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## A Comparison of Four Methods of Pecan Orchard Establishment<sup>1</sup>

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**Abstract.** The effect of 4 methods of orchard establishment of pecan [*Carya illinoensis* (Wang) K. Koch] on early production was determined: 1) by planting seed in place, 2) by transplanting 1-year-old seedlings, 3) by transplanting 3-year-old seedlings, and 4) by transplanting trees budded with 'Wichita' scions. Treatments 1, 2, and 3 were budded in the field at the end of the third growing season with 'Wichita'. Both yield and trunk measurements indicated that treatment differences decreased over 10 years. Yield estimates indicate that treatment 4 would yield about 340-560 kg/ha more during the first 10 years than any of the other treatments. The first 3 treatments differed little in tree development and yield.

Pecan orchard establishment techniques vary greatly and each method has advantages and disadvantages (1, 6, 7). The least expensive method is to grow rootstocks from seed and to graft or to bud improved cultivars on these rootstocks. This requires specialized skills and delays production. The other extreme involves buying 3- or 4-year-old budded trees from nurserymen. This method is expensive, but it is the fastest way to bring an orchard into bearing. A compromise method is to buy rootstock seedlings and to bud or graft them with improved cultivars after establishment in the field. Seedlings usually can be purchased for a fraction of the cost of budded or grafted trees.

A grower must choose which method of orchard establishment to use. Earliness of production is one of the most important economic factors affecting this decision. Yield data comparing these methods are very limited, although various studies have compared initial tree growth (2, 4, 6, 7, 8). This study was undertaken to study differences in yield during the first 10 years after planting.

The study was field-planted at Brownwood, Texas, on deep, loamy Frio soil that formed in calcareous alluvium on flood plains. Slopes were 0-1%. Open-pollinated 'Riverside' was used as rootstock for all treatments. All seed or trees were planted in the field in April 1968.

There were 4 treatments: 1) *Seed planted in place.* Three seed of open-pollinated 'Riverside' were planted at each site where a permanent tree was desired. A 20-cm-diameter hole was drilled 8 cm deep. Three seed were placed around the outside of the hole with the apex of each seed pointing toward the center. This allowed the selection of the largest seedling at the time of budding and the removal of the tops of the less vigorous seedlings. This system would require about 1.6 kg of seed per hectare. 2) *One-year-old seedlings.* Seedlings were grown in barrels at the Brownwood Station in semishade conditions. The tops of these trees averaged 30-37.5 cm and the roots were about 75 cm long. The trees were transplanted to holes 10 cm in diameter and 90 cm deep. Only the more vigorous trees were planted. 3) *Three-year-old seedlings.* The 1.8-m-high trees were purchased from a commercial nurseryman for \$1.50 each. They were planted in holes 22 cm wide and 105 cm deep. The tap roots were treated with IBA-treated toothpicks (9). 4) *Budded 'Wichita' trees.* These trees consisted of patch-budded, 1-year-old 'Wichita' scions on 3-year-old 'Riverside' rootstocks. They were purchased from a commercial nurseryman for \$4 each. They were planted

in holes 22 cm in diameter and 105 cm deep and treated with IBA as those in treatment 3.

All trees in treatments 3 and 4 were pruned to remove about 1/2 of the top to insure survival after transplanting. There were 5 replications of 5 trees each. All treatments were randomized within replications. Spacing was 5.2 m within and 10.5 m between rows (183 trees per ha). The experimental area was 3 rows wide and 34 trees long, with guard trees on the sides.

Annual rainfall plus irrigation water received by the plots averaged 118 cm. All trees received 4 additional tank waterings in 1968.

All but 3 of the 75 seedlings (treatments 1, 2, and 3) were large enough to bud to 'Wichita' in August of 1970 (after 3 growing seasons). Most of the 1- and 3-year-old seedlings (treatments 2 and 3) were large enough for budding in 1969, but patch budding was delayed until 1970 so that most trees of all 3 treatments could be budded at the same time. The remaining 3 seedlings were budded in the spring of 1971. Buds were forced by stripping the bark above the buds.

It took 16 min per tree, or almost 50 hr per ha, at this spacing to cut budwood, bud, remove budding tape, force the buds (strip the bark), remove rootstock sprouts, and tie the forced buds to stubs.

Several of the sprouted buds soon exceeded the height of the stubs, so 2.4-m wooden stakes were driven in the ground for support of the rapidly growing tops. This was done in early July 1971 and required an additional 5 min per tree, or 15 hr per ha.

Trees received 63 g of actual nitrogen per cm of trunk diameter annually for the first 3 years. This was applied to the soil surface in a 1-m-diameter circle around the tree. After the third year, 122 kg/ha of actual N was applied uniformly to the surface in February of each year. Ammonium nitrate was used as the nitrogen source throughout the study. Zinc was applied twice each year by wetting the leaves to runoff with a ZnSO<sub>4</sub> solution (2.4 g/liter H<sub>2</sub>O).

Trunk diameter was measured in February 1969 and every other February thereafter through 1979. These measurements were made 15 cm above ground in 1969 and 1971 and at a height of 1.2 m thereafter. Nuts on individual trees were harvested in 1972, 1974, 1975, 1977, and 1979.

The budded trees (treatment 4) would have started yielding in 1971, but a spring freeze destroyed all production up to 9 m high. A similar freeze occurred in 1973.

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Table 1. Effect of 4 methods of pecan orchard establishment in 1968 on yields, Brownwood, Texas.

Treatment <sup>z</sup>	Nut yields (kg/tree)				
	1972	1974	1975	1977	1979
1. (seed planted in place)	.03a <sup>y</sup>	1.73a	2.36a	6.94a	25.54a
2. (1-yr-old seedlings)	.05a	1.51a	2.11a	6.85a	20.86a
3. (3-yr-old seedlings)	.06a	1.78a	2.20a	6.76a	25.71a
4. (budded trees)	.39b	1.78a	3.92b	6.39a	23.70a

<sup>z</sup>Refer to text for details.

<sup>y</sup>Mean separation in columns by Duncan's multiple range test, 5% level.

There were obvious significant differences in yield in 1972 (Table 1). Treatment 1 (seed in place), as well as treatments 2 and 3 (seedlings), set essentially no nuts, while the budded trees (treatment 4) yielded 0.4 kg each. The scions of treatments 1, 2, and 3 were 2 years old, and the tops of treatment 4 were 5 years old. The 0.4 kg per tree average yield (or 71.4 kg/ha) for treatment 4 when the trees were 5 years old is similar to that obtained by other workers (1).

We were surprised that there were no significant differences between treatment yields in 1974. Treatment 1 yielded more than we expected and treatment 4 less than expected (Table 1).

There were again significant differences in 1975, with treatment 4 yielding 717 kg/ha (much more than the other treatments), with no significant differences between the other 3 treatments. The 1977 and 1979, treatment yields were not significantly different, indicating that treatment effects had disappeared at the beginning of the 9th season after establishment.

The cumulative yields for 1972, 1974, and 1975 of the trees in treatments 1 through 4 were 4.1, 3.7, 4.0, and 6.1 kg/tree, respectively, or 750, 677, 732, and 1,116 kg/ha.

The difference in yield is substantial, and 350 kg/ha of production (plus small differences which probably occurred in 1973) should largely recover the extra original cost of the budded trees in treatment 4.

Tree growth, expressed as increase of cross-sectional trunk area, is shown in Table 2. These measurements in alternate years may be a more reliable estimate of how soon treatment differences disappeared, since yield is largely a function of tree size (5). In 1969, cross-sectional trunk areas of the trees in treatments 1 and 2 were very small, and they were smaller with treatment 1 than with treatment 2 (Table 2). Trees in treatments 3 and 4 were identical in size in 1969, but the trees in treatment 3 were larger in 1971. In 1975 the largest trees were those in treatment 4. The reasons for these changes are not known.

Considering both yield and trunk measurements, it appears that treatment differences decreased by the end of 1977. There were still size differences, but there were no yield differences between treatments. After 10 years, all trees were equal in productive capacity. 'Wichita' is precocious, and this should be considered when predicting how other varieties would react in similar circumstances. Differences between the treatments

Table 2. Effect of 4 methods of pecan orchard establishment in 1968 on trunk cross-sectional area, Brownwood, Texas.

Treatment <sup>z</sup>	Trunk cross-sectional area (cm <sup>2</sup> /tree)					
	1969	1971	1973	1975	1977	1979
1. (seed planted in place)	0.2a <sup>y</sup>	6.3a	33.9a	57.0ab	130.5a	224a
2. (1-yr-old seedlings)	0.4b	8.0a	32.1a	53.1a	122.9ab	208a
3. (3-yr-old seedlings)	2.2c	13.7c	42.5b	63.9b	139.7ab	228a
4. (budded trees)	2.2c	10.6b	42.7b	85.1c	160.4b	228a

<sup>z</sup>Refer to text for details.

<sup>y</sup>Mean separation in columns by Duncan's multiple range test, 5% level.

probably would be smaller with less precocious varieties. When comparing varieties, there seems to be little relationship between early productivity and tree size development (10).

We estimate that 'Wichita' trees planted as budded nursery trees should yield 340–560 kg/ha more during the first 10 seasons than trees budded *in situ*. This should serve as a guide for making decisions as to which establishment method will work best for each grower. The results agree fairly well with those of an earlier study done in Louisiana with 'Mahan' on 'Riverside' rootstock (3), where nursery trees began bearing 3 years earlier than trees from seed planted in place.

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