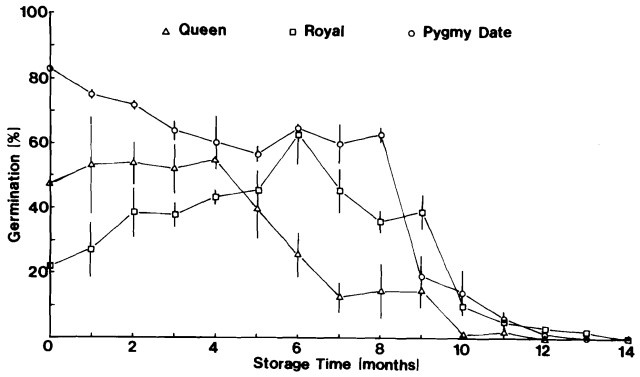

Fig. 1. Effects of storage on germination of queen, pygmy date, and royal palm seed. Points represent means ± SE.

cleaned green or half-ripe seed is used. Cleaned ripe or half-ripe seeds germinated best for pygmy date and royal palms. Cleaned palm seed can be stored for 4 to 9 months in sealed polyethylene bags and royal palm seed stored in this manner germinated better than seed planted immediately. Gibberellic acid presoaking is not recommended.

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Effect of Vigorous Shoot-Tip-Removal on Increased Fruiting of Young 'Western' Pecan Trees[1]

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Abstract

Tip removal pruning of long vigorous shoots of young 'Western' pecans, *Carya illinoensis*, (Wang) K. Koch, growing in the Rio Grande Valley in El Paso County, Texas, increased lateral buds persisting and growing through the season, decreased growth per lateral bud forced, and increased fruiting of shoots from buds forced from pruned shoots during both years. Total yield per tree was increased the second year. A useful role for tip-pruning in controlling vigor and converting vigorous shoot growth to fruiting shoots is indicated.

Index words: *Carya illinoensis*, (Wang) K. Koch, tree size control, apical dominance, fruiting, pruning

Introduction

The pecan, *Carya illinoensis*, (Wang) K. Koch, is a long-lived tree which is often grown as a landscape tree across the southern and southwestern United States for both shade and fruit. The tree can reach considerable size, and often outgrows its planting site. It is a terminal fruiting species, and thus does not adapt to most methods of tree size control by pruning. The young tree has a vigorous growth habit, strong apical dominance, and a minimum of branching and production for the first few years. Dwarfing rootstocks are not yet available for pecans, so the homeowner is faced with a long delay before fruiting commences. Any practice that would shorten this period is desirable.

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According to Sitton (8), the initial stage of growth in budded pecan trees consists of long, strongly vegetative shoot growth, with no production observed until the second stage, when shorter shoots in the lower interior portion of the tree began to fruit.

Several early researchers also noted the relationship of terminal growth to physiological age and maximum fruiting (1, 3, 4). Isbell (4) found that each pecan cultivar appeared to have a typical intermediate range of shoot growth associated with flowering, and that neither longer, strong growing shoots nor very short, weak growing shoots were productive. Any cultural treatment that prolonged the initial vegetative growth stage delayed fruiting (2).

Several attempts to suppress annual shoot growth increments have been made using hedging and tip pruning with apparently conflicting results. Kuykendall (5) made a detailed study of regrowth and fruiting patterns on vigorous

shoots headed back at three levels on 4-year-old 'Western' trees growing in Arizona. High nitrogen levels in irrigation water influenced tree vigor, and shoot regrowth was only slightly affected, but a significant fruiting increase was noted on regrowth from vigorous horizontal branches in the lower half of trees receiving the least severe pruning treatment. An attempt was made in Georgia (6) to reduce annual shoot growth by pruning back the shoot tips on vigorous regrowth following mechanical pruning. No significant results were obtained, possibly attributable to strong invigoration from the previous hedging treatment. Overcash (7) used tip-pruning on 'Desirable' and 'Stuart' pecan trees in Mississippi, but obtained no significant results. Neither cultivar is precocious, and severe heading was utilized.

The purpose of this study was to study the effect of removing the tips of long vegetative shoots on the fruiting and growth pattern of young 'Western' pecans. This should remove apical dominance, force increased numbers of lateral buds to develop into shoots, and result in shorter shoot growth with increased fruiting. An increase in fruiting in the upper and outer portions of the canopy, where long vigorous shoots normally occur, might be expected to further suppress vigor. This may also delay the onset of overcrowding.

Materials and Methods

Five-year-old trees of the precocious pecan cultivar 'Western' were dormant pruned by removing 5 to 7 cm (2 to 2.75 in) of the shoot apex of all previous season's growth which exceeded 40 cm (16 in) in length. An average of 20% of the shoots of each tree were in this vigorous, non-flowering state, ranging from 24 to 36, primarily in the upper canopy. Eight replications of nine-tree-plots [3 trees in 3 adjacent rows spaced 4.6m × 9.2m (15 × 30 ft)] in a randomized complete block design were treated, but data were utilized from only the center tree. Shoots over 40 cm (16 in) in length were marked in the check plots. During the dormant season following the sixth year's growth, all previous season's shoots which exceeded 40 cm (16 in) in length were again pruned by removing 5 to 7 cm (2 to 2.75 in) of the shoot apex. An average of 9% of the total number of shoots of each previously pruned tree were still in this vigorous, non-flowering state. The number of shoots pruned ranged from 17 to 29 per tree.

During the sixth and seventh growing seasons data were recorded for buds forced per shoot, average growth per shoot, percent of lateral buds forced and persisting in growth, total nuts per long shoot, total yield per tree, tree diameter increase, kernel percentage, and average nut weight.

Results and Discussion

Tip-pruning did not affect the numbers of lateral buds forced from vigorous previous season's shoots in either year, but the percentage of lateral buds persisting was greater due to lower levels of bud mortality after growth initiation in the spring (Table 1). Growth of shoots from these buds was shorter, resulting in a more compact, denser tree. Tipping increased fruiting. Total yield per tree was not affected by the first year's pruning, but the cumulative effect of the two years of tip-pruning increased yield. Tree diameter increase, and percent kernel and nut weight were not affected, since only a small percent of the total shoots on the trees were pruned during either year, thus diluting the impact of shoot treatment effects on the entire tree.

Significance to the Nursery Industry

This study indicates that tip-pruning can increase fruiting, modify the growth habit, and reduce the total regrowth increment from vigorous shoots on young 'Western' pecan trees. A worker utilizing commercial hydraulic pruning equipment, can prune a tree in about 6 minutes. Since the maximum number of cuts on any one tree was 36, a homeowner should be able to hand-prune similar trees in 30 minutes or less. The shorter shoot growth and increased fruiting on regrowth from long shoots should contribute to the early productivity of the tree by increasing the percentage of bearing-length shoots throughout the canopy. Compact growth resulting in a smaller tree would prolong the productive period prior to tree overcrowding and reduce the cost of cultural practices, such as spraying.

The long range effects of tipping on orchard performance, its effects on tree form and shape, and its effectiveness as a tool for other cultivars are yet to be determined. The positive benefits of increased early production in this trial indicate its usefulness as a tool for the landscape pecan tree.

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Table 1. Influence of tip-pruning of vigorous shoots on shoot growth, nut set, and yield of 'Western' pecan trees.

Year	Pruning Treatment	Buds forced/ shoot	% of lateral buds persisting after 1 year	Avg. growth/ forced bud (cm)	Total nuts/ vigorous shoot	Yield after tip-pruning (Kg/tree)
1st	Tipped	5.6 a[z]	69.9 a	36.0 a	13.5 a	5.3 a
	Control	5.0 a	51.0 b	43.9 b	9.7 b	4.0 a
2nd	Tipped	6.1 a	65.8 a	33.5 a	14.4 a	11.0 a
	Control	5.1 a	49.6 b	41.2 b	10.6 b	7.6 b

[z]Means in columns for each year followed by the same letter or letters are not significantly different at the 5% level by Duncan's Multiple Range Test.

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Characterization of Filbert (*Corylus*) Species and Cultivars Using Gradient Polyacrylamide Gel Electrophoresis[1]

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Abstract

A chemical identification procedure previously used to identify apple and pear species, cultivars and clonal accessions, was tried with *Corylus* (filbert, hazel) species, cultivars and clonal accessions. Following electrophoresis, the peroxidase, phenol oxidase, and acid phosphatase isozyme patterns on anionic polyacrylamide gradient gels were determined. These patterns were found to vary between clonal accessions, but did not change, within a given accession during and following the test period (May through October). Thus, these patterns were considered to represent genetic characteristics suitable for identification purposes. The patterns were used to identify 78 *Corylus* accessions at the National Clonal Germplasm Repository Corvallis, Oregon. All accessions tested (species, cultivars and clones) were distinguishable using this system. The diversity of isozyme patterns was greater in *Corylus* than *Pyrus* populations previously sampled. This technique appears to have the potential to readily identify filbert accessions and could be an important aid in the characterization of germplasm material.

Index words: acid phosphatase, *Corylus*, electrophoresis, filbert, hazel, isozyme diversity, peroxidase, plant fingerprinting, phenol oxidase, pear, *Pyrus*

Introduction

Chemical identification (fingerprinting) of plant species and cultivars has received increased attention (3, 4, 6, 7, 20) from plant breeders, the nursery industry, growers, and U.S. trade officials (1) because of the increased recognition of germplasm reserves and the importance of exact clonal identification. Genetic markers are useful in identifying clonally propagated material in many crops (2, 12, 16, 21). The National Clonal Gerplasm Repository (NCGR) system, collects, maintains, identifies and characterizes clones of selected crop genera (11). The NCGR at Corvallis, Oregon is responsible for eight genera, including *Corylus* (filbert, hazel). At present the collection of *Corylus* is much smaller (about 150 accessions, 78 of which are large enough to be sampled) than the world collection of pears (19) which comprises over a thousand accessions. Thus, it was thought possible that this relatively small collection could be identified and classified in one year.

A search of the literature showed that only one electrophoretic fingerprinting method was available for *Corylus* (8), but this method, designed for industrial products, was not appropriate for our purpose. A second method—developed originally for apple cultivars (*Malus*) (13), and then modified for pear (*Pyrus*) accessions (14)—was tested. This second method showed that shoot extracts yielded identifying electrophoretic isozymic patterns. The particular patterns that identified each clone remained constant throughout the test period and were not affected by the age of the plant from which the shoots were collected. This technique can be used with very young specimens before phenotypic morphological characteristics, such as those associated with filbert production, become apparent. This paper reports the first application of this method to the genus *Corylus*.

The gene pool for cultivated plants resides, largely, in the wild or less used species of the same genus, and closely related genera (19). *Corylus* has about nine recognized species (Hummer *et al.*, 1986). In the NCGR collection five species had enough growth to be sampled, these are: *C. avellana*, *C. colurna*, *C. heterophylla*, *C. maxima* and *C. vilmorinii*.

Materials and Methods

Plant material was obtained from the NCGR, Corvallis, Oregon *Corylus* Collection. One-year-old shoots (except when otherwise indicated) were collected from May through

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