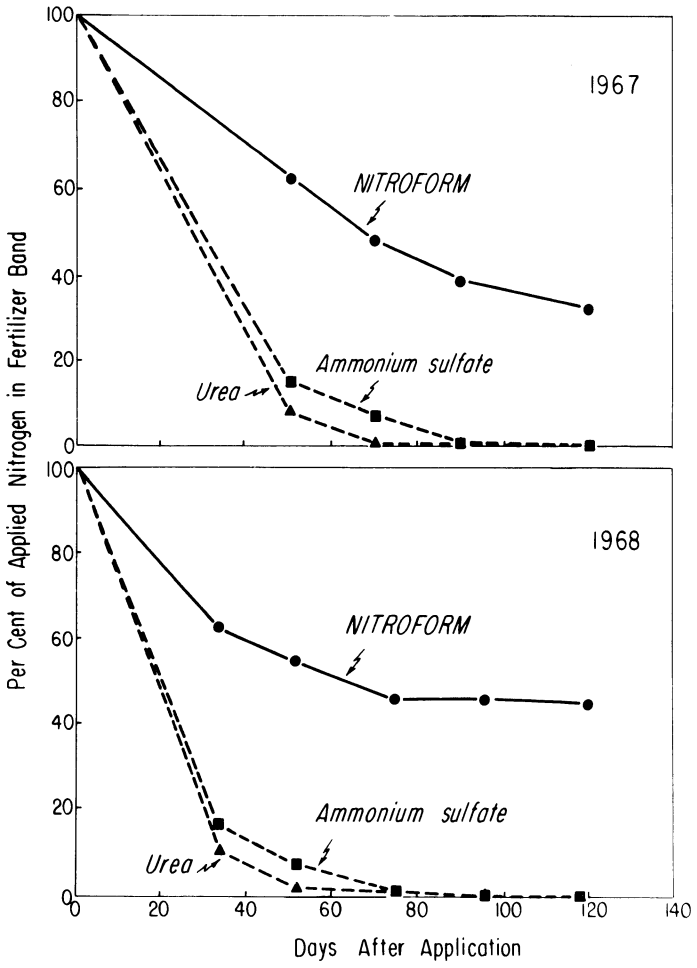

Fig. 1. Effect of source of N on the rate of leaching of N from the fertilizer band.

transformation of N from Nitroform even after 60 days makes the value of this material in vegetable fertilizer programs doubtful. As noted in previous experiments with potatoes grown on similar soils (6), the yields with $(NH_4)_2SO_4$ were slightly better than with urea. In these experiments significant differences were noted in 3 comparisons within 8 experiments.

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Effects of Crop Load, Girdling, and Auxin Application on Alternate Bearing of the Pistachio[1]

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Abstract. Alternate bearing in the pistachio, in contrast to other tree fruit species, is caused by abscission of abundant inflorescence buds during the heavy crop year. Bud abscission was found to increase as the number of nuts per branch increased. Branch girdling between the developing nuts on 1-year-old wood and the inflorescence buds on current wood reduced bud abscission to practically the same extent as that resulting from removing the young nuts from the branches. Application of para-chlorophenoxyacetic acid delayed but did not alter the degree of bud abscission. The greater the crop load in 1970, the shorter the shoot growth in length in 1971.

The pistachio (*Pistacia vera* L.) characteristically is an alternate bearer (5, 8), but the mechanism involved is unlike that of other alternate bearing tree-fruit species. Whereas other species produce relatively few flower buds during the year of a heavy crop, the pistachio produces abundant inflorescence buds every year. However, they abscise in such numbers during the summer of a heavy crop that few remain to produce a light crop the next year (2). Thus, alternate bearing in the pistachio is the result of abscission of inflorescence buds during a heavy crop year rather than lack of bud formation.

Research on other tree fruits involving various manipulative techniques relative to alternate bearing has indicated the importance of leaf area to flower bud differentiation and subsequent fruit production (1, 3, 4). For example, a greater number of leaves per fruit was required for flower bud formation on ungirdled than on girdled apple branches (4). Apparently some product of the leaves effective in flower

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differentiation was retained in the branches distal to the girdles. Blossom removal generally has resulted in extensive flower bud formation (3). A similar response has been elicited by removal of fruits during rather definite periods of time after full bloom (1). Apparently, unless leaf area exceeds that needed for fruit and vegetative growth, few or no flower buds are formed for a crop the next year. Although alternate bearing in the pistachio does not result from lack of flower bud formation, experiments were conducted to determine if some of the above manipulations would alter the abscission phenomenon. The effects of girdling, adjustment of crop load, and application of a growth regulator are presented.

Materials and Methods

'Bronte' trees in a 40-year-old commercial orchard at Elk Grove, California were selected for uniformity of crop load and vigor of growth. The crop generally was very heavy, 1970 being an "on" year. Number of nuts per branch was the main criterion used in selecting branches for treatment, but length of current growth and number of inflorescence buds were also considered. The treatments of branches indicated in Fig. 1 were replicated 5 times on each of 4 trees on June 23, 1970. Branches bearing slightly more than the desired numbers of nuts were selected and the numbers reduced to those shown in parentheses in Fig. 1.

Branches bearing approx an average load were used for girdling or auxin application. Girdling was done by making parallel cuts 1/8-inch apart with a knife and removing the bark. The girdles, located between the lowest leaves on current wood

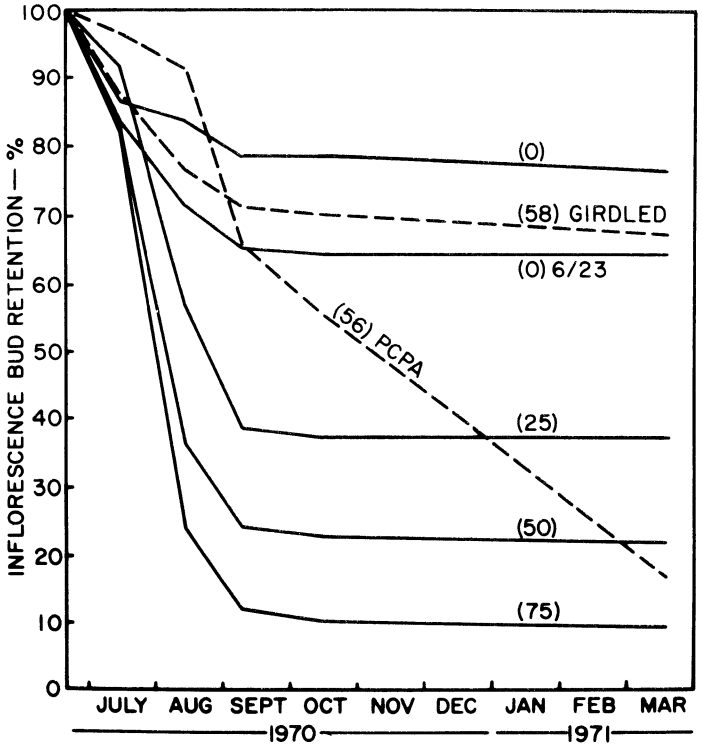

Fig. 1. The effect of number of nuts per branch (numbers in parentheses), girdling, and PCPA (100 ppm) application on retention of inflorescence buds of the 'Bronte' pistachio. Branches without nuts were of 2 types: those bearing no nuts prior to initiation of the experiment and those bearing nuts that were removed on June 23.

and the nuts on 1-year-old wood, were sealed immediately with a commercial asphalt emulsion. As para-chlorophenoxyacetic acid (PCPA) had been found useless in preventing flower abscission but did prevent abscission of peduncles (Crane, unpublished), a 100-ppm aqueous solution was applied with a hand sprayer to the leaves and nuts to the point of drip.

The number of inflorescence buds on each experimental branch was recorded on June 23 and periodically thereafter until March 19, 1971, shortly before bloom. Shoot growth in length during 1971 was measured on June 10, about a month after cessation of growth, and the number of leaves per shoot was determined.

Results and Discussion

The higher the number of nuts produced per branch in 1970, the lower the number and percentage of inflorescence buds retained for crop production in 1971 (Fig. 1, Table 1). Whereas an average of 4.3 buds (76.8% of the initial number) was retained on each branch that was devoid of nuts throughout 1970, an average of only 0.6 (10.3%) was retained per branch that had produced 75 nuts.

Table 1. The effect of crop load, girdling, and application of PCPA (100 ppm) on June 23, 1970, on inflorescence bud retention and shoot length of the 'Bronte' pistachio in 1971.

Treatment and no. of nuts/branch	No. of inflorescence buds		Shoot length (cm)	No. of leaves/ shoot
	Produced/ branch	Retained/ branch		
0	5.6	4.3	24.0	10.8
0 as of 6/23	6.4	4.1	21.4	10.7
25	6.1	2.3	18.6	10.1
50	6.6	1.5	18.2	9.8
75	5.8	0.6	14.2	8.7
PCPA	6.2	1.1	15.2	9.5
Girdled	5.9	4.0	19.3	10.3

Abscission of inflorescence buds occurred mainly during July and August (Fig. 1), the period in which practically all seed growth and development occur (2). Because of this correlation, we proposed that dominance of the developing seed and ovary over the inflorescence buds in competition for metabolites is primarily responsible for bud abscission. The fact that 23.2% of the buds abscised from branches devoid of nuts in 1970 suggests that metabolite movement may also occur from nonfruiting to fruiting branches.

Although little or no seed growth had occurred by June 23 when all nuts were removed from certain branches, the presence until that time of the developing pericarps had an adverse effect on bud retention. On branches so treated, 12.7% more buds abscised than on branches which carried no nuts throughout 1970.

Since the average number of nuts on branches not included in the experiment was 56, we assume that flower bud retention on a tree basis was somewhat less than 22.7%, the percent bud retention on branches that produced 50 nuts (Fig. 1). This compared to the 79% retention of 1969 buds (determined from the average number of nodes on the 1969 wood and the number producing nuts in 1970) which produced the heavy crop in 1970, caused us to anticipate the light crop produced in 1971.

Branch girdling induced an inflorescence bud response similar to that resulting from removal of young nuts on June 23, (Fig. 1). Despite an average of 58 nuts per girdled branch, bud retention was 3.7% greater than on defruited branches. Girdling essentially isolated the inflorescence buds from the nuts and reduced competition between them for metabolites. That carbohydrates and other metabolites accumulate above a girdle has been demonstrated previously (6). As is true with other types of wounds in the pistachio (8), periodic examination revealed that healing of the girdles proceeded slowly. As a matter of fact, 5 of the 20 branches that were girdled died in late summer. The remaining 15 branches, however, recovered and appeared normal throughout 1971.

Application of PCPA markedly delayed abscission of the inflorescence buds. Practically all of the buds destined to abscise in the other treatments had done so by Sept. 11, but less than

half of those treated with PCPA had abscised by that time. The degree of bud abscission, however, was not altered by PCPA treatment; and treated branches retained a percentage of buds commensurate with their crop load.

The precise cause of alternate bearing of fruits in general has not been clearly defined. For example, it is not known if limited flower bud formation during a heavy drop year is the result of a critical depletion of assimilates, or if it reflects the action of an inhibitor(s) originating in the fruits. Crane and Nelson (2) found that shoot growth of the 'Bronte' pistachio was relatively limited the year after a heavy crop. This indicated that abscission of the inflorescence buds was more likely the result of assimilate depletion than the action of an inhibitor. The data for shoot length and number of leaves presented in Table 1 corroborate that interpretation. The greater the crop load in 1970, the shorter the shoot growth in length and the lower the number of leaves in 1971. The same relationship was found by Rogers and Booth (7) in a study of yield and shoot growth of apple over a period of 25 years. They tentatively concluded that less assimilates were stored during the heavy crop year than during the light crop year.

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Quality of 'Lula' Avocados Stored in Controlled Atmospheres with or without Ethylene[1]

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Abstract. Storage of 'Lula' avocados in controlled atmosphere (CA) of 2% oxygen (O_2) and 10% carbon dioxide (CO_2) at 50°F for 30, 45, and 60 days resulted in more acceptable fruit than storage in air at this temp for similar durations. The removal of ethylene from the storage chambers increased the percentage of acceptable fruits, especially in the lots stored 60 days. CA-stored avocados, when placed in air at 70°F, softened more slowly than similar fruits that had been stored in air, and those stored without ethylene softened more slowly than those stored with ethylene. Anthracnose decay was the primary factor affecting acceptability, especially during the softening period at 70°F.

Ethylene long has been known to affect the physiology of various fruits in storage. Classic examples of the use of ethylene are its commercial application to ripen bananas and to degreen citrus fruits. Ethylene has been reported to increase disorders in citrus fruits, including pitting and decay (8, 17), and has been found to accumulate in apples during storage in quantities sufficient to injure the fruit (16). Storage in an atmosphere of 5% O_2 + 10% CO_2, however, reduced ethylene production in apples (13).

Eaks (7) found that neither a 6- nor 12-hr exposure to 100 ppm ethylene at 68°F was sufficient to initiate the ripening process of avocados, but a 24-hr exposure initiated ripening which was completed 3 or 4 days after the treatment was begun.

Recently Gazit and Blumenfeld (9) found that avocados did not respond to ethylene treatments given immediately after harvest, but a softening response to treatment given 25 to 49 hr after harvest was observed at 17°C. They also found that avocados treated with either 10, 100, or 1,000 ppm ethylene softened at the same rate, which confirms the previous findings of Biale (3). A concn of ethylene as low as 0.1 ppm was reported to initiate the ripening process of avocados (3, 4).

Several investigations showed that the storage life of avocados was extended in a CA environment containing less O_2 and more CO_2 than normal atmosphere (2, 10, 11, 15). Biale (1) reported that low concn of O_2 reduced the respiratory activity during the preclimacteric period and postponed the climacteric. Young et al. (18) showed that CO_2 delayed the onset of the respiratory rise in the avocado, reduced the rate of O_2 uptake at the climacteric peak, and extended storage life.

In 1968, at the USDA Station in Miami and based on the results of previous tests (10, 11), a constant flow of an atmosphere containing 2% O_2 + 10% CO_2 was selected as promising for the storage of 'Lula' avocados (14). The previous tests conducted at Miami employed numerous combinations of O_2 and CO_2 ranging from 1% to 5% and from 5% to 14%, respectively; a closed gas system was used in which ethylene presumably accumulated within the chambers. This investigation was initiated to compare the effects of storage in an atmosphere of 2% O_2 + 10% CO_2 with the ethylene removed from the system with similar storage during which the evolved ethylene was allowed to accumulate.

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[4]Manufactured by Marbon Division, Borg-Warner Corp., Washington, W. Va. Use of trade name and manufacturer's name is for identification purposes only and is not intended as a recommendation by the USDA of the article mentioned over similar articles by other manufacturers.