

Crop Profile for Pecans in Kansas

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General Production Information

The commercial production of pecans in the Northern and Central Plains is limited to eastern Kansas and to a few hobby farms in Southeastern Nebraska. A native to the central plains, pecan is often a major component of the urban forest in Kansas and S.E. Nebraska. Commercial pecan production in Kansas is based on the harvesting of nuts from native stands of seedling trees that grow in the flood plains of major rivers. Kansas contributes approximately 1% to the total U.S. pecan production. There are an estimated 8500 acres of pecans in Kansas mostly concentrated in the Southeastern corner of the state. Cherokee Co. is the leading County in pecan production in Kansas, followed by Neosho, Labette, Linn, Montgomery, Miami, Cowley, Chautauqua, Wilson, Crawford, and Coffey Counties.

During the period 2002 through 2004, Kansas contributed 2.9, 2.0 and 1.8 million lbs of pecans to the U. S. market (<http://usda.mannlib.cornell.edu/reports/nassr/fruit/pnf-bb/ncit0705.txt>). The average price per pound received by producers during that same period (2002-2004) was \$0.75, \$0.87 and \$1.75 per pound respectively.

Pesticide Usage on Pecans for Year 2003

The pesticide usage survey on pecans in the region during 2003 was conducted by the Kansas Agricultural Statistics Service (KASS) and Kansas State University from October to December 2003. Pecan is a major forest product in the region, occurring predominantly in Kansas. Thus, the majority (76%) of the questionnaires were

allocated to Kansas and mailed directly to all pecan growers/producers, identified by KASS based on historic survey. In total, 62 questionnaires were sent out and 39 of them were collected with valid data from two states and 17 counties. However, only one response from Nebraska had valid data. The following table displays the sample distributions in terms of states and counties in the Northern and Central Plains.

Sampling Data Distribution

State	Sample Allocated	Sample Collected	Return Rate %	County	Sample %
KS	50	38	76.00	16	97.44
NE	12	1	8.33	1	2.56
ND	0	0	#	#	#
SD	0	0	#	#	#
Total	62	39	62.90	17	100

Data Unspecified.

Overall valid responding was approximately 62.9%. Over 97% of them were from Kansas alone. Approximately 15% of the pesticides used were applied directly by farmers/producers against various pests and the rest were applied by commercial entities.

Cultural Practices

Pecan trees require deep alluvial soils for best growth. Commercial pecan production in Kansas is limited to soils found within the floodplains of major river systems, including the Neosho, Verdigris, Walnut, Caney, Osage, and Marais des Cygnes rivers. Soil types vary from clay loam to sandy loam soils, with good internal drainage, and a static water table that ranges from 10 to 25 feet below the soil surface. Most upland soils are not suitable for pecan growth in Kansas.

Average rainfall in Kansas ranges from 16-18 inches in the western half of Cheyenne, Sherman, and Wallace Counties in the northwest to 42-44 inches in eastern half of Crawford and Cherokee Counties in the southeast region. Pecan trees require at least 28 inches of rainfall per year to survive unless supplemental irrigation is added. Since most of the commercial pecan industry in Kansas is located in the eastern portion of the state, most pecan trees in Kansas are not irrigated.

Pecans require a long, warm growing season to mature their fruit. The pecan industry is concentrated in the southeastern portion of Kansas where the frost free period extends from 170 to 200 days per year. Although pecan can grow and thrive in other portions of the KS and NE, the increased frequency of late spring freezes and early fall freezes often limits nut production in areas outside the southeastern KS.

In the U.S., pecans are produced from native or seedling trees or from orchards of clonally propagated cultivars.

In Kansas, pecans are primarily produced by native trees (seedling). The nuts produced by pecan trees are used for human consumption while the wood produced by these trees is used for furniture, firewood, and charcoal wood.

Native pecan groves are thinned at regular intervals to maintain proper tree spacing. During the thinning process, producers select inferior trees to remove while retaining trees that produce high-quality nuts annually.

In Kansas, a permanent groundcover is maintained in pecan groves and much of the pecan acreage is grazed by cattle. Groundcovers include native grasses and forbs as well as cool season forage grasses and legumes.

Pecans are harvested mechanically. Kansas producers start harvest shortly after the first freeze in the Fall and continue harvest through the winter months. Kansas pecans are cleaned on the farm to remove all foreign material before being readied for shipment to major shelling facilities located outside of the state.

Worker Activities

Primary activities include irrigation, fertilizer application, pesticide sprays, pruning, thinning, and harvesting. Majority of pecan trees are harvested in this region with machine. However, hand-harvesting by knocking the pecans out of the tree with a pole and then picking the nuts off the orchard floor may serve as a complementary approach on a small scale. Pruning and tree thinning are very common management practices that prevent crowding of the pecan trees and enhance the production of high quality nuts. In addition, hand-weeding is only a minor practice for weed control in this region. Overall, there is very limited orchard activity during the pecan growing season in this region.

Pecan pest management

As a native crop species, pecan trees are attacked by a large number of natively occurring insects and diseases. However, only a handful of pests regularly cause economic crop loss. An integrated pest management (IPM) approach using selective tree thinning (genetic selection for pest resistance), scouting and economic thresholds, pheromone traps and biological and synthetic pesticides to minimize losses has been adopted. Sound management of diseases and insects in native pecan groves, combined with proper fertilization, culture, and management significantly improves production and quality of pecans. A minimum level of pesticide applications are currently employed to reduce the populations of key nut damaging pests.

Guidelines for pecan pest management have been established for native pecan groves (Reid 2003). Monitoring methods are used to determine the activity of major nut feeding pests while diseases management centers on climatologically based models. The utilization of these IPM techniques has led to a low input management strategy that improves grower profitability (Reid and Eikenbary 1990).

Insect Pests

Several insects may attack pecan trees, however, pecan nut casebearer and pecan weevil are the most serious pests. Secondary insect pests include hickory shuckworm, fall webworm, walnut caterpillar, and pecan phylloxera. Following are the insect pests treated with pesticides in 2003.



Pecan Nut Casebearer (PNC) (*Acrobasis nuxvorella*), has three generations per year in Kansas. Only the first summer generation larvae cause significant reduction in pecan production. The PNC adult is a small (0.33 inch) gray to dark gray moth with a dark ridge of scales on the forewings. Mature larvae are green about 0.5 inches long with yellowish brown heads. The distinctive signs of PNC damage are frass at the base of nuts and silken webbing between damaged nuts and the pedicle. (larval image courtesy of <http://aggie-horticulture.tamu.edu/carya/>

[Manual/CASEBR3.JPG](#)).

Partially grown larvae pass the winter in small cocoons, known as hibernacula, attached to the base of the bud on a pecan twig. In early spring, larvae emerge from the cocoon, feed on the opened buds and bore into the buds and stems, where they will mature and pupate. Adult moths emerge in late May and lay eggs on the developing nuts. First summer generation larvae hatch and feed on the nuts, entering through the stem end and completely hollowing out the nut. Since pecan fruit are quite small at this time in the growing season, a single larva may destroy two to three nuts before completing its life cycle. Subsequent summer generations are often difficult to detect because naturally occurring bio-control organisms hold populations below threshold levels for the rest of the growing season.

Regular and frequent scouting during the period immediately following pollination is necessary to determine when first summer generation larvae begin entering pecan fruit. Visual inspection of nut clusters and the use of pheromone traps to predict first significant nut entry are used to determine an optimum “spray date” which allows a single insecticide application to keep PNC populations in check. During years of high fruit set, PNC infestation rates remain low (<8% damage) and growers often choose not to control this pest allowing PNC to become a beneficial insect by removing a portion of the excessive fruit load thus helping to alleviate alternate bearing.



Pecan Weevil (PW) (*Curculio caryae*), is the most serious nut-feeding pest of pecan. The gray to brown adults are hard-shelled beetles with long slender snouts and thin legs. The adults emerge from the soil under or near pecan trees during late-July and August. Before fruit enter the dough stage, PW punctures the fruit causing premature abortion. Once fruit enter the dough stage, female PW lay eggs in to kernel tissue deep inside the fruit. The larvae are creamy white colored legless grubs with reddish brown heads. Larvae feed on the kernel tissue,

devouring the entire kernel. Mature larvae burrow out through the shell and drop to the ground. Larvae bore into the soil and remain there for two to three years. They pupate and pass the winter as adults. (Adult image courtesy of <http://insects.tamu.edu/images/insects/common/images/b-txt/bimg200.html>). ‘Circle’ pecan weevil traps are used to determine when weevil adults are emerging from the soil (Mulder et al. 1997) Growers time their

insecticide treatments based on trap catch and a determination of fruit development stage (dough stage).



Hickory Shuckworm (HSW) (*Cydia caryana*), is another important insect pest in pecan. Mature larvae are creamy-white in color with five pairs of prolegs. Adult moths are dark-gray with a wingspread of one-half inch. Pupae are one-third inch long and dark-brown color. Several generations of this insect occur each year. First summer generation larvae feed on other hickory species or the inside of pecan phylloxera galls. Larvae in the second summer generation feed on fruit in early July, which may cause some minor nut drop. The third summer generation has the greatest potential for crop loss. Third generation eggs are deposited over a long time period—from late July to early September. Before shell hardening, larval feeding results in fruit abortion. Once the shell hardens, larval feeding is confined to the shuck preventing normal shuck dehiscence. Full-grown larvae overwinter in the shucks, either hanging on the tree or on the ground. The late summer generation is usually controlled with pesticide applications aimed at controlling pecan weevil. (Image courtesy of <http://muextension.missouri.edu/xplor/miscpubs/mp0711.htm>).



Walnut Caterpillar (*Datana integerrima*), adults are light brown moths with four narrow, brown bands on their forewings. The caterpillars (larvae) are dark red with many silver hairs along the body. They feed in groups on leaf tissues causing defoliation and severely affecting tree vigor, yield, and nut quality. The larvae crowd together on the lower parts of trees to molt and leave a patch of hairy cast skins. There are two generations each year with the second generation appearing in greater numbers. Larvae pupate in the soil where they pass the winter before adult moths emerge in early summer. Walnut caterpillar is a periodic outbreak pest in pecan. During most seasons, naturally occurring populations of *Trichogramma minutum* heavily parasitize the egg masses of walnut caterpillar. Only when the balance between pest and parasite is disturbed (usually by unusual weather conditions) does walnut caterpillar become a serious economic pest. (Larval image courtesy of <http://insects.tamu.edu/images/insects/common/images/cd-43-c-txt/cimg310.html>).



Fall Webworm (*Hyphantria cunea*), has two generations per year in Kansas. It is the most common gregarious caterpillar that feeds on pecan and can completely defoliate trees. Dirty white webs enclosing a colony of caterpillars are the distinctive signs of fall webworm infestations. Adult moths are white with small dark brown spots. The larvae construct a web (1 to 2 yards long) that covers a cluster of leaves on which they feed. Larvae leave the web in late fall to pupate in constructed hairy cocoons under the scales of the bark on the trunks or on the ground. In Kansas, the first generation moth flight occurs in late-June while the

second generation moths emerge in late-August. Populations of fall webworm are often controlled by pesticide applications aimed at control PNC and PW. (Image courtesy of <http://pecankernel.tamu.edu/media/newsletters/2004/html/04-4.html>).



Sawfly Adults are small, bee-like in appearance and are about 1/4 to 1/3 inch long. Larvae feed on foliage and leave holes in the leaves or consume the whole leaf. Sawfly larvae resemble caterpillars but are actually larvae of a wasp. Larvae of moths and butterflies have 1 to 4 sets of abdominal prolegs, whereas sawfly larvae have 6 sets. Once larvae finish feeding, they drop to the ground and burrow into the soil to overwinter. There is only one generation per year. Sawfly is a periodic outbreak pest those populations can build to levels that lead to the complete tree defoliation and subsequent pistillate flower abortion.

Outbreaks occur during unusually dry spring weather conditions. (Damage image courtesy of http://pecankernel.tamu.edu/local_images/insects/sawflydamage_better.jpg).



Stink bug (*Nezara viridula*) build up on other crops or weeds and then migrate to pecans during early August to feed on pecan fruit. Stink bug feeding before shell hardening causes fruit abortion while feeding after shell hardening produces large black spots on the kernel. Damage in pecan groves is most severe where soybeans are planted in adjacent fields. In groves with a history of stink bug damage, growers must apply a broad spectrum insecticide in late July to reduce stink bug numbers. Subsequent pesticide applications aimed at controlling pecan weevil keep stink bugs in check. (Adult image courtesy of

http://creatures.ifas.ufl.edu/veg/bean/southern_green_stink_bug_adult.htm).

Insecticide control

Currently, approximately 65% of pecan production acreage is treated with insecticides. At least 6 insecticides (ingredients) were applied in the control of 8 major insect pests on pecans. The following table lists the insecticides used and insect pests targeted on pecans.

Insecticides used and insect pests targeted

Insecticide (Ingredients)	Insect Pest Targeted
Carbaryl	Fall Webworm, Hickory Shuckworm, Pecan Weevil, Walnut Caterpillar

Zeta-Cypermethrin	Fall Webworm, Hickory Shuckworm, Pecan Nut Casebearer
Chlorpyrifos	Pecan Nut Casebearer, Pecan Phylloxera, Sawfly
Esfenvalerate	Pecan Nut Casebearer, Sawfly, Stink Bugs
Tebufenozide	Pecan Nut Casebearer, Walnut Caterpillar, Fall Webworm, Hickory Shuckworm
Lambda-Cyhalothrin	Sawfly, Stink bug, Pecan weevil

The following table displays the insecticide trade names, acres treated, percentage of area treated, and application rate.

Insecticide usage survey on pecans

Insecticide (Ingredient)	Trade name	Acres Treated	Percent Treated*	Rate (lb a.i./a)
Carbaryl	Carbaryl, Sevin 50W, Sevin 80W, Sevin XLR	970	47	4.14
Malathion	Malathion 57EC	6	0	0.2
S-Cyano	Fury 1.5 EC	150	7	0.04
Chlorpyrifos	Lorsban 4E	240	12	0.56
Esfenvalerate	Asana XL	700	34	0.03

*: Percent Treated = (acreage treated with a given insecticide / the total acreage treated) * 100.

** : The amount may be less than recommended due to the small sample size.

Carbaryl is the most frequently applied one among insecticides used against various insect pests on pecan in the Northern and Central Plains, up to 47% of the sampled treated areas did so at a rate of 4.14 lb/a, followed by esfenvalerate at a rate of 0.03 lb/a.

Diseases

Diseases pressure varies widely from year to year in this region. During high rainfall and high humidity years, pecan foliar and shuck diseases can cause significant economic loss. Growers in this area normally make a single fungicide application timed to co-inside with the June insecticide treatment for pecan nut casebearer. Pecan scab is the primary target disease for this fungicide application, however many of the leaf spot diseases are also

suppressed by this treatment. The table below list the fungicides applied to pecan groves in 2005, primarily to control pecan scab.

Fungicides used to control pecan scab in Kansas

Fungicide Ingredient	Trade Name
Thiophanate-methyl	Topsin-M
Fenbuconazole	Enable
Azoxystrobin	Abound
Propiconazole & Trifloxystrobin	Stratego
Propiconazole & Triphenyltin hydroxide	SuperTin Agpack



Pecan Scab, is caused by the fungus *Cladosporium caryigenum*. Scab is the most serious disease of pecan tree throughout its growing range, especially during high rainfall and/or high humidity. The fungus passes the winter on infected shucks, leaf petioles, and stems in stroma. Spores are released from the stroma during budbreak. Moisture and warm temperatures in the spring favor the development of spores on the stroma. Scab occurs on young leaves, leaf petioles, and nut shuck tissue. Initial symptoms are the development of small circular, olive green to black spots that expand causing the terminals and the catkins to drop. Lesions on the mature leaves dry, crack and fall out of the leaf blade. Severe infections cause the shuck to adhere to the nut and prevent nut separation from the shuck. Disease management includes selecting resistant cultivars, using Fungicide treatments, and thinning out high susceptible trees in native groves. (Image courtesy of <http://www.aces.edu/pubs/docs/A/ANR-0606/>).



Downy spot, the causal fungus was described in 1932 as *Mycosphaerella caryigena* Demaree and Cole, and attacks only pecan leaves. Infection reduces photosynthesis and may cause defoliation. Tree vigor and yield are reduced. An effective pre-pollination spray program is critical for control of downy spot. Downy spot first appears on the lower surface of young foliage in late spring or early summer as small yellow spots, ranging from 0.06 to 0.12 inch in diameter. These spots may turn white as spores are produced. With age, spots on the under side of the leaf develop a dark-yellow to light-brown color, and then begin to appear on the upper surface of the leaf. (Image courtesy of <http://www.aces.edu/pubs/docs/A/ANR-0606/>).



Liver spot, is a leaf spot disease caused by the fungus *Gnomonia carvae* variety *pecanae*. In some years, substantial losses from the disease have been reported. Liver spot can cause severe defoliation during late summer and early fall,



particularly in orchards exposed to prolonged periods of wet weather. Weak trees are more susceptible to liver spot than are healthy trees. The first sign of the disease appears in May and June. Circular, dark brown spots ranging from 0.12 to 0.37 inch in diameter appear along the midrib on the lower surface of the leaflets.

In late summer, the spots turn a cinnamon brown or liver color. (Symptom image courtesy of <http://www.aces.edu/pubs/docs/A/ANR-0606/>).

Fungicide usage on pecans

Fungicide (Ingredient)	Trade name	Acres Treated	Percent Treated*	Rate (lb a.i./a)
Thiophanate methyl	Topsin M WSB	50	100	0.7

*: Percent Treated = (acreage treated with a given fungicide / the total acreage treated)*100.

Thiophanate methyl is the only fungicide reported being used again several plant diseases including pecan scab on pecan based year 2003 survey. Recently, the use of Topsin-M against plant diseases is discouraged because of its poor performance.

Weeds

Generally, pecan orchard floor management in Kansas consists of mowing a permanent ground cover and/or grazing by livestock. Cool season grasses and legumes are often planted in pecan groves to increase forage production. In native pecan groves, vining weed species that can climb trees and compete within the tree's canopy for light are serious crop limiting pests. Following are brief descriptions of the major vining weeds that experienced by farmers/producers in pecan fields, which were treated using herbicides and cultural practices in year 2003.



Poison ivy (*Toxicodendron radicans*), is a native weed, widely spread throughout the United States and parts of Canada. Poison ivy climbs the trees, clinging to the bark by aerial roots. Poison ivy vines out-compete pecan leaves for sunlight and can cause limb loss. All parts of the plant contain an alkaloid that can cause inflammation, blistering, and itching of the human skin.

Flowering season is from May to June in Kansas. Seeds and rhizomes are the source of reproduction. (Image courtesy of http://plants.usda.gov/cgi_bin/large_image_rpt.cgi?imageID=tora2_002_ahp.tif).

In orchards of young trees, a six-foot, weed-free circle is often maintained around each tree using Glyphosate. Pre-emergent herbicides are infrequently used in addition to the glyphosate application to maintain the weed-free zone.

In recent years, several other weed species in Kansas including Trumpet Creeper (*Campsis radicans*), Riverbank Grape (*Vitis riparia*), Virginia Creeper (*Parthenocissus quinquefolia*), Raccoon Grape (*Ampelopsis cordata*) raise attention to agricultural scientists due to their harmful potentials to pecan production.

Herbicide Usage in 2003

Various weeds may compete for resources with pecan tree. However, only few of them became problematic and treated with herbicides during 2003. Approximately 11% of the pecan production acreage was treated with herbicides, indicating weed control may be one of the minor practices for pecan production in the region. The survey shows at least 3 herbicides (ingredients) were applied in the control of 6 different weeds on pecan production. The following table lists the herbicides used and weeds treated explicitly. In addition, other non-chemical methods may also be applied in weed control.

Herbicides used and weeds targeted

Herbicide (Ingredients)	Weeds Targeted
Glyphosate	Common ragweed, Curly dock, Johnsongrass, Large crabgrass, Others, Poison ivy
Paraquat dichloride	Common ragweed, Curly dock, Johnsongrass, Large crabgrass, Others, Poison ivy

Herbicide usage survey on pecans

Herbicide (Ingredient)	Trade name	Mode of Action ^b	Acres Treated	Percent Treated*	Rate (lb a.i./a)
2,4-D ^a	2,4-D amine	GR	5	3	1.17
Glyphosate	Roundup	EPSP	110	67	4.12
Paraquat dichloride	Gramoxone Max	CMD	50	30	0.83

*: Percent treated = (acreage treated with a given herbicide / the total acreage treated)*100.

** : Unspecified.

^bEPSP = EPSP synthase inhibitors; CMD = Cell membrane disruptor; GR = growth regulator

Glyphosate was the most frequently applied herbicides against weeds on pecans in the region, up to 67% of the sampled treated areas did so at a rate of 4.12lb/a, followed by paraquat dichloride at a rate of 0.83 lb/a.

^a Even though pecan is sensitive to 2,4-D herbicide products, 2003 survey showed that 2,4-D amine was used against weeds in pecan orchard in Kansas.

Pesticide Application methods

Pesticide application methods may vary with target pests and environments. The table ‘**Application Methods**’ lists application methods and its possibility to be adopted by farmers/producers in year 2003.

Application Methods

Control Method	Weed (%)	Insect (%)	Disease (%)
1 Broadcast (ground)	16.67	36.36	0
2 Broadcast (by air)	0	27.27	100
3 Spot Treatment	33.33	18.18	0
4 Banded in or over row	16.67	9.09	0
5 Foliar or directed spray	33.33	9.09	0

Spot Treatment and Foliar or directed spray were more frequently used methods in weed control, followed by Broadcast (ground) and Banded in or over row. Broadcast (ground and by air) was adopted dominantly in insect control. The only method applied in plant disease control was broadcast by air. In recent years, pecan producers use air-blast sprayers or fixed wing aircraft to apply insecticides and fungicides. In addition, herbicides are applied as spot treatments with small hand-gun type sprayers in practice.

Non-chemical Control Practices

Non-chemical control plays a critical part in pest control. For example, cultural practices such as mowing, burning, or tilling around the fields were adopted in Kansas by growers for weed control. In addition, pecan growers may selectively thin native groves to remove disease and insect susceptible individual trees, while improving light penetration into the orchard. Pecan growers may also choose the resistant varieties to reduce the incidences of pest outbreaks and plant diseases in pest management.

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