Short Communication

Acaricidal action of two detergents against Panonychus ulmi (Koch) and Panonychus citri (Mcgregor) (Acarina: Tetranychidae) in the laboratory

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Abstract

Two laboratory experiments using a leaf-dip technique evaluated the effect of two detergents, Quix and Nobla, on *Panonychus ulmi* and *P. citri*. Fenazaquin 0.01% a.i. was used on *P. ulmi* as a standard. Mortality increased with higher concentrations in both mite species. In addition, detergent treatments also dislodged *P. citri* mites from leaves. Dislodged + dead mites varied between 31.7% (Quix 0.25%) and 91.3% (Nobla 0.45%), in comparison with 22% in the control. These results suggest the need to evaluate the use of detergents against both mite species in field orchards.

Keywords: Detergents; Fenazaquin; Nobla; *Panonychus ulmi*; *Panonychus citri*; Quix

1. Introduction

Detergents are used in agriculture to wash trees (Thompson, 1992), as tensioactive agents in pesticide formulations and mixtures (Hassall, 1990; Ware, 1994), and directly to control pests (Koehler et al., 1983; Heinz et al., 1984; Hastings et al., 1986; Asiático and Zoebisch, 1992; Green and Chou, 1993), particularly aphids, mites (Osborne and Petitt, 1985; Lawson and Weires, 1991), whiteflies (Butler and Henneberry, 1990; Butler et al., 1991; Puri et al., 1991, 1994; Nava-Camberos et al., 2001), thrips (Moore et al., 1979; Warnock and Loughner, 2002), mealybugs (Ware, 1994), and cockroaches (Szumlas, 2002). Although they are not exempt from toxicological and eco-toxicological questioning (Anónimo, 1993), their reduced impact on the environment and natural enemies (Osborne and Petitt 1985), their low cost and absence of legal restrictions, make them an alternative in integrated pest management (Curkovic et al., 1993).

The insecticidal activity of detergents and soaps is attributed to their capacity to drown insects and mites, the destruction of biological membranes, enzymatic inhibition, removal of individuals from the foliage, the removal of waxes from their cuticle or combinations of all the above (Marer et al., 1988; Hassall, 1990; Curkovic et al. 1993; Ware, 1994).

The effect of detergents has been evaluated in the Department of Crop Protection of the Faculty of Agronomic Sciences of the University of Chile against the olive scale *Saissetia oleae* Olivier (Curkovic et al., 1993, 1995), and *Panonychus*, *P. ulmi* and *P. citri* (Curkovic, 1995; Astorga, 2003). This paper reports results obtained with treatments with two detergents against these mites.

2. Materials and methods

2.1. Source of mites

Leaves were collected from 14-yr-old 'Starking Delicious' apple trees (*Malus* × *domestica* Borkh.) planted at 5 × 4 m, at an orchard infested with *P. ulmi*, and from 5-yr-old 'Eureka' lemon trees [*Citrus limon* (L.) Burm. f.] planted at the variety garden at the Antumapu Experiment Station, University of Chile, La Pintana, Santiago, Chile. These plants had not previously been treated with acaricides.

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2.2. Handling of samples and evaluations

The infested foliage was taken to the laboratory, where apple leaves were submerged for 2–4 s in solutions of the detergents (Table 1). A standard treatment of the acaricide fenazaquin at 0.01% (Magister 20 F; Dow AgroSciences) and a water control were included. Lemon foliage was kept at ~6°C for 30 min to reduce mite mobility. Prior to application of treatments (Table 2), motile mites were counted and dead individuals were removed. The leaves were also submerged for 2–4 s in the treatment solutions. The solutions used were filtered through paper tissue to determine the percentage of mites dislodged from the leaves by immersion. The leaves were maintained at ~22°C after their treatment. Mortality of *P. ulmi* and *P. citri* on the leaves was evaluated after 24 h by visual examination under magnification (20 ×). Individuals considered dead were those that did not move when touched with a needle, and looked wrinkled (dehydrated) and had their legs crossed unnaturally.

2.3. Detergents

Two detergents (Johnson & Diversey Co., Santiago) available for domestic use in Chile were evaluated, a neutral liquid detergent (Quix) composed of a tensioactive non-ionic agent (3–5%), sodium bencen sulfonate (15–30%), urea and water, and the other an alkaline powder (Nobla) composed of an anionic tensioactive (5–15%), silicates, phosphates (inorganic sequesters) and salts (sodium chloride, etc.) (A. Chappuzzeau, Johnson & Diversey, personal communication).

Table 1
Mortality (%) of *Panonychus ulmi* on apple leaves treated with detergents

Treatments	Concentration (% commercial product in water)	Mortality (%)
Quix	1.00	82.7b
Quix	0.50	52.3c
Nobla	0.30	79.2b
Nobla	0.15	73.0bc
Fenazaquin	0.05	97.6a
Control	0.00	6.8

Means with different letters are significantly different ($P \leqslant 0,05$), according to a test of Tukey. Mortality was corrected by Abbott (1925).

2.4. Experiment design and statistical analysis

A completely randomized design was used, with four replicates of 10–15 leaves (lemon) and 6–10 (apple) (approximately 43–50 mites per replicate). Percentages of mortality and dislodged mites were normalized by angular transformation (arcsin $\%^{1/2}$) and subjected to ANOVA, after correcting for control mortality when $>5\%$ by Abbott (1925); means were separated by Tukey's test ($P \leqslant 0.05$; Kuehl, 1994).

3. Results and discussion

3.1. Panonychus ulmi

All treatments in Table 1 caused levels of mortality greater than the control. Detergent treatments were, however, significantly inferior to the standard insecticide treatment (97.6% mortality; $F = 13.37$; d.f. $= 4,15$). Dead mites looked dehydrated (dry and brittle) when viewed under magnification, similar to the effect observed by Curkovic et al. (1993, 1995) on *S. oleae*. Dehydrated quiescent stages were also observed. Mortality of P. *ulmi* with Quix was greater with the greatest concentration of this detergent. A similar trend, though without statistical significance, occurred with the detergent Nobla, a result which coincides with diverse studies indicating a greater control when using higher concentrations (Lawson and Weires, 1991; Curkovic et al., 1995). The concentrations used did not cause foliar toxicity in previous studies (Curkovic et al., 1995).

Table 2
Individuals of *Panonychus citri* dislodged and mortality (%) on lemon leaves treated with detergents

Treatments	Concentration comm. product (%)	Mites prewashing	Mites dislodged (%)	Mortality (%)	Mortality + dislodged (%)
Quix	1.00	207	22.2ab	59.4ab	81.6ab
Quix	0.50	184	21.7ab	32.6bc	54.3bc
Quix	0.25	199	14.1abc	17.6c	31.7c
Nobla	0.45	195	27.2a	64.1a	91.3a
Nobla	0.30	196	29.6a	55.6ab	85.2ab
Nobla	0.15	209	10.5bc	52.6ab	63.2abc
Control	Water	186	3.2d	18.8	22.0

Means in a column with different letters are significantly different ($P \leqslant 0,05$), according to a test of Tukey. Means in columns of mortality and mortality + dislodged were corrected by Abbott (1925).

3.2. *Panonychus citri*

All treatments with detergents in Table 2 dislodged 3–10 times more mites from the leaves treated, than the control (3.2%). Both dead (17.6 to 64.1%; $F = 9.25$; d.f. = 5,18) and dislodged mites (10.5 to 29.6%; $F = 10.12$; d.f. = 6,21) decreased when lower concentrations of the detergents were used, which is in agreement with the results of Lawson and Weires (1991) and Curkovic et al. (1993). Also, eggs were removed from the leaves and dehydration of the quiescent stages (proto- and deutonymphs) was observed.

The combined effect of the detergent treatments (mites dead + dislodged) varied from 31.7% (Quix 0.25%) and 91.3% (Nobla 0.450%), in comparison with 22.0% in the control ($F = 8.76$; d.f. = 5,18). Some of the mites dislodged remained alive, but this parameter was not evaluated. However, mortality in the control (submerged in water without detergent) was high (18.8%), indicating that water alone also removes and drowns individuals, as indicated by Ware (1994).

References

Abbott, W.S., 1925. A method for computing the effectiveness of an insecticide. J. Econ. Entomol. 18, 265–267.

Anónimo, 1993. Lavalozas líquidos. Lo importante es su eficacia. Sernac, Consumo y Calidad de Vida (CCV), Servicio Nacional del Consumidor, Ministerio de Economía, Teatinos 120, Santiago, Chile, CCV 34 (julio), pp. 6–7.

Asiático, J., Zoebisch, T., 1992. Control de mosca blanca *Bemisia tabaci* (Gennadius) en tomate con insecticidas de origen biológico y químico. Manejo Integrado de Plagas (Costa Rica), 24–25, 1–7.

Astorga, I., 2003. Efecto del dioctil sulfosuccinato sódico sobre arañita roja europea *Panonychus ulmi* (Koch) y su enemigo natural *Neoseiulus californicus* (McGregor). Memoria Ing. Agrónomo, Fac. Cs. Agronómicas, Univ. de Chile, Santiago, 48p.

Butler Jr., G.D., Henneberry, T.J., 1990. Pest control on vegetables and cotton with household cooking oils and liquid detergents. Southwestern Entomol. 15, 123–131.

Butler Jr., G.D., Puri, S.N., Henneberry, T.J., 1991. Plant-derived oil and detergent solutions as control agents for *Bemisia tabaci* and *Aphis gossypiii* on cotton. Southwestern Entomol. 16, 331–337.

Curkovic, T., 1995. Evaluación de la acción acaricida de dos detergentes contra *Panonychus ulmi* (Koch) y *Panonychus citri* (McGreg.) (Acarina: Tetranychidae) en laboratorio. Resúmenes XVII Congreso Nacional de Entomología, Univ. de Chile, Santiago, p. 40.

Curkovic, T., González, R., Barría, G., 1993. Efectividad de un detergente en el control de la conchuela negra del olivo *Saissetia oleae* (Olivier) (Homoptera: Coccidae), en pomelos y laurel de flor. Investigación Agrícola (Chile) 13 (1–2), 43–46.

Curkovic, T., González, R., Barría, G., 1995. Control de ninfas de primer estado de *Saissetia olea* (Olivier) (Homoptera: Coccidae) con detergentes, en pomelos y laurel de flor. Simiente (Chile) 65, 133–135.

Green, S., Chou, J., 1993. Studies on management practices to reduce aphid-transmitted viruses and their vectors in pepper (summary). Rev. Agric. Entomol. 81 (8), 982.

Hassall, K.A., 1990. The Biochemistry and Uses of Pesticides, 2nd Edition. MacMillan Press, London, 535p.

Hastings, F.L., Hain, F.P., Mangini, A., Huxster, W.T., 1986. Control of the Balsam whooly adelgid (Homoptera: Adelgidae) in Fraser fir Christmas tree. J. Econ. Entomol. 79, 1676–1680.

Heinz, K.M., Newman, J., Parrella, M., 1984. Biological control of leafminer on greenhouse marigolds. California Agric. 42 (2), 10–12.

Koehler, C.S., Barclay, L.W., Kretchun, T.M., 1983. Soaps as insecticides. California Agric. 41, 11–13.

Kuehl, R.O., 1994. Statistical Principles of Research Design and Analysis. Duxbury Press, Belmont, California. 686p.

Lawson, D.S., Weires, R., 1991. Management of European red mite (Acari: Tetranychidae) and several aphid species on apple with petroleum oils and an insecticidal soap. J. Econ. Entomol. 84 (5), 1150–1557.

Marer, P.J., Flint, M.L., Stimmann, M.W., 1988. The safe and effective use of pesticides. Univ. California, Statewide IPM Project, Div. Agric. & Natural Resources, Oakland, California, Publication 3324, 387p.

Moore, W.S., Profita, J.C., Koehler, C.S., 1979. Soaps for home landscape insect control. California Agric. 37, 13–14.

Nava-Camberos, U., Riley, D.G., Harris, M.K., 2001. Temperature and host plant effects on development, survival, and fecundity of *Bemisia argentifolii* (Homoptera: Aleyrodidae). Environ. Entomol. 30, 55–63.

Osborne, L.S., Petitt, F.L., 1985. Insecticidal soap and the predatory mite *Phytoseiulus Persimilis* (Acari: Phytoseiidae), used in management of the twospotted spider mite (Acari: Tetranychidae) on greenhouse grown foliage plants. J. Econ. Entomol. 78, 687–691.

Puri, S.N., Butler Jr., G.D., Henneberry, T.J., 1991. Plant-derived oils and soap solutions as control agents for the whitefly on cotton. J. Appl. Zool. Res. 2, 1–5.

Puri, S.N., Bhosle, B.B., Iiyas, M., Butler Jr., G.D., Henneberry, T.J., 1994. Detergents and plant-derived oils for control of sweetpotato whitefly on cotton. Crop Protection 13 (1), 45–48.

Szumlas, D., 2002. Behavioral responses and mortality in German cockroaches (Blattodea: Blattellidae) after exposure to dishwashing liquid. J. Econ. Entomol. 95, 390–398.

Thompson, L., 1992. A guide to agricultural spray adjuvants used in the United States. Thompson Publications, Fresno, CA, 206p.

Ware, G.W., 1994. The Pesticide Book, 4th Edition. Thompson Publications, Fresno, CA, 386p.

Warnock, D.F., Loughner, R., 2002. Comparing three solutions for extracting western flower thrips from coleus shoots. Horti. Sci. 37, 787–789.