

## PREY SEARCHING ABILITY OF *BRUMUS SUTURALIS* (FABRICIUS) (COLEOPTERA: COCCINELLIDAE) ON COTTON MEALYBUG UNDER LABORATORY AND FIELD CONDITIONS

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### ABSTRACT

Studies were carried out to investigate the searching ability of *Brumus suturalis* (Fab.) for cotton mealy bug at Department of Entomology, Sindh Agriculture University, Tandojam during 2007. The ability of predators to reduce prey populations is generally ascribed to the consumption of prey individuals. However, predators may also induce behavioural changes in prey individuals, which can reduce prey survival and reproduction. Searching ability of *B. suturalis* both in laboratory and field revealed that 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> instar larvae of *B. suturalis* were affected significantly ( $P < 0.05$ ) by prey density. The searching distance covered by *B. suturalis* were significantly higher ( $P < 0.05$ ) in 4<sup>th</sup> instar larvae as compared to 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> instars. These results suggested that *B. suturalis* had high ability of searching prey for the control of cotton mealybugs and search strategy of predator may provide a better understanding of the conditions of generalist predator living in a particular crop.

**Keywords:** *Brumus suturalis*, distance covered, prey and cotton crop, searching ability.

### INTRODUCTION

Cotton, *Gossypium hirsutum* L., is one of the most important cash crops of Pakistan is ranked 4<sup>th</sup> largest lint producer in the world (Saeed *et al.*, 2007). Cotton crop in Pakistan is continuously under attack and damage by mealy bug, *Phenacoccus solenopsis* (Tinsly) since 2005 (Mahmood *et al.*, 2011). Mealybugs have integument with thick waxy layer and insecticides do not penetrate in its body therefore are ineffective. Alternatively, awareness increased for the use of biological control of mealybugs by coccinellid and other generalist predators. Among these, three-striped beetle, *Brumus suturalis* (Fab.) (Coccinellidae: Coleoptera) is important and the most voracious predator of mature and immature stages of mealybug on different field and vegetable crops (Lohar and Khuhro, 2009).

This beetle is widely distributed and occurs in all the ecological regions in diverse habitats in Pakistan (Rafi *et al.*, 2005) and is a major biological control agent of aphids, mealybugs, scale insects, thrips, and mites. This is a generalist predator occurring in tropical and sub-tropical agro-ecosystems. All the coccinellid beetles are considered as successful biological pest control in IPM (Majerus, 1994; French and Elliott, 1999; Bale *et al.*, 2008). Searching ability of predators is a dynamic movement and behaviour by which insects seek food, mate and oviposit. These foods are essential for growth, development and maintenance of the individuals and for ensuring the success of future generations (Bell, 1990). Keeping the importance of prey searching ability of predator especially of *B. suturalis*, in view present studies on *B. suturalis* and its prey cotton mealybug was investigated.

### MATERIALS AND METHODS

#### Prey searching behaviour of *B. suturalis* in laboratory

Prey searching efficiency of the predator, *B. suturalis* was recorded on cotton plants in laboratory of Entomology Department as well as in the experimental field of Faculty of Crop Protection, Sindh

Agriculture University, Tandojam during 2007-2008. In the laboratory, the cotton plants were grown in small pots and were kept in the cages by maintaining temperature at  $28 \pm 2^{\circ}\text{C}$ , R.H.  $65 \pm 5\%$ . The male and female adults were collected from the field and kept in the laboratory for oviposition. After hatching of the eggs, 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> instars of *B. suturalis* were kept separately for prey searching experiment. Laboratory reared 2<sup>nd</sup> instar mealybugs were released and glued on cotton plants grown in the pots at 30 cm from base of plants. The prey densities of 10, 15, 25 and 30 were glued on different leaves of cotton branches. The predators were released one each per treatment at the base of the stem of cotton plants in the same pots and the observations were noted on distance covered by the predators for searching the mealybug. The experiment was replicated three times. The searching efficiency of the adults and larvae of *B. suturalis* were observed after 20 minutes. Before releasing the predator (larva and adults) were kept starved for 24 hours. The prey searching efficiency of 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> instars and adults of *B. suturalis* against mealybugs was recorded separately and repeated five times. The number consumed by larval instars and adult stages were counted and means with standard errors were calculated for comparison of treatment means.

### **Prey searching ability of *B. suturalis* in field**

For observing the distance covered by *B. suturalis* for its prey (mealybug), the cotton crop was sown in the experimental field. For taking the observations, twenty-five plants were randomly selected and tagged in the field. The laboratory reared 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> instars larvae and adults of *B. suturalis* were released at the base of stem of tagged plants separately. The searching efficiency of larvae and adults of *B. suturalis* was observed for a fixed time of 20 minutes. The distance covered by larvae and adults for searching prey was recorded in centimeters (cm). The student Statistics 1.8 package was used for analysis of data.

## **RESULTS AND DISCUSSION**

### **Prey searching behavior of *B. suturalis* in the laboratory and in the cotton field**

#### **Distance covered (cm) by predator larval instars under laboratory and field conditions**

The data in table-1 depicted that the searching distance covered by the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> instars larvae of *B. suturalis* was significantly different for various prey densities ( $P < 0.05$ ). Prey at density of 10 mealybugs indicated that 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> instar larvae of *B. suturalis* (per leaf) covered distance of 13.57, 19.48, 22.56 and 27.59 cm (per larva), respectively under laboratory conditions, while, it was 21.39, 24.55, 30.27 and 35.59 cm under field conditions. The searching distance under prey density of 15 mealybugs (per leaf) by 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> larvae of *B. suturalis* was 15.10, 20.17, 21.99 and 28.0 (cm/larva) under laboratory conditions, while the same was 2.76, 26.37, 30.69 and 34.57 cm/larva under the field conditions, respectively (Table 1). The searching distance covered by 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> instar larvae of *B. suturalis* with a prey density of 20 mealybugs per leaf was 14.77, 18.90, 24.24 and 28.81 cm/larva under laboratory conditions, while it was 22.77, 25.81, 30.59 and 34.53 cm/larva under field conditions, respectively. Similarly, under a prey density of 25, searching distance was 13.63, 17.70, 21.44 and 28.07 cm/larva under the laboratory conditions, while it was 19.64, 26.09, 29.62 and 35.29 cm/beetle under the field conditions by 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> instar larvae of 3-striped beetle, respectively. The searching distance covered by *B. suturalis* under prey density of 30 was 11.43, 17.95, 23.19 and 29.95 cm/larva under the laboratory conditions and 19.71, 26.06, 29.58 and 35.95 cm/beetle under the field conditions by 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> instar larvae, respectively. The searching distance covered by the predator was significantly ( $P < 0.05$ ) higher for 4<sup>th</sup> instar larvae as compared to 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> instars. This increased searching distance was mainly associated with advancement in the age of the predator, which required more food to consume and hence more distance was covered to fulfill their food requirements. Furthermore, the searching distance of the predator under the field conditions was significantly greater ( $P < 0.05$ ) as compared to those under laboratory conditions (Table 1). The results of this study are supported by Solangi *et al.*, (2007), who reported that searching distance of *Coccinella septempunctata* covered by the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> instar larvae under host density of 10 was 15.56, 21.69, 28.35 and 37.91 cm in lab and 24.56, 31.64, 38.68 and 46.39 cm under field conditions, respectively. Searching distance decreased with increasing host density and under host density of 30 searching distance was

10.26, 16.92, 22.43 and 33.41 cm in lab and 19.91, 27.02, 33.58 and 41.51 cm/beetle in the field by 1st, 2nd, 3rd and 4th instar larvae, respectively. Searching distance of 7-spotted beetles under field conditions was significantly greater as compared to those under laboratory conditions, because the beetles had unlimited area in field to move and searched freely for their food and hence covered more distance as compared to laboratory conditions. Kauffman and Laroche (1994) studied the searching time of predators and reported that adults and larvae were on plants less than or equal to 65% of the time. Larvae of all species and adults of *Scymnus frontalis* and *Propylea quatuordecimpunctata* searched more for prey on rolled leaves than on open leaves. Searching time inside rolled leaves was greater by adults of *S. frontalis* than by other adults, and greater by 4<sup>th</sup> instar larvae of *S. frontalis* and *P. quatuordecimpunctata* than by *Coccinella septempunctata*, *Hippodamia variegata* and *H. tredecimpunctata*. There were no significant differences in the searching times among 2<sup>nd</sup> instar larvae inside rolled leaves. Vohland (1996) recorded that all stages of *Scymnus nigrinus* spent most of their time searching on needles, on which their prey feeds. First instar larva searched fewer needles than all other stages, while 4<sup>th</sup> instar larva showed the highest searching activity. Adult beetles also spent more time where prey densities were highest.

### Distance covered (cm) by predator adults under the laboratory and field conditions

The data in Table-2 indicated that the searching distance covered by the adult male and female beetles under a prey density of 10 mealybugs (per leaf) was 56.86 and 67.25 cm, respectively under the laboratory conditions, while it was 67.84 and 81.50 cm under the field conditions, respectively. Searching distance under a prey density of 15 was 60.33 and 68.71 cm/beetle under laboratory conditions, while it was 60.85 and 79.71 cm/beetle under field conditions by adult male and female of *B. suturalis*, respectively. The prey searching distance covered by beetle under a prey density of 20 mealybugs per leaf was 56.14 and 59.25 cm/beetle under laboratory conditions, while it was 78.66 and 86.72 cm/beetle under field conditions by adult male and female, respectively. Similarly, under prey density of 25, searching distance was 60.43 and 68.30 cm/beetle under laboratory conditions, while it was 82.04 and 84.09 cm/beetle under the field conditions by adult male and female, respectively. The searching distance covered by the beetle under prey density of 30 was 58.22 and 67.97 cm/beetle under the laboratory conditions and 78.73 and 84.97 cm/beetle under the field conditions by adult male and female of *B. suturalis*, respectively. It was obvious from the results that the searching distance covered by *B. suturalis* was significantly ( $P < 0.05$ ) higher for adult females as compared to males, because female required more food for its greater body size and egg laying and covered more distance for searching aphids to consume as their food than males with smaller size and their body requirement. Furthermore, the searching distance of *B. suturalis*, under the field conditions was significantly ( $P < 0.05$ ) greater as compared to those under the laboratory conditions (Table-2). The results agree with the Liu and Stansly (1994) who reported that the coccinellid predators, *Nephaspis oculatus* and *Delphastus catalinae* were the predators of whitefly. Furthermore, mentioned that adults of both Coccinellid species travelled in a similar pattern and *D. catalinae* moved at a greater rate, searched a greater area than *N. oculatus*. Loannou, *et al.*, (2008) reported that increased prey density significantly reduced the time taken to encounter prey by the predator.

Table 1. Comparative distance covered by different larval instars of *B. suturalis* to search different prey densities under the laboratory and field conditions.

Prey density	distance covered (in cm) by Larval instars							
	1 <sup>st</sup> instar		2 <sup>nd</sup> instar		3 <sup>rd</sup> instar		4 <sup>th</sup> instar	
	Lab	Field	Lab	Field	Lab	Field	Lab	Field
10	13.57	21.39	19.48	24.55	22.56	30.27	27.59	35.59
	± 1.84b	± 2.31b	± 2.20ab	± 2.47ab	± 2.37ab	± 2.75ab	± 2.62a	± 2.98a
15	15.10	21.76	20.17	26.37	21.99	30.69	28.00	34.57
	± 1.94c	± 2.33b	± 2.24bc	± 2.56ab	± 2.34b	± 2.76ab	± 2.64a	± 2.93a

20	14.77 ± 1.92c	22.77 ± 2.38b	18.90 ± 2.17bc	25.81 ± 2.54ab	24.24 ± .46ab	30.59 ± 2.76ab	28.81 ± 2.68a	34.53 ± 2.93a
25	13.63 ± 1.84c	19.64 ± 2.21c	17.70 ± 2.10bc	26.09 ± 2.55bc	21.44 ± 2.313ab	29.62 ± 2.72ab	28.07 ± 2.64a	35.29 ± 2.97a
30	11.43 ± 1.69c	19.71 ± 2.21c	17.95 ± 2.11b	26.06 ± 2.55bc	23.19 ± 2.40b	29.58 ± 2.71ab	29.95 ± 2.73a	35.95 ± 2.99a

Means ± SE followed by similar letters in a column are not significantly different ( $P \leq 0.05$ ) from each other

Table 2. Distance covered (cm) by male and female adults, *B. suturalis* for different prey densities under the laboratory and the field conditions.

Prey density	Distance covered (in cm) by adult			
	Male		Female	
	Laboratory	Field	Laboratory	Field
10	56.86 ± 3.77a	67.84 ± 4.11a	67.25 ± 4.10a	81.50 ± 4.51a
15	60.33 ± 3.88a	60.85 ± 3.90b	68.71 ± 4.14a	79.71 ± 4.46a
20	56.14 ± 3.74a	78.66 ± 4.43a	59.25 ± 3.84a	86.72 ± 4.65a
25	60.43 ± 3.88a	82.04 ± 4.52a	68.30 ± 4.13a	84.09 ± 4.58a
30	58.22 ± 3.81a	78.73 ± 4.43a	67.97 ± 4.12a	84.97 ± 4.60a

Means ± SE followed by similar letters in a column are not significantly different ( $P \leq 0.05$ ) from each other

## CONCLUSION

It is concluded from present study that in larval stages searching distance covered by *B. suturalis* was significantly ( $P < 0.05$ ) higher in case of 4<sup>th</sup> larval instar as compared to 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> instars. In case of adults, female searching distance covered was significantly higher than males. Increased searching distance was associated with advancement in age of beetles, which required more food to consume and hence more distance was covered to fulfil their food requirement. Furthermore, the searching distance of 3-striped beetle under field conditions was significantly ( $P < 0.05$ ) greater as compared to those under laboratory conditions.

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