Floriculture and Ornamental Biotechnology ©2011 Global Science Books

Frankliniella occidentalis (Pergande) (Thysanoptera; Thripidae) Sensitivity to Two Concentrations of a Herbal Insecticide "Baicao 2" in a Tunisian Rose Crop Greenhouse

Mohamed Elimem* • Brahim Chermiti

Laboratoire d'Entomologie et de Lutte Biologique, Département de Protection des Plantes, Institut Supérieur Agronomique de Chott-Mériem (ISA CM). 4042, Université de Sousse, Tunisia

Corresponding author: * **chermiti.ibrahim@iresa.agrinet.tn**

ABSTRACT

The sensitivity of *Frankliniella occidentalis* (Pergande) (Thysanoptera; Thripidae) to two doses of an herbal insecticide based on plant extract "Baicao 2" was estimated by monitoring a thrips population in a rose crop greenhouse. The number of thrips decreased considerably after the first treatment in all treated plots at both concentrations (D1 with 100 ml/l and D2 with 200 ml/l) of "Baicao 2" with mortality rates between 40 and 60% and often with insignificant differences. The efficacy of both concentrations compared with that of the reference product was almost the same with insignificant differences with values of about 83.02, 78.74 and 79.89% respectively for "Baicao 2" dose D1, "Baicao 2" dose D2 and the reference product Tracer®. On the other hand, complementary treatments using this herbal product are needed to maintain mortality rate around 60% with low thrips number in roses.

Keywords: efficacy rate, herbal product, mortality rate, thrips

INTRODUCTION

Several pest species may attack rose (*Rosa indica* L.) crop including thrips. The most common thrips species is the Western flower thrips *Frankliniella occidentalis* Pergande (Thysanoptera, Thripidae) (Brødsgaard 1989; Alford 1991). In Tunisia, *F. occidentalis* is still considered as a quarantine pest due to its ability to transmit viruses (Belharrath *et al.* 1994). This species, which originally came from the Western United States and specifically from California, was first reported by Pergande in 1895 on apricot leaves and tomatoes, as well as on flowers of various weeds. Until the 1960s, its distribution was limited to the northwest of the USA, Canada and Mexico, but since 1970 it has spread to many countries in different continents such as Europe, Africa, Asia and Oceania (Anonymous 2002; Kirk and Terry 2003).

F. occidentalis is a polyphagous thrips species that attacks many plants belonging to several botanical families (Yudin *et al.* 1986; Lewis 1973) including tree species, vegetables such as cucumber (*Cucumis sativus* L.), eggplant (*Solanum melongena* L.), melon (*Cucumis melo* L.), bean (*Phaseolus vulgaris* L.), pepper (*Capsicum annuum* L.), tomato (*Solanum lycopersicum* L.) and strawberry (*Fragaria* sp. L.) (González-Zamora and Garcia-Mari 2003; Papadaki *et al.* 2008), and ornamental crops like chrysanthemums (*Chrysanthemum* sp. L.), orchids (*Orchidacea* Jussieu), rose (*Rosa* L. spp.), *Gypsophila* spp., *Dendranthema grandiflora*, etc. (Yudin *et al.* 1986; Chau and Heinz 2006). On the other hand, *F. occidentalis* has been reported on weeds that may constitute a reservoir host on which the pest can take refuge during hostile conditions for its development or in case of absence of the primary host (Reddy and Wightman 1988).

The control of *F. occidentalis* may be attempted in different ways. Biological management, using predators such as the *Anthocoridae* bugs of the genus *Orius*, and parasitoids such as the genus *Ceranisus* and *Tetrastichus*, is a promising way to control Western flower thrips on many crops (Loomans van Lenteren 1995; Sánchez and Lacasa 2002; Bosco *et al.* 2008). Chemical control has not changed greatly since the pest arrived from the New World. This is due to various difficulties encountered using this control strategy (Grasselly 1996; Kirk and Terry 2003). Among these difficulties, the thrips pest acquires resistance toward several families of insecticides, making chemical treatments ineffective. This resistance is developed especially toward the most commonly applied insecticides against the pest. Thus, it is strongly recommended to alternate use of insecticides from different families every two to three weeks depending on the biology of the pest, the season of the year, environmental factors and the number of generations of thrips (Fougeroux 1988; Grasselly 1996; Shelton *et al.* 2003; Shelton *et al.* 2006).

The second complexity for chemical treatment is related to the biology and behavior of the thrips. Thrips species belonging to the sub-order Terebrantia, such as *F. occidentalis*, insert their eggs into the plant epidermis, and this prevents insecticides from reaching them. Otherwise, it is necessary to repeat treatments every 10 days to kill newly hatched larvae (Bournier 1983; Freuler and Benz 1988). Larvae are also usually hidden within host plant flowers, buds or in very young leaves. Pupae are generally in the ground which consequently makes them unaffected by treatments. All these elements make the pest a hard target for insecticides (Grasselly *et al.* 1999; Fraval 2006). Thus, strategies must be developed to preserve or restore the effectiveness of currently applied insecticides. To develop strategies, it is important to monitor resistance and understand underlying resistance mechanisms (Jensen 2000).

On the other hand, herbal insecticides or plant extracts and products are used against some pests such as some species of thrips on many crops and showed high efficacy with no phytotoxicity (Venkateshalu *et al.* 2009; Wohlenberg and Lopes da Silva 2009).

The purpose of this study was to test the efficiency of

Received: 15 July, 2011. Accepted: 9 September, 2011.

Short Communication

two concentrations of a herbal insecticide "Baicao 2" against *F. occidentalis* in a rose crop greenhouse compared to a reference product Tracer® (Spinosad).

MATERIALS AND METHODS

Study site

The study was carried out during July and August 2008 in the region of Sahline (35° 44′ 07.58″ N, 10° 43′ 36.69′ E, 14 m asl), which belongs to the Tunisian Central-Eastern coast (Governorate of Monastir), in a rose crop greenhouse. Two varieties of rose crop were cultivated within the greenhouse: 'First-red' and 'Oceana'. Each variety was cultivated in two rows making thus a total of four rows.

Products used

The organic insecticide tested was "Baicao 2" (0.1% Oxymatrine) (Matrine Based Organic Insecticide). This product is manufactured by Beijing Multigrass Formulation Company in China. According to the catalogue of this Company (Anonymous 2005) this product is extracted from several Chinese herbs; it is a totally natural organic insecticide, with the advantages of high efficacy, non-residue and non-phytotoxicity. The main ingredients include plants such as *Platycladus orientalis* (Lin.), *Stemona japonica* (Kunth), *Chenopodium ambrosioides* (Lin.) and *Sophora flavescens* (Ait). Among physical and chemical characters, the formula of this product is: $C_{15}H_{24}N_2O$, $C_{15}H_{24}N_2O_2$. The color and state is dark brown liquid with no bad odor, and a density of about 1.03 kg/l and a pH around 5.5~6.5. Concerning the toxicity of this product, it has an oral LD_{50} for rats of about 5000 mg/kg, a dermal LD_{50} for rats of 2100 mg/kg, inhalation LC_{50} of about 1500 mg/m^3 and a low toxicity. This product, when applied on pests, firstly acts as a contact poison and then suffocates. The insects suffer nerve paralysis, then solidify albumen and stop up the air vent of insects' body, finally the insects die of suffocation. It suppresses food absorption by insects, and reduces larval viability, and prevents oviposition. Target pests for Baico 2 are especially thrips, aphids, white flies and leaf hoppers.

The product of reference was Tracer® which was applied at a dose of 40 ml per 100 l of water. "Baicao 2" was tested at two doses: dose D1 with 100 ml per 100 l of water, and dose D2 was 200 ml per 100 l of water. Products were applied three times on a one-week spraying. Dates of treatments were July 28th, August 4th and August 11th 2008. Treatments were done using a backpack sprayer with a capacity of twenty liters and equipped with an engine.

F. occidentalis mortality rate was calculated using the following formula (Ramade 2003):

F. occidentalis mortality rate (%) = (Number of dead thrips found after treatment / Total of thrips counted) × 100

Insecticides' efficacy on *F. occidentalis* was evaluated with the Abbott's formula (Mansour et *al.* 2010):

$$\% \text{ efficacy} = [(T_0 - T_t / T_0) \times 100]$$

where: T_0 (control) = number of living thrips on untreated roses' plots; T_t = number of living thrips on treated vines.

Sampling and experimental design

The experimental design was a randomized complete block design with four treatments: each row was divided into four experimental units making a total number of 16 experimental units and from each one five flowers were sampled randomly from different parts of a rose plant chosen randomly also and marked after sampling that will not serve for the next one. The starting of sampling took place the first day of treatment (July 28th 2008) just before spraying the products, and then, every two, four and seven days after each treatment. To monitor *F. occidentalis* population and the effect of the product, flower sampling was started three weeks before treatments on July 12th 2008.

Table 1 Efficacy rates of different insecticides and doses used against *Frankliniella occidentalis* in rose crop greenhouse.

Treatment	**% Efficacy**
Tracer®	83.02 a
"Baicao 2" Dose D1 (100 ml/100 l of water)	78.74 a
"Baicao 2" Dose D2 (200 ml/100 l of water)	79.89 a
df	2
F test value	0.351

Means followed by the same letter are not significantly different at α = 0.05 within the column

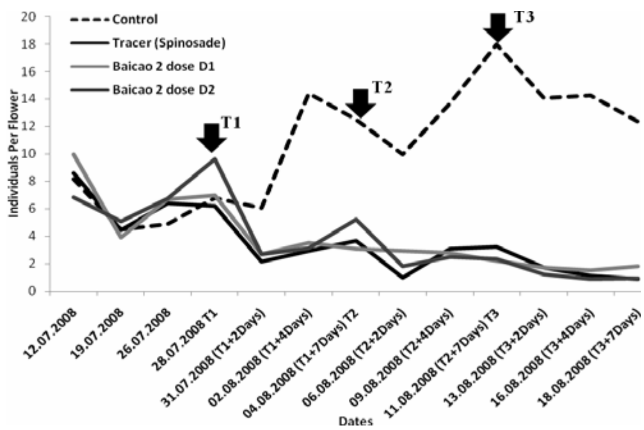

Fig. 1 Evolution of *F. occidentalis* mobile forms in relation with different treatments in a rose crop greenhouse in 2008. T1-T3: 1st treatment-3rd treatment, T1-T3+2-7 Days: 2-7 days after treatment) (🡇) = Treatment.

Statistical analysis

The statistical analyses were done by the statistical software program SPSS 17 (Statistical Package for the Social Sciences version 17). This program was used for analysis of variance (ANOVA) and Duncan's multiple range test at P=0.05 to determine differences between different mortality rates.

RESULTS AND DISCUSSION

Monitoring *F. occidentalis* population revealed that in the untreated plots the number of thrips increased steadily since the start until the end of the study period. The average number was about 17.95 thrips mobile forms per flower, with some variation recorded on August 6th and August 13th 2008 when thrips numbers were slightly decreased (**Fig. 1**).

In the treated plots, the thrips population decreased considerably after the first spray. This decrease occurred in all treated plots, chemical and organic ones, with often insignificant differences according to the Duncan's test. This proves that efficacy rates of both doses are equal and similar to that of the reference product and were respectively 83.02, 78.74 and 79.89 for Tracer®, "Baicao 2" D1 and "Baicao 2" D2 without showing any significant differences (**Table 1**). Thrips population decline was observed after the first treatment, while second and third applications just maintained this reduction at an average of less than 2 mobile forms per flower during the last week of observations. These results showed that both products, and both dosage rates, have the same effect on the thrips population development.

Mortality rates caused by both products and different doses showed that two days after the first treatment, the reference product showed the highest mortality rate with more than 60 % of dead thrips recorded during the 2nd and 4th day after the first treatment. Both doses of the organic product gave lower mortality rates of about 40% two days after the first treatment with insignificant differences (**Fig. 2**). However, 4 days later, both doses of the herbal product reached mortality rates of more than 60% with insignificant differences with the reference product. Results after the second

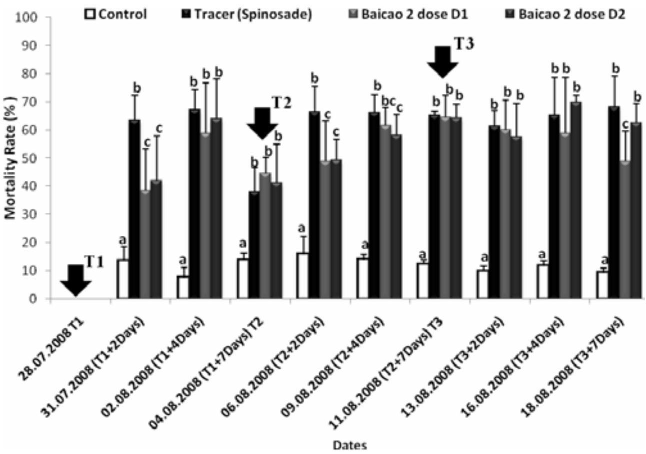

Fig. 2 ***F. occidentalis*** **mortality rate evolution in relation with different treatments in a rose crop greenhouse in 2008.** T1-T3: 1st treatment-3rd treatment, T1-T3+2-7J: 2-7 days after treatment) (Means followed by the same letter are not significantly different α=0.05) (🡇) = Treatment.

and third treatment showed that the mortality rates are more or less similar at about 60% and generally with insignificant differences proving that both products have the same efficacy. Similarly, it is important to note that during the seventh day after the first treatment, mortality rates tended to decrease and to attain values around 40% for the three doses and even number of thrips per flower have had a tendency to increase slightly reaching thus numbers between 5.25 thrips per flower for dose D2 of the organic product and 3.05 thrips per flower for the dose D1. However, these results were not observed after the second and third treatments; the mortality rates have been maintained constant till the end of observations and even thrips number per flower continued to decrease continually. This shows that complementary treatments are needed to strengthen the effectiveness of the first application of both products' different doses to keep mortality rates around 60% and near 70% and a low number of thrips in rose flowers. Studies on the effect of an extract of *Chenopodium ambrosioides* L., one of the components of "Baicao 2", on *Drosophila melanogaster* (Meigen) by Wohlenberg and Lopes da Silva (2009) showed that flies reared on medium with plant extract had less offspring and a significant difference in sex ratio. Life span of both sexes was affected by the plant aqueous extract, and females seemed to die earlier than males. According to Anonymous (2005), this herbal extract product suppresses food absorption by insects and reduces larval viability. It hinders the pest's growth and prevents it from laying eggs, which explains the decrease of *F. occidentalis* numbers in treated plots with both doses of "Baicao 2".

REFERENCES

Alford DV (1991) *Atlas en Couleur. Ravageurs des Végétaux d'Ornement: Arbres-Arbustes-Fleurs*, INRA Editions, Paris, 464 pp

Anonymous (2005) *Herb Source Pesticides and Special Fertilizers. Baicao*, Beijing Multigrass Formulation Co., Ltd. Catalogue, Beijing, China, 52 pp

Anonymous (2002) *Frankliniella occidentalis*. Diagnostic protocols for regulated pests. *OEPP/EPPO Bulletin* **32**, 281-292

Belharrath B, Ben Othmann MN, Garbous B, Hammas Z, Joseph E, Mahjoub M, Sghari R, Siala M, Touayi M, Zaidi H (1994) *La Défense des Cultures en Afrique du Nord, en Considérant le Cas de la Tunisie*, Rossdorf, Germany, 372 pp

Bosco L, Giacometto E, Tavella L (2008) Colonization and predation of thrips (Thysanoptera: Thripidae) by *Orius* spp. (Heteroptera: Anthocoridae) in sweet pepper greenhouses in Northwest Italy. *Biological Control* **44**, 331-340

Bournier A (1983) *Les Thrips. Biologie, Importance Agronomique*, INRA, Paris, 128 pp

Brødsgaard HF (1989) *Frankliniella occidentalis* (Thysanoptera; Thripidae) - a new pest in Danish glasshouses: A review. *Frankliniella occidentalis* (Thysanoptera; Thripidae) - et nytskadedyr I danske voeksthuse. *En Litteraturgennemgang Tidsskr Planteavl* **93**, 83-91

Chau A, Heinz KM (2006) Manipulating fertilization: A management tactic against *Frankliniella occidentalis* on potted chrysanthemum. *Entomologia Experimentalis et Applicata* **120**, 201-209

Fougeroux S (1988) Aux quatre coins de France: *Frankliniella occidntalis*. *Phytoma – La Défense des Cultures* **403**, 43-45

Fraval A (2006) Les thrips. *Insectes* **143**, 29-34

Freuler J, Benz M (1988) La sensibilité en laboratoire du thrips de l'oignon, *Thrips tabaci* Lind., et du thrips de Californie, *Frankliniella occidentalis* Pergande, à l'égard de l'étrimfos, du furathiocarbe et de la cyperméthrine. *Revue Suisse de Viticulture Arboriculture Horticulture* **20 (6)**, 25-26

González-Zamora JE, Garcia-Mari F (2003) The efficiency of several sampling methods for *Frankliniella occidentalis* (Thysanoptera, Thripidae) in strawberry flowers. *Journal of Applied Entomology* **127**, 516-521

Grasselly D, Trottin-Caudal Y, Trapateau M (1991) Lutte chimique contre le thrips californien *Frankliniella occidentalis*. Essai de quelques spécialités en laboratoire. *Phytoma-la défense des cultures* **433**, 54-56

Grasselly D (1996) Le thrips *Frankliniella occidentalis*, Les possibilité de lutte. *Phytoma – La Défense des Cultures* **483**, 61-63

Jensen SE (2000) Insecticide resistance in the Western Flower Thrips, *Frankliniella occidentalis*. *Integrated Pest Management Reviews* **5**, 131-146

Kirk WDJ, Terry LI (2003) The spread of the western flower thrips *Frankliniella occidentalis* (Pergande). *Agricultural and Forest Entomology* **5**, 301-310

Lewis T (1973) *Thrips. Their Biology, Ecology and Economic Importance*, Academic Press, London, 349 pp

Loomans AJM, van Lenteren JC (1995) *Biological Control of Thrips Pests: A Review on Thrips Parasitoids*. Wageningen Agricultural University Papers 95-1, Wageningen, the Netherlands, 237 pp

Mansour R, Youssfi FE, Grissa Lebdi K, Rezgui S (2010) Imidacloprid applied through drip irrigation as a new promising alternative to control mealybugs in Tunisian vineyards. *Journal of Plant Protection Research* **3 (50)**, 314-319

Papadaki M, Harizanova V, Bournazakis A (2008) Influence of host plant on the population density of *Frankliniella occidentalis* pergande (Thysanoptera: Thripidae) on different vegetable cultures in greenhouses. *Bulgarian Journal of Agricultural Science* **5**, 454-459

Sánchez JA, Lacasa A (2002) Modeling population dynamics of *Orius laevigatus* and *O. albidipennis* (Hemiptera: Anthocoridae) to optimize their use as biological control agents of *Frankliniella occidentalis* (Thysanoptera: Thripidae). *Bulletin of Entomological Research* **92**, 77-88

Shelton AM, Nault BA, Plate J, Zhao JZ (2003) Regional and temporal variation in susceptibility to lambda-cyhalothrin in onion thrips in onion fields in New York. *Journal of Economic Entomology* **96**, 1843-1848

Shelton AM, Zhao JZ, Nault BA, Plate J, Musser FR, Larentzakie E (2006) Patterns of insecticide resistance in onion thrips (Thysanoptera: Thripidae) in onion fields in New York. *Journal of Economic Entomology* **99 (5)**, 1798-1804

SPSS 10 Inc (1999) Statistical Package for the Social Sciences. Version 10. Chicago. USA

Ramade F (2003) *Eléments d'Écologie, Ecologie Fondamentale*, Dunod (Ed), Paris, France, 704 pp

Reddy DVR, Wightman JA (1988) *Tomato spotted wilt virus*: Thrips transmission and control. *Advances in Disease Vector Research* **5**, 203-220

Venkateshalu AG, Nadagouda SS, Hanumantharaya L (2009) Bio-efficacy of plant product, Stanza against chilli thrips, *Scirtothrips dorsalis* Hood and chilli mite, *Polyphagotarsonemus latus* (Banks). *Karnataka Journal of Agricultural Science* **22 (3rd Special Issue)**, 559-560

Wohlenberg VC, Lopes da Silva M (2009) Effect of *Chenopodium ambrosioides* L. (Chenopodiaceae) aqueous extract on reproduction and life span of *Drosophila melanogaster* (Meigen) (Diptera: Drosophilidae). *Bioscience Journal* **6 (25)**, 129-132

Yudin LS, Cho JJ, Mitchell WC (1986) Host range of Western Flower Thrips, *Frankliniella occidentalis* (Thysanoptera: Thripidae), with special reference to *Leucaena glauca*. *Environmental Entomology* **15 (6)**, 1292-1295