TOXICITY OF SEVERAL INSECTICIDES TO WHITE PEACH SCALE, *PSEUDAULACASPIS PENTAGONA* TARGIONI (HEMIPTERA: DIASPIDIDAE)

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ABSTRACT: White peach scale, *Pseudaulacaspis pentagona* Targioni, as a common pest of peach, has become the most important pest of peach in Iran. We tested the effect of five insecticides including, diazinon, azinphosmethyl, chlorpyrifos, methoxyfenozide, spinnosad and mineral oil on the adult stage of white peach scale. Experiments were done under laboratory conditions (22 ± 2 °C and 60 ± 5 % RH). Toxicity of various insecticides to *P. pentagona* was assessed by dipping method (infested branches to scale dipping in solutions of insecticides for 10 S). In all treatments, the mortality percentage was determined after 24 h. Bioassay results showed that chlorpyrifos had high toxicity on white peach scale. The LC_{90} values were 11636.94, 12243.03, 14181.02, 17254.60, 21603.60 and 30954.77$_{ppm}$ for chlorpyrifos, diazinon, azinphosmethyl, mineral oil, spinosad and methoxyfenozide, respectively. Mineral oil had the moderate toxic effect on *P. pentagona;* thus the use of mineral oil to prevent the build-up of the pest population could be a useful alternative to other insecticides or mixed with them because of its least adverse effects on human and environment.

KEY WORDS: *Pseudaulacaspis pentagona*, mineral oil, insecticides, environment.

White peach scale, considered as a key pest of world gardens, is a polyphagous scale insect with a world wide distribution (Crause, 1990; Abbasipour, 2007). This scale is a serious pest of peach orchard, and its damage occurs on trunks and branches of the host plants (Kuitert, 1967). *Pseudaulacaspis pentagona* overwinters as fertile females and ovipositing females (Duyn & Murphey, 1971; Trencheva, 2004). Diverse methods including sex pheromones traps and natural enemies, has been utilized for decreasing of the pest population (Rosen, 1973; Heath et al. 1979; McLaughlin, 1990; Uygun & Elekcioglu, 1998; Erler & Trunc, 2001). Besides these methods, insecticides application is common tactic in controlling of white peach scale but population suppressing of this pest by this tool is difficult because the scales protect themselves very effectively with their hard and waxy armor (Duyn & Murphey, 1971; Draga, 2005). Duyn and Murphey (1971) studied the effect of several insecticides on controlling of *P. pentagona* population so that ethion plus oil and parathion plus oil were reported very effective when applied to crawler stage. Alternative control methods and new selective compounds that are less disruptive to beneficial arthropods are needed for an effective pest management program.

The adaptation of integrated pest management (IPM) often requires the integration of biologically based on controls with chemical pesticides (Rongai et al. 2008) because broad spectrum insecticides, especially organophosphates, are extremely toxic to non target organisms including natural enemies. An alternative in the management of scale pest consists of application of oil spray (Moretti et al. 2002). Mineral oil spray has been used for many centuries in agriculture for pest control (Najar-Rodriguez et al. 2008). They seem to be promising insecticides for IPM program because they have high toxicity on insects and very low on vertebrates (Mensah et al. 2005). The mineral oil is usually less toxic to natural enemies than conventional insecticides (Yang et al. 2006). Oil molecules degrade relatively quickly by microbes, oxidation to harmless molecules (Yang et al. 2006). In recent years, the toxicity of insecticides to humans and wildlife has caused much public concern and led to use of safe chemical materials for pests control (Nicoli, 2008).

In current study, efficacies of diazinon, azinfosmethyl, chlorpyrifos, methoxyfenozide, spinosad and a mineral oil were assessed against *P. pentagona* under laboratory conditions.

MATERIALS AND METHODS

Pieces of peach branches covered by white peach scales in adult stage were obtained from peach orchard in Sari region, Mazandaran province, Iran. The infested branches were transferred to laboratory and experiments were done on branches at the same day under laboratory conditions (22 ± 2 °C and 60 ± 5 % RH). Treatments applied in bioassays were consisted of diazinon (Diazinon®) 4000, 5000, 6000, 7000 and 8000_{ppm}, azinophosmethyl (Gusathion M®) 3000, 4000, 5000, 6000 and 7000_{ppm}, chlorpyrifos (Dorsban®) 2000, 3000, 4000, 5000 and 6000_{ppm}, spinosad (Tracer®) 2000, 4000, 6000, 7000 and 8000_{ppm}, methoxyfenozide (Runner®) 2000, 3000, 4000, 5000 and 7000_{ppm} and mineral oil (Volk®) 4000, 5000, 6000,7000 and 8000_{ppm} and distilled water as a control. Five concentrations of each chemical and three to five replicates at different days were used in all experiments. Toxicity of various insecticides to *P. pentagona* was assessed by branches (infested branches to scale) dipping in different solutions of insecticides for 10 s. Treated branches were transferred to Petri dishes (9 cm in diameter). The mortality percentage was determined after 24 h. The data were analyzed using the probit procedures with SPSS for Windows® release 13.0 (SPSS Institute, 2004).

RESULTS AND DISCUSSION

The results of LC_{50} and LC_{90} estimations for white peach scale are shown in Table 1. In current study, methoxyfenozide had the least toxic effect (LC_{90} = 30954.77 ppm) and chlorpyrifos had highest toxic effect (LC_{90} = 11636.94 ppm) to the white peach scale in adult stage. At all, the toxicity of insecticides on the white peach scale was less than their toxicities on other insects. Based on the estimated LC_{90}, the toxicities of all insecticides tested can be rated in following order chlorpyrifos> diazinon>azinphosmethyl> mineral oil> spinosad> methoxyfenozide (Table 1). Our results were similar to Duyn & Morphey (1971) findings. They declared that the chemical control of *P. pentagona* in adult stage is very difficult.

The toxicity of commercial insecticides to white peach scale has been studied by several workers. For example, Kuitert (1967) tested six insecticides against *P. pentagona*. Diazinon plus oil and Ethion plus oil had high toxicity to white peach scale at crawler and immature stages of pest. Findings of Hill et al. (2006) showed that buprofezin was effective for controlling of white peach scale at crawler stage.

Management of the white peach scale is very difficult, because the scales protect themselves very effectively with their hard and waxy armor. Sometimes, the female offspring sheltering under their mother armor, thus making some heavy infestations consist of layers of the scales (Kuitert, 1967; Hamon, 1983). Thus the control of white peach scale in adult stage was required to high concentration of insecticide, that it is detrimental to the ecosystems and serious consequences for the human health and the environment. Control methods are often best directed at the crawler stages which are the most vulnerable (Bobb et al. 1973). Traditional methods of white peach scale control have included various insecticidal oils as well as a number of other insecticides (Hamon, 1983). According to findings of Hill et al. (2006), chemical control of white peach scale in adult stage is difficult. They suggested that, for sufficient control of the pest, insecticide applications must employ during dormant period and in crawler stage of scale at the first generation. Over the past few years, information has continued to accumulate that modern formulation superior spray oils are safe and effective means of controlling a wide range of arthropod pest such as scales, mites, whitefly, mealybugs, aphids, psylla, and fruit-feeding Lepidoptera (Davidson et al. 1991; Coll & Abd-Rabou, 1998; Mensah, 2005; Najar-Rodriguez, 2008). The mineral oil alone may be an efficient means of controlling *P. pentagona* in peach, since oil is virtually non-toxic to human and has little impact on the wide range of predator and parasite insects (Coll & Abd-Rabou, 1998; Yang et al. 2006). Coll & Abd-Rabou (1998) were evaluated the effects of oil emulsion spray on *Parlatoria ziziphi* Lucas and three associated parasitoid species on grapefruit, *Citrus paradise*. Oil spray was highly toxic to black parlatoria and had the low toxicity to its parasitoid, *Encarsia citrina*. The mineral oil is desirable when dealing with the problems of pest resurgence, secondary pest outbreaks, and insecticide resistance. Mineral oil don't have a quick knockdown effect (versus synthetic insecticides), thus farmers don't consider oil for controlling of pests when their economic threshold are reach. Although the use of mineral oil enhanced the risk of phytotoxicity, but the most accumulation of white peach scale on peach trees is on trunks and main brunches, then high concentration of mineral oil can be utilized on trunks and branches. Also, the risks of acute phytotoxicity will decrease when oil treatment is applied in dormant season. According to Sadof & Sclar (2000) the use of mineral oil on euonymus scale at dormant season gave the high level of control than mobile stages of the insects during the summer. Bobb et al. (1973) reported that the application of two dormant oil treatments at two week intervals were effective for controlling of white peach scale. Consequently, in current study we find that mineral oil had the moderate toxic effect on *P. pentagona;* thus the use of mineral oil to prevent the build-up of the pest population could be a useful alternative to other insecticides or mixed with them.

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Table 1. Toxicity of some insecticides to *Pseudaulacaspis pentagona* in laboratory conditions.

Insecticide	**n**	**LC_{50}**	**95% CL**	**LC_{90}**	**95% CL**	**X^2**	**df**	**Slope±SE**
Methoxyfenoizide	296	2473.55	774.38-3361.00	30954.77	12644.62-47763.96	0.695*	3	1.17 ± 0.42
Spinosad	304	4225.73	3153.97-5287.07	21602.60	13020.83-79497.85	1.787*	3	1.80 ± 0.42
Mineral oil	369	5260.86	4165.28-6046.24	17254.60	11132.64-106787.64	2.925*	3	2.48 ± 0.78
Azinphosmethyl	305	4132.39	2904.63-4877.79	14181.02	9399.68-64251.38	0.112*	3	2.39 ± 0.71
Diazinon	347	4824.78	4014.29-5404.11	12243.03	9363.53-24479.49	0.180*	3	3.17 ± 0.742
Chlorpyrifos	340	3292.18	2569.55-3893.30	11636.94	7939.05-31823.27	1.067*	3	2.33 ± 0.56

* No significant at P< 0.01