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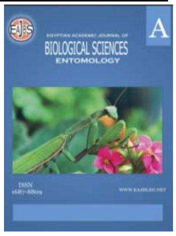

Effects of Mineral Fertilizers on Peach Infestation With The Mediterranean Fruit Fly, *Ceratitis capitata* (Wied.) (Diptera: Tephritidae)

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ABSTRACT
The most important management for high yielding production is nutrition management, but it may affect the response of peach trees to *Ceratitis capitata* insect. This experiment was carried out to evaluate the effect of different mineral fertilizers Bio max, Thiosilicon and the mixture of them) on increasing the defense mechanism of peach trees to infestation by the Med. fly *C. capitata* in the field. In this study 5 concentrations were used Bio max and Thiosilicon (0.05, 0.1, 0.2, 0.4 and 0.6%) and mixture of them was used (0.2 Bio +0.2 Thio, 0.4 Bio +0.2 Thio and 0.2 Bio +0.4 % Thio) there were applied in two separated sprays (1 and 2) and at three times intervals (3, 5 and7 days). The obtained results showed that in spray 1, the mixture of the two compounds recorded highest reduction % of infestation by *C. capitata* and in spray 2, Bio max recorded highest reduction % of infestation. In spray 1 highest reduction % of infestation was obtained at three days interval while in spray 2 the best reduction % was obtained at seven days interval. These results concluded that the used mineral fertilizers enhance peach trees in controlling *C. capitata*,as the silicon, once absorbed by the xylem veins, is deposited on the wall of the plant tissues, forming a mechanical barrier. This control tactic increased the obtained yield.

INTRODUCTION

The Mediterranean fruits fly, *Ceratitis capitata* (Wied.) is a major pest attacking over 250 species of fruit, nuts and vegeTables. In Egypt, it invades many kinds of fruits causing a serious decline in both quantity and quality of fruit yield. The present study aimed to reveal the role of some plant nutrients have to reduce infestation with the Mediterranean fruit fly in peach orchards such as silicon and mineral nutrition's. Haas-Stapleton *et al*., (2003) reported that the use of insecticides in agriculture fields causes biological imbalance. The role of silicon (Si), as a nutrient enable plants to ameliorate the effects of a range of abiotic and biotic environ- mental stresses, has become the subject of a burgeoning field of research (Ma, 2004; Fauteux *et al*., 2005; Laing, *et al*., 2006). Traditionally, it is suggested that an accumulation of Si in the epidermal tissue of the plant is the basic line of defense against insect and fungal attacks. Some new eco-friendly formulation pesticides become the target (Bulmer *et al*., 2009; Yadav, 2010; Zhang and Xiao-Zhen, 2010 and Cloy & Bethke, 2011). The application of silicon in crops provides a viable component of integrated management of insect pests and diseases because it leaves no pesticide residues in food or the environment and can be easily integrated with other pest management practices (Laing *et al*., 2006).

The field application of silicon to susceptible wheat cultivars increased crop resistance and reduced pest infestation (Basagli *et al*., 2003 and Ecole & Sampaio, 2004).

The induced resistance of plants to insects is a potential strategy in the integrated pest management aiming the reduction of deleterious effects of chemical compounds.

Therefore, although not being considered an essential nutritional element to the plants, the addition of silicon has induced resistance in many plant species. El-bendary and El-helaly, (2013) stated that, nano-silica sprays affect the feeding preference of *Spodoptera littoralis*, thus increasing the resistance of tomato plants, therefore being a useful component of an integrated pest management strategy. In the strategies of integrated pest management, mineral nutrition is first base. All essential nutrients can affect disease severity (Huber and Graham, 1999). Nutrients can affect disease resistance or tolerance (Graham and Webb, 1991). The physiological functions of plant nutrients are generally well understood, but there are still unanswered questions regarding the dynamic interaction between nutrients and the plant-pathogen system (Huber, 1996). It is important to manage nutrient availability through fertilizers or change the soil environment to influence nutrient availability, and in that way to control plant disease in an integrated pest management system (Huber and Graham, 1999; Graham and Webb, 1991). The level of nutrients can influence the plant growth, which can affect the microclimate, therefore affecting infection and sporulation of the pathogen (Marschner, 1995). Also, the level of nutrients can affect the physiology and biochemistry and especially the integrity of the cell walls, membrane leakage and the chemical composition of the host, e.g. Ramesh *et al*. (2005) concluded that organic crops have been shown to be more tolerant as well as resistant to insect attacks and organic rice is reported to have thicker cell wall and lower levels of free amino acid than conventional rice. Magdoff *et al*. (2000) indicated farming practices that cause nutrition imbalances can lower pest resistance. Much of what we know today about the relationship between crop nutrition and pest incidence comes from studies comparing the effects of organic agricultural practices and modern conventional methods on specific pest populations. Soil fertility practices can affect on the physiological susceptibility of crop plants to insect pests by either affecting the resistance of individual plant to attack or by altering plant acceptability to certain herbivores. Some studies have also documented how the shift from organic soil management to chemical fertilizers has increased the potential of certain insects and diseases to cause economic losses. The concentration of phenolics can be affected by B deficiency (Graham and Webb, 1991). This review aims at summarizing the most recent information regarding the effect of nutrients on disease resistance and tolerance and their use in sustainable agriculture. Although researches on this area have been done for many years, most of the research mainly focused on impacts of chemical nitrogen and silicon on major pests, such as rice blast, stem borers and brown plant hopper (BPH) and the role of organic fertilizers on the reaction of rice to insect pests and diseases is still clearly have not known The understanding of these interactions between organic fertilizers and insect pests and disease becomes the basis for design of the sustainable rice production system. The organic fertilizers affected to rice plant growth and minimized the outbreak of insect pests and diseases such as brown plant hopper, stem borer, leaf folder, blast and sheath blight (Luong and Heong, 2005).

MATERIALS AND METHODS

Two mineral fertilizers were used in the present study

Easterna Max B (Bio max):

Phosphatidyel cholin (organic phosphorus), Copper glochonates – Potassium salt-Fat organic and amino acids – Aldhydes – Terpophans and glutamic.

Easterna Silicon (Thiosilicon potassium):

14% Silicon cholidal, 14% Sulpher cholidal and 15% Potassium cholidal

All compounds Produced by Easterna Egypt under Technical Company Operation with Green Terra Greece.

Procedures:

Experiment (1):

The experiment was carried out in a peach orchard (5 Acres) at Adlyea, Belbeas, Sharkyea governorate, Egypt. Five concentrations (0.5, 1, 2, 4, 6 %) of each mineral fertilizer were performed then, Tencotic as emulsifier was added. The two compounds were sprayed separately on trees (5 years old) by using small sprayer (5 Liter in capacity) by 200 ml/tree. Three replicates for each concentration were used (three peach trees for each replicate), control is three replicates without treatment and the distance between trees was 2 meters. The two mineral fertilizers were sprayed twice every ten days interval. Examination of fruits was performed after the application of the mineral fertilizers at three time intervals, 3, 5 and 7 days and the rate of infestation were calculated.

Experiment (2):

The two mineral fertilizers used were mixed together at three different concentrations (2% Thio+2 %Bio, 4% Thio+2% Bio and 2% Thio+4% Bio) from Thiosilicon and Bio max. The procedures performed above were also performed here.

Statistical analysis:

Obtained results were analyzed using ANOVA in SAS (SAS Institute, 1988).

RESULTS AND DISCUSSIONS

Data in the Table indicate that, after the first spray, the mixture of Bio max + Thiosilicon high significantly surpassed the two used compounds individually showing the highest reduction percent in infestation by *C. capitata* of 61-96. Thiosilicon compound recorded an intermediate value of 49.70 % reduction, which significantly higher than that investigated with Bio max (27.727 %).

Respecting the tested concentrations, the increment of concentration, the increase of reduction of infestation percentage for the three lower concentrations, (0. 5, 1 and 2 %) but the two higher concentrations (4 and 6 %) showed insignificantly high reduction percent in infestation of 44.972 and 49.24%, respectively. The lowest tested concentration (0. 5%) significantly recorded the lowest value of reduction percent in infestation of 31.006.The highest reduction percent in infestation of 52.219 was shown with the concentration of 2%.

With regard to inspection interval, statistical analysis indicated that the reduction of infestation percentage insignificantly decreased with the increase of time, where the highest reduction percent of infestation (46.910%) was recorded 3 days after treatment, but the lowest value of 41.934 % was obtained after 5 days of application.

Respecting the second spray, data in the Table 1 reveal that Bio max compound high significantly surpassed the other two treatments separately showing the highest reduction percent in infestation by *C. capitata* of 96.275%. The mixture of Bio max + Thiosilicon recorded an intermediate value of 95.829% reduction, which significantly higher than that investigated with Thiosilicon compound (89.605%).

Table 1: Compined effect of two mineral fertilizers with different concentrations and their mixture on peach infestation by *Ceratitis capitata*.

	Spray 1	**Spray 2**
	Mean % reduction in infestation	
Treatments		
Bio max	27.727[c]	96.275[a]
Thiosilicon	49.703[b]	89.605[b]
Bio max+ Thiosilicon	61.960[a]	95.829[a]
F	33.36	14.43
P	0.0001[***]	0.0001[***]
LSD	8.661	3.194
Concentrations (%)		
0.5	31.006[b]	91.243[a]
1	44.977[a]	94.083[a]
2	52.219[a]	94.028[a]
4	44.972[a]	94.942[a]
6	49.240[a]	94.479[a]
F	8.05	1.84
P	0.0002[***]	0.147[NS]
LSD	8.661	4.085
Interval (day)		
3	46.910[a]	89.104[b]
5	43.393[a]	94.328[a]
7	41.934[a]	97.388[a]
F	0.77	15.20
P	0.4716[NS]	0.0001[***]
LSD	8.415	3.103

On the other, hand the increase of tested concentrations, the increase of reduction of infestation percentage. The all used concentrations showed insignificantly high reduction percent in infestation of 91.243, 94.083, 94.028, 94.028 and 94.479 for the concentrations of 0.5, 1, 2, 4 and 6%, respectively.

With regard to inspection interval, statistical analysis of data indicated that the reduction of infestation percentage insignificantly increased with time, where the highest reduction percent of infestation (97.388%) was recorded 7 days after treatment, but the lowest value of percentage reduction (89.104 %) was obtained after 3 days of application.

As shown in Figure (1) Bio max +Thiosilicon recorded the highest % reduction in infestation at 3 and 5 days after the first application, while with respect to spray 2, the mixture recorded the highest reduction percent at 7 days.

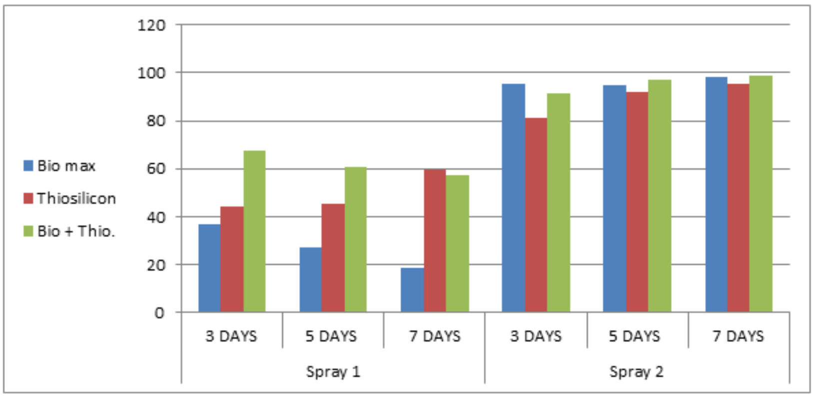

Fig. 1: Effect of mineral fertilizers on reduction of infestation with *C. capitata* after 2 sprays.

As shown in Figure (2) the highest reduction percent in infestation was obtained at 6 % in spray1with Thiosilicon give the highest reduction percent with a concentration 6% followed by Bio max at the same concentration while, in spray 2, Bio max recorded the highest reduction percent at a concentration 4% followed by Thiosilicon at a concentration 6%.

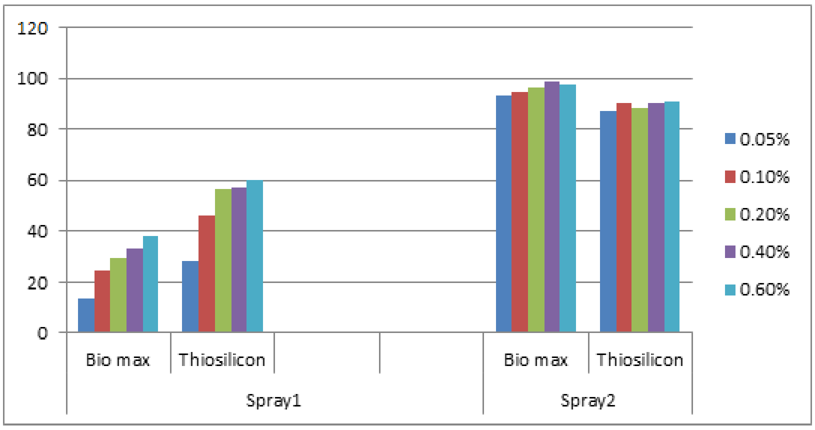

Fig. 2: Effect of the concentrations of each treatment on reduction percent of infestation with *C. capitata*.

As shown in Figure (3), the highest reduction percent was obtained at 3 days interval in spray1 while in spray2, the best reduction percent was obtained at 7 days interval.

Results indicated that the two mineral fertilizers and their mixture seemed to enhance peach fruits against *Ceratits capitata*, this control tactic increased the obtained yield.

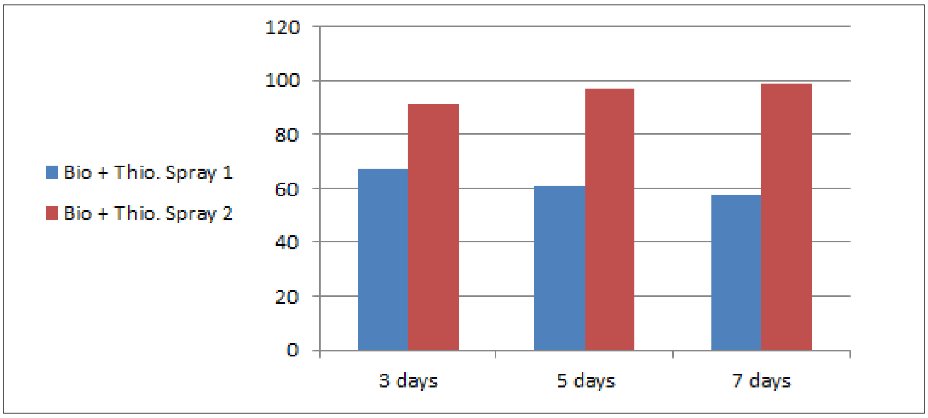

Fig. 3: Effect of the mixture of Bio max and Thiosilicon on reduction of infestation % after 3, 5 and 7 days.

Similar results were recorded by used potassium silicate for the small larval instars of *Spodoptera littoralis*، as the percentage reductions that ranged between (41.61- 51.50 and 22.07- 36.68 %) respectively, and reduction in feeding consumption of the fourth instars that ranged between 15.56- 31.50 % (El-bendary and El-Helaly 2013). Results of Goussain *et al*. (2002) proved that *Spodoptera frugiperda* larvae displayed increased mortality, cannibalism and mandibular wear after feeding on corn plants fertilized with silica. Massey *et al*. (2006) indicated that increasing silica content of grasses deterred feeding and reduced the growth rates and feeding efficiency of *Spodoptera exempta*. Research results have indicated that silicon, once absorbed by xylem veins, is deposited on the wall of plant tissues, forming a mechanical barrier (Richmond and Sussman, 2003 and Ma, 2004) found silicon alleviates many a biotic stresses including chemical stress (salt, metal toxicity, nutrient deficiency) Boron deficiency reduces the resistance to pest attack in the same ways and reduces resistance to fungal infections. The goal is to recognize these interactions and see the possibilities and limitations of disease and pest control by mineral nutrition and fertilizer applications. Mineral nutrition also affects the formation of mechanical barriers in plant tissue. Nutrients can reduce disease to an acceptable level, or at least to a level at which further control by other cultural practices or conventional organic biocides are more successful and less expensive. Nutrients are important for growth and development of plants and microorganisms and they are important factors in disease control (Agrios, 2005).

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