PROPAGATION OF WALNUT, CHESTNUT, AND PECAN BY ROOTED CUTTINGS

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Producing genetic duplicates of existing walnuts *(Juglans* spp.), chestnuts (*Castanea* spp.), and pecans (varieties of *Carya illinoensis* [Wangenh.] K. Koch) would enable growers to produce clones of desirable types for timber production, nut production, disease resistance, or a combination of desirable qualities. For example, clones of fast growing, high quality black walnut *(Juglans nigra* L.) timber types would offer the same advantages of clones of superior poplars (6). Selected nut types or nut and timber types of all three genera could be duplicated, and disease-resistant types of each genus could be reproduced. The vegetative reproduction of blight resistant American chestnuts *(Castanea dentata* [Marsh.] Borkh.) (if such exist) and blight resistant hybrids of American and Asiatic chestnuts offers a route to reestablishment of important timber and nut-bearing trees to American forests.

Black walnut seedlings have been rooted by trench layering *(2)* and by treating cuttings under mist with indolebutyric acid (IBA) *(4,5).* Black walnut cuttings made from shoots of adventitious origin have been rooted under mist with high concentrations of IBA and transplanted to the field (9).

Hardwood pecan cuttings have been rooted, but the author did not indicate that new shoot growth was initiated after rooting *(11).*

Pecan softwood cuttings have been rooted under mist, but efforts to induce shoot growth during these studies met with little success *(8, 10,* and *12).* In 1968, scientists in South Africa succeeded in rooting pecan cuttings made from shoots resulting from cutting back stock trees and in getting the rooted cuttings to initiate shoot growth *(1).* Both hardwood and softwood cuttings of chestnut have been rooted, but difficulty in promoting shoot growth in rooted cuttings has been a major problem (3,7).

Studies to develop a method to grow rooted cuttings of black walnut, Chinese chestnut, and pecan are included in this report.

Materials and Methods

I. Black walnut studies in 1970-1971 (9):

Cuttings of black walnut selected for rooting in 1970 and 1971 were made when leaves were about 9/10 developed. Eight-inch cuttings were wounded by removing one-inch strips of bark from opposite sides of the base and treated by dipping in solutions for one second. After being set in a 1:1 peat/perlite mixture, cuttings were sprayed with 4-4-8 Bordeaux mixture. The propagation bed was enclosed except at the top with clear polyethelene. Cuttings were maintained under intermittent mist (5 seconds/3 minutes, 6 a.m. to 9 p.m.).

Table 1 shows materials and methods used in attempts to root cuttings in 1970-71.

Cuttings rooted in 1970 were transplanted into one-gallon cartons containing a 1:1 peat/perlite mixture and watered with commercial fish emulsion fertilizer. Survival was recorded February 1, 1971.

II. Black walnut rooting studies in 1972:

Black walnut cuttings studied in 1972 were not wounded as in previous experiments, and treated cuttings were set in 1:1 peat/perlite mixture contained in one-quart, paper milk containers in the mist bed. Containers were left open at the ends to assist water intake and drainage. The mist bed was located inside a temporary greenhouse made by covering a 6 x 6 (army 2 1/2 tons) bed rack with clear polyethelene. Cuttings were maintained under intermittent mist (1 second/minute, 6 a.m. to 9 p.m.). Cuttings were sprayed with 4-4-8 Bordeaux mixture as in previous experiments.

III. Chinese chestnut rooting studies in 1971 and 1972:

Visible bud cuttings tested in 1971 were prepared, maintained, and treated in the same way as black walnut cuttings in table 1. Adventitious cuttings tested in 1972 were prepared, maintained, and treated the same as black walnut cutting studies in 1972.

IV. Pecan rooting studies:

Six one-year-old pecan seedlings were utilized. Three seedlings were pruned to the root collar and all visible buds removed. The terminal buds were removed from the stems to force growth from lateral visible buds on three others. All seedlings were set in pots of 1:1 peat/perlite on 7/10/72. Twelve cuttings (2 from each seedling) were set (6 from visible buds, 6 from adventitious shoots). Cuttings were treated and maintained in the same way as 1972 walnut cuttings.

Results

I. Black walnut cuttings studied in 1970-71 experiments *(9):*

Table 1 shows results of attempts to root black walnut cuttings in 1970-71. Cuttings from shoots of adventitious origin and from current-year seedlings treated with IBA rooted. Cuttings from shoots originating from visible buds did not initiate roots.

Seventy-three percent (41 of 56) of rooted cuttings transplanted to greenhouse benches in 1970 initiated new growth.

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Table 1. Effects of applied auxin, shoot origin, and source of cutting on rooting response of black walnut soft wood cuttings during 1970 and 1971

Date cuttings set	Date examined	Source of cutting	Shoot origin	Treatment*	No. of cuttings Alive	Dead	Callused	Rooted
3/1/70	3/20/70	1 yr. seedling	adventitious	5,000 ppm IBA	10	0	0	10
7/5/70	9/5/70	3 yr. seedlings	visible bud	5,000 ppm IBA	60	0	60	0
8/11/70	9/10/70	3 yr. seedlings	adventitious	5,000 ppm IBA	20	0	2	18
		3 yr. seedlings	adventitious	10,000 ppm IAA	20	0	20	0
		3 yr. seedlings	adventitious	none	20	0	19	1
8/19/70	9/18/70	3 yr. seedlings	adventitious	5,000 ppm IBA	20	0	2	18
		3 yr. seedlings	adventitious	10,000 ppm IAA	20	0	17	3
		3 yr. seedlings	adventitious	none	20	0	20	0
8/24/70	9/20/70	3 yr. seedlings	adventitious	5,000 ppm IBA	32	0	6	26
8/29/70	9/20/70	3 yr. seedlings	adventitious	5,000 ppm IBA	30	0	6	24
7/5/71	8/26/71	4 yr. seedlings	visible buds	5,000 ppm IBA	60	0	60	0
		4 yr. seedlings	adventitious	5,000 ppm IBA	5	0	2	3
		4 yr. seedlings	adventitious	95% ethanol	5	0	5	0
7/25/71	9/3/71	13 yr. old tree	visible bud	2,500 ppm IBA	5	0	5	0
		13 yr. old tree	visible bud	5,000 ppm IBA	5	0	5	0
		13 yr. old tree	visible bud	95% ethanol	5	0	5	0
		term. of current seed.	adventitious	2,500 ppm IBA	4	1	0	4
		term. of current seed.	adventitious	5,000 ppm IBA	5	0	0	5
		term. of current seed.	adventitious	95% ethanol	5	0	5	0
		13 yr. old tree**	adventitious	2,500 ppm IBA	7	3	5	2
		13 yr. old tree**	adventitious	5,000 ppm IBA	3	7	2	1
		13 yr. old tree**	adventitious	8,000 ppm IBA	12	0	2	10
		13 yr. old tree**	adventitious	10,000 ppm IBA	12	0	5	7
		13 yr. old tree**	adventitious	95% ethanol	10	0	10	0
7/25/71	9/3/71	current yr. seedling	adventitious	2,500 ppm IBA	9	1	1	6
		current yr. seedling	adventitious	5,000 ppm IBA	5	5	0	5
		current yr. seedling	adventitious	8,000 ppm IBA	10	0	0	10
		current yr. seedling	adventitious	10,000 ppm IBA	12	0	0	7
		current yr. seedling	adventitious	95% ethanol	9	1	9	0
		shoot from lyr. graft	visible bud	5,000 ppm IBA	10	0	10	0
		shoot from lyr. graft	visible bud	8,000 ppm IBA	10	0	10	0
		shoot from lyr. graft	visible bud	10,000 ppm IBA	10	0	10	0

*All solutions of 95% ethanol except that first experiment listed used 25% ethanol and 75% water.
**Shoots result of grass fire that killed all visible buds and caused adventitious shoots to form.

II. Black walnut cuttings studied in 1972:

Table 2 shows that 100 percent (43 of 43) of adventitious black walnut cuttings treated with 8,000 ppm IBA rooted and initiated new shoot growth within 27 days from time of treatment.

Five thousand to 8,000 **ppm** IBA gave best results. Roots initiated by application of the latter concentration were larger, more numerous and branched than at other concentrations. Five thousand and 10,000 ppm IBA application produced roots of about equal size and quality.

Table 2. Effects of 8,000 ppm IBA on rooting softwood black walnut cuttings made from adventitious shoots on the lower trunk of two five-year seedling trees

Clone No.	No. cuttings	Date set	Date examined	No. rooted cuttings	No. cuttings initiating shoot growth
1	20	8/28/72	9/25/72	20	20
2	23	8/28/72	9/25/72	23	23
Totals	43			43	43

III. Attempts to root chestnut cuttings:

Chinese chestnut cuttings from visible buds (1971) did not develop roots even after 5 months under mist when treated with 8,000 ppm IBA (Table 3). Cuttings made from adventitious shoots,, resulting from limbs being cut to form a pollard, rooted and initiated new shoot growth 35 days after being treated wtih 8,000 ppm IBA and set under mist. Of 15 cuttings from the same pollard, set 8-25-72 and examined 9-28-72, fourteen had formed roots.

Roots 1/2 to 1 inch in length developed 10 days after treatment on cuttings from adventitious sources if leaves were 9/10 developed when they were set; cuttings taken when leaves were fully developed sometimes required up to 20 days to form roots of equal size. If pith had formed into plates when cuttings were set, they callused but did not form roots.

Successful transplanting was achieved only if root laterals had formed and leaves were retained at time of transplanting. Shoot growth began in 4 to 6 weeks after transplanting. Time of shoot initiation was reduced to 2 weeks after transplanting if 4,000 ppm gibberellic acid (GA) in lanolin was applied to terminal buds.

Table 3. Effects of 8,000 ppm IBA on rooting softwood cuttings of Chinese chestnut made from shoots of visible bud origin and adventitious origin with all shoots being taken from the same tree

Date cutting set	Date examined	Shoot origin	No. of cuttings Set	Alive	Callused only	Rooted	Initiated Shoot Growth
7/10/71	12/10/71	Visible Bud	30	30	30	0	0
8/11/72	9/15/72	Adventitious	36	35	0	36	35
8/25/72	9/28/72	Adventitious	15	15	1	14	0

IV. Pecan rooting studies:

The six cuttings from adventitious shoots formed roots in 15 days and shoot growth in 35 days. Cuttings from visible buds formed roots in 30 to 70 days, but none developed shoots.

Discussion

Black walnut cuttings from adventitious shoots and current-year seedlings treated with IBA in 1970-71 rooted successfully. Rooted cuttings from adventitious shoots survived transplanting and initiated shoot growth. Rooted current-year shoots were not transplanted.

Rooting response of adventitious cuttings was similar to that of cuttings from terminals of current-year seedlings. It appears that the characteristic, juvenility, is common to both types of cuttings.

Successfully rooted and transplanted black walnut cuttings were made from adventitious shoots from seedlings, young trees, and trees up to 85 years of age.

Studies of cuttings from adventitious shoots rooted in 1972 show that genetic duplicates of existing walnut trees may be successfully rooted and shoot growth renewed when treated cuttings are set in containers under mist. This eliminates transplant shock and allows planting of the rooted cutting directly into the field with a minimum of time in the greenhouse.

The failure of Chinese chestnut cuttings from visible bud shoots to form roots during 1971 is similar to results obtained with black walnut cuttings from visible bud shoots. Rooting of Chinese chestnut cuttings from adventitious shoots in containers, followed by new shoot growth within 35 days, is comparable to results obtained with black walnut cuttings of similar origin.

Of 64 rooted pecan cuttings originating from visible bud shoots in 1968, only one initiated new shoot growth *(8).* Rooted cuttings from visible buds in 1972 also failed to initiate shoot growth, but cuttings of adventitious origin formed roots and started shoot growth in about the same time as walnuts or chestnuts.

The results of these studies indicate that it is practical to produce genetic duplicates of existing black walnuts, Chinese chestnuts, and, probably, pecans from desirable trees. Also, findings indicate that it may be possible to produce genetic duplicates of any woody plant that will develop adventitious shoots.

Summary

Softwood cuttings from adventitious shoots and current-year seedlings of black walnuts were rooted under intermittent mist when treated with IBA in 95 percent ethanol. Rooting percentages of 80 to 100 were attained from shoots of adventitious origin with 1-, 3-, and 4-year-old seedlings, and lower limbs of a current-year seedlings were similarly high.

Seventy-three percent of rooted cuttings transplanted from the mist bed to containers in the greenhouse, in 1970, initiated shoot growth within two to six weeks after being transplanted.

Black walnut and Chinese chestnut cuttings from shoots of adventitious origin treated with 8,000 ppm IBA in ethanol (1972 studies) and kept under mist, rooted and initiated shoot growth in 28 to 35 days, respectively, from the time they were set.

Rooting and shoot initiation percentages were 100 for black walnut and 93 and 99 for chestnut.

Softwood pecan cuttings from visible buds formed roots within 35 to 60 days after treatment with 8,000 ppm IBA, and cuttings from adventitious shoots treated with the same concentration formed roots in 15 days. Rooted cuttings from visible bud shoots did not initiate shoot growth, but rooted cuttings from adventitious sources initiated shoot growth within 34 days after being set under mist.

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