Technical Papers

Effect of N-1-Naphthyl Phthalamic Acid on Fruit Set of Peaches

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In an orchard test designed to evaluate several chemicals as spray thinning agents for peaches in 1953, it was found that N-1-naphthyl phthalamic acid (NPA) effectively reduced set when applied at bloom. This chemical had been included in this test on the basis of its effectiveness in reducing fruit set on certain ornamentals (*1*).

Limbs on Halehaven and Redhaven peach trees were sprayed with 500-ppm aqueous solution of NPA at approximately full bloom. This concentration resulted in excessive thinning, with only 1.3 percent of the flowers setting fruit on the Halehaven compared with 33 percent for the controls, and 1.6 percent of the flowers setting fruit on Redhaven compared with 30 percent for the controls. However, leaf development and growth following the treatments were normal, and the fruits that did set developed to excellent size. Even though these preliminary tests with NPA were conducted on relatively young trees, which are more responsive to chemical thinning sprays, it was apparent that the concentrations employed were too high.

Tests in 1954 were made (*2*) on mature trees having a good bloom and with promise of a heavy fruit set. Entire trees were sprayed, with eight trees per treatment. A high-pressure orchard sprayer was used for applying the treatments and the trees were sprayed to a point of moderate runoff to insure thorough coverage. Concentrations of 200 and 400 ppm were used on July Elberta and 150 and 300 ppm on Elberta. The application dates for the two varieties were approximately 3 days past full bloom (Table 1). Flowers were counted on two representative limbs on each tree at bloom, and fruit counts were obtained on the same limbs on 20 July to determine percentage of flowers setting fruit.

Thinning effects were evident on the treated trees within 10 days after the spray application, with many of the flowers becoming shriveled and dropping from the trees. The higher concentrations with both varieties resulted in excessive thinning, whereas the lower concentrations reduced the flower set to about the optimum level (Table 1). Foliage and shoot growth were excellent at the lower concentrations, with no visible injury apparent. Some of the July Elberta trees receiving 400-ppm NPA showed slight injury in the form of yellowing of occasional leaves on the weaker shoots, but the trees appeared normal at harvest time. However, it would not be necessary to employ such a high concentration on this variety.

In addition, NPA applications were made on 8 June, approximately 5 wk after bloom, on July Elberta to evaluate the possibility of NPA as a thinning agent at that time. The 400-ppm treatment resulted in appreciable thinning, but it was insufficient for these trees (Table 1). A comparable degree of thinning was obtained on Halehaven in another orchard where NPA at 400 ppm was applied, 5 wk after bloom. Although NPA will thin peach fruits when applied at this time, it has resulted in some leaf injury and stunted growth when used at concentrations high enough to thin. Also, the later application does not accomplish the benefit in fruit size that is achieved by thinning at bloom time or shortly after.

Dinitro chemicals have been used with some success as thinning sprays for peaches applied at bloom (*3*). However, their more extensive use is limited by the precise timing necessary to coincide with proper bloom stage and, in many instances, the lack of uniformity in bloom stage among trees in various parts of an orchard.

Experience with NPA suggests that this chemical is superior to dinitro as a thinning spray for peaches, since its thinning action is not dependent upon a particular stage of bloom. The possibility of applying NPA a few days after bloom would often permit more accurate appraisal of the need for thinning than would be possible at full bloom.

Experiments have been conducted and some experience has been gained with other chemicals that are effective in thinning peaches when applied about 1 mo after bloom. These include α-naphthalene acetic acid (*3*) and 3-chloro-isopropyl-N-phenyl carbamate (*4*). Where earlier thinning is warranted, NPA would have an advantage over these chemicals in achieving

Table 1. Fruit set of two peach varieties sprayed with N-1-naphthyl phthalamic acid (NPA).

Variety	Treatment	Date applied*	Flowers setting fruit 20 July (%)	Avg. fruit weight 20 July (g)†
July Elberta	NPA 200 ppm	5 May	7.8	
	NPA 400 ppm	5 May	3.9	
	NPA 200 ppm	8 June	18.3	
	NPA 400 ppm	8 June	15.2	
	Control		21.7	
	L.S.D. 5%		5.1	
	L.S.D. 1%		7.0	
Elberta	NPA 150 ppm	11 May	11.6	42.6
	NPA 300 ppm	11 May	4.1	
	Control		33.3	27.4
	L.S.D. 5%		5.9	
	L.S.D. 1%		8.2	

* July Elberta were in full bloom on 2 May; Elberta on 8 May.

† Average of 100 fruits collected at random from trees in two plots.

maximum benefit in fruit size. These characteristics of NPA would appear to justify further work with this chemical as a thinning agent for peaches and perhaps other fruits.

References and Notes

1. L. C. Chadwick, R. R. Miller, Donald Erskine, *Proc. Am. Hort. Soc.* **58**, 308 (1951).
2. The N-1-naphthyl phthalamic acid formulation (ACP-L-322) used in these studies was supplied by R. H. Beatty of the American Chemical Paint Co., Ambler, Pa.
3. L. P. Batjer and M. B. Hoffman, *U.S. Dept. Agr. Circ.*, No. 867 (1951).
4. P. C. Marth and V. E. Prince, *Science* **117**, 497 (1953).

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Brief, Noninjurious Electric Waveform for Stimulation of the Brain

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Long-term electric stimulation of the unanesthetized brain in animals and in man is becoming increasingly important in the fields of neurophysiology (*1*), psychology (*2*), and psychiatry (*3*). Despite indications that unidirectional pulses are injurious (*4*) their use in the afore-mentioned fields is quite extensive. In order to obtain reproducible results, injury to nerve cells by the passage of current must be avoided (*5*). We have found that one type of stimulating waveform does not injure the brain.

The processes that produce lesions by the passage of unidirectional pulses are apparently similar to those that produce lesions with small direct currents (*6*). The probable mechanisms of production of such lesions are those involving the displacement by the ionic current of charged particles (ions, enzymes, proteins, and so forth) from their key positions within and around the neurons. Presumably these displacements and the subsequent cellular destruction can be avoided by using sufficiently brief currents which pass an amount of electricity first in one direction and then an equal amount in the other within a short time. Conversely, any alternating waveform that has an additional small net flow in one direction will presumably cause net displacements and hence injury. If such a "zero net flow" waveform is brief enough, simple metallic nonreversible electrodes pass the current through the tissue without distortion of the waveform, and in addition the stimulus artifact is minimized.

With these points in mind, one of us in 1950 devised a waveform whose shape does not change with repetition frequency; it also has a net zero current and an invariant interval between the positive and negative peaks with change of frequency (Fig. 1). Despite the zero net flow and the brief time course of the pulse-pairs, it was found that such currents stimulate sensorimotor cortex and the responses to this stimulus are similar to those seen with rectangular pulses (*4*). These pulse-pairs probably are within the "constant coulomb threshold" region for nerve processes and cell bodies (*7*), and hence their absolute shape should not be critical.

The pulse-pairs (Fig. 1) are generated by quasi-differentiating (*8*) a rectangular pulse and amplifying the resultant with a Williamson type a-c amplifier that has a 100 kcy pass-band. The output of this amplifier is matched to the animal-electrode circuit by means of a high-frequency transformer (UTC-LS 63). The voltage drop across a 100-ohm resistor in series with the animal circuit is amplified and measured on a cathode-ray oscilloscope that has a pass-band of 0 to 10 Mcy (Tektronix type 535). This latter measurement is converted into current by calculation. By graphical integration on an enlarged photograph of these pulses, it has been shown that the quantity of electricity in the positive (upward) pulse is equal to that in the negative (downward) pulse within the experimental error of less than 0.4 percent. For a 10 ma peak current value, the quantity of electricity is about 0.2 μcoul per pulse.

In order to conduct these pulse-pairs through the cortex, an array of 25 or 36 electrodes is implanted over the sensorimotor cortex in a monkey with or without removal of the dura (*9*). This array is surrounded by a stainless steel ring screwed into the bone. The stimulating current is passed into the cortex from a given single electrode to the ring.

In our experiments, we have investigated the motor responses to these stimuli near the threshold (*4*). Pulse-pairs are used to stimulate the cortex on a schedule of a 2-sec train at 60 pulse-pairs per second every 30 sec for several hours a day.

A few results from observations on two unanesthetized monkeys (*Macaca mulatta*) are presented: the

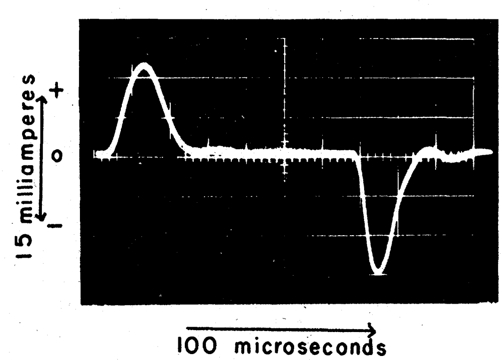

Fig. 1. Waveform of stimulating current: pulse-pairs of current resulting from quasi-differentiation of a rectangular pulse. Measured at 2 percent of the peak, the duration of the positive pulse (upward) is 34 μsec, and the duration of the negative (downward) is 28 μsec. The areas under the two pulses are equal; therefore, the net coulomb flow is zero for the pulse-pair algebraically summed during a time interval of 200 μsec from the beginning of the positive pulse.