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Host Range of Pakistan Strain of *Lysiphlebus ambiguus* (Haliday) (Hymenoptera: Braconidae) as Determined in the Laboratory

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Abstract: Introduction of a parasitoid in new locality is not without risk to indigenous insect's community, therefore, host range of the parasitoid *Lysiphlebus ambiguus* associated with *Sipha maydis* in Pakistan was studied. Eighteen species of aphids mostly associated with graminaceous crops and some others were tested in laboratory to determine their suitability as hosts of *L. ambiguus*. In 15 minute observation time the parasitoid made significantly higher number of antennal tapping and ovipositional attempts on *S. maydis* (26.8 and 20.8 respectively) than on other species. Although, it made many tapping and ovipositional attempts on *Brevicoryne brassicae* (12.2 and 6.0, respectively) it did not complete development in this species. The parasitoid strain existing in Pakistan seems to be highly specific to *S. maydis* as it completed development only on this species and therefore, poses no risk of parasitization of non target species.

Key words: *Lysiphlebus ambiguus*, *Sipha maydis*, host range

Introduction

Several native pests in the world have been controlled by introducing natural enemies of related genera and species (Pimental, 1963 and Carl, 1982). Introduction of the parasitoid *L. ambiguus* native to Pakistan was considered by state of Hawii to control *Sipha flava* (Forbes), a pest of sugarcane crop.

Introduction of a parasitoid in new locality is not without risk to indigenous insect's community, therefore, host range of the parasitoid associated with *Sipha maydis* in Pakistan was studied. *L. ambiguus* has been reported from a number of aphid species in the world. The known hosts include *Aphis gossypii* Glover from Greece (Argyriou, 1970); *Toxoptera aurantii* (Boyerde Fonscolombe) from Italy (Stary, 1964), Israel (Rosen, 1967) and Georgia (Santas, 1979); *Myzus persicae* (Sulzer) from Greece (Argyriou, 1970) and Israel (Rosen, 1967); *Aphis craccivora* Koch from Georgia (Stary, 1968), Greece (Argyriou, 1970) and Korea (Chang and Youn, 1983); *Sipha maydis* Passerini from Madrid and Cardoba (Castanera and Santiago, 1983) and *Aphis donacis* (Pass.) from Mediterranean region (Sharma, 1966). Some of these species also occur in Pakistan but *L. ambiguus* has not been recorded from any of these except *S. maydis*.

To assess the suitability of *L. ambiguus* as bio-control agent for different aphid species, host range studies of *L. ambiguus* were conducted in laboratory. Eighteen species of aphids including the ones reported as hosts were tested for development of parasitoid in laboratory.

Materials and Methods

Studies were carried out at CAB International, Regional Bioscience Center, Rawalpindi, during 1997-98, to determine host range of Pakistan strain of *L. ambiguus* reared from *S. maydis* from Quetta and Parachinar. The culture of *L. ambiguus* was maintained in laboratory at 23 ± 2 °C using *S. maydis* as principal host on barley. Plants were grown in small pots. At two leaf stage 100 second instars nymphs were released on these plants. When aphids got established and formed colonies, one pair of field collected *L. ambiguus* was released on plants in a ventilated glass cage measuring 57 x 40 x 40 cm^3. When leaves started yellowing, aphids on these were transferred to fresh barley plants. Aphid mummies were regularly removed from the plants and stored singly in gelatin capsules for emergence of the parasitoid adult.

Tapping and ovipositional response: Different species of field collected aphids were cultured in the laboratory. Already parasitized aphids were removed from the collection. Cultures of aphids were started on the host plant from which the collections were made (Table 1). This culture was screened for one generation to remove any chance of prior parasitism.

On emergence parasitoid females were put together with males in a glass tube measuring 1.5x6 cm^2 for two hours for mating. Honey solution (honey: water, 50:50) was offered for feeding during this period. Twenty aphids of each species, containing all instars were transferred to glass tube along with parasitoid female. The tube was kept under constant visual observation for fifteen minutes and tapping and ovipositional attempts made by the female parasitoid were counted.

Table 1: List of aphid species cultured on different host plants in laboratory for studies on development of *L. ambiguus*

Aphid species	Host plant
Sipha maydis	*Hordeum vulgare*
Rhopalosiphum padi	*Hordeum vulgare*
R. maidis	*Hordeum vulgare*
Sitobian avenae	*Hordeum vulgare*
Aphis donacis	*Arundo donax*
A. gossypii	*Gossypium* sp.
Macrosiphum rosae	*Rosa indica*
Aphis sp.	*Sorghum* sp.
Aphis sp.	*Solanum melongena*
Aphis sp.	*Mangifera indica*
Aphis sp.	Brinjal
Brevicoryne brassicae.	*Brassica* sp.
Lipaphis erysimi	*Brassica* sp.
Pentalonia nigronervosa	*Musa paradisiaca*
Aphis fabae	Weed unidentified
Aphis sp.	Weed unidentified
Aphis sp.	*Tecoma grandiflora*

Development of *L. ambiguus* on different aphid species: To check the development of *L. ambiguus* on eighteen aphid species clean aphid cultures reared in the laboratory were used. One hundred aphids were transferred on potted host plants and were caged along with a pair of parasitoid. These aphids were kept under observation for twenty days to check any development of *L. ambiguus*. On yellowing plants/leaves were replaced with fresh plant/leaves. Observations were made for the development of mummies.

Results

Antennal tapping of *L. ambiguus*: Under laboratory conditions tapping response of *L. ambiguus* to eighteen aphid species proved to be highly significant ($F = 20.37$; $Pr > f = 0.0001$). Maximum number of tapping attempts were made on *S. maydis* (mean 26.80 ± 7.2) followed by *Brevicoryne brassicae* (Linnaeus) (Mean 12.20 ± 2.4). Antennal tappings ranged between 7-9 on *Rhopalosiphum padi* (Linnaeus), *R. maidis* (Fitch), *Sitobion avenae* (Fabricius), *Aphis donacis*, *A. gossypii*, *Lipaphis erysimi*

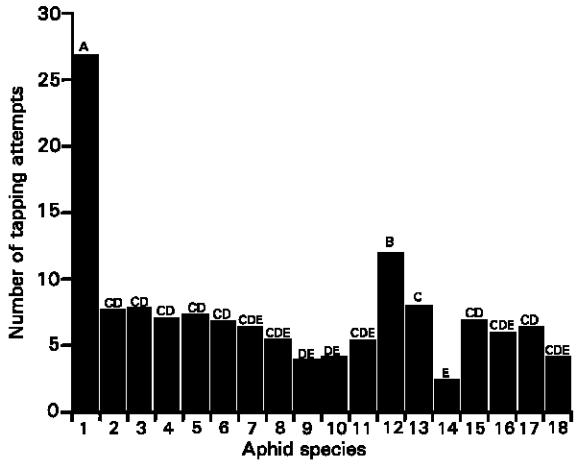

Fig.1: Number of antennal tapping attempts by *L. ambiguus* on 18 species of aphide in 15 minutes after exposure. Means with same letters are not significant different at 5% significant level
1. *Sipha maydis*, 2. *Rhpoalosiphum padi*, 3. R. *Maidis*, 4. *Sitobion avence*, 5. *Aphis donacis*, 6. *Aphis gossypii*, 7. *Macrosiphum* rosae, 8. *Aphis* sp. on *Sorghum* sp., 9. *Aphis* sp. on green pepper, 10. *Aphis* sp. on mango, 11. *Aphis* sp. on brinjal, 12. *Brevicoryne brassicae*, 13. *Lipaphis erysimi*, 14. *Pentalonia nigronervosa*, 15. *Aphis fabae*, 16. *Aphis* sp. on weed, 17. *Aphis* sp. on *Tecoma grandifora*, 18. *Aphis* sp. on *Mentha longifolia*

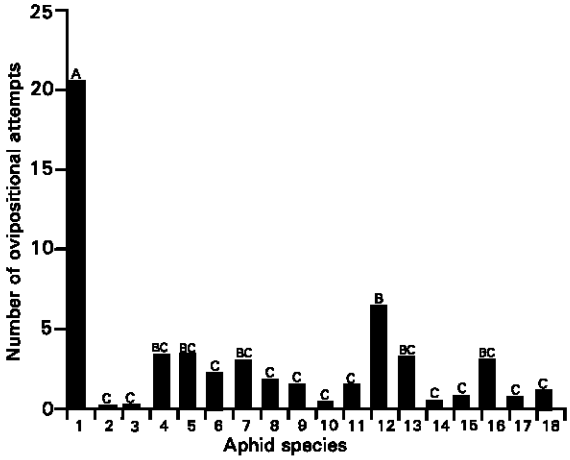

Fig. 2: Number of ovipositional attempts by *L.* Ambiguus on 18 species of aphids in 15 minutes after exposure. Means with same letter are not significant different at 5% significant level

(Kaltenbach) and *Aphis fabae* scopoli. *Aphis* sp. on *Tecoma grandiflora* and *Pentalonia nigronervosa* Coquerel were tapped the least (Fig. 1). Higher number of antennal tapping on *S. maydis* indicated that preferred host induced more time spent on it by the parasitoid. It may also be due to recognition and search for suitable oviposition site whereas non-host species were recognized during initial tapping and avoided further tapping and contact.

Ovipositional response by *L. ambiguus* on different aphid species: Oviposition by *L. ambiguus* was significantly different on different aphid species ($F = 18.92$; $Pr > f = 0.0001$). The highest number of aphids oviposited by *L. ambiguus* were of *S. maydis* (mean

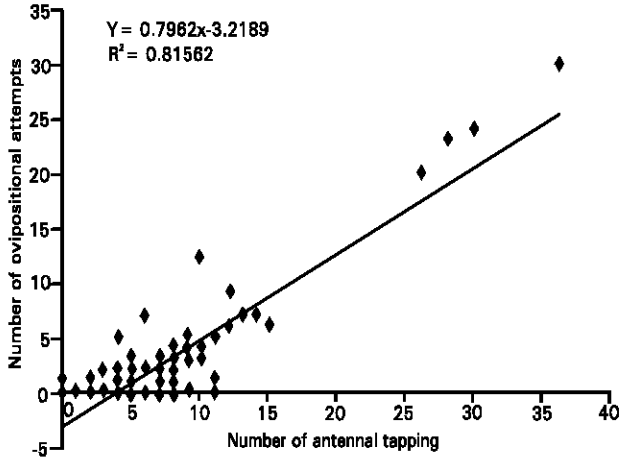

Fig. 3: Relationship of antennal tapping and oviposition attempts by Lysiphelbus ambiguus on 18 aphid species

20.80 ± 7.6) followed by *B. brassicae* (mean 6 ± 3). The oviposition attempts ranged between 3 – 4 on *S. avenae*, *A. donacis*, *Macrosilphum rosae* (Linnaeus), *L. erysimi* and *Aphis* sp. on weed, 1 – 2 on *R. maidis*, *A. gossypii*, *Aphis* sp. on mango, *Aphis fabae*, *Aphis* sp. on *Tecoma grandiflora* and *Aphis* sp. on *Mentha longifolia*, whereas no oviposition attempts were made on *R. padi*, *Pentalonia nigronervosa* and *Aphis* sp. on green pepper (Fig. 2). To assess the relationship between antennal tapping and oviposition, the regression analysis was conducted and is presented in Fig. 3. The R^2 was more than 0.81 indicating that there was a strong relation between tapping and oviposition. More tappings by the parasitoids was followed by oviposition.

Development of *L. ambiguus* in different aphid species: None of the aphid species tested supported complete development of *L. ambiguus* though oviposition attempts by the parasitoid were seen in some cases. Some of the aphid species which were reported as hosts, such as *Aphis gossypii* on cotton and citrus (Rosen, 1967; Argyriou, 1970) and *Aphis donacis* on *Arundo donax* (Sharma, 1966) when cultured on the reported host plant did not support development of *L. ambiguus*. These results may be due to the conditioning effects of the host plant.

Discussion

A parasitoid may find a potential host in its habitat and even select to attack it but its relationship still may not succeed if the attacked host is immune. Griffiths (1960a) reported that in laboratory the parasitoid *Monoctonus paludum* Marshall oviposited in the aphid species *Macrosiphum euphorbiae* (Thos.), *Aulacorthum solani* (Kalt.), *Myzus persicae* (Sulz.) and *Nasonovia ribis-nigri* (Mosley) but completed development only in *N. ribis-nigri*.

Sekhar (1960) obtained oviposition by *Aphidius testataceipes* (Cresson) and *Praon aguti* (Smith) in several aphid species but they emerged from only a few of the hosts. Miller (1928) found that *Lysiphlebus testaceipes* (Cresson) attacked *Aphis spiraecola* Patch and this host was ultimately killed but the parasitoid larvae never completed development.

The insect immune system serves as a key defense against attack by parasitoids. Incompatible hosts often eliminate prasitoids by encapsulation in which homocytes form a multilayered envelope around the invading organism (Michael and Louis, 1995, Carton and Kitano, 1979). Encapsulation of parasitoid eggs and larvae was observed by Griffiths (1960b) in aphids in which it could complete the development.

The studies on host range of *Lysiphlebus ambiguus*, which is naturally associated with *Sipha maydis* on graminaceous crops in Pakistan completed development only in this species indicating

that it is probably specific to this genus and species, though, it attacked several species of aphids in laboratory it did not complete the development in them.

It is not clear in this study that if nutritional requirements of the parasitoid were not met in unsuitable hosts or the defense mechanism like encapsulation of eggs and larvae, as observed by other authors, inhibited the development of the parasitoid.

Some of the aphid species, which are reported as hosts such as *Aphis gossypii* on cotton and *A. donacis* on *Arundo donax*, when cultured on these host plants did not support the development of *L. ambiguus*. Thus the conditioning effects of host plant as observed by Laing (1937) may also be a factor that parasitoid could not complete development on these reported hosts.

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