

Efficiency of an enzymatic detergent in the control of *Praelongorthezia olivicola* (Beingolea) (Hemiptera: Ortheziidae) in the Northern Chile

Eficiencia de un detergente enzimático en el control de *Praelongorthezia olivicola* (Beingolea) (Hemiptera: Ortheziidae) en el norte de Chile

Víctor Cisterna Cahuer, Germán Sepúlveda Chavera

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ABSTRACT

The efficiency of an enzymatic detergent (Nudisoit®) in the control of the mobile scale of the olive tree, *Praelongorthezia olivicola* (Hemiptera: Ortheziidae), was evaluated under laboratory and on-field conditions. In the laboratory test, four treatments and four repetitions were established in a completely randomized design; individuals surviving after 72 hours was evaluated. In the on-field test, the experimental design was completely randomized with four treatments and three repetitions; the treatments were done 7 days after the application, determining the degree of efficiency. The results indicates a higher control of the mobile scale under laboratory conditions, with an efficiency above 99%, both for nymphs and egg-laying females. On the field test, Nudisoit® exhibited levels of efficiency close to 74% on nymphs and 48% on egg-laying females. Both, the lower control of the plague and the variations observed on field are probably explained by deficiencies in the coverage, where the leaves acted to the detriment of the detergent, which principally acts by contact.

Keywords

Arica • control • enzymatic detergent • integrated management

Universidad de Tarapacá, Avda. General Velásquez 1775, Casilla 6-D, Arica, Chile.
germanfsch@gmail.com - gsepulve@uta.cl

RESUMEN

Se evaluó la eficacia de un detergente enzimático (Nudisoit ®) en el control de la "conchuela blanca móvil del olivo", *Praelongorthezia olivicola*, en condiciones de laboratorio y campo. En las pruebas de laboratorio, se establecieron cuatro tratamientos y cuatro repeticiones en un diseño completamente aleatorio; se evaluaron individuos sobrevivientes a los tratamientos después de 72 horas. En las pruebas de campo, el diseño experimental fue completamente aleatorio con cuatro tratamientos y tres repeticiones; los tratamientos se evaluaron 7 días después de establecido el ensayo, determinando el grado de eficacia. Los resultados indican un control más alto de la conchuela móvil en condiciones de laboratorio, con una eficacia superior al 99%, tanto para ninfas como para hembras oviponentes. En las pruebas de campo, el detergente enzimático presentó niveles de eficacia cercanos al 74% sobre ninfas y a 48% en hembras oviponentes. Tanto el menor control de la plaga y las variaciones observadas en campo, probablemente se expliquen por deficiencias en el cubrimiento, donde el follaje actuó negativamente sobre el detergente, que actúa principalmente por contacto.

Palabras clave

Arica • control • detergente enzimático • manejo integrado

INTRODUCTION

In Chile, mobile scale of olive trees, *Praelongorthezia olivicola*, is categorized as an occasional plague. Nonetheless, in olive trees from Azapa Valley, this insect is transformed into a serious plague (2), being recurrent and hard to be controlled.

Trophic and reproductive conditions of this Coccoidea include 45 species of host plants (13). Its attack gradually weakens the trees, thus drastically reducing the productive capacity of the orchard.

The conventional control with broad-spectrum insecticides is not effective to solve the problem, because not only eliminate beneficial insects, but also alter the agroecosystem balance (12). In this sense, *Syphoninus phyllirae* was reported in the north of Chile (3) with a relative abundance similar to informed in Argentina (7). Among the most widely used toxic products, dimethoate and methomyl they are frequently mentioned.

Their continuous use has contributed to the development of resistance (11), specially against the latest product. This results in a steady increase in dose with the subsequent selection of the fittest individuals in the population.

To the date, detergents used to combat pests have yielded erratic results. These products act by contact, as their molecules penetrate the insect cuticles to tear apart the cellular membrane (4, 15).

The surface tension decreases by the mix of water and detergent allows the chemical penetrates through the spiracles, oxygen availability is reduced and insect death occurs (6, 14). Furthermore, during the application, a mechanical effect occurs that helps the insects off plants attached (10, 5).

Prado *et al.* (2003) recommend the use of dish-washer detergents at 0.5% for the control of the mobile scale of olive trees; especially during the most susceptible

stages (first and second nymphal stages). Treatments using summer mineral oils (1.5%) and anionic detergents are also recommended (13).

The agriculture enzymatic detergent (Nudisoit®) is a mix of non-ionic tensio-active plus a protein and a chitin degrader enzymatic complex, recently introduced in the market. It may present biocide action due to the presence of proteins and enzymes. It acts by contact and does not generate residues; it is recommended for clean agriculture.

Both, since controlling the mobile scale of olive trees appears as highly difficult and having an environment-friendly alternative appears as necessary, this work had the objective of assessing the efficiency of the enzymatic detergent Nudisoit® in the control of nymphal state and egg-laying females of *P. olivicola* under laboratory and on-field conditions in Azapa Valley.

MATERIALS AND METHODS

To determine the efficiency of the enzymatic detergent Nudisoit®, two trials were developed; one under laboratory conditions and another under on-field conditions.

Laboratory trial

Two 12-15 cm long branches of olive tree, infested by *P. olivicola* were sprayed with a hand sprayer at a distance of 40 cm. Afterwards, they were placed inside a 1L glass flask with ventilation.

The experiment was based on a completely randomized design, including four treatments and four repetitions. Treatments were T0: Control (distilled water); T1: Nudisoit® 100 g·HL⁻¹; T2: Nudisoit® 150 g·HL⁻¹ and T3: methomyl (Balazo®90 SP) 0.6 g·L⁻¹.

Counting was carried out 72 hours after spraying. Survival of individuals was

evaluated (live nymphs and egg-laying females) using a stereo magnifier (Nikon model 211538).

On-field trial

In a 70-year-old olive field, located at kilometer 11.5 in Azapa Valley, intensely attacked by all stages of *P. olivicola*.

A completely randomized experimental design consisting of 4 treatments and 3 repetitions was applied.

Treatments were T0: Control (water); T1: methomyl (Balazo® 90 SP) 0.6 g·L⁻¹; T2: Nudisoit® 100 g·HL⁻¹; and T3: Nudisoit® 150 g·HL⁻¹. Branches were sprinkled by means of a 100 L sprayer, commercial brand Lévera, having a Mitra® spray nozzle, 2 mm in diameter beak and a work pressure of 240 pound·inch⁻².

Evaluations were carried out 7 days after spraying, using a stereo magnifier (Nikon, model 211538).

Individuals survival criterion and statistical analysis

Those individuals reacting when mechanically stimulated on the lower posterior part of the abdomen, by lifting their back limbs onto the air, were considered as living. Those individuals lacking movement were considered as dead.

Forty egg-laying females and 80 nymphs were counted on three leaves coming from two 12-15 cm long twigs by experimental unit. Parasite females were not considered.

To appraise the efficiency degree the criterion defined by Abbott (1925) was applied:

$$\text{Efficiency degree } (^{\circ}) = C - T / C * 100,$$

where

C= number of living individuals on the control

T= number of living individuals in the treatment

Data obtained as percentage were transformed into Bliss degrees (arcsine $V_x/100$), before being submitted to the variance analysis and means separation tests for treatments (Tukey Test at a confidence level of 5%).

RESULTS AND DISCUSSION

Laboratory trial

Seventy two hours after application, treatments T2 and T1 showed 99.68% and 99.38% of control, expressed as dead nymphs; whereas, T3 presented 16.93% and T0 showed 0.31% (table 1).

Regarding egg-laying females, the treatment T1 presented 100% mortality after 3 days; followed by T2 with 99.38%, though without statistical differences between them. T3 presented 25.78% of mortality and T0 showed 0.625% of efficiency.

Efficiency of methomyl (Balazo® 90 SP), *in vitro*, was low for a product possessing a high *knock-down* effect; which suggests the presence of a resistant population.

Nudisoit®, in doses of 150 g·HL⁻¹ (T2) and 100 g·HL⁻¹ (T1), presented a higher efficiency level over *P. olivicola*, probably due to wider foliage coverage, since this enzymatic detergent preferably acts by direct contact with the insect.

The dish detergent Quix®, evaluated in concentrations of 1; 1.5 and 2.0%, demonstrated mortality over 93% on juvenile stages of olive tree mobile scale 48 hours after application (8).

On-field trial

Treatments T3, T1 and T2 (table 1) registered 88.18%, 86.4% and 74.96% of efficiency over nymphs -respectively- without presenting statistical differences among them. Unlike the other treatments, the control presented 1.67% of mortality.

For egg-laying females, the treatment T1 (Balazo® 90 SP) presented 89.25% of efficiency; followed by T3 with 63.25 % and T2 with 48.25%. Mortality for the control treatment was null (0% of efficiency).

Table 1. Efficiency of 4 treatments in the control of nymphs and egg-laying females of *P. olivicola* under laboratory conditions, 72 h post-application and on-field, 7 days post-application. Azapa, Chile, December 2014.

Tabla 1. Eficiencia de 4 tratamientos en el control de ninfas y hembras oviponentes de *P. olivicola* bajo condiciones de laboratorio, 72 h post-aplicación y en campo, 7 días post-aplicación. Azapa, Chile, Diciembre 2014.

Treatment	Efficiency (% of control)			
	Laboratory		On field	
	Nymphs	Egg-laying females	Nymphs	Egg-laying females
T0 (Control)	0.31 c	0.63 c	1.67 b	0.00 c
T1 (Nudisoit® 150 gL ⁻¹)	99.38 a	100 a	86.40 a	89.25 a
T2 (Nudisoit® 100 gL ⁻¹)	99.68 a	99.38 a	74.96 a	48.25 b
T3 (methomyl)	16.93 b	25.78 b	88.18 a	63.25 b

Values followed by the same letter indicate statistical equality according to Tukey Test ($p = 0.05$).

Valores seguidos por la misma letra indican igualdad estadística de acuerdo con el Test de Tukey ($p = 0,05$).

Treatments T1, T3 and T2 did not present statistical differences among them; though they showed differences regarding the control treatment.

Over nymphs under on-field conditions, the enzymatic detergent Nudisoit® -in both doses- (150 and 100 g·HL⁻¹) presented no statistical differences with the insecticide methomyl. Over egg-laying females, the doses 150 and 100 g·HL⁻¹ presented no statistical difference; though they presented difference with methomyl, which showed higher effect 7 days after spraying. This is explained when considering failures in foliage coverage.

Under on-field conditions, the detergent Quix® (1.5%) showed 86.1% of mortality of *P. olivicola* nymphs 48 h after application (8).

The results of *in vitro* and on-field assessments allow us to point out that the enzymatic detergent Nudisoit® presents high efficiency regarding the control of nymphs and adults of *P. olivicola*; this effect is highly dependent on liquid covering and spraying efficiency. It is necessary to effectively cover the plague to achieve efficiency levels comparable to an insecticide product.

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