Toxicity of Herbal Insecticides on *Aphis gossypii* and Its Natural Enemy (*Aphidius colemani*) in Laboratory and Greenhouse Conditions

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***Abstract*—**This study was carried out to evaluate the toxicity of herbal and chemical insecticides on various stages of cotton aphid (aphis gossypii) and parasitoid wasp (*aphidius colemani*). The experiment was done in laboratory and greenhouse as a factorial experiment in completely randomized design with three replications. Two herbal insecticides (palizin and tondexir), one chemical insecticide (imidacloprid) and control (water) were used in 0.3, 0.6, 0.9, and 2.7 ppt (part per thousands) doses on cucumbers. Interaction effect of pesticides and concentrations on aphid and aphidius wasp were significant highly ($P<0.01$). Mortality of aphid was increased by increasing concentration and both imidacloprid and tondexir (2.7ppt) caused the highest mortality (92.1% and 91%). Laboratory results were similar to greenhouse results and imidacloprid and tondexir (2.7ppt) had the highest effect whereas palizin (0.3ppt) had the least. Various concentrations of imidacloprid had the highest effect on aphidius wasp and were significantly different from each other and also from other pesticides. Mentioned herbal insecticides are recommended to replace chemical insecticides in integrated pest management plans.

***Keywords*—**Aphidius colemani, Cotton aphid, Imidacloprid Palizin, Tondexir

I. Introduction

APHIDS are from the most important greenhouse pests and are main threat for cucumber. These insects are distinguished by double jointed paws, a pair of nail, and a pair of cornicles on 5th and 6th abdominal segments. They cause a lot of agricultural losses by rapid reproduction, sucking sap from plants, honey dew production, and preparing appropriate environment for growing fumagine fungus in case of appropriate situation [1]. Aphid is found in most of subtropical and moderate countries. In Iran also, cotton aphid is found in many regions. Some of their hosts in Iran are: cucumber, melon, cotton, hemp, egg plant, tobacco, beets, tomato, sesame, and sometimes pistachio, and citrus[3]. *Aphidius colemani* wasp is from natural enemies of cotton aphid.

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This wasp is belonging to braconidea family. Large group which includes several species that all attack to aphids and control them naturally.

Female wasp lays eggs on aphid nymphs. Wasp Larva feeds from aphid body and by maturing larva the aphid will die. *A.colemani* is used against various species of Aphis sp. and Myzus sp[4].

Development stages of A. Colemani in aphid body are egg, four larval instars, and pupa. Wasp lays its eggs in aphid's body and larva will eat from aphid body, forces nucleus to physiological changes which will lead to thick, waxy cuticle.

Since producing healthy products and reducing chemical insecticides residuals are very important for greenhouses, this study was done to determine effective concentrations of herbal compounds (palizin and tondexir) on controlling cotton aphid and possibility of using them in place of usual greenhouse insecticides

II. Material And Methods

Cucumber seeds were sown in plastic pots containing sterilized soil in greenhouse. After sufficient growth of plants, some of pots were located in bar cages to be ready for aphid growth. Cages were covered by white silk cloth to prevent escaping of insects. Primary population of aphid was collected from cucumber plants of an aphid infested greenhouse. To ensure the existence of desirable species aphids were placed in cages. After destruction of plants, they were being replaced with another plant. Wasps were bought from Alvand Company (Coupert Co. Branch) and were released in cages covered with silk cloth.

A.Laboratory tests

Bio assay test of cotton aphid was done according to Desneux method with a little change[5]. To obtain desired concentrations infected leaves with thirty 0-1 day old mature aphids were considered as experimental units and their nymphs were eliminated using small brush. 0.3 And 2.7 (ppt) concentrations of tondexir insecticide were prepared and sprayed on both sides of leaves by hand sprayer. Leaves were wetted completely by poison. After drying, leaves were located in disposable cups and cups were covered by nets to prevent immigration. 12, 24, and 36 hours after treatments, mortality amount of each cup was evaluated. After that we found 0.3 And 2.7 (ppt) concentrations are minimum and

maximum concentrations, following formulas were used to determine other concentrations:

$D=\frac{\text{Log high dose}-\text{log low dose}}{n-1}$ Log low dose-d = x_1

Log high dose - 2d = x_2

Anti logs of x_1 and x_2 were used as desired concentrations, which were 0.6 and 0.9 ppt. Obtained data were corrected using Abott and Handerson- Tilton and were analyzed using SAS program. Means were compared and classified using Duncan's multiple ranges test.

B. Bio assay tests of pest in pots

Thirty mature aphids were released in each pot and 24 hours after establishment of insects, spraying was done. Prior to spraying, color papers were placed beneath pots and on their soils.since some aphids died before 24 hours, dead numbers was calculated before spraying and therefore data were corrected using Handerson-Tilton formula.

C. Bio assay tests on natural enemy

Desneox et al. (2006) method with some changes was used in laboratory[5]. The inner surface of the test tube was covered by poison. After drying the poison, two drops of honey on a small plastic tape were placed in every tube. Thirty female wasps were released in each tube and tubes were covered by nets. Mortality amounts were measured after 12, 24, and 36 hours.

D. Greenhouse tests on parasitoid wasps

At first, some infected pots were selected and different mature aphidiuces were released in each pot. At the bottom of pots and also on their soils color papers were used to easier counting of mortalities. After that, spraying was done and after 12, 24, and 36 hours dead wasps were count.

III. Results

A. Effect of insecticides on mature aphids in laboratory and greenhouse

After 12 hours, the highest mortality in laboratory was belonging to 2.7ppt of imidacloprid (16.95%) and tondexir (16.77%) but they were not different significantly (P<0.05). Also, the same pesticides had the highest mortality (15.1% and 14.3%) in greenhouse. Palizin (0.3, 0.6 and 0.9ppt) had the least mortality in both stages. After 24 hours, imidacloprid (2.7ppt) had the highest mortality (90.13%) in laboratory. Tondexir (2.7ppt) was in next place (86.4%). In greenhouse, imidacloprid and tondexir (2.7ppt) caused the highest mortalities (87.3 and 85.23%) but were not different at 5% probability level. For this period, palizin (0.3 and 0.6 ppt) had the least mortality (14%). After 36 hours, in laboratory imidacloprid and tondexir (2.7ppt) with 92.13 and 90.2% had the highest effect. Also, in greenhouse imidacloprid and tondexir (2.7ppt) with 92.1 and 91% had the highest effect. After those, palizin (2.7ppt) in laboratory and pots caused the highest mortality (64.26% and 61.46%, respectively) which was different from other treatments at 5% probability level. The least mortality (21.96%) was belonging to palizin 0.3ppt. Control was significantly different from other treatments and was located in separate statistical group (P<0.05).

B. Effects of insecticides on mature insects of A.Colemani in laboratory and greenhouse

After 12 hours in laboratory, imidacloprid 2.7 and 0.9 (ppt) caused the highest mortality (76.88 and 74.54%). 0.6 and 0.3(ppt) concentrations of imidacloprid were in next place. Among herbal insecticides, tondexir (2.7ppt) caused the highest mortality (21.33%). In greenhouse, imidacloprid (2.7ppt) had the highest effect (75.33%) and palizin (0.3ppt) had the least (7.63%). After that, imidacloprid (0.9, 0.6, and 0.3 ppt) had next mortalities (70.56, 63.13, and 52.7%, respectively) and showed significant differences (P<0.05). Among herbal insecticides which were highly different from imidacloprid, tondexir (2.7ppt) had the highest effect (20.53%). After 24 hours, imidacloprid 2.7ppt had the highest effect (100%) and was placed in a group solely. Imidacloprid (0.9 and 0.6 ppt) were in the next place (94.13 and93.51%) without significant difference. Imidacloprid (0.6 and 0.3 ppt) were located in next group with 90 and 89.33% mortality. The least mortality in laboratory (10.93%) and greenhouse (11.5%) were belonging to palizin (0.3 ppt). The highest mortality of herbal insecticides in laboratory (47.3%) and greenhouse (45.06%) was observed in tondexir 2.7ppt.

After 36 hours in laboratory, imidacloprid (2.7, 0.9 and 0.6ppt) showed 100% mortality. In greenhouse, these concentrations caused 100, 100, and 98% mortality, respectively. The least effect (17.3%) was belonging to palizin (0.3 ppt). The highest mortality of herbal insecticides in laboratory (29.26%) and greenhouse (27 %) were belonging to tondexir (2.7 ppt). control was different from all other treatments at 5% probability level and was located in a separate statistical group (p<0.05).

IV. Discussion

Pinho studied effect of imidacloprid on *Trichogrammchilonis*, *Chelonusblackburni, and Braconhebetor* parasitoid wasps and showed that it had intermediate effect on *C.blackburni* with 56% mortality and had toxic effect on *B.hebetor* with 70% mortality but didn't affect *T.chilonis* (17.8%)[6] . In this study, imidacloprid had the highest effect on natural enemies. Shaaya studied effects of imidacloprid ,methamidophos, stamipride and diafenthiuron on some insect species including cicadas, thrips, whitefly, ticks, spiders and wasptles in farm[7] . According to their results, all insecticides affected all insects and caused high amounts of mortality. Among these insecticides, imidacloprid had the highest effect on cicadas, thrips, and whitefly which was in agreement with our results. Banimiri (2008) studied effects of three concentrations of palizin (1.5, 2.5, and 5 g/lit) with metasystox (1 ml/lit) on cotton aphid of cucumber in greenhouse, and showed that chemical and herbal insecticides didn’t have significant difference[2]. The highest and the least mortalities caused by palizin were obtained in 2.5 and 1.5 g/ lit of this poison. He proposed that 25 g/lit concentration of palizin

were appropriate for aphid of greenhouse but in our study 2.7ppt concentration of palizin had high effect on aphid.

Considering the results, we can conclude that mortality has increased by concentration increasing so that the highest mortality was obtained by imidacloprid and tondexir 2.7ppt which were not different significantly. It shows that both insecticides can be used against aphid cotton but due to effects of imidacloprid on parasitoid wasp, it is not suitable for integrated pest management. Also, studied herbal insecticides didn't have high negative effects on wasp and can be used for biological control in IPM plans. These insecticides can be appropriate replacement for chemical insecticides due to low risks for natural enemies of pest, producers, and consumers.

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