A seed production program can have an important impact on a propagation program. Having known seed sources that will remain consistant from year to year is extremely important to a production program. Like any other production system, seed production must be treated as an important part of a total nursery growing program.

RALPH SHUGERT: Have you tried pruning 6 to 8 year old viburnums to the ground instead of your normal method of pruning about 50%?

ROBERT LOVELACE: I have not tried that because I felt I would get a quicker return to production my way.

RALPH SHUGERT: I would suggest that you take a few plants of *V. prunifolium* or *V. lantana* and make a comparison.

PROPAGATION AND GROWING OF THE CHINESE PISTACHE[1]

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Abstract. Germination percentages of Chinese pistache (*Pistacia chinensis* Bunge) seed ranged from 63 to 92 percent after 60 days stratification at 40°F (4°C) compared to 0 to 24 percent when sown directly without chilling. T-budding performed in August was more successful than in May. Softwood cuttings taken from juvenile shoots of seedlings and treated with 0, 5,000, 10,000 and 20,000 ppm IBA rooted at all hormone concentrations, but cuttings from older trees were unsuccessful.

REVIEW OF LITERATURE

The Chinese pistache (*Pistacia chinensis* Bunge) is an ornamental member of the Cashew family, Anacardiaceae (7). The name, pistachio, is generally reserved for the edible species, *P. vera*, which is not as hardy and is occasionally budded on rootstock of *P. chinensis* in California (1,8), but, more often, on *P. atlantica* or *P. terebinthus* (6). The Chinese species also has excellent heat and drought tolerance (2) and thrives in regions of long, hot summers but needs moderately cold winters to satisfy its chilling requirement (7). Chinese pistache is widely grown in California and has been suggested as a tree for desert and seaside plantings in the southwest and Gulf coast areas (1). It has proven hardy throughout Texas, Oklaho-

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ma, and into southern Kansas (zone 6 — USDA). Several trees occur on the Kansas State University campus in Manhattan (zone 5).

This highly ornamental tree is valued for its showy, autumn coloration of deep burgandy, red and eventually bright orange hues, particularly on drought-stressed, sandy sites. In addition to autumn colors, female trees exhibit attractive, multi-colored red, green and blue fruit. Fruitless, male trees are prized as street trees in the southwest because of their dense canopy. It is used extensively for residential, street and park planting (5). The cultivar 'Keith Davey' is reported to be excellent (1). Mature trees may reach a height of 20 meters in their native range in China but usually only 10 to 15 meters in Kansas.

Seed propagation is the most common method of growing this species in commercial nursery production. Fruit is harvested in late September or October. Red fruits are immature and only seed from purplish or bluish-green fruit will germinate (3). Seeds from superior trees are used by the Modesto, California, Park and Recreation Department in their selection of trees for improved type and vigor (5). Superior forms with outstanding fall color have been observed by the Wichita, Kansas, Park Department and attempts to propagate them vegetatively are currently underway.

Vegetative propagation is quite difficult and may explain why few cultivars are available in the trade. Several authors have noted difficulty with budding (3,5,6). Budding is best done in August with poorer results obtained during March and April, especially if the weather is cool and rainy (3). Hall (6) also reported difficulty in budding pistachio. However, Long (5) reported 96% success with shield budding, using buds that were not enlarged but with wood mature enough to be firm. Some California growers report better success when wood is removed from the bud (3).

Rooted cuttings would appear to be the easiest and most rapid propagation method for superior clones. Joley (3) reported only 5% rooting of cuttings under mist, but Lee and others (4) increased rooting of semi-hardwood cuttings from 28 to 70% using a pretreatment of 2N H_2SO_4 for 15 seconds, followed by a 20 second dip in 3,000 ppm IBA. This acid treatment was thought to stimulate rooting in the way that auxins affect cell wall loosening through enhanced acidity.

MATERIALS AND METHODS

Seed propagation. The mature, resinous fruit was collected as soon as ripe in October, removed from the loose panicles

and soaked for 2 or 3 days to allow the pulp to lightly ferment so it slipped free from the seed. Fruit were then macerated in a blender at a slow speed for a few seconds to separate pulp from seed. Heavier seed settled to the bottom and light seed and pulp were strained off and discarded.

In 1980 seed was obtained from several locations to test hardiness in zones 5 and 6. Sources included seed from Lubbock, Texas, and various locations in Kansas, including a tree in Manhattan. Some of the seed, obtained earlier, was stratified in November, some not until January, and germination of both was compared with seed sown directly in March without chilling. All seed was sown in trays in a commercial peat and vermiculite mix then placed in a cooler at 4°C until spring, when unchilled seed stored dry through the winter were also planted. All seeded flats were placed over bottom heat at approximately 27°C.

Vegetative propagation. Since fruiting might be a desirable characteristic of trees in a park or wildlife area, but less desirable in downtown street plantings or near patios, the ability to propagate male and female clones would be advantageous. Trees of superior form and outstanding fall color have been observed among both male and female trees in the Wichita area. Scionwood from two such trees was collected and budded on August 21, 1981 on seedling understock using standard T-budding techniques. Spring budding had been unsatisfactory in previous years. A few rootstocks were also budded in 1982 using a chip budding technique in an attempt to improve percent bud take.

Hardwood cuttings, approximately 10 to 12 cm long, from previous season's growth were taken in January of 1981 and 1982, treated with 0, 5,000, 10,000 and 20,000 ppm indolebutyric acid (IBA) and placed in a peat:perlite (30:70 v/v) medium with bottom heat. Cuttings were also wounded on both sides before dipping in IBA in 1982.

Softwood cuttings, approximately 10 to 15 cm long, were taken from tips of young, one-year-old seedlings because of the abundance of juvenile wood available and previous difficulty in rooting more mature cuttings. These tip cuttings were given a 10-sec dip in 0, 5,000, 10,000 or 20,000 ppm IBA dissolved in ethanol and water (50:50 v/v), stuck in coarse sand, and misted intermittently for 10 seconds every 6 minutes in an outdoor mist bed. Cuttings were taken on May 4 and June 15, 1981 and repeated on June 8, 1982. Since percent rooting did not increase above 10,000 ppm, the 20,000 ppm treatment was omitted in 1982 when cuttings were again taken from young, juvenile seedlings as well as a branched, two-year-old budded clone.

RESULTS AND DISCUSSION

Germination improved dramatically when seed was stratified (Table 1). From 63 to 92% of stratified seed germination compared with 0 to 24% for untreated seed. Joley (3), however, had reported that no pretreatment was necessary other than soaking for 2 to 3 hours prior to sowing, especially if spring-planted. We experienced some germination without stratification when using one-year-old seed in a separate study, but generally achieved more rapid and complete germination with stratified seed, usually within 15 days if given 6 weeks of chilling.

Table 1. Germination of *Pistacia chinensis* seed as affected by stratification.

Seed source	*Seed treatment	Date planted	Stratification time	**Date of emergence	Percent germination
Manhattan, Kansas	Stratified	11/26/79	110 days	3/31/80	82%
	Non-stratified	3/18/80	None	4/20/80	20
Waterloo, Kansas	Stratified	11/26/79	110 days	3/31/80	63
	Non-stratified	3/18/80	None	—	0
Wichita, Kansas	Stratified	1/17/80	60 days	3/31/80	92
	Non-stratified	3/18/80	None	4/25/80	1
Lubbock, Texas	Stratified	1/17/80	60 days	3/31/80	94
	Non-stratified	3/18/80	None	4/20/80	24

* Non-stratified seed stored dry at 40°F until planted.
** Stratified seed brought out of cooler on 3/18/80 and all seed given 50°F night and 80°F daytime temperature.

No appreciable differences were apparent among seed sources nor were there detectable differences in hardiness when seedlings were later grown at various locations in the state. Although considerable dieback occurred following −30°C on February 6, 1982, most seedlings recovered. It was formerly thought that the Manhattan, Kansas trees originated from a different part of China, but apparently they are not of a hardier strain.

Vegetative propagation has been quite difficult. T-budding in August was more successful than in May, which agrees with Joley (3), but even then, no more than 40% success was achieved in budding a superior male selection. Other clones and methods, including chip budding, were even less successful.

Softwood cuttings from seedlings appear quite promising as a means of asexually producing superior clones. As high as 92% rooting occurred using 5,000 ppm IBA, but considerable variability occurred among treatments and dates on which cuttings were taken (Table 2). Although percentage of cuttings

rooted did not increase appreciably above 5,000 ppm, root development appeared better at the higher IBA levels (Fig. 1). Although 56% of the juvenile cuttings rooted at 10,000 ppm, none of the cuttings from the two-year-old clone rooted sufficiently to survive transplanting. It appears that juvenility is very much a factor in the rooting of this species as, reported by Joley (3) and Lee (4).

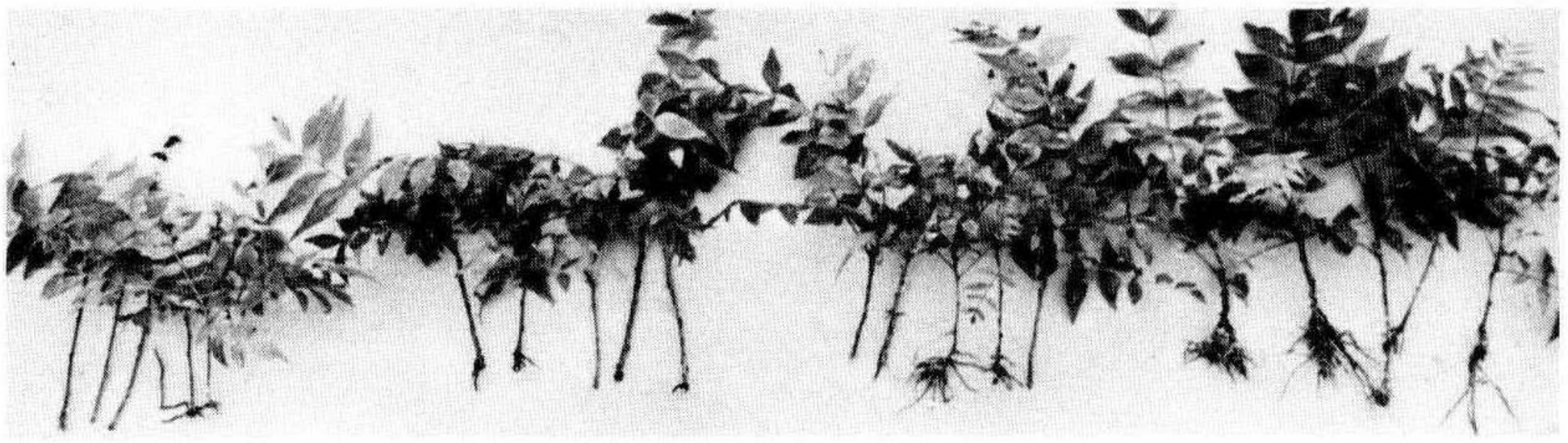

Figure 1. Rooting response of softwood cuttings of *Pistacia chinensis* treated with various rates of IBA.

A common practice in the Wichita Park Department is to sow seed outdoors in the fall with germination occurring the following spring. Seedlings, grown without disturbance in the cold frame, often attain a height of 60 to 75 cm the first summer. Plants are lifted bareroot in the fall, stored in moist packing and replanted in a nursery row where they become 2 to 2.5 meter whips the second year. Although the species does not handle well as a bareroot tree (6), no difficulty has been encountered with one or two-year-old seedlings if roots are kept moist in storage or if transplanted immediately after digging.

Table 2. Rooting of juvenile, softwood cuttings of *Pistacia chinensis* as affected by IBA concentration

IBA (conc. (ppm)	Percent rooting on dates: May 1981	June 1981	June 1982
0	20%	8%	28%
5,000	92	50	39
10,000	59	68	56
20,000	50	62	—

Container production is by far the most common method of handling Chinese pistache commercially. Their rapid growth makes the species very adaptable to container production. A 2 to 3 meter, branched tree can be produced in 2 to 3 years.

As propagation techniques continue to improve, it may become feasible to propagate Chinese pistache vegetatively to provide both male and female trees of superior growth habit and fall color. Other outstanding attributes such as drought tolerance and pest resistance should expand the desirability and use of this species in areas where it is not currently being grown.

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GLEN LUMIS: What type of root system do you get with *Pistachia chinensis* in the field?

JOHN PAIR: The container method is the most widely used method commercially. The root system will tap down if given the time. We have no problem transplanting 1 or 2 year old seedlings. We bare root them without any problems at this age but they are more difficult to bare root as an older tree.

PHILIP SOMMER: Is there a difference in growth habit between the male and female forms?

JOHN PAIR: No, however, the male form has a denser canopy which is more desirable.

HARRISON FLINT: Have you tried forcing juvenile shoots from root pieces?

JOHN PAIR: No, however, that is an excellent idea that we have not tried yet.

WAYNE LOVELACE: How did your trees survive the winter of 1981-82?

JOHN PAIR: On February 6, it went to −21°F for 4 to 5 hours. We rarely get below −10° to −15°F. Mature trees were not affected; however seedling trees died to the ground but

sprouted from the roots. Most of the seedlings survived.

JOE FOUCEK: How long does it take to obtain a saleable plant?

JOHN PAIR: A minimum of 3 years is required to make a 6 to 8 foot branched tree. For a specimen with a 1¼ to 1½ inch caliper it will take 5 to 6 years.

PHILIP SOMMER: Do you know any trees of this species growing in the Maryland or Pennsylvania area?

FRANK GOUIN: There is one at the U.S. National Arboretum in Washington, D.C.

DON SHADOW: I saw them growing in Tifton, Georgia, this past summer and they had no problems. They were approximately 20 years old.

JACK ALEXANDER: We have some seedlings at the Arnold Arboretum. Last year they were outside but mulched with pine boughs. We did get some tip dieback.

JOHN PAIR: You will often get tip dieback but it will disappear after the plants reach 10 years old. I am not recommending it for Zone 5 but am always surprised at how it survives outside its normal range.

CHARLES TAFT: You mentioned the use of 2 lbs of sulfur per cu. yd. of medium, is the right? Are you putting lime into that? What is the pH?

JOHN PAIR: Most mixes with wood chips:peat:sand (3:1:1) plus 2 lbs sulfur range in pH from 6.1 to 6.5. We do not see the need for lime in our wood chip work.

Tuesday Afternoon, December 14, 1982

The afternoon session was convened at 2:00 p.m. with Leonard Stoltz serving as Moderator.

PROPAGATION OF PLANT CULTIVARS WITH "YATSUBUSA" CHARACTERISTICS

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In Japan, horticulturists have promoted gardening with ornamentals into highly refined art forms involving both artistically trained dwarfed potted trees and Japanese gardens. To meet the demands of both bonsai and Japanese gardens horti-