Aphids and Their Biological Control in Pakistan

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Abstract: Aphids are important pests of cultivated crops in Pakistan. They not only reduce the yield of crops but also serve as vectors of disease. There are about 92 species of aphids in Pakistan. Some of these are serious pests of crucifer crops, vegetables and fruit trees. In Pakistan, aphids have mostly been controlled by insecticidal applications. However, due to adverse effects of insecticides, total reliance on them cannot be made. Alternative control strategy is Integrated Pest Management (IPM). In IPM, the role of parasitoids and predators is very important. The parasitoids attacking various aphids amount to 30 belonging to 6 families. Similarly the apidivorous predators are 42. Pathogens have not been recorded. Thus a large complex of natural enemies exists in the aphid environment. The possibility of biological based IPM has been explored and discussed.

Key words: Aphids, biological control, predators, parasitoids

Introduction
Insects are the limiting factor for healthy growth of cultivated plants; hence it is difficult to cultivate a crop without sound plant protection measures. Among insects, aphids are important throughout the world. Aphids suck sap from the plants, weaken the plant, and subsequently reduce the yield. In Pakistan aphids are the pests of oilseeds like sazon, rapeseed, canola, sunflower, etc., fruit trees like peach, plums; vegetables like cauliflower, cabbage, potato; graminaceous crops like wheat, maize, barley and forage; legume crops like lycium and cotton. Acanthocephalum picum (Harra), Aphis cracivora Koch, Theraphora eflati attacks on legumes, Phyllocoptus medis (Ritch.), R. padl (L.), Blattaphila gyniunum, Rond., Macrocephus averani (F.) and M. graminis Kby attacks on graminaceous crops. Myzus persicae (Sult.) affects fruit crops while Lophaphila erysimi (Klb), L. pseudobassicassae (Davis) and Myzus persicae attack on brassicas. These are the important aphid species of Pakistan (Ameer et al., 1997; Ahmad and Soomro, 1997; Amjad et al., 1999; Azim, 1997; Inayatullah et al., 1993; Karimullah et al., 1995; Nasir and Yousaf, 1982; Soomro and Khalid, 1994). They are known vectors of diseases as reported by Soomro et al. (1982). At present they are mostly controlled through insecticides. However, due to adverse effects of insecticides their rational use is being advocated. Use of pesticides to control pests is generally bunched up when these chemicals indiscriminately kill the naturally occurring agents like predators and parasitoids. As a result there is pest resurgence. Therefore, now biological based Integrated Pest Management (IPM) is recommended. For this purpose detailed information of a pest and its environment is required.

Occurrence: The importance of aphids on various crops is established. All these crops are either cash or staple food of the people. It also shows that aphid are widespread in Pakistan. However, they have not been documented comprehensively. The reported species compiled from the literature are given in Table 1.

<table>
<thead>
<tr>
<th>Table 1: Aphids and Their Host Plants in Pakistan</th>
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<tbody>
<tr>
<td>1. Ancylostoma picum</td>
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<td>2. Acanthocephalum picum</td>
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<td>4. Macrosiphum abbreviatum</td>
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<td>5. Macrosiphum javanicum</td>
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<td>6. Macrosiphum persicae</td>
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<td>7. Macrosiphum sordidum</td>
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<td>8. Macrosiphum testaceum</td>
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<td>10. Macrosiphum vicium</td>
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</tbody>
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47. Lachnus sp. on Pyrus pashdia, Rosa sp.
48. L. pyrastri sp. on Apium graveolens, Brassica campestris, Brassica oleracea, Raphanus sativus.
49. L. ibadi (Neckyus) on Chrysanthemum leucanthemum, Lepidium ramosissimum, L. perpusillum (Davis) on Brassica campestris, B. napus, B. oleracea, B. rapa.
50. L. saltans (Gotthard) on Taraxacum officinale, Fumaria officinalis.
51. L. psyllidum (Kuwahara) on Sarghun sp.
52. Malphas sp. on Cirsium arvense (Gillats) on Chrysanthemum leucanthemum.
53. Micranthus aequalis sp. on Hordeum vulgare, Triticeum aestivum.
54. M. ramosissimum sp. on Raphanus sativus, Lepidium ramosissimum, L. ramosissimum, L. perpusillum (Davis) on Brassica campestris, B. napus, B. oleracea, B. rapa.
55. M. pustulatus sp. on Cirsium arvense (Gillats) on Chrysanthemum leucanthemum.
56. M. sp. on Lepidium ramosissimum, L. perpusillum (Davis) on Brassica campestris, B. napus, B. oleracea, B. rapa.
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120. M. sp. on Cirsium arvense (Gillats) on Chrysanthemum leucanthemum.

Table 2: Parasites of Aphids in Pakistan

<table>
<thead>
<tr>
<th>Family</th>
<th>Common Name</th>
<th>Host Plant</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphidae</td>
<td>Western Increase</td>
<td>Hordeum vulgare, Triticum aestivum</td>
<td>Pakistan</td>
</tr>
<tr>
<td>Psyllidae</td>
<td>Bubble-Covered Ant</td>
<td>Hordeum vulgare, Triticum aestivum</td>
<td>Pakistan</td>
</tr>
<tr>
<td>Pseudococcidae</td>
<td>Pink Stink Bug</td>
<td>Hordeum vulgare, Triticum aestivum</td>
<td>Pakistan</td>
</tr>
<tr>
<td>Trialeurodes</td>
<td>Green Plant Bug</td>
<td>Hordeum vulgare, Triticum aestivum</td>
<td>Pakistan</td>
</tr>
</tbody>
</table>

Control strategy: Before embarking on the control of any pest, it is essential to know the biology and prevalence of it. Investigations on these aspects of aphids in Pakistan has been conducted by Ameer et al. (1993a, b). The control methods include the use of natural enemies such as predatory wasps and ladybirds. In recent years, the use of chemical pesticides has been reduced due to environmental concerns. The most effective method is to integrate biological control with other management practices to reduce the impact of aphids on crops. This approach has been successful in several regions of Pakistan.
Mohammad Irshad: Aphids, biological control, predators, parasitoids


Table 3. Predators of Aphids in Pakistan

**Coleoptera**

**Coordinellidae**

1. Adalia spp. on Chrysobalanus sp., D.C. Mandan, Sattu, Thal.
3. Alisa manderestriens Muls. on Aphis gossypii Glover. Northern Pakistan.
7. Erichsonius fulvus (Thun.) on Rhopalosiphum maidis, Aphis fabae Fayalwadi, Sattu, Murave, Pushkar, Wah, Kohat, Hangu, Dr.
8. Euphyas sp. on Aphis crassata Pushkar.
9. Mesaphos venetana (Gosse) on Shizaphis graminum, Rhopalosiphum maidis Pushkar.
13. Pankypae saundersi Cort. on Aphis sp., Brochacauda sp.
14. Pulius gauriti Muls. on Aphis fabae, A. gossypii, Shizaphis graminum, Macrocephalus rosaeformis, Rhopalosiphum maidis, Northern Pakistan.
15. Pulius sp. on Aphis gossypii, Chrysosoma sp., Pushkar.
17. S. rubidus Muls. on Aphis fabae, A. gossypii, Chrysosoma sp., Shizaphis graminum, Rhopalosiphum maidis, Pakistan.
18. Scymnus sp. on Aphis fabae, Chrysosoma sp., Eriosoma lanigerum (Haus.) Northern Pakistan.
19. Stethorus sp. on Aphis gossypii, Myzus persicae, Northern Pakistan.

**Diptera**

**Chamaemyzidae**

20. Lauxancor sp. on Aphis Fabae. Pakistan.

**Syphidae**


23. Metaaphorina contrator (Weed) on Eriosoma lanigerum Murave.

24. M. contrator (Weed) on Aphis piorn, Aphis crassata, Eriosoma lanigerum Murave.


27. P. serrana F. on Shizaphis graminum, Macrocephalus rosaeformis, Myzus persicae. Pushkar.


29. Sphaerophoria sp. on Shizaphis graminum, Macrocephalus rosaeformis, Myzus persicae. Pushkar, Faisalabad, Pakistan.


32. Syrphus bauerni Deg. on Chrysosoma sp., Myzus persicae, Shizaphis graminum, Macrocephalus rosaeformis, Rhopalosiphum maidis, Myzus persicae. Pushkar, Faisalabad, Rawail.

33. S. corallae F. on Aphis Fabae. Hangu.

34. S. corallae F. on Aphis Fabae. Hangu.

35. S. corallae F. on Acrysta phylarum, Macrocephalus rosaeformis, Myzus persicae. Pushkar, Faisalabad, Pakistan.


37. S. corallae F. on Lipaphora pseudoechincola. Rawail.

38. Xanthogramma acetutale F. on Shizaphis graminum, Macrocephalus rosaeformis, Myzus persicae. Pushkar, Faisalabad, Pakistan.

Hemiptera

**Anthocoidea**


**Lygaeidae**

40.隶属于pulicatus Dist. on Aphis gossypii. Northern Pakistan.

Neuroptera

**Chrysopidae**

41. Chrysopidae areae Stephan. on Eriosoma lanigerum, Shizaphis graminum, Acrysta phylarum, Aphis crassata Abbotdell, Mandan, Pushkar, Sialkot, Multa, Sahiwal.

42. Chrysopidae sp. on Eriosoma lanigerum. Sialkot, Pakistan.

It is evident that enormous work has been conducted on chemical control of aphids along with studies on varietal resistance. However, varietal resistance work is mostly confined for the purpose of screening. No significant work has been conducted on field utilization of this component of control. Therefore control of aphids has mainly been attempted through chemicals. Varietal resistance can afford maximum profitability by virtue of inherent potential to safeguard against aphid infestations.

**Biological control:** The use of pesticide has inherent disadvantages, as it is not environmentally friendly, therefore reliance on biological control or biological based IPM has to be made. In this context little efforts have been made in the country. Now it is the need to exploit the natural enemies in this control concept. The importance of biological control in Pakistan has been discussed by Irshad, (1987) and Mohyuddin, (1981). Biological control work on aphid has been reported by Alam et al. (1999), CIBC (1977), Habib (1973), Hamid 83, 84, 85, Hamid et al. (1974), Khan et al. (1990), Khalil et al. (1990), Mughal and Munshi (1985), Mustafa et al. (1986), Pirzade et al. (1998), Stary et al. (1998), Suhail et al. (1999). Most of the work is concerned with the record of natural enemies, their incidence, biology, ecology and host range. Some feeding and parasitizing studies are also reported. Little work has been done on mass rearing these biotic agents. Almost negligible work on utilizing these natural enemies in the fields of Pakistan is available. There are about 30 species of parasitoids of aphids in Pakistan (Table 2).

**Discussion**

Despite the extensive precautions, biological control, like all integrated pest management strategies, is not a panacea and also not risk-free. The consequences of inaction are far greater than the risks, as millions of acres of rangeland, cropland, and wildlife habitat are affected each year by habitat disruption. Biological control takes many years to succeed. But it is often the best, safest, and most cost-effective approach to long-term management of pests. Sometimes it is the only practical approach.

The first step in biological control of aphid like other pests is to evaluate the natural enemy effectiveness by identifying...
those species that have the high potential for use. Their use depends on the characteristics of the pest and cropping system in which it causes the damage. Variation in plant parts and prey species affects the survival, dispersal, and population size of some predators. The dispersal of adult predators varies from plant to plant and different plant parts. Therefore before conducting this venture, it should be given due consideration. Coccinellid beetles are important predators of aphids and their release should be done at night because at that time they will stay close, and in the morning, when they are hungry, they will munch on the aphids. A predator also needs a lot of different aphids, which means a lot of different plants, and she needs a really good infestation. Therefore release should be made in such periods when aphid populations are abundant. But they should not be allowed to cause economic loss. For this purpose a trap crop should be provided wherever necessary. One tenet of strategy of aphid control is interplanting, which should be done to attract ladybirds and other predators naturally. Thus a natural balance would be available for the population build up of aphids.

Interactions among predators can have a substantial effect on the total impact of the predator complex. The combined predation rate of two predators could nearly be double the sum of their individual predation rates. The strength of the synergistic interaction increases with increasing prey density. Although most aphid species are attacked by several predator species, predator-prey theory has historically focused on interactions between individual prey and predator species. There are cases in which enemy complexes provide enhanced pest suppression but there are other instances in which predator complexes are less effective in reducing the pest populations. In biological control of aphids through predators in Pakistan these considerations must be given weight.

There are no reported instances of arthropod predators attacking prey displaced by predatory drivers or of synergism between two arthropod predators. Demonstrating such synergistic interactions among arthropod predators, and determining the mechanisms that underlie them, may provide new insight into the regulation of aphid populations and offer opportunities for improved pest management. Coccinellidae, Chrysoptidae and Syphid predators must be used in combination to get better aphid control in Pakistan. Apart from releasing these natural enemies it is important to conserve their population through adjusting the chemical control as such that there is minimum effect on these natural enemies. The important parasitoids of different aphids are Aphidius colemani, A. maccaneae, and Diaeretiella rapae. These have been used elsewhere in the world. These are easy to be mass reared. A colemani has a scope in biological control of aphids. It has been recorded from S. granarium but it can be utilized against other aphids, as it is also found on other hosts in the world. It can easily be mass bred in the laboratory and released in the field. It has been mass reared and used unsuccessfully against Panteronia nigronervosa. Diaeretiella rapae has multiple hosts and it is also not difficult to be mass reared. It has the potential to be used on vegetables, oilseed and cotton. Habib (1973) has discussed their biotic potential and found suitable as biocontrol agents. A prerequisite of augmentative releases of natural enemies is the ability to produce the natural enemy in sufficient numbers at competitive costs. The control potentials of some of these predators have been explored by Hamid (1985). The important predators are Adonis variegata, Brachonidea satureia, Menochius sexmaculus (Coccinellidae), Metasys aequalis (Coccinellidae), Metasys nepalensis (Chrysopidae), Chrysoptera camae (Chrysopidae), Aphelinus mali has been imported from Switzerland for the control of Erissoma lanigerum on apple and has been established in the release area of Murree hills (CIBC, 1987). It has reported to give good control. As a large complex of potentially important natural enemies are prevalent therefore they must be utilized in the aphid control strategy.

References
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