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# The Effects of Container Design, BA, and $GA_3$ on Root and Shoot Growth of Seedling Pecan Trees[1]

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*Additional index words.* *Carya illinoensis*, patch-budding, 6-benzylamino purine, gibberellic acid

***Abstract.*** **Ten day-old seedling pecans (*Carya illinoensis* (Wang.) K. Koch) grown in square plastic pots, speedling containers and styrene cylinders were treated with 1000 mg/liter 6-benzylamino-purine (BA) and 5000 mg/liter gibberellic acid ($GA_3$) singly and in combination. $GA_3$ at 5000 mg/liter promoted stem diameter enlargement of seedlings grown in cylinders and pots but had no effect on stems of speedling-grown seedlings. BA and container design had no influence on stem diameter. "Air-pruning" of roots which occurred in speedling-grown seedlings produced a compact, fibrous root system. Stem diameter and height were not significantly reduced by root "air-pruning." $GA_3$ significantly reduced root dry weight of seedlings grown in cylinders.**

$GA_3$ treated pecan nursery seedlings form 2 cm diameter stems in 4 months while untreated seedlings take 20 months. The economic advantage of $GA_3$ treatment is great since 2 cm is the minimum stock size required for successful patch budding (5, 6). However, reports demonstrating the success of patch-budding $GA_3$ enlarged stocks has not been reproducable (5). Perhaps $GA_3$ exerts a morphological or physiological influence that limits union success. Other growth regulator applications may have more promise for stem diameter enlargement with ultimate patch budding success.

Cukier (1), working with citrus, reported stem enlargement with BA applied to the trunk as a lanolin paste. Another method to increase stem enlargement might be to grow seedlings in square, bottomless containers (2). Pecan seedlings produced in containers without $GA_3$ treatment were of acceptable caliper for grafting in 1 year compared with 2 years required for regular nursery seedlings (4).

The objectives of this study were to determine the effects of BA, $GA_3$, and/or container design on root and shoot development of seedlings. Stem diameter effects in particular were examined to determine if an improved system of stem enlargement could provide earlier patch-budding of seedling stocks.

'Stuart' pecan seeds were soaked in running water for 24 hr and stratified in flats containing moist sand at 10°C for 10 weeks, after which the flats were moved into a greenhouse and the seed germinated at 30° ± 2°. Five day-old seedlings were transplanted (1 seedling per container) into each of 3 different container types: 10 cm square plastic pots; 10 cm speedling containers; and 10 cm styrene cylinders 100 cm deep. After potting, the seedlings were grown in the greenhouse at 30° ± 2°. Seedlings were liquid fed with 200 ppm liquid 20N-8.6P-16.6K fertilizer (Peters 20-20-20) at each irrigation at 10 day intervals. Ten ml of 5000 mg/liter $GA_3$ and 1000 mg/liter BA were mixed separately or together in 20 g of lanolin paste. Stems of 10 day old seedlings were treated immediately above the soil line with a 3 cm wide band of lanolin paste containing each growth regulator alone and in combination. The experimental design was a randomized-complete-block with 4 replications and 24 plants per treatment.

Stem height was measured from the soil line to the growing point, while stem diameters were measured with a vernier caliper at a point 2.5 cm above the soil line. All data was taken at the end of the 4 month experiment.

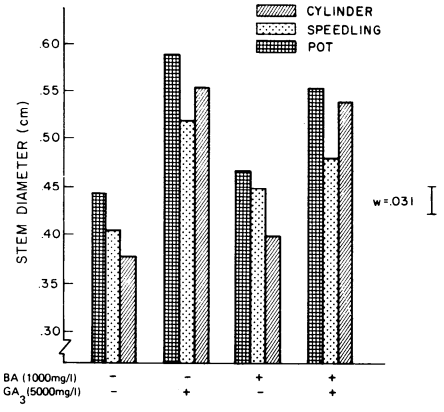


Fig. 1. The effects of container and growth regulator treatments on stem diameter of 'Stuart' pecan seedlings. The "–" symbol means absence of indicated regulator and "+" symbolizes the presence of the designated concentration of regulator. Mean separation by Tukey's w procedure, 5% level.

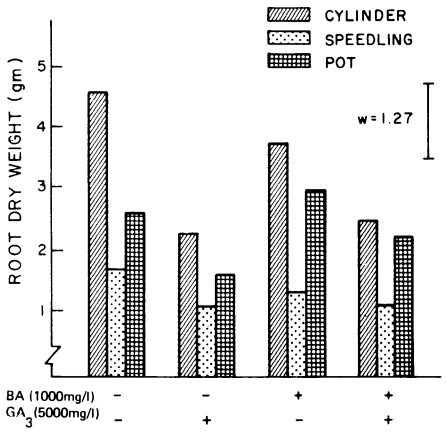


Fig. 2. The effects of container and growth regulator treatments on root dry weight of 'Stuart' pecan seedlings. The "–" symbol means absence of indicated regulator and "+" symbolizes the presence of the designated concentration of regulator. Mean separation by Tukey's w procedure, 5% level.

*Stem diameter.* Gibberellic acid increased stem diameter in cylinder and pot-grown seedlings, but not in speedling containers (Fig. 1). Container design and BA had no effect. The $GA_3$ promotion of stem diameter enlargement is in agreement with previous work (3, 5, 6). Significant growth in stem diameter by containers and BA may have resulted if seedlings had been grown for a longer period of time. $GA_3$ did not influence stem diameter of speedling-grown seedlings, possibly due to carbohydrates being diverted into the formation of fibrous root systems.

*Root dry weight.* Seedlings grown in cylinders had greater root dry weight than seed-

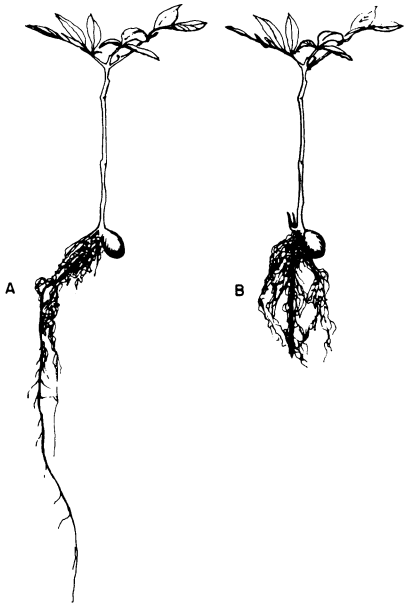


Fig. 3. Drawing illustrates shoot and root growth of container-grown seedlings:
(A) Cylinder-grown seedlings showing limited lateral development and a long tap root.
(B) Speedling-grown seedling showing a small compact fibrous root system and "air-pruned" tap root.

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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, $GA_3$ increased stem diameter of cylinder and pot-grown seedlings but not of speedling-grown seedlings. The speedling system, however, might prove profitable to nurserymen, since the tap root is eliminated reducing pruning costs.

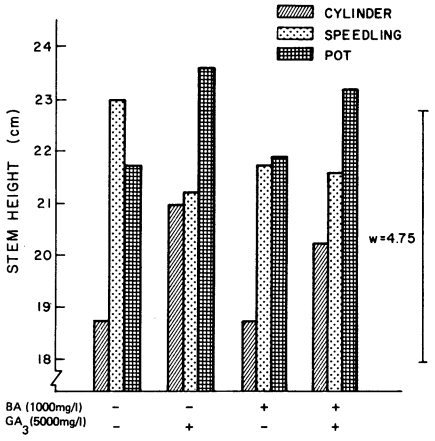


Fig. 4. The effect of container and growth regulator treatments on stem height of 'Stuart' pecan seedlings. The "–" symbol means absence of indicated regulator and "+" symbolizes the presence of the designated concentration of regulator. Mean separation by Tukey's w procedure, 5% level.

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# Induced Somatic Reduction of Chromosome Number in a Tetraploid Grape Shoot after *p*-Fluorophenylalanine Treatment[1]

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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; 2*n*=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 (2*n*=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

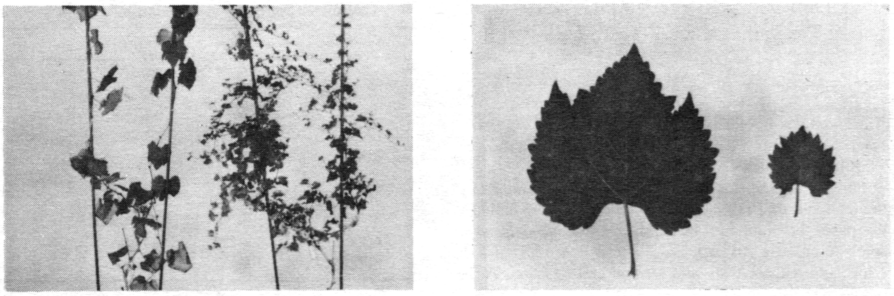

Fig. 1. Original tetraploid grape vine and leaf (2*n* = 76) (left); Triploid mutant (2*n* = 57) induced by 10 ppm PFP treatment (right).

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