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GENERAL IDEAS ABOUT GENETIC IMPROVEMENT IN PECAN

Tommy E. Thompson and L. J. Grauke[1]

This paper presents ideology concerning genetics and breeding of pecan [*Carya illinoinensis* (Wangenh.) K. Koch]. The ideas presented here are meant to stimulate discussion and concept development that will contribute to pecan genetic improvement. Most plant breeders operate on some genetic frontiers that are unproved and often unresearched by scientists in other academic areas of plant research.

Pecan genetic improvement remains a long-term breeding process. Success will continue to come from organized programs that allow parental selection, crossing, and systematic long-range testing of known-parentage clones. The idea that the perfect cultivar exists in native stands or will be discovered in random trees in orchards or yards is less and less true as requirements for cultivars that combine <u>all</u> desirable genetic characteristics are an absolute requirement for profitable pecan production. Future orchards will require improved cultivars and high levels of management for profitability as they do today.

As production expenses continue to escalate, pecan cultivars with low productivity, small nut size (more than 80 or so per pound), or low percent kernel (less than about 40%) will continually be eliminated from production. This elimination process has been continuous in the pecan industry since its inception. It is economically driven since producers of native pecans (or any cultivar that produces nuts similar to the low percent kernel and small size of natives) receive about 33 cents per pound less compared to improved (Fig. 1). This lower return per acre means owners cannot economically manage these stands. Production of natives has declined severely in Arkansas, Mississippi, Texas, and to some extent in Oklahoma (Grauke, Thompson, and Marquard, 1995).

Genetically, we are moving pecan away from being a native. That is, more and more, we can classify cultivars empirically based upon percent kernel, nut size, and time of nut maturity; and without knowing their origin. In the future, native and other random clone selections will be useful mainly as germplasm sources of disease and insect resistance and early nut maturity. They will be crossed with improved cultivars and other selected clones to produce improved cultivars with adequate genetics for yield, precocity, nut quality, disease and insect resistance, etc.

The current interest in selecting new cultivars with ultrahigh levels of disease and insect resistance, and without high selection pressure on nut quality parameters and yield is unrealistic. Selection pressure for disease resistance is excellent to produce parental material useful in the crossing operation to produce new cultivars, but growers cannot afford to plant such clones as new cultivars. We remain very interested in such clones as sources of disease resistance and other traits. These clones will continue to be used as parental material to combine with the superior yieldability, nut quality, earliness, etc. of current cultivars and clones.

Currently the most neglected area of pecan science is the testing of new clones and cultivars. This is the obvious way to increase profitability, protect the environment from chemical pollutants, and thus place pecan culture more in sink with current valid environmental demands by the public at large. State cultivar recommendations, in many instances aren't sufficiently based upon current research results.

The largest pecan producing areas of the southeast rely largely upon old cultivars with obviously inferior nut quality and (or) yieldability. As a result, nut quality and production levels are not what they should be. Figure 2 shows the average cultivar age for different states. Generally, the western states have newer cultivars. New Mexico is an exception due to its large plantings of 'Western', an older cultivar. The use of old cultivars in the Southeast is one reason why pecans sell for less per pound in this area. The average price per pound of all pecans produced in Georgia during the last ten years is about 18 cents below the Texas price (Fig. 3). Considering only improved pecans Fig. 4), the average price for the last ten years is about cents greater in Texas. These price differentials are generally true for the main pecan producing areas of the southeast, compared to western production.

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[1] Research Geneticist and Research Horticulturist, U.S. Dept. of Agriculture, Agricultural Research Service, Pecan Genetics Program, College Station, Texas.

Therefore, the testing and utilization of improved USDA cultivars in the Southeast is way overdue. 'Stuart' is a good example of an old cultivar that should not be recommended anywhere. The production data has shown for years how lacking this cultivar is as far as production and nut quality. The idea that it performs better as an older tree has also been disproved. Yet, even today, it is still recommended in many southeastern states. It is one thing to manage 'Stuart' orchards and orchards with other old cultivars. This is often good economic sense. It is quite another thing to still recommend these inferior cultivars for planting new orchards. As has always been the case, recommendations should be based upon production data.

Unfortunately, 'Sioux' and 'Caddo' remain largely unused in the Southeastern U.S. The traditional ideology was that these cultivars produced nuts too small to consider in commercial production. Recently, the utility and value of these cultivars in the Southeast is becoming apparent. The scab resistance of these two is excellent, and both have nut quality that is unexcelled.

In Ray Worley's test at Tifton, Georgia (Worley, 1997), 'Caddo' produced pecans worth $463 per acre through the 17th year, compared to $163 for 'Desirable' and $82 for 'Stuart'. Yet 'Stuart' continues to be recommended in parts of the Southeastern U.S. We also have not seen data that shows that 'Stuart' becomes much more profitable as tree age increases. 'Desirable' is a good cultivar in some areas, but it will soon be replaced by improved cultivars. In our own NPACTS (National Pecan Advanced Clone Testing System) tests at College Station, Texas, 'Pawnee' has outyielded 'Desirable' everywhere it has been tested. 'Pawnee' also has similar nut quality and superior yellow and black aphid resistance. Plus 'Pawnee' is not equaled by any other cultivar in producing such a high quality nut marketable during Sept. Thus 'Pawnee' is currently one of the most popular cultivars as far as number of trees being planted in the pecan industry.

Other scab-resistant USDA cultivars continue to perform well in the Southeast, especially 'Oconee'. 'Kanza' is a new USDA cultivar that has excellent scab resistance and should be adapted to the Southeast.

The USDA pecan breeding program continues to produce scab-resistant cultivars and NPACTS clones to test in the Southeast. Controlled-cross seedlings in the Basic Breeding Program at College Station, Texas are not sprayed with a fungicide and are rated for scab resistance each year. College Station's climate is similar to the most concentrated pecan production area in the U.S. near Albany, Georgia, and is a high scab area. Therefore, the location of this breeding site is conducive to the selection of scab resistant cultivars.

Table 1 shows a few of the many NPACTS scab-resistant clones that are currently under test in Texas and at some other NPACTS locations. It is important to point out that all these clones are products of a systematic, long-range breeding program and have been evaluated over multiple years and preselected for nut and tree quality parameters. Therefore, they have a much greater chance of becoming important new cultivars.

'Western' has come and gone in its area of initial use (Central Texas). In production tests at Brownwood, Texas; it yielded only 39% of 'Wichita' and produced nut quality inferior to 'Wichita' (Thompson, et al. 191981; Thompson and Hunter, 1983). It is not even considered a realistic check cultivar in production tests now in the Central Texas area. Scab problems on 'Western' have also escalated in this area recently, and 'Western' is much more susceptible than 'Wichita'.

From a breeding standpoint, alternate bearing is still the largest problem. The question is how to genetically design a pecan tree to produce a large crop <u>and</u> insure that the tree will set another heavy crop the next spring. The reason for alternate bearing was obvious to pecan scientists in the 1930s (Crane et al. 1934, Smith and Waugh 1938). We are convinced that we can circumvent this problem by developing early nut maturing cultivars that have a window of opportunity to replenish CHO reserves between nut maturity and leaf dehiscence each season.

We believe cultivars of the future must have the unique genetic characteristics of early nut maturity combined with other desirable characteristics. Early nut maturity will be an absolute requirement to prevent alternate bearing by allowing tree energy rebound each season. Such clones do not currently exist in nature nor will they ever likely be produced by accident in nature. They must developed over time in a well-planned breeding program.

As pecan researchers, we must place much more emphasis on testing new pecan genetic material. We must also continually evaluate and update recommendations based on the latest test results.

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Table 1. USDA NPACTS clones with high levels of scab resistance.

Clone	Parentage	% Kernel	Nuts/Lb.	Shucksplit
70-03-0034	ShoshoniXCheyenne	57	46	10-18
72-05-0058	OsageXCheyenne	51	59	10-02
72-06-0009	Shoshoni(BrakeXSioux)	55	53	09-20
74-05-0055	CheyenneXSioux	56	44	10-12
74-05-0060	CheyenneXSioux	58	56	10-28
77-21-0003	CreekXCape Fear	55	47	10-07
82-17-0680	Wichita Open Pollinated	58	55	09-27
82-17-1316	Wichita Open Pollinated	54	54	10-09
82-17-1614	Wichita Open Pollinated	63	55	09-27
86-02-2645	WichitaXPawnee	64	52	10-05
86-03-0008	CheyenneXPawnee	61	49	09-28
86-03-0040	CheyenneXPawnee	62	52	10-07
86-03-0624	CheyenneXPawnee	62	43	09-25
86-03-0627	CheyenneXPawnee	62	47	09-30
87-01-0016	CheyenneXPawnee	61	52	10-01

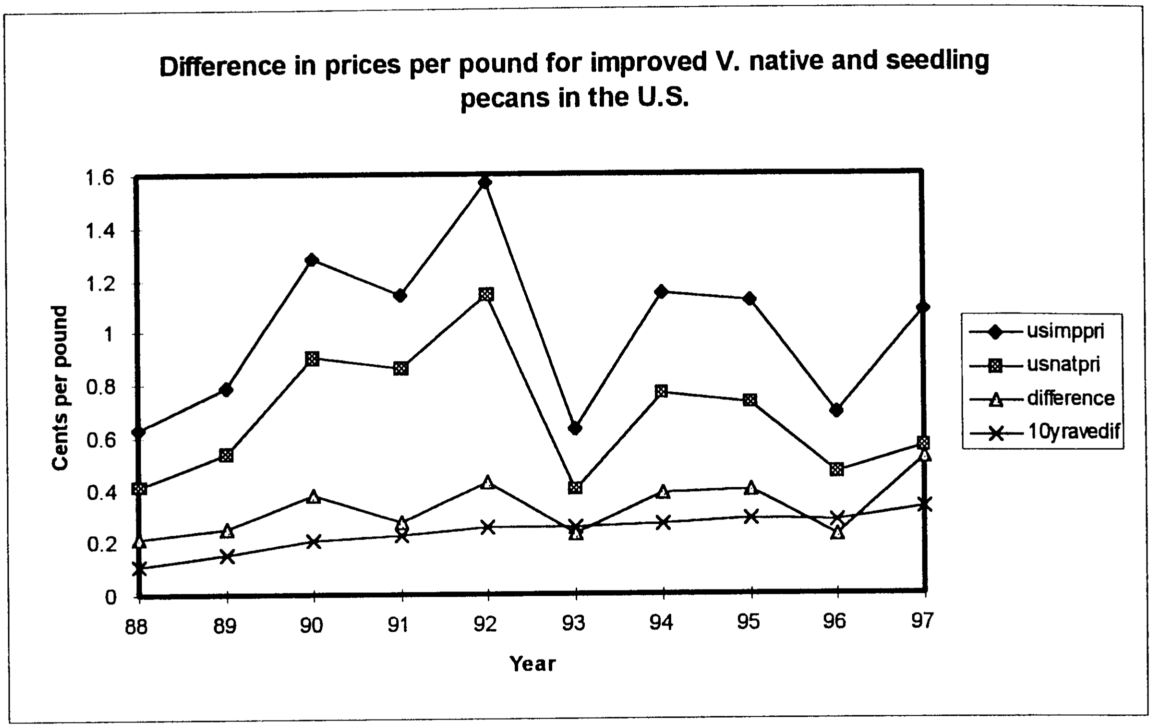

Fig. 1. Differences in prices paid per pound for improved V. native and seedling pecans in the U.S.

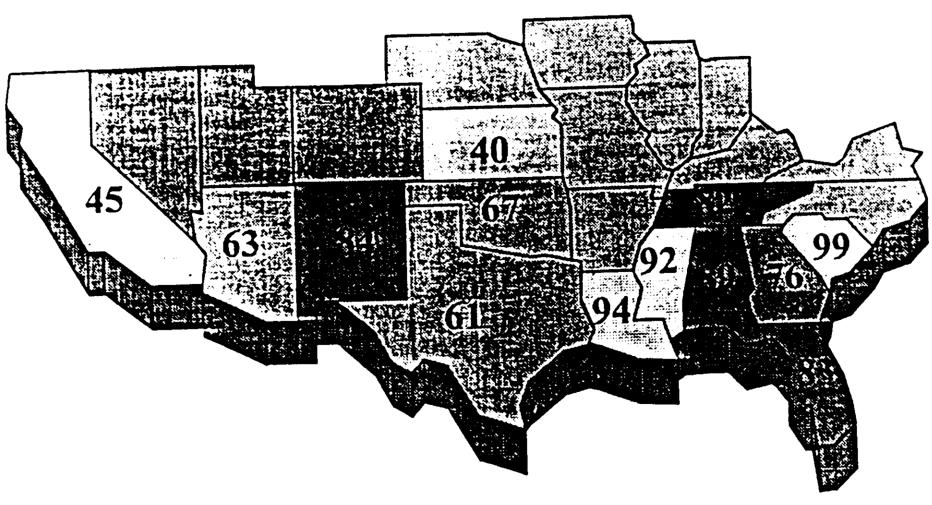

Fig. 2. Average pecan cultivar age by state.

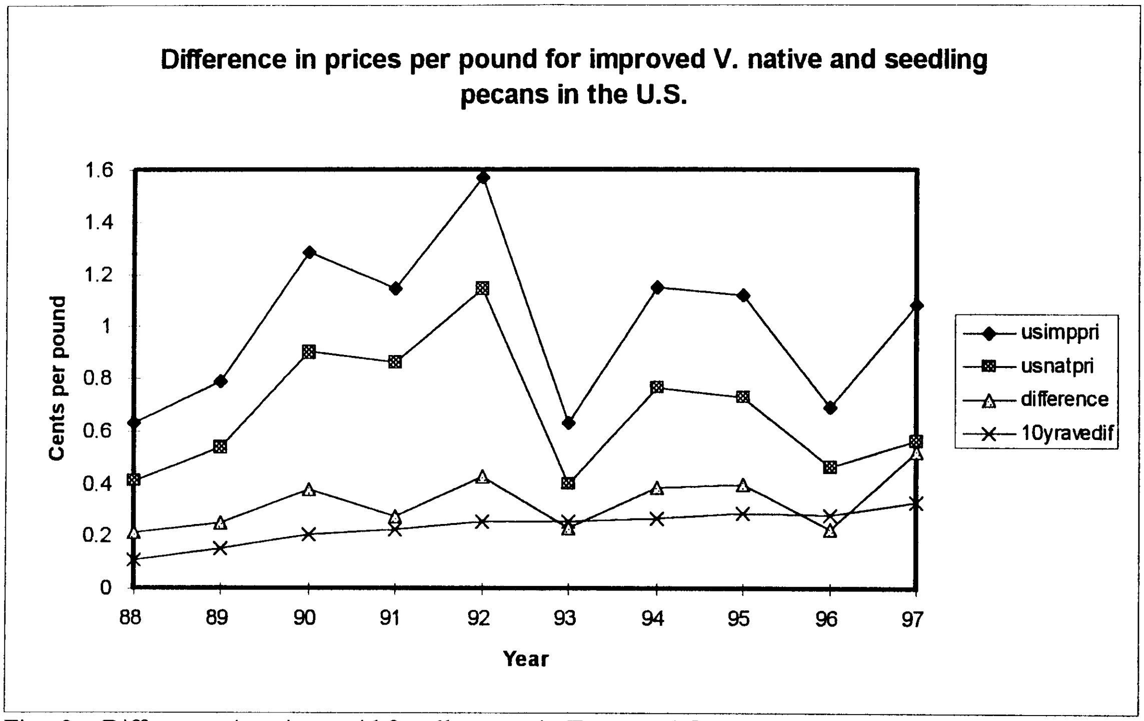

Fig. 3. Differences in prices paid for all pecans in Texas and Georgia.

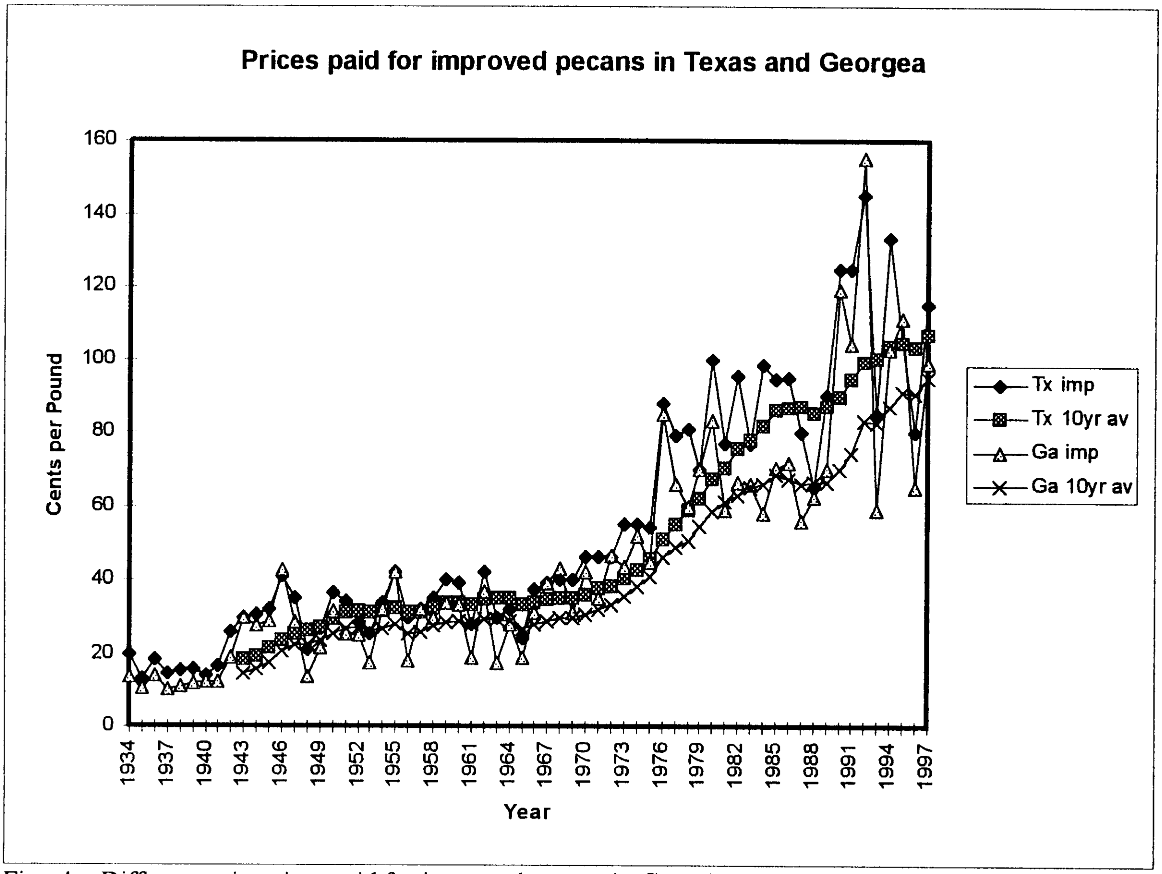

Fig. 4. Differences in prices paid for improved pecans in Georgia compared toTexas.