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EFFECT OF ESSENTIAL OILS OF FENNEL, CARAWAY AND ROSEMARY ON GREENHOUSE WHITEFLY (*Trialeurodes vaporariorum*)

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ABSTRACT

The insecticidal activities of the essential oils of three different medicinal plants (caraway, fennel and rosemary) were investigated the control of greenhouse whitefly (*Trialeurodes vaporariorum*). The activities of the essential oils were evaluated on basis of fatalities percentage of greenhouse whitefly after three days of application. The results indicated that the most effective essential oils from caraway (*Carum carvi* L.) and fennel (*Foeniculum vulgar* MILL) were active at concentrations of 7.5 and 5 ppm, respectively.

KEYWORDS: Medicinal Plants, Essential Oils, White fly

1. INTRODUCTION

The warm temperatures of the summer bring on a rush of new foliage growth, attracting a wide variety of pests. Whitefly one of the most difficult pests to control, pose a special challenge to gardeners [1]. Whitefly numbers increase dramatically in the heat; most strains are resistant to pesticides, and the pests infest a huge range of hosts including bedding plants, strawberries, tomatoes, and poinsettias. Whitefly is one of the most serious pests of vegetable and ornamental crops that feed on plant juices and, in large numbers, can consume a considerable amount of nutrients, causing plant to pale in color. Like aphids, they also excrete honeydew, attracting black sooty mold fungus. Recently, these pests have been found to spread viruses [1]. Whiteflies began showing resistance to synthetic insecticides early on, and by the 1980s they were a very serious greenhouse pest. Several species of whiteflies attack greenhouse plants, and they typically have a wide host range and resist insecticides. The most common whiteflies on greenhouse crops are the greenhouse whitefly (*Trialeurodes vaporariorum*), sweet potato whitefly *(Bemisia tabaci*) and the silverleaf whitefly (*Bemisia argentifolii*). The various whitefly species and biotypes look very much alike, but they have subtle physiological differences. These differences can cause them to respond differently to control strategies. Because control measures must be selected according to the type of whitefly present, accurate identification is critical to successful control [2]. Synthetic pesticides are more of a threat to man than the insects it would seem.

Today, people want an organic or natural solution to gardening problems, and few are as natural or effective as repellant planting [3]. Using organic methods to control insect damages in garden, greenhouse and field will protect and improve the quality of the crops. Trapping with yellow sticky cards, is essential for a successful whitefly management program [4]. Greenhouse plastics themselves may have significant influence on the initial attraction of insects into greenhouses. A study from the late 1990s showed that silver leaf whiteflies

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preferred to enter greenhouses covered with film that transmitted higher levels of ultraviolet light [5]. Biological control is a defined as the reduction of pest populations by natural enemies and typically involves an active human role [6]. The parasitic wasp *Encarsia formosa* preys on immature whiteflies and is commonly used for greenhouse whitefly. Sweet potato and silverleaf whiteflies are controlled by two other wasp parasites, *Encarsia luteola* and *Eretmocerus californicus* [7-9]. Some microorganisms also control whiteflies. For instance, the fungus *Beauveria bassiana* (trade names Naturalis-O™ and BotaniGard™), is effective against eggs, immature and adult whiteflies. Several least-toxic, or bio-rational, pesticides have been evaluated for their effectiveness against the different whitefly species. These include neem-based formulations (Neemazad™ and Azatin™), insecticidal soap (M-Pede™), and horticultural oil [10]. Insect growth regulators (IGRs) are another least-toxic pesticide control option. IGRs typically kill insects by disrupting their development. They have a complex mode of action that precludes insects from rapidly developing resistance [11]. Pyriproxyfen (Knack®) and buprofezin (Applaud®) became available to Arizona cotton growers for control of whitefly, *Bemisia argentifolii* [12]. Changing the composition of the atmosphere in the greenhouse by either reducing oxygen or increasing carbon dioxide appears to provide some control of greenhouse whiteflies, especially adults [13]. Throughout history, plant products have been successfully exploited as insecticides, insect repellents, and insect antifeedants. The insecticidal properties of the several *Chrysanthemum* species were known for centuries in Asia. Probably in some cases the use of plant products as an insecticide is successful, that is related to components of the plants (Pyrethroids and Camphene in al *Chrysanthemum* spp.; Nicotine and Nornicotine in the genus *Nicotiana*; Ryanodine, an alkaloid from *Ryania speciosa*; and Physostigmine, an alkaloid from *Physostigma venenosum*). Control of insects can be achieved by means other than causing rapid death. Plants produce many compounds that are insect repellents or act to alter insect feeding behavior, growth and development ecdysis (molting), and behavior during mating and oviposition. Most insect repellents are volatile terpenoids such as terpenen-4-ol [14-20]. The aim of the present study was to evaluate the insecticidal activity of essential oils of some medicinal plants against greenhouse whitefly.

2. MATERIALS AND METHODS

The experiment was conducted under greenhouse conditions during the 2003 crop season. Inodorous melon (*Cucumis melo var. inodorous*) seeds sowed at the conditions that temperature fixed on 24 °C (until germination). When 80% of seeds germinated the temperature was regulated at 27 and 20 °C for day and night, respectively. Relative humidity was maintained at 70 %. Scientific names of the plants study are given in Table 1. The essential oils of the plants were extracted by Clevenger instrument, via water distillation. The plant material was placed in water, heated to boil and the steam carrying the essential oil was condensed and collected in a receiver flask and essential oils were separated from water by a separator container. The treatments were 0 (control), 5 and 7.5 ppm essential oils obtained from medicinal plants listed in Table 1. The experimental design was Randomized Complete Block Design (RCBD) with four replicates. The plants were placed in single rows a spacing of 1.20 cm between rows. The solutions containing essential oils were given daily via mist system to the plants.

3. RESULTS AND DISCUSSION

In order to introduce a natural product for substitution of synthesized insecticides a study conducted with essential oils of some medicinal plants. The results indicated that essential oils, had insecticide effect, against tested pest (whitefly) are shown in Figures 1 and 2.

Essential oils of fennel at 7.5 ppm (89.82 %) and caraway at 5 ppm (82.95 %) had highest effect on whitefly fatality. Essential oils of caraway at 7.5 ppm and rosemary at 5 ppm were in second fatality grad with 73.05 % and 72.7 % killing effect of greenhouse whitefly respectively. The results showed that essential oils at certain concentration were more effective on controlling whitefly (*Trialeurodes vaporariorum*). The investigations of Vandermark [3], Williams and Pat [10], Duke [14-16], Duke and Lydon [17], Duke *et al.* [18-20], Yang, and Tang [21], Rice [22], Mandava [23], Gill [24], Klocke [25], showed that the some of the plants contain different active substances (essential oils or plants extracts) that were most effective on controlling of the pests.

Table 1 Essential oils of plants used in the experiments.

Name	Botanical name	Family	Part used for essential oil extraction
Fennel	*Foeniculum vulgar* MILL.	Apiaceae	Fruits (Seeds)
Caraway	*Carum carvi* L.	Apiaceae	Fruits (Seeds)
Rosemary	*Rosemarinus officinalis*	Lamiacea	Leaves + Stem

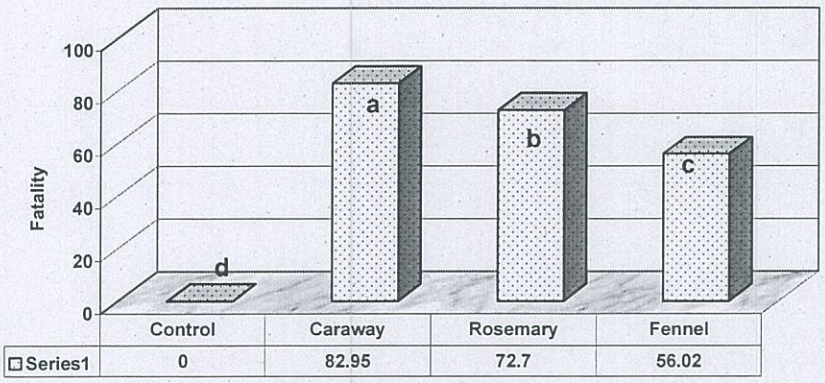

Figure 1 Effects of essential oils (5 ppm) of some medicinal plants on greenhouse whitefly control (Fatality %)

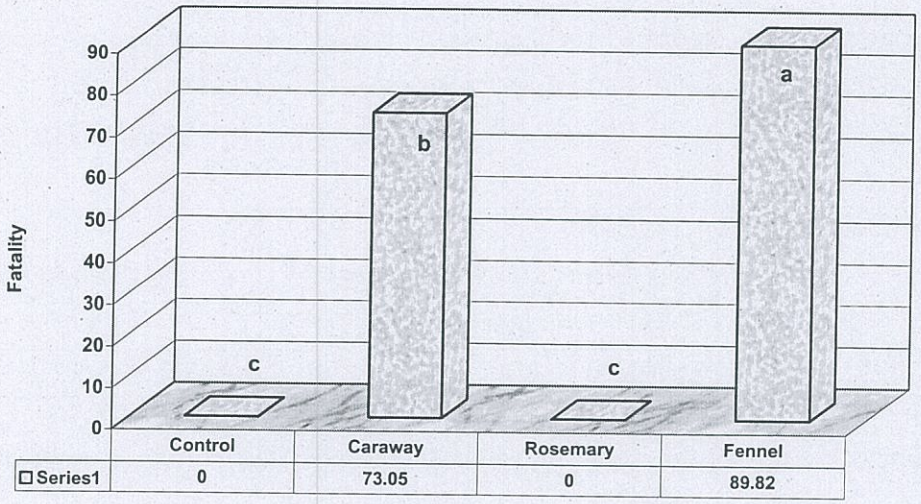

Figure 2 Effects of essential oils (7.5 ppm) of medicinal plants on greenhouse whitefly control (Fatality %)

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