Rapusas, 1989). Although this predator beetle is widely distributed in Bangladesh, the predation potentiality of it on BPH has not yet been studied so far. Therefore, this study was aimed to investigate the biology of *M. discolor* and its predation potential on BPH under laboratory and greenhouse condition.

## Materials and Methods

The studies were conducted during the period from March-September, 1999 in the Laboratory and Greenhouse of the Division of Entomology, Bangladesh Rice Research Institute (BRRI) at Gazipur. The temperature range during the period was 25-30 °C and relative humidity was 70-80%.

The field collected *M. discolor* were reared in a mylar cage on BR3 rice seedling with 3rd instar brown plant hopper. Mating and egg laying occurred inside the cage. The eggs were transferred into petridish for hatching. The newly hatched grubs were transferred into a test tube where the first instar BPH on rice seedling was used as prey for the first three days and thereafter reared on third instar (15 nymphs/grub/day) BPH. The grubs were observed daily until pupation to record the larval duration. When pupation took places the pupae were kept undisturbed for adult emergence and the pupal period was recorded. After emergence, the adults were kept in the small earthen pot covered with lamp chimney provided with third instar BPH (15 BPH nymphs/grub/day). The adults were separated after mating and the pre-oviposition period was recorded. When the egg laying started the beetles were transferred to the other pot after laying a batch of eggs and the date of egg laying was noted. The eggs were observed everyday to record the incubation period and determine viability. The oviposition period, fecundity and longevity of the predator were recorded. Ten predator individuals were observed for determining the duration of each life stage.

Predation potential of the grub and adult of *M. discolor* was determined by recording the number of BPH (nymph and adult) consumed daily. Preference of the grub and adult predator was investigated in choice and no choice test by using different stages of prey (first to fifth instar nymphs). Preference of the adult beetle and the grub were investigated separately. Data were analyzed using one-way ANOVA of Gomez and Gomez (1984).

## Results and Discussion

**Egg:** Female laid 4-16 eggs per day, in cluster on the stem, leaf surface and walls of the mylar cage. Within a cluster the eggs remained unattached to each other. Eggs were about 1.06 mm long and 0.38 mm wide, elongate, oval, smooth and shiny surface (Table 1). Before hatching the eggshell turned to pale brown with black eye spot. Mean incubation period was 2.7 days and the average egg viability was 83.74%. The incubation period and viability of eggs in this study was close to the report of Islam and Nasiruddin (1978), Samal and Misra (1985) and Prodhan *et al.* (1995).

**Larva:** Larva passed four larval instars. Newly hatched larva was soft bodied, elongate and somewhat flattened, greyish brown in colour and about 1.54 mm long and 0.48 mm wide (Table 1). The final instar larva attained the largest size and become sedentary before pupation. The total larval period was 13.3 days. Samal and Misra (1985) found 16.4 days of total larval period on third instar of BPH, which is higher than this study. This variation may due to feeding plants of BPH and seasonal variation.

**Pupa:** Newly formed pupa is pinkish but later turns into orange to reddish orange. Mean pupal period was 3.5 days. Mean length and breadth of pupa were 3.1 and 2.22 mm respectively (Table 1).

**Adult:** Adult *M. discolor* was oval, convex bodied with orange to red orange elytra. Male was usually smaller (3.64 mm long and 2.82 mm wide) than female (4.08 mm long and 3.24 mm wide) (Table 1). The beetles were cannibalistic in habit. In shortage of BPH they fed on their own eggs and larvae. Mean longevity of female was 32.4 days and male 27.4 days (Table 2). The pre-oviposition and oviposition period were 6.6 and 25.1 days respectively.

Maximum number of eggs was laid on 6th and 8th days of oviposition period. A female laid an average of 117.7 eggs during its lifetime. Female did not lay eggs every day (Fig. 1). Prodhan *et al.* (1995) showed the fecundity of female, which varied from 200-300 with a mean of 270.5 eggs when it fed on *Aphis*

**Corresponding Author:** Md. Nazmul Bari, Scientific Officer, Entomology Division, Bangladesh Rice Research Institute (BRRI), Gazipur-1701, Bangladesh

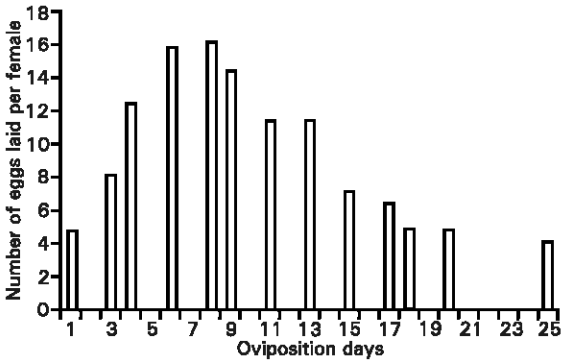


Fig. 1: Egg laying pattern of *M. discolor* during the oviposition period

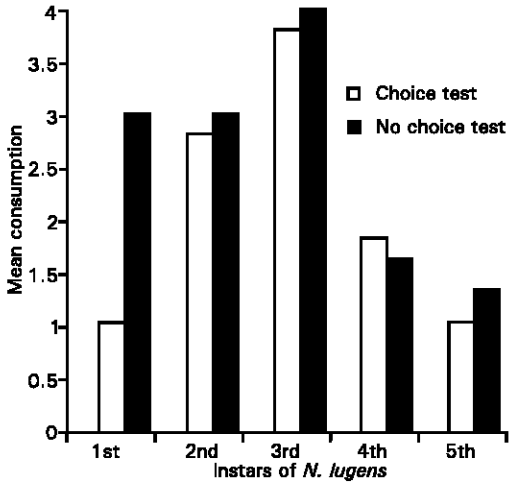


Fig. 2: Prey preference by adult *M. discolor* on *N. lugens* in choice and no-choice test

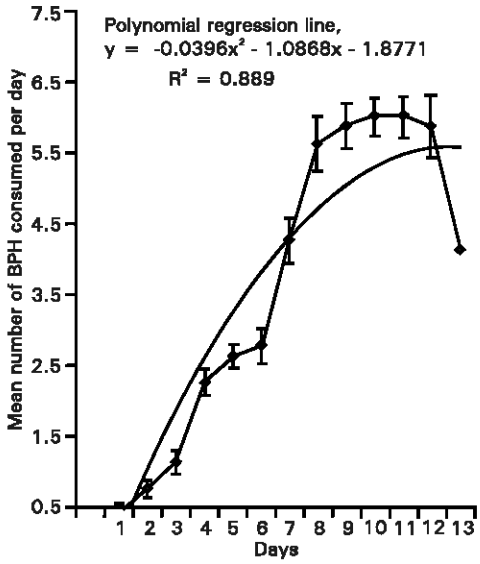


Fig. 3: Age-specific prey consumption by larva of *M. discolor*

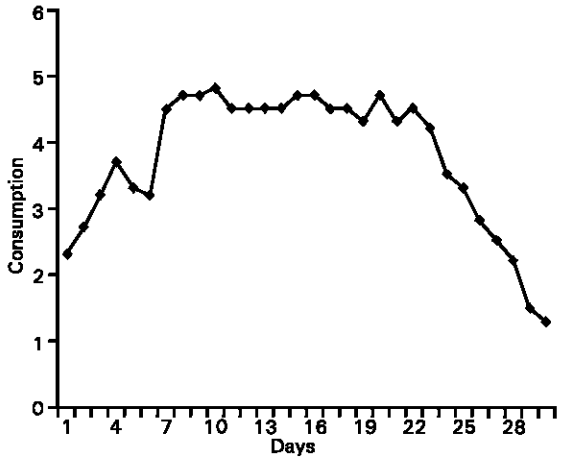


Fig. 4: Age-specific prey consumption by adult of *M. discolor*

Table 1: Size of different stages of *M. discolor*, BRRI Gazipur, 1999

| Life stages | Mean length (mm) ± SE | Mean width (mm) ± SE |
|---|---|---|
| Egg | 1.06 ± 0.005 | 0.38 ± 0.003 |
| First instar larva | 1.54 ± 0.05 | 0.48 ± 0.004 |
| Second instar larva | 2.84 ± 0.05 | 0.60 ± 0.004 |
| Third instar larva | 4.02 ± 0.03 | 1.01 ± 0.020 |
| Fourth instar larva | 5.08 ± 0.03 | 1.14 ± 0.050 |
| Pupa | 3.10 ± 0.07 | 2.22 ± 0.070 |
| Adult female | 4.08 ± 0.07 | 3.24 ± 0.050 |
| Adult male | 3.64 ± 0.05 | 2.82 ± 0.070 |

Table 2: Developmental period of different stages and longevity of *M. discolor* on third instar of brown plant hopper, BRRI Gazipur, 1999

| Life stages | Duration of different life stages (days) (Mean ± SE) |
|---|---|
| Incubation period | 2.7 ± 0.2 |
| First instar larva | 3.1 ± 0.2 |
| Second instar larva | 3.1 ± 0.1 |
| Third instar larva | 4.0 ± 0.2 |
| Fourth instar larva | 3.1 ± 0.2 |
| Total larval period | 13.3 ± 0.4 |
| Pupal period | 3.5 ± 0.1 |
| Total developmental period from egg to adult | 20.2 ± 0.2 |
| Pre oviposition period | 6.57 ± 2.1 |
| Oviposition period | 25.1 ± 0.4 |
| Adult longevity of female | 32.4 ± 0.4 |
| Adult longevity of male | 27.4 ± 0.4 |

*craccivora* (Koch). Hannan (1997) showed that the number of eggs laid per female was 234.4 when it fed on bean aphid. The variation found in the fecundity in different studies was probably for the different nutritive value of food. Although aphid is the usual prey for *M. discolor*, it was evident from these findings that the predator can survive and reproduce on brown plant hopper.

**Prey preference of the predator:** The preference for a particular instar of prey was studied by offering the equal number of all instar in choice and no choice test. In choice test among the mixed population (10 No. of each instars) of first, second, third, fourth and fifth instar of BPH the first instar grub of *M. discolor* had shown choice for the first and second instar BPH (Table 3). The second instar grub preferred first to third instar prey but the most preferable stage was first instar nymph. The third instar *M. discolor* accepted all the prey stages but showed higher preference for second and third instar of BPH. The mature grub (fourth instar) of *M. discolor* accepted all stages of BPH but the highest

Table 3: Number of *N. lugens* consumed by different instars of *M. discolor* in 24 h (choice and no choice test), BRRI Gazipur, 1999

| Instars of *M. discolor* | Number of *N. lugens* of different instars consumed (Mean ± SE) | | | | |
|---|---|---|---|---|---|
| | First instar | Second instar | Third instar | Fourth instar | Fifth instar |
| **Choice test** | | | | | |
| First | 2.8 ± 0.3NS | 2.0 ± 0.3NS | - | - | - |
| Second | 4.3 ± 0.2b | 3.2 ± 0.3a | 2.5 ± 0.2a | - | - |
| Third | 2.0 ± 0.3b | 5.7 ± 0.5c | 5.8 ± 0.3c | 2.2 ± 0.3b | 0.67 ± 0.2a |
| Fourth | 0.67 ± 0.2a | 5.3 ± 0.2c | 6.0 ± 0.4c | 3.5 ± 0.2b | 0.66 ± 0.2a |
| **No choice test** | | | | | |
| First | 3.0 ± 0.3 | - | - | - | - |
| second | 4.5 ± 0.2b | 3.0 ± 0.3a | 2.2 ± 0.3a | - | - |
| Third | 3.3 ± 0.3b | 6.2 ± 0.3c | 5.8 ± 0.2c | 1.3 ± 0.2a | - |
| Fourth | 4.8 ± 0.3b | 6.2 ± 0.3c | 6.7 ± 0.3c | 2.2 ± 0.3a | 1.7 ± 0.2a |

Means followed by a common letter in a row are not significantly different at the 1% level by LSD, NS = Non significant

preference was for second and third instar nymphs. The choice of adult beetle varied with the different instar of brown plant hopper. Among the instars the second and third instar nymphs were preferable (Fig. 2). Islam (1997), reported prey consumption of *Menochillus sexmaclulatus* increased significantly with the decrease of prey size. The predator attained maximum predation (35 aphids) when prey size was smaller (0.5 mm body width) while a few aphids were consumed when the size was 1.2 mm.

In no-choice test all the stages of BPH were not accepted by the all stages of *M. discolor*. The first instar grub of *M. discolor* consumed first instar BPH (Table 3). The second instar *M. discolor* accepted the first, second and third instars but consumption of instars varied significantly ($P < 0.01$). Highest consumption was found for first instar BPH. Third instar grub accepted the first four nymphal instars but highest consumption was found on second and third instar nymph. Fourth instar grub accepted all the prey stages but a similar acceptance was found as was in third instar grub. The adult *M. discolor* showed a clear preference for third instar of BPH and the least preference to fifth instar (Fig. 2).

**Predation efficiency by *M. discolor*:** Predation efficiency of *M. discolor* larva and adult were determined by counting the total number of BPH consumed in every 24 h in its life. A larva consumed on an average 47.6 BPH (3rd instar nymph) during its larval period. The feeding rate of the grubs of *M. discolor* at different ages was evaluated and was shown in Fig 3. Regression between the age of the grub and rate of consumption showed that the consumption by the predator at larval stage is highly correlated to its age ($r = 0.94$, $Y = -0.0541x^2 + 1.2425x - 1.6251$). Maximum prey consumption occurred on 8th to 12th day of the larval age. An adult predator consumed an average of 2.3 BPH (3rd instar nymph) within 24 h after emergence (Fig. 4). Prey consumption during the first week was similar but it increased and maintained a steady rate until 22nd day and there after a sharp decline was observed. A predator consumed on an average of 112.6 BPH during its adult stage.

Rahman (1990) reported that the feeding rate of *M. discolor* larvae on the first day after hatching ranged between 2 and 7 on cotton aphids with an average of 5.2. From the second day the average rate of consumption gradually increased to 26.8 on the 9th day after which feeding rates dropped sharply. Each larva of this beetle consumed with an average of 131.6 aphids in total larval period. The adult consumed 21.0 aphids during her first day and the rate gradually increased up to 9th day (86.4) aphids. There were great variation among the previous results and present study, which might be due the different species of prey.

Although *M. discolor* is mainly a predator of aphid, in this study it was found that the beetle consumed a good number of brown plant hopper both in its larval and adult stage and reproduce successfully. Therefore, the predator could be considered as a potential natural enemy for the biological control of brown plant hopper.

## References


Alam, S., M.S. Alam and M.A. Chowdhury, 1980. Brown plant hopper situation in Bangladesh. Int. Rice Res. New., 3: 17-18.

Cheliah, S. and E.A. Heinrich, 1980. Factors affecting insecticide induced resurgence of the brown plant hopper, *Nilaparvata lugens* on rice. Entomol., 9: 773-777.

Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for Agricultural Research. Second Edition, John Willey and Sons, New York, pp: 208-215.

Hannan, A.K.M., 1997. Influence of different food on the biology of *Micraspis discolor* (F.) (Coleoptera: Coccinellidae). M.Sc. thesis, Department of Entomology, BAU, Mymensingh, pp: 96.

Heinrichs, E.A., 1979. Chemical control of brown plant hopper. In Brown Plan Hopper: Treat to Rice Production in Asia. International Rice Research Institute, Los Banos, Philippines, 145-167.

Hirao, J., 1972. Bionomics of the two injurious plant hoppers in a paddy field and suitable timing of insecticide application. Bull. Chugoku Nat'l Agric. Expt. Stn. Ser., 7: 19-48.

Islam, K.S., 1997. *Menochilus sexmaculatus* (F.) (Colioptera: Coccinellidae) a potential biological control agent of bean aphid. Thai J. Agric. Sci., 30: 357-364.

Islam, M.A. and M. Nasiruddin, 1978. Life history and feeding habit of *Verania discolor* F. Bangladesh J. Biol. Sci., 6, 7: 48-49.

Kamal, N.Q., 1998a. Brown plant hopper (BPH) *Nilaparvata lugens* Stal situation in Bangladesh. A report of DAE-UNDP/FAO IPM Project, Khamarbari, Farmgate, Dhaka, Bangladesh.

Kamal, N.Q., 1998b. Impact of integrated Pest Management (IPM) in farmer's field. A brief report of IPM Ecology Expert, DAE-UNDP/FAO IPM Project, Khamarbari, Farmgate, Dhaka, Bangladesh.

Prodhan, N.Z.H., M.A. Haque, A.B. Khan and A.K.M.M. Rahman, 1995. Biology of *Micraspis discolor* (Coleoptera: Coccinellidae) and its susceptibility to two insecticides. Bangladesh J. Entomol., 5: 11-17.

Rahman, A.S.M.S., 1990. Comparative feeding behaviour of *Micraspis discolor* and *Micraspis crocea* (Coleoptera: Coccinellidae) on aphids (in Bangladesh), University J. Zool. (Bangladesh), 9: 7-10.

Reissig, W.H., E.A. Heinrichs, J.A. Litsinger, K. Moody, L. Fiedler, T.W. Mew and A.T. Barrion, 1985. Insect Pests of Rice. In Illustrated Guide to Integrated Pest Management in Rice in Tropical Asia. Int. Rice Res. Inst., Los Banos, Philippines, pp: 175-186.

Samal, P. and B.C. Misra, 1985. Morphology and biology of the coccinellid beetle *Verania discolor* Fab. (Coleoptera: Coccinellidae), a predator on rice brown plant hopper *Nilaparvata lugens* (Stal). Oryza, 22: 58-60.

Shepard, B.M. and H.R. Rapusas, 1989. Life cycle of *Micraspis* sp. on brown plant hopper (BPH) and rice pollen. Int. Rice Res. Newsl., 14: 40.

Tanaka, K., S. Endo and H. Kazano, 2000. Toxicity of insecticides to predators of rice plant hoppers; spiders, the mirid bug and the dryinid waps. Appl. Entomol. Zool., 35: 177-187.