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'Pawnee' Pecan

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Genetic improvement of pecan (*Carya illinoinensis* (Wangenh.) K. Koch) has come a long way since William Nelson first sold grafted pecan trees in New Orleans in 1879 (1). Currently the oldest continuous breeding program is that of the U. S. Department of Agriculture's Agricultural Research Service. This article reviews the performance of one of its most successful cultivars.

"Pawnee' is one of the most popular pecan cultivars (as far as number of trees being planted worldwide) today. 'Pawnee' was released by the U.S. Department of Agriculture Nov. 2, 1984 (8, 10). Tested as 63-16-125, 'Pawnee' is a selection from a 'Mohawk' by 'Starking Hardy Giant' cross (Figure 1) made by L. D. Romberg in 1963 at the USDA Pecan Worksite in Brownwood, Tex. This pedigree, including the 'Mohawk' parentage ('Success' X 'Mahan'), has been verified by isozyme analyses (4). A bud from the resulting seedling was propagated onto a native tree in the summer of 1964, and forced in 1965. The scion first fruited in 1969, and scionwood was first distributed to cooperators in 1978. Sparks (5), erroneously states that 'Pawnee' probably has the record for grower distribution prior to being named, and that the profusion of 63-16-125 was a compelling reason for the USDA granting cultivar status to this selection. It did not have the record for grower distribution prior to its release. It was released based upon performance and projected suitability for the pecan industry.

Initially, there was much skepticism as to whether this cultivar was useful to the industry. Growers were very concerned about animal depredation, which can be complete on any early nut-maturing cultivar. This is because such trees are the only source of this highly nutritious and sought after nut. Squirrels, crows, bluejays, and other animal feeding is concentrated on such trees, and they can remove all nuts. Another major concern was whether the trees could be shaken with mechanical shakers to remove the nuts in September. The bark is still slipping during this time of year, and "barking" or tearing loose major bark sections from the trunk, causes severe tree damage. A desirable aspect of harvesting early is that the leaves remain on the trees and are not a source of trash to be contended with during the harvesting operation. There is also a distinct marketing advantage with an early cultivar. Today if roadside markets have pecans for sale in October in many parts of the pecan belt, they are exclusively 'Pawnee.' High-quality nuts like 'Pawnee' that are available early in the season often sell for substantially more than nuts of other cultivars harvested later.

'Pawnee' was initially reported to be precocious and prolific (5, 7), but this was an overstatement. Yield results at many NPACTS (National Pecan Advanced Clone Testing System) sites have consistently shown that 'Pawnee' has mediocre precocity and prolificacy (Table 1), which is very similar, or slightly superior to 'Desirable.' It is not a high yielding cultivar like 'Wichita,' 'Navaho,' and many of the other USDA cultivars released for the Western U.S. production area. 'Pawnee' can also alternate bear, especially from tree-to-tree in the orchard. On the whole this mediocre genetic potential for production is welcomed in most production areas, because so many cultivars set many more nuts than the trees are capable of filling with quality kernel. The result is often trashy, low quality nuts.

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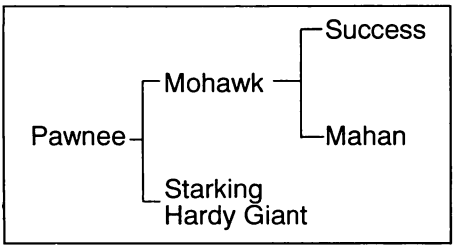

Figure 1. Pedigree of 'Pawnee' pecan. The upper parent in each generation was the female.

Many experienced pecan producers prefer cultivars like 'Pawnee,' 'Hopi,' or 'Desirable' that produce smaller quantities of higher quality nuts.

As with most pecan cultivars, and particularly early nut-maturing cultivars. 'Pawnee' must be harvested in a timely manner. Its early maturity makes it much more susceptible to animal depredation, as well as quality loss due to high ambient temperatures, and sometimes wet orchard conditions. 'Pawnee' does not ripen uniformly. About 50-75 percent of the nuts can be obtained in the first harvest, with a second clean-up harvest required later. This way the grower can take advantage of the high early market prices and minimize depredation losses. A complication here also, is that the bark of the trees is still slipping in September or early October when the majority of 'Pawnee' nuts are ready to harvest. This makes the trees especially susceptible to "barking" or bark slipping which can greatly damage the trees. Due to this potential damage, degree of tree shaking must be limited, with many nuts staying in the tree. However, this double harvest is often very profitable, due to the market demand for early crop, high-quality pecans.

Nut quality is excellent (Table 2), and in-shell appearance and size are very good (Figure 2). Nut size is comparable to or slightly larger than 'Desirable.' Kernel percentage, on the average, is about four percent above 'Desirable,' producing shelled halves that often weigh about 2.6 g. Kernel color of 'Pawnee' is comparable to 'Stuart,' and darker than 'Desirable,' an older cultivar with a reputation of producing excellent quality nuts (Table 2) (7).

'Pawnee' is protandrous, or Type I, with early pollen shed and late stigma receptivity (Figure 3). Genotypes for heterodichogamy are shown in Figure 1 of a previous publication (9) where 'Pawnee' is identified as selection 63-16-125. 'Pawnee' has pollen shed patterns similar to 'Desirable,' being in general, later than some other cultivars, such as 'Navaho.'

'Pawnee' tends to have a smaller number (as far as percentage of terminals with clusters) of larger clusters (Table 3). Although this is generally thought to be deleterious to yield and nut quality, it seems to have little or no effect on this cultivar. 'Pawnee' can load heavily with large clusters. Perhaps this increases the alternate bearing aspect of this cultivar. Alternate bearing from tree-to-tree in orchards is often obvious, even though overall orchard performance is more uniform.

'Pawnee' has a distinct upright growth habit, especially as a young tree. In an NPACTS test at College Station, 'Pawnee' trees in the seventh season had canopies that averaged 6.9 m in height, compared to 5.8 m for 'Desirable' and 5.5 m for 'Stu-

Table 1. Yield of nuts (kilograms per tree) across years for 'Pawnee' compared to standard cultivars at College Station, Texas.[z]

Cultivar	1989	1990	1991	1992	1993	Mean	Total
Pawnee	0.22a[y]	0.58a	1.71b	2.51b	19.38a	5.15ab	24.40
Navaho	0.81a	1.80a	10.51a	3.78ab	19.11a	7.43a	36.01
Desirable	0.26a	0.93a	2.81b	6.09a	7.73b	3.56bc	17.82
Stuart	0.01a	0.20a	0.14b	0.87b	4.26b	1.26c	5.48

[z]Each number is ;the mean of four ('Stuart'), five ('Navaho'), or six ('Desirable' and 'Pawnee') trees each year. Clones were grafted to established rootstocks in April 1986.
[y]Least square mean separation within columns by paired *t* test at $P < 0.05$.

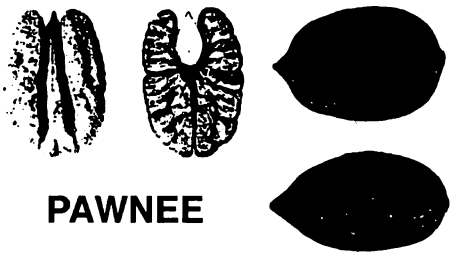

Figure 2. Nuts and kernels of 'Pawnee' pecan.

art.' Canopy width measurements for these three cultivars were 4.8 m, 4.7 m, and 3.3 m; respectively. The implications of this type of growth habit in determining optimum orchard tree spacing, and age of orchard when tree thinning is required, is currently being debated. Differences in overall tree shapes of 'Pawnee' compared to other cultivars seem to diminish as trees age. Limb angles of 'Pawnee' are narrow, but very strong. This makes the tree more difficult to train. The limbs develop rough bark more quickly than most other cultivars. 'Pawnee' leaves are dark green, as dark or darker than 'Stuart.'

'Pawnee' has mediocre scab [*Cladosporium caryigenum* (Ell. et Lang) Gottwald] resistance (Table 3). It is slightly more susceptible to nut scab than leaf scab. 'Pawnee' is favored in many areas of Texas because it does not require chemical control of this disease, while 'Wichita' and Western' do. In humid areas of the southeastern U.S., it cannot be grown without chemical scab control. Initially, 'Pawnee' was thought to be too scab susceptible for production at College Station, Tex. We have found that it performs better than 'Desirable' at this location, and requires two to three sprays as does 'Desirable' and most other cultivars. Since the environment at College Station, Tex. is remarkably similar to Albany, Ga.; the major Ga. pecan production area; we predict that 'Pawnee' will continue to prove itself to be a very desirable cultivar for this Ga. production area. Limited test-

Table 2. 'Pawnee' nut quality compared to standard cultivars.[z]

Cultivar	Nuts/kg	% Kernel	Kernel color[y]
Pawnee	115b[x]	59.6a	3.3b
Navaho	137a	60.9a	3.6a
Desirable	111b	55.2b	2.8c
Stuart	116b	49.6c	3.2b

[z]Each value is a 5-year average. Clones were grafted to established rootstocks in April 1986.
[y]Kernel color rated from 1 (light) to 10 (dark).
[x]Least square mean separation within columns by paired *t* test at $P < 0.05$.

Table 3. 'Pawnee' tree characteristics compared to standard cultivars.

Cultivar	Terminals with flower clusters (%)	No. nuts/ cluster	Leaf scab rating[z]	Nut scab rating[z]
Pawnee	34.8a[y]	3.60a	1.76bc	2.67a
Navaho	41.1a	2.73b	2.28a	2.32a
Desirable	36.6a	2.28c	2.10a	1.85b
Stuart	20.8b	1.76d	1.47c	1.12c

[z]Scab rated from 1 (no scab lesions) to 5 (severe scab), based on the worst single leaf or nut (2).
[y]Least square mean separation within columns by paired *t* test at $P < 0.05$.

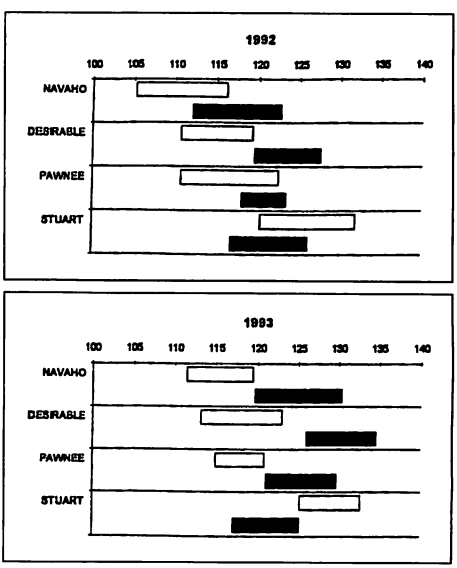

Figure 3. Patterns of flowering of four pecan cultivars, by day of year, at College Station, Texas, in 1992 and 1993. Patterns are the mean of observations made on 4-6 trees of each cultivar each year. Pollen shed is light shaded and pistil receptivity is dark shaded.

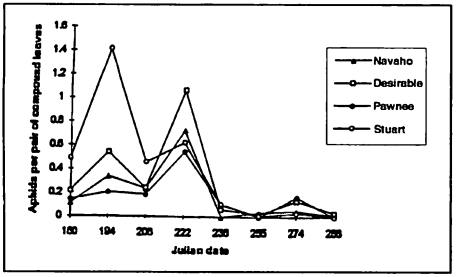

Figure 4. Adult aphids (*Monellia caryella* Fitch) per pair of compound leaflets occurring by day of year throughout the season (1990) on 'Navaho,' 'Desirable,' 'Pawnee,' 'Stuart.'

ing in the early 1980s near Albany, Ga. was very encouraging.

'Pawnee' has fair resistance to downy spot (*Mycosphaerella caryigena* Demaree and Cole), being more resistant than 'Wichita,' 'Mohawk,' or 'Choctaw'; but it is less resistant than 'Cheyenne.'

'Pawnee' has excellent resistance to aphids (3, 6). This resistance was first documented in the greenhouse by the senior author. Two replicated tests followed (6) that monitored the level of infestation by the blackmargined aphid (*Monellia caryella* (Fitch)) during most of the growing season at College Station, Tex., (Figure 4). 'Pawnee' had the lowest infestation level of all clones entered in both of these tests. 'Pawnee' has also been compared with 18 other cultivars for field resistance to blackmargined aphids in Kansas (William Reid, personal communication). 'Pawnee' had dramatically lower infestation levels compared to other cultivars. Kaakeh and Dutcher (3) tested the feeding habits of the blackmargined aphid, the yellow aphid (*Monellia caryella* (Fitch)), and the black aphid (*Melanocallis caryaefoliae* (Davis)) on detached pecan leaves from 10 different pecan cultivars in the lab. Resistance in the lab, as determined by probing behavior, was largely consistent with observed aphid densities under field conditions. 'Pawnee' was the least preferred by the three aphid species as demonstrated by low infestation levels, high number of probes per observation period, and long nonprobing durations.

The popularity of 'Pawnee' continues to grow. As the interest in early nut-maturing cultivars builds, there is an obvious need for other cultivars that can be planted with 'Pawnee' that have similar nut maturity so that the entire orchard can be harvested early. This will allow needed irrigation operations tobe completed in the orchard. More flexible moisture management in early maturing orchards should be a distinct advantage in allowing trees to maximize this window of opportunity to replenish needed carbohydrate reserves so that return bloom the following spring will be enhanced.

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