RESPONSE OF SUNFLOWER (HELIANTHUS ANNUS L.) HYBRIDS TO POPULATION OF DIFFERENT INSECT PESTS AND THEIR BIO-CONTROL AGENTS


ABSTRACT

A study was conducted at Entomological Research Institute, AARI, Faisalabad, Pakistan during the year 2008 and 2009 to investigate response of five sunflower hybrids (FH-37, FH-331, FH-259, FH-106 and Hysun-33) to insect pests population and their bio-control agents. On the basis of two years average, sunflower hybrid FH-37 was found as comparatively resistant (1.105/leaf) to aphid (Aphis gossypii Glov.) whereas FH-259 (1.922/leaf) was found to be susceptible. All genotypes showed non-significant differences regarding jassid (Amrasca biguttula biguttula Ishida). FH-259 proved as susceptible (0.393/leaf) to whitefly (Bemisia tabaci Gen.) and did not differ significantly to Hysun-33 (0.337/leaf), FH-106 (0.154/leaf) and FH-331 (0.107). The sunflower hybrid FH-37 (0.02/plant) was found as comparatively resistant to larval population of head borer (Helicoverpa armigera Hb.) and did not differ significantly to FH-259 (0.04/plant), Hysun-33 (0.03/plant) and FH-331 (0.03/plant), except FH-106 (0.07/plant). The hybrid FH-259 showed resistance (0.003/plant) to larval population of armyworm (Mythimina separata Walk.) while FH-106 proved as susceptible (0.05/plant). Whitefly and semi-looper exerted negative and significant effect on sunflower yield while aphid, jassid, cotton bollworm and armyworm had negative but non-significant correlation with yield. Spotted beetle (Coccinella spp.) had a significant impact on population fluctuation of aphid, jassid and head borer while syrphid fly (Episyrphus balleatus) had non-significant contribution in population fluctuation of all insect pests studied.

KEYWORDS: Helianthus annuus; hybrids; insect pests; biological control agent; Pakistan.

INTRODUCTION

Sunflower (Helianthus annuus L.) is one of the most important oilseed crops. However, it acts as a host of several insects ravaging it in field as well as in

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warehouses inflicting severe losses. The injurious pests of this crop are cutworms (*Agrotis* spp.), head borer (*Helicoverpa armigera* Hb.), cotton aphid (*Aphis gossypii* Glov.), potato aphid (*Lacrosiphum euphorbiae* Thos), cabbage semi-looper (*Plutia orichalcea* F.), head caterpillar (*Tathmopoda theoris* Mayr), whitefly (*Bemisia tabaci* Gen.), yellow flower thrips (*Ankliniella sulphurea* S.) and several species of army worms, grasshoppers and termites (2, 4, 8, 12, 14, 15, 17, 18).

Insecticides are being used to control these insect pests. However, excessive and injudicious use of these chemicals results in environmental pollution, health hazards, development of resistance in insect pests against insecticides, etc. Development of resistant cultivars against insect pests is one of the most useful methods to greatly reduce pesticides use in an agro-eco-system.

Alternatives to traditional chemical insecticides such as predators, parasitoids, microbes and natural products have been gaining importance among researchers concerned with developing IPM approaches for insect control (6). Biological control is generally apparent as both providing more permanent insect control as having less latent for damage to the environment or to the non-target organism than chemical pest (10). The bio-control agents for sunflower insect pests include green lace wing, spotted beetle, syrphid fly (larvae), mantids, reduvid bugs and different spiders. Among these, spotted beetles (*Coccinella* spp.) are more important that feed on aphids, whitefly, thrips, mealy bug, scales, coleopteran and lepidopteran larvae (7, 9, 19) and also syrphid fly larvae (*Episyphris balteatus*) that feed on aphids, scales, mealy bugs and small caterpillars (13).

The aim of present study was to know the response of different cultivars of sunflower hybrids to insect pests and their correlation to bio-control agents under field conditions.

**MATERIALS AND METHODS**

This study was conducted at Entomological Research Institute, AARI, Faisalabad during spring 2008 and 2009. The seed of five hybrids of sunflower (FH-37, FH-331, FH-259, FH-106 and Hysun-33) was taken from Oilseeds Research Institute, AARI, Faisalabad and sown in RCBD. Plot size was 7.78 x 2.16m and 2.88 x 7.49m during 2008 and 2009, respectively with 25cm plant to plant and 75cm row to row distance. Planting was done by dibbling with four seeds per hill. After germination, one plant per hill was
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maintained by manual thinning. All inter-cultural practices required for sunflower crop including thinning, hoeing, weeding out, earthing up, etc. were carried out at appropriate timings. The insect pests observed on sunflower hybrids were aphids, whitefly, jassid, head borer, army worm and semilooper. The data on predator’s population of spotted beetle (grubs) and syrphid fly (maggots) were also recorded.

The data were recorded of ten randomly selected leaves per ten plants per plot for sucking insects and ten randomly selected plants per plot for larval population of insects and predators at weekly interval. The population of sucking insect pests, larval and predator’s insects was recorded for eight weeks. Sunflower plants were observed with naked eyes for counting the number of insects. The leaves were turned upward through forceps carefully for white fly and jassid, to avoid insect disturbance. After crop maturity, yield data of each hybrid were recorded. All collected data were analyzed statistically using SPSS10.01 package (1).

RESULTS AND DISCUSSION

Population of insect pests

The results (Table 1) revealed significant differences (P<0.01) among genotypes population of aphid and jassid per leaf during both years. The population of aphid and jassid was significantly higher during 2008 as compared to 2009. The hybrid FH-259 showed maximum population of aphids (3.46/leaf) during 2008 against minimum on FH-37 (0.187/leaf) during 2009. Genotype FH-106 appeared as comparatively susceptible showing maximum jassid population (1.76/leaf) during 2009. Variety FH-259 showed minimum jassid population (0.370/leaf) during 2008. However, means of both the years revealed non-significant differences. The data (Table 1) further showed non-significant differences regarding whitefly population among

<table>
<thead>
<tr>
<th>Sunflower hybrids</th>
<th>Aphid/leaf 2008</th>
<th>Means 2008</th>
<th>LSD=0.1**</th>
<th>Aphid/leaf 2009</th>
<th>Means 2009</th>
<th>LSD=0.1**</th>
<th>Whitefly/leaf</th>
<th>Means 2008</th>
<th>LSD=0.1**</th>
<th>Whitefly/leaf</th>
<th>Means 2009</th>
<th>LSD=0.1**</th>
</tr>
</thead>
<tbody>
<tr>
<td>FH-37</td>
<td>2.023c</td>
<td>0.197e</td>
<td>1.105c</td>
<td>0.910c</td>
<td>0.587de</td>
<td>0.748</td>
<td>0.043</td>
<td>0.0470</td>
<td>0.045b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FH-331</td>
<td>2.190c</td>
<td>0.567d</td>
<td>1.378b</td>
<td>0.520d</td>
<td>1.567ab</td>
<td>1.043</td>
<td>0.114</td>
<td>0.100</td>
<td>0.107ab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FH-259</td>
<td>3.460a</td>
<td>0.383de</td>
<td>1.922a</td>
<td>0.370e</td>
<td>1.147bc</td>
<td>0.758</td>
<td>0.367</td>
<td>0.420</td>
<td>0.393a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FH-106</td>
<td>3.220ab</td>
<td>0.380de</td>
<td>1.860a</td>
<td>0.420de</td>
<td>1.767a</td>
<td>1.093</td>
<td>0.122</td>
<td>0.187</td>
<td>0.154ab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hysun-33</td>
<td>3.090b</td>
<td>0.393de</td>
<td>1.742a</td>
<td>0.470de</td>
<td>1.700a</td>
<td>1.085</td>
<td>0.294</td>
<td>0.080</td>
<td>0.337a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. Value</td>
<td>28.07</td>
<td>30.94</td>
<td>8.68</td>
<td></td>
<td>2.40</td>
<td>1.84</td>
<td>2.80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Means sharing similar letter(s) do not differ significantly by DMR test.

*Significant at P<0.05. **Significant at P<0.01, NS= Non-significant.
different hybrids during both years. Means of two years showed significant difference among hybrids with maximum population of whitefly (0.393/leaf) on FH-259 against minimum on FH-37 (0.045/leaf).

Larval population of lepidopterous

The results (Table 2) revealed that maximum larval population of head borer was recorded on FH-106 (0.127/plant) during 2009 and minimum (0.01/plant) on FH-37 during 2008. Significant difference was found in case of interaction between hybrids and years regarding larval population of armyworm (Table 2). Maximum population was found on FH-106 (0.08/plant) during 2008 while FH-259 was found as comparatively resistant with minimum population of the pest during both the years (0.007 and 0.0/leaf). For population of semilooper non-significant difference was observed in case of interaction between hybrids and years whereas mean of both years showed significant difference. On mean basis FH-106 proved as comparatively susceptible (0.23/plant) while FH-37 appeared as resistant (0.06/plant).

Table 2. Larval population of lepidopterous pests on different hybrids of sunflower during 2008 and 2009.

<table>
<thead>
<tr>
<th>Sunflower hybrids</th>
<th>Head borer/plant</th>
<th>Armyworm/plant</th>
<th>Semilooper/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2009</td>
<td>Mean</td>
</tr>
<tr>
<td>FH-37</td>
<td>0.010</td>
<td>0.033</td>
<td>0.022b</td>
</tr>
<tr>
<td>FH-331</td>
<td>0.014</td>
<td>0.047</td>
<td>0.030b</td>
</tr>
<tr>
<td>FH-259</td>
<td>0.020</td>
<td>0.060</td>
<td>0.040ab</td>
</tr>
<tr>
<td>FH-106</td>
<td>0.023</td>
<td>0.127</td>
<td>0.075a</td>
</tr>
<tr>
<td>Hyson-33</td>
<td>0.017</td>
<td>0.053</td>
<td>0.035ab</td>
</tr>
<tr>
<td>F. Value</td>
<td>2.36</td>
<td>3.80</td>
<td>6.53</td>
</tr>
</tbody>
</table>

Means sharing similar letters do not differ significantly by DMR test.
*Significant at P<0.05, **Significant at P<0.01, NS: Non-Significant.

The results further showed significant variation in interaction between hybrids and years regarding spotted beetle (Table 3). FH-331 showed maximum population of spotted beetle (0.65/plant) during 2009 while FH-37 showed maximum population (0.317/plant) of spotted beetle during 2008 (Table 3) with non-significant differences among hybrids during both years. However, on mean basis non-significant differences were observed. Regarding syrphid fly, interaction of hybrids and years was non-significant including mean values.

Yield (kg/ha)

The data (Table 3) showed that hybrid FH-37 produced significantly higher yield (2070.160 kg/ha) against minimum (1642.047 kg/ha) by FH-106.

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Table 3. Population of predators per plant on different hybrids of sunflower and yield during 2008 and 2009.

<table>
<thead>
<tr>
<th>Sunflower hybrids</th>
<th>Spotted beetle</th>
<th>Syrphid fly</th>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FH-37</td>
<td>0.317bc</td>
<td>0.187c</td>
<td>0.232</td>
</tr>
<tr>
<td>FH-331</td>
<td>0.283bc</td>
<td>0.65a</td>
<td>0.468</td>
</tr>
<tr>
<td>FH-259</td>
<td>0.153c</td>
<td>0.36abc</td>
<td>0.270</td>
</tr>
<tr>
<td>FH-106</td>
<td>0.157c</td>
<td>0.56ab</td>
<td>0.398</td>
</tr>
<tr>
<td>Hysun-33</td>
<td>0.150c</td>
<td>0.49ab</td>
<td>0.322</td>
</tr>
<tr>
<td>LSD=0.27*</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>F. Values</td>
<td>2.91</td>
<td>1.91</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Means sharing similar letter(s) do not differ significantly by DMR test.
*Significant at P<0.05, **Significant at P<0.01, NS = Non-significant.

Correlation among insect pests and yield

The data (Table 4) revealed that aphid population exerted negative and significant correlation (r = -0.531) with spotted beetle, while jassid and cotton bollworm had positive and significant correlation (r = 0.608 and 0.728). Whitefly and semilooper exerted negative and significant effect on yield (r = -0.394 and -0.465). Results further revealed that population of aphid, jassid, cotton bollworm and armyworm showed non-significant correlation with yield.

Table 4. Insect-pests, predators and yield relationship in terms of correlation co-efficient (r) on sunflower hybrid.

<table>
<thead>
<tr>
<th>Insect pests</th>
<th>Spotted beetle</th>
<th>Syrphid fly</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphid</td>
<td>-0.531**</td>
<td>0.054</td>
<td>-0.216</td>
</tr>
<tr>
<td>Jassid</td>
<td>0.728**</td>
<td>0.011</td>
<td>-0.148</td>
</tr>
<tr>
<td>ABW</td>
<td>0.608**</td>
<td>-0.100</td>
<td>-0.296</td>
</tr>
<tr>
<td>Whitefly</td>
<td>-0.313</td>
<td>0.196</td>
<td>-0.394*</td>
</tr>
<tr>
<td>Armyworm</td>
<td>-0.160</td>
<td>-0.123</td>
<td>-0.185</td>
</tr>
<tr>
<td>Semilooper</td>
<td>0.133</td>
<td>0.225</td>
<td>-0.465**</td>
</tr>
</tbody>
</table>

**Significant at P<0.01, *Significant at P<0.05.

Multiple linear regressions analysis

Spotted beetle had a significant impact on population fluctuation of aphid and contributed 39.7 percent role (Table 5a) while syrphid fly exerted non-significant impact with 0.2 percent role. Similarly spotted beetle also had significant effect on population fluctuation of jassid and head borer showing 53.00 and 36.9 percent contribution, respectively. Syrphid fly showed non-significant contribution in population fluctuation of all insect pests studied.

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### Table 5. Multiple linear regression analysis along with co-efficient of determination values.

<table>
<thead>
<tr>
<th>Dependent factor</th>
<th>Regression equation</th>
<th>R²</th>
<th>Role of individual factor (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(a) Predators effect on insect pests in sunflower</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aphid/leaf</td>
<td><strong>y= 3.3109 – 2.1461x₁,</strong></td>
<td>0.397</td>
<td>39.7</td>
</tr>
<tr>
<td></td>
<td><strong>y= 2.9285 – 2.165 + 0.592 x₂</strong></td>
<td>0.399</td>
<td>0.2</td>
</tr>
<tr>
<td>Jassid/leaf</td>
<td><strong>y= 0.2243 + 1.538 x₁</strong></td>
<td>0.530</td>
<td>53.0</td>
</tr>
<tr>
<td></td>
<td><strong>y= 0.1535 + 1.537 x₂ – 0.0962 x₁</strong></td>
<td>0.531</td>
<td>0.1</td>
</tr>
<tr>
<td>American bollworm/plant</td>
<td>y=0.6381 + 1.417 x₁ – 0.0475 x₂</td>
<td>0.387</td>
<td>1.8</td>
</tr>
<tr>
<td>Whitefly/leaf</td>
<td>y=1.179 – 0.3827 x₁</td>
<td>0.098</td>
<td>9.8</td>
</tr>
<tr>
<td></td>
<td>y=0.8850 – 0.3974 x₁ + 0.4007 x₂</td>
<td>0.143</td>
<td>4.5</td>
</tr>
<tr>
<td>Armyworm/plant</td>
<td>y=0.7460 – 0.0249 x₁</td>
<td>0.026</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>y=0.760 – 0.0239 x₁ – 0.0271 x₂</td>
<td>0.039</td>
<td>1.3</td>
</tr>
<tr>
<td>Semi-looper/plant</td>
<td>y=0.7311 + 0.0741 x₁</td>
<td>0.018</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>y=0.5941 + 0.0673 x₁ + 0.1863 x₂</td>
<td>0.065</td>
<td>4.7</td>
</tr>
</tbody>
</table>

x₁ = Spotted beetle, x₂ = Syrphid fly

| **(b) Insect pests effect on yield of sunflower** | | | |
| NS               | Y=43.1411 – 0.8709 | 0.047 | 4.7 |
| **               | Y=51.0955 – 2.6330 x₁ + 4.7464 x₂ | 0.232 | 18.5 |
| **               | Y=73.2888 – 3.003 x₁ – 0.3004 x₂ | 0.354 | 12.2 |
|                  | – 32.248 x₂ | | |
| **               | Y=75.910 – 2.559 x₁ – 2.483 x₂ – 32.081 x₃ | 0.457 | 10.3 |
| **               | Y=81.2480 – 2.3501 x₁ – 2.7524 x₂ – 30.845 x₃ | 0.463 | 0.6 |
| **               | Y=80.18091 – 2.4201 x₁ – 2.558 x₂ – 30.562 x₃ | 0.607 | 14.4 |
|                  | – 11.649 x₃ | | |

| **(c) Syrphid fly effect on insect pests of sunflower** | | | |
| NS               | Y=0.7568 + 8.7224 x₁ | 0.003 | 0.3 |
| NS               | Y=0.7045 + 0.0203 x₁ + 0.0312 x₂ | 0.008 | 0.5 |
| NS               | Y=1.0210 + 0.0150 x₁ + 0.0560 x₂ – 0.4632 x₃ | 0.023 | 1.5 |
|                  | **               | | |
| NS               | Y=0.9601 + 0.047 x₁ + 0.0523 x₂ – 0.4724 x₃ | 0.058 | 3.5 |
|                  | + 0.1034 x₄ | | |
| NS               | Y=1.2457 + 0.0159 x₁ + 0.05719 x₂ | 0.068 | 1.0 |
|                  | – 0.4063 x₃ + 0.0889 x₄ – 0.4773 x₅ | | |
| NS               | Y=1.2747 + 0.0178 x₁ + 0.0519 x₄ – 0.4140 x₅ + 0.07345 x₆ – 0.8396 x₇ | 0.135 | 6.7 |
|                  | + 0.3170 x₇ | | |

| **(d) Spotted beetle effect on insect pests of sunflower** | | | |
| **               | Y=1.0887 – 0.1314 x₁ | 0.282 | 28.2 |
| **               | Y=0.5235 + 0.00624 x₁ + 0.337 x₂ | 0.531 | 24.9 |

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Table contd....

<table>
<thead>
<tr>
<th>Y = 0.21456 + 0.00608 x_1 + 0.279 x_2** – 0.567</th>
<th>3.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y = 0.1138 + 0.0231 x_1 + 0.285 x_2** + 1.0956 x_3 - 0.1712 x_4</td>
<td>4.0</td>
</tr>
<tr>
<td>Y = 0.5570 + 0.04944 x_1 + 0.2968 x_2** + 1.0956 x_3 - 0.1712 x_4</td>
<td>2.4</td>
</tr>
<tr>
<td>Y = 0.5828 + 0.05113 x_1 + 0.2922 x_2** + 1.2442 x_3 - 0.21919 x_4 + 1.4432 x_5</td>
<td>0.653</td>
</tr>
<tr>
<td>Y = 0.5828 + 0.05113 x_1 + 0.2922 x_2** + 1.2442 x_3 - 0.21919 x_4 + 1.4432 x_5</td>
<td>0.631</td>
</tr>
</tbody>
</table>

X_1 = Aphid population per leaf, X_2 = Jassid population per leaf
X_3 = Helicoverpa larval population per plant, X_4 = Whitefly population per leaf
X_5 = Armyworm population per plant, X_6 = Semilooper population per plant.

Maximum per unit change in yield (18.5%) was recorded in jassid followed by semi-looper larvae (14.4%). Helicoverpa larvae (12.2%) and whitefly population (10.3%) (Table 5b). Maximum R^2 value was recorded (0.653) when effect of all insect pests was computed together. Syrphid fly and spotted beetle were found voracious for semi-looper (Table 5c) and aphids (Table 5d) which resulted in 6.7 and 28.2 percent per unit change in their populations, respectively.

The present findings are similar to those of Rogers (17), Rogers and Salier (16) and Laurence et al. (11) who observed resistance in cultivated sunflower to leaf hopper, stem weevil and sunflower moth. These findings are also in accordance with those of Des and Thukral (5), Aslam and Rehman (3) and Ashfaq and Aslam (2) who screened the sunflower genotypes against sucking insect pests. However, these findings are partially in conformity with those of Aslam et al. (4) who reported that development of resistant cultivars is one of the most useful methods to reduce pesticides use in an agro-ecosystem. Among all hybrids, FH-37 offered minimum attack to aphid, jassid, whitefly, head borer and semilooper per leaf with maximum yield.

CONCLUSION

Hybrid FH-37 was found to be resistant against aphids, jassid, head borer, whitefly and semi-looper while FH-259 appeared as resistant to armyworm and FH-106 proved to be susceptible to insect pests of sunflower. The study further concludes that jassid and semi-looper are the most notorious pests damaging sunflower yield as compared to whitefly, cotton bollworm and armyworm. Spotted beetle tended more towards hybrid FH-331 and syrphid fly towards Hysun-33. This attraction may be due to high prey population.

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Spotted beetle significantly affected the population of aphid, jassid and American bollworm as compared to syrphid fly larvae.

REFERENCES

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