CRITICAL FACTORS INFLUENCING THE INCIDENCE OF A NATIVE PREDATOR OF WHITEFLY IN MULBERRY

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ABSTRACT

Mulberry in West Bengal, India is being infested by two species of whitefly, Dialeuropora decempuncta (Quaintance and Baker) and Aleuroclava pentatuberculata (Sundararaj and David) (Homoptera : Aleyrodidae). A native predator, Micraspis crocea (Mulsant) (Coleoptera : Coccinellidae) found to feed on eggs and nymphal stages of both species of whitefly. In the preset study, the seasonal incidence of M.crocea and its hosts were studied. Their incidence data was correlated with Correlation coefficient and multiple regression to find out the critical factors that are influencing the predator population. The outcome of this study will be used for giving advance information to the farming community so as to avert serious crop losses that are being inflicted by both species of whitefly.

Key words: *whitefly, native predator, incidence, prediction model*

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1. INTRODUCTION

Mulberry gardens in West Bengal were severely infested by two species of whitefly, *Dialeuropora decempuncta* (Quaintance and Baker) and *Aleuroclava pentatuberculata* (Sundararaj and David) (Homoptera : Aleyrodidae). A biological control agent, *Micraspis crocea* (Mulsant) (Coleoptera : Coccinellidae) was found to feed eggs and nymphal stages of whitefly. The knowledge of insect population dynamics is essential for developing sustainable crop protection strategies and for safeguarding the health of the agricultural environments. The ecological factors affecting insect population are of major importance in insect pest control[1](Berryman, 1997)[1]. An understanding of this dynamics is essential for planning a control programme. A thorough knowledge on the natural enemies of a pest, their influence on the pest and climatic factors influencing them is an integral and initial component of any good control programme.

In mulberry crop, there is a limited scope of application of pesticides to protect the crop due to short spell from pruning to feeding of silkworms. So, advance information regarding the trends of population buildup of the native predator will be helpful to the farmers to remain prepared for the exigency and also reduce the indiscriminate use of pesticides. In the present study, seasonal incidence of two species of whitefly and their native predator was correlated with abiotic factors to find out the critical factors that are influencing the predator population.

2. MATERIAL AND METHODS

For studying the population dynamics of the native predator, *M.crocea*, in mulberry ecosystem, the effect of both the abiotic and the biotic factors on the population build up were considered. As for the abiotic factors, maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity and rainfall were taken into consideration. As far as the biotic factors were concerned, population of both species of whiteflies and *M.crocea* were considered. As a part of crop scouting activity the population size of *D. decempuncta* and *A. pentatuberculata* were studied in the mulberry fields of Central Sericultural Research and Training Institute, Berhampore, Murshidabad for three consecutive years from August, 2004 to July, 2007.

The population of whiteflies was recorded at weekly intervals (Hoddle and Van Driesche, 1999)[2] in randomly selected (Schuster, 1998)[3] sample of 20 plants (Assad, *et al*., 2006)[4]. Both the horizontal and vertical population of the whiteflies were assessed during morning cool hours. The horizontal population was examined by taking the adult population into account from top two leaves (Karut and Sekeroglu, 2003[5],[6],[7],[8]; Das *et al*., 2007; Naik and Lingappa, 1992; Ohnesorge and Rapp, 1986). For vertical population, each plant was considered of having three strata, top, middle and bottom which were considered for counting adults, early nymphs and late nymphal instars respectively. Vertical population was recorded by considering top (1-3), middle (4-7) and bottom (7-14) leaves for recording adults, early nymphs and late nymphs respectively (Purohit and Deshpande, 1991 and Lynch and Simmons, 1993)[9],[10]. While recording the nymphal population, the associated life stages of the predator, *M.crocea* viz., grubs, pupae and adults were also observed and recorded. For establishing the correlation between the predator population and the biotic and abiotic factors, coefficient of correlation and multiple linear regression were worked out.

3. OBSERVATIONS

During the first year (2004 – 2005) of the study, the white fly *D. decempuncta* started infesting the mulberry plant showing a number of 19.76 per plant with 8.9 adults and 10.86 nymphs/ plant. This number is almost close to the economic threshold level (20/plant) (Bandopadhyay *et al*., 2002)[11]. In the same manner the population at the end of the particular year of the study i.e. in the fifty second week was 20.31/ plant with 3.4 adults and 16.91 nymphs/ plant. During the second year of the study (2005-06), the whitefly population was above ETL till November. The peak population was recorded as 80.24/ plant in the second week of November, 2005. Even in third year (2006-07), the whitefly population found to be above ETL from August till the second week of November and reached peak (88.07/plant) during second week of September, 2006. The seasonal incidence of *D. decempuncta* during the last year of the study remained below ETL for a maximum span of time from November to June, whereas in the previous two years the population was low from February to June.

The population of another whitefly, *A.pentatuberculata* was found above ETL from the first week of the study (23.93/plant). The peak population (41.83/plant) was observed during second week of October, 2004. The pest population was found below ETL during last week of November, 2004 to August, 2005. In the second year of study, maximum population (70.05/ plant) was recorded during second week of October, 2005. The pest population remained above ETL during first week of September to last week of November and later on persisted below ETL till August, 2006. But the whitefly population suddenly soared (122/plant) during the first week of September, 2006 with 9.34 adults and 112.62 nymphs. During the third year of study, the population was found to be above ETL during first week of September and third week of November, 2006. The incidence was found below ETL during fourth week of November till June, 2007.

While recording the incidence of the native predator, *M. crocea,* it was found that during first year of study (2004-2005), the population was nil from fourth week of August till first week of March, 2005 with two exceptions in first week of September (0.05/plant) and third week of December (0.1/plant). During the second week of March, the population raised to 0.2 / plant. The population became nil again for the next four weeks. From third week of April, 2005 till third week of August, the population was 0.005 – 0.1/ plant (Fig.1). In second year (2005-2006), it was found that the predator population was nil from fourth week of August to first week of December, 05 and again from fourth week of March to third week of August, 06. The population of *M. crocea* started building up from second week of December, 2005 with 0.25 /plant. For the consecutive three weeks, the population of the predator showed an increasing trend. The predator population reached its peak (0.65/plant) on first week of January, 06. From the following week onwards, predator population receded to 0.05 per plant and became nil from third week of January, 06. (Fig.1). Similar trend was observed during the third year of study. The predator population was nil from the last week of August till the last week of November. The predator population started building during first week of December, 06 (0.05/plant) with maximum (0.1/plant) was observed during fourth week of December, 06 and first week of June, 2007 (Fig.1).

4. DISCUSSION

While studying the correlation coefficient of the native predator, *M. crocea*, it was found that its population was positively correlated only with maximum relative humidity and the relation was also found to be 0.189. Whereas the correlation of the predator population with the abiotic factors was found to be negative and non-significant except that of the minimum temperature (Table-1). With the minimum temperature, the correlation was found significant at 1% level and negative. The r values for minimum temperature was noted as -0.213. The r values for maximum temperature, minimum relative humidity and rainfall, were found to be -0.107, -0.098 and -0.103 respectively. The correlation of the predator with that of the host population was positively correlated with that of the population of *D. decempuncta* and significant at 1% level. The r value was 0.351. Whereas the correlation with the population of the other host i.e. *A. pentatuberculata* was negative and non-significant with r value as -0.020.

Multiple linear regression analysis revealed that, the regression was best found with considering the abiotic factors of previous 28-34 days and the host population of seven weeks earlier (Fig.:1). The regression equations showing the host effect (before seven weeks), meteorological factors (28-34 days prior) and the combined effect of the two are –

Regression equation for the effect of biotic factors on the population of *M. crocea* :

Y = 0.0004 + 0.001X1 – 0.001X2.

Where Y= Population of *M. crocea* ,

X1 = Population of *D. decempuncta*,

X2 = Population of *A. pentatuberculata*

With coefficient of determination $R^2 = 0.158781$ ($P= 3.29 \times 10^{-6}$).

Regression equation for the effect of abiotic factors on the population of *M. crocea* -

Y = -0.791 + 0.02X1 – 0.017X2 + 0.003X3 + 0.002X4 -0.001X5.

Where Y= Population of *M. crocea*,

X1 = Maximum temperature,

X2 = Minimum temperature,

X3 = Maximum Relative Humidity,

X4 = Minimum Relative Humidity,

X5 = Rainfall.

With coefficient of determination $R^2 = 0.152981$ (P= 0.000175).

Regression equation showing combined effect of abiotic factors and natural enemies on predator population:-

Y = -0.618 + 0.016X1 – 0.013X2 + 0.002X3 + 0.002X4 + 0.0001X5 + 0.001X6 -0.0009X7

Where Y = Population of *M. crocea* (Mulsant),

X1 = Maximum temperature,

X2 = Minimum temperature,

X3 = Maximum Relative Humidity,

X4 = Minimum Relative Humidity,

X5 = Rainfall,

X6= Population of *D. decempuncta* (Quaintance and Baker),

X7= Population of *A. pentatuberculata* (Sundararaj and David)

With coefficient of determination $R^2 = 0.232017$ ($P= 3.21 \times 10^{-6}$).

From this study it can be inferred that the abiotic factors of previous 28-34 days and the host population of seven weeks earlier were found to significantly influence the population of the native predator, *M.crocea*. In *Micraspis discolor* (Fabricius) (Coleoptera : Coccinellidae), the population is influenced by abiotic factors of previous 0-6 days and the whitefly population of previous 8 weeks[12] (Santha Kumar *et al*., 2013)[12]. The meteorological factors of previous 23-29 days and 35 days prior population of host were responsible for population buildup of *Eretmocerus adustiscutum* (Krishnan & David) (Hymenoptera : Aphelinidae) (Datta *et al*., 2011)[13]. This study is helpful in predicting the probable population of the predator well in advance. In the event of the low population of the predator, it can be procured from commercial insectaries and can be released in mulberry gardens prior to onset of whitefly infestation. This will enable the farmers to suppress the whitefly population in eco-friendly manner without leaving any chemical residues in mulberry leaves as well as in the environment.

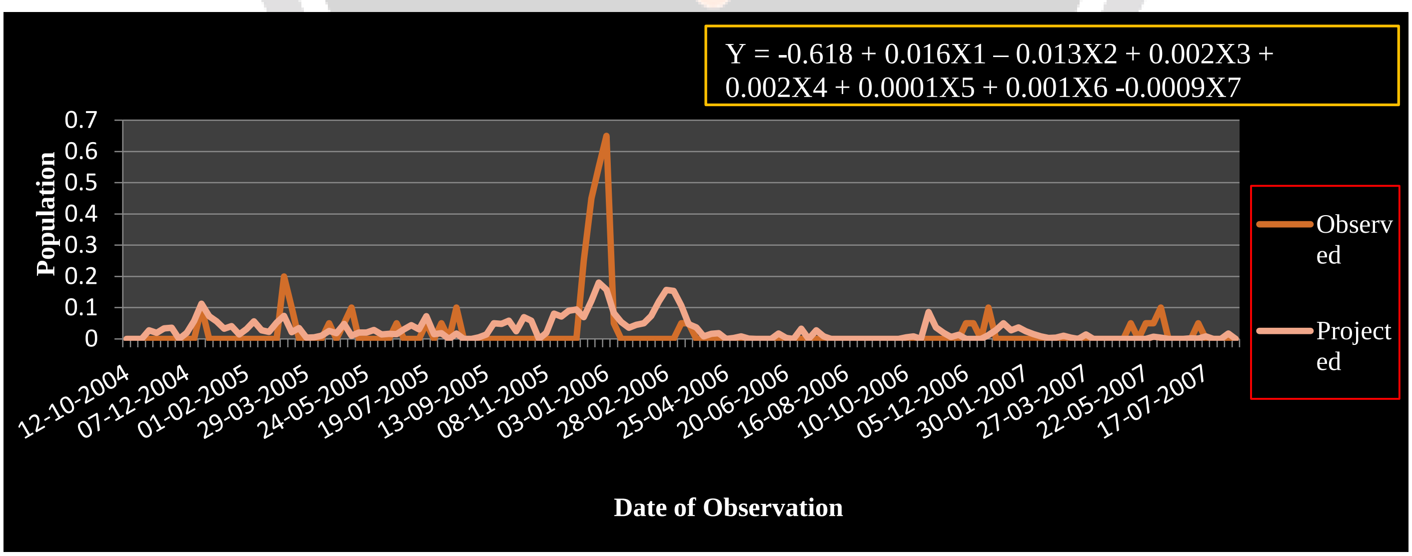
5. ACKNOWLEDGEMENTS

Authors are thankful to the Director, Central Sericultural Research & Training Institute, Berhampore, West Bengal for providing facilities for conducting the study and The Director, Zoological Survey of India, Kolkata for identifying the predator.

Table 1: Coefficient of correlation of *M.crocea* and Abiotic and Biotic Factors

Natural enemy	Max. Temp.	Min. Temp.	Max. RH	Min. RH	Rain fall	*D. decempuncta*	*A. pentatuberculata*
M.crocea	-0.107	-0.213**	0.189*	-0.098	-0.103	0.351**	-0.02
*Significant at 1%			** Significant at 5%				

Fig. 1: Correlation between seasonal incidence of *M. crocea*, hosts and abiotic factors



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