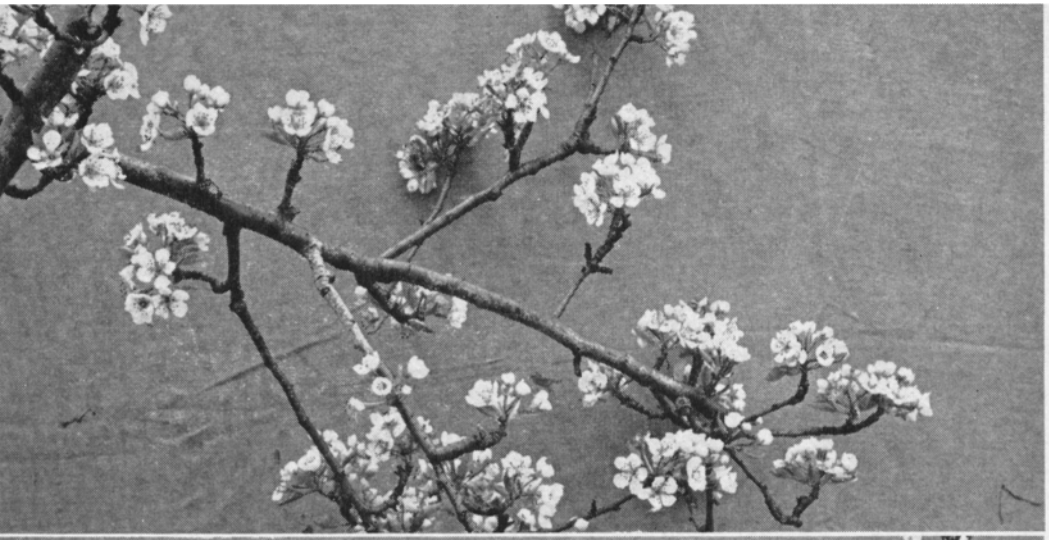
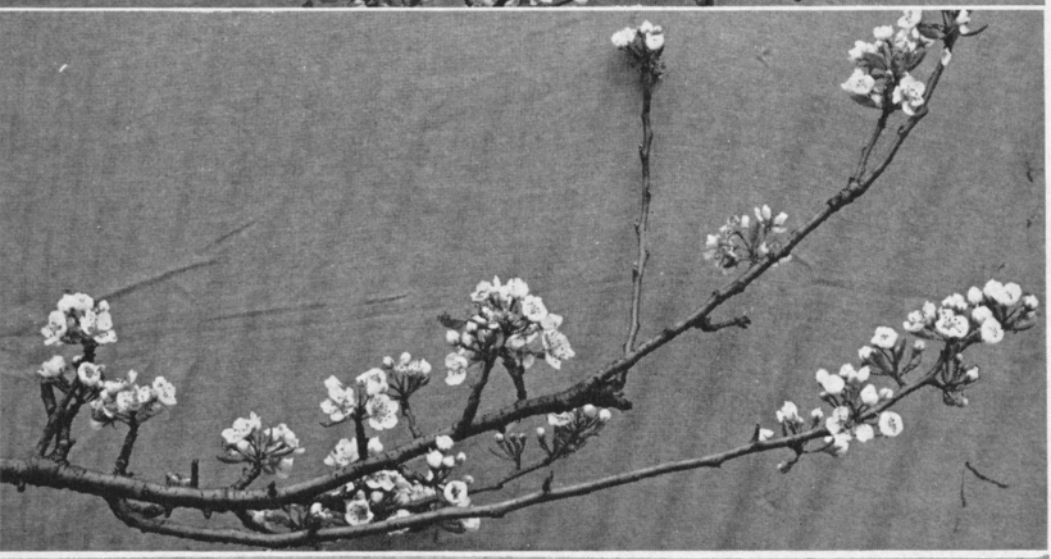
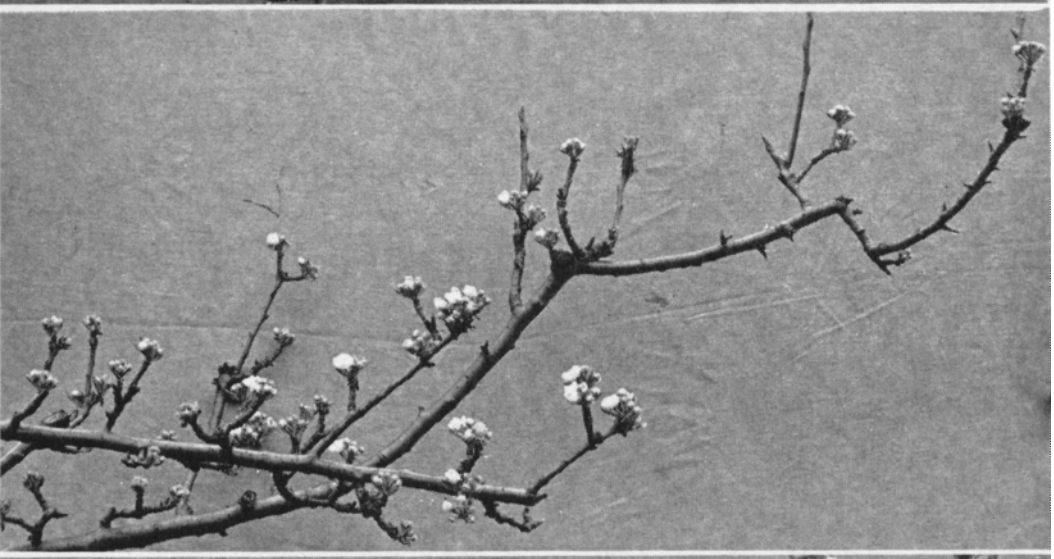
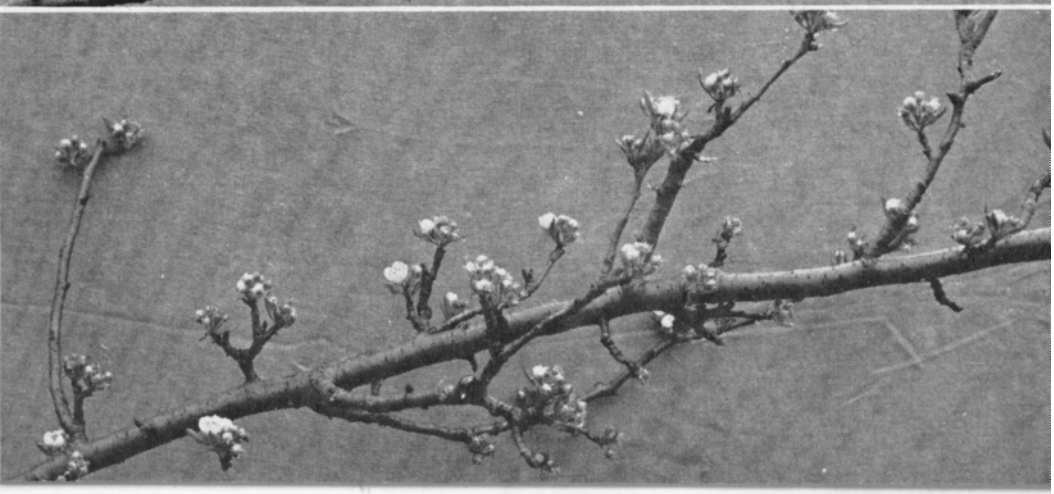








B-NINE

and Increa

Stages of Bartlett pear bloom photographed on April 5, 1965, on control trees (top photo), on trees sprayed with 500 ppm B-Nine on September 9, 1964 (second photo), on trees sprayed with 4,000 ppm B-Nine on September 9, 1964 (third photo), and on trees sprayed with 4,000 ppm B-Nine on October 14, 1964 (bottom photo).

EFFECT OF

B-Nine Treatment ppm	Date of Spray Application	MARCH, 1965 20	21	22	23	24	25
500	9/9/64						
1000	9/9/64						
2000	9/9/64						
4000	9/9/64						
1000	10/14/64						
2000	10/14/64						
4000	10/14/64						
Control							
Maximum daily temperature		63	67	63	51	39	47
Minimum daily temperature		45	44	48	40	36	37
Number of hours at 60°F or above		6½	9	6½	0	0	0

(F) denotes date of full bloom. Bars indicate length

Fall Sprays Delay Bloom se Fruit Set on Bartlett Pears

W. H. GRIGGS • B. T. IWAKIRI • R. S. BETHELL

Experimental treatments in the fall with sprays of the growth-retarding compound, "B-Nine," provided an effective and apparently safe means of delaying bloom in Bartlett pears to avoid loss due to late spring frosts. The delay in bloom resulted in increased fruit set. Shoot growth was delayed, but the total amount was not significantly reduced. Pears that developed on the sprayed trees had shorter and thicker stems, but storage, ripening and flavor qualities were not adversely affected. This chemical has not been approved for use on pears at this time.

LATE SPRING FROSTS are perennial hazards to many California pear growers, particularly in the Sierra Nevada foothills. A delay in blossoming of a few days could mean the difference between a profit and a loss for these orchardists. Since a delay in the bloom period also could result in reduced crops due to subsequent unfavorable fruit-setting weather, an ideal arrangement for areas subject to frost might be to have portions of the orchard blooming at different times.

To test the feasibility of using B-Nine or ALAR (N-dimethyl amino succinamic acid), to delay bloom in Bartlett pear trees, sprays were applied to 12-year-old trees in El Dorado County near Camino at an elevation of approximately 3,000 ft. The experimental trees were located in a relatively low area of the orchard where the frost hazard was greatest. The first series of sprays was applied September 9, 1964, while the foliage was still green.

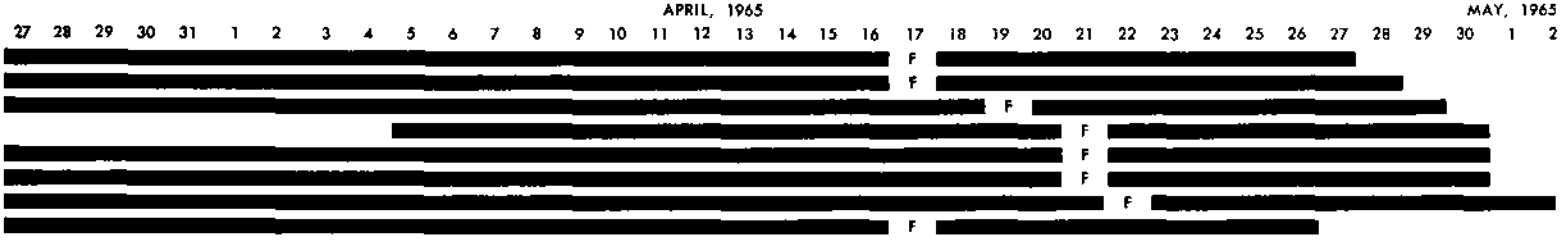
Concentrations

Concentrations of 500, 1,000, 2,000 and 4,000 ppm were used, and each was applied to a separate row of 10 trees. The second series of sprays was applied October 14, 1964, when about a fourth of the leaves had fallen. Concentrations of 1,000, 2,000 and 4,000 ppm each were applied to a separate row of 10 trees. All sprays were applied with a single-nozzle gun operated from a portable power sprayer. Ten trees in a separate row were used as controls. Temperature records were obtained from a thermograph station located in the orchard.

Shoot growth

To determine the effect of the B-Nine sprays applied in the fall of 1964 on the amount of terminal shoot growth made during 1965, the lengths of 15 upright shoots that grew during 1964 were measured on each of the 80 experimental trees before the sprays were applied. The differences in the average amount of shoot growth made during 1964 by trees in the different rows proved to be insignificant (see table) with the exception that trees sprayed with 1,000 ppm on October 14 made significantly more growth (21.7 inches) than the controls (16.8 inches). The effect of the sprays on the amount of terminal shoot growth made during 1965 was determined by measuring 15 upright shoots per tree on July 13, 1965, and

NE SPRAYS APPLIED IN THE FALL OF 1964 ON THE 1965 BLOOM PERIODS OF BARTLETT PEARS IN EL DORADO COUNTY



bloom period.

again on August 11, after the length growth was completed. By July 13, there was no significant reduction in the amount of shoot growth made by trees exposed to the various B-Nine spray rates. At this stage, the trees that received 500 ppm B-Nine had made significantly more growth than all others included in the experiment. Compensative growth occurred after July 13, however, and by August 11 there were no significant differences in the amount of terminal shoot growth made under the different treatments.

Bloom dates

The effects of the B-Nine sprays on the bloom periods during the following spring were determined by photographs as well as frequent estimates of the dates of first effective bloom, full bloom, and last effective bloom. Warm weather in February and early March stimulated a relatively early bloom and then inclement weather delayed and prolonged the blossoming period. The unsprayed control trees were in bloom from March 23 to April 26, a total of 35 days, whereas the 10-year average bloom period for Bartletts at Davis was March 23 through April 7, a total of only 17 days. The control trees had approximately 50% of their flowers open on April 5 (see photo) but did not reach full bloom until April 17. The cold weather obviously accentuated the effects of the B-Nine sprays.

Prolonging effect

The most general effect of the sprays was prolonging, rather than delaying, the bloom period. The greatest delay in bloom was effected by the 4,000 ppm spray applied September 9 which, under the cool weather conditions, delayed the date of first effective bloom 13 days beyond that of the controls. The relative dates of full bloom probably give a more accurate measure of the effect of the sprays. Of the trees sprayed September 9, those receiving 500 and 1,000 ppm reached full bloom with the controls, but those receiving 2,000 and 4,000 ppm were delayed two and four days, respectively, in reaching full bloom. Trees sprayed October 14 with either 1,000 or 2,000 ppm reached full bloom four days after the controls, while full bloom in those receiving 4,000 ppm was delayed five days. Although the October 14 sprays were more effective in delaying the dates of full bloom, the most striking result was the delaying and shortening of the bloom period of trees receiving 4,000 ppm on September 9.

Fruit set

The effect of the 1964 fall sprays of B-Nine on fruit set in 1965 was determined by counting a total of at least 100 flower clusters on one or two scaffolds on each tree early in the bloom period of 1965, and counting the number of fruit on these branches after the normal periods of fruit drop. Fruit set on the trees sprayed September 9 apparently was increased with increasing concentration of spray (see table), but only the trees receiving 4,000 ppm gave significantly higher set (31.1%) than the controls (15.8%). This raised two questions: Was the increased set due to delayed bloom which reduced loss of flowers to the freezing temperatures that occurred April 9, 10, and 11 (see graph) and allowed them to develop under more favorable fruit-setting weather? Or did B-Nine have a more direct effect, that is, the stimulation of parthenocarpic (seedless) fruit set?

Seeds

Although the differences in seed content of fruit and percentages of seedless fruit that developed under the different treatments were not significant, the samples from trees sprayed with 4,000 ppm, September 9, contained the lowest average number of seeds per fruit (1.0) and the highest percentage (62.5) of seedless fruit. However, the relationship between set and concentration of spray was not apparent for the trees sprayed October 14; and there was less variation in their bloom periods than between those sprayed September 9. It seems reasonable, therefore, to conclude that the difference in fruit set was due, primarily, to the delay or prolonging of the bloom period until more favorable weather for fruit setting rather than to any direct effect of the chemical. This conclusion also is substantiated by the fact that the trees sprayed with 500 and 1,000 ppm on September 9 had about the same percentages of fruit set as the controls, and their bloom periods coincided more closely with the controls than with those of trees subjected to higher concentrations or later applications of B-Nine.

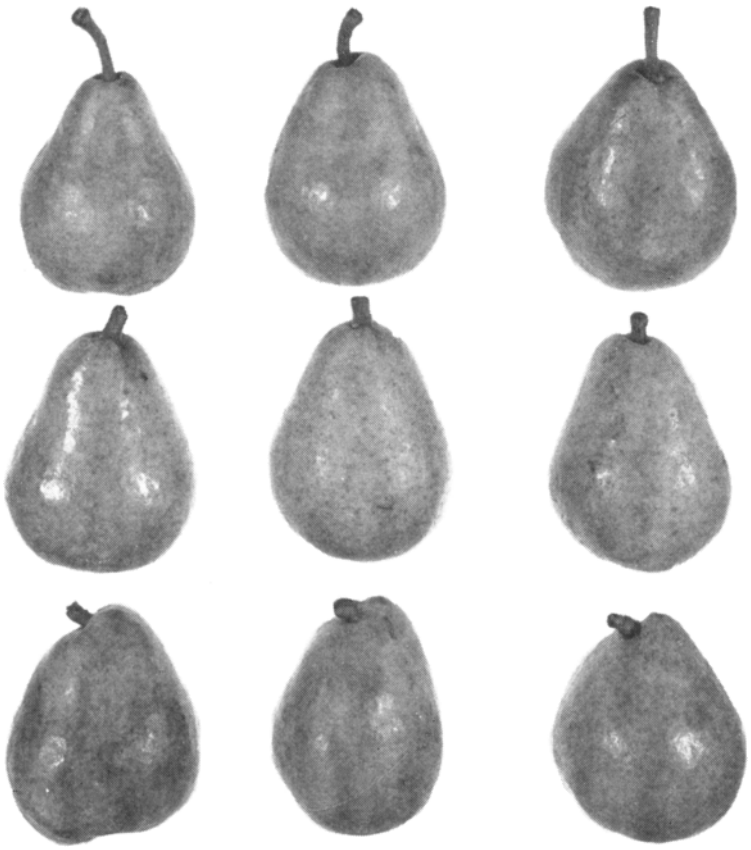
Fruit measurement

On August 11, at the beginning of commercial harvest, four pears at least 2⅜ inches (60.3 mm) in diameter were picked from each experimental tree and individually weighed and measured for length, diameter and stem size. Half of the pears were used to test for firmness, soluble solids and seed content of green fruit and half were placed in 32°F storage. On August 29, after 18 days of storage the pears were transferred to a 68°F ripening room. By September 4 they had ripened to a firmness of less than three

EFFECT OF B-NINE SPRAYS APPLIED IN SEPTEMBER AND OCTOBER ON CHARACTERISTICS OF BARTLETT PEAR TREES IN EL DORADO COUNTY

Treatment date and rate B-Nine spray (ppm)	Length of shoot growth made in 1964 (inches)	Fruit set per 100 flower clusters June 16, 1965	Length of shoot growth made in 1965		Fruit Characteristics												
					At harvest (August 11, 1965)							After storage and ripening (September 4, 1965)					
			by July 13 (inches)	by Aug. 11 (inches)	Stem length (mm)	Stem diameter (mm)	Weight (mg)	Length (mm)	Diameter (mm)	†Flesh firmness (lbs)	Soluble solids (%)	Flesh firmness (lbs)	‡Color of cuticle	Soluble solids (%)	§Flavor rating	Seeds per fruit ave.	Seedless fruit (%)
9/9/64																	
500	19.6	16.0	17.8*	22.4	19.7**	5.2**	178.6	85.4	66.5	19.9*	10.2	2.9**	2.5	11.4	2.6	1.9	52.5
1000	17.2	18.0	13.0	20.3	20.2**	5.6**	164.0*	82.6	64.4**	20.3	10.1	2.8**	2.6	10.8**	2.5	1.6	45.0
2000	17.7	21.1	12.9	20.3	17.3**	5.1*	159.8**	78.0**	63.6**	20.3	9.7	2.8**	2.8**	10.2**	2.4	1.6	40.0
4000	20.3	31.1*	13.2	21.6	13.5**	5.9**	163.5**	80.4*	64.7**	21.0	9.3*	2.6	2.9**	10.6**	2.8	1.0	62.5
10/14/64																	
1000	21.7*	27.3	14.3	22.7	17.3**	5.6**	163.4**	79.3**	65.3*	21.0	9.8	2.5	2.6	10.8**	2.8	1.3	55.0
2000	17.7	20.4	11.9	21.0	15.9**	5.9**	166.1*	79.4**	65.0**	21.4**	9.4*	2.5	2.6	10.0**	2.5	1.3	47.5
4000	19.8	23.3	12.8	20.7	14.5**	5.8**	162.2**	78.2**	65.0**	20.5	9.6	2.6	2.4	10.7**	2.3	2.0	40.0
Control	16.8	15.8	14.5	22.9	23.4	4.4	175.7	83.2	67.2	20.6	9.9	2.5	2.4	11.5	2.7	2.3	42.5

* Significantly greater or smaller than the corresponding value for the control at the 5% level.
** Significantly greater or smaller than the corresponding value for the control at the 1% level.
† Magness and Taylor pressure tester.
‡ Standard Color Chart (1 = green, 2 = light green, 3 = yellowish green, 4 = yellow).
§ Rated by judges (1 = poor, 2 = fair, 3 = good, 4 = excellent).



Bartlett pears harvested August 11, 1965: top three from control trees; middle from trees sprayed with 2000 ppm B-Nine; and lower from trees sprayed with 4000 ppm B-Nine, on October 14, 1964.

pounds and were tested for color, firmness, flavor, soluble solids and seed content.

Stem effects

The most striking effect of the sprays on the fruit was a reduction in length and an increase in diameter of stems. The cavities of affected fruit were often lipped and the stems obliquely set (see photo). The malformed fruit were intermingled with pears having normal stems and cavities. Trees receiving the highest concentrations of B-Nine produced the most fruit with short thick stems, but even under the most dilute spray (500 ppm), stem length was significantly reduced, and stem diameter was increased (see table). Date of application made little difference. According to the owner of the orchard, the short-stemmed pears caused less damage from stem punctures during harvesting and handling than those with long stems.

In general, fruit size, as shown by weight, length, and diameter, was inversely proportional to fruit set (see table). The delay in bloom caused by the sprays could account for some of the difference in fruit size, since fruit set from early bloom are known to reach harvest size before those resulting from late bloom. Since the fruit from trees receiving 1,000 and 2,000 ppm B-Nine were about the same average size as those from trees receiving 4,000 ppm, the sprays evidently had little direct effect on fruit size. Also, firmness and soluble solids of the freshly harvested pears apparently were not directly affected by spray concentration since differences in these factors were more closely associated with fruit size than with treatment. According to the present maturity standards, Bartlett pears of 2⅜ to 2½ inches (60.3 to 63.5 mm) diameter are considered mature at 20 lbs firmness, and those of 2½ inches and larger in diameter are considered mature at 21 lbs firmness. Thus, all fruit included in the samples had reached harvest maturity; and the differences in size, firmness and soluble solids between treatments are considered of little commercial importance, since pears too small or firm at the first picking normally continue to grow and soften enough to meet the maturity standards at the second or third picking.

Firmness

After six days in the ripening room, the small, though mathematically significant, differences in firmness apparently were not associated with treatment (see table). The cuticles of fruit from trees sprayed with 2,000 and 4,000 ppm B-Nine on September 9 were more advanced in color than those of the controls, but this relationship did not hold for the trees sprayed with these concentrations on October 14. The percentages of soluble solids of fruit from trees sprayed either September 9 or October 14 with 1,000, 2,000, and 4,000 ppm were significantly lower than those of the controls. This difference seems to be related to fruit size rather than a direct effect of treatment, however, since the fruit from these trees were significantly smaller than the controls at harvest. The percentages of soluble solids for all of the pear samples were relatively low in comparison to the average for the district in past years. This was due, presumably, to the unusual amount of cool, cloudy weather that occurred during the 1965 growing season. The low soluble solids content was reflected in the flavor ratings which ranged between fair and good. There were no significant differences in flavor between fruit that developed under the different treatments.

B-Nine sprays, therefore, when applied in the fall appear to offer an effective and apparently safe means of delaying bloom in Bartlett pears. Early September applications were somewhat more effective than those applied in early October. The highest concentration used (4,000 ppm) was most effective and the results indicate that still higher concentrations should be tested. With higher concentrations, however, one might expect more severe fruit malformations and a downgrading of the crop due to increased proportions of such fruit.

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The N-dimethyl amino succinamic acid (ALAR or B-Nine) was supplied by the United States Rubber Company, Naugatuck Chemical Division, Naugatuck, Connecticut. This chemical has not been cleared for use on food crops by the United States Food and Drug Administration, U.S.D.A., or the California Department of Agriculture.