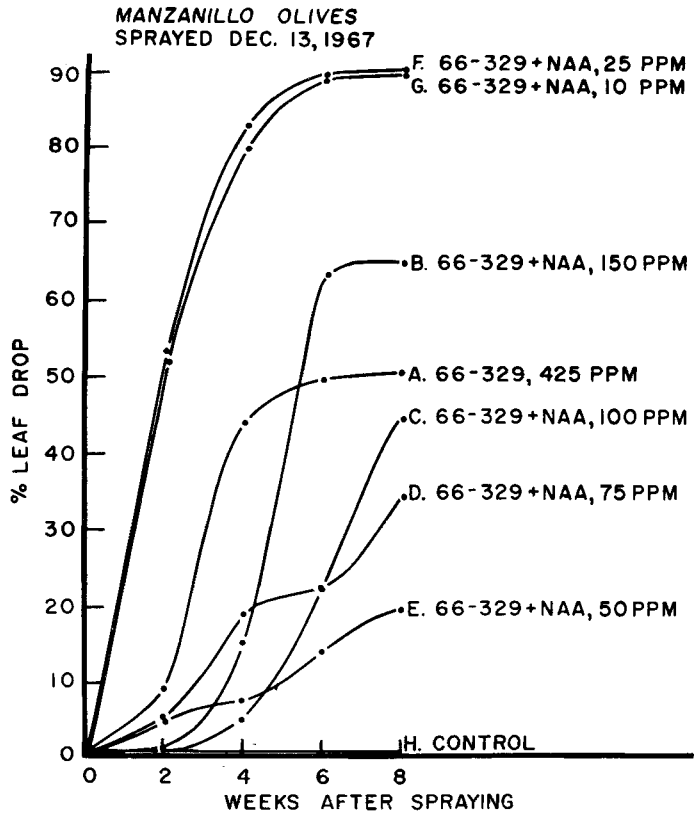
EFFECT OF ADDED NAPHTHALENEACETIC ACID AT VARIOUS CONCENTRATIONS ON AMOUNT OF LEAF DROP FROM MANZANILLO OLIVE TREES SPRAYED WITH AMCHEM 66–329 (425 PPM).



Chemical induction of FRUIT ABSCISSION IN OLIVES

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TO FACILITATE mechanical harvesting of olives by trunk or limb shakers, and increase fruit removal, research has continued toward reducing the fruit-stem attachment force. Previous studies in California have shown that ascorbic or iodoacetic acid are effective in reducing the attachment force of olive fruit, but only when applied under conditions of very high air moisture. Attempts at artificially increasing the humidity surrounding the trees during or following spray application have been unsuccessful. The addition of surfactants or penetrants has not enabled use of ascorbic or iodoacetic acid to effectively loosen olive fruits under the low humidity conditions which prevail during the table olive harvest season in California.

In screening tests with other organic acids during November and December, 1966, in California, salicylic acid was found to be quite effective in inducing abscission of olive fruits. This material, applied under cool, rainy weather conditions, at 0.5% to Manzanillo olives reduced the fruit attachment force after 13 days from an average of 552 grams on unsprayed control branches to 54 grams on sprayed branches. Some pitting of the fruit developed, however. Higher concentrations (up to 1.5 per cent) gave similar abscission promotion, but caused considerable fruit pitting and leaf damage. Lower concentrations (0.25 and 0.125 per cent) resulted in less abscission promotion, averaging 366 and 330 grams removal force, respectively.

Following completion of olive harvest in California, these studies were continued from March to July, 1967, in Victoria, Australia, during harvest there in the orchards of Oliveholme, Pty. Ltd., Robinvale. Further tests were made with salicylic acid and with a growth regulator developed by Amchem Products, Inc. and released for testing under the code number 66-329 (2-chloroethanephosphonic acid equivalent, as a mixture of free acid, anhydride, and mono 2-chloroethyl ester).

Sprays of the sodium, potassium, and ammonium salts of salicylic acid plus a wetting agent were applied May 17, 1967, to Verdale and Correggiolo olives (table 1). The force to remove the fruits was first measured five days after spraying, then at two-day intervals for five further samplings. In every case the sprays caused significant, but not pronounced, reductions in removal force in comparison with unsprayed branches. Previous studies in California indicated that with a fruit removal force of about 250 grams or less, a high percentage of olive fruits will be removed by commercially available, inertia-type tree shakers. However, residue determinations on sprayed fruits showed about 37 ppm salicylic acid, which, in Australia, is unacceptable in food products.

Sprays of Amchem 66-329 plus a wetting agent were applied June 27, 1967, in Australia, at 1000, 2000, and 4000 ppm and fruit removal force was determined (table 2). All concentrations caused pronounced fruit abscission and, at the conclusion of the trial, leaf dropping had commenced. It was obvious from this preliminary test that concentrations lower than 1000 ppm would be more suitable.

In September, 1967, these studies were conducted again in California at the onset of the olive harvest season. Sprays of salicylic acid and its sodium, potassium, and ammonium salts—each at 0.25, 0.50, and 0.75 per cent—were applied separately to Manzanillo olives as foliar sprays on September 22 under hot, dry weather conditions. Unlike the activity obtained the previous year in cool, rainy weather, there was no reduction in fruit attachment force, but at the two higher concentrations severe leaf burning and fruit pitting developed.

TABLE 1. FORCE REQUIRED TO REMOVE OLIVE FRUITS. FOLIAR SPRAYS APPLIED MAY 17, 1967, ROBINVALE, VICTORIA, AUSTRALIA.

Sampling date	Control	Sodium salicylate 0.5%	Potassium salicylate 0.5%	Ammonium salicylate 0.5%	L.S.D. 5% level	L.S.D. 1% level
		Removal force* in grams				
May 22	401	375	362	384	26	35
May 24	430	394	392	408	36	49
May 26	445	371	365	367	32	44
May 29	341	296	296	299	30	40
May 31	327	275	295	278	33	45
June 2	346	300	329	309	27	36

* Average of 40 fruits per sampling.

TABLE 2. FORCE REQUIRED TO REMOVE OLIVE FRUITS. AMCHEM 66–329 FOLIAR SPRAYS APPLIED JUNE 27, 1967, ROBINVALE, VICTORIA, AUSTRALIA.

Sampling date	Control	1000 ppm	2000 ppm	4000 ppm
		Removal force* in grams		
June 30	521	406	505	427
July 5	467	451	332	162
July 10	403	111	192	92
July 13	378	105	74	43

* Average of 10 fruits per sampling.

TABLE 3. FORCE REQUIRED TO REMOVE MANZANILLO OLIVE FRUITS. FOLIAR SPRAYS APPLIED OCTOBER 2, 1967, DAVIS, CALIFORNIA. SUR-TEN (0.1%) ADDED AS A WETTING AGENT.

Material	Rate	Fruit removal force* in grams Oct. 6	Oct. 9	Oct. 18	leaf abscission
	ppm				
Amchem 66–329	100	581	542	548	None
	500	503	459	424	Slight
	1000	428	470	0	Heavy, 100%
	1500	359	277	0	Heavy, 100%
Abscisic acid	250	654	509	500	None
	500	587	575	550	None
	1000	627	561	530	Heavy, 100%
	2000	619	569	525	Heavy, 100%
Control		537	550	494	None

* Average of 10 fruits each on 3 replicate branches.

TABLE 4. FORCE REQUIRED TO REMOVE MANZANILLO OLIVE FRUITS, DAVIS, CALIFORNIA. SUR-TEN (0.1%) ADDED AS A WETTING AGENT.

Rate	Amchem 66–329 Fruit removal force*	Amchem 66–329 Leaf abscission	Amchem 66–329 + urea, 1.35% Fruit removal force*	Amchem 66–329 + urea, 1.35% Leaf abscission
Sprays applied October 27, 1967; pull tests, Nov. 1.				
	grams		grams	
200 ppm	485	Slight	492	Moderate
300	416	Slight	494	Heavy
400	434	Moderate	414	Heavy
500	457	Heavy	285	Very Heavy
Control	647	None		
Sprays applied November 4, 1967; pull tests, Nov. 17.				
425	..	..	282	Very Heavy
450	..	..	149	Very Heavy
450 (no wetting agent)	..	..	263	Very Heavy
475	..	..	135	Very Heavy
Control			643	None

* Average of 10 fruits each on 3 replicate branches.

TABLE 5. ETHYLENE PRODUCTION* OF OLIVE LEAVES SPRAYED WITH SEVERAL ABSCISSION-INDUCING MATERIALS ON CONTAINER-GROWN TREES IN GREENHOUSE. AZAPA VARIETY. SPRAYED JANUARY 22, 1968.

Spray treatment	First leaf sampling, Jan. 26				Second leaf sampling, Feb. 5				Third leaf sampling, Feb. 26		
	Analysis date				Analysis date				Analysis date		
	1/29	2/5	2/9	2/16	2/6	2/9	2/16	2/21	2/26	3/6	3/8
Ascorbic acid, 1.5%	0	0	0	0	0	0	0	0	0	0	0
Salicylic acid, 0.5%	0	0	0	0	0	0	0	0	0	0	0
Abscisic acid, 1000 ppm	0	0	0	0	0	0	0	0	0	0	0
Amchem 66–329, 425 ppm	12.3	13.4	18.3	20.5	13.4	15.9	11.4	18.1	7.4	0	6.2
Amchem 66–329, 425 ppm + urea, 425 ppm + NAA, 1.35%	14.3	17.7	17.0	16.6	12.4	20.7	17.7	20.7	9.5	5.5	8.0
Amchem 66–329, 10 ppm	6.6	10.3	8.9	14.8	16.0	11.7	8.9	13.4	6.1	0	0
Amchem, 66–329, 425 ppm + NAA, 150 ppm	13.8	15.1	10.1	15.4	14.0	16.9	14.1	15.5	8.4	5.5	3.5
Control	0	0	0	0	0	0	0	0	0	0	0

* μl/kg/hr

On October 2, foliar sprays of abscisic acid and Amchem 66-329 were applied to olive trees at the concentrations shown in table 3. A rain shower (0.13 inches) which fell during the evening after spray application may have influenced the results obtained. Abscisic acid at 1,000 and 2,000 ppm caused complete leaf abscission after 16 days but had no effect on fruit abscission. Neither leaves nor fruit abscissed at the two lower concentrations. Amchem 66-329 at the two higher concentrations caused heavy leaf and fruit drop but had little influence at the two lower concentrations.

On October 27, Manzanillo olive trees were sprayed with Amchem 66-329 at 200, 300, 400, and 500 ppm, with and without urea (1.35 per cent). The addition of urea accentuated the loosening effect (table 4). In fact, only when 66-329 was used at 500 ppm, plus urea, was adequate fruit loosening obtained. However, this was accompanied by severe defoliation. In addition, the lenticles on the fruit became somewhat darkened.

There seems to be a varietal difference in olives in their response to Amchem 66-329. In trees sprayed on November 21 with this material at 425 ppm + urea, the fruit removal force 13 days later for Manzanillo averaged 28 grams (control 548 grams)—while in comparison, Mission averaged 291 grams, Barouni 475 grams and Ascolano 336 grams. Leaf drop was heavy for Manzanillo but only moderate for the other varieties.

Any appreciable leaf drop from olive trees in the fall cannot be tolerated since defoliation at this time interferes with subsequent flower formation. In an effort to separate leaf and fruit abscission, several treatments were tried. A water spray drench on the tree 24 hours after spray application (66-329, 425 ppm, + urea, 1.35 per cent) increased the average fruit removal force—after 13 days—from 28 grams to 353 grams but leaf drop was still heavy. The same water drench treatment—but 6 days after spraying—resulted in 329 grams fruit removal force but with a moderate leaf drop. A very light spray application of 66-329—barely wetting the leaves—in contrast to spraying to runoff, was not effective, giving an average fruit removal force of 539 grams (unsprayed control, 548 grams), with no leaf drop. However, adding naphthaleneacetic acid at 150 ppm to the 66-329 + urea combination completely blocked the abscission-inducing effect of the 66-329, giving (after 13 days) an average fruit removal force of 607 grams (control, 548 grams), with no leaf drop.

Since it appeared that naphthaleneacetic acid influenced the abscission-inducing activity of 66-329, a series of spray treatments using 66-329 with various concentrations of NAA, plus a wetting agent, was made to young non-fruiting Manzanillo olive trees grown in containers in the greenhouse. Sprays were applied December 13, 1967, and leaf abscission counts were subsequently made at 2-, 4-, 6-, and 8-week intervals. These results are shown in the graph. Low concentrations of NAA added to 66-329 gave a rapid and pronounced promotion of leaf abscission; at high concentrations (150 ppm) a lesser and delayed stimulation occurred. At intermediate levels, especially 50 ppm, a reduction in the leaf-abscission effect of

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66-329 occurred. However, when further similar tests were conducted with this same series of spray combinations, both with and without added urea (1.35 per cent), but with another variety—Ascolano—different results were obtained. Leaf abscission at all concentrations was not only much less than obtained with Manzanillo, reaching a miximum of 40 per cent 6 weeks after spraying (control, no leaf drop), but the addition of NAA at 5 to 150 ppm did not appreciably influence the abscission-inducing effect of 66-329 on the leaves. Apparently, as noted earlier, the abscission-inducing influence of 66-329 is not the same for all varieties of olives.

It is known that, in some cases at least, the physiological action of 66-329 follows that of ethylene. In view of this, gas chromatography was used for determinations of the ethylene production of leaves taken from young olive trees (Azapa variety) sprayed with 66-329 (425 ppm) + urea (1.35 per cent), with and without added NAA. The ethylene production of leaves sprayed with other materials (ascorbic acid, salicylic acid, and abscisic acid) known to have caused abscission of olive fruits or leaves was also determined (table 5). Since only the leaves sprayed with 66-329-containing materials showed a production of ethylene, it is considered likely that the abscission of such leaves resulted from the presence of ethylene.

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