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# ABUNDANCE AND DIVERSITY OF TYPHLOCYBINE LEAFHOPPERS ON VEGETABLE PLANTS IN PAKISTAN

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A brief survey of typhlocybine leafhoppers affecting vegetable plants was made in Pakistan. The results of 1493 samples collected indicated that nearly 39 species of leafhoppers infested 37 species of vegetable plants . Of these the plants observed seriously affected were potato, pumpkin, spinach, carrot, bitter gourd, brinjal, chillies, okra, turnip, tomato and sugarbeet. Emerging out as the most important species in these studies were *Empoasca punjabensis* which affected 35 out of 37 plants species of vegetable plants.

## INTRODUCTION

Vegetable plants are known to be preferred hosts of typhlocybine leafhoppers all over the world. In Pakistan however no satisfactory information was available apart from a few studies of Ahmed [1], Ahmed *et al.* [2] and Pruthi [4]. A brief survey was, therefore, conducted in the country for the first time, which showed a large number of typhlocybine species feeding on these plants. In addition to collecting as many species as could be possible, every plant species was separately sampled with the help of a hand-operated sweep net, of which 25 sweeps on a plant constituted one standard sample. Data of leafhoppers collected in 1493 such samples has been presented in the Tables 1 and 2.

## RESULTS AND DISCUSSION

The data presented in the Tables indicates that most of the vegetable plants are affected by more than one, and in some cases by a large number of species of typhlocybine leafhoppers. There were e.g. 15 species on pumpkin *(Cucurbita pepo)* 12 on potato *(Solanum tuberosum)*, 10 on spinach *(Spinacia oleracea)*, 9 on carrot *(Daucus carota)*, 7 on each of bitter gourd *(Momordica charantia)*, and chillies *(Capsicum annum)*, 6 on each of tomato *(Lycopersicum esculentum)*, and brinjal *(Solanum mellongena,)* 5 on each of raddish *(Rhaphanus sativus)*, turnip *(Brassica napus)*, sugar beet *(Beta vulgaris)*, and coriander *(Coriandrum sativum)*. Vegetable plants like luffa *(Luffa cylindrica)*, okra *(Abelmoschus esculentus)*, pea *(Lathyrus odoratus)*, tobacco *(Nicotiana tabaccum)*, water gourd *(Benincasa hispida)*, white gourd *(Praecitrullus fistulosus)*, cluster bean *(Cyamopsis tetragonoloba)*, mint *(Mentha piperata)*, and sesame *(Sesamum indicum)* though not affected by a large number of species, nevertheless harboured 1–4 leafhopper species each. Vegetable plants like onion, garlic, cabbage, and cauliflower, did not appear to be suffering from any serious attack of leafhoppers, and species collected on them appeared only chance catches.

Of the 39 species of typhlocybines studied in the present survey, *Empoasca punjabensis* turned out to be the commonest and most widespread, as it was recorded all over Pakistan, and on 35 out of 39 species of vegetable plants studied. A similar situation existed with *E. punjabensis* on fruit plants in Pakistan as reported by Ahmed *et al.* [2,3]. *Amrasca devastans* is also fairly common and has been collected on 18 plants species. *Empoasca syedi* was collected on 14 species on vegetables, in N.W.F.P. only, and *Empoasca kerri* on 7 plant species in Punjab, Sind and N.W.F.P. The present survey revealed that the leafhoppers affecting vegetable plants belonged mostly to the tribe Empoascini, and were general feeders rather than host specific.

Although the total number of samples of leafhoppers collected appears fairly reasonable, but their plant-wise and region-wise number varies considerably due to the relative abundance, and varieties of vegetable plants grown in different regions of the country. It is, however, quite satisfactorily shown that most of our vegetable plants are under heavy attack of a large number of typhlocybine species. A brief discussion of important infestations is given

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Table 1a. No. of adult typhlocybine leafhoppers collected on vegetable plants in Pakistan

| Leafhopper species | Host and food plants (No. of leafhoppers collected) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bauhinia | Bitter gourd | Brinjal | Cabbage | Carrot | Cauliflower | Chillies | Cholai | Coriander | Cowpea | Cucumber | French beans | Kulfa | Long cucumber | Luffa | Okra | Onion | Pea | Potato | Pumpkin | Raddish | Salad | Spinach | Tobacco | Turnip | Water gourd | White gourd | Tomato | Total |
| In Punjab | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Zygina binotata* | 306 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 306 | |
| *Empoasca punjabensis* | – | 2170 | 825 | 11 | 139 | 10 | 1143 | 274 | 432 | 77 | 541 | 456 | 26 | 2788 | 1730 | 222 | – | 50 | 1686 | 6562 | 123 | 140 | 1312 | 2680 | 51 | 1301 | 1470 | 737 | 26956 | | |
| *Empoasca kerri* | – | 25 | – | – | – | – | – | – | – | – | – | – | – | –– | – | – | – | 5 | – | – | – | – | – | – | – | – | – | – | – | 30 | |
| *Zyginidia quyumi* | – | 1 | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | 3 | |
| *Empoasca decipiens* | – | – | 30 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 30 | |
| *Empoasca solanifolia* | – | – | 16 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 16 | |
| *Amrasca devastans* | – | – | 7640 | – | 32 | – | 24 | – | 3 | – | – | – | 13 | – | 36 | 4400 | 30 | – | 53 | 97 | 30 | – | 10 | – | – | – | – | – | – | 12368 | |
| *Empoasca jabbari* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 14 | – | – | – | – | – | – | – | – | – | 14 | |
| *Empoasca minor* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 13 | – | – | – | – | – | – | – | – | – | 13 | |
| *Austroasca ghaziensis* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 5 | – | – | – | – | – | – | – | – | – | 5 | |
| Total samples | 4 | 129 | 82 | 2 | 22 | 1 | 38 | 1 | 21 | 5 | 40 | 8 | 2 | 121 | 64 | 59 | 12 | 5 | 82 | 237 | 21 | 15 | 59 | 75 | 9 | 29 | 32 | 62 | 1237 | | |
| Total leafhoppers | 306 | 2196 | 8512 | 11 | 171 | 10 | 1167 | 274 | 435 | 77 | 541 | 456 | 39 | 2788 | 1766 | 4622 | 30 | 55 | 1739 | 6691 | 153 | 140 | 1322 | 2681 | 51 | 1301 | 1470 | 737 | 39741 | | |

Table 1b

| Leafhopper species | Host and food plants (Number of leafhoppers collected) | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bauhinia | Bitter gourd | Brinjal | Cabbage | Carrot | Chillies | Cluster bean | Coriander | Luffa | Mint | Okra | Onion | Potato | Pumpkin | Raddish | Sesame | Spinach | Sweat potato | Tomato | Total |
| In Sind | | | | | | | | | | | | | | | | | | | | |
| *Empoasca sindhensis* | – | 19 | – | 1 | 2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 22 |
| *Zygina sindhensis* | – | 1 | – | – | 7 | – | – | 3 | – | – | – | – | – | – | – | – | 5 | – | – | 16 |
| *Amrasca devastans* | – | 1 | 108 | – | 18 | 3 | – | – | – | – | 118 | – | 72 | 20 | – | – | – | 14 | 70 | 424 |
| *Empoasca bostanensis* | – | – | – | – | 5 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 5 |
| *Empoasca kerri* | – | – | – | | 30 | – | 117 | – | – | – | – | – | – | – | 7 | – | 8 | – | 1 | 163 |
| *Empoasca mardanensis* | – | – | – | – | 6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 6 |
| *Empoasca punjabensis* | – | – | – | – | 10 | – | – | – | 37 | 6 | – | 1 | 5 | 5 | 1 | 182 | 32 | – | 12 | 291 |
| *Austroasca jamkandensis* | – | – | – | – | – | 7 | – | – | – | – | – | – | 27 | – | – | – | – | – | – | 34 |
| *Empoasca sesamae* | – | – | – | – | – | – | 3 | – | – | – | – | – | – | – | – | 45 | – | – | – | 48 |
| *Empoasca cyamopsae* | – | – | – | – | – | – | 10 | – | – | – | – | – | – | – | – | 3 | – | – | – | 13 |
| *Austroasca tuberosa* | – | – | – | – | – | – | – | – | – | – | – | – | 2 | – | – | – | – | – | – | 2 |
| *Austroasca viniferae* | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 | – | – | 2 | – | – | 4 |
| *Empoasca masoodi* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 10 | – | – | 10 |
| *Empoasca syedi* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 12 | – | – | 12 |
| *Zygina binotata* | 240 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 240 |
| Total samples | 1 | 4 | 7 | 1 | 10 | 2 | 4 | 1 | 1 | 1 | 1 | 1 | 6 | 3 | 2 | 4 | 10 | 1 | 3 | 63 |
| Total leafhoppers | 240 | 21 | 108 | 1 | 78 | 10 | 130 | 3 | 37 | 6 | 118 | 1 | 106 | 27 | 8 | 230 | 69 | 14 | 83 | 1290 |

below.

*Sugar Beet.* It was observed largely affected by leafhoppers in Baluchistan and N.W.F.P. Of the five typhlocybine species collected, *Empoasca punjabensis* and *Empoasca syedi* were the most abundant. Both the species were recorded breeding on the plant.

*Bitter Gourd.* It is grown all over Pakistan, but suffered from leafhopper attack in Punjab, Sind and N.W.F.P. Of the seven species collected on it, *Empoasca punjabensis* was the most abundant. To a lesser extent *Empoasca kerri* was also collected on it. *E. punjabensis* also breeds on the plant.

*Brinjal.* It was the most heavily infested plant by typhlocybines, almost all over the country. Of the six species recorded on it, *Amrasca devastans* was the most abundant. *Empoasca punjabensis* was also collected quite commonly on it in Punjab. *A. devastans* freely breeds on the plant.

Table 1c

| Leafhopper species | Host and food plants (Number of leafhoppers collected) | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sugar beet | Bitter gourd | Bottle gourd | Brinjal | Chillies | Coriander | Cucumber | Garlic | Kulfa | Frenu-greek | Mint | Okra | Pea | Potato | Pumpkin | Raddish | Salad | Spinach | Water gourd | Tomato | Total |
| In N.W.F.P. | | | | | | | | | | | | | | | | | | | | | |
| *Empoasca punjabensis* | 150 | 59 | 67 | 73 | 18 | – | – | – | 24 | – | 16 | 100 | – | 2 | 161 | – | 15 | 25 | – | 64 | 774 |
| *Empoasca syedi* | 191 | 4 | – | 147 | 1 | – | 15 | 1 | – | – | – | 162 | – | 51 | 224 | – | 16 | 50 | 3 | 49 | 914 |
| *Empoasca kerri* | – | 48 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 48 |
| *Erythroneura nagpurensis* | – | 2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 |
| *Amrasca devastans* | – | – | – | 52 | – | – | – | – | – | – | – | 113 | – | – | – | – | – | – | – | – | 165 |
| *Zyginidia quyumi* | – | – | – | – | 4 | – | – | – | 1 | – | 6 | – | – | – | – | – | – | – | – | – | 11 |
| *Byphlocyta spinosa* | – | – | – | – | 1 | – | – | – | – | – | – | – | – | 3 | – | – | – | – | – | – | 4 |
| *Empoasca capsicae* | – | – | – | – | 7 | – | – | – | – | – | – | – | – | – | 2 | – | – | – | – | – | 9 |
| *Empoasca planata* | – | – | – | – | – | 84 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 84 |
| *Zyginidia behrinensis* | – | – | – | – | – | 4 | – | – | – | 11 | – | – | 1 | – | – | – | – | – | – | – | 16 |
| *Empoanara ghulami* | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | 1 |
| *Erythroneura hazarensis* | – | – | – | – | – | – | – | – | – | – | – | 10 | – | – | – | – | – | – | – | – | 10 |
| *Empoasca khaliquei* | – | – | – | – | – | – | – | – | – | – | – | 47 | – | 18 | 22 | 6 | – | – | – | – | 85 |
| *Eupteryx tuberculata* | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 | – | – | – | – | – | – | 3 |
| *Zyginidia bindrai* | – | – | – | – | – | – | – | – | – | – | – | – | | 59 | – | – | – | – | – | 9 | 68 |
| *Empoasca apodema* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 18 | – | – | – | – | – | 18 |
| *Zygina haripurensis* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 | – | – | – | – | – | 2 |
| *Zyginidia sawaii* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 | – | – | – | – | – | 2 |

(Table 1c continued)

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Empoasca mardanensis* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 20 | – | – | 5 | – | 39 | | | 64 |
| *Erythroneura vinealis* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 5 | – | – | – | – | – | | | 5 |
| Total samples | 2 | 6 | 1 | 8 | 5 | 2 | 1 | 1 | 4 | 1 | 4 | 13 | 1 | 8 | 19 | 1 | 2 | 7 | 1 | 10 | | | | | 97 |
| Total leaf-hoppers | 341 | 113 | 67 | 272 | 31 | 88 | 15 | 1 | 25 | 11 | 23 | 432 | 1 | 128 | 456 | 6 | 31 | 80 | 3 | 161 | | | | | 2285 |

| | Sugar beet | Brinjal | Carrot | Chillies | Coriander | French beans | Luffa | Frenugreck | Mint | Mustard | Okra | Pea | Potato | Pumpkin | Raddish | Spinach | Turnip | Water gourd | Tomato | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In Baluchistan | | | | | | | | | | | | | | | | | | | | |
| *Empoasca punjabensis* | 1394 | 45 | 1900 | 1020 | 497 | 40 | 15 | 168 | 105 | 169 | 98 | – | 2003 | 8 | 1559 | 1798 | 2340 | 10 | 712 | 13881 |
| *Empoasca bostanensis* | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 | – | – | – | – | – | 2 |
| *Empoasca persicae* | – | – | 137 | – | – | – | – | – | – | – | – | – | 149 | 4 | – | 36 | – | – | | 326 |
| *Empoasca masoodi* | – | – | – | – | – | – | 6 | – | – | – | – | – | – | – | – | – | 26 | – | – | 32 |
| *Empoasca planata* | 27 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 27 |
| *Typhlocyba quettensis* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 19 | 4 | – | 23 |
| *Zyginidia quyumi* | – | – | 5 | – | – | – | – | – | – | – | – | – | – | – | 9 | 4 | 4 | – | – | 22 |
| *Amrasca devastans* | 10 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 6 | 7 | – | – | 23 |
| *Amrasca elongata* | – | – | – | – | – | – | – | – | 6 | – | – | – | – | – | – | – | – | – | – | 6 |
| *Zygina haripurensis* | 9 | – | – | – | – | – | 6 | – | – | – | – | – | – | – | – | – | – | – | – | 15 |
| *Zyginidia sawaii* | – | – | – | – | – | – | – | – | – | – | – | 1 | 34 | – | – | – | – | – | – | 35 |
| *Empoasca tabaci* | – | – | – | – | – | – | – | – | – | – | – | – | 41 | – | – | – | – | – | – | 41 |
| Total samples | 10 | 1 | 8 | 10 | 4 | 1 | 3 | 1 | 2 | 1 | 1 | 1 | 4 | 3 | 8 | 11 | 16 | 2 | 9 | 96 |
| Total leaf hoppers | 1440 | 45 | 2042 | 1020 | 497 | 40 | 27 | 168 | 111 | 169 | 98 | 1 | 2227 | 14 | 1568 | 1844 | 2396 | 14 | 712 | 14433 |

*Carrot.* It was observed most heavily infested in Baluchistan, and to a lesser extent in Punjab and Sind. Of the nine typhlocybines collected, *Empoasca punjabensis* was most abundant on the plant in general. Nymphs of the species were also collected on it.

*Chillies.* It was observed very heavily infested by leafhoppers in Punjab and Baluchistan. Of the seven species of typhlocybines collected on chillies, *Empoasca punjabensis* was the most abundant. Occasionally specimens of *Amrasca devastans* were also recorded occuring in mixed populations with *E. punjabensis,* which also breeds on the plant.

*Okra.* The plant was very seriously infested by typhlocybines almost all over Pakistan. Of the five species collec-

Table 2. Summarised table of leafhopper abundance on vegetable plants in Pakistan

| | Punjab | | | Sind | | | N.W.F.P. | | | Baluchistan | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Samples collected | Total leafhoppers | No. of species | Samples collected | Total leafhoppers | No. of species | Samples collected | Total leafhoppers | No. of species | Samples collected | Total leafhoppers | No. of species | Samples collected | Total leafhoppers | No. of species |
| Bauhinia | 4 | 306 | 1 | 1 | 240 | 1 | – | – | – | – | – | – | 5 | 546 | 1 |
| Sugar beet | – | – | – | – | – | – | 2 | 341 | 2 | 10 | 1440 | 4 | 12 | 1781 | 5 |
| Bitter-gourd | 129 | 2196 | 3 | 4 | 21 | 3 | 6 | 113 | 4 | – | – | – | 139 | 2330 | 7 |
| Bottle gourd | – | – | – | – | – | – | 1 | 67 | 1 | – | – | – | 1 | 67 | 1 |
| Brinjal | 82 | 8512 | 5 | 7 | 108 | 1 | 8 | 272 | 3 | 1 | 45 | 1 | 92 | 8937 | 6 |
| Cabbage | 2 | 11 | 1 | 1 | 1 | 1 | – | – | – | – | – | – | 3 | 12 | 2 |
| Carrot | 22 | 171 | 2 | 10 | 78 | 7 | – | – | – | 8 | 2042 | 3 | 40 | 2291 | 9 |
| Cauli-flower | 1 | 10 | | – | – | – | – | – | – | – | – | – | 1 | 10 | 1 |
| Chillies | 38 | 1167 | 2 | 2 | 10 | 2 | 5 | 31 | 5 | 10 | 1020 | 1 | 55 | 2228 | 7 |
| Cholai | 1 | 274 | 1 | – | – | – | – | – | – | – | – | – | 1 | 274 | 1 |
| Cluster-beans | – | – | – | 4 | 130 | 3 | – | – | – | – | – | – | 4 | 130 | 3 |
| Coriander | 21 | 435 | 2 | 1 | 3 | 1 | 2 | 88 | 2 | 4 | 497 | 1 | 28 | 1023 | 5 |
| Cowpea | 5 | 77 | 1 | – | – | – | – | – | – | – | – | – | 5 | 77 | 1 |
| Cucumber | 40 | 541 | 1 | – | – | – | 1 | 15 | 1 | – | – | – | 41 | 556 | 2 |
| French-beans | 8 | 456 | 1 | – | – | – | – | – | – | 1 | 40 | 1 | 9 | 496 | 1 |
| Garlic | – | – | – | – | – | – | 1 | 1 | 1 | – | – | – | 1 | 1 | 1 |
| Kulfa | 2 | 39 | 2 | – | – | – | 4 | 25 | 2 | – | – | – | 6 | 64 | 3 |
| Long-cucumber | 121 | 2788 | 1 | – | – | – | – | – | – | – | – | – | 121 | 2788 | 1 |
| Luffa | 64 | 1766 | 2 | 1 | 37 | 1 | – | – | – | 3 | 27 | 3 | 68 | 1830 | 4 |
| Frenugreck | – | – | – | – | – | – | 1 | 11 | 1 | 1 | 168 | 1 | 2 | 179 | 2 |
| Mint | – | – | – | 1 | 6 | 1 | 4 | 23 | 3 | 2 | 111 | 2 | 7 | 140 | 4 |
| Mustard | – | – | – | – | – | – | – | – | – | 1 | 169 | 1 | 1 | 169 | 1 |
| Okra | 59 | 4622 | 2 | 1 | 118 | 1 | 13 | 432 | 5 | 1 | 98 | 1 | 74 | 5270 | 5 |
| Onion | 12 | 30 | 1 | 1 | 1 | 1 | – | – | – | – | – | – | 13 | 31 | 2 |
| Pea | 5 | 55 | 2 | – | – | – | 1 | 1 | 1 | 1 | 1 | 1 | 7 | 57 | 4 |
| Potato | 82 | 1739 | 2 | 6 | 106 | 4 | 8 | 128 | 6 | 4 | 2227 | 4 | 100 | 4200 | 12 |
| Pumpkin | 237 | 6691 | 5 | 3 | 27 | 3 | 19 | 456 | 9 | 3 | 14 | 3 | 262 | 7188 | 15 |
| Raddish | 21 | 153 | 2 | 2 | 8 | 2 | 1 | 6 | 1 | 8 | 1568 | 2 | 32 | 1735 | 5 |
| Salad | 15 | 140 | 1 | – | – | – | 2 | 31 | 2 | – | – | – | 11 | 171 | 2 |
| Sesame | – | – | – | 4 | 230 | 3 | – | – | – | – | – | – | 4 | 230 | 3 |
| Spinach | 59 | 1322 | 2 | 10 | 69 | 6 | 7 | 80 | 3 | 11 | 1844 | 4 | 87 | 3315 | 10 |
| Sweet-potato | – | – | – | 1 | 14 | 1 | – | – | – | – | – | – | 1 | 14 | 1 |
| Tobacco | 75 | 2681 | 2 | – | – | – | – | – | – | – | – | – | 75 | 2681 | 2 |
| Turnip | 9 | 51 | 1 | – | – | – | – | – | – | 16 | 2396 | 5 | 25 | 2447 | 5 |
| Water gourd | 29 | 1301 | 1 | – | – | – | – | – | – | 2 | 14 | 2 | 31 | 1315 | 3 |
| White gourd | 32 | 1470 | 1 | – | – | – | 1 | 3 | 1 | – | – | – | 33 | 1473 | 2 |
| Tomato | 62 | 737 | 1 | 3 | 83 | 3 | 10 | 161 | 4 | 9 | 712 | 1 | 84 | 1693 | 6 |
| Total | 1237 | 39741 | 10 | 63 | 1290 | 16 | 97 | 2285 | 20 | 96 | 14433 | 12 | 1495 | 57749 | 39 |

ted on it, *Amrasca devastans* far outnumbered any other typhlocybine. The other less abundant species was *Empoasca punjabensis*. Both *A. devastans* and *E. punjabensis* breed on the plant all over Pakistan.

*Potato.* Potato plants were observed seriously infested by leafhoppers in Punjab and Baluchistan, and to a lesser extent in Sind and N.W.F.P. Of the twelve species collected on it, *E. punjabensis*, and *A. devastans* were the most abundant. Both the species freely breed on the host.

*Pumpkin.* Pumpkin plants were extensively infested by leafhoppers in Punjab, and to a lesser extent in other provinces of the country. Of the fifteen species of typhlocybines collected on the plant, *E. punjabensis* was the most abundant, and also breeds on it. *A. devastans* and *E. syedi* were also recorded, but in smaller numbers on the plant.

Apart from the plants discussed above, cholai, coriander, cowpea, cucumber, French beans, kulfa, long cucumber, luffa, mint, mustard, spinach, tobacco, water gourd, and white gourd were all observed heavily infested by

*E. punjabensis* in Punjab, and most of them by the same species in Baluchistan. The leafhopper infestations in Sind, and N.W.F.P. remained usually at a low level during the period of study. Whereas leafhopper species like, *E. punjabensis* and *A. devastans* were the most abundant, being approximately 70% and 22% respectively of the total typhlocybine catches on vegetable plants. The species like *Zyginidia quyumi, Austroasca ghaziensis,* in Punjab, *Empoasca bostanensis, Empoasca mardanensis, Austroasca tuberosa,* and *Austroasca viniferae* in Sind, *Byphlocyta spinosa, Empoanara ghylami, Eupteryx tuberculata, Zygina haripurensis, Zyginidia sawaii,* and *Erythroneura vinealis* in N.W.F.P. and *Empoasca bostanensis,* and *Amrasca elongata* in Baluchistan appeared to be only chance captures on vegetable plants.

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