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The Effect Of Low Temperature Treatments On Pistillate Pecan Flowers

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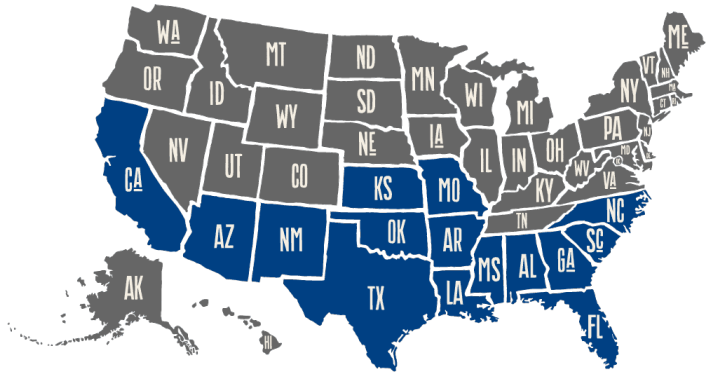
PECAN!!

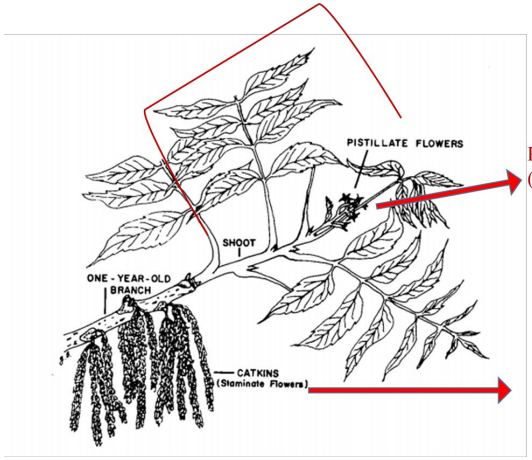
- Have medicinal and nutritional properties
- Native to northeastern North America
- USA produce 80% of world's pecan market



Production of Pecan nuts in USA

Sparks, D. (2000)

Pecan Orchard: Cimarron Research Station, Perkins



Pistillate flowers (4-5 per branch)

Staminate flowers (2.65 million pollen per Catkin)

- Monoecious plant

Spring Freeze:

- During spring the pecan bud breaks the dormancy and starts to enlarge and grow, is most susceptible to environmental changes
- An unexpected '**The 2007 Easter Freeze**' event occurred on 5-9 April caused severe damage to a wide region of the eastern United States
- Even a single incident of spring freeze can cause drastic loss in production

- Opening flowers are exposed to freezing temperatures

Pecan bud and inflorescence damage after Spring Freeze

2012-2020 Spring cold temperatures at Cimarron Valley Research Station, Perkins

Year	April 1st– May 18th (Hours<4 °C)
2012	3
2013	181
2014	50
2015	12
2016	10
2017	9
2018	144
2019	18
2020 April 1st -April 18th (Hours<4 °C)	83

Wood, B.W. (2011); Gu et al. (2008)

Objective: To Find The Threshold Temperatures And Tolerance Range Of Pecan Buds And Flowers To Spring Freeze

- Cultivars- **Kanza, Pawnee, and Maramec**
- Two growth stages-

1) Branch with buds at outer bud scale shed stage

2) Bloom stage

Treatments

5 different temperature (-6, -2, 0, 2, and 4 °C),

2 durations (4 and 8 hours) using **Conviron E8 Freezing Unit**, and control

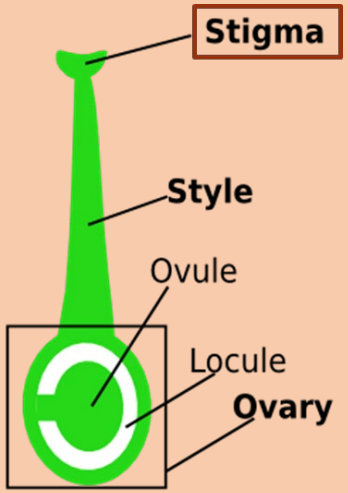
Branches in Growth chamber

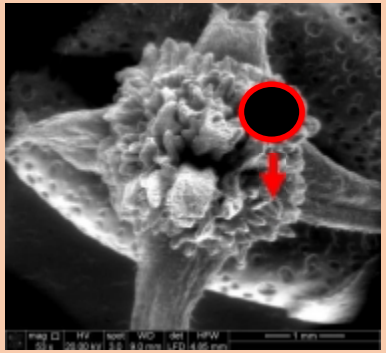
Conditions inside the growth chamber

Time	Temperature (F)	Temperature (C)	Relative Humidity(%)
0:00	58.1	14.5	75.7
1:00	57.0	13.9	77.9
2:00	56.1	13.4	79.5
3:00	55.3	12.9	80.7
4:00	54.7	12.6	81.5
5:00	54.2	12.3	82.7
6:00	53.7	12.1	83.7
7:00	54.3	12.4	83.0
8:00	56.9	13.8	78.3
9:00	59.7	15.4	72.1
10:00	62.5	16.9	66.2
11:00	65.0	18.3	60.9
12:00	67.0	19.4	56.9
13:00	68.6	20.3	54.0
14:00	69.8	21.0	52.0
15:00	70.7	21.5	50.2
16:00	70.9	21.6	49.4
17:00	70.5	21.4	49.8
18:00	69.4	20.8	51.4
19:00	67.1	19.5	55.6
20:00	63.8	17.7	55.6
21:00	61.7	16.5	66.0
22:00	60.2	15.7	69.5
23:00	59.1	15.1	72.4

❖ Observations After bloom:

1) Stigma structure-SEM





Flower Stigma

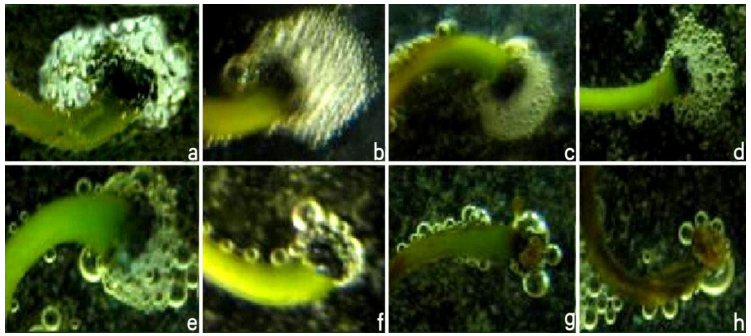
Oklahoma State University, Microscopy Laboratory

2) Stigma receptivity-Microscope

- Benzidine-Hydrogen peroxide (H_2O_2) test
- Collect the pistils
- Stain for 10-15 minutes
- Observe under Microscope

- Appearance of air bubbles and color of the solution

Stigmatic reaction to Benzidine-H_2O_2



Chen et al., 2013

3) Ovule viability-Microscope

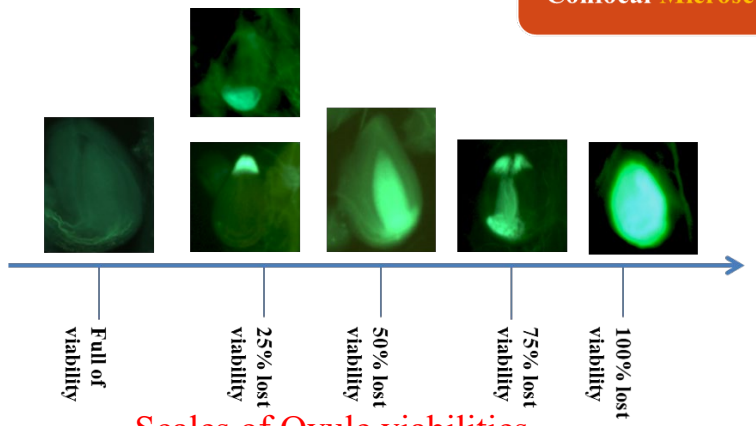
Flower fixation- FAA solution

Flower tissues - **rinsed** with distilled water three times for 30 minutes each and then transferred to 5 N **NaOH** solution

After tissues **softening,** samples will be transferred to a 0.1% **Aniline Blue** solution and left until the pistils become transparent

Whole pistils- placed on a slide with 1-2 drops of 50% glycerol and then squashing with a cover slip

Leica TCS SP2 Confocal Microscope



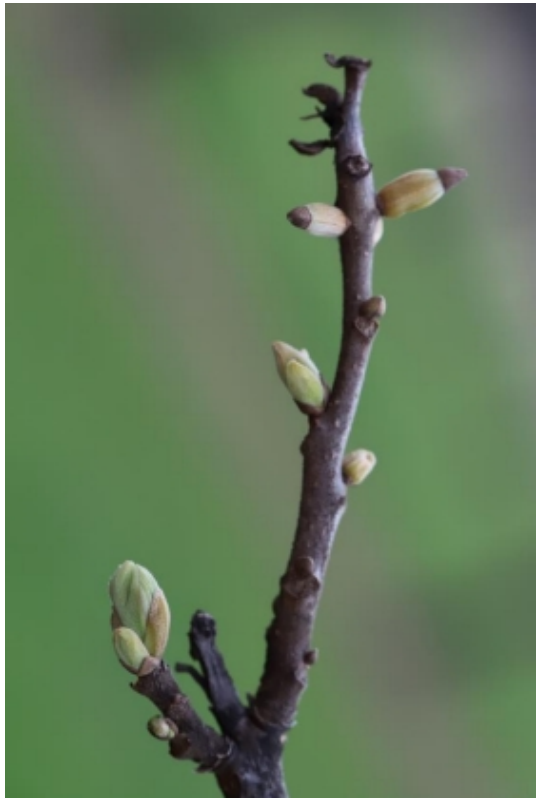
Scales of Ovule viabilities

Zhang et al., 2018

SPRING FREEZE RESULT 1: **OUTER BUD SCALE SHED STAGE**

- All of the -6°C and all of the -4°C treatments

  - no leaves or female flower development



Branch with buds at outer bud scale shed stage

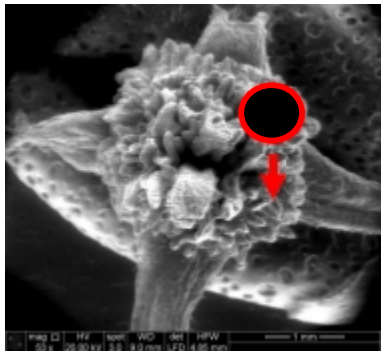
After treatment

Treatment: 4°C 4 hours

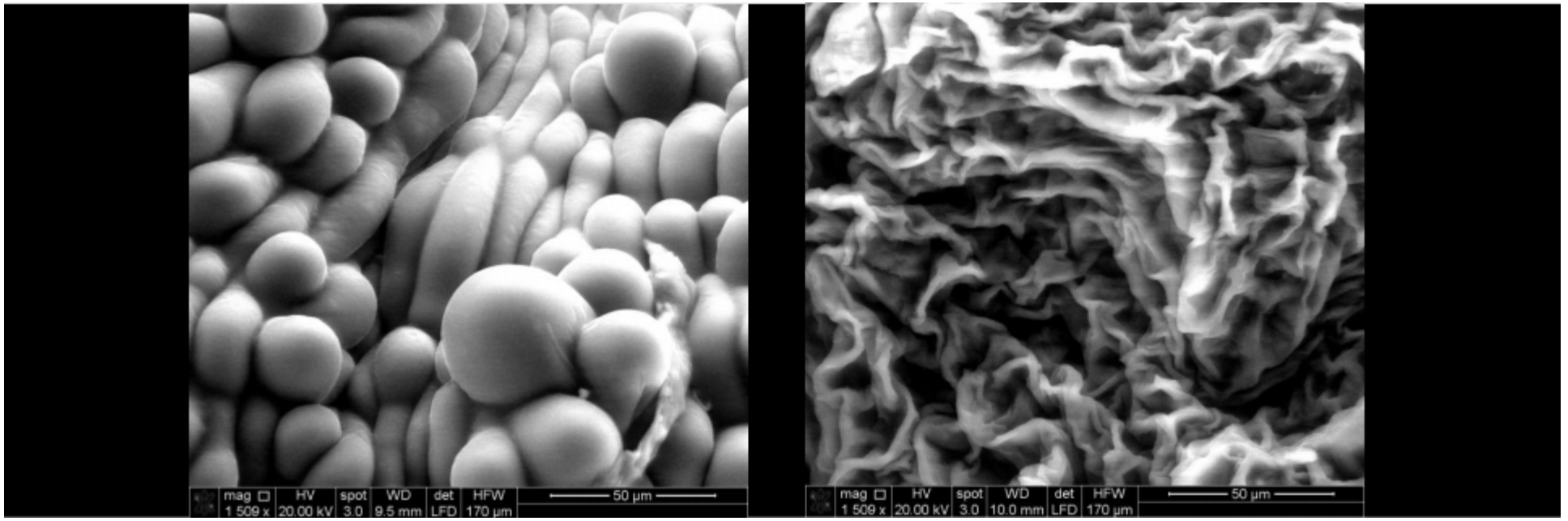
Control

Spring Freeze Result 2: **At bloom stage**

Flower Stigma



- Cold temperature treatment at bloom stage
- Stigma **papillar cells collapsed**
- **Cannot accept pollen**



Control Stigma Papillar Cells

Treatment: 4°C 4 hours
Stigma Papillar Cells

Spring Freeze Result:

- The poor development of both buds and flowers by **-6°C** and **-4°C** treatments
- A wider temperature range than our previous perception of spring freeze causes effective damage to pecan flowers

4°C for 4 hours

Future Experiments:

- Continue the experiments and will observe Stigma receptivity and Ovule Viability

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