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CENTER FOR PECAN AND SPECIALTY AGRICULTURE

Scientific advancements provide pecan cultivar ID tools

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Most of us enjoy pecan pie during Thanksgiving. Pecans provide multiple health benefits, contain more than 19 vitamins and minerals, and are a great source of protein and fiber. U.S. pecan production represents approximately 75 percent of the pecans grown worldwide and has an annual market value of $500 million with Oklahoma contributing $20 million.

Pecan *(Carya illinoinensis)* is an outcrossing tree species native to the Mississippi River Valley. Commercial production began in the late 1800s with the first commercial orchards established by selecting and planting nuts from a tree with desirable characteristics. Because each nut was the result of an independent pollination event, growers noticed the resulting trees did not look uniform; they were not genetically identical. As a result, pecan cultivars were grafted so that each tree would be genetically identical to the tree from which it came. Pecan cultivars differ in characteristics including nut size and shape, disease resistance, and tree architecture. Some cultivars may be adapted for growth in certain regions based on their winter hardiness and disease resistance. For example, trees grown in Georgia are adapted for growth in humid, disease-promoting conditions, while those grown in Arizona are adapted to much drier conditions. Pecan scab is a disease caused by the fungus *Fusicladium effusum* and can completely annihilate pecan orchards. Fungicide applications are used to help mitigate the negative impacts from pecan scab but can be costly and do not represent a viable long-term strategy for managing the disease. An alternative is to plant pecan scab resistant cultivars.

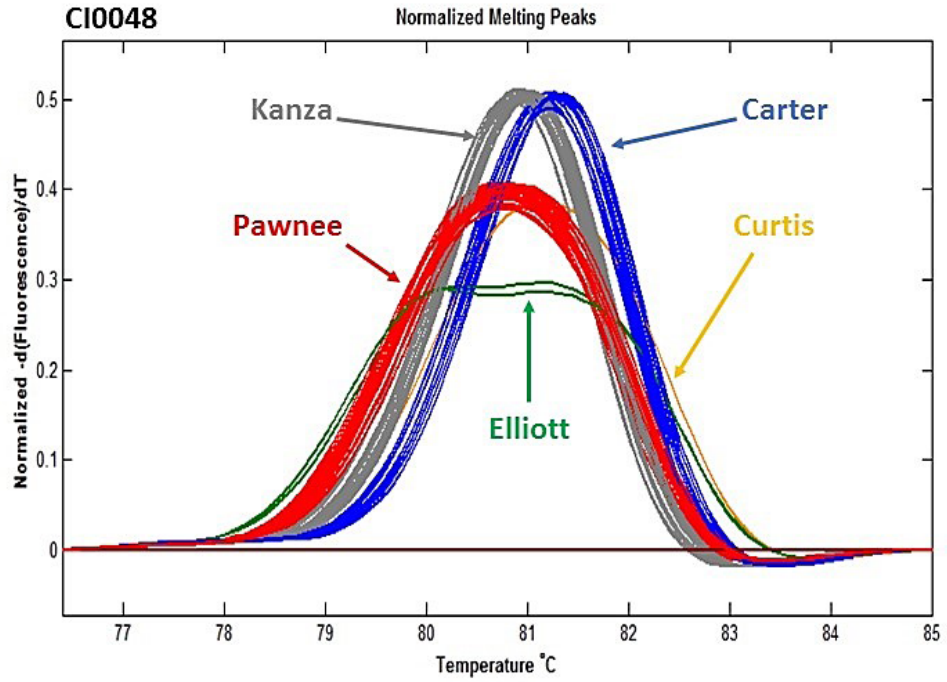

Figure 1: DNA fingerprinting of pecan cultivars. Each color represents a unique DNA sequence that can distinguish the pecan cultivars Pawnee, Kanza, Carter, Curtis and Elliott.

The performance of a pecan tree depends on the DNA of the cultivar planted. Historically, pecan trees have been visually characterized based on the nut size and shape. The chal-

lenge is that the nut features used for identification may be impacted by environmental conditions. For example, drought conditions may result in smaller nuts. Because nuts will not be produced until five to ten years after planting, a grower may need to manage the orchard for disease without knowing the specific cultivar and/or disease resistance of the trees present in the orchard. Therefore, the capacity to identify pecan cultivars and select the most suitable cultivars for the growing conditions is a key component for the continued success of an expanding pecan industry.

Technological advances can provide tools for pecan cultivar identification. Each individual tree has a unique combination of letters in its DNA that serve as a "DNA fingerprint," similar to the unique combination of ridges in our fingerprints. In some cases, these DNA fingerprints, represented by molecular markers, are also associated with disease resistance, nut size and shape or composition. Our team at the Noble Foundation has developed a DNA fingerprint for pecan (see Fig. 1) using young leaves as starting material that facilitates the identification of pecan cultivars without having to wait for the tree to produce nuts. The pecan fingerprints are based on variations in a single base pair (or letter) at the DNA level. The technology's practical value is that cultivar identification can proceed at any time during active tree growth regardless of whether the tree is producing nuts or not. Additionally, a grower will now have the tools to understand the tree genetics and manage their orchard accordingly.

Molecular markers can also be used to "tag" valuable characteristics including disease resistance. The use of DNA markers would enable the identification of trees that are resistant to pecan scab within weeks of sampling leaf tissue from young trees. The approach was used successfully by the apple industry to develop scab resistant apple cultivars. Researchers from the Noble Foundation and other institutions are working to understand diversity in the pecan scab pathogen and the mechanisms for pecan scab resistance using molecular markers technologies. The DNA fingerprinting and identification of disease-resistant trees are examples of science- and technology-driven advances that will enable pecan growers to effectively manage their orchards by understanding the disease susceptibility of their trees and contribute to their ability to expand the pecan industry and provide pecans for the traditional Thanksgiving pie or anytime.

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GENETIC TERMS

DNA encodes the genetic instructions contained in every cell of every living organism for how an individual grows, looks and functions. The DNA code consists of a string of four letters: A, C, G and T.

Molecular markers are small fragments of DNA located in specific regions of the chromosomes. These can be used to identify sequence variations that are unique for each individual. For example, Kanza may have a G while Pawnee may have a C.