AN EVALUATION OF DORMANT OIL PHYTOTOXICITY ON SIX SPECIES OF WOODY ORNAMENTALS

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Abstract. Conflicting reports concerning possible phytotoxicity of horticultural oils applied to woody plants in dormant condition prompted an evaluation of superior oil Sunspray 6E on six species of ornamentals. Young dormant saplings of pear, sugar maple, Japanese maple, European hornbeam, Scots pine and red pine were unaffected by oil concentrations of up to 8%. Bud break was neither reduced nor significantly delayed and no damage to bark or bud scales was observed at any concentration. Leaves developed normally when dormancy was broken with no twig dieback observed. Results show no phytotoxicity for this product even when applied at rates 4X the usually recommended concentration.

Although petroleum-based spray oils have been of considerable importance in agriculture and horticulture for more than a century (1), the history of their use has been characterized by widespread confusion. Conflicting reports of nearly inevitable damage to plants (8), or complete absence of any observable phytotoxicity (7), suggested that considerably more detailed information was needed regarding the use and safety of horticultural oils. This study was designed to investigate the possible phytotoxicity of oil when applied in the dormant condition to species of woody ornamentals described in the literature as oil- sensitive (4, 5, 6). Studies on foliar phytotoxicity and efficacy of oil in controlling arthropod pests will be described in a subsequent report. These investigations seem especially timely in the light of a recent survey (1987) of arborists and nurserymen conducted by Johnson and Caldwell (5): "The members of the Green Industry...had little concrete knowledge about horticultural oil and its use, and it was apparent they did not have access to current, unbiased information." Since there have been intermittent reports of serious spring bud break impairment and/or delay by application of dormant oil, one of the primary objectives of this study was an evaluation of bud damage by Sunspray 6E.

Materials and Methods

Late in February of 1987, 100 dormant saplings representing 6 species of common woody ornamentals were moved from outside into a precooled greenhouse. Included in the 4 deciduous and 2 evergreen varieties were a pear cultivar *(Pyrus calleryana 'Bradford')*, sugar maple *(Acer saccharum)*, Japanese maple *(A. palmatum)*, European hornbeam *(Carpinus betulus)*, Scots pine *(Pinus sylvestris*, and red pine *(P. resinosa)*. Plants were 3-4 years old and included both single and multiple-stemmed forms. Following introduction into the greenhouse, all were thoroughly watered and allowed a week to acclimate prior to any experimental treatment. Subsequent watering was usually twice weekly, with a single application of time released fertilizer (20-20-20) two weeks after plants were introduced into the greenhouse. Plants were retained in their original 5" and 6½" diameter plastic pots, being neither repotted nor pruned. Since facilities to artificially refrigerate the greenhouse were not available, temperatures were maintained as low as possible by the use of 1) a large blower fan bringing in and circulating outside air, 2) heavy gauge translucent polyethylene sheeting to filter and reflect direct sunlight, and 3) white washed walls to reduce both incident and reflected radiation.

The horticultural oil being evaluated for dormant phytotoxicity was superior oil Sunspray 6E, a product of Sun Refining and Marketing Company, Philadelphia, PA. The refining specifications of this product are:

Unsulfonated Residue (UR)	92% (minimum)
Flash Point °F	345 (minimum)
Viscosity SSU @ 100°F	62-80
Gravity API @ 60°F	30 (minimum)
Distillation range @ 10 mm Hg	
50% °F	412±/8
10-90% °F	80 (maximum)

It is interesting to note that on the new label recently approved for this product by the Environmental Protection Agency, only the first two properties are specified, even though it is the distillation characteristics of this oil that separate it from other products on the market (3).

Using a set of hand sprayers adjusted to deliver a uniform, fine mist, all plants were sprayed to the point of runoff. Oil was diluted with distilled water to concentrations by volume of 2%, 4%, 6% and 8% while control plants received only a distilled water spray. Daily fluctuations in air temperature were recorded on a Taylor Instrument Company thermograph, itself being periodically checked for accuracy against a Tel-Tru rotary stem thermometer. Plants were usually evaluated on an every-other-day basis for 11 weeks. Replications per treatment were as follows: Japanese maple, European hornbeam, and Scots pine had 4 each, pear, sugar maple and red pine had 2 each.

Results and Discussion

Sunspray 6E was applied to dormant saplings at up to 4 X the usually recommended concentration. Treatment results are given in Table 1. It appears from these data that, at least for these six species, overwintering buds were not damaged by dormant oil applications at concentrations of up to 8%. This is well above the usual recommendation of 2%. No abnormal developmental differences were observed between terminal and lateral buds, although a few of the terminal buds had been winter killed through lack of watering prior to being brought to the greenhouse. With up to 10X magnification, no morphological changes were observed in any of the buds that failed to open. The bud scales did not flare apart and there was no indication that the oil had solvent properties, dissolving the resins sealing the bud scales and facilitating dessication damage. Final bud break percentage did not seem to be influenced in any way by the oil.

Table 1. Bud break percentage for six species of woody ornamentals following treatment with various concentrations of Sunspray 6E horticultural oil.

Plant species	*Control*	*2% Oil*	*4% Oil*	*6% Oil*	*8% Oil*
Pear	95	89	95	95	94
Sugar maple	74	84	88	92	87
Jap. maple	90	91	92	93	92
Hornbeam	84	84	83	82	84
Scots pine	88	86	88	94	91
Red pine	95	90	89	89	94

Since it became apparent that Sunspray 6E did not *damage* dormant buds, the second question we asked was whether any of the treatments *delay* or retard bud break? Table 2 gives the number of days following treatment to first bud break. The average number of days is given in parentheses.

Only in the pear species did bud opening seem to be slightly slowed by the oil, and only then at the highest concentration. This result in pears may well represent an abberation due to the small number of replications available, since a similar response was not seen in any of the other species. The same possible cause, that of few replications, is suggested for the (apparent) delay in sugar maple bud break at only the 6% oil concentration. All plants of both conifer species initiated shoot growth nearly synchronously within a day or two of each other. A similar response was seen in the Japanese maples with no determinable differences between oil-treated plants and controls. These findings indicate that Sunspray 6E did

Table 2. Number of days to first bud break following application of Sunspray 6E to six species of woody ornamentals. Time periods are shown as minimum number of days, (average) and maximum number of days.

Plant species	*Control*	*2% Oil*	*4% Oil*	*6% Oil*	*8% Oil*
Pear	16 (16) 17	16 (16) 16	16 (17) 18	17 (17) 18	16 (19) 22
Sugar maple	16 (23) 30	18 (22) 25	18 (18) 18	19 (28) 37	19 (19) 19
Jap. maple	Nearly 100% bud break by day +7 regardless of oil concentration				
Hornbeam	19 (24) 37	25 (29) 32	16 (19) 25	16 (27) 42	16 (21) 25
Scots pine	Nearly all shoots started elongating about day +37				
Red pine	regardless of oil concentration				

not significantly retard either lateral or terminal buds from breaking winter dormancy and initiating growth.

Neither did we observe any inhibition or damage to the actual foliage of any test plant as it developed. Evaluation of conifer shoot elongation by the end of the study, as given in Table 3, is representative of this finding.

In general, as the oil concentration increased, average shoot length also showed a slight increase. The cause(s) and/or validity of this apparent stimulation of growth is unknown.

Throughout the course of this study, careful attention was paid to possible mechanical damage to bark or bud scales that might have been caused by the oil treatment. None was observed at any concentration in any plant species. No splitting, blistering, cracking or lenticel enlargement had occurred by the end of the study or upon inspection several months later when the saplings were established in an outdoor planting. No twig dieback was observed. Even though plants in the greenhouse were regularly subjected to severe daily temperature fluctuations as shown in Table 4, there was no indication that Sunspray 6E caused either mechanical or physiological damage to any plant part. It is worth noting that test plants were first sprayed when the air temperature was 85°F, the top of the "permissible" range suggested on the product label.

In summary, this study has shown that the superior oil Sunspray 6E is apparently free of any serious phytotoxic side effects when applied to these six species of dormant woody ornamentals. Oil concentrations well above the levels usually recommended and wide fluctuations in daily air temperature did not result in observable damage to any plant part or subsequent foliage. The plants' vigor and normal spring development schedule did not seem to be affected. Foliar phytotoxicity and efficacy in controlling arthropod pests will be evaluated in a report in preparation.

Table 3. Shoot elongation in scots pine and red pine following treatment with various concentrations of Sunspray 6E horticultural oil. Measurements are in inches.

	Control	*2% Oil*	*4% Oil*	*6% Oil*	*8% Oil*
Scots pine					
No. measured	69	77	56	57	63
Total length	166	181	192	140	195
Avg. length	2.4	2.4	3.4	2.5	3.1
Red pine					
No. measured	39	13	28	22	24
Total length	89	19	52	56	44
Avg. length	2.3	1.4	2.6	2.6	3.0

Table 4. Weekly entomology department greenhouse temperature ranges (°F) at Cornell University, Ithaca, NY, for the period March 8 - May 17, 1987.

Week	*Maximum*	*Minimum*	*Mean*
1	85	25	48
2	59	16	38
3	68	27	45
4	84	37	57
5	68	30	49
6	88	42	56
7	90	45	66
8	97	40	66
9	84	37	55
10	97	38	66
11	101	42	69

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Abstracts

HIGGINBOTHAM, J.S. 1987. **New Jersey fights pest problems with beneficial insects.** Am. Nurseryman 66(4): 73-76, 78, 80.

In a state-of-the-art lab north of Trenton, technicians employed by the New Jersey Department of Agriculture are producing up to 25 million insects a year. The Beneficial Insect Rearing Laboratory opened in 1984 and is one of the nation's largest facilities for breeding parasites and predators of economically important pests. The program is intended to help plant producers reduce pesticide use without sacrificing efficient control. New Jersey has been researching biological controls for gypsy moth for more than 20 years. New Jersey has a particular interest in pest control because of its history as a point of entry for problem insects. Its first organized battle against such an enemy centered around the Japanese beetle, which was introduced to the state from Japan in 1916. New Jersey researchers did pioneering work on biological controls for the pest and found two effective weapons: milky spore disease and a nematode. Since then, New Jersey has successfully used parasites to fight other foreign-born pests, including Oriental Fruit moth, European corn borer and European pine sawfly.

HIGGINBOTHAM, J.S. 1987. **A new EPA ruling on inert ingredients raises more pesticide questions.** Am. Nurseryman 166(4): 103-104, 106, 108, 110, 112, 114.

Nurserymen and other pesticide users have one thing in common with those who purchase patent medicines; they can't tell for sure what's in the product they're buying. Pesticides undergo extensive toxicity testing and labeling procedures, both for the formulated or "end-use" pesticide and for active ingredient. But active ingredients are only part of a pesticide.—often, less than half of a product's total volume. The remainder consists of inert ingredients: solvents, carriers, emulsifiers and so on. Unlike active components, these chemicals are rarely identified on labels. "Inert" does not necessarily mean inactive. Pesticide makers have traditionally held that the identity of these components should remain a trade secret. Until recently, EPA agreed. Though not intended to affect pests, inerts can have drastic effects on people. The medical community has identified a number of suspicious incidents involving inerts. Even some manufacturers agree that a number of inerts are hazardous and should probably be banned. Approximately 1,200 inerts are currently included in registered pesticide formulations.