

# The Effect of Some Biorational Insecticides on Cotton Aphid (*Aphis Gossypii*) in Laboratory and Greenhouse Conditions

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**Abstract** – *Aphis gossypii* is one of the most important pests of vegetables especially green house cucumber. In this study, the sensitivity of mature aphids in laboratory and also nymph and matured insect in green house was evaluated. Sensitivity was measured against buprofezin, pyriproxyfen, flufenoxuron, azadirachtin, and pymetrozine. Bioassay method was spraying pesticide on insects. In green house, mentioned insecticides were used as five treatments of a completely randomized design (500, 100, 60, 44 and 2500 ppm, respectively) with three replications. Each experimental unit had three pots of same age plants of cucumber. In bioassay method,  $LC_{50}$  of insecticides were determined as 23.88, 55.43, 48.41, and 2.9 ppm, respectively for buprofezin, pyriproxyfen, flufenoxuron, azadirachtin, and pymetrozine. The highest and the least mortality of nymphs were belonging to pymetrozine (95.78%) and buprofezin (55.05%). For matured insects, these amounts were pymetrozine (94.94%) and pyriproxyfen (56.41%). According to results, using pymetrozine in green house will control Cotton aphid.

**Keywords** – Cotton Aphid, Bioassay, Buprofezin, Pyriproxyfen, Flufenoxuron, Azadirachtin, Pymetrozine.

## I. INTRODUCTION

Cotton Aphid is one of the common pests of plants which weaken plants by feeding from their latex and reduces their yield. This insect also produce honeydew production and virus transferring which is really a problem in green house [1,2]. Many chemical and non chemical methods have been used for controlling this pest. But due to high usage of pesticides, some reports have been announced about resistance of pest against organic phosphorus pesticides, carbamates, and artificial pyrethroids [3,4]. Biorational pesticides are from third generation pesticides which are commonly in nature or sometimes are made from artificial materials. Therefore, they have low toxicity, side effects, slightly toxic residues

in the environment, and have little cytotoxic effects on natural enemies of aphids [5]. Pyriproxyfen is a growth regulator for insects which prohibits their evolution and transformation with impaired juvenile hormone balance. Buprofezin is from chitin synthesis inhibitors and causes molting disorders. Therefore, insect will die because of unsuccessful molting [6]. Alich and Ahmadi reported considerable mortality of second instar larvae of cottony cushion scale (*Icerya purchasi*) and disorders in the formation of adults and their spawning due to pyriproxyfen [7]. Kernes and Stewart reported also reduction in reproduction and existence of cotton aphids on leaves treated with pyriproxyfen and buprofezin. Flufenoxuron is a chitin synthesis inhibitor and a contact-alimentary pesticide which kills larvae in time of molting. This compound affects pests of fruit trees, vegetables and ornamental plants [8]. Sadeghi and coworker investigated the sensitivity of pea cotton aphid (*Acyrtosiphon Pisum*) against some biorational pesticides with artificial diet. It was found out that flufenoxuron, pyriproxyfen, and azadirachtin had strong effects and reduced 50% of cotton aphid population [9]. Reda reported increase in mortality of cotton worm (*Spodoptera Littoralis*) by flufenoxuron [10]. Azadirachtin is completely natural and its effective materials are extracted from neem. This compound is feeding inhibitor and its effect is generally alimentary. It also has ecdyson-like property which interferes insect molting and produce incomplete mature insects Santos and coworker studied azadirachtin effects on Cotton Aphid [11]. Their results showed that this matter caused 60 and 100% nymphal mortality in two high concentrations. Besides causing mortality, this compound reduced reproduction and survival. Pymetrozine pesticide doesn't have impact effect and is not poisonous for insect directly but stops its feeding rapidly and without return. Of course, this is because of prohibition stylet penetration in plant tissues Tebasian studied sensitivity of *Aphis*

*Gossypii* against this pesticide [12]. Considering that Cotton Aphid is from important green house pests and because of resistance of this insect to many pesticides and also desirable results of biorational pesticides in controlling this pest, killing effects of buprofezin, pyriproxyfen, flufenoxuron, azadirachtin, and pymetrozine were studied in this research and also,  $LC_{50}$  amounts of these pesticides were determined.

## II. MATERIALS AND METHODS

### 2.1. Cotton aphid bioassay:

Cotton aphids were collected from green houses of Yazd abad and Baharan city in Isfahan province and were transferred on 3-4 leaves cucumber plants (green magic variety). Infected pots were located in cages (100×100×100cm). For ensuring infection some female Cotton aphids were located by brush in each pot randomly and were kept in a green house with  $26 \pm 2^{\circ}$  temperature,  $75 \pm 5\%$  relative humidity, and 16:8 photo period (L:D). In bioassay experiment buprofezin, pyriproxyfen, flufenoxuron, and pymetrozine were evaluated. In primary test, eight concentrations of each poison were selected considering their recommended concentrations and then those which caused mortalities from 10 to 90% were used in final test. Laboratory bioassay tests were done with mature Cotton aphids using Herron and coworker method. At first, cucumber leaves were cut in size of Petri dishes with 75 mm diameter and for saving moisture were located on agar (3mm) [13]. After agar fixation, ten mature one day old cotton aphids were transferred on leaves were cut and then solutions were sprayed from 20 cm distance. Petri dishes were covered by nets for avoiding Cotton aphids running. Dishes were located in incubator with  $26 \pm 2^{\circ}$ c and 6% relative humidity for 48 hours. After that, dead insects were count. This experiment was done for each treatment separately with for treatments and four replications. In green house, following treatments were sprayed in a completely randomized design with three replications: Buprofezin: 1.25 ml/lit (100ppm), pyriproxyfen: 750 ml/ha (60ppm), flufenoxuron: 0.5 ml/ lit (500ppm), azadirachtin: 2.5 ml/ lit (2500ppm), and pymetrozine: 0.5 kg/ha (44ppm) (five treatments and control). Each replication had three pots in same age. The number of dead nymph and mature insects were count three and seven days after spraying and the number of live nymphs and mature insects were count 14 and 21 days after spraying. In all experiment insects with brown shrunked bodies or those who didn't show any movement by brush stimulating were known as dead.

### 2.2. Analysis

Obtained data were analyzed using SAS program and means were compared using Duncan's multiple ranges test at 5% probability level. In green house tests, mortality percentage of nymphs and matured insects were corrected with Henderson- Tilton formula and normalized using Arc sin  $\sqrt{x}$  method. In bioassay tests, lethal concentration ( $LC_{50}$ ) was determined using linear regression for 50% of population. Preprobit software was used for probit analysis and graphs were drawn using Excel program.

## III. RESULTS AND DISCUSSIONS

### 3.1. Bioassay test

By probit analysis of Cotton Aphid bioassay with buprofezin, pyriproxyfen, flufenoxuron, and pymetrozine pesticides,  $LC_{50}$  amount of mature insects were measured as 23.88, 55.43, 48.41, and 2.9 ppm, respectively. Sattar et al. (2008) reported 386 ppm as  $LC_{50}$  amount of buprofezin and Qingyun observed 21.7, 38.86, 43.3, and 4.2 ppm for omethoate, phoxim, triazophos and imidacloprid. Differences can be ascribed to different host plant and therefore various feeding and sometimes difference in photoperiod. Also, it can be because of poison, poison auxiliary materials, factory, synergistic ingredients, method of bioassay test or internal factors like genus, size, age, species, growth stage, resistant or sensitive colony, or external factors including temperature, moisture, chemical materials of test, purity of materials, additives or formulation. Dose-response graph was drawn for buprofezin, pyriproxyfen, flufenoxuron, and pymetrozine pesticides. Considering the results, the highest sensitivity of mature insects was against pymetrozine.

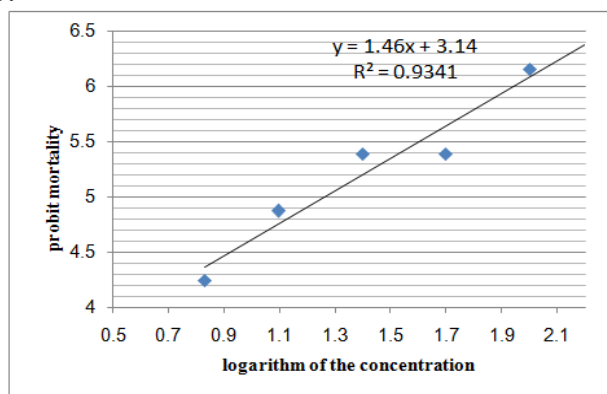


Fig.1. Linear regression of probit mortality of *Aphis gossypii* treated with buprofezin in the lab.

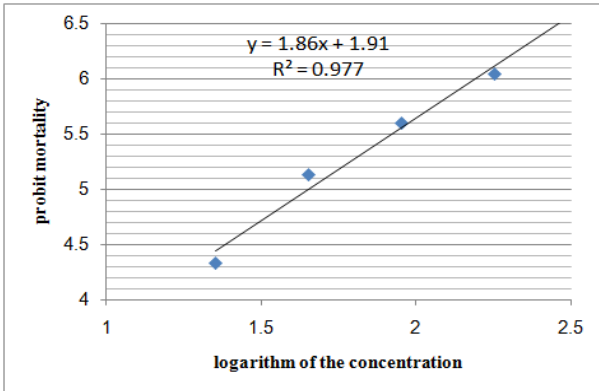


Fig.2. Linear regression of probit mortality of *Aphis gossypii* treated with pyriproxyfen in the lab

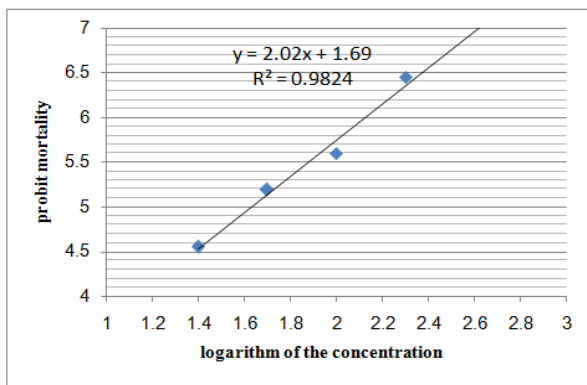


Fig.3. Linear regression of probit mortality of *Aphis gossypii* treated with flufenoxuron in the lab

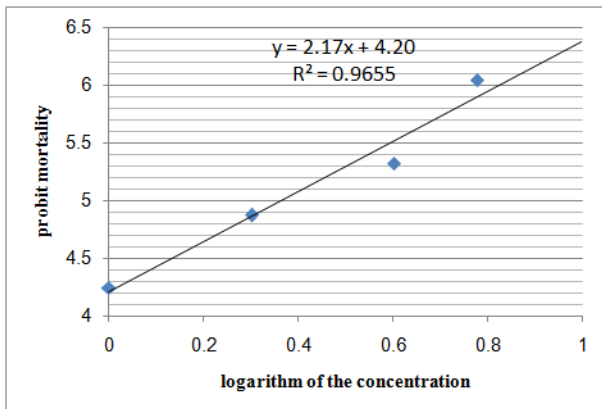


Fig.4. Linear regression of probit mortality of *Aphis gossypii* treated with pymetrozine in the lab

Mortality of matures was increased by higher concentrations of pesticides and following results were obtained: 25, 55, 72.5, and 85% loss for 22.5, 45, 90, and 180ppm of pyriproxyfen; 32.5, 57.5, 72.5, and 92.5% loss for 25, 50, 100, and 200 ppm of flufenoxuron; 22.5, 45, 65, and 87.5% for 6.75, 12.5, 25, 50, and 100ppm of buprofezin; and finally 22.5, 45, 62.5, and 85% for 1, 2, 4, and 6ppm of pymetrozine ( $P < 0.05$ ).

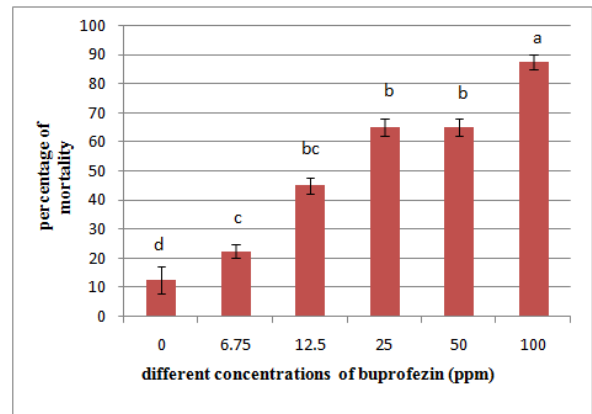


Fig.5. The percentage of mortality of mature *Aphis gossypii* in the effect of different concentrations of buprofezin 48 hours after treatment

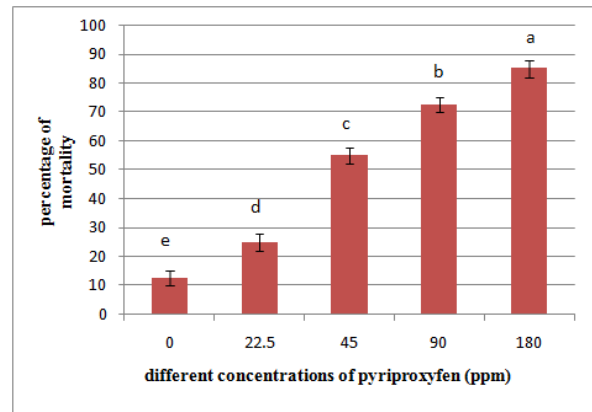


Fig.6. The percentage of mortality of mature *Aphis gossypii* in the effect of different concentrations of pyriproxyfen 48 hours after treatment

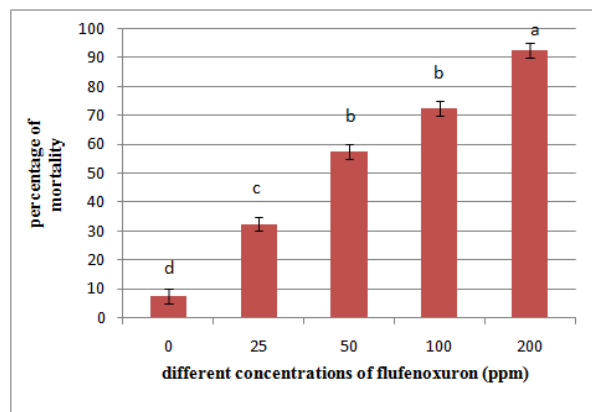


Fig.7. The percentage of mortality of mature *Aphis gossypii* in the effect of different concentrations of flufenoxuron 48 hours after treatment

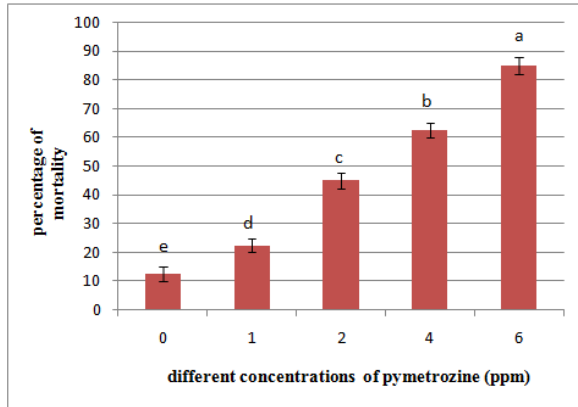


Fig.8. The percentage of mortality of mature *Aphis gossypii* in the effect of different concentrations of pymetrozine 48 hours after treatment

### 3.2. Green house experiments

Results of various samplings in green house showed significant difference between various treatments and control ( $P < 0.05$ ). The highest average nymphal mortality among whole days (3, 7, 14, and 21) was belonging to pymetrozine (95.78%) whereas buprofezin had the least amount (55.05%) and were determined as 76/61, 57/22 and 78/8%, respectively for flufenoxuron, pyriproxyfen and azadirachtin.

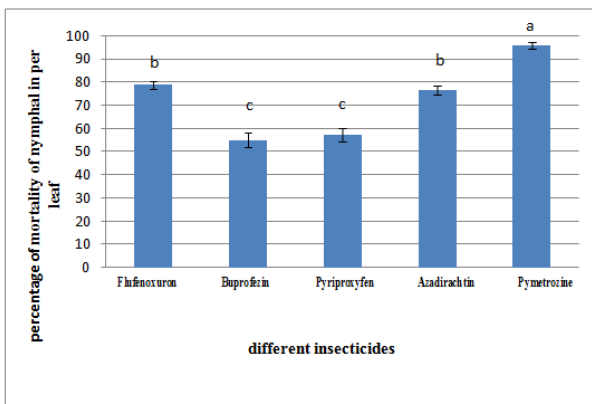


Fig.9. The average of percentage of mortality of nymphal *Aphis gossypii* in the entire experimental period, after treatment with recommended dose of buprofezin, pyriproxyfen, flufenoxuron, azadirachtin, and pymetrozine in per leaf

The highest mature mortality was belonging to pymetrozine (94.94%) and pyriproxyfen had the least percentage (56.41%) and were determined as 66/14, 61/22 and 80%, respectively for flufenoxuron, buprofezin and azadirachtin.

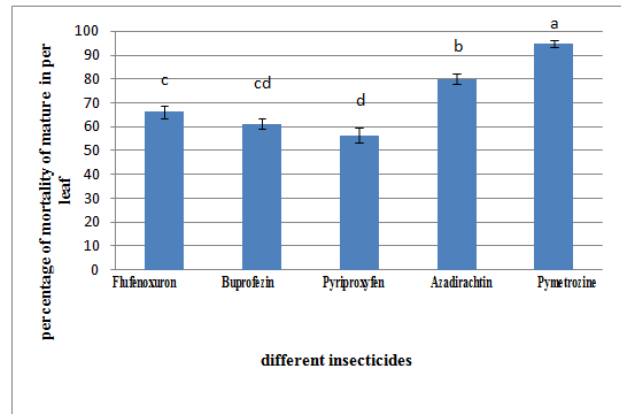


Fig.10. The average of percentage of mortality of mature *Aphis gossypii* in the entire experimental period, after treatment with recommended dose of buprofezin, pyriproxyfen, flufenoxuron, azadirachtin, and pymetrozine in per leaf

The results were not in agreement with Kernes and Stewart for pyriproxyfen, Sattar for buprofezin and pyriproxyfen, Ranaei for pymetrozine and Zhao for deltamethrin. Differences can be ascribed to different host plant and therefore various feeding and sometimes difference in photoperiod [8,9]. Also, it can be because of poison, poison auxiliary materials, factory, synergistic ingredients, method of bioassay test or internal factors like genus, size, age, species, growth stage, resistant or sensitive colony, or external factors including temperature, moisture, chemical materials of test, purity of materials, additives or formulation. These amounts of mortality in treatments can be due to inappropriate coverage of pesticide [14,9]. Although, we tried to cover host plant totally, some nymphs which were behind leaves especially in lower leaves, were safe from direct effect of poison and had less mortality. Also, nymphal skin prohibited entrance of experimental materials. Nymphs which were exposed directly were observed on leaves surface with brown color and dehydrated body. This is probably because of lack of chitin synthesis or fixation of it in nymphal skin [15]. On the whole, we can conclude that pymetrozine can control cotton aphid very well in green house. By using this pesticide, population of insect will be lessened and pest will be controlled finally. More studies are inevitable to determine whether obtained results are from intrinsic effects of mentioned pesticide or because of selecting resistant insects which have generally less reproduction rate.

## REFERENCES

- [1] P.L. Lo, S.J. Bradley, V.C. Murrell, "Evaluation of organically-acceptable pesticides against the green peach aphid (*Myzus persicae*).", New Zealand Plant Protection journal, vol. 5(1), 1999, pp: 75-79.

- [2] L. Saninno, F. Porrone, C. Biondani, M. Contiero, A. Cersosimo, "Control of tobacco aphids by means of spray." *Il tabacco*, vol. 8, 2000, pp:15-20.
- [3] G.B. Wilde, R.A. Shufran, S.D. Kindler, H.L. Brooks, P.E. Sloperbeck, "Distribution and abundance of insecticide resistance green bugs (Homoptera: Aphididae) and validation of a bioassay to assess resistance". *Journal of Economic Entomology*, vol.94, 2001, pp:547-551.
- [4] K.Y. Wang, X.B. Kong, X.Y. Jiang, M.Q. Yi, T.X. Liu, "Susceptibility of immature and adult stages of *Trialeurodes vaporariorum* (Hom: Aleyrodidae) to selected insecticides." *Journal of Applied Entomology*, vol. 127, 2003, pp: 527-533.
- [5] K. Etebari, J. Jalalisandi, "Growth regulators in insects." *Gilan journal*, vol. 2, 2000, pp:100-193.
- [6] M.S. Emami, "The effect of juvenile hormone of pyriproxyfen on first instar nymphs of pear psylla (*Psylla pyricola*)." *Proceeding of the second applied biology*, vol. 5, 2004, pp: 52-56.
- [7] M. Alich, A. Ahmadi, "The effect of two regulator material on insect growth, buprofezin, pyriproxyfen on cottony cushion scale (*Icerya purchasi* Maskell)." *Agricultural Science and Technology Journal and Natural Resources*, vol. 3: 2008, pp:75-83.
- [8] D. Kernes, S.D. Stewart, "Sublethal effect of insecticides on the intrinsic rate of increase of cotton aphid." *Experimental and Applied Entomology*, vol. 94: 2000, pp: 41-49.
- A. Sadeghi, E.J.M. Damme, G. Smaghe, "Evaluation of the susceptibility of the pea aphid, *Acyrtosiphon pisum*, to a selection of novel biorational insecticides using an artificial diet." *Journal of Insect Science*, vol. 9, 2009, pp: 60-65.
- [9] F. Reda, A. Bakri, M. Nehad, M.F. baky, M.H. Abd Elaziz, "Effect of Chitin synthesis inhibitors (flufenoxuron) on some biological and biochemical aspects of the cotton leaf worm *Spodoptera littoralis* Bosid (Lepidoptera: Noctuidae)." *Journal of biological Science*, vol. 2 (2), 2010, pp: 43- 56
- [10] T.M. Santos, N.P. Costa, A.L. Torres, A.L. Junior, "Effect of neem extract on the cotton aphid." *Agriculture* vol. 39, 2004, pp: 1071-1076.
- [11] C.R. Fluckiger, H. Kristinsson, R. Senn, A. Rindlisbacher, H. Buholzer, G. Voss, "A Novel Agent to Control Aphids and Whiteflies." *Pest and Diseases*, vol. 1, 1992, pp: 43-50.
- [12] G. Herron, K. Powis, J. Rophail, "Baseline studies and preliminary resistance survey of Australian populations of cotton aphid *Aphis gossypii* Glover (Hemiptera:Aphididae)." *Australian Journal of Entomology*, vol. 39, 2000, 33-38.
- [13] M.L. Richardson, D.M. Lagos, "Effect of juvenile hormone analog, pyriproxyfen, on the apterus form of soybean aphid *Aphis glycine*." *Journal of Applied Entomology*, vol. 131, 2007, pp: 297- 302.
- [14] A.L. Simmons, L. Williams, T.J. Dennehy, L. Antilla, "Investigations of two IGRS against Arizona whitefly population." *Proceeding Beltwidw*. Vol. 3, 1997, pp:23-29
- [15] Allen M, Lau CY (2008). Social impact of preventive HIV vaccine clinical trial participation: A model of prevention, assessment and intervention. *Social Science & Medicine*, 66(4): 945-95.