EVALUATION OF SOME PLANT EXTRACTS AND CONVENTIONAL INSECTICIDES AGAINST *TRIALEURODES VAPORARIORUM* (WESTWOOD) (HOMOPTERA: ALEYRODIDAE) IN GREENHOUSE CONDITION

Mahsa Dehghani*, Kamal Ahmadi* and Hadi Zohdi**

* Department of Plant Protection, Faculty of Agriculture, Shahid Bahonar University of Kerman, Kerman, IRAN. Member of Young Researchers Society, Shahid Bahonar University of Kerman, Kerman, IRAN. E-mail: Mahsa.d6614@yahoo.com
** Department of plant protection, Agricultural and Natural Resources Research Center of Kerman, Kerman, IRAN.

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ABSTRACT: The influence of methanolic extracts (at 80 mg/mL) of *Melia azedarach* L. (Meliaceae) and *Peganum harmala* L. (Zygophyllaceae) as well as commercial insecticides (at the maximum label-recommended rate) were conducted against pupa of *Trialeurodes vaporariorum* westwood (Aleyrodidae) in greenhouse. The plant extracts and the insecticides were sprayed on the plants with the maximal amount of pupa (*Ca.* 90%). The control plants were treated with the distilled water. During two steps, the numbers of adult emergence were recorded. All the chemical products have exhibited significantly reduction effect on mean numbers of adult emergence as compare with the control treatments. The extracts of *M. azedarach* and *P. harmala* had the most effects on decrease percentage of adults population as compared with neem oil, abamectin and acetamiprid in the first record with a mean of 92.21% and 90.26%, respectively. The highest mean reduction percentage of the population was calculated in the *P. harmala* treatments (92.21%) during the last record.

KEY WORDS: *Trialeurodes vaporariorum*, methanolic plant extract, *Melia azedarach*, *Peganum harmala*, commercial insecticides, adults population.

The greenhouse whitefly, *Trialeurodes vaporariorum* westwood is a serious pest of various vegetable and ornamental crops in greenhouse (Gerling, 1990). Whiteflies damage the plants through direct sap feeding (Russell, 1977), honeydew excretion and transmission of some plant pathogenic viruses (Wisler et al., 1998). Mostly, these insect pests are controlled by synthetic insecticides. Such reliance is expected to lead to increased tolerance or the development of resistance in addition to the adverse effects on non target organisms (Palumbo et al., 2001).

To minimize the above problems, organic or botanical compound might be affected control of population of the pests. Plant may provide an alternative to currently used pesticides for the control of plant pests, as they constitute a rich source of bioactive chemicals (Daoubi et al., 2005). Botanical pesticides are generally regarded as more eco- friendly than synthetic pesticides. Botanicals are characterized by low mammalian toxicity, reduced on non target organisms and short persistence in the environment (Georges et al., 2008). Several limonoids with these characteristics have been isolated from various representatives of Meliaceae (Wheeler et al., 2001). The Meliaceae plant family is known to contain a variety of compounds that show insecticidal, antifeedant, growth regulating, and development modifying properties (Senthil Nathan et al., 2004, 2006b, 2005c). One member of the Meliaceae, known as Chinaberry or Persian lilac tree *M. azedarach* L. (Meliaceae) has long been recognized for its insecticidal properties but is yet to be wholly analyzed. At present, some plant-derived products are used against wide variety of pests (Isman, 2006). For example, neem oil obtained from the seeds of the Indian neem tree, *Azadirachta indica* A. Juss. (Meliaceae) is effective against soft- bodies insects, mites and is also useful in the management of phytopathgens (Isman, 2006). Azadirachtin, one component of the neem seed extract and it is a triterpene limonoid, is widely used as an insect antifeedant and a growth regulator (Immaraju, 1998). Specially, neem has shown to be effective in controlling whiteflies, *e. g. Bemisia tabaci* (Gennadius) (Coudriet et al., 1985) and other plant sucking pests like aphids, *e. g.* green peach aphid *Myzus persicae* Sulzer (Bollharder et al., 1997).

According to the recent studies on the plant-derive chemicals; the extracts from *P. harmala* L. seeds also have insecticidal effect on the different pests such as plant sucking pests including whitefly e.g. *B. tabaci* (Al-mazra'aw & Ateyyat, 2009). Also, Dehghani et al. (2011) found recently that methanol harmal extracts *P. harmala*. could be affected on hatching time and hatching rate of greenhouse whitefly *T. vaporariorum*. Some conventional pesticides like abamectin (Kumar & Poehling, 2007) and acetamiprid (Zabel et al., 2001) have been commercially used to control of sucking pest including whiteflies. abamectin as a streptomycete derived is used for controlling mites, thrips, aphids, whiteflies, psyllids, diaspid scale insects, and lepidopteran pest species (Lasota & Dybas, 1991). acetamiprid, a member of the neonicotinoid insecticide family, have exhibited outstanding control of sucking pests of cotton and other crops, such as aphids and whiteflies (Natwick, 2001; Parrish et al., 2001). Moreover, acetamiprid was highly effective in controlling all stages of *B. tabaci* (Gennadius) (Naranjo & Akey, 2004).

The present study was conducted to evaluate the effective of *M. azedarach* and *P. harmala* methanolic extracts for controlling *T. vaporariorum* population in greenhouse, compared to the effect of customary insecticides that is used for control of this pest.

MATERIALS AND METHODS

General experimental procedures

T. vaporariorum was collected from the experimental greenhouse of Shahid Bahonar University of Kerman, Kerman, Iran. The colony was mass reared on tobacco, cucumber and tomato plants in insect-proof cage (80×60×60 cm).

All experiments were conducted on cucumber plants, cv. 'Negin' The cucumber seeds were first planted in plastic trays containing soil and compost. The plants with two leaves were transplanted in to plastic pots. Experimental plants possessed at least five fully developed leaves, i. e. approximately 4-5 weeks old.

Preparation of plant extracts

Fruits of *M. azedarach* L. and seeds of *P. harmala* L. were collected from Mahan [30°3'29.93"N 57°17'39.91"E, 1908m (altitude)] and Ekhtiyarabad [30°19'47.62"N 56°55'41.06"E, 1748m (altitude)] region in Kerman, Iran, respectively. The dried part of each plant was ground (200g) in electronical steel blender for five minutes, and then each sample powdered was mixed with 500 ml methanol (90%, Merck). The crushed samples were soaked for 24h in the erlenmeyer that covered with aluminum foil as dark place. The methanol extract were filtered through Whatman filter paper (9 cm diameter) and concentrated in cube- shaped glass (3 × 3 × 3 cm) under laboratory hood for 24 hours to give a dried substance. For the short time, these substances were kept at 4 °C in refrigerator. The dried extracts were dissolved in distilled water to use in bioassays.

Experimental set-up

Bioassays were performed using a spraying test in greenhouse condition. The experiments were carried out from 24 January 2011 to 10 August of 2011 in the experimental agriculture research and natural resource center of Kerman, Kerman, Iran. The cucumber plants with five fully expanded leaves were used as host plant. The cucumber plants were placed in the colony of whiteflies. After 24 hours, the adults were removed and the eggs on the plants were allowed to hatch and develop to pupa stages in a free-whitefly cage. For each experiment, one leaf of cucumber plant, at the same areas, was detached and the number of the pupa on it was recorded. To evaluate the effect each chemical product as insecticide, the cucumber plant with maximal amount of pupae (*Ca*. 90%) were separately sprayed with methanolic extracts of *Melia azedarach* (80 mg/mL) as well as *Peganum harmala* (80 mg/mL), neem oil [3 g/L (trade formulation)], abamectin [9 mg/L (ai)] and acetamiprid [70 mg/L (ai)] until run-off, using a hand-held sprayer. In control, the plant was treated with distilled water. During two step, the number of the adult emergence (based on the number of empty pupae) in different treatment were recorded as mentioned above. Immediately after the first of adult greenhouse whitefly emergence, the first record was executed. Three days later, the numbers of adult emergence in the second time were recorded. The experiment consisted of 9 replications for treatment and 9 replications for control. Control and treatment separately consisted of three cages and each cage include of three cucumber plants.

The decrease percentage of adult population in each treatment was calculated as:

$[M_t - M_c / M_c] \times 100$

where M_c is the mean number of the adults (based on the number of empty pupae) in the control, M_t is the mean number of the adults in treatment (M_t).

Statistical analysis

For statistical comparison of the mean number of the adult and the decrease percentage of adult population, the greenhouse data were subjected to a one-way analysis of variance (ANOVA) followed by a Tukey Test (StatPlus version 4.9, 2007).

RESULTS

The mean number of adult emergence per treated leaves and control is represented in (Figs. 1-2). Among the different experiments, there were no significant differences in number of pupae per leaf before spraying ($P < 0.05$). In the first and second records after spraying, all the chemicals significantly reduced the mean number of adult as compared with control ($P < 0.0005$). As in the second record after the chemical implementing, the mean number of adult emergence on the treated plants with *M. azedarch* (3.1) and *P. harmala* (4.5) were significantly less than on control leaves. Moreover, in the last record, the average number of adult of greenhouse whiteflies, when pupae were treated with different concentrations of neem oil, abamectin and acetamiprid, were reduced to 5.0, 3.3 and 4.8 respectively.

The mean decrease population percentage of greenhouse whitefly adults caused by two plants extracts and three commercial insecticides are demonstrated in (Fig. 3). The results revealed the mean decrease percentage of adult population had significant difference between two methanolic extracts and three tested insecticides in the first records after application ($P< 0.05$). In addition, the highest decrease percentage of adults averaged 92.21% and 90.26% in treatment with *M. azedarch* and *P. harmala*, respectively. Whereas the mean decrease percentage of adults population was 76.35%, 70.53% and 66.27% in neem oil, abamectin and acetamiprid, respectively. The results indicated the highest mean decrease percentage of population was calculated in the *P. harmala* treatments during the last record. However, there is no significantly difference between two plant-derived chemical treatments. The mean decrease percentage of adult population in abamectin and neem oil treatments had significantly lower than the both plant extract treatments ($P< 0.0005$). The lowest mean decrease percentage of adult population (67.23%) was recorded in acetamiprid treatments. There is no significant difference among the impact of abamectin and neem oil on the adult population in the last record ($P< 0.\ 05$).

DISCUSSION

The current study demonstrated that extracts from the plants *M. azedarach and P. harmala* were the most promising for the control of *T. vaporariorum* that resulted in more decreased adult population due to increase pupal developmental duration or mortality.

The studies of Senthil Nathan & Sehoon (2006) demonstrated that methanolic extracts of *M. azedarach* (leaves and seeds against the larvae of *Hyblaea puera* Cramer (Hyblaeidae) reduced growth rate during fifth instars, with extended span of development in treated larvae Similarly, the results of Kamaraj et al. (2010) exhibited that the leaves and seeds aqueous and hydro-alcoholic extracts of *M. azedarach* at 12.5 mg/mL inhibited 100% of larval development of *Haemonchus contortus* Rudolphi (Trichostrongylidae). In this experiment, the extract of *M. azedarach* was effective on reduces percentage of adult population of *T. vaporariorum* that similar to the reduction achieved in the neem oil treatment. The growth regulatory effect is the most important physiological effect of *M. azedarach* on insects. It is because of this property that family Meliaceae has emerged as a potent source of insecticides. For example, exposure of *Anopheles stephensi* Liston (Culicidae) larvae to sub-lethal doses of neem leaves extract in the laboratory prolonged larval development, reduced pupal weight and ovipostion (Su & Mulla, 1999). The results of this study indicate the plant-based compounds such as azadirachtin (compounds present in the Meliaceae plant family seed) may be an effective alternative to conventional synthetic insecticides for the control of *T. vaporariorum*. Other studies also confirm a decreased ability for larvae to develop normally with increasing levels of azadirachtin (Sharma, 1992). For example, in a field trial, against *B. tabaci* in cotton, only 160 ppm azadirachtin efficiently reduced the whitefly population whereas lower concentration failed to control *B. tabaci* (Flint & Sparks, 1989). Moreover, Von Elling et al. (2002) proved neem product, treatment of *T. vaporariorum* pupa significantly reduced the proportion emerged adult and led to a considerable reduction of whitefly population in tomato plants.

The present investigation proved that the seed extract of *P. harmala* had the most effective on adult population of *T. vaporariorum*. Some other interesting findings were reported by other scientists on *P. harmala* but against different insect species. Al-mazra'awi & Ateyyat (2009) reported that the extracts of *Ruta chalepensis* L. *P. harmala* L. and *Alkanna strigosa* Boiss. & Hohen were effective in reducing the numbers of *B. tabaci* immature similar to the reduction observed in the imidacloprid treatment. Also, Shonouda et al. (2008) have shown that the leaf extract of *P. harmala* had mortal effect and decreased percent pupation (73.4%) at the concentration 5% and was achieved adult emergence of the cotton leaf worm *Spodoptera littoralis* Baisduval (66.7%) at the same concentration.

Similarly the present study, the other studies conducted to the activity of neem oil, abamectin and acetamiprid against the whiteflies. For example, Kumar & poehling (2007) reported that azadirachtin and abamectin deterred the settling of white fly adults on tomato and reduced egg deposition. Moreover, Saad et al. (2007) reported that thiamethoxam, pymetrozine, abamectin, and azadirachtin were remarkable efficacy against adult and immature stages of the sweet potato white fly *B. tabaci*. According to the investigation of Zabel et al. (2001) acetamiprid significantly decreased the number of the greenhouse whitefly immature, *T. vaporariorum* compared with untreated population. In addition, acetamiprid for controlling *B. tabaci* in cotton was highly effective as compared of insect growth regulators (IGRs) of pyriproxyfen and buprofezin and decreased pest densities (Naranjo & Akey, 2004).

CONCLUSION

However, the current study exhibited that the methanolic plant extracts were extremely efficient in controlling of adult population of *T .vaporariorum* compared with the used commercial insecticides. Result of this study led to conclusion that all the used chemical products contributed in reducing the greenhouse whitefly population over the untreated plants. Nevertheless, the methanolic plant extract is reckoned to be better chemical product against the greenhouse whitefly. Therefore, it is possible to extract these substances if they have good environmental stability and are environmentally safe, and to use these extracts as botanical insecticides in plant protection against the whiteflies.

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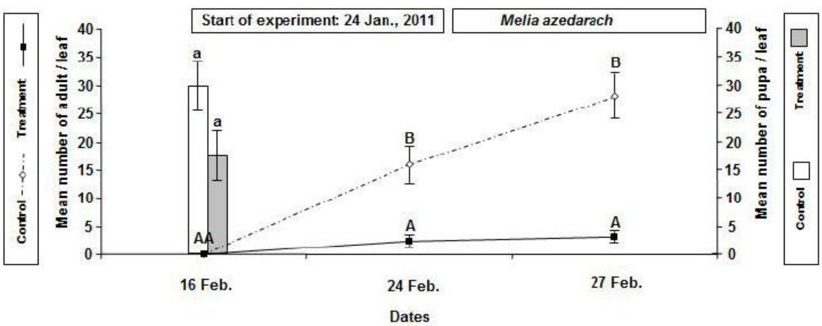

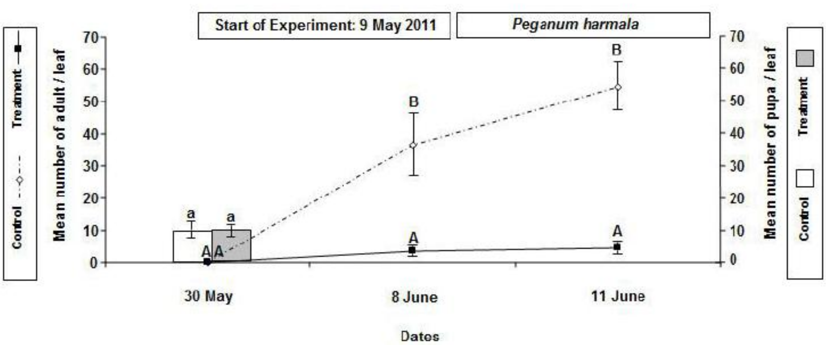

Figure 1. The mean number of adult emergence on the treated and control plants with *M. azedarch* and *P. harmala*.

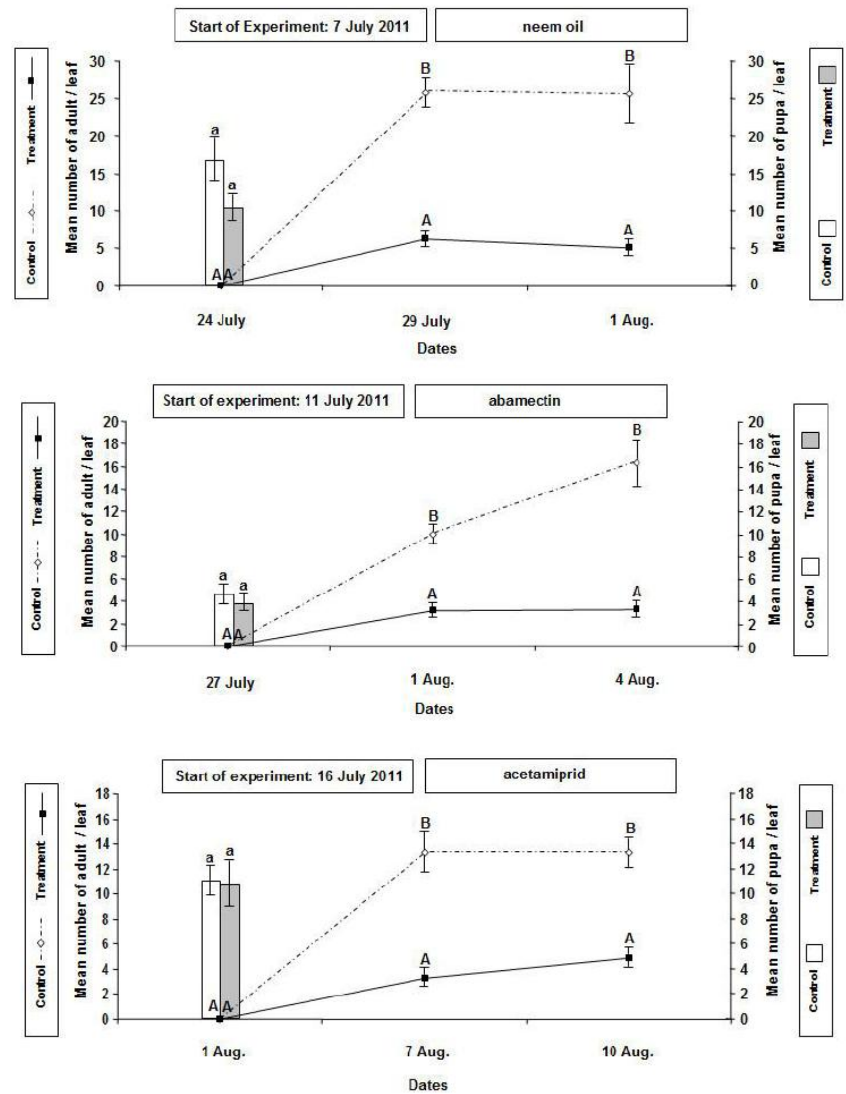

Figure 2. The mean number of adult emergence on the treated and control plants with neemoil, abamectin and acetamiprid.

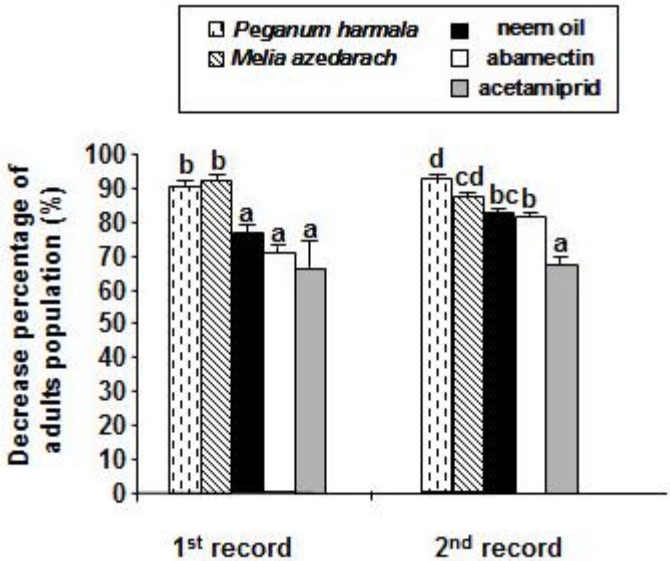

Figure 3. The mean decrease population percentage of greenhouse whitefly adults on the treated plants with two plants extracts and three commercial insecticides.