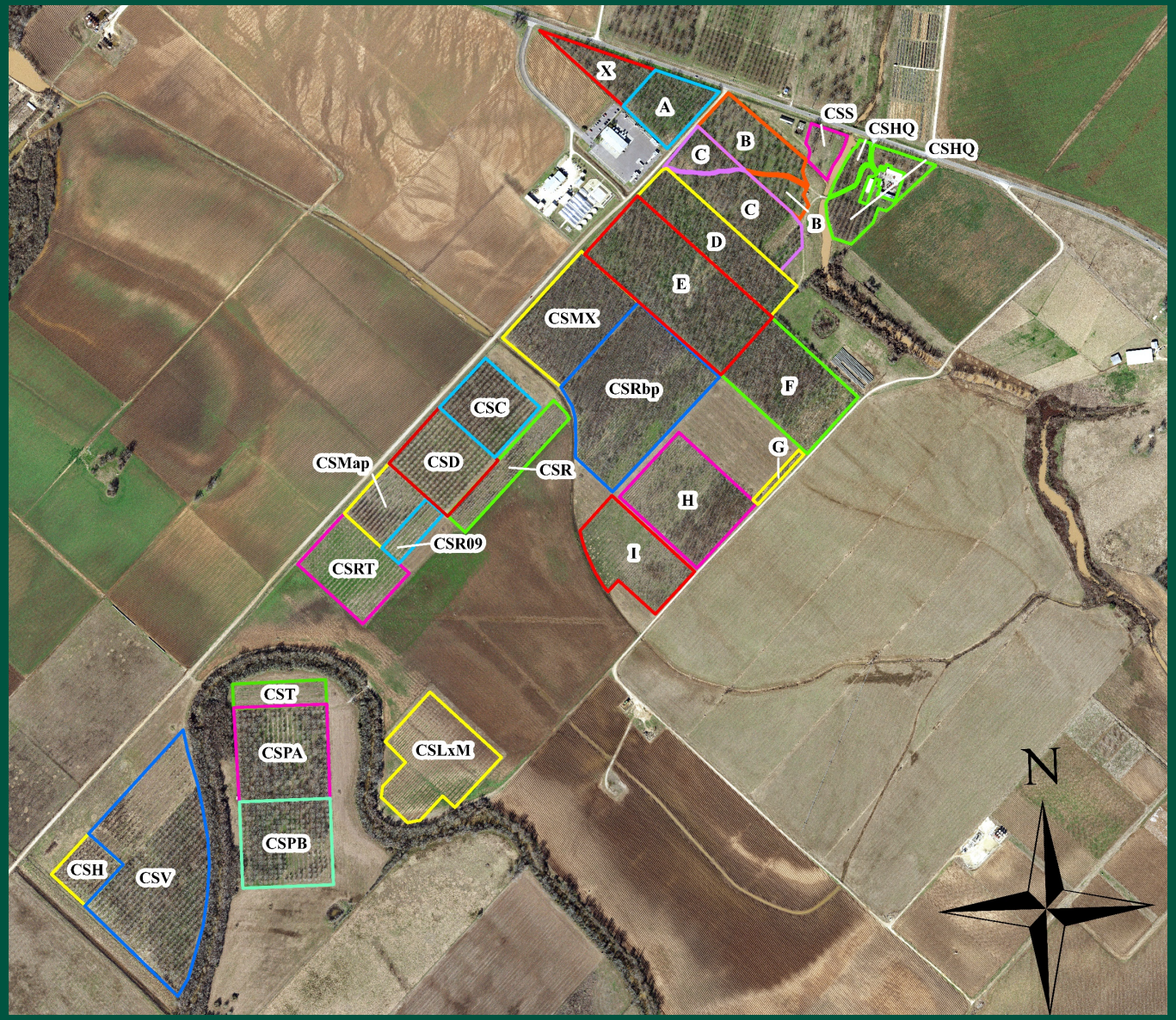
# USDA Pecan Breeding for New Cultivars

Xinwang Wang

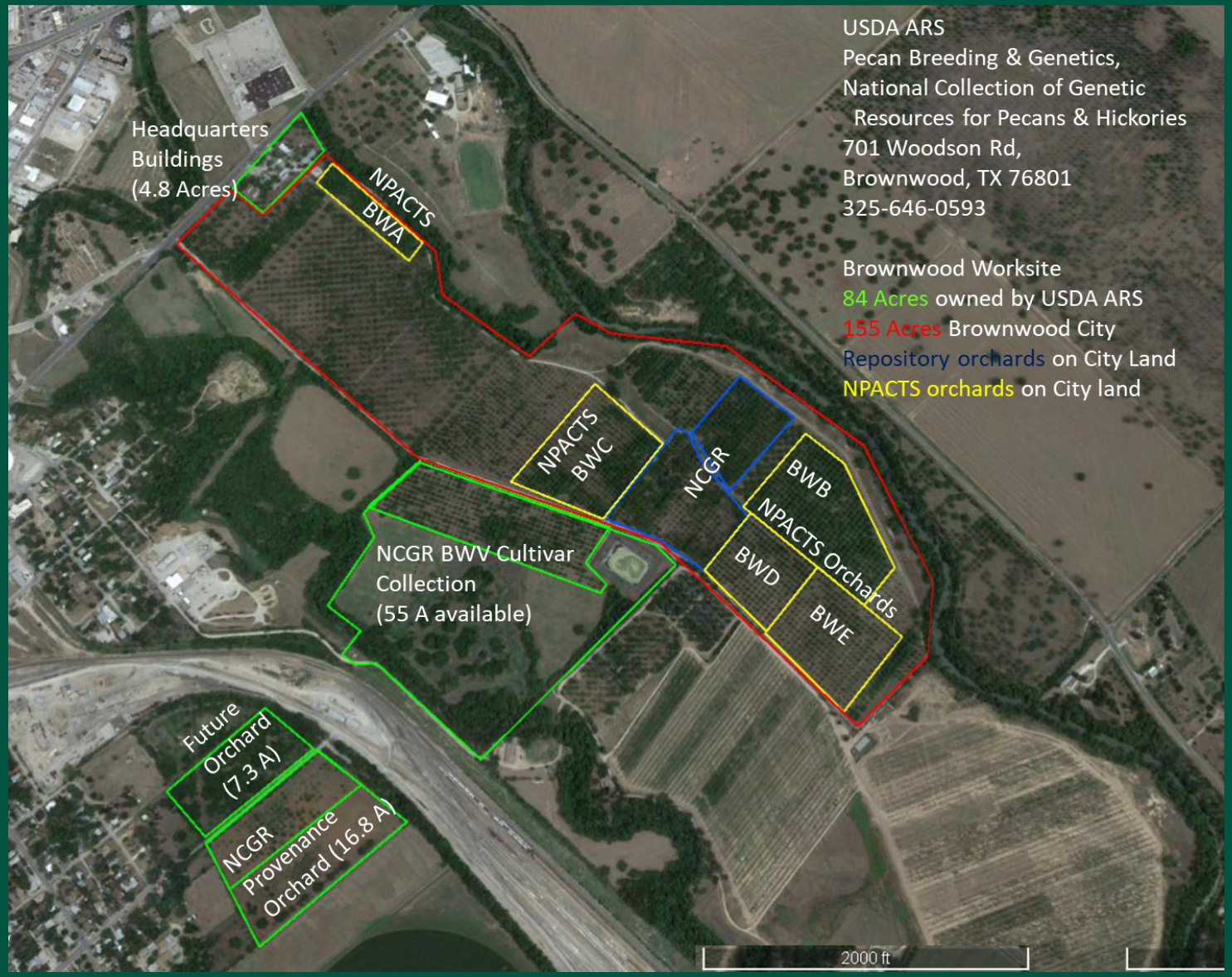
Plant Geneticist/Breeder,
USDA ARS Pecan Breeding & Genetics
College Station, TX

TPGA, Denton, TX July 30-Aug 2, 2023




USDA ARS Pecan Breeding & Genetics Program has two work sites: Somerville, TX, 360 acres. Including:

- Breeding orchards (A-I) (2200+ trees under evaluation)
- Repository orchards (CSMX, CSV, CSP)( ~3,000 trees)
- Rootstock tests (CSRT, CSR09, CSRbp, SCR) (4,000+ trees)
- Advance breeding line evaluations (CSC, CSD) (400+ trees)
- Mapping populations (CSMap, CSLxM) (~800 trees)




The Brownwood worksite is located ~200 miles away from Somerville.

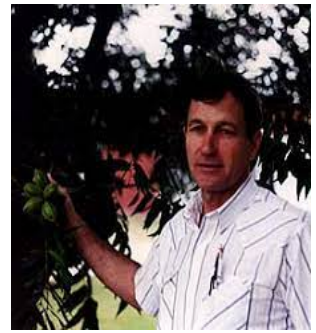
This worksite primarily focuses on the evaluation of advanced breeding lines, and all nut quality analysis is also conducted at this location.

## Cultivars Released by USDA Breeders

- **32 cultivars have been released (1953-2022)**
- **Avg. 29 years per cultivar**

**Louis Romberg**
9 Cultivars (1953-1968).
Avg. 21 Years (13-46 yrs)
Rep. 'Barton', 'Wichita', and 'Mohawk',

**Tommy Thompson**
14 Cultivars (1984-2011).
Avg. 35 Years (20-61 yrs)
Rep. 'Pawnee', 'Kanza', and 'Lakota'



**George Madden**
6 Cultivars (1970-1976).
Avg. 26 Years (23-29 yrs)
Rep. 'Cheyenne' and 'Kiowa'

**LJ Grauke**
3 Cultivars (2022).
Avg 32 Years (25-47 yrs)
Rep. 'Pueblo', 'Seneca', and 'Zuni'

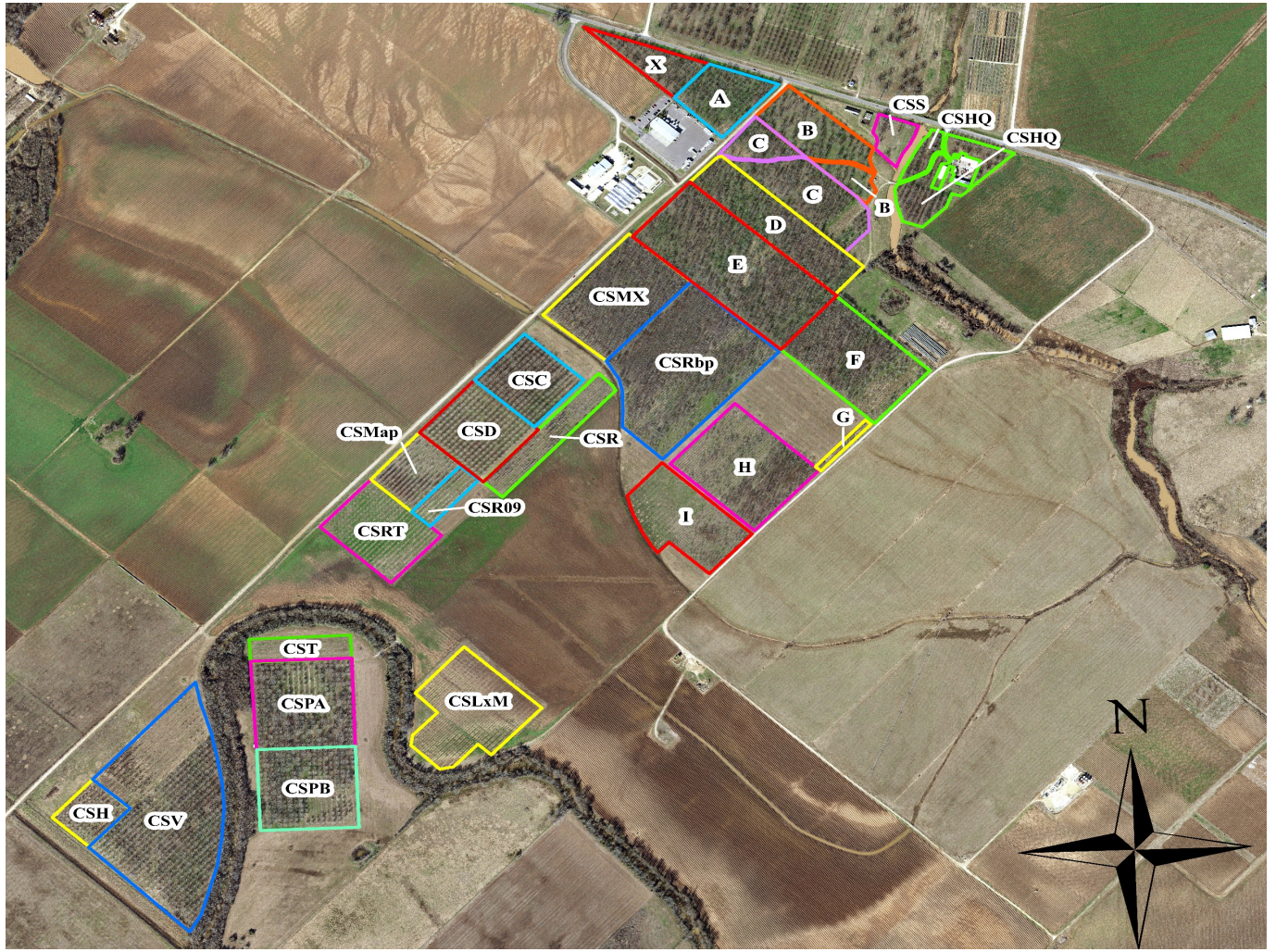
Making cross (1 year

# Pre-selection: screening for scab in greenhouse or controlled nursery (2-3 years)

Greenhouse

Screening nursery

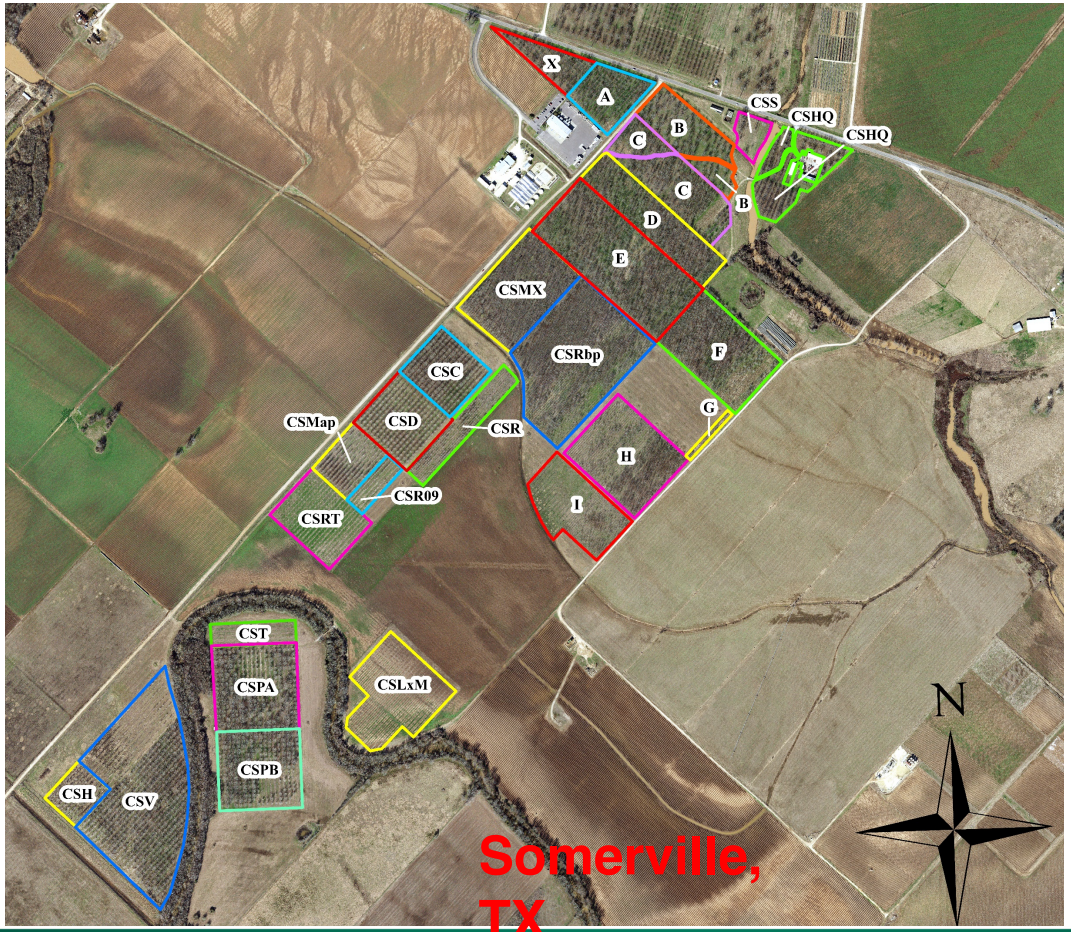
**Pre-selection**: Field evaluation for single clone (10+ years)



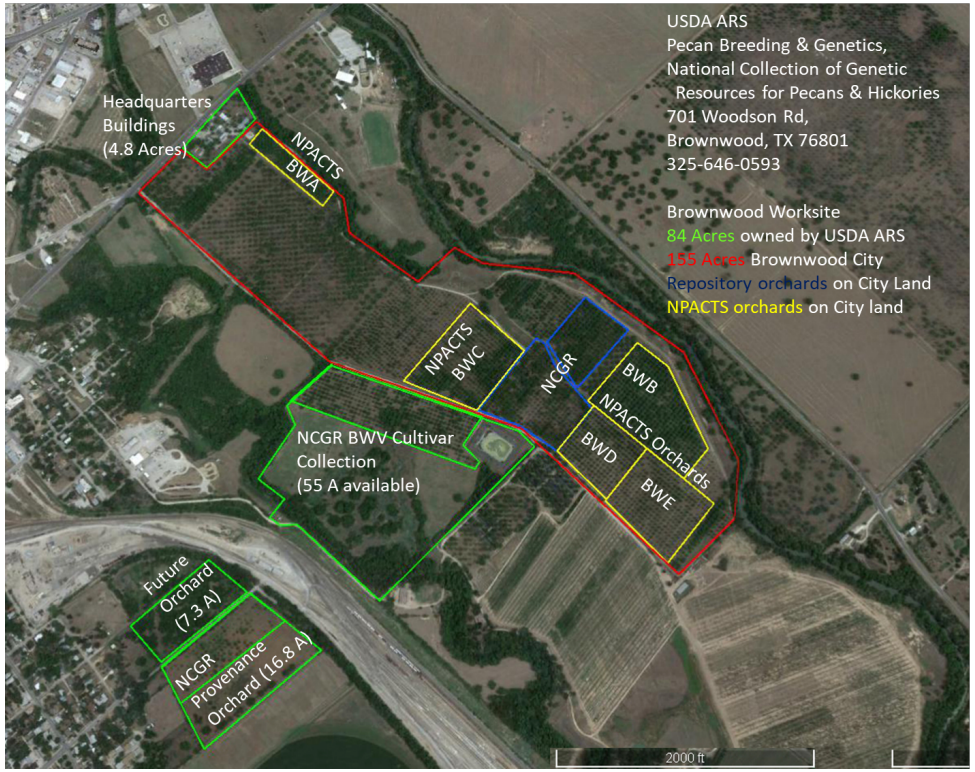
# Basic Breeding Program (BBP) orchards

Basic Breeding Program (BBP) in 15 ft x 15 ft orchard

# National Pecan Advanced Clonal Test System (NPACTS) in a 35 ft x 35 ft orchard, Somerville, TX



# National Pecan Advanced Clonal Test System (NPACTS) in a 35 ft x 35 ft orchard, Brownwood, TX (+10 years)




**Brownwood, TX**

# How did we choose Parents?

- What we want: Breeding goal
- Which we choose: Unique trai
- How we do: Flowering type (dichogamy), ……

**Case 1.**

**Pawnee** (Mohawk x St H Giant)

44 nuts/lb, 58% kernels. Nuts mature early.

**Mohawk:**

**Positive:** 32 nuts/lb, 59% kernels, high yield,

Negative: Ripens mid-season, scab susceptible, and freeze susceptible.

**Starking Hardy Giant**:

Positive: Ripens very early, cold hardy, 58% kernels,

Negative: 78 nuts/lb, wrinkled kernels w/narrow dorsal grooves, medium productivity;

# Case 2:

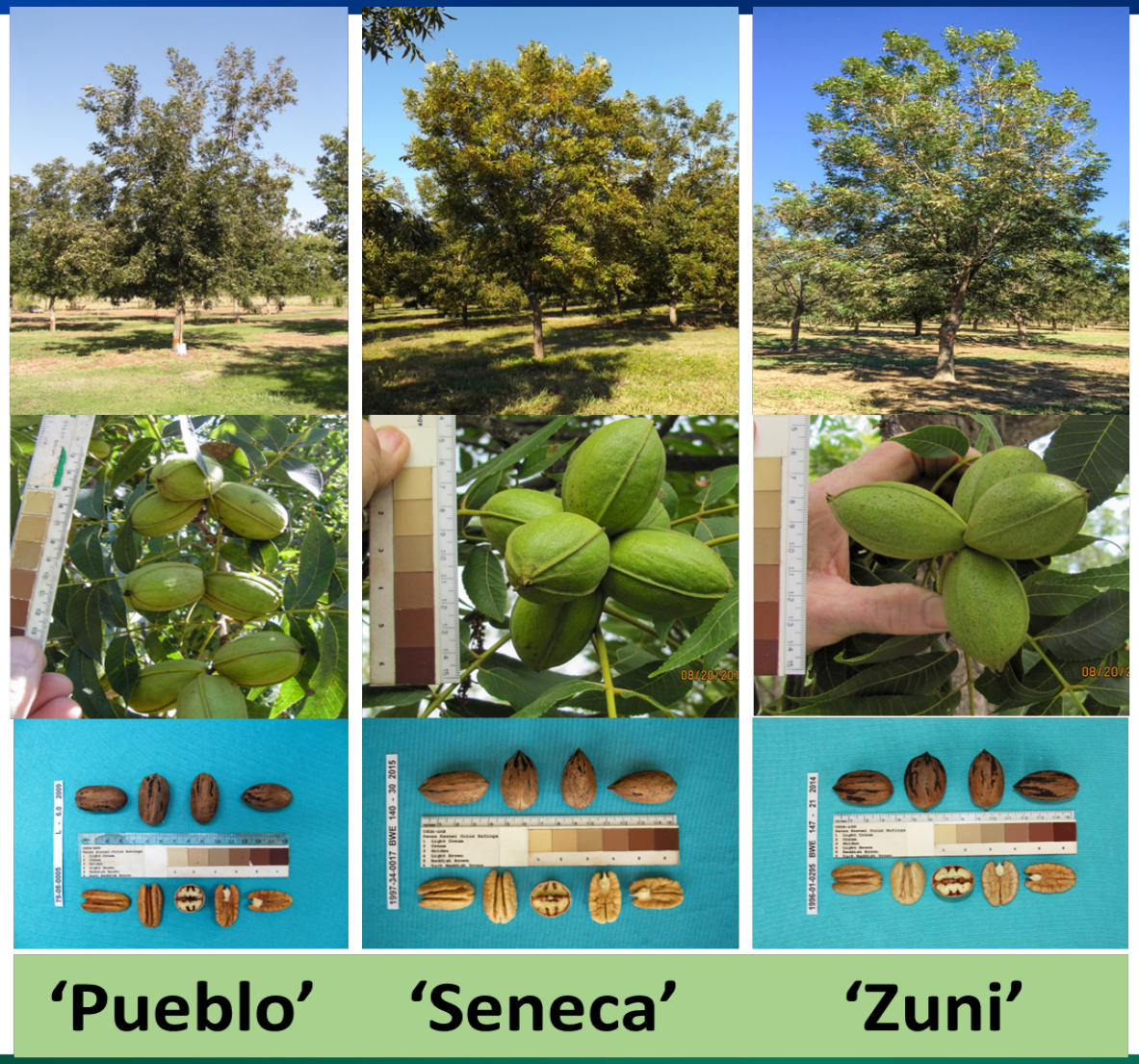
## Kanza (Major x Shoshoni)

77 nuts/lb, 54% kernels, golden kernel, excellent scab resistance, cold hardy (Zone 6b).

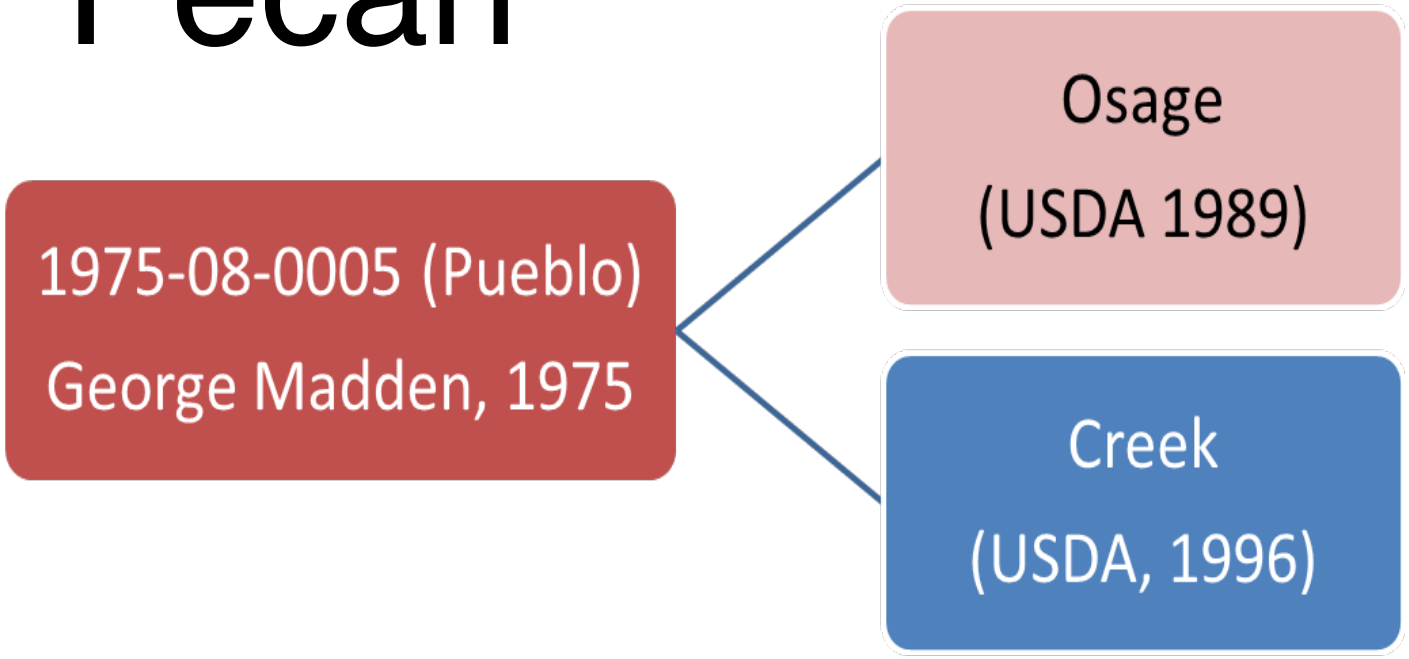

**Major**:
Positive: Good scab resistance, cream to golden kernel color, cold hardy
Negative: Susceptible to vein spot,  78nuts/lb, 49% kernels


**Shoshoni:**
Positive: 41 nuts/lb, light kernel color, high yield potential
Negative: Wrinkled kernels w/wide dorsal grooves, severe tendency to alternate bear. Scab susceptible. Freeze susceptible.

**Cases 3-5**: USDA ARS three new released pecans in 2021-2022



# ‘Pueblo’ Pecan




Positive: Very early ripens, high yield potential, and excellent shelling feature, compact tree size, resistant to scab, downy spot, and vein spot, and hardy
Negative: Small nuts

Positive: Large nuts, cream to golden kernels, wide dorsal groove, and scab resistance
Negative: Low kernel %, over-bearing, Susceptible to phylloxera ( galls)

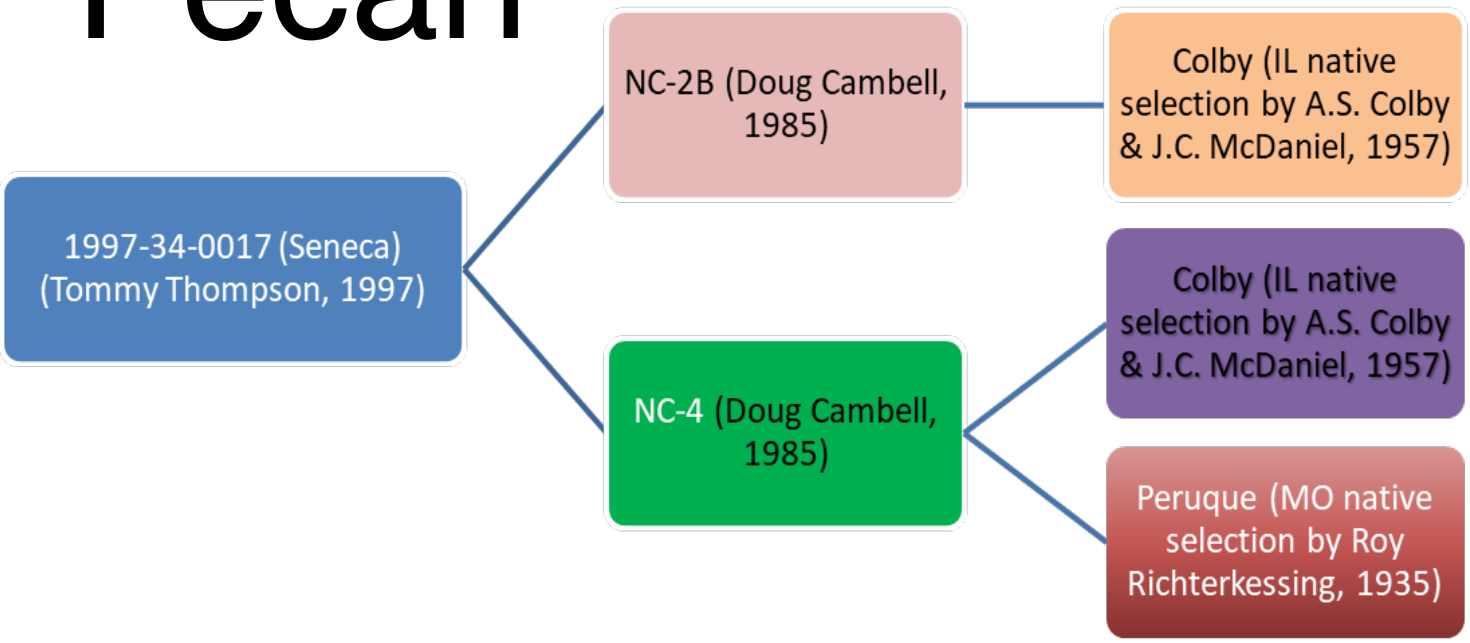
# ‘Pueblo’

Pueblo Choctaw

H10m x W6.5m vs H9.6m x W8.5m
(Grafted in 1992. Photo in Aug 2019)

- Compact tree, core crop
- Early shuck split (3 days later than Pawnee)
- 54 nuts/lb; 55% kernels, golden color
- Moderately leaf/nut scab resistance
- High yield potential
- Central and western regions


# ‘Seneca’ Pecan



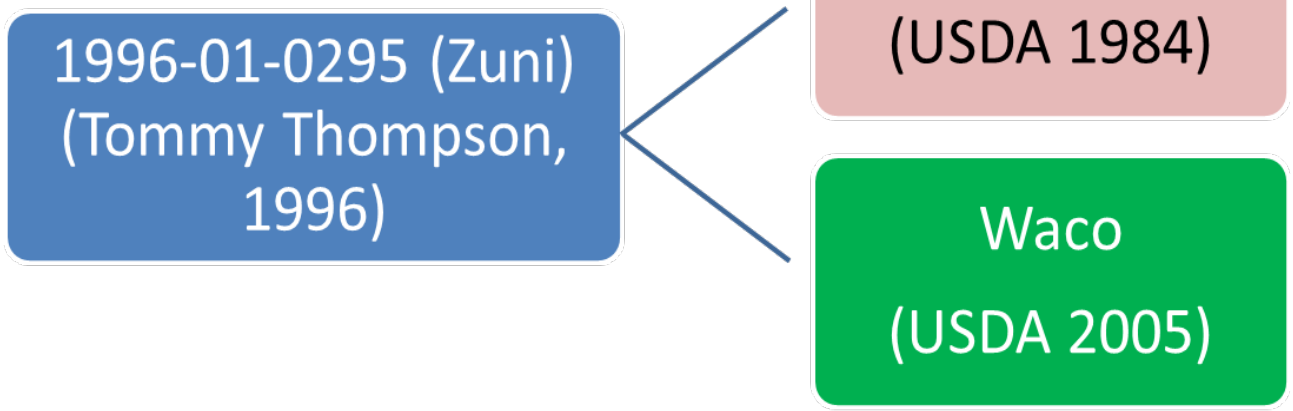

Positive: Source from Ontario, Canada, cold hardy, early maturity

Negative: Scab susceptible

# ‘Seneca’ Pecan

- Central tree
- Early shuck split (9/23) (=Pawnee)
- 63 nuts/lb; 58% kernels, cream color
- Leaf/nut scab resistance
- Strong alternate bearing tendency
- Northern growing region


# ‘Zuni’ Pecan




Positive: Early shuck split, big nuts, outstanding resistance to yellow aphids
Negative: Scab susceptible

Positive: Good looking nuts and kernels. Nuts shell out easily into full halves and are very attractive
Negative: Scab susceptible

# ‘Zuni’ Pecan

- Beautiful kernel
- Oct 3rd shuck split (~10 days later than Pawnee)
- 49 nuts/lb; 56% kernels
- leaf/nut scab resistance
- Medium alternate bearing tendency
- Central and western regions


# Case 6?

Goal: high kernel %, early maturity, scab and/or other disease resistance, low alternate bearing tendency, ……



## 1992-09-0041 (Gloria Grande x Caddo):

Positive: Low alternate bearing (*ABI* = 0.26), leaf and nut scab resistant
Negative: Lower kernel % (52.6%), late shuck split (280 days-mid Oct).

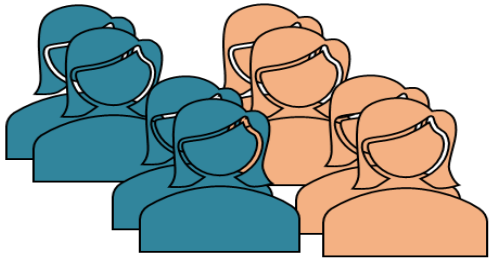
**2008-05-0026 [Madan x (Pawnee x NC-2B)]:**
Positive: Very early shuck split (Aug 25, 2018), and Pawnee
Negative: Small nuts, low kernel %

**Large nuts with high yield potential: breeding lines……**
**High oil content:** 2000-01 series (Pawnee x Carden) or other breeding lines

Preliminary studies on nut quality and storage w/collaboration with Texas Woman's Uni.

| Variety | Type | Harvest year | Origin |
|---|---|---|---|
| Tiemann | Native | 2019, 2020 | Fayette County, TX |
| Freeman | Native | 2019 | Sargent, TX |
| Foster | Native | 2019 | Gonzales County, TX |
| San Felipe | Native | 2019 | Val Verde County, TX |
| Williamson | Native | 2020 | Johnson County, OK |
| 86TX2-1.5 | Native | 2020 | Zavala County, TX |
| 87MX4-5.5 | Native | 2020 | Hidalgo, MX |
| Barton | Improved | 2019, 2020 | Brownwood, TX |
| Lakota | Improved | 2019, 2020 | Brownwood, TX |
| Pawnee_VC | Improved | 2019 | Brownwood, TX |
| Pawnee_Riv | Improved | 2019, 2020 | Brownwood, TX |
| N2-43 | Cross | 2019, 2020 | Nuggett' × 'Western', NM |
| 1991-01-0026 | Cross | 2019, 2020 | Barton' × 'Pawnee', TX |
| 1992-01-0603 | Cross | 2019 | Gloria' × 'Caddo', TX |
| 1992-09-0041 | Cross | 2019 | Pawnee' × 'Caddo', TX |
| 1996-12-0008 | Cross | 2020 | Barton' × ('Cheyenne' × 'Pawnee'), TX |
| 1997-09-0012 | Cross | 2019, 2020 | 'Osage' × ('Cheyenne' × 'Pawnee'), TX |
| Harris Super | Seedling | 2020 | Bolivar County, MS |
| McMillan | Seedling | 2020 | Baldwin County, AL |
| RuCox | Seedling | 2019 | Waller County, TX |
| Woodside Early | Seeding | 2019, 2020 | Rapides Parish, LA |

# Consumer sensory evaluation for pecan kernels



Consumers
N=99, 1st group
N=99, 2nd group


**7 pecan varieties in 1st group:** Tiemann, McMillan, Woodside Early, Lakota, Pawnee, 1997-09-0012, and 1991-01-0026

**7 pecan varieties in 2nd group:** Williamson, 86TX2-1.5, 87MX4-5.5, Harris Super, Barton, N2-43, and 1996-12-0008

## Hedonic questions

1. Overall liking
2. Nut inner color liking
3. Nut size liking
4. Pecan flavor liking
5. Raw-nut flavor liking

## Intensity questions

1. Pecan flavor intensity
2. Raw-nut flavor intensity
3. Buttery flavor intensity
4. Sweet intensity
5. Astringent intensity

## Emotional questions

1. Satiating effect
2. Energizing effect
3. CATA emotional question

## Demographic information

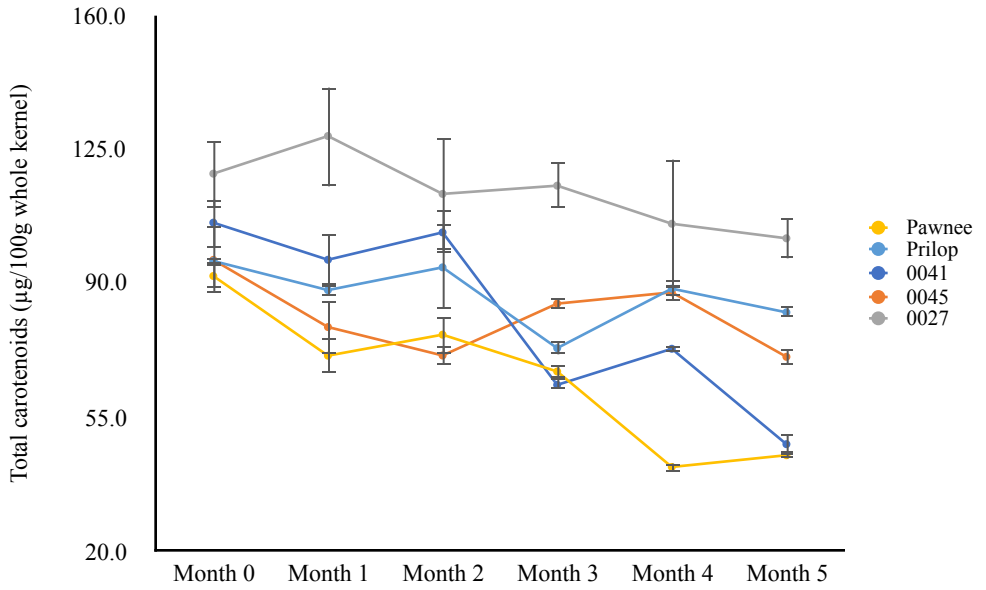
1. Age
2. Gender
3. Consumption frequency
4. How pecan consumed
5. Consumption habit compared with other nuts
6. Purchase intent

# Pecan nut shelf life

To investigate the changes in pecan kernel color, carotenoids, polyphenols, and physicochemical properties during five months of storage at room temperature for five different pecan varieties.

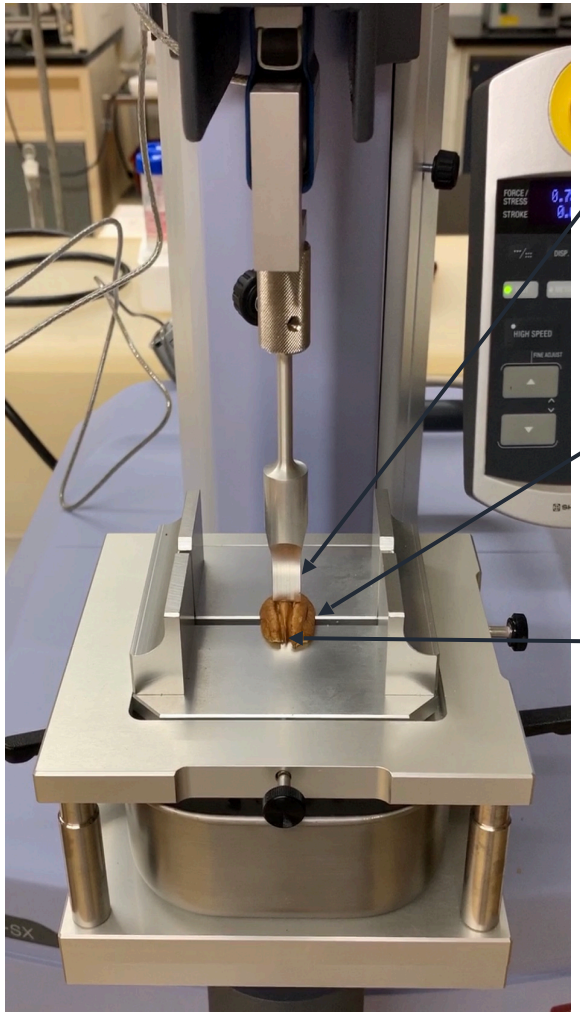
Results:

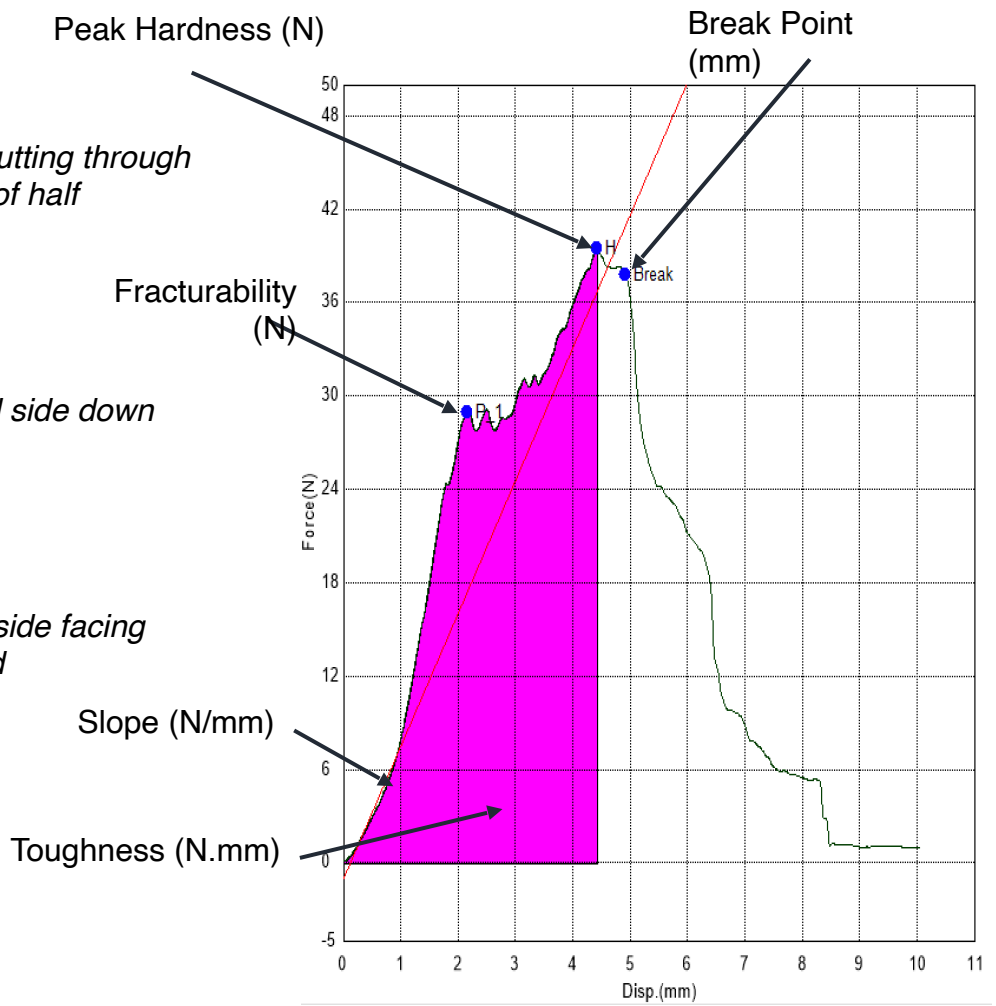
1. Kernel color darkened
2. Carotenoids decreased
3. Polyphenol increased
4. Water loss
5. No significant changes of Lipids



# Pecan kernel quality study

To investigate kernel texture, crude fat, fatty acid profile, total soluble solids, and total polyphenols in 29 samples (21 varieties, with the same 8 varieties from two harvest years)



# Funds

- USDA CRIS “Pecan Breeding and Management of the National Collection of Carya Genetic Resources” (3091-21000-046-000D)
- USDA NIFA “Trees for the Future: Coordinated Development of Genetic Resources and Tools to Accelerate Breeding of Geographic and Climate Adapted Pecan Trees” (3091-21000-039-008R)

Simon Liu, ARS Administrator and Larry Chandler, Plains Area Director, Oct 2018

Timothy Rinehart, NPL and GA group, Jun 2019


GOOSENECK
TRAILER MFG. CO.
BOYAR, TEXAS
Custom
Gooseneck
Trailers


TEXAS A&M PECAN

# Pecan group


Pecan Breeding and Genetics
Agricultural Research Service
U.S. Department of Agriculture
10200 FM 50
Somerville, Texas 77879