Proceedings VI World Avocado Congress (Actas VI Congreso Mundial del Aguacate) 2007.
Viña Del Mar, Chile. 12 – 16 Nov. 2007. ISBN No 978-956-17-0413-8.

EVALUATION OF PESTICIDE EFFECTIVENESS ON THE CONTROL OF *Heliothrips haemorrhoidalis* (THYSANOPTERA: THRIPIDAE) ON AVOCADO TREES (*Persea americana* Mill)

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The effectiveness of seven pesticides for the control of greenhouse thrips *Heliothrips haemorrhoidalis* was evaluated in two trials carried out in the province of Quillota, Chile, between January and March 2006. The foliage was treated with commercial dosages of: thiamethoxam (Actara 25 WG), mineral oil (Citroliv miscible), imidacloprid (Confidor Forte 200 SL), Thiacloprid (Calipso 480 SC), Spinosad (Success 48), abamectin+mineral oil (Vertimec+Citroliv miscible) and metomil (Lannate 90), the irrigation system was applied with thiamethoxam and a control was maintained with no spraying. Each treatment was replicated 4 times and greenhouse thrips were evaluated in 5 occasions, 1 previous and 4 post-spraying. The density of the pest was registered, in previously-labeled leaves and the percentage of infested leaves in a random extractive sampling. However, due to the high proportion of leaves that dropped naturally, in a second trial the density of the pest was evaluated through the extraction of leaves in soapy water. The neonicotinoids showed an effective control of the pest, achieving a non-detection level at the end of the evaluation period. Thiametoxam was likewise effective in both foliar and irrigation system applications. Metomil initially demonstrated (7 days) a significantly greater effect than the other treatments; however its effect is comparable to the neonicotinoides and abamectin after 60 days of application. Spinosad and mineral oil reduced the population of greenhouse thrips in the leaf, but they did not avoid the colonization of the fruit that was damaged to a level comparable to the control.

Key words: greenhouse thrips, chemical control, *Heliothrips haemorrhoidalis, Persea Americana*

EVALUACIÓN DE LA EFECTIVIDAD DE PESTICIDAS PARA EL CONTROL DE *Heliothrips haemorrhoidalis* (THYSANOPTERA: THRIPIDAE) SOBRE PALTO (*Persea americana* Mill)

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A través de dos ensayos se evaluó la efectividad de siete pesticidas para el control del trips del palto *Heliothrips haemorrhoidalis*, en la provincia de Quillota, Chile, entre enero y marzo de 2006. Se aplicó al follaje, en dosis comerciales: thiamethoxam (Actara 25 WG), aceite mineral (Citroliv miscible), imidacloprid (Confidor Forte 200 SL), Thiacloprid (Calipso 480 SC), Spinosad (Success 48),

abamectina+aceite mineral (Vertimec+Citroliv miscible) y metomilo (Lannate 90), al riego se aplicó thiamethoxam y se mantuvo un testigo sin aplicación. Se consideró 4 repeticiones por tratamiento y 5 evaluaciones, una previa y 4 post-aplicación. Se registró la densidad de la plaga en hojas marcadas y el porcentaje de hojas infestadas en un muestreo extractivo aleatorio, sin embargo debido al alto índice de caída natural de hojas, en un segundo ensayo se evaluó la densidad de la plaga a través de la extracción de hojas en agua jabonosa. Los productos neonicotinoides ejercieron un eficiente control de la plaga, llegando a niveles de no detección al final del período de evaluación. Thiametoxam fue igualmente efectivo en aplicación foliar y a través del riego. Metomilo inicialmente (7 días), tuvo un efecto significativamente mayor, sin embargo su efecto es comparable a los neonicotinoides y abamectina después de 60 días de aplicación. Tanto spinosad como el aceite mineral redujeron las poblaciones de la plaga en la hoja, sin embargo no evitaron la colonización del fruto que fue dañado en niveles equivalentes al testigo.

Palabras clave: Trips del palto, control químico, *Heliothrips haemorrhoidalis, Persea americana*

Introduction

The greenhouse thrips, *Heliothrips haemorrhoidalis* (Bouché), causes a severe damage to the production of avocados due to the russet caused by its feeding on the fruit. Brazil is the origin country of this specie and in Chile it is present for more than 90 years (Artigas, 1994).

The damage of *H. haemorrhoidalis* has a high economic impact. In New Zealand, Froud and Stevens (2003) estimated that the damage of *H. haemorrhoidalis* in the citrus industry reached USD $2,6 million/year because of rejected fruit for export and insecticide use. In California, Goodall *et al* (1987) calculated in USD $10 million the potential damage to avocados because of damage and in South Africa, Denill and Erasmus (1992) estimated financial losses circa USD 1.5 million. In Chile this has not been quantified, nevertheless, similar to the case occurred in the 80`, described by Goodall *et al* (1987) in California, *H. haemorrhoidalis* has increased its incidence and damage in avocado orchards due to the greater tree density, increasing pesticide application and production costs because of pest problems that normally were controlled biologically.

The thrips establishes and damages predominantly the areas between adjacent fruits (Denill and Erasmus, 1992). The larvae and adults of trips cause damage when feeding on the tissue of the plant, perforating and sucking the cellular content. The cellular walls deteriorate and discoloration takes place on the surface of leaves and fruits (Stevens ET to, 1999).

In California fruits with an area above 2 cm^2 damaged are downgraded (University of California, 2007). It is consider that this damage is produced by 25 trips feeding during one week or 5 trips feeding by 5 weeks. The maximum damage accepted for export in our country is 1 cm^2.

In Chile, *H. haemorrhoidalis* is associated to a reduced number of natural enemies who exert a moderate control on the populations of the pest (Ripa *et al*, 2007), which is the reason farmers require chemical tools to control it.
The insecticides pyretrum/piperonyl and sabadilla have been evaluated and recommended for the control of this pest (Blank and Gill, 1995, Goodall *et al*, 1987, Californian Avocado Commission, 1999), however these products are not available in Chile.
The objective of this study was to determine the effectiveness of available pesticides with different modes of action, so as to reduce the populations of *H. haemorrhoidalis* in Hass avocados.

Materials and methods

Two chemical product effectiveness tests were carried out for the control of greenhouse thrips on avocado in the La Cruz locality, Chile. The first of them was done in January 2006 and second in March of same year. The foliage treatments were applied with hand gun, using 300 psi of pressure and a 2 mm diameter bore nozzle. The treatments through the irrigation system were done using a hose joined to auxiliary sprinklers of the same volume as those used in the orchard, connected to a pump independent from the irrigation system of the farm. Tables 1 and 2, show the treatments evaluated in the trials.

Table 1. Treatments evaluated on *H. haemorrhoidalis* on Hass avocado (January 13th 2006). Trial A, La Cruz.

Active ingredient	Commercial product	Concentration /Hectoliter	Application methods
Mineral oil	Citroliv miscible	1000 cc	Foliage /handgun
Methomil	Lannate	50 g	Foliage/handgun
Abamectin+	Vertimec 018 EC+	75 cc	Foliage/handgun
Mineral oil	Citroliv miscible	250 cc	
Spinosad	Success 48	10 cc	Foliage/handgun
Thiametoxam	Actara 25 WG	3 g/plant	Sprinkler by Irrigation system
Control	---	---	---

Table 2. Treatments of trial carry out at March 31th 2006. Trial B, La Cruz

Active ingredient	Comercial product	Dosage/Hectoliter	Aplication methods
Thiacloprid	Calypso 480 SC	20 cc	Foliage/handgun
Thiametoxam	Actara 25 WG	20 g	Foliage/handgun
Imidacloprid	Confidor forte 200 SL	90 cc	Foliage/handgun
Control	---	---	---

In the first test the percentage of infested leaves with the pest was determined by using random extractive sampling and the density of the pest in marked leaves, nevertheless this last evaluation was rejected due to the high proportion of natural leaf drop.
The fruits were observed post application on two occasions to determine the presence of the insect and damage. In the second test the density of the pest was evaluated by random sampling leaves and through extraction in soapy water and sifting. The presence of damage on the fruit was not determined because the application was delayed and the damage had already occurred. The presence of the pest in the field was observed through head 3X magnifying lenses. The statistical design corresponds to random blocks with 4 repetitions per treatment and 5 evaluations, one previous and 4 post-application. The results were analyzed using the SAS System program, the percentage data were transformed by the arccosine formula. Variance analysis was applied to detect differences and the averages were separated by the least statistical difference (LSD), with a level of significance of p=0,05.

Results and discussion.

The neonicotinoids (thiamethoxam, imidacloprid and thiacloprid) showed an effective control of the pest, reaching nondetection levels at the end of the evaluation period (table 3 and figure 1 and 2). Thiametoxam was equally effective through foliar and irrigation application, however, the last one showed a slower action. Grout (2005) evaluated thiacloprid and imidacloprid, showing a reasonable effectiveness on the trips *Scirtothrips aurantii* and a reduced mortality of predatory mites.
Abamectin significantly reduced the population of the pest during an extensive period, coinciding with the effect reported by Morse *et al* (2005), which in addition determined a high level of control of *Scirtothips persea* decreasing the russet damage. Nevertheless, they mention the importance of restricting the use of abamectin due to the risk of developing resistance. Grout (2005), reached similar conclusions when evaluating spinosad and abamenctin against *Scirtothrips aurantii*.
Blank and Gill (1995) evaluated several novel compounds in the laboratory against *H. haemorrhoidalis*. Their results showed that the most effective were Clorpirifos, pyrethrum/piperonyl butoxide, abamectin/mineral oil and imidacloprid, with a mortality above 93%. However, Goodall *et al* (1987) achieved a lower effectiveness in field trials with abamectin.
Methomil, 7 days post treatment, had a significantly superior effect than the rest of the treatments, however 60 days after application, its effectiveness is comparable to the neonicotinoides and abamectin. Cortés (2004), determined through susceptibility tests, that methomil has a higher activity than abamectin on *Frankliniella ocidentalis*.
Both spinosad and mineral oil reduced the population of the pest on the leaf, but did not avoid the colonization of the fruit which were damaged to levels equivalent to the untreated control (table 4).

The relevance of early detection of this pest for management purposes must be emphasized. In spite of carrying out the application at the beginning of the season (fruits 2.6 cm diameter), with a low trips density, damage occurred on the fruit. These results agree with Stevens *et al* (1999 b) in relation to the significant damage caused by adults that colonize the fruit, capable of producing a damage of 0.22 cm^2 per individual per week.

Table 3. Effect of treatments on percentage of infested leaves with *H. haemorrhoidalis.* Trial A, V Region 2006.

	Days post treatment Presence of *H. haemorrhoidalis* on leaves X ± ES			
Treatment	7 days	30 days	60 days	90 days
Mineral oil	9,5±0,5 b	8,5±1,6 ab	6,0±1,3 b	1,5±0,5 ab
Methomil	1,5±1,5 d	1,0±0,0 d	1,5±1,0 bcd	1,3±0,9 bc
Abamectin+ Mineral oil	4,0±1,2 c	5,5±1,8 bc	0,5±0,5 cd	1,0±0,4 abc
Spinosad	10,5±2.2 b	8,0±3,6 ab	5,8±3,7 bc	2,5±2,5 bc
Thiametoxam	8,0±2,2 bc	2,0±0,0 cd	0,0±0,0 d	0,0±0,0 d
Control	19,5±2,9 a	16,8±5,7 a	18,0±5,3 a	10,8±2,0 a

*Values in each column followed by the same letter do not differ significantly to according LSD comparison test, p>0.05

Figure 1. Effect of treatments on percentage of infested fruits with *H. haemorrhoidalis*, 60 and 90 days post treatment. Trial A, V Region, 2006

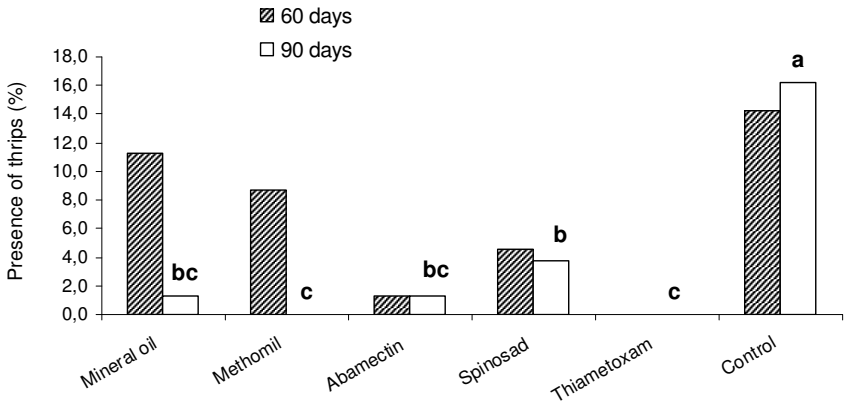


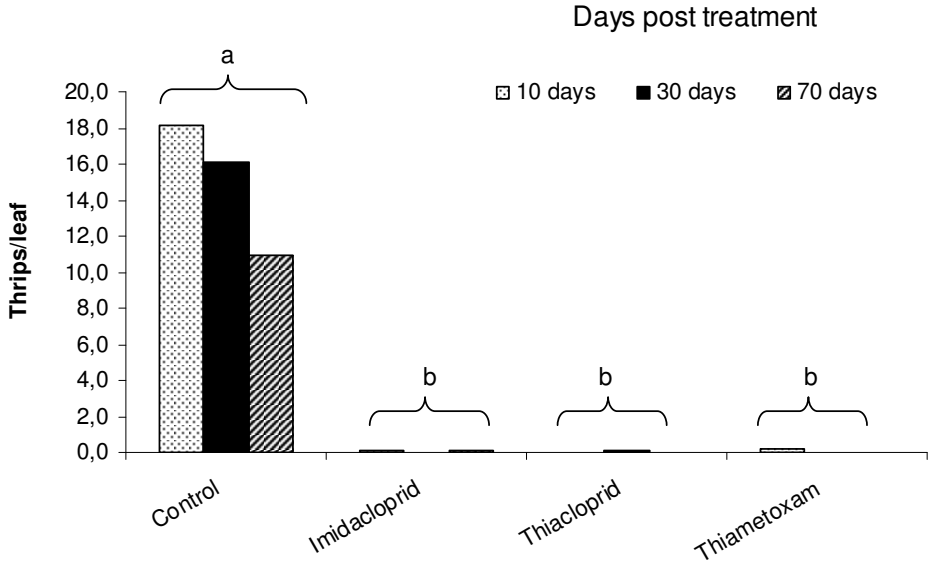
Table 4. Effect of treatments on percentage of damaged fruit by *H. haemorrhoidalis* 90 days alter treatment. Trial A, V Region, 2006

Treatment	% damaged fruit *
Mineral oil	16,3 ab
Methomil	5,0 bc
Abamectin+	2,5 bc

Mineral oil		
Spinosad	10,0	ab
Thiametoxam	1,3	c
Control	18,8	a

*Values in each column followed by the same letter do not differ significantly to according LSD comparison test, p>0.05

Figure 2. Effect of foliage treatments with neonicotinoids on the density of *H. haemorrhoidalis* on avocado leaves. Trial B, V Region 2006



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