Pecan Production in the Northern United States

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SUMMARY. More than 93% of pecans [*Carya illinoensis* (Wangenh.) K. Koch] produced in the United States are grown in the southeastern and southwestern states. However, the native range of the pecan tree extends northward into Kansas, Missouri, and Illinois. In these northern states, commercial pecan production is expanding as additional acres of native trees are brought under cultivation and orchards of short-season, cold-hardy cultivars are established. Native nut production dominates the northern pecan industry accounting for over 95% of nuts produced in the region. Cultural practices for native pecans have been developed for northern groves that feature low inputs and good yields. Pecan cultivars adapted to the north ripen their fruit in a climate that provides 155 to 200 frost-free days. Few generalizations can be made about northern cultivars. The nuts produced by these cultivars vary in size from small [4 g (0.14 oz)] to medium [8 g (0.28 oz)] with shelling percentages ranging from 44% to 59%.

Pecan (*Carya illinoensis*) is widely recognized as a nut crop that thrives in the warm, long, growing season of the southern United States. Today, the states of Georgia, Alabama, Louisiana, Texas, Oklahoma, New Mexico, and Arizona produce more than 93% of the nation's commercial pecan crop (National Agricultural Statistics Service, 1999). However, the natural range of this indigenous nut tree extends well north of the Mason-Dixon line (Peterson, 1990). Natural stands of seedling pecan trees occur in Kansas, Missouri, Iowa, Illinois, and Indiana. Growing in the floodplains of major midwestern rivers and their tributaries, northern native pecans are well adapted to the relatively short growing season and cold winter temperatures. A small, but expanding, pecan industry has emerged in northern states based on the harvest of nuts from native trees and from culture of short-season, cold-hardy pecan cultivars.

Culture of northern native pecans

Over 95% of nuts produced in northern pecan states are harvested from natural stands (Reid and Eikenbary, 1991). Nut-producing groves have been carved from riparian forests by removing all competing tree species and managing the remaining and pecan trees.

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Table 1. Prices paid for native pecans grown in selected states from 1996–98 (National Agricultural Statistics Service, 1999) (\$1.00/lb = \$2.20/kg).

State	Price (\$/lb)		
	1996	1997	1998
Kansas	0.98	0.67	0.88
Louisiana	0.40	0.48	0.60
Oklahoma	0.52	0.55	0.68
Texas	0.50	0.48	0.85

The creation of a productive native pecan grove is a five-step process: thinning trees, improving surface drainage, fertilizing, controlling key pests, and managing the groundcover (Reid and Olcott-Reid, 1985).

Tree thinning is the primary cultural practice utilized to enhance nut production from native stands. Proper tree spacing allows light to penetrate the canopy, stimulating fruit production throughout the entire tree (Hinrichs, 1958). In addition, ample space between trees improves air circulation in the grove to provide a microclimate that slows plant disease development. Trees that are diseased, susceptible to key pests, unproductive, highly alternate bearing, or those producing extremely

small nuts are removed during the thinning process. This judicious removal of inferior trees produces native groves with higher yields, low alternate bearing, and higher nut quality. Sales of wood products produced during grove creation provide landowners with significant income over and above the costs of tree and stump removal (Shreve, 1993).

Growing in the floodplains of major rivers, native pecan trees frequently are subjected to seasonal flooding (Reid, 1995). Although pecan is quite flood tolerant, persistent pools of standing water in the grove can cause nitrogen deficiency (via denitrification) and non-infectious leaf scorch (Reid, 1999a). Improving surface drainage helps reduce these physiological maladies and is an essential prerequisite for cost-effective application of nitrogen to the soil.

The alluvial soils that support stands of native pecan in northern states are typically fine-textured, fertile, and somewhat poorly drained. Pecan trees would perform better on sandier, better-drained, alluvial soils, but unfortunately, almost all riparian forests that once covered these fertile soils have been cleared for agronomic crop production. Typically, only one soil nutrient must be

added to native pecan groves—nitrogen. Zinc deficiency, common in southern states (Sparks, 1976), is rarely a problem in the north.

Pest control technologies, developed in southern pecan-producing states, have been adapted for northern growing conditions (Reid, 1988). Primary pests of northern pecans include pecan nut casebearer [*Acrobasis nuxvorella* Neunzig], pecan weevil [*Curculio caryae* (Horn)], and pecan scab [*Cladosporium caryigenum* (Ell. et Lang.) Gottwald]. These pests can be controlled with three to four pesticide applications per year (Reid and Eikenbary, 1991).

To prevent soil erosion during flooding events, grasses and forbs are allowed to grow in native groves. Growers often utilize this groundcover for livestock grazing, primarily beef cattle. Shortly before harvest season, livestock are removed from the grove; the groundcover is mowed; and the entire grove floor is raked clean of sticks, manure, and debris. The mechanical nut-harvesting equipment used in native groves is designed to pick up nuts from a well-maintained groundcover.

Northern native pecans grown under a complete management program

Table 2. Nut weight, percent kernel, maturity date, flowering type, and location of origin of important northern pecan cultivars (28.35 g = 1.0 oz).

Cultivar	Nut wt (g)	Percent kernel	Maturity date ^z	Flowering type ^y	Origin
Canton	7.86	47.95	–4	I	Native, Missouri
Chetopa	7.43	55.11	+20	II	Native, Kansas
Colby	7.02	44.15	0	II	Native, Illinois
Faith	8.11	57.91	+7	II	'Mohawk' seedling, Kansas
Giles	6.48	52.65	+18	I	Native, Kansas
Goosepond	6.65	49.80	+6		Native, Missouri
Greenriver	6.75	49.36	+20	II	Native, Kentucky
Hirschi	6.43	49.81	+4	I	Native, Missouri
Jayhawk	6.45	52.87	+18	II	'Giles' seedling, Kansas
Kanza	6.47	51.82	+7	II	'Major' x 'Shoshoni'
Lucas	3.98	56.84	–10	II	Native, Ohio
Major	6.21	49.35	+9	I	Native, Kentucky
Norton	6.67	43.55	–6	II	Native, Missouri
Osage	6.16	53.07	0	I	'Odom' x 'Evers'
Pawnee	8.40	57.12	+3	I	'Mohawk' x 'Starking'
Peruque	6.24	59.28	–2	I	Native, Missouri
Posey	6.79	53.26	+4	II	Native, Indiana
Ste. Geneveve	7.63	48.90			Native, Missouri
Shepherd	5.53	51.18	+1		Native, Missouri
Warren 346	4.78	49.28	–24	II	Native, Missouri
Wiese	4.40	52.30	–8		Native, Missouri
Witte	6.64	51.31	–4	I	Native, Iowa

^zDays before (–) or after (+) 'Colby'. The average ripening date for 'Colby' is 25 Sept. in Chetopa, Kan. and 28 Sept. in Columbia, Mo.

^yI = protandrous, II = protogynous.

can average over 1120 kg·ha⁻¹ (1000 lb/acre) (Reid, 1999b), a yield that rivals that of the best native groves in Texas (Stein and McEachern, 1993). However, grower profits from the management of northern native groves can be greater than that of native groves in southern states. Northern natives require fewer pesticide applications per year (see section below), lowering production costs. In addition, shellers pay higher prices for the high-quality, high-percent kernel, native nuts produced in northern pecan states (Table 1). Commercial production of northern native pecans is currently confined to three states: Kansas, Missouri, and Illinois. In other northern states, native pecans are harvested by hand for home consumption.

Climatic influences

Northern pecan trees are adapted to the continental climate of the central United States. Cold winters and hot summers characterize this climatic zone. Northern pecans are frequently subjected to temperatures that drop to -30 °C (-22 °F) during the winter. In sharp contrast, summer temperatures can soar to over 38 °C (100 °F) during the day and never drop below 22 °C (70 °F) at night. The frost-free growing season in northern pecan states ranges from 155 to 200 d. These climatic conditions significantly affect all aspects of pecan culture and management in the north.

Cold hardiness and early fruit maturity are generally recognized as attributes of northern pecans. It often is assumed that these two characteristics are linked. However, two early-ripening cultivars, 'Osage' and 'Pawnee', both suffer significant shoot death during test winters. In contrast, 'Stuart' is cold hardy but the fruit will not ripen before the average date of first fall freeze in southeastern Kansas. Ripening date is controlled genetically but apparently modified by warm spring temperatures (Sparks, 1989). The production of pecans in northern states is confined to the central United States where sufficient heat is available to ripen nuts properly.

Climate also plays a significant role in pecan pest management. A shorter growing season means fewer generations per year of many important insect pests. In southern states, hickory shuckworm [*Cydia caryana* (Fitch)] mines pecan shucks during kernel deposition, causing a reduction in kernel quality. The very early nut maturity of

pecans adapted to the north renders this pest inconsequential (Reid and Eikenbary, 1991). Northern pecans fill their kernels before shuckworm larvae can cut off the supply of assimilates to the fruit. In contrast, early ripening increases susceptibility to the pecan weevil (Harris, 1976). Early-ripening cultivars present emerging weevils with oviposition sites sooner than later-ripening cultivars and often become the favorite targets of this crop-destroying pest. As a consequence, northern pecan producers must work diligently to control pecan weevil but can largely ignore the hickory shuckworm.

The pecan aphid complex [*Monelliopsis pecanis* Bissell, *Monellia caryella* (Fitch), and *Melanocallis caryaefoliae* (Davis)] presents a significant threat to commercial pecan orchards in southwestern and southeastern pecan orchards and often requires chemical control (Dutcher, 1999). In contrast, a shorter growing season and a rich diversity of aphid predators keep indigenous aphid populations under control in northern native groves (Dinkins et al., 1994; Reid et al., 1999).

The native pecans produced in northern states are known for their high quality, light kernel color, and high shelling percentage. The high quality of nuts grown in the north is directly related to the cool temperatures under which they ripen. High temperatures darken kernel color and hasten the development of rancidity (Sims, 1994). In northern pecan states, temperatures during harvest season average 13 °C (55 °F) and dip below freezing at night. These conditions provide an excellent environment for on-farm storage of the crop. During years of inclement weather, cold winters allow northern growers to harvest their crop into March while avoiding appreciable loss in nut quality. In addition to having excellent kernel color, northern native pecans generally produce a higher percent of edible kernel than their southern counterparts (Grauke et al., 1991). These quality factors result in shellers paying higher prices for northern pecans (Table 1).

Northern pecan cultivars

Northern pecan cultivars are often characterized as producing small, hard-shelled nuts on trees that are slow to bear, and low yielding (Sparks, 1992). However, these generalizations paint an inaccurate picture of the wide diversity of northern pecans currently avail-

able to growers (Table 2). Most northern cultivars originated as selections from the wild. Over the years, northern growers have had the opportunity to evaluate a large number of naturally occurring pecan seedlings in their native stands. Trees that are productive, produce above-average sized nuts, and shell well are often propagated and named. Growers freely share their selections and develop their own informal cultivar trials. With time, a selection that performs well for several growers becomes more widely propagated and becomes recognized as a cultivar.

Although large pecan cultivars [>9 g (0.32 oz)/nut] can not mature their fruit in the north, several moderate-sized cultivars [6 to 8 g, (0.21 to 0.28 oz)] offer northern producers opportunities to grow a very marketable product (Table 2). When growers market pecan kernels directly to the consumer, they find that quality and flavor are far more important to the consumer than kernel size. Although several northern cultivars are thick shelled (e.g., 'Colby' and 'Norton'), other cultivars have thin or papershells (e.g., 'Lucas' and 'Peruque'). The precocity of 'Colby', 'Giles', 'Hirschi', and 'Peruque' is equal to that of precocious southern cultivars (Reid, 1992). In terms of yield, northern cultivars can overproduce like their southern counterparts and therefore require fruit thinning to ensure good nut quality during years of heavy crops (Smith et al., 1993).

Cultivar preferences of northern growers vary with location, although several cultivars have gained the attention of growers across the entire region. Two recent releases from the USDA pecan breeding program, 'Pawnee' and 'Kanza', have been widely grafted. 'Pawnee' has the largest nut that can consistently mature nuts in the north but often suffers bud and limb injury during cold winters. 'Kanza' produces a medium-sized nut with outstanding kernel and shelling characteristics. The proven cold hardiness of 'Kanza' has made this cultivar the number one choice for grafting in northern groves. 'Peruque', 'Colby', and 'Posey' are popular standard cultivars that are still propagated across the northern pecan region.

New regional cultivars offer northern growers opportunities for even greater cultivar choice. 'Chetopa', 'Faith', and 'Jayhawk' are recently named cultivars that are gaining in popularity among growers in southern Kansas.

'Faith', a seedling of 'Mohawk', looks similar to 'Pawnee' but ripens 3 to 4 d later and has shown greater scab resistance than 'Pawnee'. 'Chetopa' and 'Jayhawk' are consistent producers of high quality, medium-sized nuts. 'Goosepond' is a recently discovered seedling from Brunswick, Mo. that promises to provide good nut size for growers in northern Missouri. Although not widely propagated, 'Warren 346' deserves special attention because of its ability to ripen fruits by mid-September in a climate that provides only 155 frost-free days. Although this cultivar has a small nut, 'Warren 346' could benefit the entire pecan industry by serving as a source of genes for early ripening and cold hardiness.

Future developments

The pecan industry in the north will continue to grow as landowners discover the potential for profits from native trees. This is especially true in the Central States where northern pecans offer a profitable alternative for struggling, row-crop farmers faced with record low commodity prices. Native pecan management is often the starting point of a new pecan venture because growers can realize income from wood sales and a modest nut crop during their first year of operation. In most cases, growers who become successful with native pecans will establish additional new orchards of trees grafted to northern cultivars. These orchards are generally small in size and designed to fill gaps in native groves. Growers that develop their own retail market have a greater incentive to plant new orchards of northern cultivars—the ability to deliver a more uniform (i.e., single cultivar) product to their customers.

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