HortScience 25(11):1406-1407. 1990.

Repellency and Toxicity of a Horticultural Oil against Whiteflies on Chrysanthemum

Hiram G. Larew and James C. Locke

Florist and Nursery Crops Laboratory, U.S. Department of Agriculture, Agricultural Research Service, Beltsville, MD 20705

Additional index words. phytotoxicity, residual, *Trialeurodes vaporariorum, Dendranthema ×grandiflorum*

Abstract. **The repellency and toxicity of a petroleum-based proprietary horticultural oil, Sunspray 6E Plus, was tested against the greenhouse whitefly,** *Trialeurodes vaporariorum* **(Westwood), on greenhouse-grown chrysanthemums** *[Dendranthema ×grandiflorum* **(Ramat.) Kitamura cv. Iceberg]. A 2% (v/v) aqueous spray repelled adult whiteflies for at least 11 days after spraying and it was toxic to newly hatched and third stage larval whiteflies. No phytotoxicity was observed when four weekly sprays of 1%, 2%, and 4% oil were applied.**

Oils are used as insecticides and miticides in orchards and lawns (Chapman, 1967). They are also used as adjuvants to enhance the efficacy of insecticides (Hewitt and Hays, 1986). Fear of phytotoxicity, requisite thorough coverage, and growers' unfamiliarity with oils may explain why they have not been used on most greenhouse crops (Lindquist, 1981). Useful attributes of oils include the apparent inability of insects and mites to develop resistance to them after almost a century of use and their low mammalian toxicity (Chapman, 1967). Both features would be beneficial in greenhouse cropping systems where many pests have developed resistance to commonly used pesticides (Parrella et al., 1987) and where worker exposure is of concern. The repellency of plant-derived oils to insects has been documented (Butler et al., 1989).

The purpose of this study was to investigate the potential use of Sunspray 6E Plus (SS; Sun Refining and Marketing Co., Philadelphia, Pa.), a petroleum-based horticultural oil, on greenhouse-grown chrysanthemum against the greenhouse whitefly. A preliminary report on some of this research has been published (Larew, 1989). Sunspray 6E Plus has been shown to cause no phytotoxicity on several trees and shrubs (Baxendale and Johnson, 1988).

Experiments were conducted between Dec. 1986 and Mar. 1989. All plants were grown with a long-day photoperiod of 14 hr day/10 hr night either in a greenhouse (25 ± 7C) or an environmental chamber (25 ± 2C). Humidity was not controlled at either site.

Colonization. Commercially rooted cuttings of chrysanthemum were grown for 3 weeks in 10-cm-square plastic pots (460 ml). in a soilless medium. Fifteen plants were divided into three groups of five, and all leaves except the fifth from the top were removed. The remaining leaves were sprayed with water, 1% (v/v) or 2% SS. Plants were placed for 24 hr in a small greenhouse among tomato plants heavily infested with greenhouse whiteflies. The tomatoes were shaken to encourage whitefly movement to test plants. After exposure to whiteflies, leaves were misted with water to remove adults. Eggs were counted and leaf area was measured (LI-COR LI3100 area meter; LI-COR, Lincoln, Neb.).

Residual repellency. Thirty 2-week-old plants were stripped of all but one mature leaf. Fully expanded leaves were used so that residual activity would not be influenced by leaf expansion. Plants were divided randomly into six groups of five. Three groups were sprayed with water and three with 2% SS. Plants were grown in a greenhouse under gauze to prevent accidental infestation until exposure. On day 0, 3, and 11 after treatment, five water-sprayed and five oil-sprayed plants were placed among whitefly-infested tomatoes for 24 hr. After exposure, leaves were dipped in alcohol to capture and count adults. Leaf area was measured.

Table 1. Residual activity of Sunspray 6E Plus oil on greenhouse whitefly colonization of chrysanthemums.

Days after spray	Treatment[z]	Adults (no.)[y]
0	−	510*
	+	3
3	−	301*
	+	6
11	−	344*
	+	14

[z] − = water; + = 2% SS

[y]Means are per 100 cm² leaf area. Means followed by asterisk are significantly larger than the lower value from the same day; Student's *t* test, $P = 0.05$. N = 5.

Ovicidal activity. Ten 3-week-old plants with all but one leaf removed from each plant were exposed to whiteflies for 48 hr. Adults were removed, and then plants were divided into two groups of five. One group was sprayed with water, the other with 2% SS. Plants were grown for 10 days until most eggs had hatched on water-sprayed leaves. Leaves were then harvested, and unhatched and hatched eggs and living and dead larvae were counted. Larvae were considered dead if they were shriveled or discolored. Leaf area was measured.

Larvicidal activity. Ten, 3-week-old chrysanthemums with all but three middle leaves removed were exposed to whiteflies for 24 hr. Adults were then removed and plants were grown until third stage larvae developed (25 days after exposure) (Jewett, 1922). Plants were then divided into two groups of five. One group was sprayed with water and the other with 2% SS. Plants were grown until adults began to emerge, and then all leaves were removed and placed in sealed plastic bags. Nine days later, all pupae and empty pupal cases (emerged adults) were counted. Leaf area was measured.

Phytotoxicity. Twenty-five rooted cuttings were potted in 10-cm, round, plastic pots (385 ml) containing 3 loamy soil :3 peat : 1 perlite (by volume) and were grown in the greenhouse for 6 days. The oil was then applied at 0%, 0.5%, 1%, 2%, and 4% to upper and lower leaf surfaces (five plants per concentration) until runoff. Four sprays were applied at weekly intervals using a low-pressure, hand-held sprayer. Applications were made between 0800 and 1030 HR (22 to 23C) during periods of full sun or cloud cover. Plants were observed weekly for phytotoxicity. Temperature was continuously monitored.

All data were analyzed using the Student's

Table 2. Effect of Sunspray 6E Plus oil (SS) on greenhouse whitefly eggs and young and third stage larvae.[z]

	Eggs		Young larvae		Pupae	
Treatment	Hatched	Unhatched	Living	Dead	Total	Empty cases[y]
			No.			
Water	1091*	44*	1091*	2	296	153
2% SS	720	22	5	711*	449	0

[z]Means followed by asterisk are significantly larger than the comparable value in the same column; Student's *t* test, $P = 0.05$. N = 5. Means are per 100 cm² leaf area.

[y]Empty cases signify successfully emerged adults.

Received for publication 22 May 1989. S. Ginsberg, V. Poole, and K. Lehnert provided assistance. Plant material was donated by Yoder Brothers, Inc., Barberton, Ohio. N. Wright of Sun Refining and Marketing Co. Philadelphia, Pa., provided Sunspray 6E Plus. This paper does not recommend pesticide uses, nor does it imply that the pesticide has been registered for use by appropriate government agencies. Send correspondence to: Hiram Larew, Room 320, SA-18, USAID, Washington, DC 20523-1818. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

t test at $P = 0.05$.

The mean number of whitefly eggs laid on SS-treated foilage (one and two eggs per 100 cm^2 leaf area for 1% and 2% SS, respectively) was significantly reduced compared to water-treated foliage (380 eggs per 100 cm^2). Repellency, as indicated by adult counts, lasted for at least 11 days after treatment (Table 1). We observed adults landing on, but quickly leaving, plants, and suspect that repellency is tactile rather than olfactory in nature. SS caused significant early larval whitefly death (Table 2). About 95% of eggs in both treatments hatched. Thus, SS did not kill eggs; instead, it led to early larval death. Most larvae died as they attempted to crawl out of the, egg case. SS is also toxic to late instar whitefly larvae (Table 2). No adults emerged from treated foliage.

No phytotoxicity was observed on foliage or stems of any test plants (0% to 4% SS) after four weekly applications. Air temperatures ranged from 16 to 35C with a typical range of 18 to 30C.

Although the toxicity of petroleum oils to outdoor pests is well-documented, we found no studies detailing repellency and toxicity to a major greenhouse insect pest at nonphytotoxic rates. The potential of such oils as an option in greenhouse pest control programs should be examined further.

Literature Cited

Baxendale, R.W. and W.T. Johnson. 1988. Evaluation of summer oil spray on amenity plants. J. Arboricult. 14:220-225.

Butler, G.D., Jr., D.L. Coudriet, and T.J. Henneberry. 1989. Sweet potato whitefly: Host plant preference and repellent effect of plant-derived oils on cotton, squash, lettuce, and cantaloupe. Southwestern Ent. 14:9-16.

Chapman, P.J. 1967. Petroleum oils for the control of orchard pests. N.Y. Agr. Expt. Sta. Bul. 814.

Howitt, A.J. and A.R. Hays. 1986. Pear, full season *Psylla* block test, 1985. Insecticide and Acaricide Tests 11:71.

Jewett, H.H. 1922. The whiteflies of hothouses: *Asterochiton vaporariorum.* Ky. Agr. Expt. Sta. Res. Bul. 241:75-111.

Larew, H.G. 1989. Oils and pests don't mix. Greenhouse Grower. March 96, 98, 100.

Lindquist, R.D. 1981. Controlling the citrus mealybug on greenhouse foliage plants. Ohio Florists' Assoc. Bul. 622.

Parrella, M.P., J.R. Baker, J.P. Sanderson, R.K. Lindquist, and A.D. Ali. 1987. Resistance to insecticides: what a grower can do. Grower Talks 50:136, 138-142.