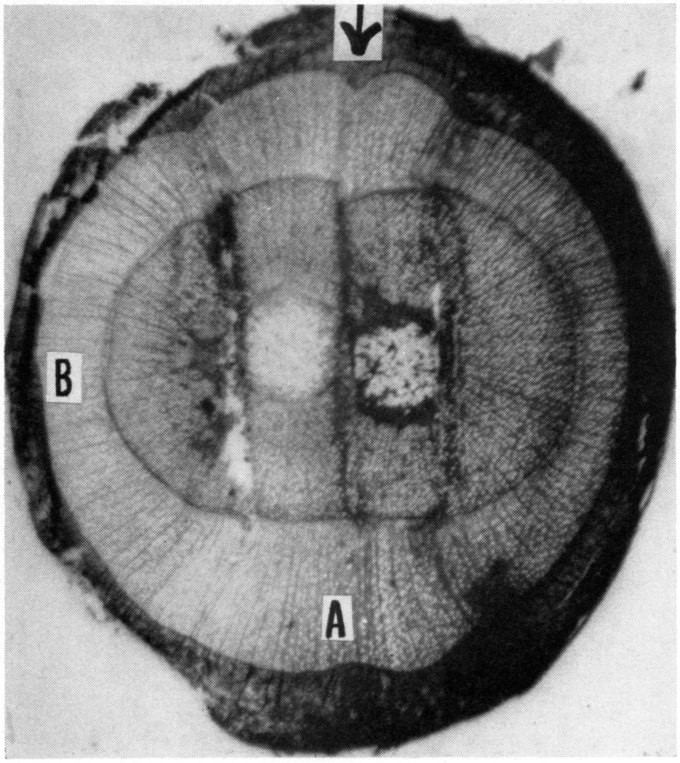

Fig. 3. A transverse section (×10) of *M. baccata*/EM VII showing healing of the graft, and phloem indentation (arrow) into the xylem. Note also positional differences in new lateral growth thickness (A vs. B) after one year of growth.

portant in graft success, were shown to be of little or no actual importance.

Some of the abnormal anatomical characteristics found in this study could have been the influence of latent viruses such as stem pitting and chlorotic leaf spot (1); however, none of the external symptoms were observed.

This study supports the premise that a successful graft union is dependent on biochemical factors associated with tissue growth and development.

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Effects of 2-Chloroethylphosphonic Acid on Ripening of Cantaloupes[1,2]

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Abstract. Applications of 2-chloroethylphosphonic acid to field grown cantaloupes resulted in yellowing of leaves, early abscission, apparent ripening of immature melons and increased total and marketable yields of full-slip melons. The percentage of soluble solids was slightly lower in treated melons.

Cantaloupes in California's San Joaquin Valley are commonly harvested 10 to 20 times during a season to obtain maximum yields. Frequent harvests are necessary because of the variability in time of fruit set and rate of fruit maturation. Treatments that might promote uniform ripening and thereby reduce the number of harvests could substantially lower harvesting costs.

The importance of ethylene as a ripening hormone has been known for some time. Recently it has been recognized as a key factor in regulating abscission and other processes often associated with ripening (3). The availability of 2-chloroethylphosphonic acid (CEPA), which on degradation yields ethylene (1, 6, 7), has made it possible to study the action of this hormone on fruit ripening in the field.

[1]Received for publication July 16, 1969.
[2]Amchem Inc., Ambler, Pa., is acknowledged for the generous supply of Ethrel, the commercial name for 2-chloroethylphosphonic acid. Drs. Kent Tyler and R. M. Davis, Jr. measured the percentage of soluble solids, and Mrs. Ann Francis analyzed the data presented in Tables 7 and 8 from the second Firebaugh study.
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Materials and Methods

The effects of CEPA on maturation and ripening of 'Powdery Mildew Resistant No. 45' cantaloupes were investigated in tests run in 1968 at the University of California at Davis and in commercial melon fields near Firebaugh, California.

The effects of submerging melons in solutions of CEPA and of spraying plants in the field prior to normal harvest were studied at Davis. For the submersion tests, 2 lots of fully netted but immature melons were harvested on July 11, one about 14 days prior to anticipated full-slip stage, and the other on July 18, about 7 days before anticipated full slip. Three comparable lots, each containing 10 melons from the first harvest and 9 melons from the second, were selected through the matched-sample technique. The melons harvested on July 11 were submerged 10 minutes in solutions containing 0, 25 or 250 ppm of CEPA. Those harvested 7 days later were submerged in water solutions containing 0, 100 or 1000 ppm of CEPA. After immersion they were stored in lined field lugs at an

ambient temperature of 18 to 20°C for 7 days, at which time they were scored for apparent ripeness.

The effect of time of application was tested in a field experiment at Davis. CEPA at 0, 100 or 1,000 ppm was sprayed to wet cantaloupe vines and fruit of two identical plots. One was sprayed July 12, about 13 days prior to anticipated full-slip stage, and the other on July 18, about 7 days prior to full slip. All melons in 10 ft sections of bed were harvested (Table 2) from the center row of each three-row plot. Maturity of harvested fruits was rated according to size, skin color and per cent of surface covered by netting (Table 1, footnote a).

In the first study at Firebaugh, 5 treatments were replicated 4 times in a randomized block design. Individual plots were 40 ft long in single rows; treated rows were separated by 3 guard rows. Two days prior to anticipated first commercial harvest, CEPA, at concentrations of 500 or 1,000 ppm was applied with a hand sprayer at a rate of 2 gal of solution per 160 ft of row, or about 81 gal per acre. The foliage and fruit were sprayed to wet in the early morning when air movement was minimal.

On the date of spraying, August 23, the vines were dark green and growing vigorously. Many melons were fully netted but not yet at full slip. However, there were a few marketable melons in each plot. All melons with fully developed abscission layers (full slip) were harvested from the center 30 ft of bed of each plot on August 26, 27, and 29. A weighted index was used to indicate differences in maturity at time of harvest.

Per cent soluble solids in the flesh of 5 mature but not overripe fruits selected at random from each plot was determined with a hand refractometer (Table 4). Percentages were transformed to arc sine angles for statistical analysis of soluble solids data.

The effects of time from spraying fruits and foliage upon yield, maturity, fruit size, and per cent soluble solids were evaluated in a second study at Firebaugh. The experiment was run in a systematic Latin square, with 2 concentrations of CEPA (0 and 1,000 ppm) replicated 5 times for each of 5 harvests (2, 3, 4, 5, and 7 days after spraying). The plots were sprayed to wet on September 16 with 2 gal of solution per 160 ft of bed, about 81 gal per acre. At harvest the melons were sorted into maturity classes (Table 1). After 10 days storage at 5 to 7°C the per cent soluble solids of the flesh was measured on 10 randomly selected, full-slip melons from each plot.

Results

Ripening of melons harvested 14 days prior to anticipated full-slip stage was enhanced by submergence in CEPA at 1,000 ppm. Ripening of fruits was not affected by treatment with 25 or 250 ppm 7 days before harvest or with 100 ppm applied 14 days before anticipated full slip (Table 1). Treatment with CEPA caused epinasty and yellowing of leaves within 2 days after spraying. Foliar applications of 1,000 ppm CEPA 1 and 2 weeks prior to full slip markedly accelerated ripening. Treatment with 100 ppm CEPA 2 weeks before harvest had no obvious effect, although treatment 1 week later increased the number of ripe fruits (Table 2).

In the first experiment at Firebaugh, maturation was accelerated significantly by CEPA at 500 and 1,000 ppm. Plots treated with CEPA yielded many more marketable and total melons than the control (Table 3). CEPA also accelerated abscission of immature melons, as indicated by the large number with incompletely developed netting, small size, and dark-green color. Clearly, CEPA caused a large number of fruits to abscise and ripen, as indicated by the number of fruits in the Hard Ripe and Eastern Choice maturity classes. Per cent soluble solids was not affected significantly by CEPA (Table 4).

In the second Firebaugh experiment, plots treated with CEPA yielded significantly more marketable melons than

Table 1. Effect of CEPA on ripening of cantaloupes in storage. Fruits were submerged in solutions on the day of harvest and were scored for ripeness on July 25.

Harvested	Treatment	Melons by ripeness class[a] (%)			
		Less than full slip	Hard ripe	Eastern choice	Western choice
7/11/68	Control	50	10		40
	25 ppm			50	50
	250 ppm	10		40	50
7/18/68	Control	20	10	60	
	100 ppm		20	60	10
	1,000 ppm	30	40	10	10

[a]Maturity classes are those used commercially. Immature and overripe melons are not marketable. Hard ripe—net green to white, ground color turning; sutures mostly green; full slip, hard. Eastern choice—net white or yellowish, ground color mostly yellow; sutures mostly green, hard. Western choice—net yellow, ground color mostly yellow; sutures partially green; firm, ideal for consumption.

Table 2. Effect of foliar application of CEPA on cantaloupe ripening.

Date sprayed	Concentration (ppm)	Full-slip melons[a] by maturity class (%)			
		Hard ripe	Eastern choice	Western choice	Over-ripe
7/12/68	Control	57	43		
	100 ppm CEPA		100		
	1,000 ppm CEPA	14	59	3	24
7/18/68	Control	27	18	46	9
	100 ppm CEPA	5	11	26	58
	1,000 ppm CEPA	47	8		45

[a]Melons from plots treated on July 12 were harvested on July 20, 25, and 27. Those from plots treated on July 18 were harvested on July 25 and August 1, 1968. Each plot was 10 ft long.

Table 3. Effect of CEPA applied in foliage sprays on ripening of cantaloupes. (totals for 3 harvests).

Concentration (ppm)	Melons harvested by maturity class (%) Ripeness classes at harvest					
	Immature	Hard ripe	Eastern choice	Western choice	Over-ripe	Total melons
Control.....	1	30	42	10	17	71
500.....	6	54	19	8	13	215
1,000.....	7	67	14	6	6	250

Table 4. Effect of CEPA on per cent soluble solids of cantaloupes (from Table 3). The first harvest was made 2 days after spraying, and the second harvest 1 day later.

Concentration (ppm)	Soluble solids[a] (%)	
	First harvest	Second harvest
Control.....	11.0	9.3
500.....	10.2	9.1
1,000.....	10.3	9.8

[a]A hand refractometer was used to measure per cent soluble solids in the juice expressed from 2 plugs (about 1.25 cm^3) from each of 5 melons per treatment. The plugs were obtained from the flesh about equidistant between the seed cavity and the rind and between the stem and blossom ends.

Table 5. Effects of CEPA applied as foliage sprays on yields of marketable cantaloupes at Firebaugh (second test).

Concentration (ppm)	Crates per acre				
	Harvested days after spraying				
	2	3	4	5	7
Control	69	100	92	121	136
1,000	202	262	299	232	96

LSD .05% = 4.14, .01% = 6.01.

did control plots on the first four harvest dates, but significantly less at the fifth harvest date, 7 days after spraying (Table 5). The greatest yield in a single harvest was on the fourth day after spraying CEPA, while the highest yield from the control plots was on the seventh day after the treated plots were sprayed (Table 5). On the dates of maximum yields, a higher percentage of smaller-sized melons was harvested from the CEPA plots than from the control plots; however, the yields of large melons were greater in the CEPA-treated plots (Fig. 1). Melons from plants treated with CEPA tended to be less mature than those from plants in the control plots, even though 13.4% of the melons in the treated plots were overripe, while none were overripe in the control plots (Table 6).

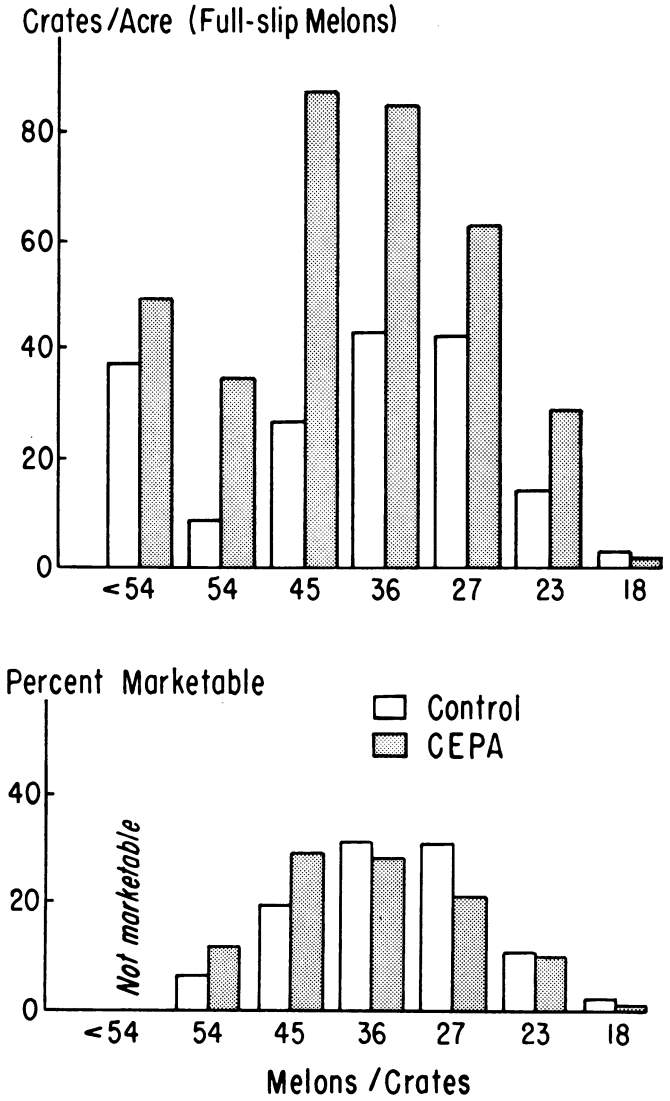

Fig. 1. Size distribution of full slip cantaloupes from CEPA-treated and control plots 4 and 7 days, respectively, after application of CEPA. Maximum yields were obtained on those dates (See Table 5).

Table 6. Effect of CEPA applied as foliar spray on ripening of full-slip cantaloupes (based on data in Table 5).

Treatment	Ripeness classes harvested				Total
	Hard ripe	Eastern choice	Western choice	Over-ripe	
Control[a] *(7th day)*					
Crates per acre	56.7	34.0	45.8	0.0	136.5
Per cent of 7th day's total harvest	41.5	24.9	33.6		100.0
CEPA (4th day after spraying)					
Crates per acre	177.9	97.5	25.2	46.6	346.2
Per cent of 4th day's total harvest	51.2	28.1	7.3	13.4	100.0

[a]Control fruits were not sprayed. The data are for fruits harvested seven days after 1,000 ppm CEPA was sprayed.

In contrast to the results of the first experiment (Table 4), the percentage of soluble solids was lower in the CEPA-treated melons than in the controls in the second experiment (Table 7). CEPA decreased the percentage of soluble solids in Western choice and Eastern choice but not in hard ripe melons (Table 7). The interaction between treatments and days from spraying to harvest was not statistically significant.

Discussion

In addition to 2-chloroethylphosphonic acid, the sample of CEPA used contained the mono-2-chloroester of this acid. CEPA has been shown by Maynard and Swan (1) and Yang (7) to degrade to ethylene, inorganic phosphate and chloride. While it has not been proved that the entire effect of CEPA is due to the ethylene released, many of the effects of CEPA previously described are characteristically ethylene-like (3). Thus it is not surprising that applications of CEPA should promote ripening in cantaloupes growing in the field, just as ethylene promotes ripening of harvested melons in storage under controlled conditions. McGlasson and Pratt (2) showed that ethylene first induced apparent ripening in stored cantaloupes harvested only 30 days after anthesis. The effect on skin ground color and its ability to stimulate abscission are both characteristic of the effect of ethylene on the complex of events that comprise the ripening process. Moreover, CEPA effects on foliage are also typical of those elicited by ethylene.

In view of the foregoing, it is likely that increases in yields in the first few harvests of the treated plots in the first Firebaugh experiment are attributable to the ethylene-like effects of CEPA in stimulating immature fruits to abscise and ripen. It was obvious that fruits on control plants would also have ripened eventually. Indeed, the control plots conceivably might have produced even greater yields of marketable melons than did the CEPA

Table 7. Effect of CEPA applied as foliar spray on per cent soluble solids of cantaloupes in different ripeness classes.

Concentration (ppm)	Per cent soluble solids by ripeness class			
	Hard ripe	Eastern choice	Western choice	Mean
None	10.0	10.8	10.7	10.5
1,000 ppm	9.2	9.7	9.9	9.6
LSD .05%	not significant	2.18	.70	

plots had they been harvested carefully a sufficient number of times. Nevertheless, the yield of marketable melons from plots treated with CEPA at 1,000 ppm was slightly greater (375 crates/A) than the yield from 12 harvests (359 crates/A) from a comparable area in the remainder of the commercial field (Table 5). The lower yield in the controls probably resulted from damage to vines and developed fruits during the frequent hand harvests.

The timing of treatment with CEPA greatly influences yield of marketable melons. The closer the time of spraying to time of normal commercial harvest, the greater the number of ripe melons (Table 2).

The percentage of soluble solids in the fruits sampled was acceptable by standards set forth in the California Agricultural Code. However, there were indications that the sugar content was slightly lower in treated fruits than in untreated fruits of the same apparent ripeness. It was obvious that CEPA caused many small, immature fruits to develop characteristics of ripe ones. Thus CEPA-treated fruits, selected as Hard Ripe for determination of soluble solids, did not attain all the attributes of Hard Ripe fruits, despite their appearance. This result has special significance in view of Rosa's (5) observation that maximum concentration of total solids is attained by cantaloupe fruits at about the half-slip stage; thereafter no further important increase in soluble solids content can be anticipated. Since CEPA induces early abscission and apparent fruit ripening, it is evident that the soluble solids content cannot surpass the level attained shortly after the time the chemical is applied. Therefore, before CEPA can be used commercially to enhance ripening, it will be necessary to study further the relationships between time of application and time of onset of abscission, increase in soluble solids content, and changes in other factors associated with ripening.

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The Inheritance of Number of Pods Per Node in Peas, *Pisum sativum* L.[1]

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Abstract. Field studies of crosses involving lines of peas which produce predominantly 1, 2 and 3 pods at each peduncle showed that inheritance of number of pods is quantitative. As many as 8–9 genes appear to differentiate pod number of the cultivars used in this study.

Estimates of heritability showed that about 50% of the total field variance of pods per peduncle was due to genetic causes. Of this about 17% was due to additive genetic effects.

A major objective of present-day pea breeding programs is concentrated set to increase yield for mechanical harvest. Early workers recognized that one of the best ways to increase yield of peas which mature at the same time was to increase the number of pods produced at each peduncle (4, 6). Although most pea breeders have some knowledge of factors which affect pod number, the genetic basis for this character is not well understood. Despite earlier suggestions of simple genetic control (4, 6), more recent information suggests a more complicated mode of inheritance. The environmental contribution to variability of number of flowers or pods per peduncle has been shown to be considerable (2, 4), but this component of variability has not been previously stated in quantitative terms. Also interrelationships between single, double and triple pods have not been investigated.

Further elucidation of the genetic basis of number of pods per peduncle would be useful in the planning of breeding programs for increased yield in peas. The experiments reported in this paper were designed to study the genetic relationships, under outdoor conditions, among 3 pea lines which produce predominantly single-, double- and triple-podded peduncles respectively. A similar experiment has been conducted under the controlled environment of a growth chamber and the results of this later study have been reported in a separate paper.

[1]Received for publication July 23, 1969. Scientific paper no. 3309, College of Agriculture, Washington State University, Pullman, Project No. 1549.

[2]From a thesis presented in partial fulfillment of the requirements for the degree of Doctor of Philosophy. Washington State University, Pullman. Present address: Department of Horticulture, University of Missouri, Columbia.

Materials and Methods

The research reported in this paper compared number of pods per peduncle produced by parental lines, F_1, F_2 and backcross progenies from the 3 parental combinations of peas—PI 210586 × 'Thomas Laxton' (TL), G113 × TL and G113 × PI 210586. Pertinent information regarding the parental lines is presented in Table 1. Information on reciprocal crosses has not been included in this paper; however, reciprocal crosses made in preliminary studies showed that the inheritance of pod number was the same regardless of which parent was used as the female.

Seed for the hybrid generations was produced in the greenhouse during the fall and winter preceding spring planting. All data reported in this paper are from plant-