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Research Article

Host Searching Efficiency of *Cotesia Flavipes* Cameron (Hymenoptera: Braconidae) an Important Parasitoid of the Maize Stem Borer *Chilo Partellus* Swinhoe

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ABSTRACT
The intra-specific variation among the different geographic populations of *Cotesia flavipes* (from India), with respect to their host searching ability was evaluated under laboratory conditions. Intra-specific variation was observed among the different populations with respect to host searching ability. The searching efficiency in terms of number of larvae parasitized was higher in 1 cu.ft cage than in 3 cu.ft cage in all the populations, irrespective of the geographic location. The searching efficiency was maximum in the parasitoid population obtained from Shimla, Dindigal and Bangalore, while it was on par with each other in the populations from Coimbatore, Devganahalli, Malur and Aurangabad. Parasitoid strains with higher response to plant odours or an intercrop that emits significant levels of odours could increase attraction of the parasitoid to control stem borer larval populations in an integrated pest management strategies.

Key words: *Cotesia flavipes*, Host searching, Parasitoid

INTRODUCTION
The genus *Cotesia* is a large group of internal gregarious parasitoids of lepidopteran larvae with 1500 – 2000 species worldwide. *Cotesia flavipes* Cameron (Hymenoptera: Braconidae) is a gregarious larval endoparasitoid of a species complex that is used in biological control of several lepidopteran stem borers. (Muirhead *et al.*, 2006). The economic importance of the parasitoid is tremenderous since most of the crops attacked are principle staple crops in many countries. The parasitoid is reported to cause 32-55% decrease in stem borer densities in various crops (Kfir, *et al.*, 2002). Varying extent of parasitism has been reported on *Chilo partellus* from different states, 36.67 per cent in Pantnagar (Choudhary and Sharma, 1987), 35 -50 per cent in Himachal Pradesh (Nirmala Devi and Desh raj,1996) 6.6 to 21 per cent in Assam (Borah, and Arya, 1995) and 2-33 percent in Haryana (Mohan *et al.*, 1999). Effective biological control of the pest is achieved when large scale release of the parasitoids are made, which in turn is dependant on mass production on a commercial scale. Scale up of production in the laboratories is governed by the inherent biological attributes of the parasitoid and the predisposing biotic and abiotic factors.

The differences in the biology of geographic populations have generally been interpreted as genetic divergence among strains but evidence is lacking particularly for the populations from India (Potting *et al.*, 1997). Parasitoid strains may differ in their propensity to search host species and parasitisation efficiency depends on the location specific strain and its adoption to the prevalent biotic and abiotic stress. In addition, the rates of parasitism of population of *Cotesia* and the level of control exerted on these pests are highly variable geographically. The genetic divergence therefore influences the population dynamics of the parasitoid and the tritrophic interactions.

The host searching ability of the parasitoid collected from different geographic locations was evaluated under laboratory conditions, to assess the intraspecific variation among the populations.

MATERIALS AND METHODS
Stock culture and rearing of the parasitoid on Chilo partellus larvae
Nucleus culture of the parasitoid populations was obtained from the Maize ecosystem in different locations in Karnataka (Bangalore, Devaganahalli, Malur), Aurangabad (Maharshtra), Coimbatore (Tamilnadu), Dindigal (Tamilnadu), Hyderabad (Andhra Pradesh) and Hoshiarpur (Punjab), Freshly emerged adults were transferred in to plastic jars (1.0 litre capacity) fitted with brass mesh for ventilation. Cotton swab soaked in 50% honey was provided as food for the adults. Larvae of *C.partellus* reared on semi-synthetic diet prescribed by Ballal *et al.* (1995) were utilized for parasitisation. Fouth-fifth instar larvae

Table 1: Host searching ability of different *C.flavipes* populations

Population	Number of larvae parasitised			Number of cocoons formed		
	3 cu ft cage	1 cu ft cage	"t "test	1 cu ft cage	3 cu ft cage	" t "test
Shimla (HP)	3.8^{a1}	4.2^{b1}		56.2^{a1}	45.8^{b1}	
Bangalore	2.4^{a2}	3.2^{b3}		32.6^{a2}	25.4^{b2}	
Malur (Bangalore rural)	2.2^{a2}	2.8^{b2}	0.148 *	30.2^{a2}	28.6^{b2}	0.788 *
Devaganahalli (Bangalore rural)	2.2^{a2}	2.6^{b2}		36.6^{a2}	34.2^{b3}	
Dindigul (TN)	2.6^{a2}	3.4^{b3}		50.2^{a1}	48.6^{b1}	
Coimbatore (TN)	2.8^{a2}	2.8^{a}		39.6^{a3}	42.4^{b}	
Aurangabad (MS)	2.8^{a}	3.2^{b3}		34.6^{a2}	32.8^{b3}	
Hoshiarpur (Punjab)	1.6^{a3}	2.2^{b2}		42.4^{a3}	48.6^{b1}	
Hyderabad (AP)	2.2^{a2}	2.2^{a2}		38.2^{a3}	44.2^{b1}	
CD	0.42	0.45		6.52	5.66	

Mean of six replications.
Figures followed by the same letter in superscript in a row are not significant.
Figures followed by the same numerical in superscript in a column are not significant.

(1995) were utilized for parasitisation. Fouth-fifth instar larvae were offered to two day old adults for 24 hours and the parasitized host larvae were transferred in to vials (10 x 2.5 cm) containing artificial diet and reared till the formation of cocoons. The cocoons were then separated in to another vial for adult emergence. The populations were maintained in the laboratory at ambient temperature of 26 + 1^{o}C and 65% RH.

Host Searching ability of C. flavipes

The host searching ability of different population's was studied in 1 cu. ft and 3 cu.ft cages at 26 ± 1^{0}C and 65% RH. Maize seedlings raised in polythene bags were kept in the cages (1 cu ft and 3 cu ft cages). Third to fourth instar larvae of *Chilo partellus* were released on to the saplings @ 5/ plant and 10 adults of the parasitoid *C.flavipes* were released. The searching efficiency of the various populations was recorded in terms of parasitism (number of larvae parasitized) and the number of cocoons formed. The data was subjected to statistical scrutiny using student's "t" test for the differences within the population from each location with respect to the size of the cage and ANOVA for the differences in between the populations with respect to the size of the cage.

RESULTS AND DISCUSSION

The host searching ability of different populations of *C. flavipes* was assessed in terms of their ability to parasitize the number of cocoons formed in the 1 and 3 cu. ft cages. Significant differences were observed within the populations with respect to parasitism in the different size cages. The number of larvae parasitized was higher in 1 cu ft cage than in 3 cu.ft in all the populations, except in the populations from Coimbatore and Hyderabad which were on par (2.8). The searching efficiency was maximum in the Shimla population followed by Dindigal and Bangalore in both sizes of the cage (Table 1), while the population from Hoshiarpur registered the lowest (2.2). The searching efficiency of Coimbatore, Devaganahalli, Dindigal and Malur populations was on par with each other, irrespective of the size of the cage. Overall, the searching efficiency was more in the 1 cu.ft. cage than the 3 cu.ft cages.

The number of cocoons formed in both the sizes of the cage also differed significantly within the various populations. Population from Shimla and Dindigal recorded higher number of cocoons than others (56.2 and 45.8 in 1 cu.ft and 3 cu.ft, respectively), while it was low in the population from Malur (30.2 and 28.6, respectively) (Table-1). The proximity of the host availability and lesser arena had resulted in the enhanced parasitism, in the present studies. Parasitoids use chemical, visual, mechanical and acoustic cues or a combination of these to locate host habitats and hosts (Weidenmenn *et al*., 1993., Vet *et al.,* 2002). Variations in colour, size and shape of plants play an important role in host selection, behavior of insects, especially in close range (Prokopy *et al.,* 1993., Schoonhoven *et.al.*,1998). The presence of essential oils and plant signaling odours attractive to parasitoids, mostly the terpernoids (E-β-farnesene) in the maize plants (Ngi Song *et al.,* 2000) gets activated upon feeding by the stem borers and serve as potential lures, and act as a kairomone for the parasitoids (Gohole *et al.,* 2005). The quantum and frequency of release would contribute to the difference in searching ability in terms of parasitism (Esther *et al*., 2005). The higher parasitisation by the parasitoid population from Dindigal and Shimla therefore appears to have resulted due to enhanced response of the parasitoids to the kairomone than others since, the plant and the host insect and the *invitro* conditions were essentially the same for the parasitoids from different geographic locations. Nevertheless, the intra-specific variability in hymenopterous parasitoids has been reported from ecological, behavioural and physiological traits (Tanwar, 2004). Potting *et.al.,* (1997) however, failed to observe intra-specific variation in host selection behaviour among *C.flavipes* strains. Therefore the variability in terms of searching efficiency is a potential inherent capability of the population. Increased attraction to a specific plant odour after perception during contact with hosts (heribivore induced odours) or associative learning is an innate response of the parasitoid (Costa *et al.,* 2010). From a practical point of integrated pest management , parasitoid strains with higher response to plant odours or an intercrop that emits significant levels of odours could increase attraction of the parasitoid to control stem borer larval populations.

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