COTTON & GRAIN IPM 2023

Danielle Sekula – Extension Agent, IPM

Texas A&M AgriLife, Weslaco

Diamond

*Americot-NexGen
*BASF
*Bayer
*Capital Farm Credit
*Farmers Crop Insurance
*RegalAG

Platinum

*La Feria Co-op Gin

Gold

*Cameron County Farm Bureau
*Nichino
*Sesaco
*Simplot
*Texas Farm Credit
*Texas Sorghum Producers
*Valley Co-op Oil Mill
*Vital Fertilizers

Silver

*Adams Farms
*Frisby-Bell Gin Co.
*Hargill Growers' Gin
*RGV Gin Company, LLC
*Rob See Co.
*Ross Gin Company ltd
*Valley Ag Insurance Services Inc
*Willamar Operating, L.P.

IPM Program in the LRGV

- https://southtexas.tamu.edu/programs-and-services/ipm/

*To Review Past Pest Cast Newsletters simply scroll down to review PDFs below for that Growing Season/ Year:

PEST CAST NEWSLETTER SERIES – FY 2023

PestCast_1_2023

PestCast_2_2023

PestCast_3_2023

PestCast_4_2023

PestCast_5_2023

PestCast_6_2023

***To sign up for Pest Forecasts & Alerts in real time for the LRGV Growing Season:

- To receive the Pest Cast Newsletter simply email Danielle.sekula@ag.tamu.edu and you will be added to the email list.
- To sign up for the South Texas IPM audio updates to receive a text about current pests seen in your area that week simply go to: https://www.texasinsects.org/south-texas.html to sign up.

Upcoming Programs & Events:

Cotton & Grain Scouting School (2023)

Important Resources in IPM:

Controlling Volunteer Cotton in Grain Sorghum using Herbicides_2022

Cotton Stalk Herbicide trial_2022

New Sorghum Insect Guide: managing-insect-and-mite-pests-of-texas-sorghum-2023

Managing Cotton Insects in Texas ENTO-075_2019

Cotton Fleahopper Insecticide Efficacy trial_2020-Danielle Sekula & Dr. Holly Davis

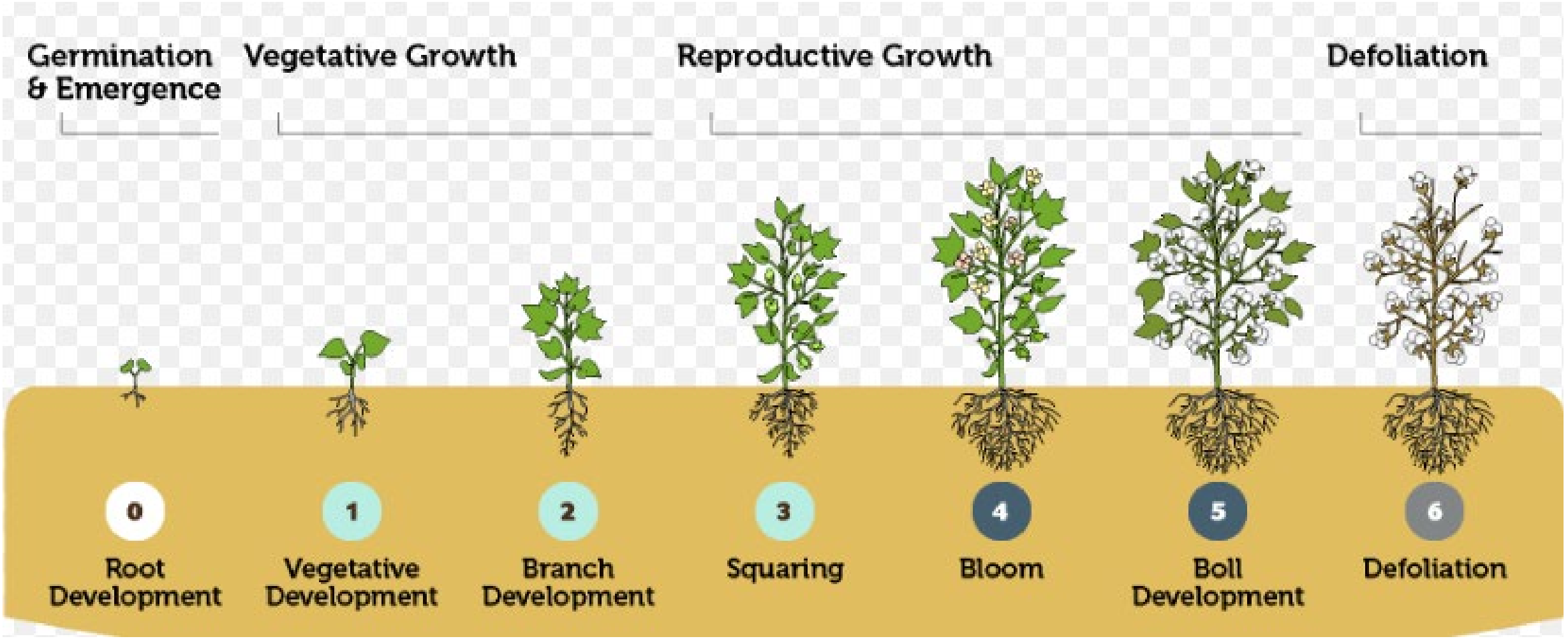
Controlling Chilli thrips in Cotton Efficacy trial_2022-Danielle Sekula (IPM agent)

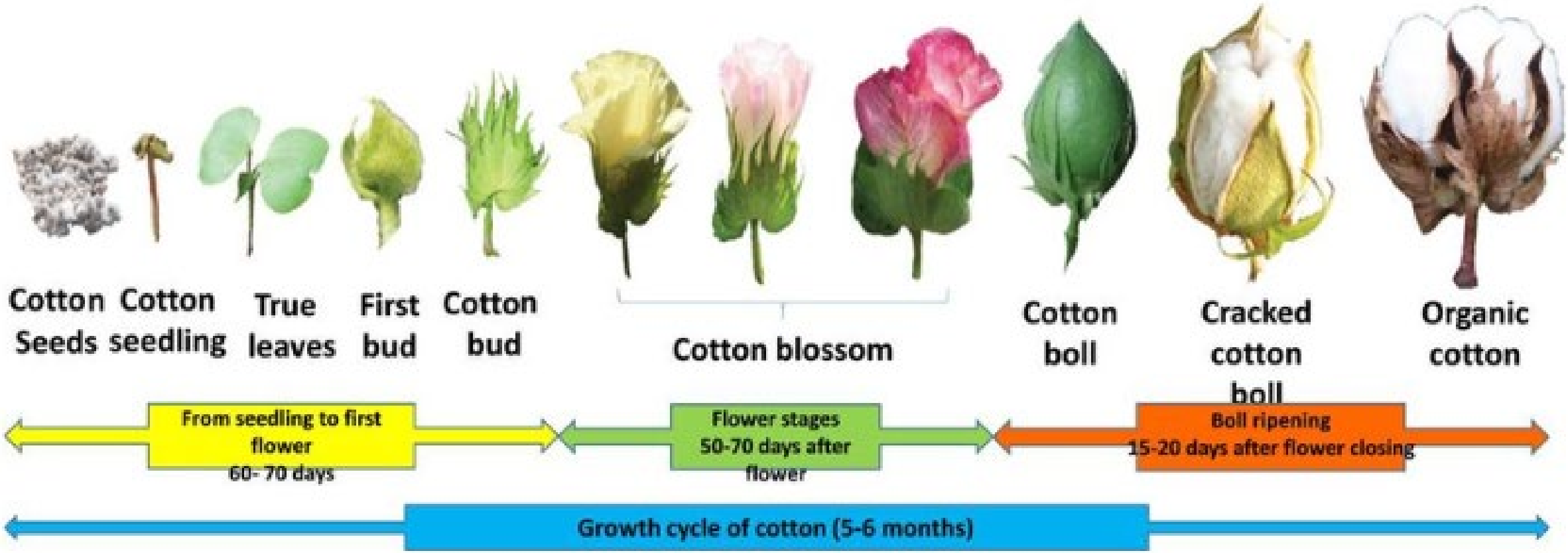
chilli-thrips-in-cotton_2022. ENTO- PU- 216

Impact of Cotton Growth on Management

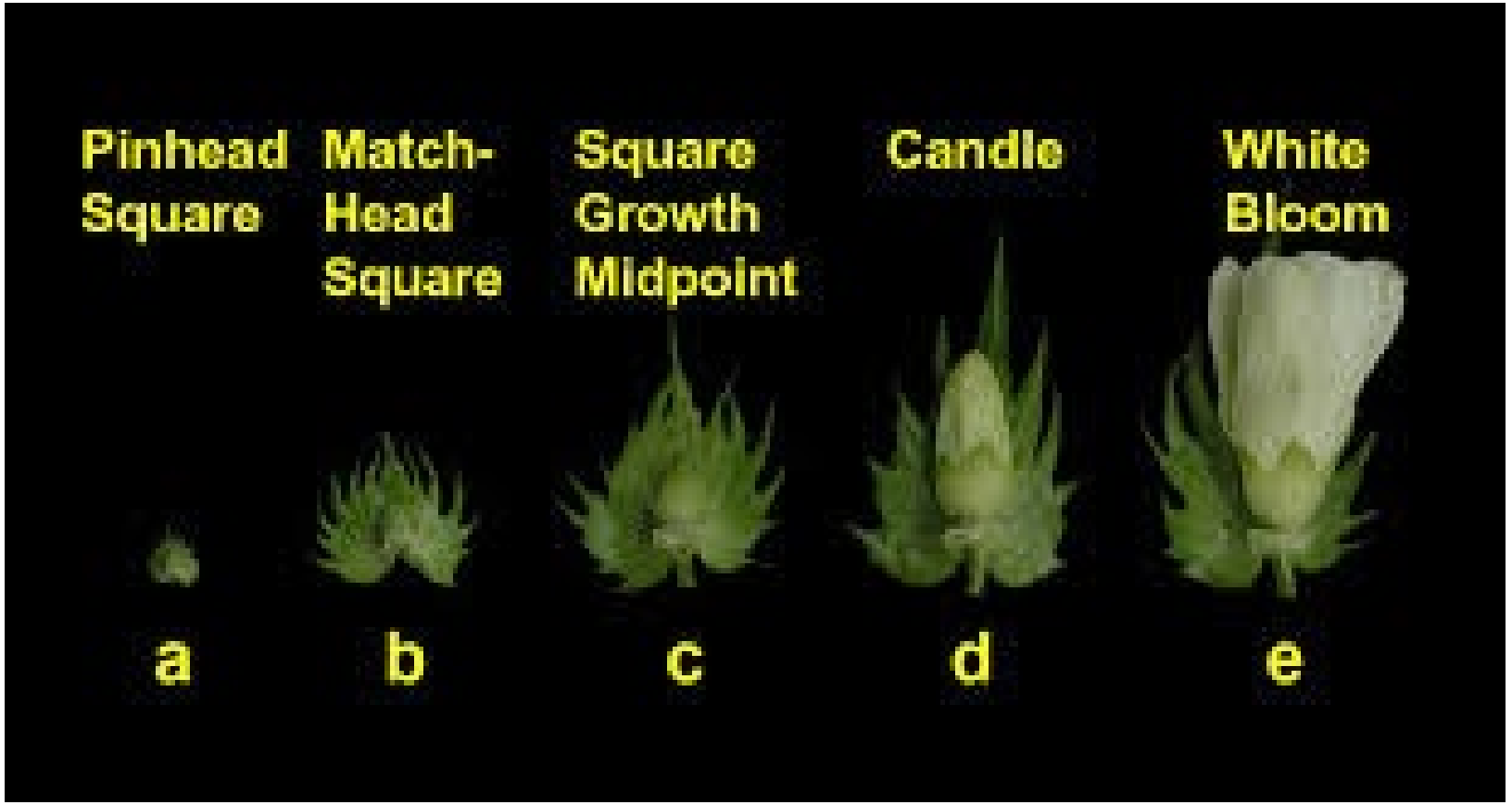
- Perennial growth
  - slow shoot development
    - weed competition
  - indeterminate growth
    - plant growth regulators

- Long fruiting period
    - stress avoidance
    - insect management
    - fiber quality

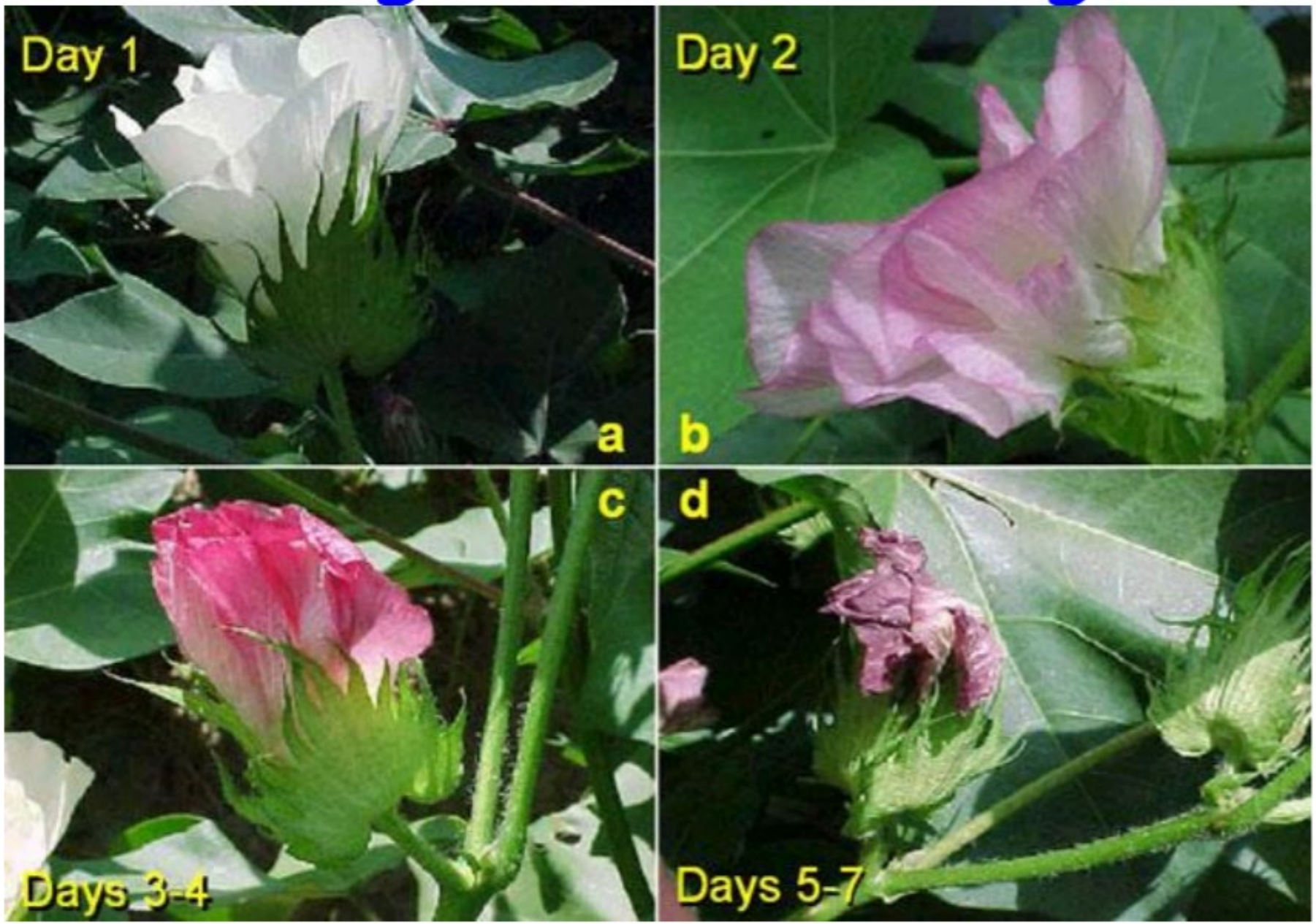

Germination & Emergence
Vegetative Growth
Reproductive Growth
Defoliation
0
Root Development
1
Vegetative Development
2
Branch Development
3
Squaring
4
Bloom
5
Boll Development
6
Defoliation



Life cycle of cotton (http://www.cottonsjourney.com/Storyofcotton/page3.asp).


Pinhead Square
Match-Head Square
Square Growth Midpoint
Candle
White Bloom
a
b
c
d
e

Stages of Flowering



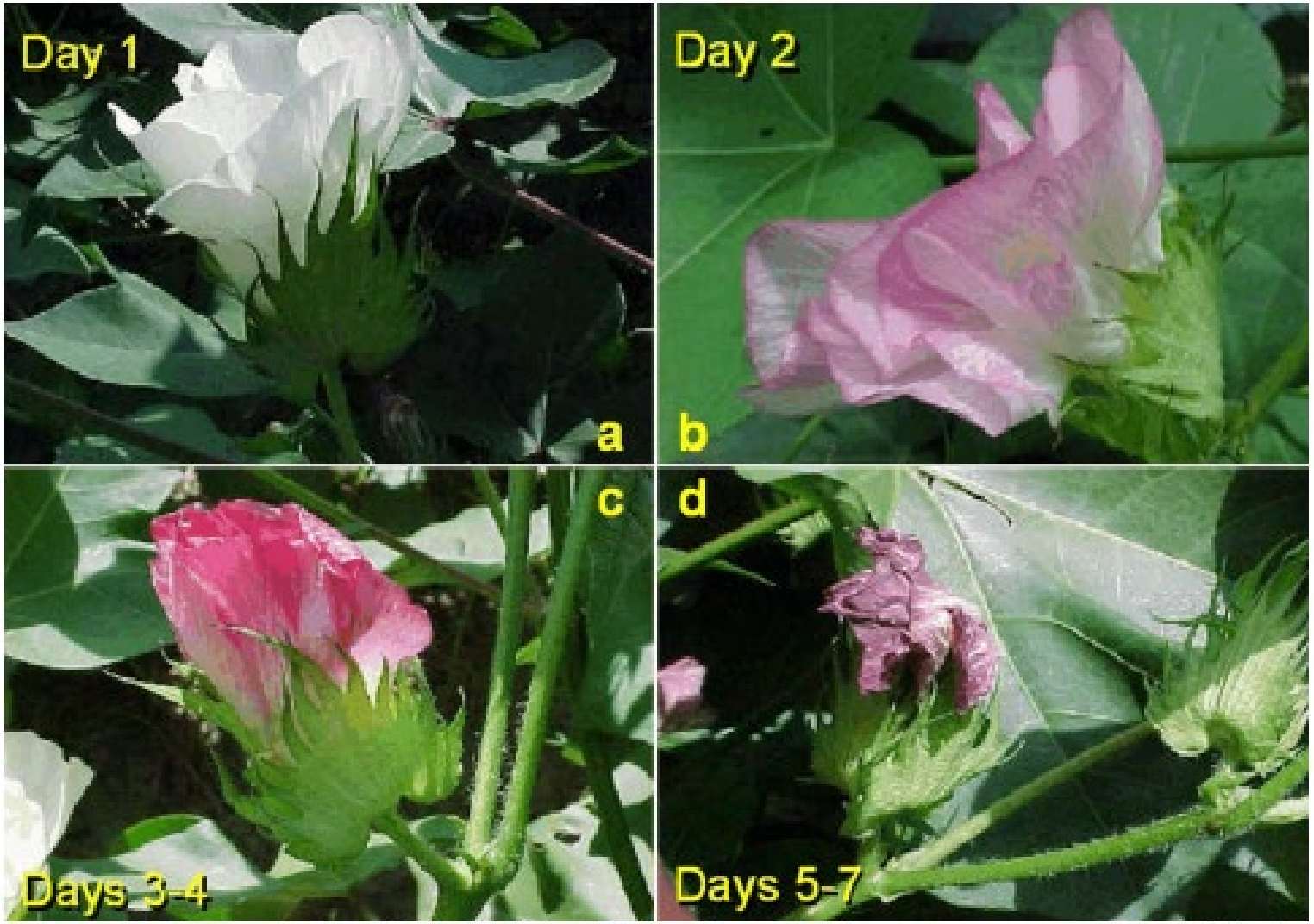


Figure 17. Development of a cotton bloom. A white flower emerges on day 1 (a), then gradually darkens and takes on a red color during days 2, 3 and 4 after emergence (b and c). The bloom eventually dries up and either falls off or becomes a bloom tag (d).

Figure 19. Square shedding is a common occurrence in cotton.

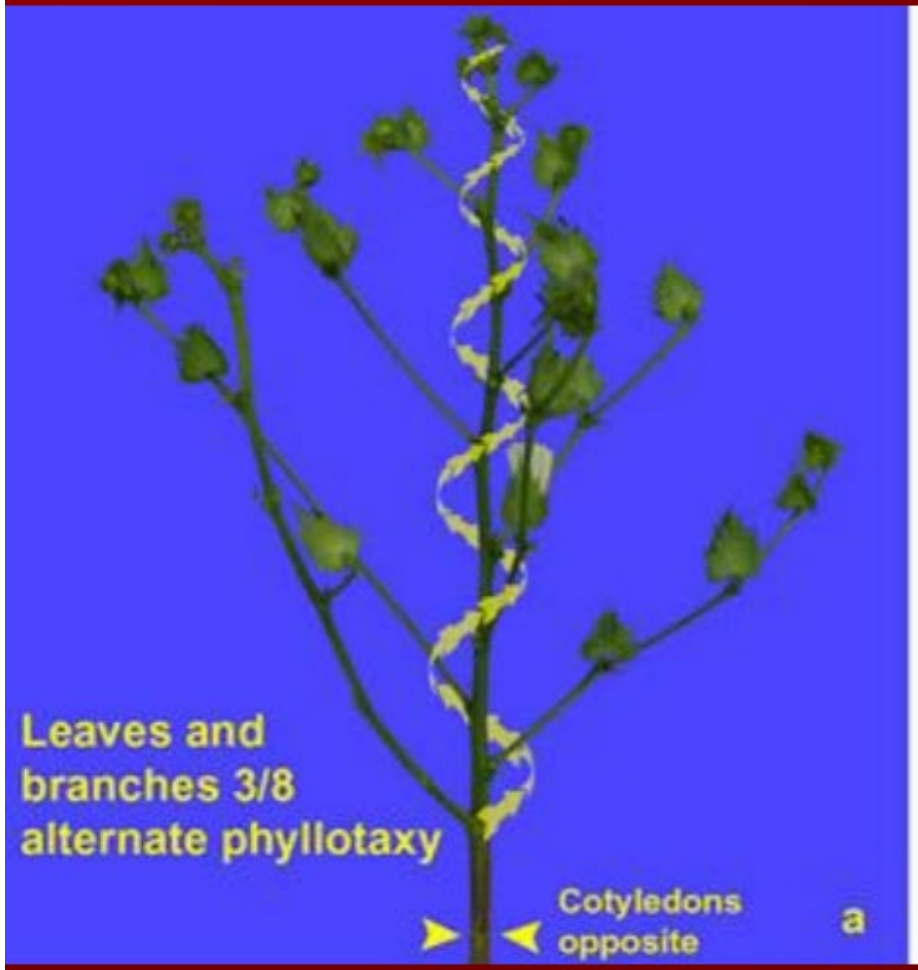
sion publication *Cotton Defoliation, Harvest-Aids, and Crop Maturity,* by Philip Jost and Steve M. Brown, and yearly updated specific harvest-aid suggestions can be found on the University of Georgia Cotton Web Page at **http://www.griffin.peachnet.edu/caes/cotton**

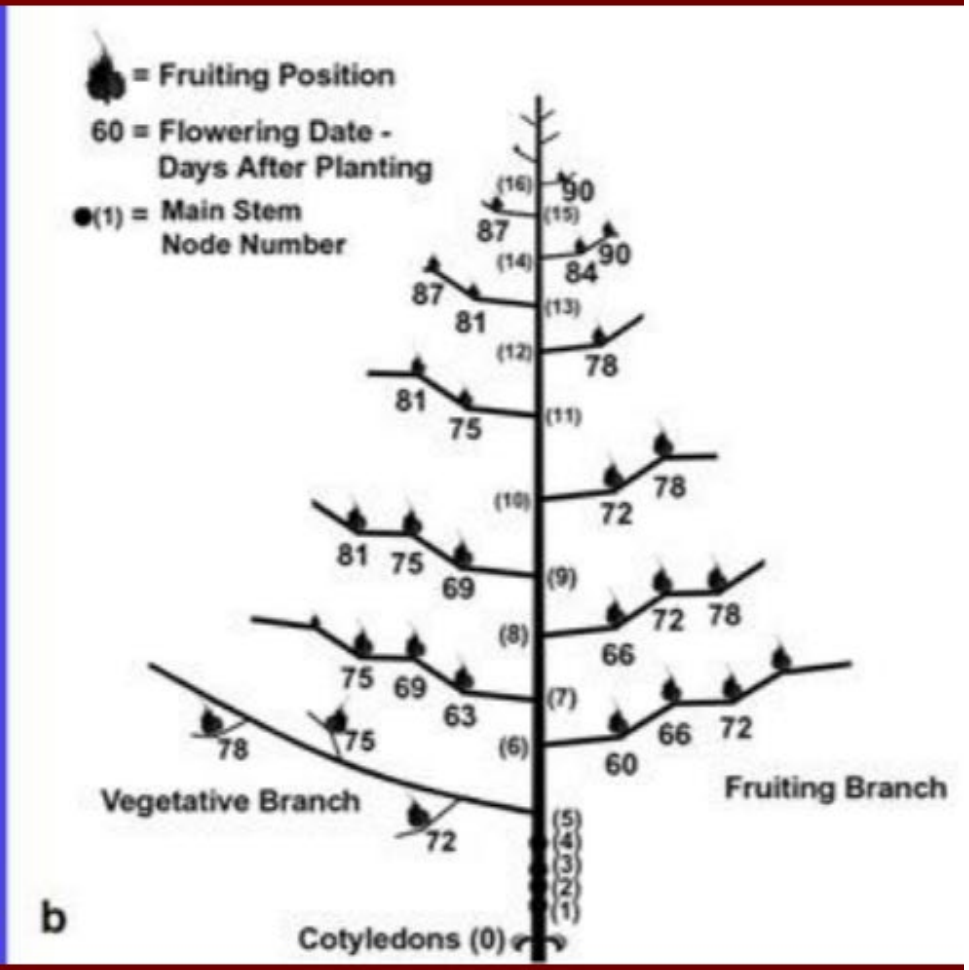
Fruit Shedding

A phenomenon often seen in a cotton field is square shedding (Figure 19). The shedding of squares may be the result of several factors, including water stress, shading (from prolonged cloudy weather), nutrient deficiencies (especially N), high temperatures, high plant populations, high percent fruit set and insect damage. In addition, the reproductive cells formed during square development are very sensitive to environmental conditions. High temperatures and humidity, and nutrient deficiencies (especially boron) can inhibit gamete production and result in flower sterility and ultimately square loss. Sterility may also decrease seeds per boll and locks per boll. One cause of pollen sterilization and subsequent yield loss is misapplication of glyphosate in Roundup Ready® cotton.

Flowers and young bolls may also be shed from the plant due to the same factors that lead to square shedding (Figure 20). Generally, though, the sensitivity of squares, flowers and bolls to shedding can be related to their age. Young fruiting forms are more likely to be shed than are more developed squares and bolls.

Fruiting Timeline





Ritchie, Bednarz, et al. 2007

Sequence of Growth

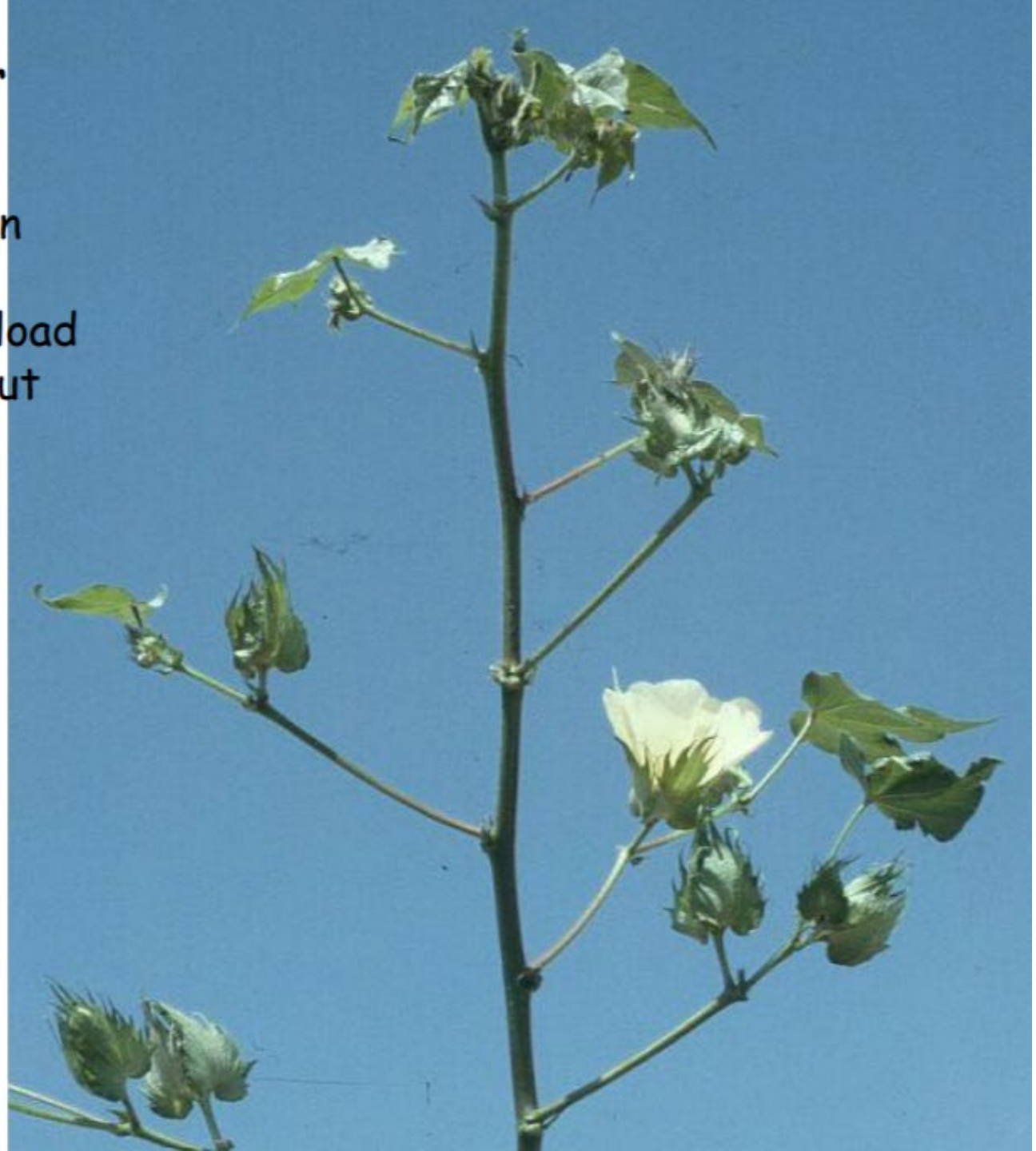
Planting to 50% open - 135 Days

110 days from planting to 1st open boll

55 Days		55 Days	25 Days
32 Days Planting to 1st Square	23 Days 1st Square to bloom	1st Flower to 1st open boll	1st open boll to 50% open

Nodes Above White Flower
NAWF

1. Water and nitrogen management
2. Indication of boll load
3. Indication of cutout
4. Vigor of the plant




Cotton at full bloom, Many Pests are encountered during the different growth stages of cotton throughout the season


COTTON

TOPICS

- Cotton early season pests
  - Cotton aphids
  - Fleahoppers
  - Western flower & Tabacco thrips
  - Wire worms, cutworms
- Cotton mid-late season pests
  - Verde Bug
  - Tarnished Plant Bugs
  - Whiteflies
  - Chilli thrips

Thrips in Cotton

Thrips feed on cotton by inserting their mouth parts into the plant and sucking its juices, causing silver colored leaf scaring and leaving the leaves with a stunted, crinkled

The treatment threshold is 1 thrips per true leaf or higher.

Thrips (above & bottom)

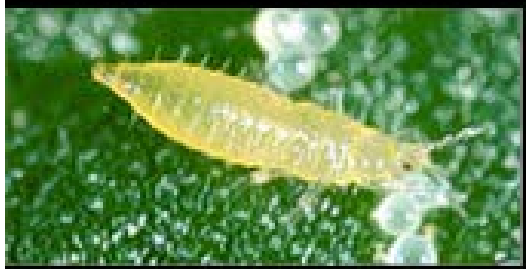
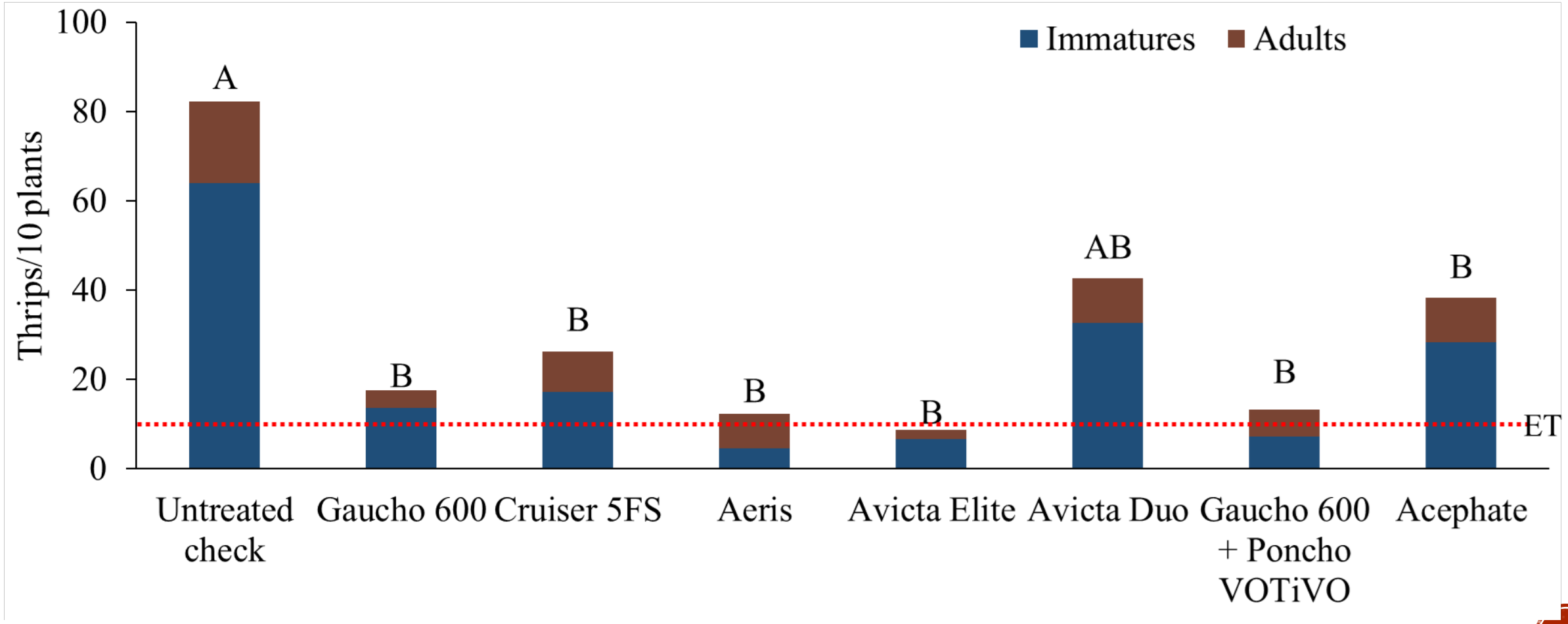


Table 3. Thrips action threshold

Cotton stage	Action threshold
Emergence to	
1 true leaf	1 thrips per plant
2 true leaves	2 thrips per plant
3 true leaves	3 thrips per plant
4 true leaves	4 thrips per plant
5–7 leaves or squaring initiation	Treatment is rarely justified.

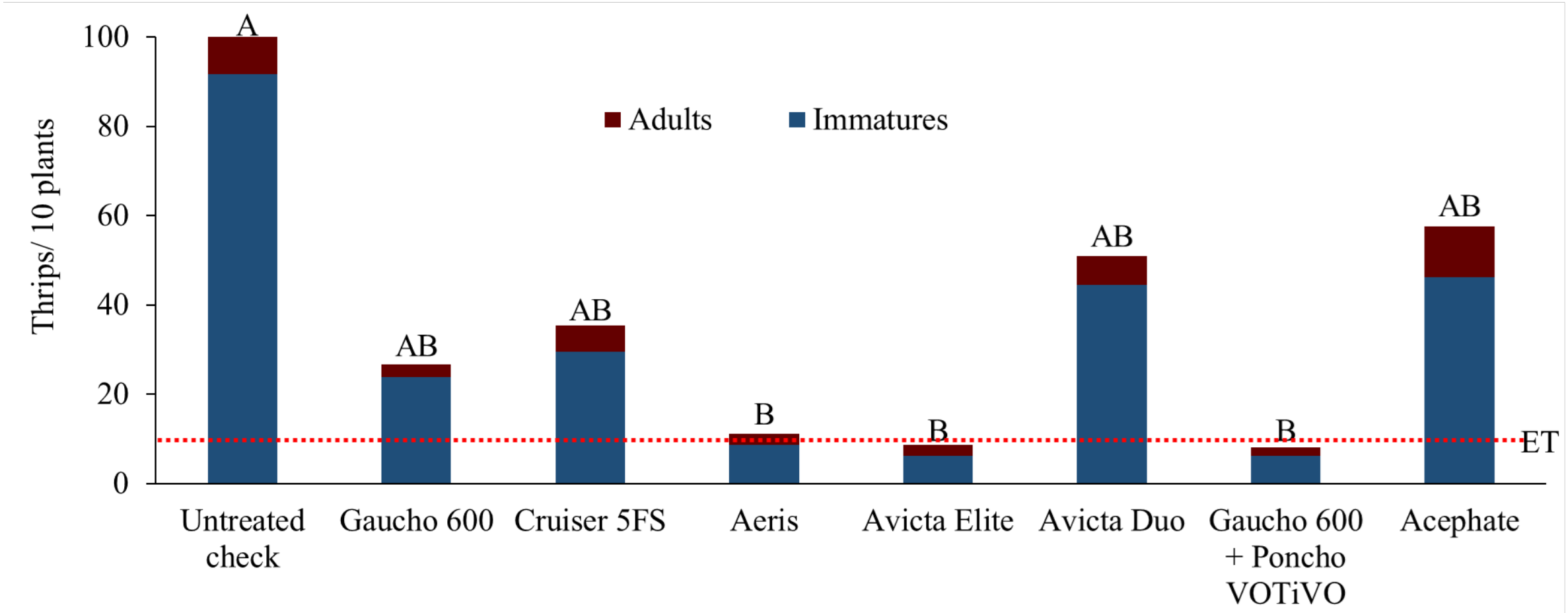
1TL, 16DAP, Lubbock, TX, 2018



T. tabaci & F. occidentalis

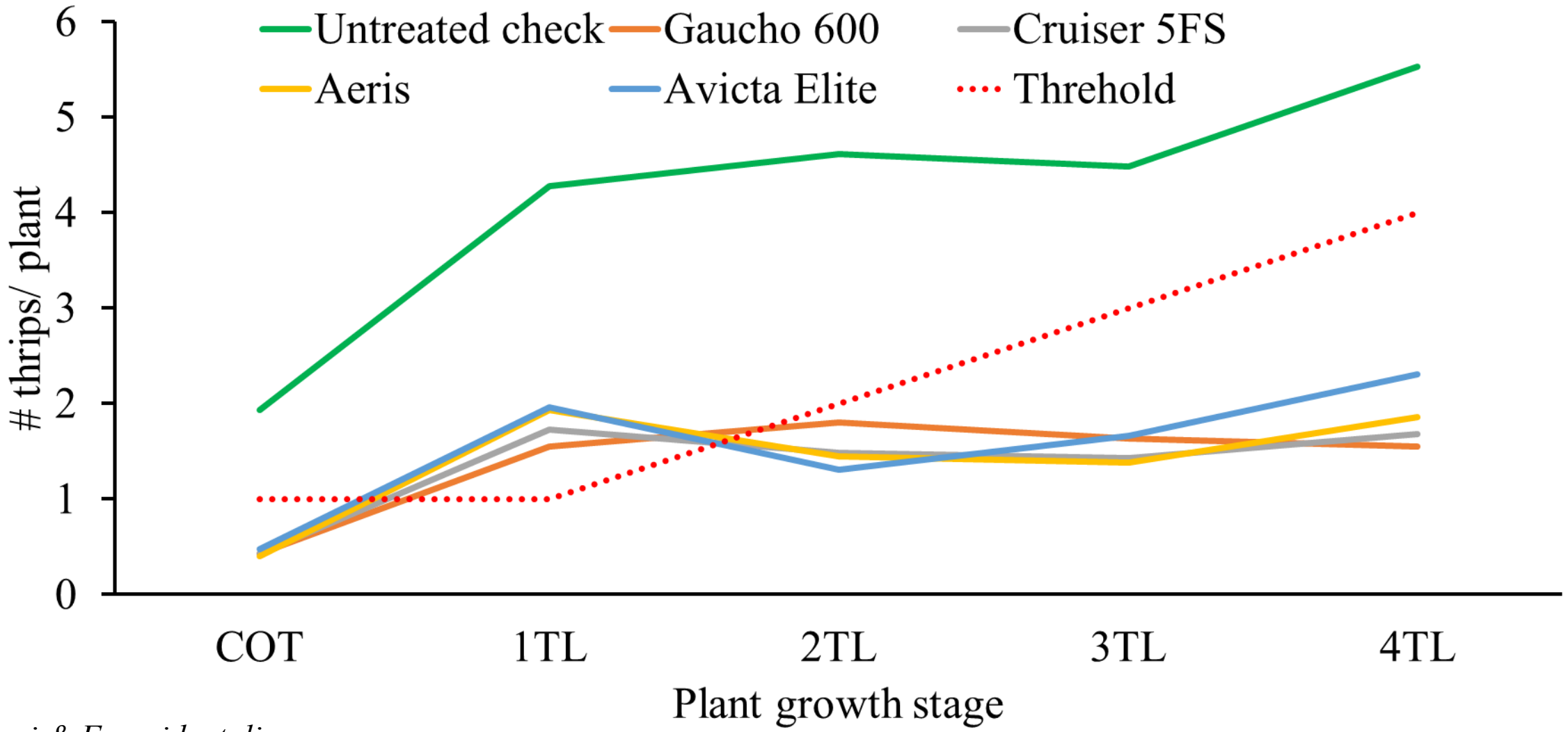
P = 0.0001

1TL, 25DAP, LUBBOCK



P = 0.0118

KRESS, TX



T. tabaci & F. occidentalis

Cotton Aphids

- Aphids will feed on cotton from emergence to open boll sucking plant juices from terminals, stems, and undersides of leaves.
- Aphid infestations can cause leaves to curl and turn yellow.
- Most aphid infestations do not cause economic damage until after first bloom and can be controlled by many natural predators.
- However if infestation levels reach 50 aphids per leaf, control in warranted.

Figure 80. Minute pirate bug.

Scymnus Beetle Adult

Big eyed bug Adult (above and below)

Scymnus Beetle Larvae

Table 6. Aphid action threshold

Cotton stage	Action threshold
Prior to first cracked boll	40–70 aphids per leaf*
After first cracked boll	10 aphids per leaf**

*Higher the yield potential (>1000 lbs lint/acre), lower the threshold
**Where rainfall is not likely to wash honeydew from the lint

APHIDS

Aphids

In Texas, three species of aphids feed on cotton plants as secondary pests: the cotton aphid, the cowpea aphid, and the green peach aphid (Figs. 29, 30, and 31). Cotton aphids are the primary aphid species of concern in cotton. Their color varies from light yellow to dark green or almost black. They are not shiny and can occur anytime during the growing season. The cotton aphid and the cowpea aphid are the only species that establish sustainable, reproductive colonies during most of the growing season. Common on seedling plants, the cowpea aphid is shiny black with white patches on its legs. The nymphs of the cowpea aphid are ash-gray. Green peach aphids are light green or pink and can occur on cotton seedlings early in the growing season.

Figure 29. Cotton aphids.

Figure 30. Cowpea aphids feeding on weedy kochia.

Figure 31. Green peach aphid adult.

Figure 32. Cotton aphid colony on the underside of a cotton leaf.

Figure 33. Leaf curling from cotton aphid infestation.

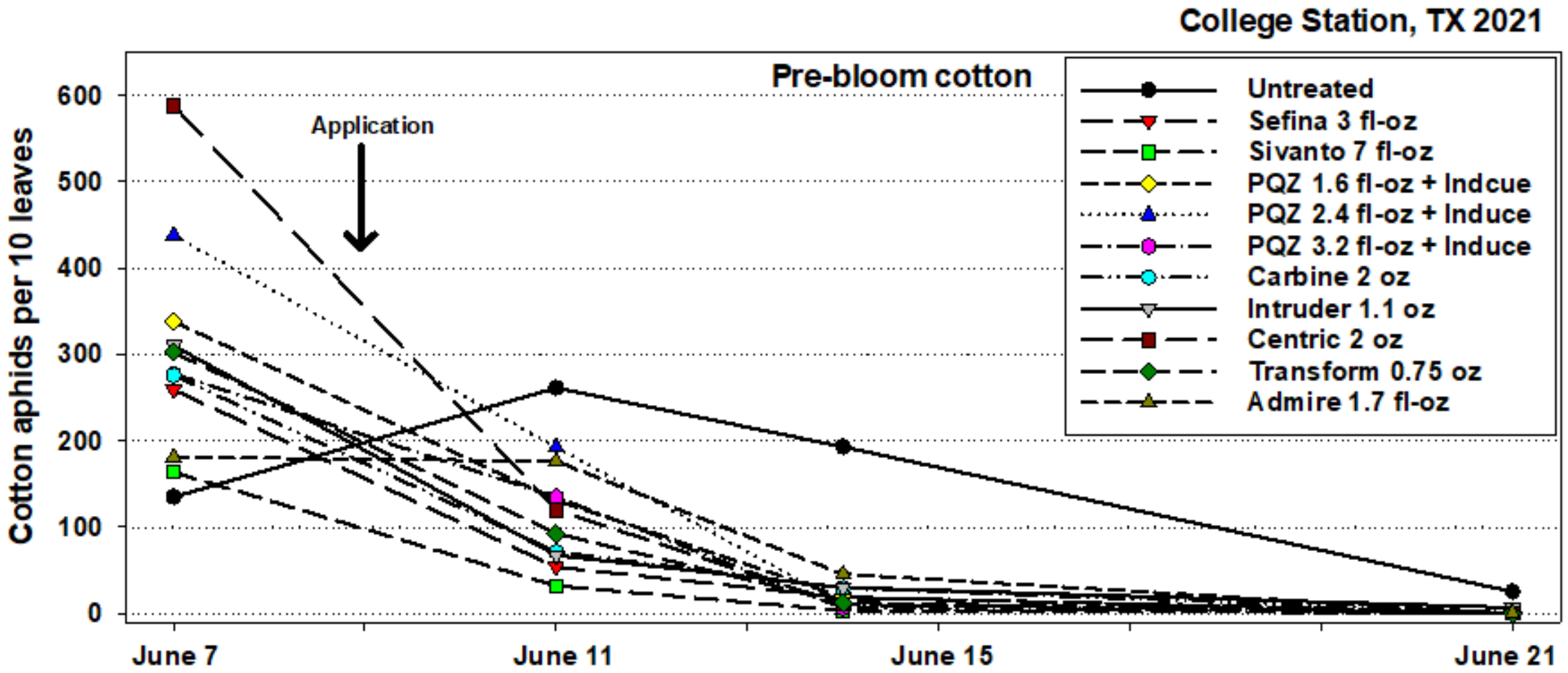
Scymnus Beetle Larvae

Scymnus Beetle Adult

Figure 35. Aphid colony on the plant terminal.

Figure 34. Honeydew accumulation on leaves.

COTTON APHID EFFICACY TRIAL , DAVID KERNS



COTTON FLEAHOPPER

- Have piercing-sucking mouthparts – suck sap from tender portions of crop
- Many alternative hosts (weeds)
- 1st 3 weeks of squaring are most sensitive
- Scout weekly (bucket method)
- Treatment rarely justified after bloom
- Avoid broad spectrum insecticides after 2nd week of squaring


Fleahopper adult


Fleahopper nymph

Photos by Danielle Sekula

Early season Pests in Cotton

Fleahoppers in Cotton

- adults are 3mm in length, oval shaped
- yellowish/green in color.
- nymphs are quite smaller, are light green in color with purple antennae.
- avoid fleahoppers feeding / blasted squares.
- When scouting for fleahoppers, each time you sample (weekly is good) you will want to check 25 terminals at at least 4 locations of a field starting when the first squares are appearing
- If you notice anywhere from 15 to 25 fleahoppers per 100 terminals (2 to 3 per 10 plants) with squares being lost (rule of thumb: 10% the first week of squaring, 15% the second week of squaring, and 25% the third week of squaring, with treatment rarely needed after first bloom) treatment is justified.

Adult cotton fleahopper

Blasted squares due to fleahoppper feeding

Table 4. Cotton fleahopper action thresholds

Region	Fleahoppers	Cotton growth stage
Blacklands	10–15 per 100 terminals (terminal inspection)	During squaring
Coastal Bend Winter Garden Lower Rio Grande Valley	15–25 per 100 terminals (terminal sampling) In development: 20–40 adults and nymphs per 100 plants (beat bucket sampling)	
Panhandle South Plains Permian Basin Rolling Plains Trans Pecos	25–30 per 100 terminals (terminal inspection)	

Week of squaring	Square set
1st week	< 90%
2nd week	< 85%
3rd week	< 75%

After 1st bloom, treatment is rarely justified.

TEXAS A&M AGRILIFE EXTENSION

2020 Cotton Fleahopper Insecticide Efficacy Trial – Hidalgo County, TX

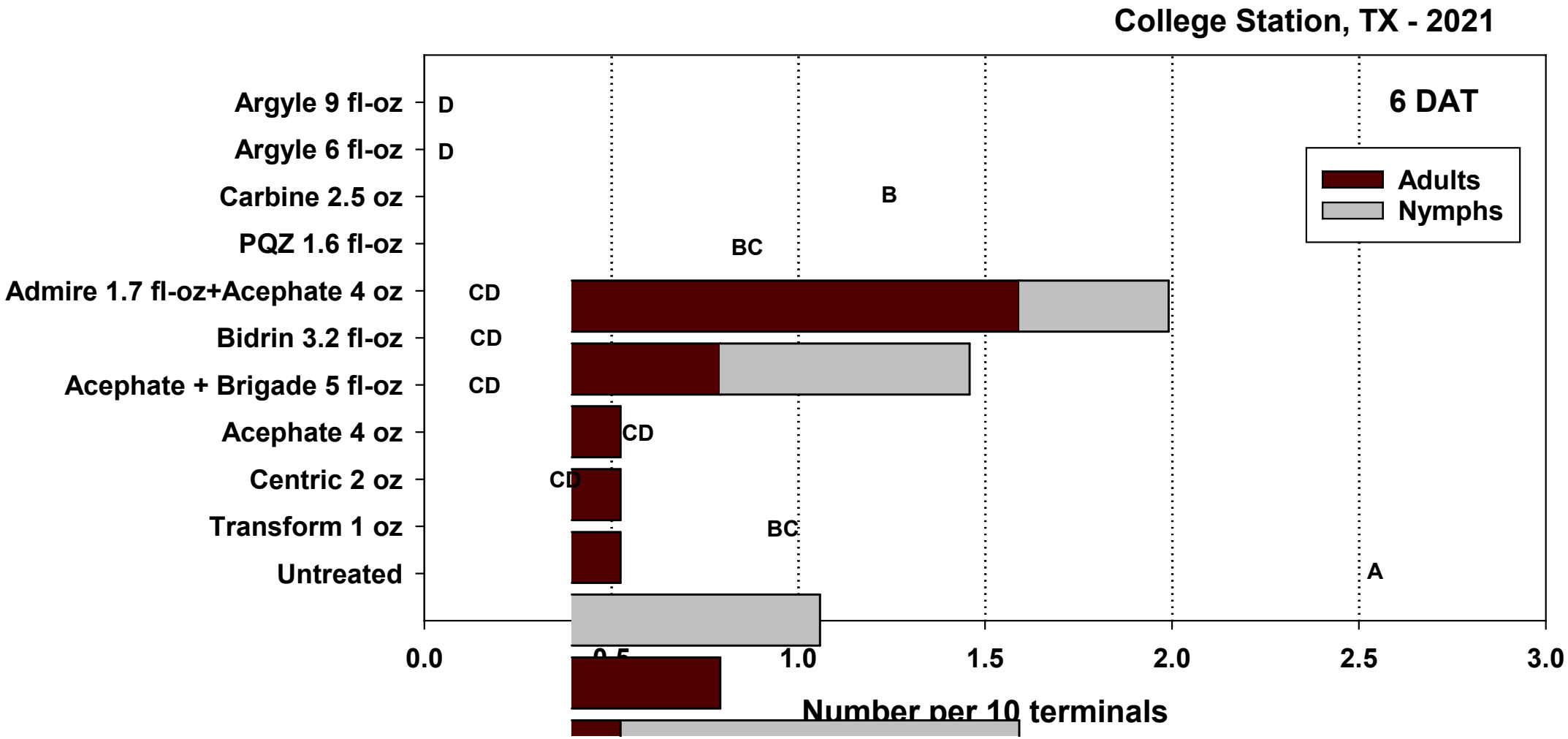
Holly Davis and Danielle Sekula –Texas AgriLife Research & Extension Center
Weslaco, TX

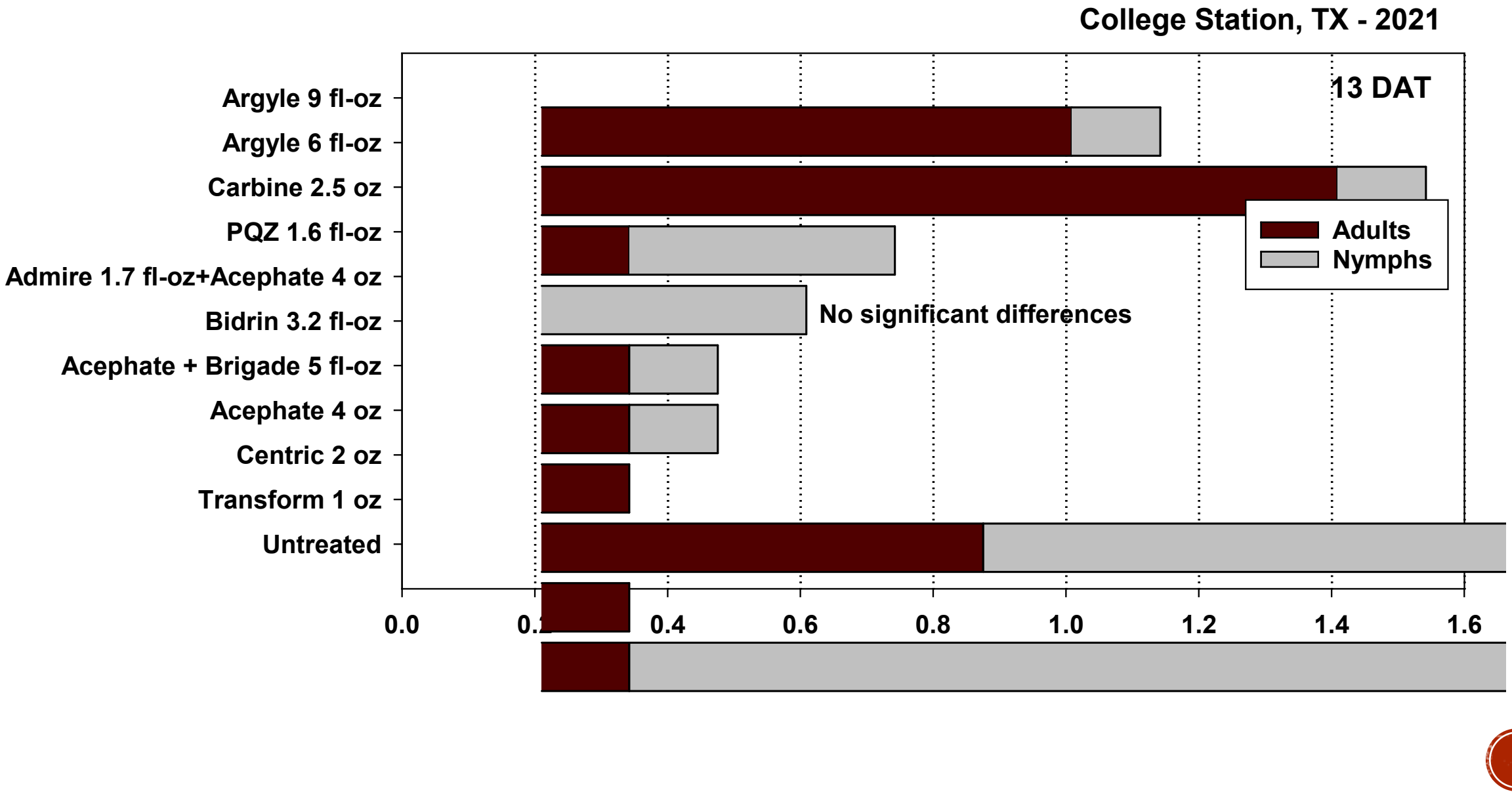
Treatment Date: 5 June 2020

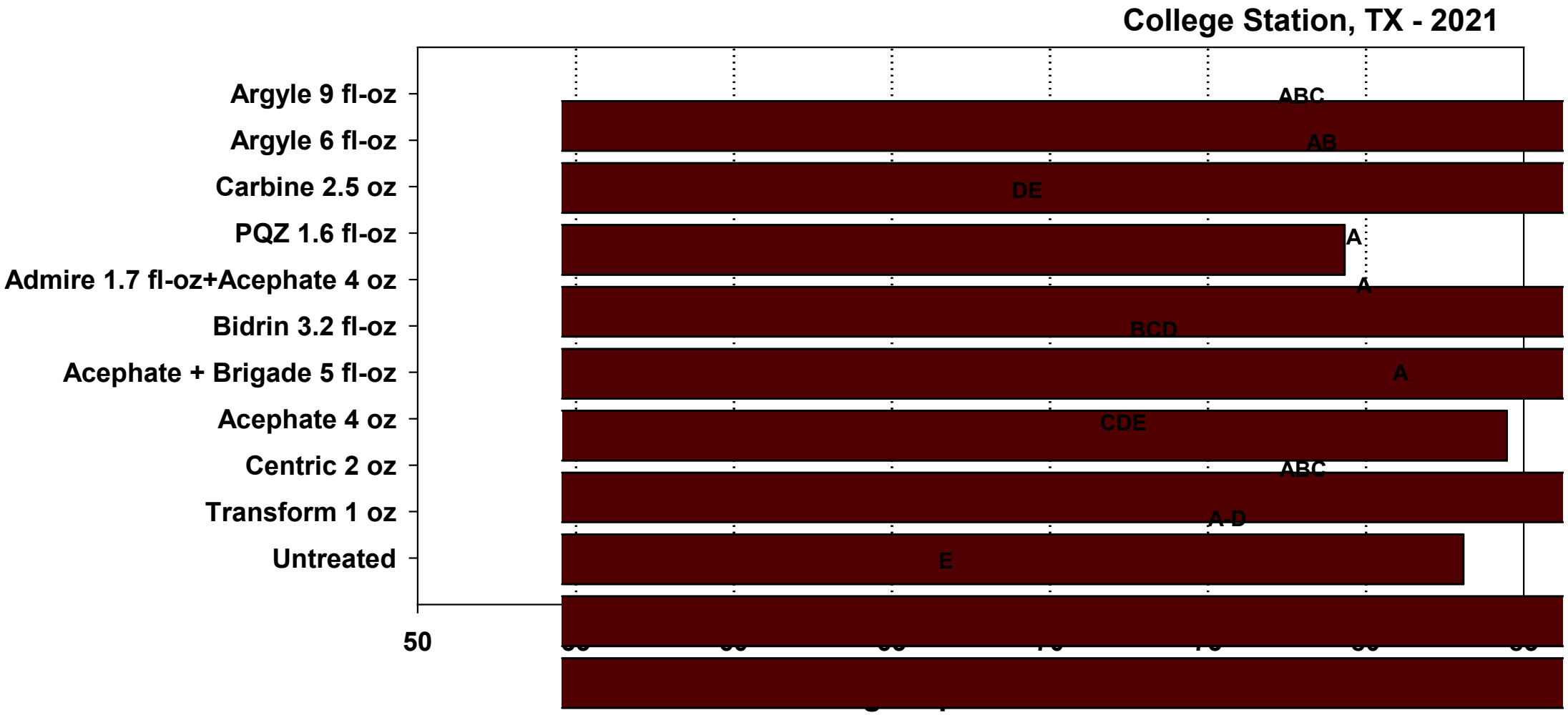
	4 June (Pre-trmnt counts)		8 June (3 DAT)		11 June (6 DAT)		19 June (14 DAT)		24 June (19 DAT)		24 June (19 DAT)		
Treatment	Mean # CFH adults/ plant	Mean # CFH nymphs/ plant	Mean # CFH adults/ plant	Mean # CFH nymphs/ plant	Mean # CFH adults/ plant	Mean # CFH nymphs/ plant	Mean # CFH adults/ plant	Mean # CFH nymphs/ plant	Mean # CFH adults/ plant	Mean # CFH nymphs/ plant	Mean # squares in top 5 nodes/ plant	Mean # squares blasted/ plant	Mean % of squares blasted/ plant
Untreated	0.8	1.1	0.3a	0.6a	0.5a	0.5a	0.6a	1.4a	0.4ab	0.6a	16.0	2.3a	14.4a
PQZ @1.6 oz/a + 0.25% Dyne-Amic	0.7	1.1	0.2a	0.3b	0.2bc	0.3abc	0.5ab	1.2a	0.4ab	0.5a	15.8	1.4bc	8.6b
PQZ @ 2.4 oz/a + 0.25% Dyne-Amic	0.9	1.4	0.03c	0.03c	0.03c	0.2bc	0.4ab	0.3b	0.1b	0.2b	16.2	1.1c	6.8b
PQZ @3.2 oz/a + 0.25% Dyne-Amic	0.8	1.2	0.03c	0.03c	0.2bc	0.3abc	0.2b	0.3b	0.2b	0.1b	15.2	1.1c	7.1b
Transform @ 1.0 g/a + 0.25% Dyne-Amic	1.2	1.7	0.05bc	0.03c	0.3ab	0.1c	0.4ab	0.3b	0.1b	0.2b	15.4	1.1c	6.8b
Sefina @ 3.0 oz/a + 0.25% Dyne-Amic	0.8	1.0	0.2ab	0.4b	0.3ab	0.4ab	0.5ab	1.4a	0.6a	0.2b	15.7	1.8b	11.8a

Means within a column followed by the same letter are not significantly different ($P>0.05$; PROC ANOVA; Mean comparison by LSD [SAS 9.4]). Reference to specific products is provided for informational purposes. Experiments with pesticides on non-labeled crops or pests is part of the insecticide registration process, it does not imply endorsement or recommendation of non-labeled uses of pesticides by Texas A&M University. All pesticide use must be consistent with current labels.

CFH trial done by Dr. David Kerns (My Boss!)




College Station, TX - 2021
13 DAT
Argyle 9 fl-oz
Argyle 6 fl-oz
Carbine 2.5 oz
PQZ 1.6 fl-oz
Admire 1.7 fl-oz+Acephate 4 oz
Bidrin 3.2 fl-oz
Acephate + Brigade 5 fl-oz
Acephate 4 oz
Centric 2 oz
Transform 1 oz
Untreated
Adults
Nymphs
No significant differences
0.0
0.4
0.6
0.8
1.0
1.2
1.4
1.6


College Station, TX - 2021
Argyle 9 fl-oz
Argyle 6 fl-oz
Carbine 2.5 oz
PQZ 1.6 fl-oz
Admire 1.7 fl-oz+Acephate 4 oz
Bidrin 3.2 fl-oz
Acephate + Brigade 5 fl-oz
Acephate 4 oz
Centric 2 oz
Transform 1 oz
Untreated
ABC
AB
DE
A
A
BCD
A
CDE
ABC
A D
E
50

SPIDERMITES

Figure 55. Twospotted spider mite.

Figure 56. Twospotted spider mite infestation on the underside of a cotton leaf.

Spider Mites

Two species of mites commonly feed on cotton plants in Texas: the twospotted spider mite and the carmine spider mite. These two species are difficult to distinguish from one another. Carmine spider mite females are red; twospotted spider mites are greenish. When conditions are suitable for initiating diapause (dormancy), female twospotted spider mites may also be red. Because the damage they inflict and their biology and ecology are similar, we will discuss them as one pest for this guide (Fig. 55).

Spider mites can infest cotton at any point in the growing season, but cotton is most susceptible to injury from spider mites during fruiting periods and when the crop suffers water-deficit stress. Spider mites infest the underside of leaves (Fig. 56).

Infestations most often develop in hot spots in fields, near grain crops, and at dusty field margins. Spider mite infestations are often

Sweep net sampling

- Use a standard 15-inch canvas sweep net with a handle. One sample should consist of 50 sweeps across a single row of cotton. However, if you pick up too much plant material in 50 sweeps, reduce the sweeps to 25 or less.
- Walk briskly down the row and swing the net in front of you, perpendicular to the row.
    - Strike the plants so that the lower edge of the rim strikes the plants about 10 inches from the top.
    - Keep the lower edge tilted slightly ahead of the upper edge.
    - Keep the sweeps far enough apart that you do not sweep plants that have already been jostled by the net.
    - Keep the net moving to prevent adults from flying out.
    - After each set of sweeps, count all the insect stages in the net.
    - Go through the sample slowly, counting insects, inspecting each leaf, and watching closely for adults flying from the net.

Figure 5. Sweep net sampling.

Beat bucket sampling method

- Tilt a 2.5- or 5-gallon white or black plastic bucket toward the plants.
- Grasp the plant stems of two or three representative plants (depending on plant size) and bend them into the bucket.
- Vigorously shake the plants against the side of the inside of the bucket.
- Hit the outside of the bucket several times to knock the bugs to the bottom and quickly inspect the inside of the bucket to count pests.
- Count the adults first because they can fly from the bucket and may be missed during scouting.
- Keep a running total of the number of plants shaken and the adults and nymphs of the insect being monitored.
- Shake a minimum of 40 plants to get an estimate of the number of insects per plant.

Figure 3. Beat bucket sampling.

VERDE PLANT BUG

- Many alternative hosts: seepweed, pigweed, and sorghum
- Piercing-sucking mouthparts used to feed on large squares and bolls up to 1 inch in diameter
- Causes dropped mature squares and young bolls and boll rot
- Treat when 20-25 bugs/100 plants, or
- (1-2 bugs per 10 sweeps) (4-5 per 20 sweeps)
- Beat bucket is 1 per plant
- Access your cotton field to see if you have more immature bolls than mature as once bolls are larger than 1 inch diameter and cannot be squeezed open they are generally safe from plant bug damage.

TARNISHED PLANT BUG (LYGUS BUGS)

- Prefer Legumes
- Feed on cotton terminals, squares, flowers, and small bolls
- Feeding may cause:
  - Deformed bolls
  - Dirty bloom (damaged anthers) and puckered petals
  - Shedding of squares and small bolls
  - Stunted growth
  - Sunken lesions on outer surface of bolls
  - Damaged developing seeds or lint

Tarnished Plant bugs

- have piercing sucking mouth parts
- brown in color mottled with red yellow and black and have wings.
- similar to the adults, lack wings and are greenish in color with black spots
- Females lay whitish eggs inserted into the host plant and hatch in about 8 days
- From egg to adult the tarnished plant bug life cycle is about 3 to 4 weeks and produce 5 generations a year.
- Usually by the time June comes we already have already seen the first 2 generations of tarnished pant bugs.
- Early to mid-June is typically when you have tarnished plant bugs
- are known for aborting pin head squares when feeding but also feed on large squares and tender bolls.
- *will inject a toxin to help dissolve plant tissue so that it can be ingested.
- *Tarnished plant bugs prefer soft immature bolls and damage will appear as small dark sunken spots on the bolls.

Adult Verde plant bug

Be mindful if cotton field is across from mature Sorghum field

Table 8. Lygus action threshold

	Sampling method	
Cotton stage	Drop cloth	Sweep net
1st two weeks of squaring*	1–2 per 6 ft-row with unacceptable square set	8 per 100 sweeps with unacceptable square set
3rd week of squaring to 1st bloom	2–3 per 6 ft-row with unacceptable square set	15 per 100 sweeps with unacceptable square set
After peak bloom	4–6 per 6 ft-row with unacceptable fruit set the first 4-5 weeks	15–20 per 100 sweeps with unacceptable fruit set the first 4–5 weeks

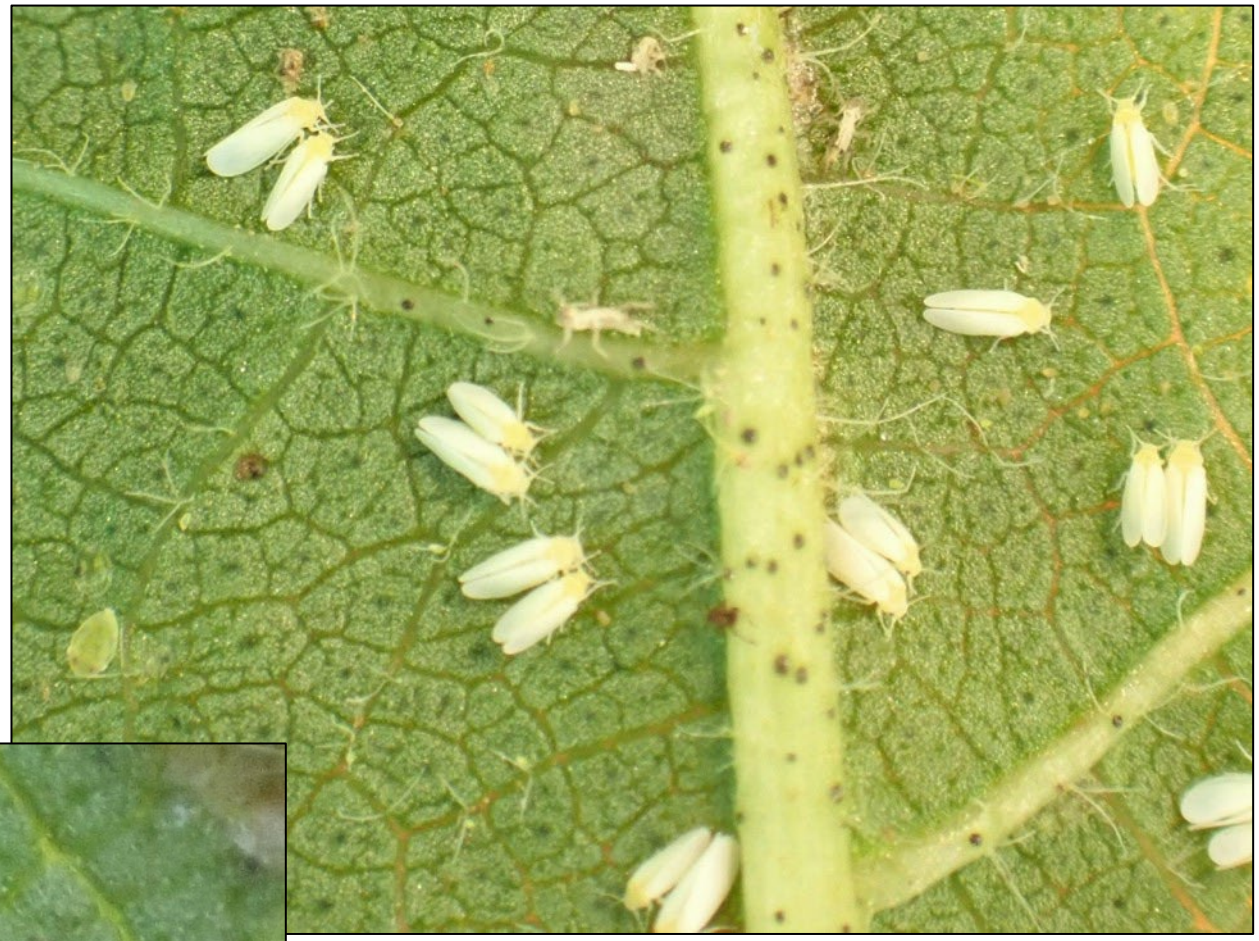
Sweep net: Standard 15-inch net, sample 1 row at a time, taking 15–25 sweeps. Recommended before peak bloom.

Drop cloth: Black recommended, 3-foot sampling area, sample 2 rows. Recommended after peak bloom. Stop sampling and treating when NAWF = 5 + 350 DD60's.

*In West Texas, insecticide applications for lygus are rarely needed in prebloom cotton as lygus generally stay in roadside weeds and vegetation until cotton begins flowering.

Whiteflies in Cotton

- Piercing-sucking mouthparts
  - Stunts growth
  - Reduces plant vigor
- Produce honeydew
  - Premature defoliation
  - Sticky cotton
  - Stain lint and reduce fiber quality



Whitefly adults

Closeup of whitefly nymph

Photos by Danielle Sekula

Whitefly Control

Minute pirate bug is a great predator when it comes to whitefly in cotton

Mirid plantbugs are good whitefly predators on sesame and tomato. 2020 is first year observed in cotton

Mirid plantbugs (*Nesidiocoris tenuis*), adult on the left, nymph on the right

Photos by Danielle Sekula

Whitefly trial conducted in 2019, tested 9 different spray applications
All applications had a NIS added
Average number whiteflies before spray = 100 whiteflies/leaf

14 days				
				Least Sq Mean
Control	A			38.40
Sivanto (14 oz)		B		14.77
Sivanto (8oz) + Oberon (4oz)		B		12.37
Sefina 14 oz		B		12.13
PQZ (3.2)			C	6.50
Courier (9oz) +PQZ (2.4)			C	6.43
Couier 13.6 oz			C	5.97
PQZ (1.6)			C	5.70
Courier (9oz) + PQZ 1.6			C	4.47
Courier (9oz) + PQZ (2oz)			C	3.93

Cotton lint stained by black sooty mold in a cotton field infested with whiteflies

Data and photo: Danielle Sekula

Whiteflies in cotton

Figure 71. Adult whitefly.

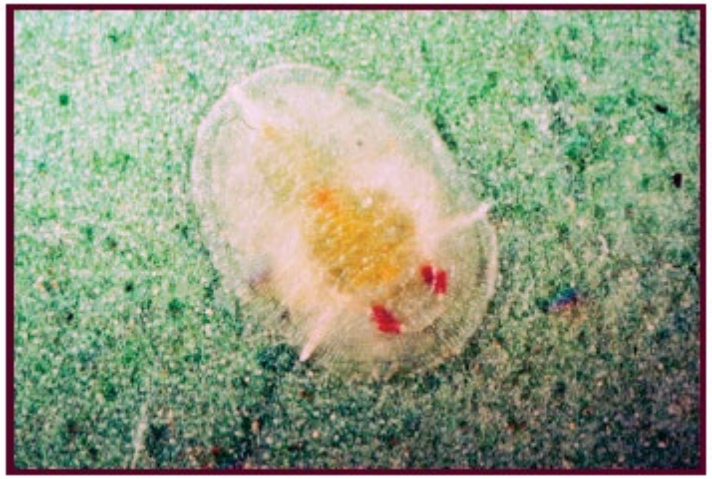


Figure 72. Whitefly nymph.

Chemical Control and Action Thresholds

Table 10. Whitefly action thresholds

Insecticide option	Silverleaf whitefly	
Adulticide	When ≥40% of the 5th node leaves are infested with 3 or more adults	
Insect growth regulator (IGR)	When ≥40% of the 5th node leaves are infested with 3 or more adults and nymphs are present	When ≥40% of quarter-sized disks* contain at least one large nymph

Pest	Product Name/ Common Name	Active Ingredient/s	Formulated Rate (fl oz or oz/A)
Whiteflies			
	Intruder Max 70WP/Strafer Max	acetamiprid^	1.7–2.3
	Acephate 90 Prill	acephate^	8.9–17.6
	Orthene 97	acephate	8–16
	Oberon 4SC	spiromesifen	3–8
	Knack	pyriproxyfen	8–10
	Centric 40 WG	thiamethoxam	2.0–2.5
	Sivanto 200 SL	flupyradifurone	10.5–14.0
	Admire Pro	imidacloprid^	1.3–1.7

Chilli thrips, *Scirtothrips dorsalis*

- From Southeast Asia
- First detected in Florida in 1991, considered established by 2005
- Found in Southeast TX in 2005
- Detected in grapefruit by Dr. Mamoudou Sétamou in 2018, and every year since
- Late season bronzing lead to discovery in cotton throughout the Valley in 2020

Identification

- Field detection and ID is difficult! Adults are about 2mm in length
- Typically found on underside of foliage (under heavy pressure may also be on top)… but not in flowers.
  - In cotton finding them in upper canopy
- Tend to remain near mid-vein but will "scamper" around leaf surface if disturbed
- Adults are weak fliers, often distributed longer distances by wind, machinery, etc.

Highly polyphagous species

- Known to reproduce on over 100 plants from about 40 different families
- As this pest expands its geographical range… it expands its host range

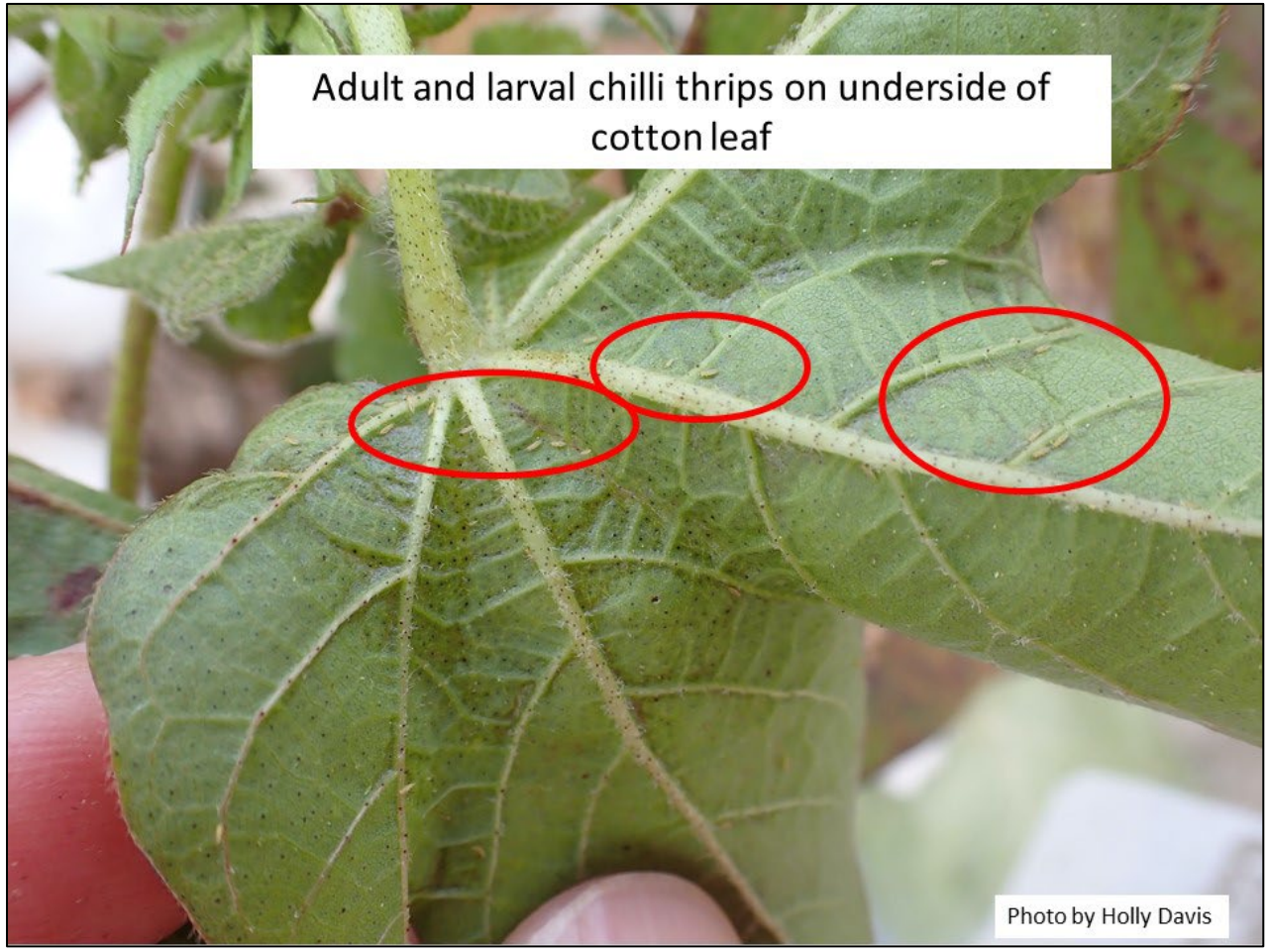
Known to vector at least 7 viruses

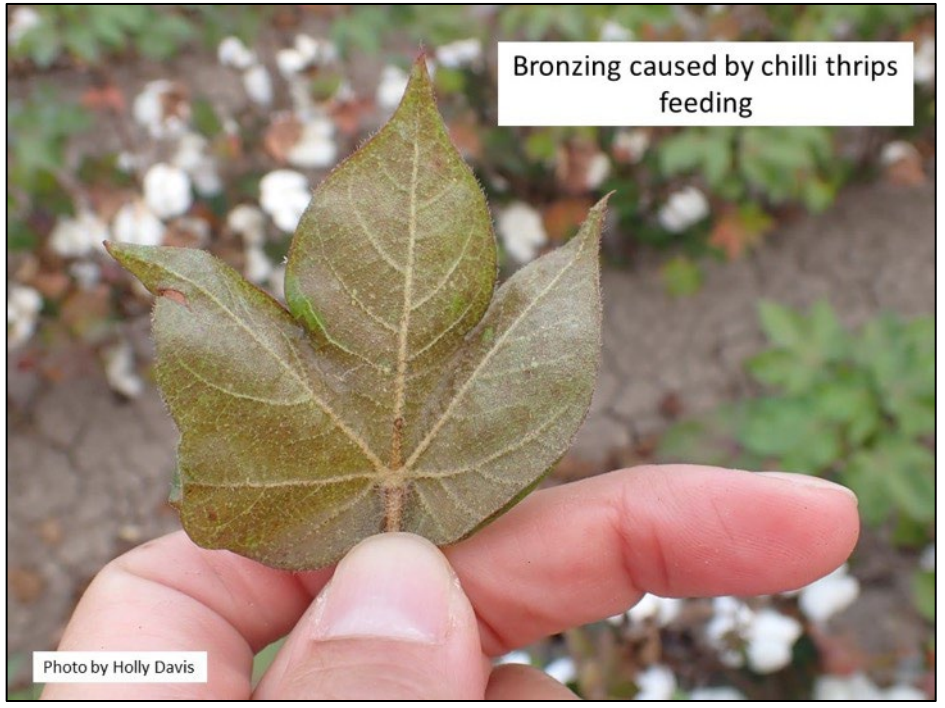
- Chilli leaf curl virus
- Peanut necrosis virus
- Tobacco streak virus
- Melon yellow spot virus
- Watermelon silver mottle virus
- Capsicum chlorosis virus

and rose.

USDA United States Department of Agriculture National Institute of Food and Agriculture

Damage: Cotton





Monitoring Program

- Currently monitoring a wide range of crops:
  - Soybeans
  - Corn
  - Tomatoes- just got a hit in tomatoes 5-10-2022
  - Chilli
  - Cabbage
  - Onion
- Thus far, finding small numbers in most crops but populations remaining low
- Steady populations found in weeds along field margins
- At this time, it appears that chilli thrips are established throughout the landscape but not as problematic as feared
- Need hot temperatures to reproduce explosively
- May be problematic in greenhouse production
- Can become a problem in cotton late in season around mid July during full bloom and prior to harvest

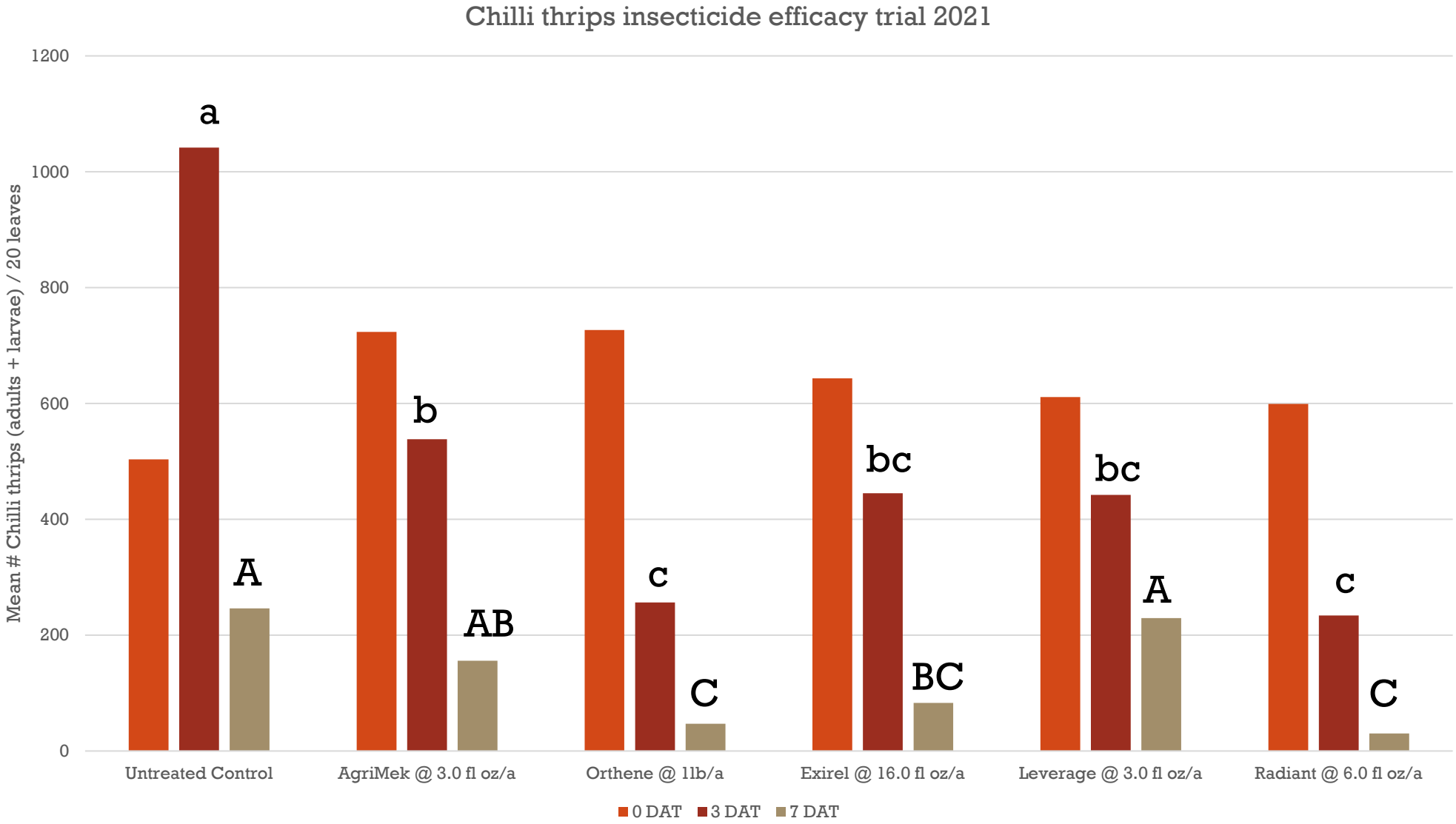
Chilli Thrips Efficacy Trial July 2022

Mean No. Chilli Thrips in Cotton Efficacy Spray Trial July 2022												
	Mean # of chilli thrips larvae/ 10 leaves				Mean # of chilli thrips adults/ 10 leaves				Mean # of total chilli thrips / 10 leaves			
	21-Jul	28-Jul	4-Aug	11-Aug	21-Jul	28-Jul	4-Aug	11-Aug	21-Jul	28-Jul	4-Aug	11-Aug
Insecticide Treatments	Precounts	7 DAT	14 DAT	21 DAT	Precounts	7 DAT	14 DAT	21 DAT	Precounts	7 DAT	14 DAT	21 DAT
untreated control	315.25 b	145.75 a	213.50 a	154.50 a	55.75 a	47.75 a	30.00 a	51.25 ab	371.00 b	193.50 a	243.50 a	205.75 a
Agrimek @ 3 oz/A (abemectin)	292.5 b	89.50 abc	64.50 b	112.50 ab	53.25 a	37.50 ab	18.00 ab	64.75 ab	345.75 b	127.00 ab	82.50 b	177.25 a
Acephate @ 1 lb/A	357.25 ab	52.75 bc	71.50 b	94.00 ab	70.00 a	24.50 ab	26.00 ab	77.75 a	427.25 ab	77.25 bc	97.50 b	171.75 a
Excirel @ 16 oz/A (Cyantraniliprole)	421.00 ab	58.00 bc	61.50 b	91.00 b	49.25 a	26.25 ab	17.00 ab	48.00 ab	470.25 ab	84.25 bc	78.50 b	139.00 ab
Leverage @ 3oz/A (imidacloprid and β-cyfluthrin)	454.25 ab	106.75 ab	168.25 a	153.50 ab	53.25 a	38.00 ab	26.75 ab	44.00 b	507.50 ab	144.75 ab	195.00 a	197.50 a
Radiant @ 6oz/A (spinetoram)	345.25 b	25.75 c	51.25 b	27.00 c	46.00 a	17.25 b	11.75 b	36.50 b	391.25 ab	43.00 c	63.00 b	63.50 b
PQZ @ 3.2 oz/A (Pyrifluquinazon)	576.25 a	104.00 ab	204.75 a	153.00 ab	58.00 a	37.25 ab	31.00 a	60.00 ab	634.25 a	141.25 ab	235.75 a	213.00 a

*All Insecticide treatments included 0.25 % v/v Dyne-amic. Controls were Not sprayed. Means within a column followed by the same letter are not significantly different (P>0.05; PROC ANOVA; Mean comparison by LSD [SAS 9.4]). Reference to specific products is provided for informational purposes. Experiments with pesticides on non-labeled crops or pests is part of the insecticide registration process, it does not imply endorsement or recommendation of non-labeled uses of pesticides by Texas A&M University. All pesticide use must be consistent with current labels

Management

- Broad-spectrum insecticide applications may promote thrips outbreaks
- Controlling weeds (alternative hosts) is important



Management

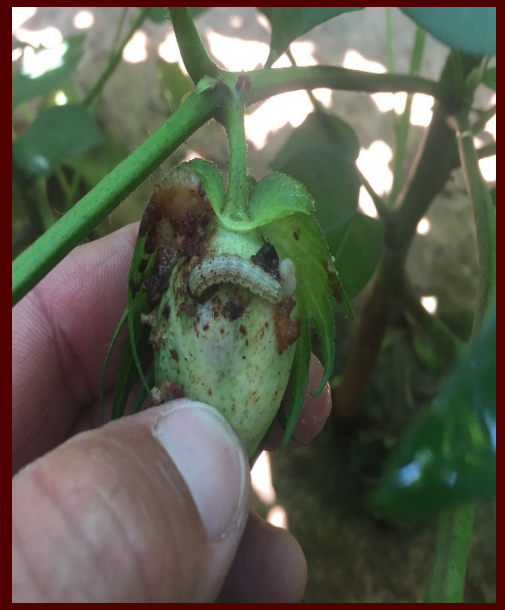
- Natural enemies have been documented feeding on this species in Florida
- Broad-spectrum insecticide applications may promote thrips outbreaks
- Trials in Florida have indicated that:
  - Pyrethroids are not effective
  - Imidacloprid and spinotram provide good control (Seal et al., 2006, 2008, 2009)
- Rotating between classes of insecticides will be key to reduce resistance development
- Controlling weeds (alternative hosts) is important

https://mrec.ifas.ufl.edu/lso/thripslinks.htm

VALUE OF BT TECHNOLOGY FOR BOLLWORM MANAGEMENT: CURRENT SITUATION AND FUTURE SUSTAINABILITY

DAVID L. KERNS

TEXAS A&M UNIVERSITY, COLLEGE STATION, TX



BT AND VIP TECHNOLOGOIES DEFINED

Bt *Bacillus thuringiensis*

- Bt crystlline endotoxins (Bt Cry proiens) protect crops by disrupting the insect midgut after injestion, typically leading to feeding reduction or cessation, and then eventually death of susceptible insects
- Mode of action for Bt Cry proteins is activation by gut proteases after ingestion, binding to midgut receptors, and pore formation leading to cell lysis
- Most common mechanism for resistance to Bt Cry proteins is reduced or altered binding to midgut receptors

VIP3A

- VIP3A was isolated form Bt
- First reported by Ciba Agricultural Biotechnology (Now Syngenta)
- Are insecticidal proteins with activity against a wide range of Lepidopteran larvae including: black cutworm, fall armyworm, tabacco budworm, and corn ear worm
- Has two key findings, first Vip3A is an endotoxin produced and secreted without N-terminal processing during the vegitative growth stage (differs from Bt Cry proteins that produce during sporulation
- Secondly, VIP3A shares no sequence homology with any know Bt Cry proteins

PAST AND CURRENT BT COTTON TECHNOLOGIES

Company	1st generation (single gene)	2nd generation (dual gene)	3rd generation (multi-gene)	3rd generation (2017)
Monsanto	Bollgard (Cry1Ac)	Bollgard 2 (Cry1Ac+Cry2Ab)		Bollgard 3 (Cry1Ac+Cry2Ab+Vip3A)
Dow		WideStrike (Cry1Ac+Cry1F)	WideStrike 3 (Cry1Ac+Cry1F+Vip 3A)	
Bayer		TwinLink (Cry1Ab+Cry2Ae)		TwinLink Plus (Cry1Ab+Cry2Ae+ Vip3A)

Homogeny across crops				
Crop	**Cry1A**	**Cry1F**	**Cry2**	**Vip3A**
Cotton	Cry1Ac, Cry1Ab	Cry1F	Cry2Ab, Cry2Ae	Vip3A
Corn	Cry1Ab	Cry1F	Cry2Ab2	Vip3A
	Cry1A.105 (Cry1Ab, Cry1Ac, Cry1F)			

Table 2. Relative efficacy of Bt traits against caterpillar pests

Pest	Bollgard (Cry1Ac)	Bollgard II (Cry1Ac + Cry2Ab)	Widestrike (Cry1Ac + Cry1F)	TwinLink (Cry1Ab + Cry2Ae)	Widestrike 3 (Cry1Ac + Cry1F + Vip3A)	Bollgard 3 (Cry1Ac + Cry2Ab + Vip3A)	TwinLink Plus (Cry1Ab + Cry2Ae + Vip3Aa19)
	1996	2003	2005	2013	2014	2017	2017
Bollworm	4	2.5	4	2.75	2.5	2*	2*
Tobacco budworm	1	1	1	1	1	1	1
Pink bollworm	1	1	1	1	1	1	1
Beet armyworm	2	2	2	2	1–2*	1–2*	1–2*
Fall armyworm	2.5	2	1	2	1	1–2*	1–2*
Soybean looper	1	1	1	1	1	1	1

1 = Complete control
2 = Rarely requires oversprays
3 = Sometimes requires oversprays
4 = Frequently requires oversprays
*Incomplete data