

lings in other containers (Fig. 2). Seedlings grown in speedling containers, regardless of growth regulator treatment, produced lower root dry weights than seedlings grown in cylinders and pots. "Air-pruning" of the root system (Fig. 3) in the speedling containers probably resulted in low root fresh weights. The cylinder-grown seedlings had the greatest root dry weight, since the tap root was allowed to grow undisturbed in a greater volume of soil.

A close look at the speedlings showed that a small compact fibrous root system was produced (Fig. 3), indicating that these plants would transplant well. Another potential benefit derived from speedling containers was mass production in a limited amount of space and soil. The speedling can be visualized as a small compact unit that can be economically handled and shipped.

Stem height. Stem height was not influenced by growth regulator treatment or container design (Fig. 4).

In summary, GA₃ increased stem diameter of cylinder and pot-grown seedlings but not of

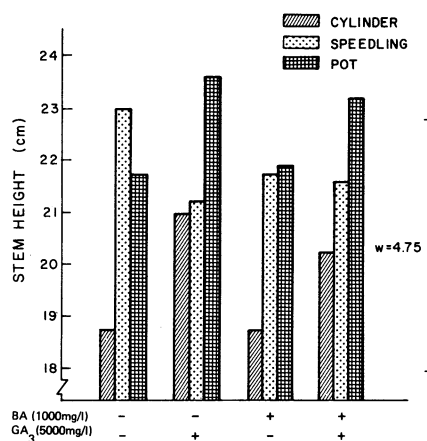


Fig. 4. The effect of container and growth regulator treatments on stem height of 'Stuart' pecan seedlings. The "--" symbol means absence of indicated regulator and "--+" symbolizes the presence of the designated concentration of regulator. Mean separation by Tukey's w procedure, 5% level.

speedling-grown seedlings. The speedling system, however, might prove profitable to nurserymen, since the tap root is eliminated reducing pruning costs.

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Induced Somatic Reduction of Chromosome Number in a Tetraploid Grape Shoot after *p*-Fluorophenylalanine Treatment¹

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Additional index words. interspecific hybrid, mutation, fruit breeding, cytology

Abstract. New shoots of a tetraploid grape (*Vitis vinifera* L. x *V. labrusca* L. cv. Kyoho; 2n=76) treated with *p*-fluorophenylalanine produced a mutant shoot with 57 chromosomes. The mutant shoot had small, thin leaves and a bushy growth habit.

Reduction of chromosome number by *p*-fluorophenylalanine (PFP) has been confirmed in root tip cells of grape seedlings (4) and in other higher plants (1, 2, 3, 5). PFP was applied to new shoots of a tetraploid grape cultivar as a direct means of chromosome reduction.

New shoots of 'Kyoho', a tetraploid grape (2n=76), grown in a greenhouse were cut back to 3 buds. The internodes above the lowest bud were cut obliquely to half the thickness of the stem diameter with a grafting knife. PFP solution was successively infiltrated into the incised part through cotton

gauze from a glass vial. The solutions used were 0, 10, 100 and 1000 ppm with 10 plants treated with each concentration. Cutting back and PFP treatment was repeated 4 times (April 7, June 7, July 7, and August 7) following the same procedure each time new

shoots grew in order to ensure the PFP infiltration into adjacent buds. Chromosome counts were conducted on roots and young leaf tips.

The number of sprouting buds was decreased by more frequent application or by higher concentrations of PFP. No buds sprouted after the 2nd cutting back of the 1000 ppm treatment, but bud sprouting of the 100 ppm PFP treatment was not reduced until the 4th sequence of treatment was applied. Leaf browning was observed on 100 and 1000 ppm treated shoots. Only 2 brown-spotted leaves developed in the shoots treated with 10 ppm PFP after the 4th cutting back while no abnormal leaves were observed on untreated shoots.

Most shoots developed after cutting back showed the original stem and leaf shape characteristics, and root and leaf tips showed only tetraploid cells. However, 1 shoot produced after the 4th cutting back and PFP application of a 10 ppm treatment was extremely different in appearance from the original cultivar. It had small, thin leaves and short internodes. The lateral shoots grew as well as the apical

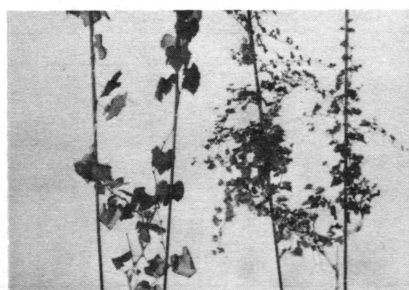


Fig. 1. Original tetraploid grape vine and leaf (2n = 76) (left); Triploid mutant (2n = 57) induced by 10 ppm PFP treatment (right).

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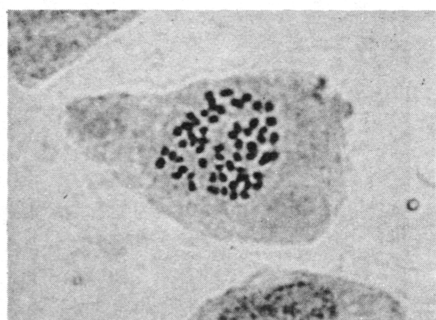


Fig. 2. Mitotic figure with 57 chromosomes in a young leaf tip cell of induced mutant of a tetraploid grape ($2n=76$) treated with PFP.

ones, resulting in a bushy growth habit (Fig. 1). This characteristic was maintained in all axillary shoots. The mutant had 57 chromo-

somes, which was counted in 32 mitotic figures of young leaf tips and in 16 of roots (Fig. 2). These observations suggested that the shoot was a triploid mutant; however, it is not known which chromosomes were actually eliminated from the original tetraploid.

Cytological observation of chromosome reducing procedures by PFP was not reported in plant cells, but mitotic abnormalities including subdivision of spindle poles which was observed in PFP treated HeLa cell (6) might result in somatically reduced chromosome number of the cells. Thus, the nature of somatic reduction and mutant shoot formation remain unresolved, but the method of direct induction of chromosome-reduced plants will be available for triploid and aneuploid breeding and genetic analysis of grape.

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Yield and Growth Response of 'Heritage' Raspberry to Daminozide and Ethephon¹

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Additional index words. *Rubus idaeus*, flower initiation, growth regulators, butanedioic acid mono-(2,2-dimethylhydroxide), (2-chlorethyl)phosphoric acid

Abstract. Butanedioic acid mono-(2,2-dimethylhydroxide) (daminozide) at concentrations ranging from 2000-8000 ppm applied when primocanes were 45 cm tall (12-16 nodes) greatly increased the early yield of 'Heritage' raspberries (*Rubus idaeus* L.). The addition of (2-chlorethyl)phosphoric acid (ethephon) at 300 ppm tended to further increase the effectiveness of the daminozide treatments. None of the treatments significantly affected the total primocane height. Microscopic examination of the axillary buds of untreated primocanes revealed that first signs of floral development occurred soon after the growth regulators were applied.

The 'Heritage' raspberry grows well under western Washington conditions and produces good late season crops. The purpose of this research was to investigate the control of vegetative growth and earlier fruiting.

Mature 'Heritage' plants were mowed off during the dormant season to limit the production to primocane fruiting. Individual plants were sprayed to the dripping point when they reached a height of 45 cm. At this stage of development, there were about 12-16 nodes above the soil surface. Treatments included

daminozide at 2000, 4000, 6000, and 8000 ppm alone and in combination with 300 ppm ethephon. These were compared with a control and with ethephon alone. Regulaid spreader-activator at 250 ppm was added to

all treatments except ethephon alone and the control.

Individual primocanes were tagged and their height measured weekly until July 23. Beginning in early September, fruits were harvested every 5 days for a total of 4 harvests.

Axillary buds for microscopic examination of flower bud initiation were collected weekly from untreated primocanes beginning when the shoots were 50 cm tall. No buds from treated canes were examined. Excised buds taken from 5 primocanes in each sampling date were grouped according to location on the shoot beginning just below the terminal bud; buds 1-3, 4-6, 7-9, 10-12. Buds were embedded in paraffin, sectioned, and evaluated for stage of floral development according to the classification system used by Mather (1).

None of the treatments significantly affected total primocane growth (Table 1). Although the daminozide treatments tended to reduce the final height, the maximum difference, when compared to the control, was only 20 cm.

The growth regulators did not alter the onset of ripening. Only the 2000 and 8000 ppm daminozide with ethephon treatments

Table 1. Effect of daminozide and ethephon on growth and yield of 'Heritage' raspberries.

| Treatment (ppm) ^a | | Height ^b (cm) | Yield (MT/ha) ^c | | | | | |
|------------------------------|----------|-----------------------------|----------------------------|-----|----------|-------|-----|--------|
| | | | Sept. | | Total | Sept. | | Total |
| | | | 2 | 8 | | 12 | 17 | |
| Daminozide | Ethephon | | | | | | | |
| 0 | 0 | 89 abc | 0.2 | 0.4 | 0.6 cd | 0.4 | 0.8 | 1.8 c |
| 2000 | 0 | 87 abc | 0.7 | 1.3 | 2.0 bcd | 1.2 | 1.6 | 4.8 b |
| 4000 | 0 | 85 abc | 0.9 | 1.7 | 2.6 abcd | 2.0 | 2.1 | 6.7 b |
| 6000 | 0 | 96 ab | 1.0 | 2.2 | 3.2 abc | 1.9 | 2.4 | 7.5 ab |
| 8000 | 0 | 69 c | 0.9 | 2.0 | 2.9 abcd | 2.0 | 2.1 | 7.0 ab |
| 0 | 300 | 103 a | 0.2 | 0.3 | 0.5 d | 0.5 | 0.9 | 1.9 c |
| 2000 | 300 | 81 abc | 1.2 | 2.3 | 3.5 ab | 2.1 | 1.9 | 7.5 ab |
| 4000 | 300 | 83 abc | 1.1 | 1.9 | 3.0 abcd | 1.7 | 2.3 | 7.0 ab |
| 6000 | 300 | 87 abc | 0.7 | 1.4 | 2.1 abcd | 1.8 | 2.6 | 6.5 b |
| 8000 | 300 | 75 bc | 1.6 | 3.1 | 4.7 a | 2.4 | 2.9 | 10.0 a |

^aRegulaid spreader-activator at 250 ppm was added to all growth regulator sprays except the ethephon treatment.

^bHeight measurements made July 23.

^cMean separation by Duncan's multiple range test, 5% level.

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