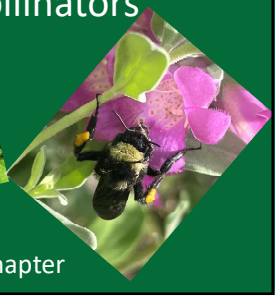
Powerhouse Pollinators



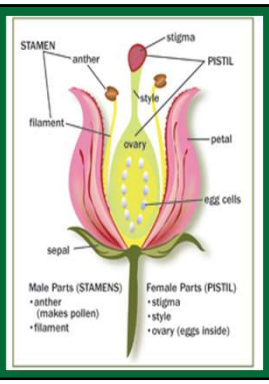
Presented by the

Gideon Lincecum Chapter

1

What is pollination?

- **Pollination**: The transfer of a pollen grain from the male **anther** to the female **stigma**.
- **Pollination** can occur through self-pollination, wind or water pollination, or through the work of animals that move pollen within the flower and from bloom to bloom.



2

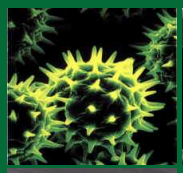
Types of pollination

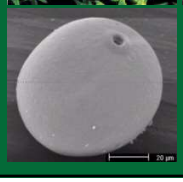
- Self-pollination
- Cross-pollination
  - Wind
  - Water
  - Animal
    - Insects - bees, wasps, flies, butterflies, moths, beetles, ants
    - Birds - hummingbirds
    - Bats
    - And even other small mammals

3

A word about pollen…

- The shape and form of pollen is related to its method of pollination.
- Insect-pollinated species have sticky or barbed pollen grains.
- Wind-pollinated species are lightweight, small, and smooth (corn pollen).





4

Self-pollination

- **Self-pollination** is when a flower fertilizes itself with its own pollen, without the help of wind, insects, or other agents.
- Advantages:
  - Doesn't require a pollinating agent
  - Ensures that the plant passes on its genes and traits to the next generation, without any variation or mixing.

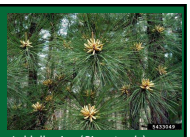
From top: eggplant, green bean, tomato, and pepper plants

5

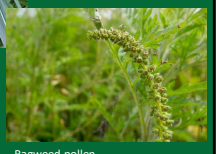
Wind pollination

- Small flowers with no bright colors, special odors, or nectar.
- Plants produce large amounts of pollen that is distributed by wind.
- Conifers and many trees are wind pollinated as are most grasses and **ragweed.**
- Advantages: no animal pollinator required, pollen can travel long distances.
- Disadvantages: allergens

Grass flowers. USDA Forest Service.



Loblolly pine (*Pinus taeda*) branch tips with flowers. Photo Erich G. Vallery, USDA Forest Service.



Ragweed pollen.

6

Water pollination

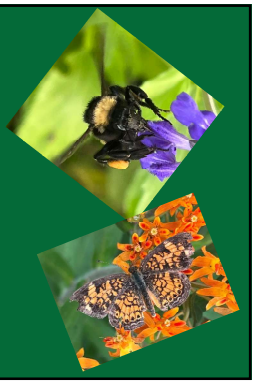
- Many aquatic plants have insect-pollinated flowers, but others are water pollinated.
- Pollen floats on the surface, or occasionally underwater, until it contacts flowers.
- Disadvantages: many water pollinated plants have become invasive.

Hydrilla – US Geological Survey.

7

What's a pollinator?

- Any critter who transports pollen from one plant to another.
- Birds, bats, butterflies, moths, flies, beetles, wasps, and ***bees*** are pollinators.
- They visit flowers to drink nectar or feed off of pollen and when they move from spot to spot, grains of pollen go with them.
- Voila! Reproduction!



8

Animal pollination

- Typically the unintended consequence of an animal's activity on a flower. Pollinators search for food, mates, shelter, and nest-building material.
- Pollen grains attach themselves to an animal that visits the flower to collect pollen or to sip nectar.
- Pollen is deposited on other flowers visited.

9

Pollinators and plants

- Plants and pollinators co-evolved and depend on each other.
- Pollination is essential for plant reproduction – for the plant to produce seeds.
- Because plants are rooted in place, they need help to move their pollen.
- In turn, the pollinators receive their reward in the form of pollen or nectar.
- Plants and animals can evolve specialized relationships where each develops physical characteristics that makes them more likely to successfully interact. The relationship between monarchs and milkweeds is a well-known example.

10

Monarchs and Milkweed

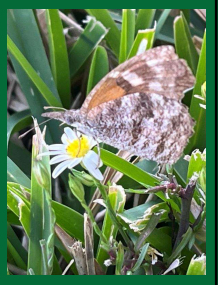
Asclepias viridis

Monarch caterpillar on *Asclepias perennis*. Photo by Chuck Leaman, posted to JOYS of Butterfly Gardening SE Texas.

11

Why are pollinators important?

- A "keystone species" – pollinators are species upon which others depend.
- They are essential to maintaining healthy ecosystems.
- Many plants can not reproduce without them.
- Many species depend on "pollinators" for food.



12

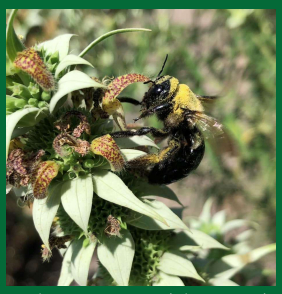
Getting the pollinator's attention with colorful petals, scent, nectar, and pollen

- Plants advertise their pollen and nectar rewards with:
  - Colors – bees see **blue**, **yellow**, and UV; while birds see **red**. Bats don't see well and are active at night, so flowers are white.
  - Nectar guides – a visual guide for pollinator to locate the reward (pansy flower)
  - Aromas – for insects, nectar. Can also be carrion or dung smell.

13

Bees

- Bees are champion pollinators of agricultural crops and native plants.
- Bees have high energy needs. They drink the nectar and eat pollen, which is also used to provision nests for the next generation.
- Bees are guided by sight and smell. They see **yellow** and **blue** colors, and ultraviolet light, but not **red**.



Female Eastern Carpenter Bee (*Xylocopa virginica*), foraging on Spotted Beebalm (*Monarda punctata*). Look at all that pollen on her! Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

14

Honeybees

- European honeybee (*Apis mellifera*) is not native to North America
  - Common agricultural crop pollinator.
  - Despite media attention, honeybees are not endangered in their native habitats or in the U.S. *Why Getting a Hive Won't "Save the Bees"*, Xerces Society, https://www.xerces.org/sites/default/files/publications/22-011.pdf.

European honey bees, *Apis mellifera*, on comb in a colony. Photograph by Ashley N. Mortensen, Entomology and Nematology Department, University of Florida.

15

North American Native Bees

- More than 4,000 species of native bees in North America.
- Per TPWD, there are more than 700 species of native bees in Texas, 90% of which are solitary bees.
- Many are in decline because of habitat loss and pesticide use.

Endangered Southern Plains Bumble Bee (*Bombus fraternus*). Photo by Jennifer Hopwood/Xerces Society.

16

Buzz pollination unique to native bees

Female American Bumble Bee (*Bombus pensylvanicus*), foraging on Prairie Blazing Star (*Liatris pycnostachya*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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Flower characteristics that attract bees

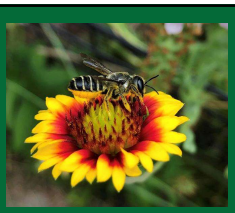
- Full of nectar
- Brightly colored with petals that are usually blue or yellow or a mixture of these (bees cannot see red)
- Sweetly aromatic or have a minty fragrance
- Open in daytime
- Provide landing platforms
- Often bilaterally symmetrical (one side of the flower is a mirror image of the other)
- Flowers are often tubular with nectar at base of tube

A male carpenter bee stealing nectar from the base of a penstemon. Photo by Julian Cowles, USDA Forest Service.

18

Nectar guides and landing platforms

- Bees are drawn to flowers by nectar guides, some of which are ultraviolet, and appreciate landing platforms that make it easier for them to gather pollen or drink nectar.

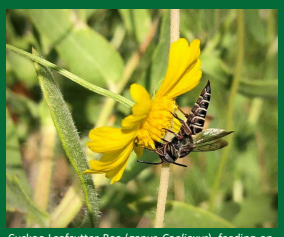


Above: Leafcutter bee on firm landing platform of firewheel. Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

Far Left: As humans see the flower. Left: As bees see it. Photos by Apalachicola National Forest.

19

Bees

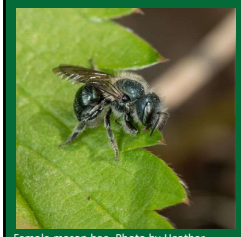


Cuckoo Leafcutter Bee (genus *Coelioxys*), feeding on Bitter Sneezeweed (*Helenium amarum*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

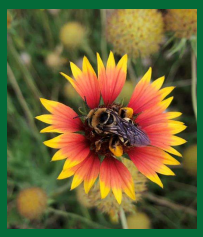
A tiny female Metallic Sweat Bee (genus Dialictus), foraging on Corpus Christi Fleabane (Erigeron procumbens. Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

20

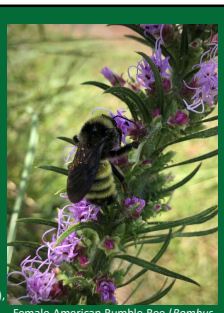
Bees



Female mason bee. Photo by Heather Holm.



Female Longhorn Bee (tribe *Eucerini*), foraging on Firewheel (*Gaillardia pulchella*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.



Female American Bumble Bee (*Bombus pensylvanicus*), foraging on Prairie Blazing Star (*Liatris pycnostachya*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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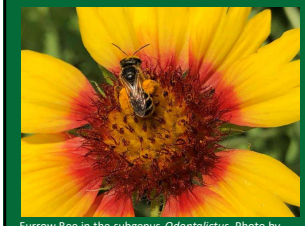
Bees



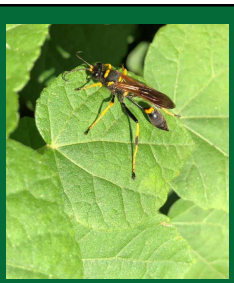
Furrow Bee in the subgenus *Odontalictus*. Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

Female Two-spotted Longhorn Bee (*Melissodes bimaculata*), launching from a Corpus Christi Fleabane (*Erigeron procumbens*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

22

Wasps

- Important pollinators like bees.
- Similar appearance to bees, but generally less hairy.
- Less efficient pollinators because pollen more likely to fall off as they move between flowers.
- Pollen and nectar satisfy high energy needs of adults.
- Capture insects or spiders as food for larvae.



Black and Yellow Mud Dauber (*Sceliphron caementarium*), sunning on the leaf of a Drummond Turkscap (*Malvaviscus arboreus* var. drummondii). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

23

Wasps

Elegant Tarantula-hawk Wasp (*Pepsis menechma*).). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

Female Red and Black Mason Wasp (*Pachodynerus erynnis*), nectaring on Rattlesnake Master (*Eryngium yuccifolium*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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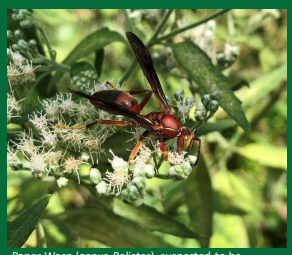
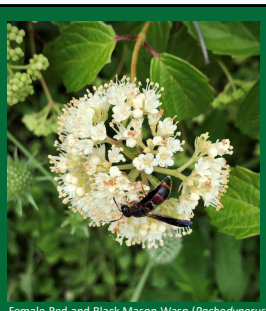
Wasps



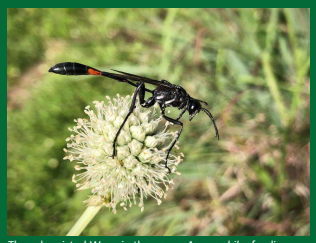
Paper Wasp (genus *Polistes*), suspected to be Metricus Paper Wasp (*Polistes metricus*), feeding on Late Boneset (*Eupatorium serotinum*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.



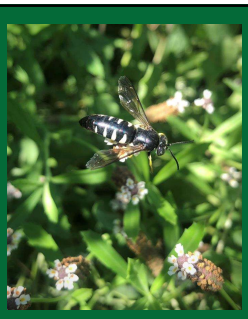
Female Red and Black Mason Wasp (*Pachodynerus erynnis*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

25

Wasps



Thread-waisted Wasp in the genus *Ammophila*, feeding on Rattlesnake Master (*Eryngium yuccifolium*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

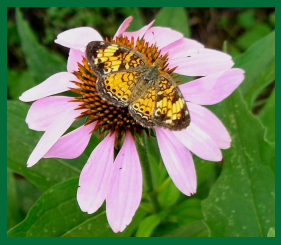


Sand Wasp in the genus *Bicyrtes* feeding on frogfruit. Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

26

Butterflies

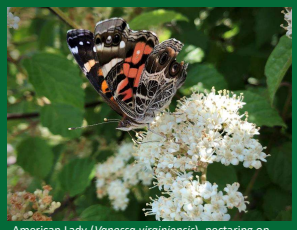
- Butterflies are guided by sight and smell
- Butterflies typically visit flowers that are:
  - In clusters and provide landing platforms
  - Brightly colored (red, yellow, orange)
  - Open during the day
  - Ample nectar producers, with nectar deeply hidden in tube-shaped flowers
  - Nectar guides present
  - May be clusters of small flowers (goldenrods, Spirea)



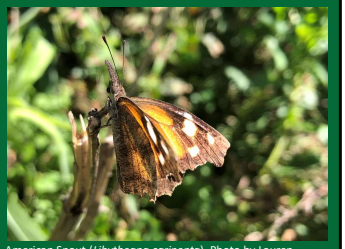
Checkerspot butterfly on a cone flower. Photo by Wayne Owens, USDA Forest Service.

27

Butterflies



American Lady (*Vanessa virginiensis*), nectaring on Southern Arrowwood (*Viburnum dentatum*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.



American Snout (*Libytheana carinenta*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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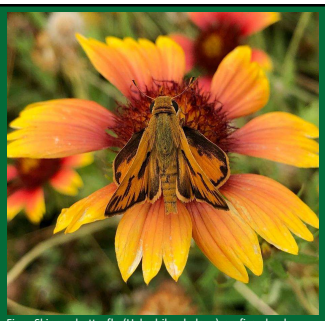
Butterflies

Female Gray Hairstreak (*Strymon melinus*), nectaring on Corpus Christi Fleabane (*Erigeron procumbens*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.



Fiery Skipper butterfly (Hylephila phyleus) on firewheel (*Gaillardia pulchella*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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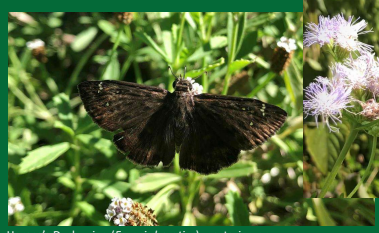
Butterflies



Horace's Duskywing (*Erynnis horatius*), nectaring on Texas Frogfruit (*Phyla nodiflora*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

Male Queen (*Danaus gilippus*), nectaring on Gregg's Mistflower (*Conoclinium greggii*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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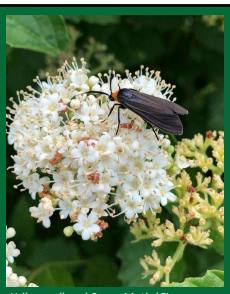
Moths

- Moths are pollinators of the night. They prefer flowers that are:
  - In clusters and provide landing platforms
  - White or dull colors
  - Open late afternoon or night
  - Ample nectar producers, with nectar deeply hidden, such as morning glory, tobacco, yucca, and gardenia.
  - Prefer sweet, strong odors
- More than 11,000 species compared to 800 species of butterflies in the U.S.



Yellow-collared Scape Moth (*Cisseps fulvicollis*), on Southern Arrowwood (*Viburnum dentatum*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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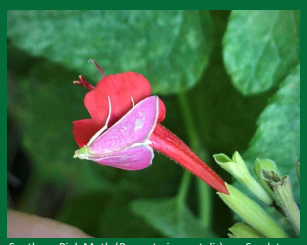
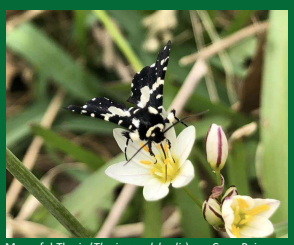
Moths



Southern Pink Moth (*Pyrausta inornatalis*), on Scarlet Sage (*Salvia coccinea*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.



Mournful Thyris (*Thyris sepulchralis*), on Crow Poison (*Nothoscordum bivalve*) Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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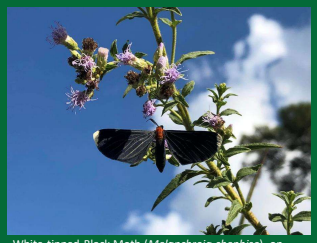
Moths



White-tipped Black Moth (*Melanchroia chephise*), on Ivyleaf Thoroughwort (*Chromoleana ivifolia*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

Tersa Sphinx Moth (*Xylophanes tersa*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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Moths

Grapeleaf Skeletonizer (*Harrisina americana*), on Blue Mistflower (*Conoclinium coelestinum*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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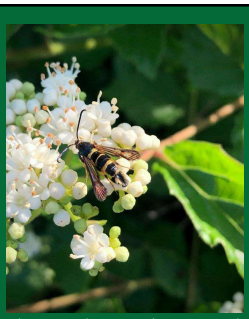
Moths

Amorpha juglandis moth. Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.



Clearwing moth species in the genus *Synanthedon*, on Southern Arrowwood (*Viburnum dentatum*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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Flies

- Flies have two wings (bees have four), less hairy and less efficient
- Flowers pollinated by flies are:
  - Pale and dull to dark brown or purple
  - Sometimes flecked with translucent patches
  - Often putrid odors
  - Nectar guides not present
  - Produce pollen
  - Flowers are funnel like or complex traps

Blow fly or green bottle fly. Photo by Beatriz Moisset, 2002-2004, USDA Forest Service.

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Flies

Tachinid fly on catnip. Photo by Beatriz Moisset, 2002-2004, USDA Forest Service.

Hairy-legged fly (*Trichopoda pennipes*). Photo by Beatriz Moisset, USDA Forest Service.

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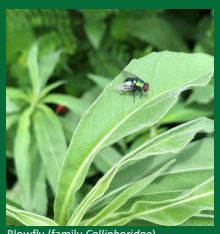
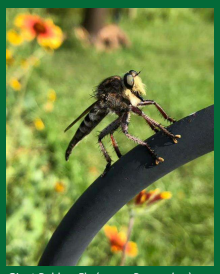
Flies



Blowfly (family *Calliphoridae*), perched on Maximilian Sunflower (*Helianthus maximiliani*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.



Giant Robber Fly (genus *Promachus*), perched in waiting for prey. Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

Northern Plushback (*Palpada vinetorum*), a hoverfly, on Texas Frogfruit (*Phyla nodiflora*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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Flies

Golden Mydas Fly (*Mydas brunneus*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

Oblique Syrphid Fly (*Allograpta obliqua*), shown here feeding on a Shepherd's Needle (*Bidens alba*). Its larvae eat aphids and mealy bugs. Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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Flies

Above: Robber Fly, unknown genus, resting between hunting sessions. Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

Right: Syrphid Fly (*Fazia micrura*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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Bee Mimics

- Some flies, such as syrphid flies, masquerade as bees and wasps
- Can be distinguished from bees and wasps by close inspection.
- Flies have only a single set of wings and are typically less hairy.

The syrphid fly is a bee mimic. Photo by Beatriz Moisset, 2002-2004, USDA Forest Service.

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Bee Mimics

The tachnid fly is similar in general appearance to bees or wasps. Photo by Beatriz Moisset, 2002-2004, USDA Forest Service.

A bee fly is a good bee mimic. It lays eggs near bee nests and its larvae feed on bee larvae. Photo by Beatriz Moisset, USDA Forest Service.

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Beetles

- Beetles have been present in the environment since the Mesozoic era (200 million years ago)
- Beetles co-evolved with many ancient species such as the magnolia and the spicebush.
- Beetles are capable of color vision.
- They rely on their sense of smell for feeding and to finding a place to lay eggs.

Magnolia. Photo by Steve Baskauf, USDA Forest Service.

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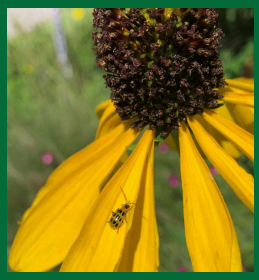
Beetles

- Flowers visited by beetles are typically
  - Bowl-shaped with sexual organs exposed
  - White, to dull white or green
  - Strongly fruity odor
  - Open during the day
  - Moderate nectar producers
  - May be large solitary flowers (*e.g.*, magnolias, pond lilies)
  - May be clusters of small flowers (*e.g.*, goldenrod, spirea)



Spotted Cucumber Beetle (*Diabrotica undecimpunctata*), on Giant Coneflower (*Rudbeckia maxima*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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Beetles

Red-necked false blister beetle, *Asclera ruficollis*. Photo by Beatriz Moisset, 2002 ,USDA Forest Service.

Locust borer beetle on goldenrod. Photo by Beatriz Moisset, 2002, USDA Forest Service.

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Beetles

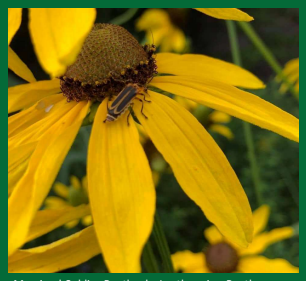
Female valley elderberry longhorn beetle. Photo by Charles Webber © California Academy of Sciences

Delta Flower Scarab (*Trigonopeltastes delta*), feeding on Late Boneset (*Eupatorium serotinum*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

46

Beetles

Emerald Flower Scarab Beetle (*Trichiotinus lunulatus*) on *Viburnum dentatum*. Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.



Margined Soldier Beetle aka Leatherwing Beetle (*Chauliognathus marginatus*). Photo by Lauren Simpson: St. Julian's Crossing Wildlife Habitat.

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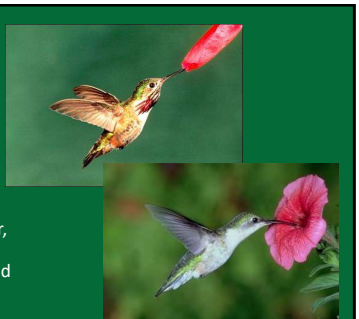
Birds

- Birds are important pollinators worldwide. In Texas, hummingbirds and the Baltimore Oriole are key bird pollinators.
- Birds have a good sense of color, preferring flowers that are brightly-colored (red, yellow, and orange).



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Birds

- Birds do not have a good sense of smell, so bird-pollinated flowers usually have little odor.
- Other preferred flower characteristics include:
  - Hummingbird-pollinated flowers usually have long, tubular corolla
  - Strong supports for perching
  - Open during the day
  - Prolific nectar producers
  - Modest pollen producers that dust the bird's head and neck

Ruby throated hummingbird feeding in a trumpet creeper (*Campsis radicans*). Photo by T.G. Barnes, University of Kentucky.

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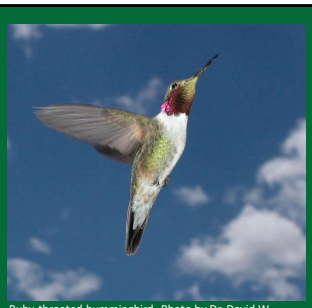
Ruby-throated hummingbird

- Very good eyesight
- Highly attracted to red flowers
- Weigh 2 – 8 grams (a penny weighs 2.5 grams)
- Need to eat several times their weight in nectar daily to sustain high metabolism (1,200 heart beats per minute, 70 wingbeats per second).



Ruby-throated hummingbird. Photo by Dr. David W. Inouye.

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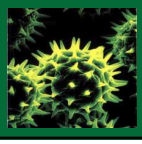
Baltimore Oriole

- Considered a pollinator because of its messy nectar-feeding habits.
- Baltimore Orioles have short beaks, which results in sticky pollen covering their bodies like a bumblebee.



Baltimore Oriole. Photo by Hanna McBrearty, USFWS.

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Summary of characteristics that attract pollinators

Pollinator Syndrome Traits Table

Trait	Pollinator							
	Bats	Bees	Beetles	Birds	Butterflies	Flies	Moths	Wind
Color	Dull white, green or purple	Bright white, yellow, blue, or UV	Dull white or green	Scarlet, orange, red or white	Bright, including red and purple	Pale and dull to dark brown or purple; flecked with translucent patches	Pale and dull red, purple, pink or white	Dull green, brown, or colorless; petals absent or reduced
Nectar guides	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent
Odor	Strong musty; emitted at night	Fresh, mild, pleasant	None to strongly fruity or fetid	None	Faint but fresh	Putrid	Strong sweet; emitted at night	None
Nectar	Abundant; somewhat hidden	Usually present	Sometimes present; not hidden	Ample; deeply hidden	Ample; deeply hidden	Usually absent	Ample; deeply hidden	None
Pollen	Ample	Limited; often sticky and scented	Ample	Modest	Limited	Modest in amount	Limited	Abundant; small, smooth, and not sticky
Flower Shape	Regular; bowl shaped – closed during day	Shallow; have landing platform; tubular, c	Large bowl-like, Magnolia	Large funnel like; cups, strong perch support	Narrow tube with spur; wide landing pad	Shallow; funnel like or complex and trap-like	Regular; tubular without a lip	Regular: small and stigmas exerted

The Simple Truth: We Can't Live Without Them, https://www.fs.usda.gov/wildflowers/pollinators/documents/simpletruthbrochure.pdf

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Why help pollinators?

- 1/3 of the world's food plants and 3/4 of the world's flowering plants ***depend*** on pollinators
- Pollinators are in ***rapid decline*** because of
  - urbanization,
  - pesticide use,
  - habitat destruction, and
  - climate change
- No pollinators = No plants
- Let's help reverse that decline

"We are nature's best hope!" – Doug Tallamy, entomologist, conservationist, and cofounder of https://homegrownnationalpark.org/

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4 Steps to Help Pollinators!

- Grow a pollinator friendly garden (native plants that span the seasons)
- Provide nest sites and natural habitat (food, shelter, water, space)
- Avoid pesticides/insecticides
- Spread the word about pollinator protection

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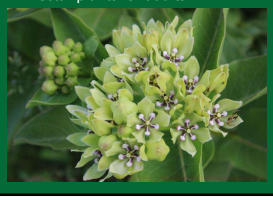
What to plant for pollinators

- Plants that flower during different seasons
- A variety of flowers for each season (3)
- Swathes of the same plant
- Different colors and shapes for variety (for example, hummingbirds are attracted to red, tubular flowers)
- Native plants rather than cultivars (so your pollinators feel right at home)
- Include grasses (yes, they "flower" too) for structure and winter interest (***and*** for hosting butterflies)
- Shrubs and trees for a variety of habitat

55

Habitat requirements (1)

- ***Food*** available across seasons to support the full life cycle
  - Host plants for caterpillars
  - Nectar plants for adults



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Habitat requirements (2)

- ***Shelter***
  - Provide bare patches of ground, small brush piles, stems on herbaceous plants over the winter to protect overwintering eggs and caterpillar pupae waiting to emerge
  - Leave the leaves – many pollinators overwinter in leaf litter such as this bumblebee queen
  - A question of housing?
    bee houses,
    bird houses,
    bat houses

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Habitat requirements (3)

- ***Water***
  - Puddler will provide water and minerals (like salt)
    - Use a wide, shallow dish such as a terra cotta saucer
    - Fill with sand with some compost mixed into the sand
    - Keep the sand moist, but not standing water
    - Add small rocks if desired
  - Natural water features
  - Bird bath question?

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Which pollinators do you want to attract?

- Butterflies
- Moths
- Bees/wasps
- Flies
- Hummingbirds
- Bats
- All of them!

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Resources to learn more about pollinators

POLLINATOR PARTNERSHIP

https://www.pollinator.org/

U.S. Fish Wildlife Service

https://fws.gov/initiative/pollinators

Start a new HABITAT® HOMEGROWN NATIONAL PARK®

https://homegrownnationalpark.org/

XERCES SOCIETY For Invertebrate Conservation

https://xerces.org/pollinator-conservation

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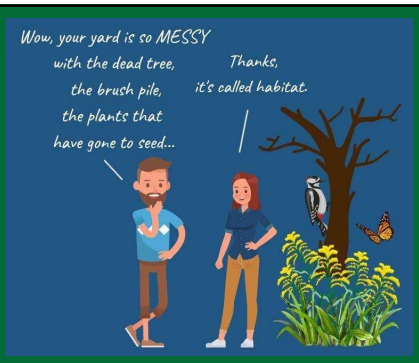
Post Presentation Survey Discussion and Questions



Learn more about the Texas Master Naturalists and the Gideon Lincecum Chapter at https://txmn.org/glc/

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Berries: Blue, Black, and Red

STEPHEN JANAK
EXTENSION PROGRAM SPECIALIST – HORTICULTURE
TEXAS A&M AGRILIFE EXTENSION

1

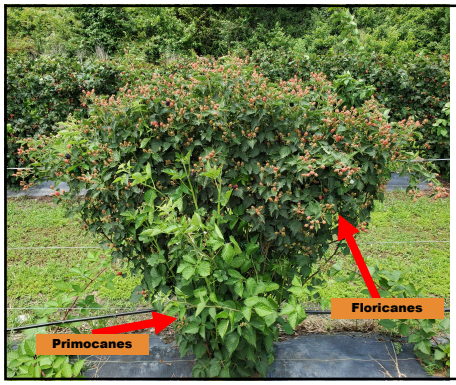
Blackberry Performance on the Gulf Coast


ABOUT BLACKBERRIES


WHY BLACKBERRIES


ON-FARM VARIETY EVALUATION

2

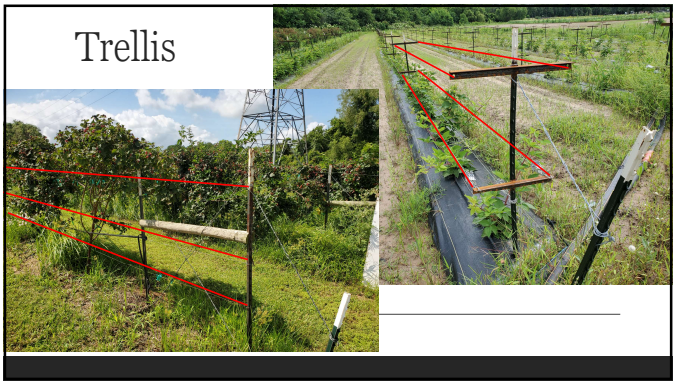


About

- Perennial
- Not a vine
  - Stems called "canes"
  - Erect or semi-erect
- Simple trellis recommended
- Biennial growth habit
  - Primocanes (first year)
  - Floricanes (second year)

3

Trellis



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Trellis

Rotating Cross Arm (RCA)

Shift Trellis

5

Spacing

10 – 15 feet between rows

2 - 4 feet between plants

6

Why Blackberries?

2017 Texas Census of Agriculture

791 farms, 769 acres

Arkansas: 15,000 – 22,000 lbs/ac

Texas growers: $4.50 - $6.00 per pound

7

General overview TEXAS

- # of samples received at the TPDDL
  - 57 diagnosis since 2010

Common disease name	# of diagnosis results
Downy mildew	8
Phytophthora crown & root rot	7
Rust	5
Cercospora leaf and bud damage*	3
Cane blight	7
Anthracnose	3
Cotton root rot	1

Slide courtesy: Dr. Kevin Ong

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Why Blackberries?

Precocious – harvest in 2nd year

Adaptable – soil pH 4.5-7.5

Grow just about anywhere in Texas

Later bloom typically escapes frost

Cold hardy – no injury from 2021 @ studied locations

High production in small area

Low chill requirement

Relatively easy to grow!

9

Why Blackberries?

Sustainable Fruit Project

Update on: what can be sustainable/profitable here?

TX: 5,000-10,000 lbs/ac

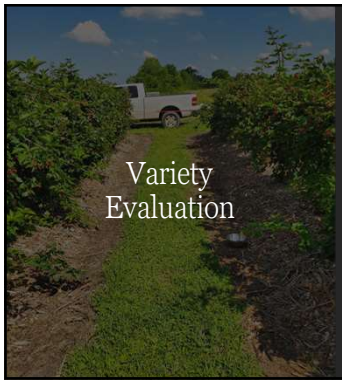
Ark: 10,000-22,000 lbs/ac

'Brazos' – 1959

'Rosborough' - 1977

10

Variety Evaluation



Start: 2020

Froberg's Farm

Alvin, TX

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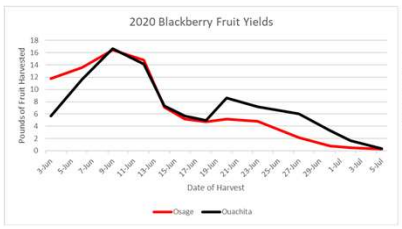

	TOTAL (lbs)	PER PLANT
Osage	87.32	8.732
Ouachita	93.23	9.323

Table 2. 2020 Cultivar Total and Per Plant Fruit Yield (lbs).

2020 Variety Evaluation

10 PLANTS PER VARIETY

12

2021 Variety Evaluation

Ouachita – Thornless (2004)

Osage – Thornless (2013)

Prime Ark Traveler – Thornless (2015)

Caddo – Thornless (2018)

Ponca – Thornless (2019)

Kiowa – Thorny (1996)

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2021 – a good year

15

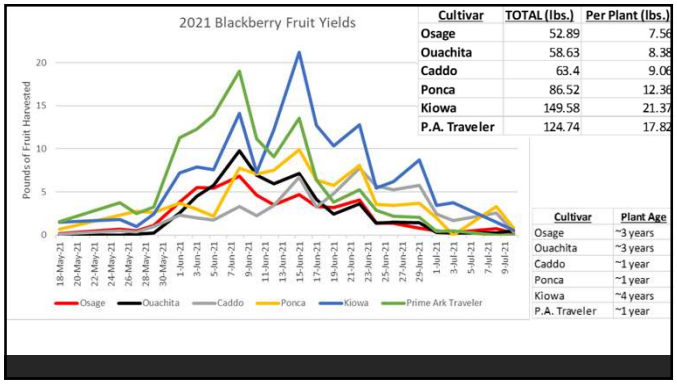
2021

Harvested 7 plants per variety

Total 535 pounds of fruit harvested from 42 plants

~ 12 lbs/plant

16



Cultivar	TOTAL (lbs.)	Per Plant (lbs.)
Osage	52.89	7.56
Ouachita	58.63	8.38
Caddo	63.4	9.06
Ponca	86.52	12.36
Kiowa	149.58	21.37
P.A. Traveler	124.74	17.82

Cultivar	Plant Age
Osage	~3 years
Ouachita	~3 years
Caddo	~1 year
Ponca	~1 year
Kiowa	~4 years
P.A. Traveler	~1 year

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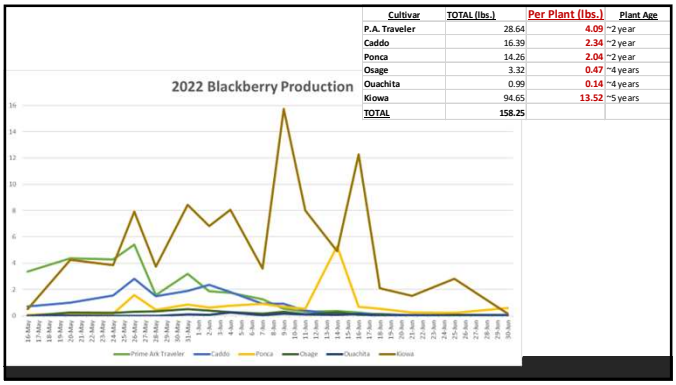

Cultivar	TOTAL (lbs.)	Per Plant (lbs.)	Plant Age
P.A. Traveler	28.64	4.09	~2 year
Caddo	16.39	2.34	~2 year
Ponca	14.26	2.04	~2 year
Osage	3.32	0.47	~4 years
Ouachita	0.99	0.14	~4 years
Kiowa	94.65	13.52	~5 years
TOTAL	158.25		

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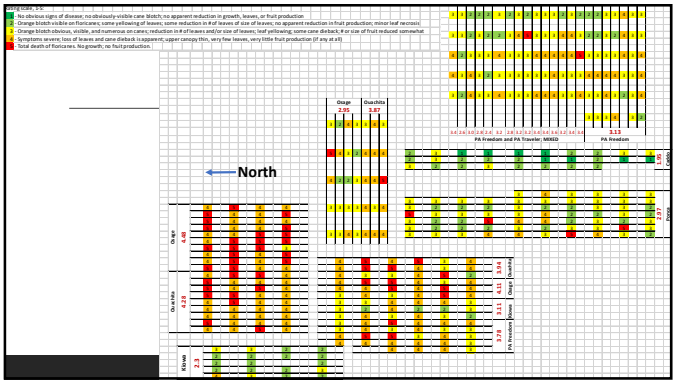

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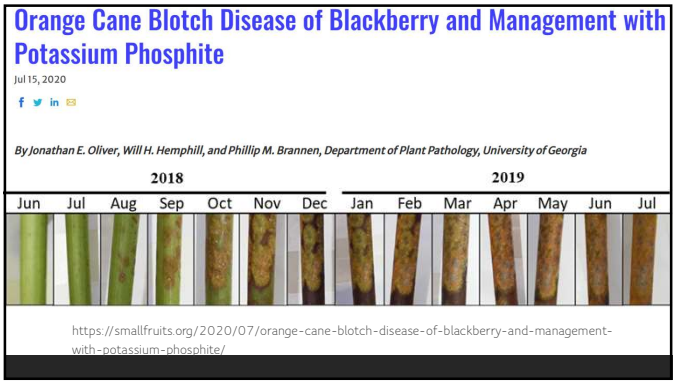

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Blackberry Performance on the Gulf Coast

	Per-plant fruit yield (lbs)			
Cultivar	2020	2021	2022	Average
Osage	8.73	7.56	0.47	5.59
Ouachita	9.32	8.38	0.14	5.95
Caddo	-	9.06	2.34	5.70
Ponca	-	12.36	2.04	7.20
P.A. Traveler	-	17.82	4.09	10.96
Kiowa	-	21.37	13.52	17.45

OCB infection OCB symptoms

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2021 yields

Variety	Spacing:	# per acre	lbs/acre	*$5/lb
Osage	3x12	1210	9142	$ 45,712.07
Ouachita	3x12	1210	10135	$ 50,673.07
Caddo	3x12	1210	10959	$ 54,795.71
Ponca	3x12	1210	14956	$ 74,778.00
Kiowa	3x12	1210	25856	$ 129,279.86
P.A. Traveler	3x12	1210	21562	$ 107,811.00

Blackberry Performance on the Gulf Coast

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Consumer Evaluation

1-9 scale: 1 = extremely unpreferred, 5 = neither like nor dislike, 9 = extremely preferred

	Osage	Ouachita	Ponca	Caddo	Kiowa	PA Traveler	Store-bought*
AVERAGE	6.9	6.6	7.2	7.9	6.0	6.7	4.8
Flavor (sweet/tart/acid)	6.7	6.5	6.3	7.8	6.1	6.2	4.0
Mouthfeel (seediness/firmness)	6.6	6.3	6.9	7.3	7.1	6.4	5.3
Overall Appearance	7.1	6.6	7.4	8.6	8.1	6.7	5.0
Overall Eating Experience	6.7	6.5	6.9	7.9	6.4	6.3	4.8
Ease of Harvest	7.5	7.2	8.3	8.1	2.5	7.8	N/A
Weight (in ounces) of 10 berries	2.1	2.0	2.0	2.3	2.8	1.8	1.3

Evaluations made during harvests from 10 June to 24 June, 2021.
Eight (8) individuals made evaluations; Fourteen (14) evaluations total
**only 4 evaluations made on store-bought berries*

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Blackberry Performance on the Gulf Coast

- Great potential
- Fewer challenges than some other crops
- With hard work and good management, very successful
- Excessive rain/humidity may pose a problem for Ark. Varieties
- Longevity of Ark. Thornless blackberries?

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Strawberry Basics

Botany,
Growing Practices,
&
Varieties

Stephen Janak – Extension Horticulture Program Specialist

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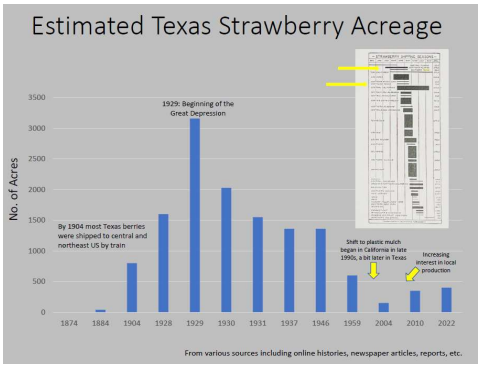
Estimated Texas Strawberry Acreage



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Exporting Texas Strawberries

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Strawberry Acreage and Production 1929 and 1934

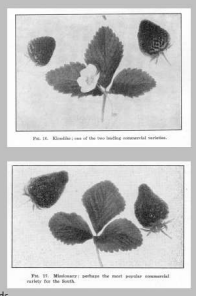
Production increased although acreage decreased

Table 1. Strawberry acreage and production in Southwest Texas

County	Acreage		Production (quarts)	
	1929	1934	1929	1934
Atascosa	277	659	567,625	878,670
Bee	3	2	2,682	4,975
Bexar	1	9	300	1,957
Brooks	*	2	500	2,511
Cameron	9	8	12,548	19,525
Dimmit	2	191	1,500	427,793
Frio	4	*	6,659	150
Hidalgo	19	26	56,065	39,701
Jim Wells	3	2	1,813	1,900
La Salle	1	1	900	20
Maverick	0	2	0	3,900
Medina	3	7	3,200	4,206
Nueces	*	1	150	3,385
San Patricio	5	3	5,922	9,345
Zavala	0	34	0	61,200
Totals Southwest Texas	327	947	658,853	1,459,038
Entire State	2,852	3,345	3,089,948	4,577,702

*Less than one.

Source: 1937. Strawberry Varieties in Southwest Texas, TAEX Bulletin No. 556.



Close to 9 million pounds

34

Houston area, Texas

Baldwin & Cargill Produce: 320 acres of strawberries on southside of Southmore (Houston area)

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Strawberries

Locally-grown

Store-bought

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Why Strawberries??

Health Benefits:
Vitamin C: 58 mg/100 g (98% RDI)
Vitamin E: .29 mg (2%)
Vitamin A: 12 IU (0.5%)
Fiber: 2 g
Beta Carotene 7 ug
Lutein 26 ug
Anthocyanins & Ellagic acid (Flavonoids)

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Opportunities – Farmers Markets

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Opportunities – U-Pick Farms

KH Farms, Poteet

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Field Production

EXTENSION

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Alternative Production Methods

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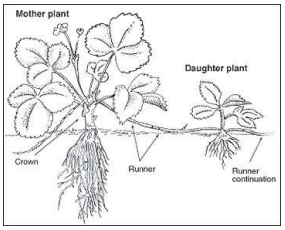
Strawberry Plant Anatomy

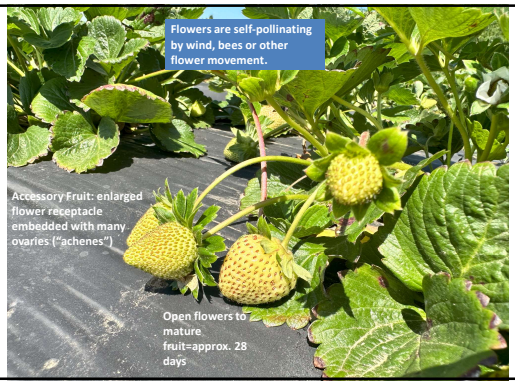


Phase Development

1. Dormant crowns form new roots and leaves.
2. Flowering & fruit development
3. Runner (stolon) extension
4. New daughter plant formation

New plants may try to "run" if temperatures are warm after planting.
On-set of cooler Fall weather will halt vegetative growth

42



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Selecting Varieties

- June-bearing –
  - Short-day varieties where peak production is in May/June in Texas. Larger fruit and more productive. Harvest season is usually 3 – 4 weeks. Most commonly grown.
- Ever-bearing –
  - Long-day or ever-bearers initiate flowering when day length is about 12 hours, but struggle to flower above 90 °F. Difficult to grow in certain Texas environments.
- Day-neutral –
  - These varieties are insensitive to day length. An improvement over ever-bearing types as they flower and bear fruit over extended periods. Fruit damaged above 90 °F.

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Spring-Bearing Strawberries

- Plant plants in early Fall months.
  - Late Sept. to Early October
  - No Local Plants—Order from a strawberry plant supplier.
- Protect through Winter by covering, mulch, sprinkler irrigation, etc.
  - 15 F is critical temperature
- Harvest fruit in late Winter (February) to Spring.
- Mulch mother plants through Summer and remove runners and root for new Fall plantings.

45

Strawberries in High Tunnels---increasing in Texas

Photo: Russ Wallace

46

Freeze Protection Inside High Tunnels

Slide Credit: Russ Wallace

47

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Challenges: Labor

Winterizing and protecting crop

49

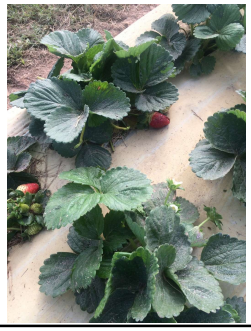
Colorado County
Planted October 2022
All organic
No freeze protection December 2022 ~15 degrees
~50%+ plant loss

Brazoria County
Planted September 2022
Frost cloth
No plant loss

50

Horticultural Keys—Any system

- Full Sun
- Well-drained soil
  - Sand or high-drainage potting soil.
- Frequent Watering
  - Shallow-rooted, not drought tolerant
  - Mulch is good
    - Plastic or organi
- Freeze protection
  - Mulch, Fabrics, or Tunnels
- Good nutrition



51

Growing location is important!

- Strawberries prefer full sun with a good quality soil and water.
- Wind and cold protection is also critical.

52

When to Buy Strawberry Plants

- Order transplant plugs in June.
- Many plants can now be purchased online.
- Many nurseries and local retailers will sell you plants in the spring… Don't buy in the spring and plant those!
- After planting, strawberries need cold temperatures to create new crowns and develop flowers.

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Spring vs. Fall Planting

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Farmers Market
@ $5 - $7/pint

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Fertilizing Strawberries

Strawberries perform best at 5.5 – 7.0 pH. Any higher may result in iron deficiency or chlorosis.

Leaf chlorosis can result in misshapen fruit and yield losses.

Some solutions:
Amend soil with compost and/or sulfur; apply iron chelates through drip or onto leaves; use acidic fertilizers and/or humic acid through drip system.

Strawberries require high amounts of nitrogen.

TEXAS A&M AGRILIFE EXTENSION

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Fertilizer and Nutrients

- Nitrogen, Iron and Potassium – about 150 – 200 lbs/A or about 1 – 1.25 lbs/Acre per day.
- Fertilizer is best applied throughout the season.
  - Apply about 50% at planting and follow with weekly applications for the rest during the season.

TEXAS A&M AGRILIFE EXTENSION

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Strawberry Pests & Diseases

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Phytophthora Root Rot

- *Phytophthora fragaria- Red Stele disease*
- *Phytophthora citricola- Root & Crown rot*

- Poorly drained fields
  - Heavy soil, slow surface run-off
- Cool-wet weather conditions
- Contaminated plants
  - Use certified, disease-free nursery plants.
- Failure to rotate planting sites or sterilize soil/growing media

Pink to red-colored central root stele

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Nematode Stunting

Nutrient deficiencies where plants have been adequately fertilized. Poor plant development, few/weak blooms, & low fruit yields

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Nematode damage

Control: Plant Healthy plants, Improve or Refine fertilizer and water practices, raise organic matter levels, relocate orchard

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Soil solarization—a good idea for strawberry patches and raised beds.

Ncsu.edu

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Other disease challenges statewide…

Powdery mildew—Podosphaera aphanis—high RH & 60-80 F temps

Anthracnose—Colletotrichum spp. – high RH & >68 F temp.

Botrytis Gray Mold—Botrytis cinerea—high RH—all temps.

Avoid overhead irrigation, prevent fruit-soil contact; promote drying with plant spacing and open site selection.

Fungicides—captan, sulfur, Topsin-M (thiophanate-methyl), Pristine (pyraclostrobin + boscalid)

Slide Credit: Russ Wallace

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Insects & Mites

- Most important "insect problem" of strawberries.
- Often buildup in mild, dry weather patterns.
- Prevent high populations which can stunt plants.
- Treat as needed with insecticidal soaps, sulfur or miticide products.

Spider Mites

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Flower Thrips

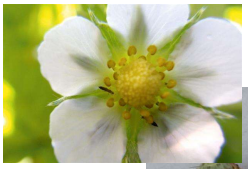

Image: Gary Chang (www.hortweek.com)

Flower-infesting insects that damage the growing receptacle, causing bronze shoulders and poor color development.

65

Lygus bugs (tarnished plant bug)

Surface fruit feeders with piercing/sucking mouthparts that kill streaks or spots on the receptacle causing misshapen fruit.

"catfacing"

66

Texas Raspberry Production

Visions and Prospects for a New Texas Specialty Crop

Jacy L. Lewis
Program Manager -Viticulture and Sustainable Fruit Applied Research Program

Texas A&M AgriLife Extension

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- Life span- 7-10 years; Production regimes of 1 to 4 years is common
- Biennial Vegetative Growth on Perennial Root System.
- Drupelet or aggregate fruits
- Self-Fruitful: *wind or insect pollinators to size and set*
- Must be Hand Harvested

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- Growth Habits
  - Erect
  - Semi Erect
  - Sprawling

Spiney/Thorny Canes Require Gloves when working

Raspberries Managed as a Hedgerow, vs Blackberries as Individual Plants

70

Challenges

Must be grown under "**protected cultivation**" i.e. shaded tunnel- $$$

Hand Labor Required for training /pruning and harvesting

New Crop for this area, little research, lots of unknowns.

Limited Grower Support and Consultation Services

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Planting

- **Order** Plant Material Previous Fall for early spring delivery for best availability

  (Tissue Culture Plants Recommended); Bare Root

- **Soil-** Well drained, rich in organic matter, prefer slightly bermed up beds. Not recently used to cultivate crops susceptible to verticillium wilt. pH 6-7. recommended

- **Time-** Early Spring (March) / When Soil is Workable

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Planting

- **Weed Barrier-** if desired to control both weeds and canes.
- **Spacing-** 2.5 to 4 ft centers depending on vigor and shade selection.
- **Access-**Make sure you have a way to access / mow your alley

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Cultivation

Water- Root zone irrigation (drip) with ability to fertigate.

Nutrition- Compost incorporated then top dress yearly, Soil and plant test, may need nitrogen, micronutrients (water soluble). Extra potassium if double cropping

Light- Raspberries cannot tolerate the high heat and solar irradiance found in Texas Climates. Light must be managed with precision shading techniques. Day-long filtered light.

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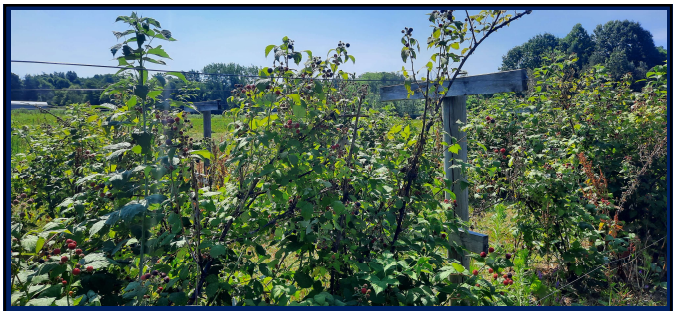

Trellising- Double or Triple Wire on Two Sides

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Cultivation

Shade

High or Modified Tunnels Covered in Specialty Shade Fabric

- Reduces Light Intensity and Modifies the Spectrum
- Provides Protection from Drying Winds / Increases Humidity /(Water on Foliage)
- Reduces Evaporation Rate during irrigation
- Assists with exclusion of both vertebrate and invertebrate pests
- Helps modulate temperature, some colors reduce heat

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Harvest

Time- varies by variety but (primocane early -May/June full Aug/ Frost)

Location on plant- Starts on tips, continues down the cane until freeze

Shelf Life- Variety Dependent (Cold Storage, Clean Fruit, Extend Shelf Life)

Interval-Approximately 4 weeks from bloom to ripe fruit / can vary with temperature

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Harvest

October 9th – October 24th, 2021

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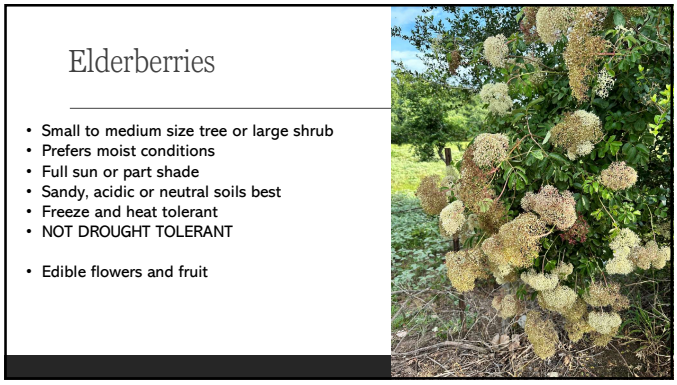

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- Mostly wind pollinated
- Fruit set is better with multiple varieties

Insufficient pollination

Good pollination

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Elderberries

- **Research is ongoing to determine:**
  - **Pruning practices**
  - **Variety recommendations**
  - **Fertilization needs**
  - **Irrigation requirements**
  - **Etc.**

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Varieties

- Recommendations cannot be made at this time.
- Most "improved varieties" found in the US are selected wild types, found on farms, fields, along streams, etc.
  - Most originate in the Midwest or the Northeastern US
  - Adaptability to Texas is unknown
- Local wild types are suggested for home planting.
  - Dig/pull plant off-shoots, ensuring some root(s) attached.
    - Best done in spring, planted quickly or kept moist
  - Hardwood dormant cuttings root easily in late winter.

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Irrigation, weed control, and fertilization are important for good growth and production.

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Potential Commercial Crop?

- Potential for commercial production is good, but UNTESTED.
- Challenges:
  - Unknown variety adaptability
  - LABOR
  - Processing of berries
  - Pest and disease complex is generic

Elderberry fruit are harvested when all berries in the cyme are fully colored.

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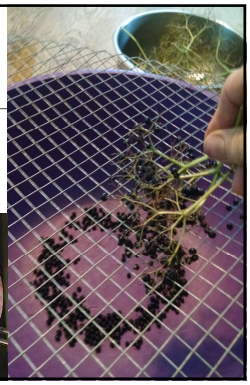
Processing



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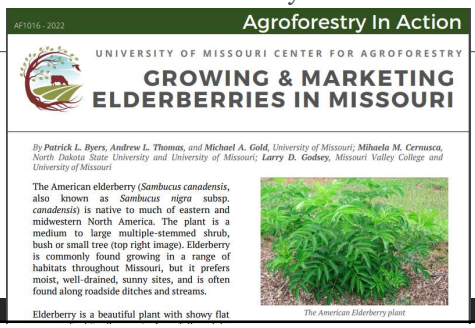
For more info on elderberry



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Sources

- Again, mention of companies is not an endorsement.
- Pense Berry Farms
- Elderberry Edge Farm
- Many more

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Elderberries

- Well-suited to home production
- Adapted to challenging weather
- Small space requirement
- Good option for a low, wet area.
- Processing can be a challenge
- Rewarding fruit/flower products with purported human health benefits.
- More research needed and is starting in Texas.

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Additional Resources

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The Texas Fruit Conference is a Texas A&M AgriLife Extension event aimed at educating new and experienced fruit growers through classroom instruction, experiential learning, and peer-to-peer networking.

Event 1: Intro to Fruit Growing Workshop: Considering an orchard for the first time? Never planted a fruit tree? We have you covered! Our Half-Day-workshop is designed to get you started on a path to long-term financial success.
When: Wednesday, October 18th, Gillespie County AgriLife Extension Office, 38 Business CT, Fredericksburg, TX 78624. Program: *Site and resource evaluation for new fruit orchards* -Jim Kamas; *Fruit orchard establishment*-Larry Stein; *Budgeting time resources- what it takes to start and manage an orchard*-Jacy Lewis; *Disease & insect threats to successful fruit production*—Brianna Hoge; *Developing an orchard IPM philosophy*—Monte Nesbitt; *Deciding what to grow: major production & marketing considerations*—Tim Hartmann

Event 2: Commercial Orchard Tour : Gain firsthand insight and experiences of Fredericksburg-area fruit growers in an educational group field trip.
When: Wednesday, October 18th; Location(s) to be determined.

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Event 3: Fruit Conference Main Program: Delve deeper into commercial or recreational fruit production in a 1 & 1/2-Day educational program aimed at keeping Texas fruit growers abreast of sustainable practices, emerging issues, new crop opportunities, variety introductions, novel production approaches, marketing strategies, and integrated pest management. Texas Pesticide Licence CEU's will be offered.
When: Thursday-Friday, October 19th & 20th, Pioneer Pavilion, 432 Lady Bird Dr., Fredericksburg, TX.

Event 4: Taste of Texas Fruit Reception: Meet fellow fruit growers, Texas A&M AgriLife personnel, eat great fruit-centered food, and sample Texas wines.
When: Thursday, October 19th, Pioneer Pavilion.

Event 5: Post-Conference Training: Want to learn more? This year we are offering a "mini-intensive" training centered on one important commercial orchard topic—irrigation. Explore irrigation system design, delivery options, troubleshooting, and new technologies from AgriLife personnel and commercial irrigation companies that serve the fruit industry in Texas.
When: Friday, October 20th, Viticulture and Fruit Laboratory, 259 Business Ct, Fredericksburg, TX.

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Thank you!
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