HortScience 27(12):1304-1305. 1992.

Application of Dormant Oil to Peach Trees Modifies Bud-Twig Internal Atmosphere

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Additional index words. Prunus persica, respiration, phenology

Abstract. **Treatments of single applications of 0%, 3%, 6%, 9%, or 12% dormant oil were sprayed on peach (*Prunus persica* L. Batsch) trees on 6 Feb. 1990. A repeat application of 6% oil plus 6% oil applied 6 days later was also made. Internal CO_2 concentrations of oil-treated buds and twigs were higher than the control the day after treatment and continued to be higher for 6 days. The second application of 10% oil prolonged the elevated CO_2 concentration. Applications of 9% or 12% oil delayed flower bud development and bloom. The repeated application of 6% oil delayed bud development and bloom more than a single application of 6% oil. Damage to fruit buds increased as oil concentration increased, but repeated application of 6% oil resulted in less damage than a single application of 12% oil.**

Freezes during cold deacclimation of peach buds can drastically reduce yields. Farrar and Kelley (1935) reported that application of 8% dormant oil retarded early season apple bloom and foliage development and that the retardation was striking for 3 to 7 days after growth started. Call and Seeley (1989) found that dormant oil applied after rest completion could delay peach flower bud deacclimation and bloom by 5 days. Burroughs (1923) suggested that dormant oil may retard bud development due to an accumulation of CO_2 or a deficiency of O_2 inside the buds.

The objectives of this experiment were to determine the effects of concentration of dormant oil on: 1) peach flower bud phenology; 2) bud mortality; and 3) bud-twig respiration and internal CO_2 concentrations.

Single applications of 0%, 3%, 6%, 9%, or 12% (by volume) dormant oil (Drexel Chemical Co., Memphis, Tenn.) were made to 4-year-old 'Biscoe' trees on Lovell rootstock on 6 Feb. 1990. A dual application, consisting of one application of 6% oil followed by a second application 6 days later, was also carried out. Treatments were arranged in an incomplete block design with 10 blocks and four single tree plots per block. Flower buds had completed rest and accumulated 2384 growing degree hours according to the Utah models (Richardson et al., 1974, 1975) when the first treatments were applied. Treatments were applied with a hand gun until runoff.

Development of fruit buds was rated periodically (on a scale of 1 = dormant to 5 = first bloom) from time of treatment until bloom (indication of bloom delay). After initial anthesis, the trees were rated for percent open bloom. During bloom, 50 flower buds were collected and cut longitudinally. Flowers and large buds typically had healthy-appearing pistils and stamens and were termed healthy. Small buds usually had darkened pistils and stamens and were termed unhealthy. A sample of five shoots was collected at random during bloom from a 1.5- to 2.0-m-high region in each tree and the percent healthy fruit buds determined for each tree,

Four 38- to 50-cm-long shoots were randomly sampled from each tree at 1, 3, 6, 10, and 17 days after initial treatment. Collection of samples from trees receiving the split application was started after the second application. The internal atmosphere of 12-cm sections of the buds-twigs was extracted in a vacuum-extracting apparatus described by Salveit (1982). The CO_2 content of the internal atmosphere samples was measured with

Table 1. Phenological development of peach flower buds treated with dormant oil.

	Visual bud stage[z]				
	Days after treatment				
Oil (%)	10	12	17	22	33
0	1.4	1.7	2.4	3.1	3.6
3	1.4	1.8	2.3	3.0	3.6
6	1.4	1.9	2.3	3.0	3.6
9	1.2	1.6	2.1	2.9	3.3
12	1.1	1.6	2.0	2.7	3.2
6,6	1.1	1.7	1.9	2.6	3.4
Significance (P > F)					
Oil	0.005	0.014	0.001	0.001	0.002
3% vs. 0%	0.816	0.361	0.308	0.158	0.872
6% vs. 0%	0.922	0.104	0.237	0.112	0.869
9% vs. 0%	0.078	0.124	0.022	0.007	0.016
12% vs. 0%	0.016	0.101	0.002	0.001	0.001
6%,6% vs. 6%	0.004	0.074	0.001	0.001	0.042
6%,6% vs. 12%	0.560	0.134	0.178	0.021	0.314

[z]All buds were rated as dormant the day after treatment. Bud stage scale: 1 = dormant, 2 = green calyx, 3 = red calyx, 4 = pink tip.

Received for publication 28 Feb. 1992. Accepted for publication 17 Aug. 1992. 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.

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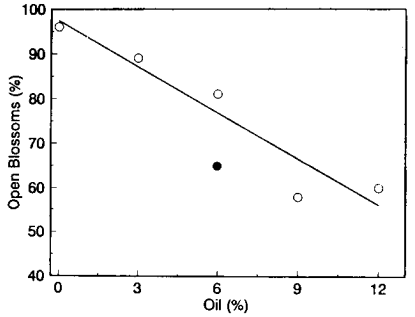

Fig. 1. Percentage of open peach blossoms 37 days after treatment of trees with a single (○) application of dormant oil ($y = 97.4 - 3.43x$, $r^2 = 0.906$). The mean value (●) for a repeated application of 6% oil is included on the plot. Each point is the mean rating of six trees.

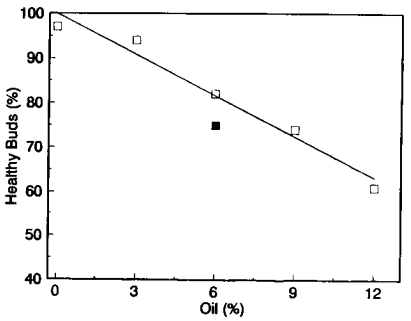

Fig. 2. Health of peach buds after single (□) applications of dormant oil ($y = 100.0 - 3.07x$, $r^2 = 0.969$). The mean value (■) for a repeated application of 6% oil is included on the plot. Each point is the mean count from 60 shoots.

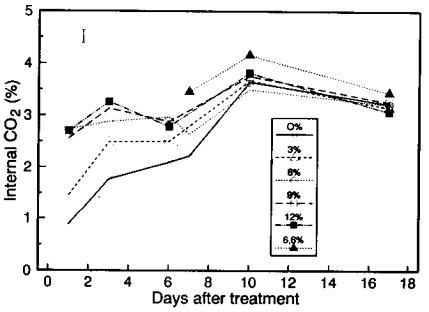

Fig. 3. Internal CO_2 content of peach buds–twigs treated with dormant oil. Each point is the mean of six replications. The vertical bar represents SE. The experimental CV is 14.1%.

a gas chromatograph (model 8A, with a molecular sieve column; Shimadzu, Columbia, Md.).

Respiration rates were measured 8 days after the first treatment. Five shoots per tree were sampled at random, cut into 12-cm lengths, and placed into a septum-capped 55 ml test tube. After 1 h, the CO_2 content of the head space was determined by gas chromatography. Rates of CO_2 production were calculated. All data were analyzed with the Genera1 Linear Mixed Models program (Blouin and Saxton, 1990).

Applications of 9% or 12% dormant oil delayed flower bud phenological development (Table 1). Increasing concentrations of dormant oil decreased the percentage of blooms open 37 days after initial treatment (Fig. 1). The repeated application of 6% oil delayed bud development and bloom more than a single application of 6% oil, but the delay was similar to a single application of 12% oil. Oil damage to fruit buds increased as concentration increased. Repeated application of 6% oil resulted in more damage than the single application but less than the 12% oil (Fig. 2). Thus, repeated applications of less concentrated dormant oil may delay bloom with less injury than a single application.

Internal CO_2 concentration of buds-twigs receiving all treatments was significantly higher than that of the control the day after initial treatment, and in buds-twigs treated with 6%, 9%, or 12% oil it was 3-fold higher than in the control (Fig. 3). The treated buds-twigs had significantly more internal CO_2 than the control up to 6 days after treatment, but at 10 and 17 days after treatment there were no significant differences. The second application of 6% oil resulted in elevated CO_2 concentration compared with buds treated with a single application of 6% oil or the control at 6, 10, and 17 days after initial treatment.

Respiration rates were measured 8 days after initial application of 6% oil (2 days after second treatment). Rates of CO_2 production of buds receiving a single application of oil were 5% to 19% lower than the rate of the control, but the difference was not statistically significant at $P = 0.10$ (data not shown). Differences in internal CO_2 concentration were smaller on the 6th day after treatment, and no differences were found 10 days after treatment. Thus, effects on respiration may have declined by date of measurement. Buds treated with two applications of 6% oil had a 22% lower production of CO_2 than the control (difference significant at $P = 0.07$).

Thus, application of dormant oil to peach trees appears to delay flower bud phenological development by modifying the internal concentration of CO_2 and suppressing bud-twig respiration. Repeated applications of dormant oil can extend the period of modification of the internal bud atmosphere and thus delay bud phenological development with less bud mortality than a single application of higher concentration.

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