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Biological Characteristics of Certain Diamondback Moth Ecotypes

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Abstract: Studies on Diamondback moth (DBM), *Plutella xylostella* (L.) population gathered from eight different locations in India revealed significant variations existing among them. The tenure of life cycle of all the eight ecotypes varied from each other ranging from 20.1±1.3 to 20.9±1.01 days, longevity of adult males and females also differed. The other biological traits like egg hatchability (Varying from 83.2±7.96-91.2±4.68) and fecundity of female (Between 268.5±10.59-305.11±12.11) differed among the DBM population.

Key words: *Plutella xylostella*, ecotypes, longevity

Introduction

Diamondback moth is the most serious and widely distributed pest of cruciferous crop in many countries including India (Bonnemaison, 1965; Chelliah and Srinivasan, 1986; Krishnamoorthy, 2002). The diamondback moth has ability to multiply rapidly in the favorable tropical climates due to its high reproductive ability, wide host range and to develop resistance against an array of insecticides (Talekar *et al.*, 1990). From our experience surprisingly an unspotted DBM population was encountered from certain parts of Tamilnadu during 1994-1996 and the unspotted population differed in certain morphometric and biological features from those of the spotted DBM (Ganesan, 1996). Taking this into cognizance, series of studies were made to capture the unspotted DBM again in 1998-1999 and in 2005-2006. During 1998-1999 the variant to DBM race could not be detected, but in 2005-2006 few unspotted DBM surfaced. Appearance of the unspotted character in the DBM had intrigued us to investigate plausible responsible factors and the genetical difference if any between the spotted and unspotted DBM. Hence, it was envisaged to garner DBM populations at selected DBM hot spots in Tamilnadu, Karnataka and far off places like New Delhi and to subject them to certain biometric investigations in comparison with those from Karnataka and far off places like New Delhi.

Materials and Methods

Cultures of the DBM ecotypes were collected from eight locations viz., Annamalainagar, Oddanchatram, Ootacamund, Dharmapuri and, Andipatti, Hosur (Tamilnadu), Kolar (Karnataka), New Delhi and the collected larvae were grown on *Brassica rapa* seedlings raised in paper cups kept in separate insect cages. Pupae developed from time to time were collected from the cages and kept in separate petriplates placed inside the insect cages for the adult moths to emerge.

Duration and hatchability of the eggs in all the ecotypes were tracked on the basis of 25 eggs paced in a petriplate having moist sponge covered with blotting paper. Number of eggs hatched in to larvae were counted daily during 7 am to 5 pm and the mean duration and percent hatchability were worked out. The duration of larval development was ascertained with 10 neonate larvae in each of the

ecotype reared on a young small leaf for feeding and covered with another leaf in separate petriplates. Fresh food was provided daily. To calculate the pupal period and % adult emergence, 10 pupae were placed in a petriplate and the number of adults emerged was observed.

Ten newly emerged adult males and females in pairs were caged separately in glass jars with a young mustard seedling to provide a natural environment and the set up was placed in new jar daily and the fecundity and longevity of both the females and males were assessed.

Results and Discussion

Bionomics

Eggs were found both on the upper side and lower sides of the leaves and on the stem of the mustard seedling in laboratory conditions while in field eggs were laid mostly on the underside of the leaves. But the eggs were usually laid singly. These features were alike with all the ecotypes as was reported earlier (Talekar and Shelton, 1993). Results further revealed that the egg period was as low as 4.3 ± 0.46 days in the case of Annamalaiagar, Andipatti, New Delhi and Kolar ecotypes, 4.5 ± 0.46 days in case of Ottacamund and Oddanchatram ecotypes and 4.7 ± 0.46 days in the case of Dharmapuri and Hosur ecotypes.

The Kolar and Hosur DBM ecotypes had highest number of days (11.5 ± 0.67 days) for completing the larval growth followed by those of Annamalaiagar, Andipatti and New Delhi ecotypes, whilst the Dharmapuri, Oddanchatram and Ootacamund ecotypes had 10.5 ± 0.67 days (Table 1). In general the larvae passed through four instars. The larvae were voracious feeders and their feeding potential remained unchanged even after continuous rearing for over 10 generations in all the ecotypes. These findings would only confirm those of Kandoria *et al.* (1994) and Folcia and Bado (1997).

It was found that the pupal tenure was more or less similar in all the ecotypes of Annamalaiagar, Andipatti, Ootacamund, Kolar and New Delhi (5.0 ± 0.63 days) and 5.5 ± 0.67 days were with the Dharmapuri, Hosur and Oddanchatram ecotypes.

When the entire life cycle parameters among the eight ecotypes were compared, the Annamalaiagar, Andipatti and Dharmapuri ecotypes had longer period of (20.7 days) than that of Hosur (20.5 days), Kolar (20.4 days), New Delhi and Oddanchatram (20.2 days). Typically, the Ootacamund ecotype recorded the lowest life cycle period of 20.1 days (Table 1). These observations are in line with that of Usha Chauhan *et al.* (1994) and Satapathi (1990) who found that the DBM took 23 days and 12.3 to 43.9 days, respectively for completing life cycle. Although the total number of days taken for completion of life cycle was almost identical in all the ecotypes, the actual infestation period of larval stage varied significantly.

Adult Longevity

It was found that the adult males of Ootacamund and Oddanchatram ecotypes survived longer (15.0 ± 1.5 days) than others, including the Kolar population (14.9 ± 1.6 days). The New Delhi and

Table 1: Bionomics of the selected DBM ecotypes

Ecotypes	Egg period (Days)	Larval period (Days)	Pupal period (Days)	Total life cycle (Days)
Annamalaiagar	4.3 ± 0.46	11.4 ± 0.80	5.0 ± 0.63	20.7 ± 0.90
Dharmapuri	4.7 ± 0.46	10.5 ± 0.67	5.5 ± 0.67	21.2 ± 1.01
Oddanchatram	4.5 ± 0.40	10.7 ± 0.65	5.4 ± 0.63	20.6 ± 0.70
Andipatti	4.4 ± 0.46	11.3 ± 0.67	5.0 ± 0.67	20.7 ± 0.90
Hosur	4.3 ± 0.46	11.6 ± 0.66	6.5 ± 0.65	22.4 ± 1.10
Ootacamund	4.6 ± 0.49	10.5 ± 0.67	5.5 ± 0.63	20.6 ± 1.30
Kolar	4.3 ± 0.46	11.5 ± 0.67	5.8 ± 0.63	21.6 ± 1.80
New Delhi	4.3 ± 0.46	11.0 ± 0.77	5.0 ± 0.63	20.3 ± 0.98

Each value is a mean of ten replications; single insect used per replication; mean values followed by standard deviations

Table 2: Adult longevity of the selected DBM ecotypes

DBM ecotypes	Longevity (days)	
	Male	Female
Annamalainagar	14.6±1.8	15.4±1.8
Dharmapuri	14.6±1.8	14.4±1.8
Oddanchatram	15.0±1.5	15.1±1.6
Andipatti	14.7±1.6	14.9±1.7
Hosur	14.9±1.7	15.2±1.8
Ootacamund	15.2±1.5	15.3±1.9
Kolar	14.9±1.6	15.3±1.7
New Delhi	12.8±1.6	13.1±1.9

Each value is a mean of ten replications; single insect used per replication; mean values followed by standard deviations

Table 3: Fecundity and per cent egg hatchability in the selected DBM ecotypes

DBM ecotype	Eggs lid/female (No.)	Egg hatchability (%)
Annamalainagar	305.2±12.11	91.2±4.67
Dharmapuri	277.3±13.83	85.6±5.71
Oddanchatram	280.7±10.45	88.5±5.40
Andipatti	283.2±10.95	86.3±5.50
Hosur	295.5±12.15	92.5±3.47
Ootacamund	304.1±10.45	88.4±5.20
Kolar	289.7±15.42	84.8±7.55
New Delhi	265.5±10.59	83.2±7.96

Each value is a mean of ten replications; single insect used per replication; mean values followed by standard deviations

respectively for completing life cycle. Although the total number of days taken for completion of life cycle was almost identical in all the ecotypes, the actual infestation period of larval stage varied significantly.

Adult Longevity

It was found that the adult males of Ootacamund and Oddanchatram ecotypes survived longer (15.0±1.5 days) than others, including the Kolar population (14.9±1.6 days). The New Delhi and Hosur ecotypes survived to the least (12.8±1.6 days). The Annamalainagar, Andipatti and Dharmapuri ecotype males lived for 14.6±1.8 days (Table 2).

In the case of adult females, the Annamalainagar and Andipatti ecotypes had longer life of 15.4±1.8 days than the Ootacamund, Oddanchatram and Kolar populations (15.3±1.7 days), Hosur and Dharmapuri (14.4±1.8), whereas the females of the New Delhi population were short lived (13.1±1.9 days) (Table 2).

From the above it becomes clear that there was marked variation in the longevity of adults of the eight DBM ecotypes as experienced by Kandoria *et al.* (1994) and Yadav *et al.* (1974).

Fecundity and Egg Hatchability

Highest fecundity of 305.2±12.11 eggs/female was recorded with the Annamalainagar population followed closely by the Ootacamund population (304.1±10.45 eggs) (Table 3). Conversely the fecundity of the New Delhi DBM was low with 268.5±10.59 eggs. The tenure of oviposition in general varied from 13 to 15 days in all the DBM ecotypes. The fecundity rate indicates the ability of the insect to multiply in large number within a short span of time. Regarding the percent hatchability of eggs. A maximum of 92.5±3.7 was witnessed with the Hosur ecotype whereas the New Delhi population had the least (83.2±7.96). Generally the hatchability of the eggs was more than 80% in all the DBM populations. From the above it is construed that the fecundity and egg hatchability varied significantly in all ecotypes investigated.

Considering the biological traits of all the eight ecotypes, it could be seen that the Annamalainagar ecotype had high adult longevity and fecundity but per cent egg hatchability was high in the Hosur

ecotype. The other ecotypes namely Oddanchatram, Ootacamund, Dharmapuri, Andipatti, Kolar and New Delhi showed moderate level of longevity, fecundity and hatchability.

The study thus reveals that the *Plutella xylostella* (L.) population could survive and multiply at very high rate even in places with varying climatic situations as compared to the native location, which makes it the most potential pest of the crucifers. In the light of the present findings it is observed that the spotted population is likely to be erratic in its activity and behavior with respect to causing damage to the host plant in tune with the available ecological parameters. In the high of these, it is expected that the DBM may repeat the character of loosing its characteristic diamond spot and emergence of a more virulent more virulent is likely a feature to be watched carefully.

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