2020 Tobacco Agent Training
March 13, 2020
UKREC, Princeton KY

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2020 Burley Tobacco Economics

2019-2020 Burley Growing/Marketing Season

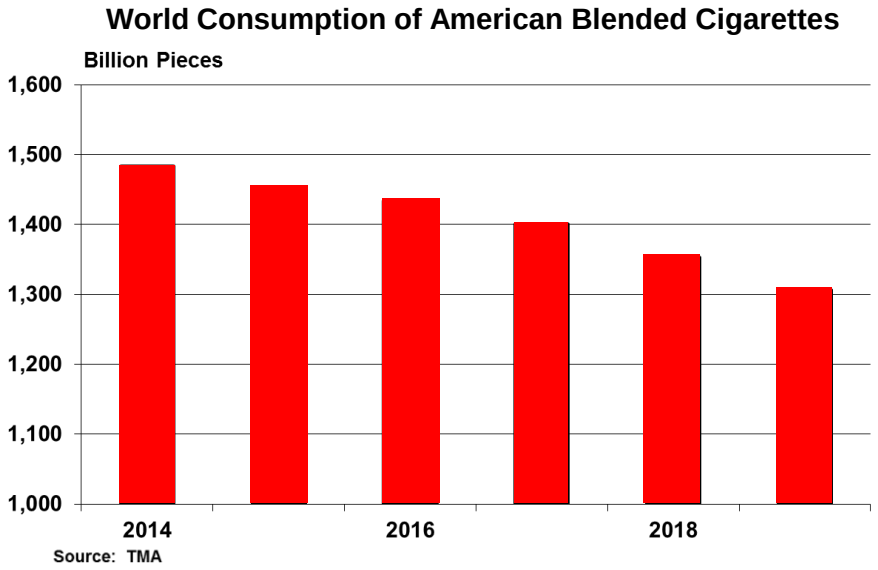
Disaster

- **Quality Issues**
- **Buyer Contract Volumes Overestimated ???**
- **Import/Export Trends Accelerate**

Global Burley Demand – The Cold Hard Facts

Globally – American Blended Cigarette Sales Have Peaked and are Trending Down (-2 to -3% Annually)….

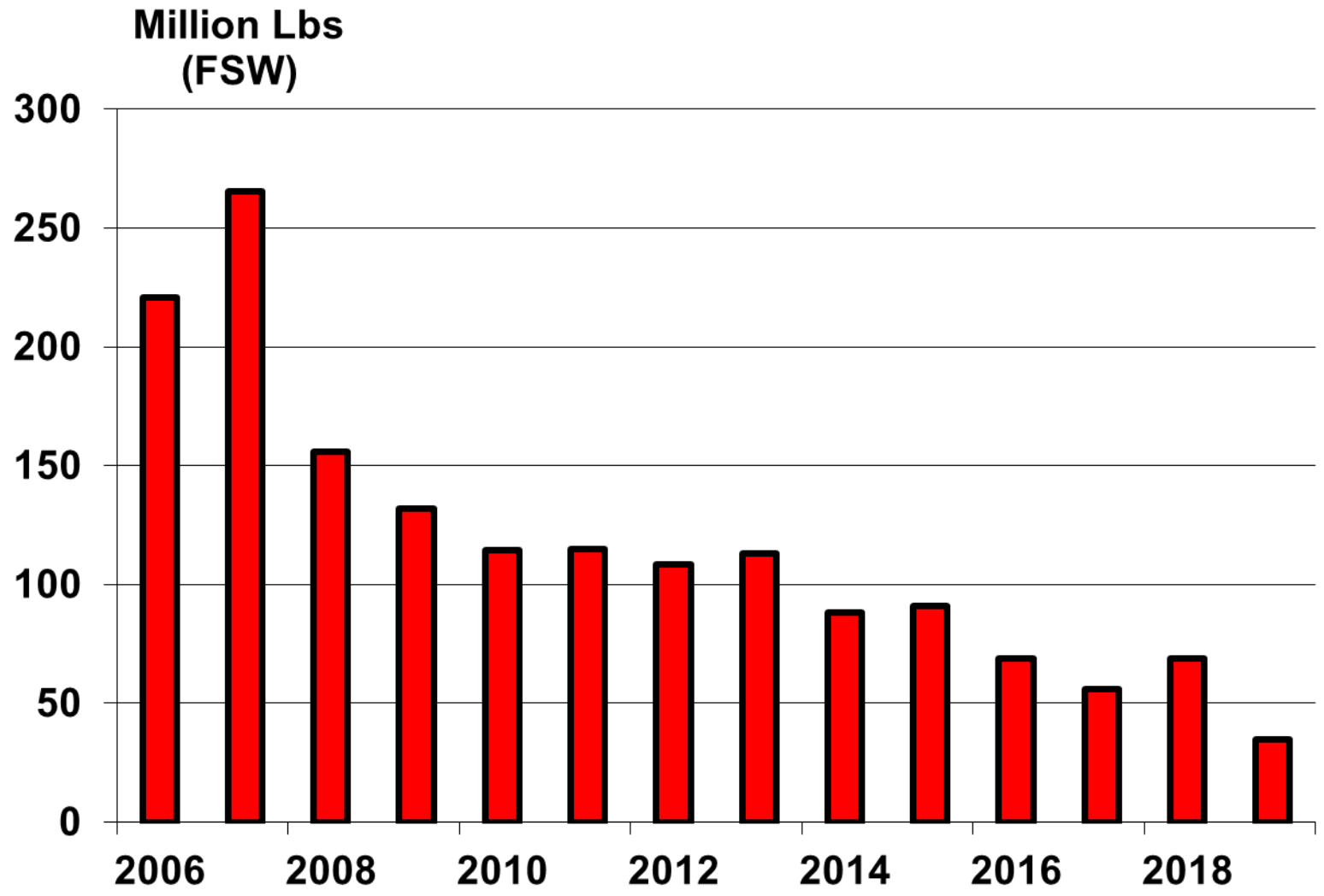
Health Reasons/Smuggling/Alternative Products



- **U.S – annual decline in cigarette sales are accelerating (-5 to -6%)**
- **Alternative products don't use (much, if any) U.S. burley**
- **Price differential between U.S & foreign burleys is increasing**
- **Premium for U.S. burley quality is deteriorating**

World needs less U.S. burley tobacco

U.S. Burley Exports

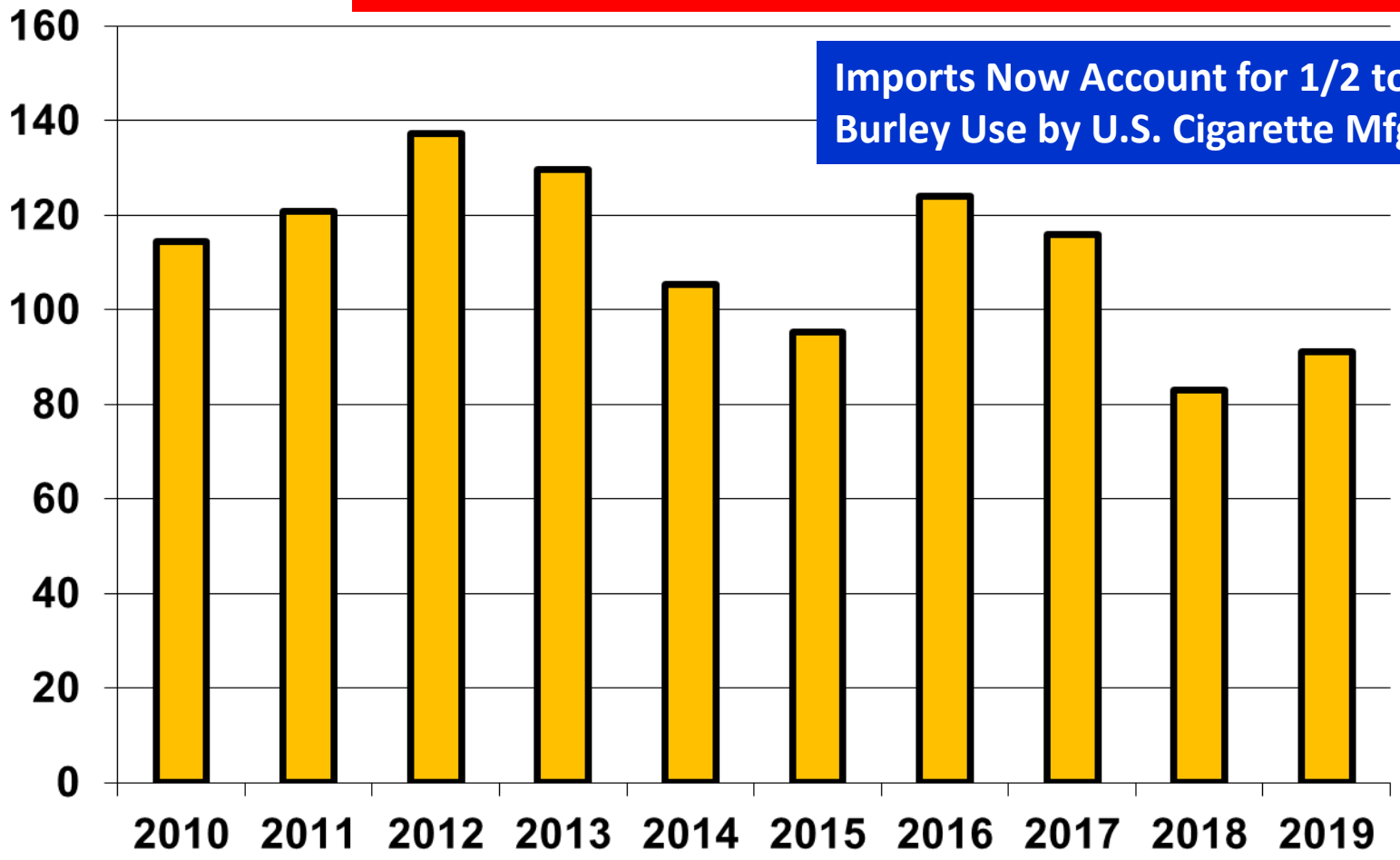


Source: TMA/US Customs Data

U.S. Burley Imports

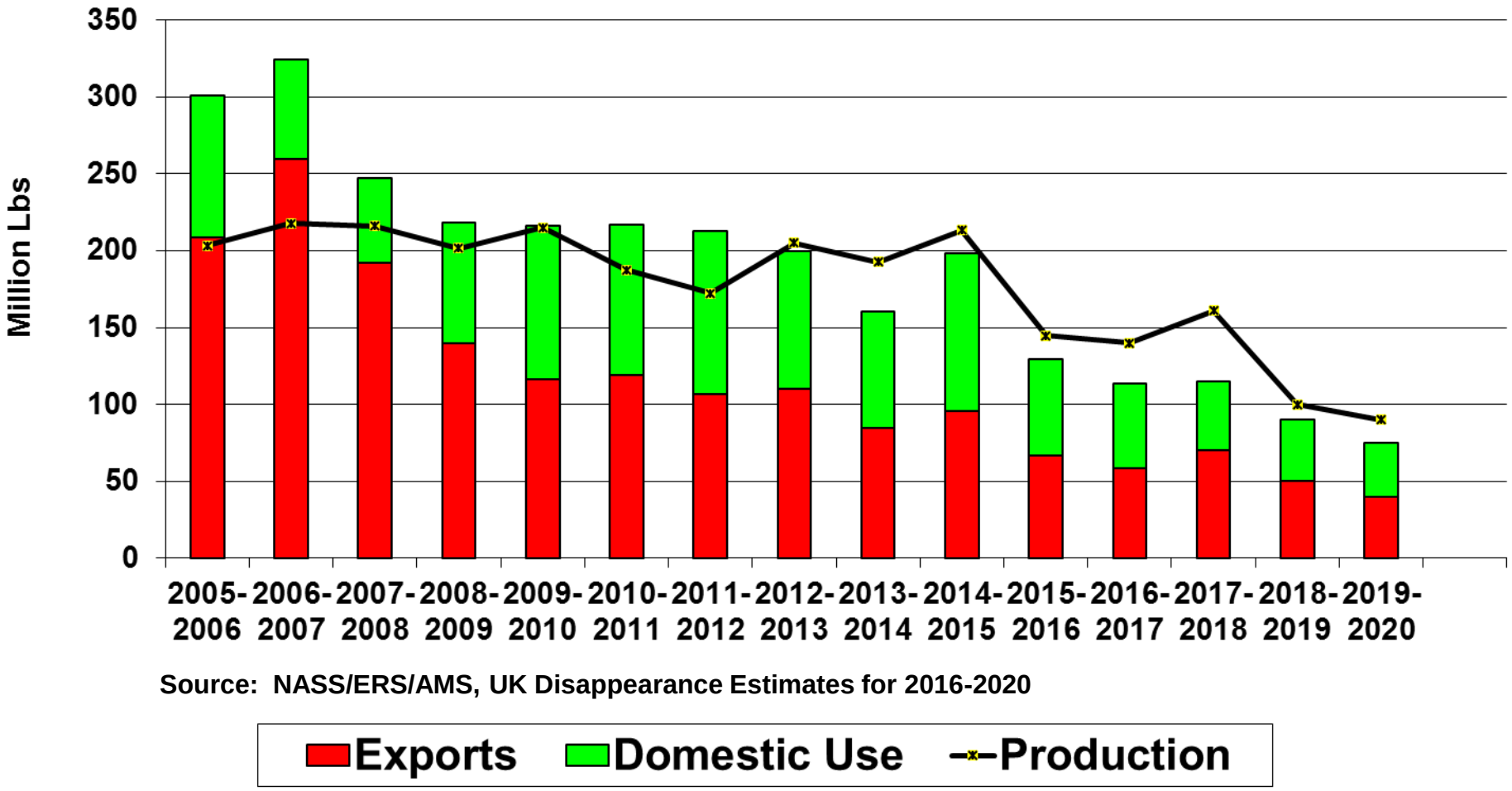
Over the past decade, U.S. burley imports relatively constant, while U.S. cigarette production has decline by more than 30%

Imports Now Account for 1/2 to 2/3 of Burley Use by U.S. Cigarette Mfgs



Source: TMA/US Customs Data

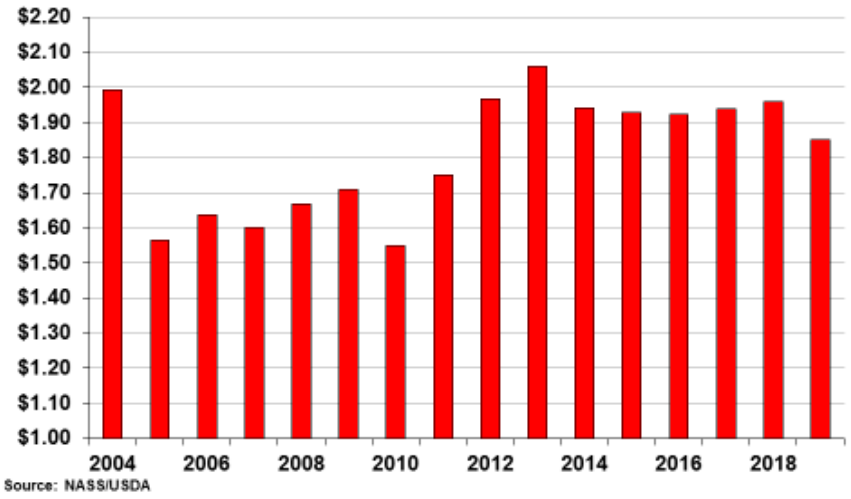
U.S. Burley Production vs Disappearance



Source: NASS/ERS/AMS, UK Disappearance Estimates for 2016-2020

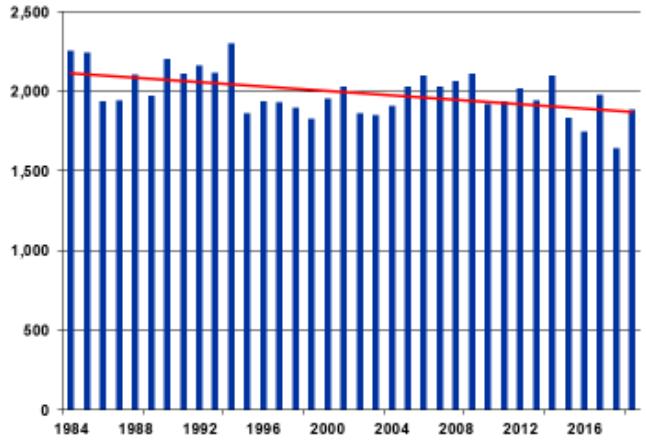
“Simple” Burley Grower Economics

U.S. Burley Prices

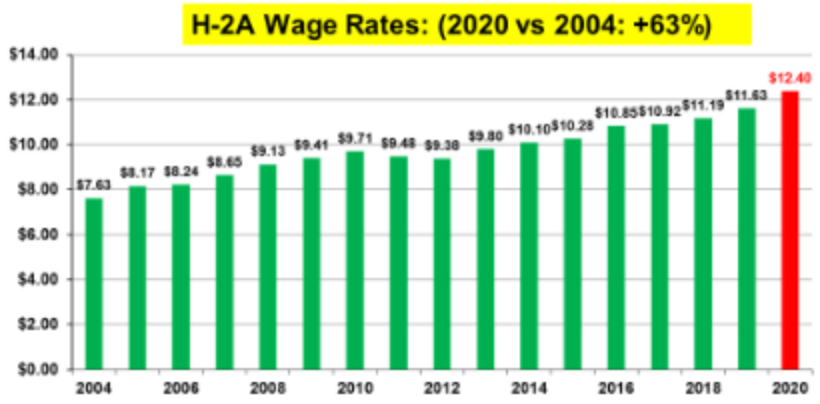


Source: NASS/USDA

U.S. Burley Yields



KY H-2A Wage Rates ($/hr)



Source: NASS/USDA

To Offset each 4-5% Increase in Wage Rates it takes Approx. 50 to 60 lb/Acre Gain in Yields

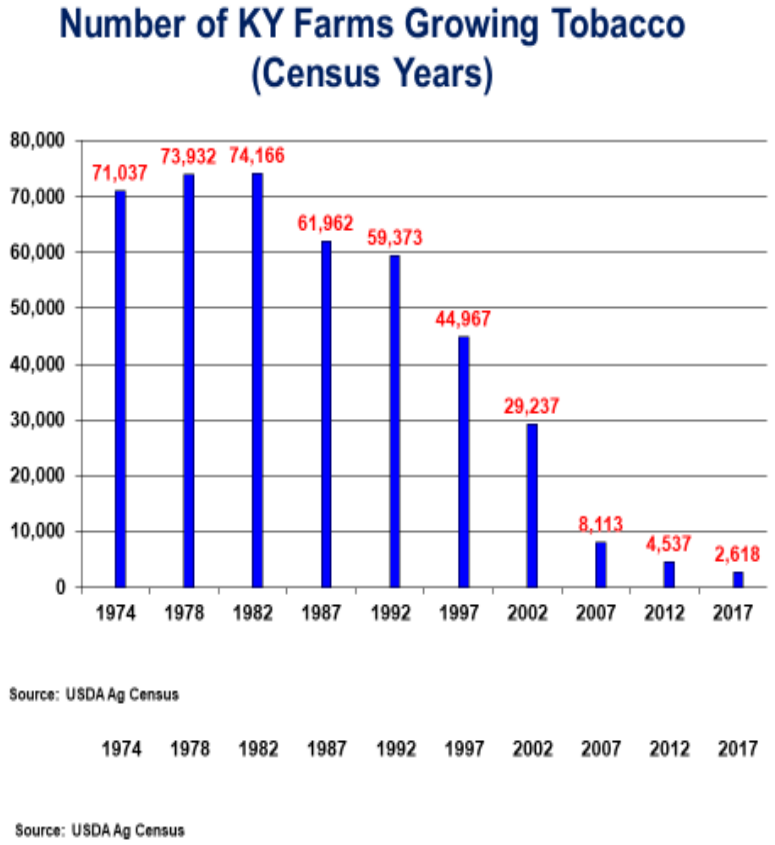
2020 Outlook

Lower U.S. Burley Leaf Needs

Could Individual Contract Volume Stabilize ??? due to:

- **2019 Contract Adjustment**
- **2019 Crop Size**
- **2020 Grower Exit due to Tight Margins, Labor, GAP**

…. Not likely in aggregate, but will vary from company to company



Appropriate Strategy Moving Forward for Survival ???

- **EDUCATE** ??? – through research and extension
  - Labor efficiency
  - Yield gains
  - Leaf requirements of companies and regulators

- **COMMUNICATE ???** – with company mgt, shareholders, policymakers
  - Improved margins
  - Reward grower for US GAP compliance
  - Grower price reflect the “value” of the U.S. grower

- **LEGISLATE ???**
  - Trade imbalances
  - Labor availability and cost

- **REGULATE ???**
  - Impact the share of U.S. leaf in tobacco products
  - Reduce health risks associated with our leaf

Farm Leadership: Tough choices, tough issues, difficult choices

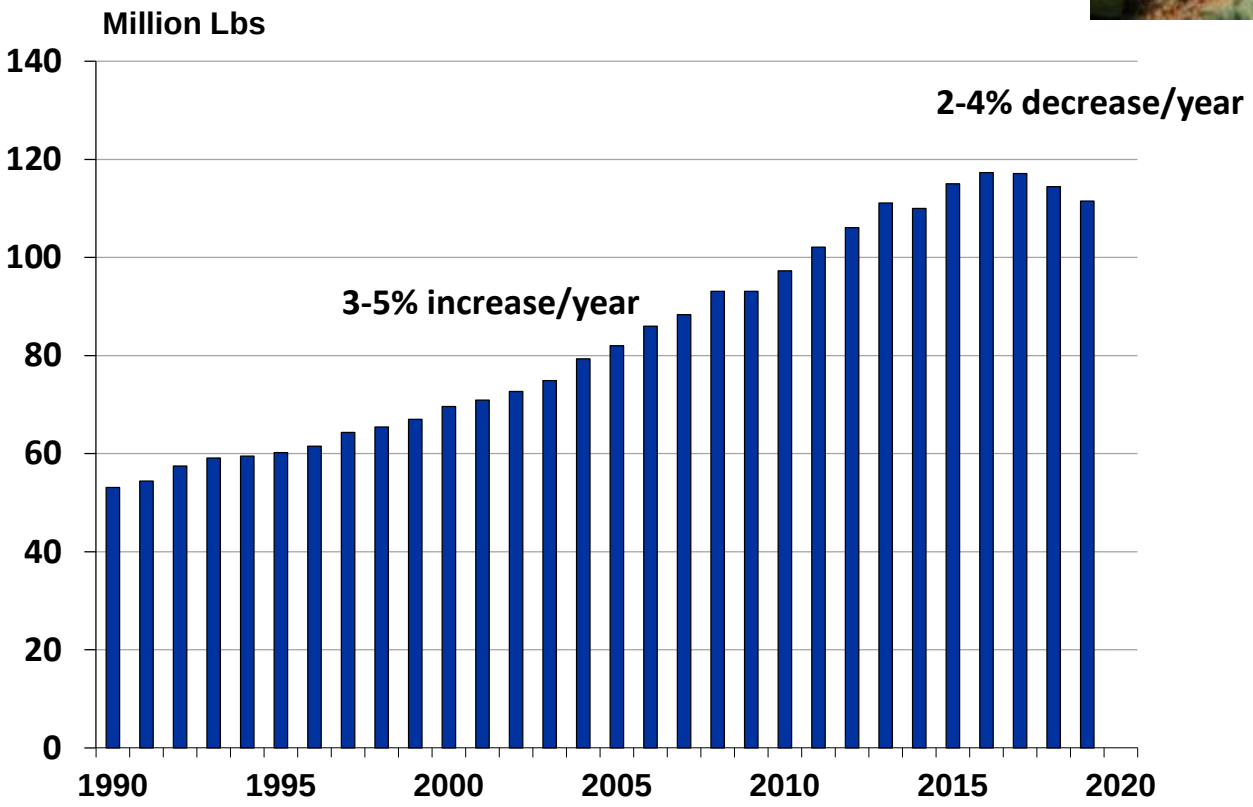
Industry/Market Will Provide Opportunities for Some (but not all) to Survive

2020 Dark Tobacco Economics

How has Dark Tobacco "Survived"

- **Grower Monopoly Power**
- **Growth in Product Demand**

U.S. Snuff Consumption Growth Has Reversed – Down Past Two Years

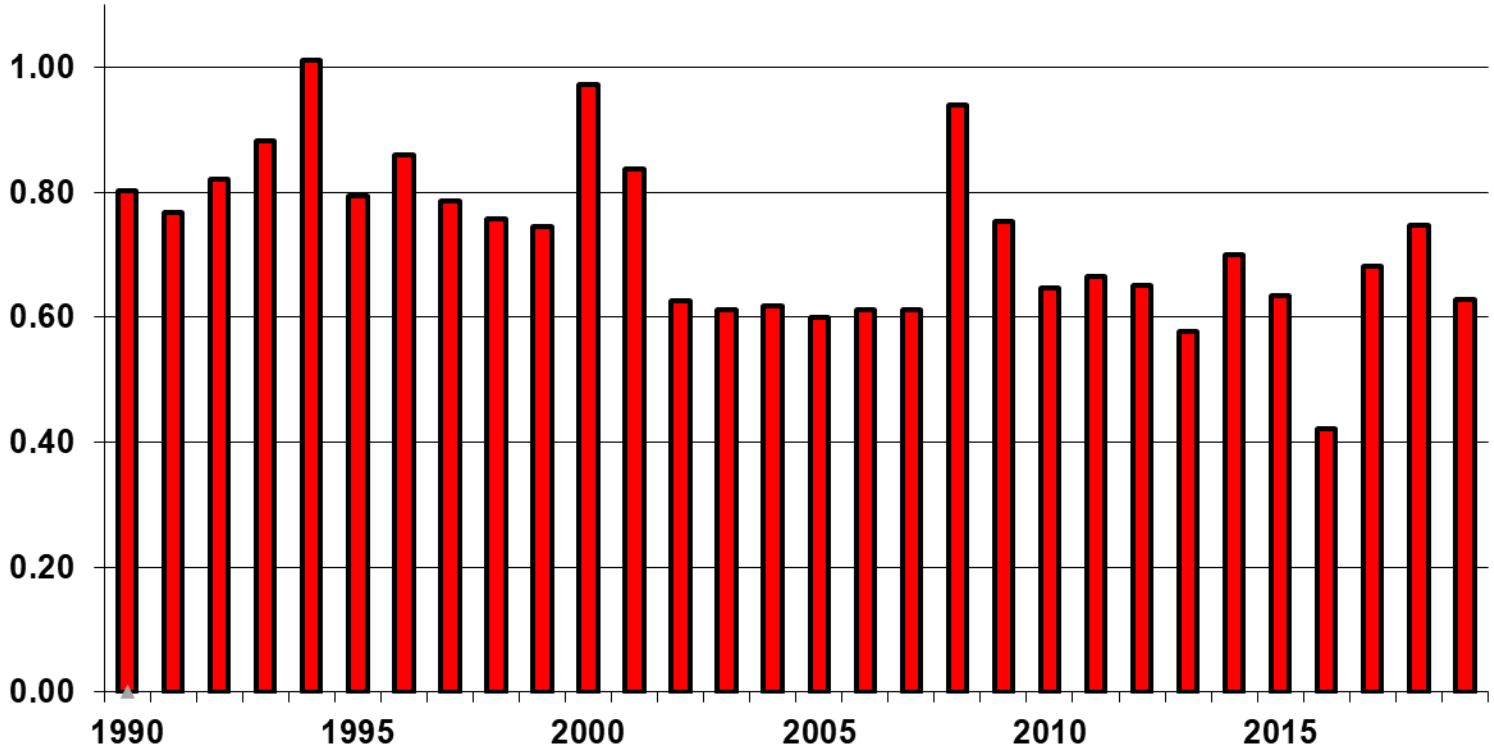


2004 - 2018
U.S. Dark Tobacco Production +74%

2019
U.S. Dark Tobacco Supply Adjustment -15 to - 20%

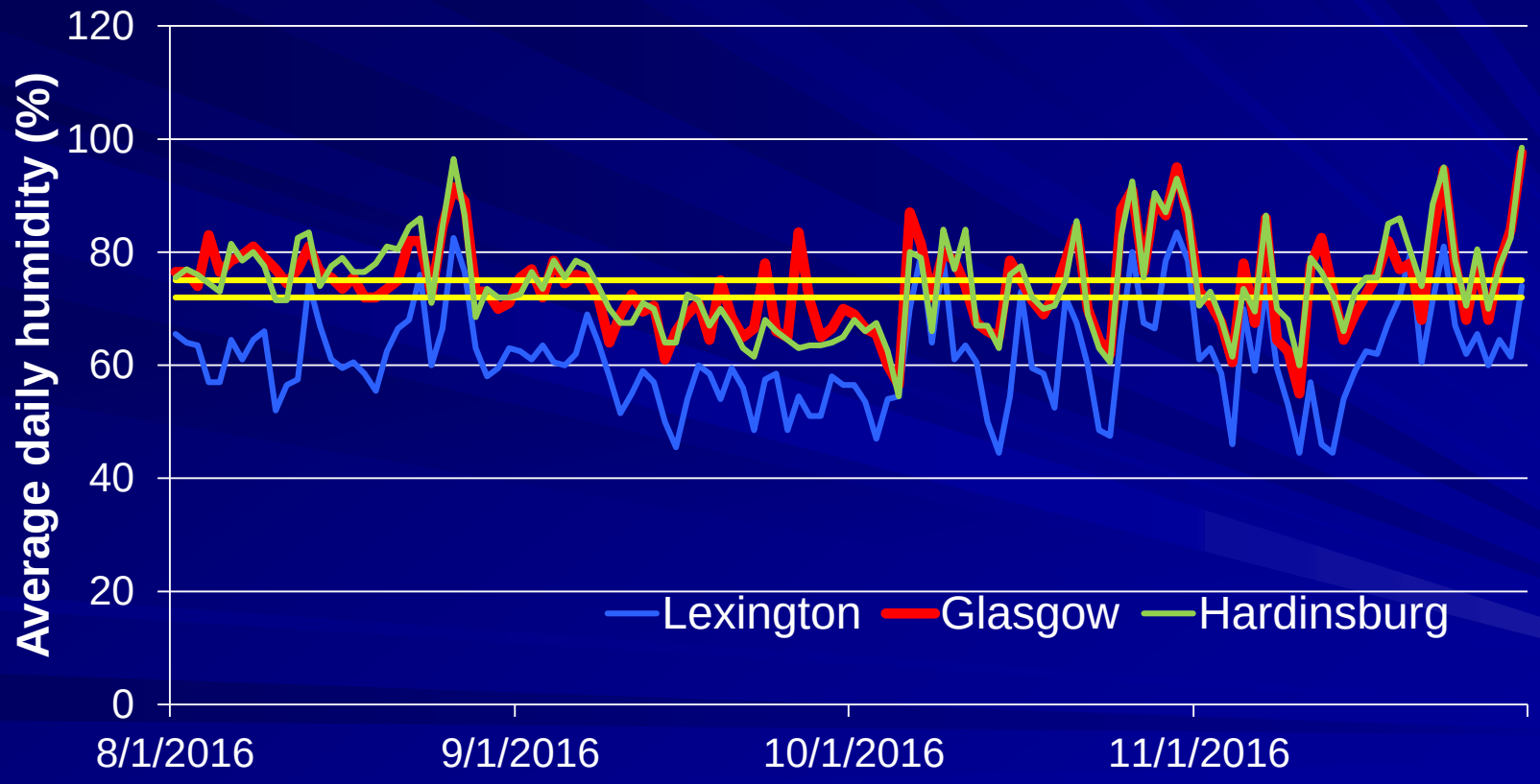
2020
45 to 48% cut from USST
No cut from ASC

Ratio of U.S. Dark Tobacco Production (lbs) vs Smokeless Tobacco Production

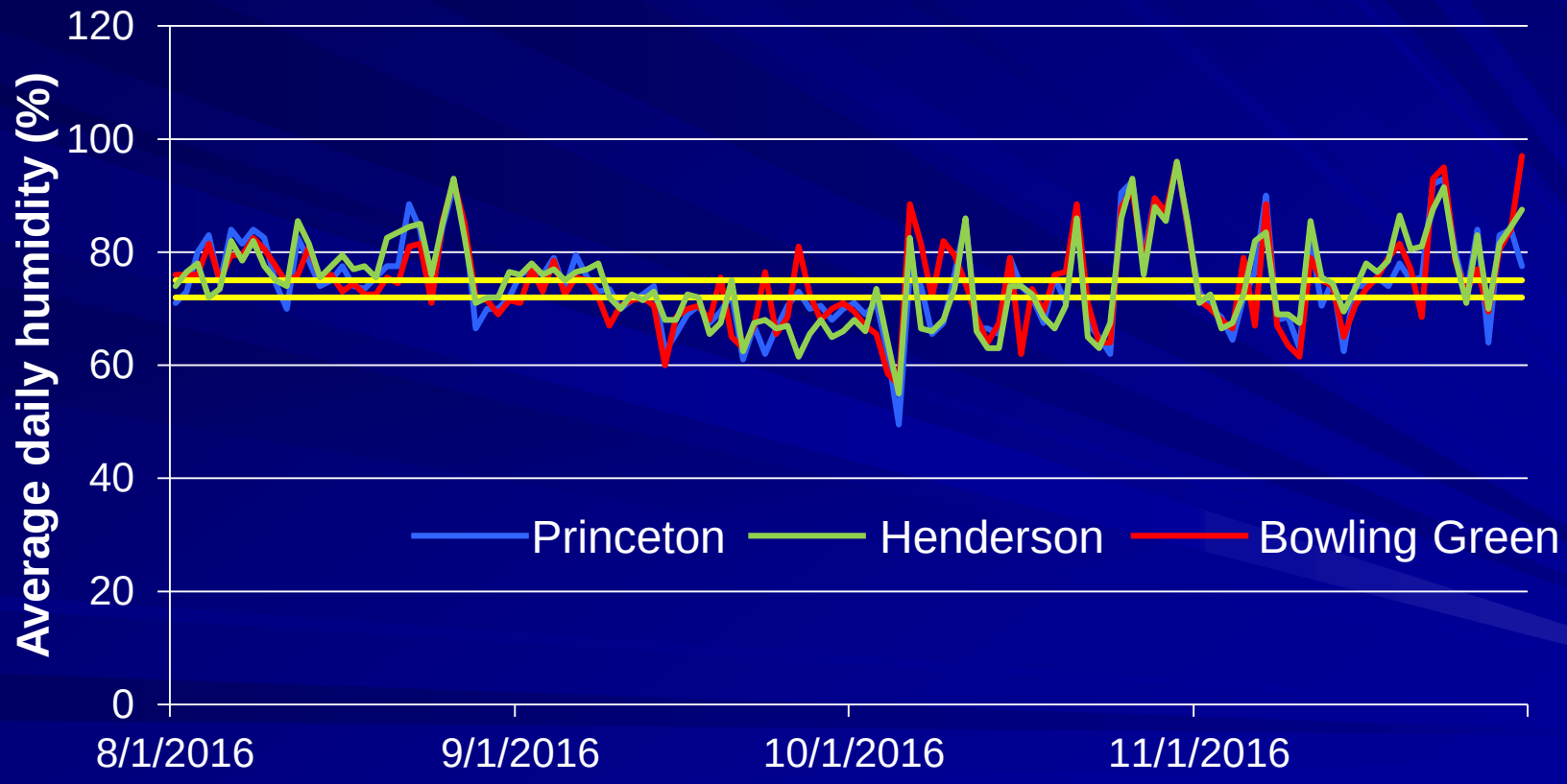


Air-Curing Principles
Connecticut Broadleaf Cigar Wrapper

Relative Humidity During Curing – Central KY
2019 Curing Season, Aug. 1 – Nov. 30



Relative Humidity During Curing – Western KY
2019 Curing Season, Aug. 1 – Nov. 30



Barn Management Considerations for Air-Curing

- Ideal curing conditions:
  - Mean daily temperature 60 to 90 F
  - Mean daily relative humidity 65 to 75%

- Best chance of getting these conditions is to harvest by September 15
- House burley 6- to 8-inches in barns and 4- to 5-inches in outdoor structures

Barn Management Considerations for Air-Curing: Dry Curing Seasons

- Managing barns in dry curing seasons (2019):
  - Conserve moisture in the barn by:
    - Opening barn at night when humidity is high
    - Closing barn during the day when humidity is low
    - May also help to wet floor and walls of barn in evening
    - Dry seasons generally better for outdoor curing structures

Barn Management Considerations for Air-Curing: Wet Curing Seasons

- Managing barns in wet curing seasons (2016):
  - Promote drying in the barn by:
    - Opening barn during the day
    - Closing the barn at night
    - Can add heat to lower humidity in other tobacco types (not burley)
    - Wet seasons generally better for barns

Connecticut Broadleaf Cigar Wrapper

- Air-cured cigar wrapper type
- High demand by leaf dealers
- >1500 acres grown in KY/TN in 2019.
- Much more expected in 2020
  - USST cuts dark volume 45-48%

Connecticut Broadleaf

- CT Broadleaf could be good opportunity for KY/TN growers that have seen declining contract volume.
- Dark tobacco growers accustomed to management for high leaf quality standards.
- KY-TN dark tobacco production area has history of cigar wrapper production
  - Niche market (1-2% of total production)
  - Mostly fire-cured, some air-cured

Traditional Cigar Wrapper Production Area in KY/TN

- Mostly in TN: Robertson, Montgomery, Cheatham Co.
- Logan, Simpson, Todd Co. KY

CT Broadleaf Production Timeline

- Short-season crop
  - Fast growing in greenhouse and field
  - Early harvest before leaf deterioration begins

- Transplants ready in 7 weeks (8 weeks for burley/dark)
- 7 weeks from transplanting to topping (9 wks for burley/dark)
- Harvest at 2 to 3 weeks after topping (4-6 wks for burley/dark)

- 9 to 10 week field season (14-16 weeks for dark-fired)

- Harvest complete before burley or dark harvest begins

- Average yield for CT Broadleaf: 2,000 lbs/A
  - 2,500 lbs/A for burley; 3,000 lbs/A for dark air; 3,500 lbs/A for dark fired

CT Broadleaf Pricing

High Risk but High Reward

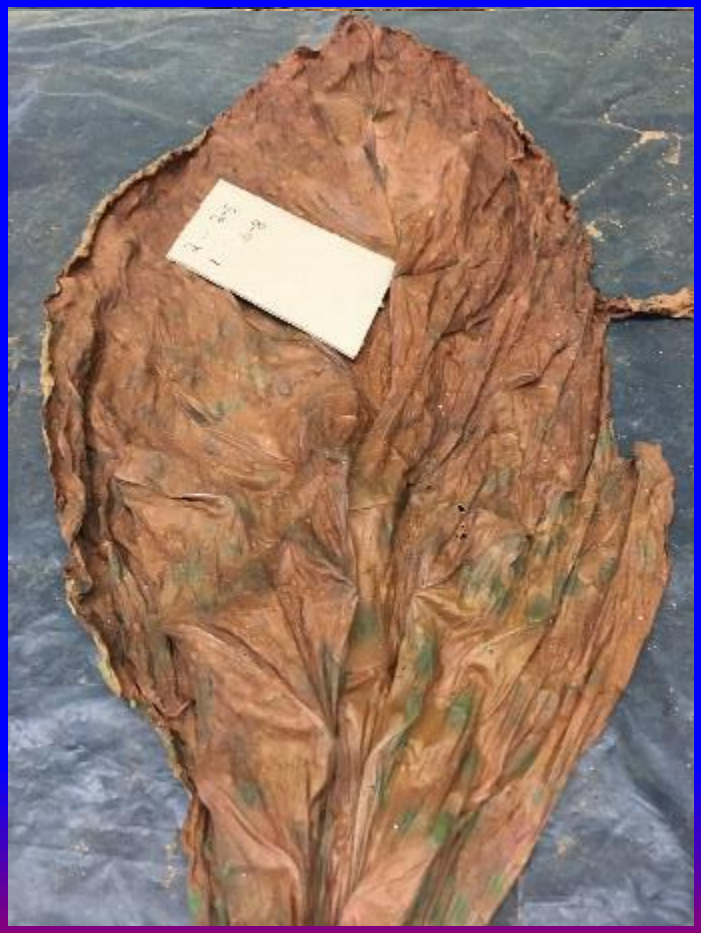
Grade	Price Range ($/lb)
Wrapper (#1)	$5.80 - $6.25/lb
Binder (#2 wrapper)	$3.80 - $4.65/lb
Filler	$1.50 - $1.75/lb
Trash	$0.50 - $0.60/lb

CT Broadleaf Grading/Sorting

- Wrapper grade depends on how many ‘cuts’ can be made in a leaf
- ‘Cut’ is 3” to 5” area
  - Uniform brown color
  - No flaws (white or green spots, holes)
  - Leaf at least 9” wide

- #1 Wrapper: 6 to 8 cuts
- #2 Wrapper (binder): 2 to 5 cuts
- Filler: Solid leaf but 0-1 cut
- Trash: Excessive ground injury

- Profitability depends on %wrapper
  - 50%+ wrapper



2019 CT Broadleaf Research Projects

- Nitrogen rate trial
- Variety Trial
- Fungicide Trial

2019 CT Broadleaf Nitrogen Rate Trial

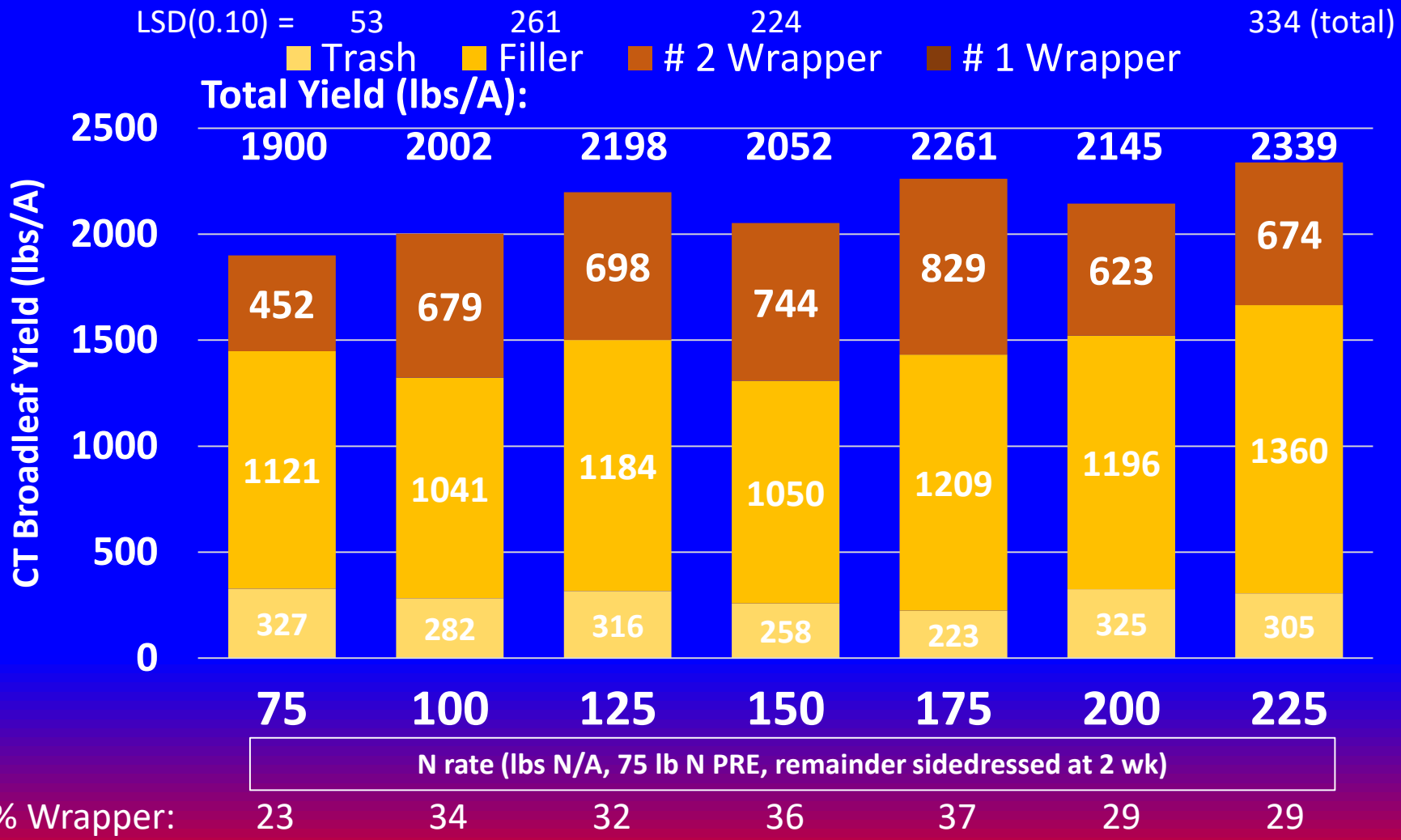
- Crider silt loam, pH 5.9
- 1 ton/A lime, 70 lbs P_2O_5/A, 150 lbs K_2O/A
- RCBD with 4 replications of nitrogen rate treatments
- ‘C33’ variety used

- 7 nitrogen rates: ammonium nitrate
  - 75 lbs N/A (broadcast PREtransplant)
  - 100 lbs N/A (75 PRE + 25 sidedress at 2 wks)
  - 125 lbs N/A (75 PRE + 50 SD)
  - 150 lbs N/A (75 PRE + 75 SD)
  - 175 lbs N/A (75 PRE + 100 SD)
  - 200 lbs N/A (75 PRE + 125 SD)
  - 225 lbs N/A (75 PRE + 150 SD)

2019 Connecticut Broadleaf Nitrogen Rate Trial

UKREC, Princeton KY

Variety: C33
Transplanted May 28
Harvested 3 wk after topping



LSD(0.10) for % wrapper = 9

Mean total yield for trial = 2148 lbs/A; mean % wrapper = 32%

CT Broadleaf Variety Trial

CT Broadleaf Variety	Disease resistance
A1	Fusarium wilt, TMV
B1	Fusarium wilt, TMV
B2	Fusarium wilt, TMV, black root rot, blue mold male sterile hybrid
D1	Fusarium wilt, TMV, black root rot
D2	Fusarium wilt, TMV, black root rot, cyst nematode
C33	No disease resistance open-pollinated industry standard

- No black shank resistance in any CT Broadleaf variety
  - Must put in clean field and use fungicides in KY/TN
- Variety trial was RCBD with 4 replications of treatments
  - 2-row plots, 35 ft. long

2019 CT Broadleaf Variety Trial – Pre-Harvest

No disease resistance

Fusarium wilt, TMV

Fusarium wilt, TMV

Fusarium wilt, TMV, black root rot, blue mold
Male Sterile Hybrid

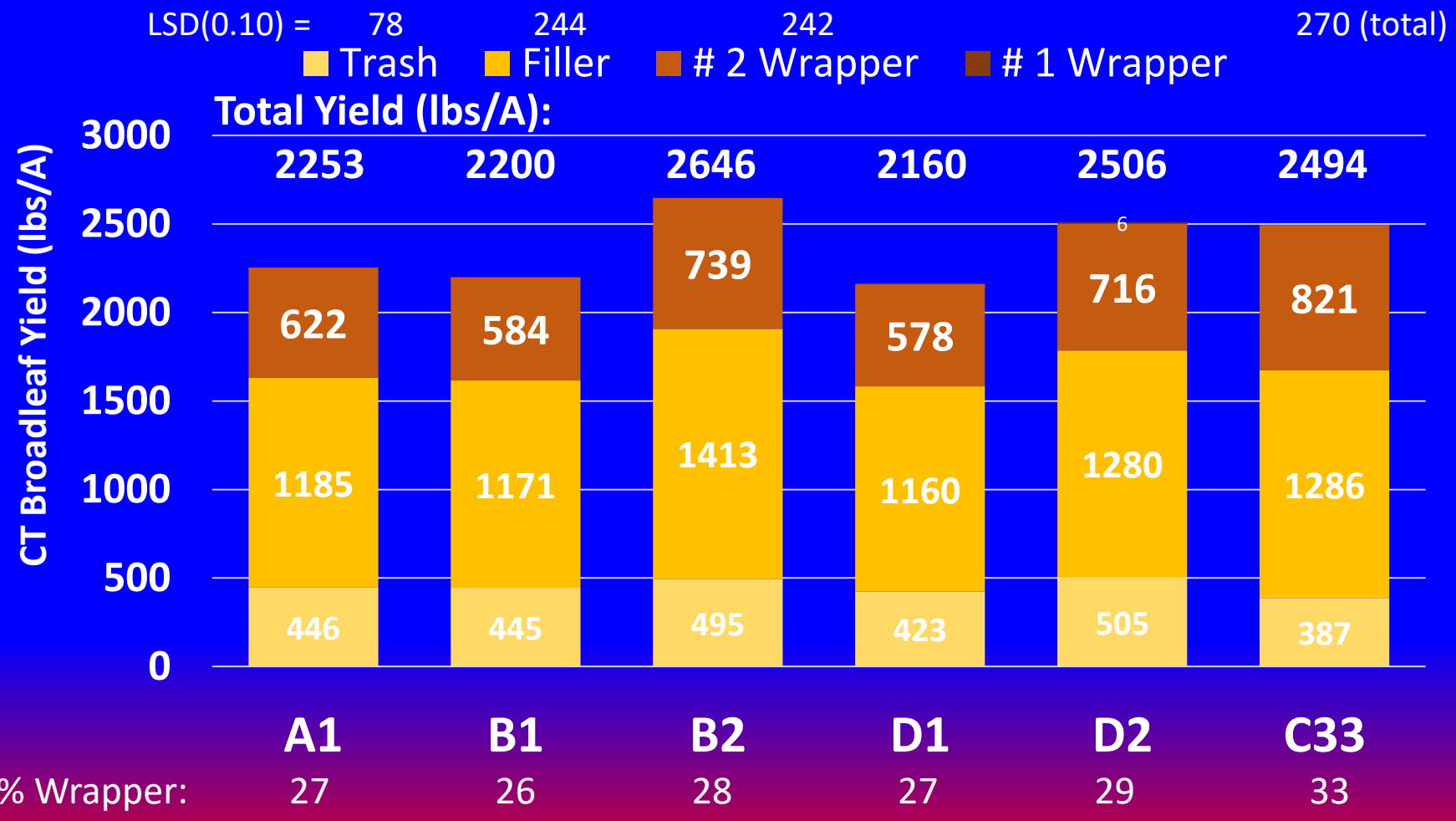
Fusarium wilt, TMV, black root rot

Fusarium wilt, TMV, black root rot, cyst nematode

2019 Connecticut Broadleaf Variety Evaluation

UKREC, Princeton KY

N: 175 lbs N/A (75 PRE; 100 Sidedress)
Transplanted May 28
Harvested 3 wk after topping

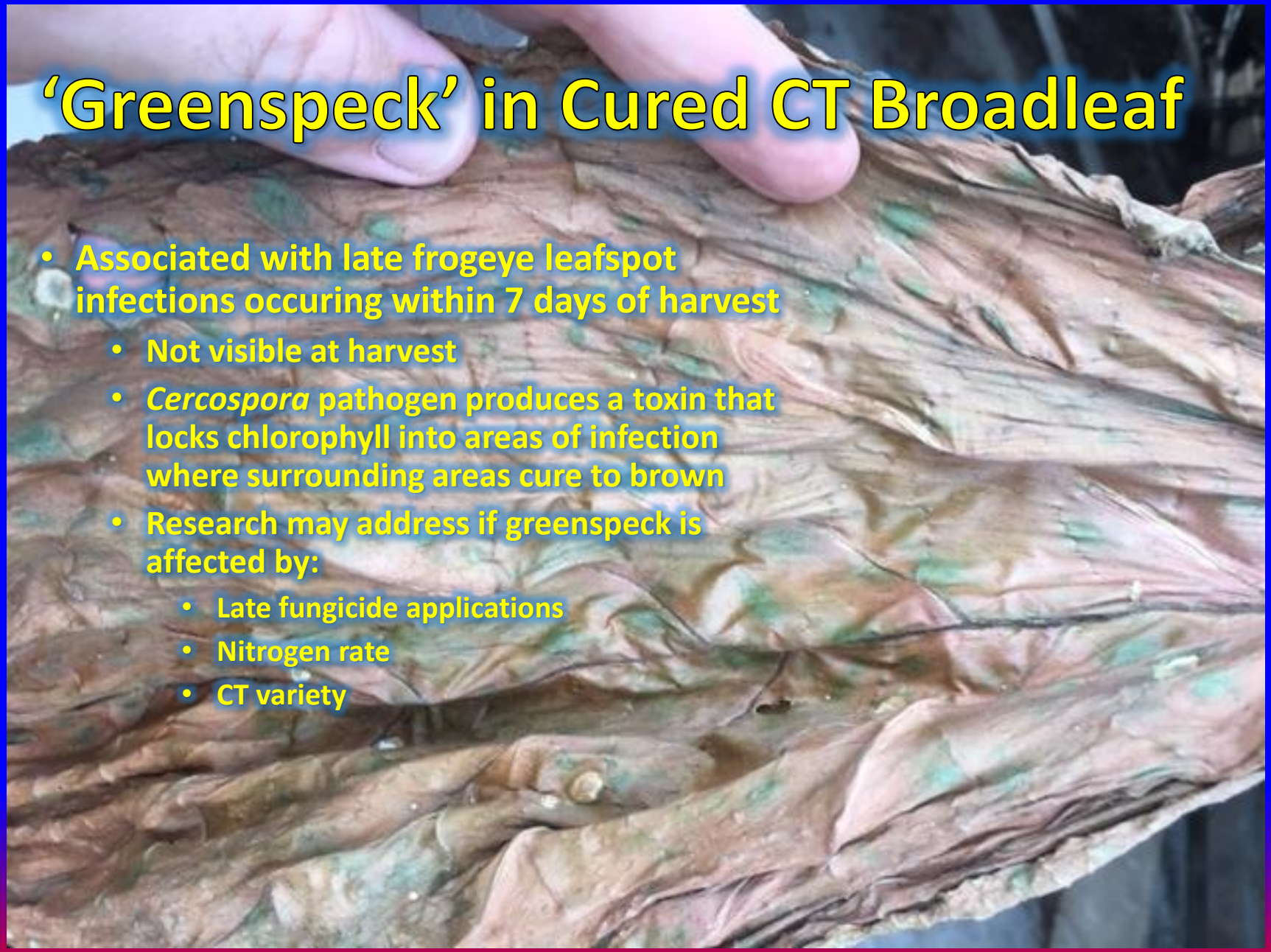


% Wrapper: 27 26 28 27 29 33

LSD(0.10) for % wrapper = 9.7

Mean total yield for trial = 2376 lbs/A; mean % wrapper = 28%

‘Greenspeck’ in Cured CT Broadleaf



- Associated with late frogeye leafspot infections occuring within 7 days of harvest
  - Not visible at harvest
  - *Cercospora* pathogen produces a toxin that locks chlorophyll into areas of infection where surrounding areas cure to brown
  - Research may address if greenspeck is affected by:
    - Late fungicide applications
    - Nitrogen rate
    - CT variety

2019 CT Broadleaf Fungicide Trial

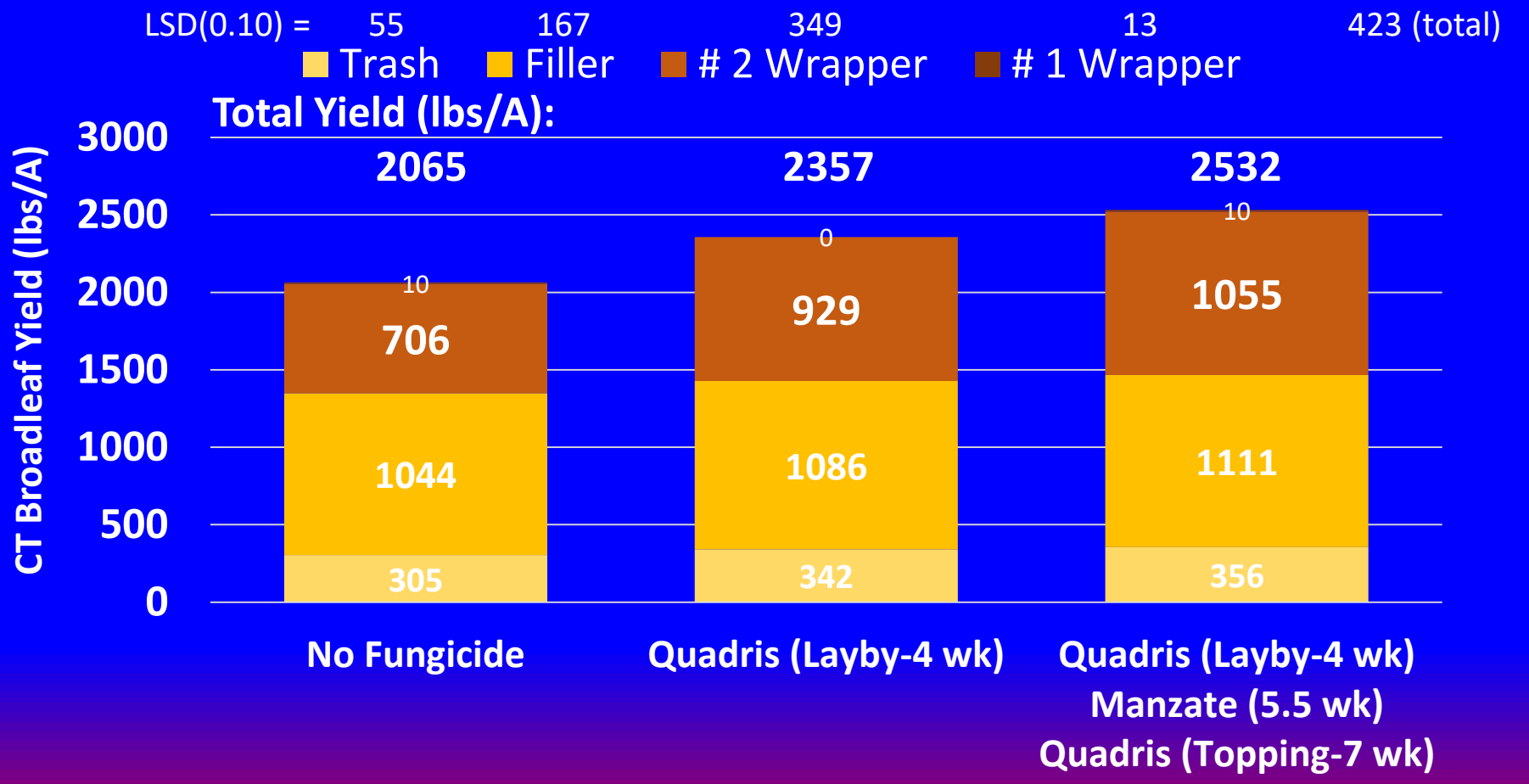
Trt	Treatment	Rate/Acre	Timing	Spray Volume
1	No Fungicide	-	-	-
2	Quadris	8 oz/A	Layby (4 wks)	15 gal/A
3	Quadris Manzate Quadris	8 oz/A 2 lb/A 8 oz/A	Layby (4 wks) 5.5 wks 7 wks (topping – 21 d PHI)	15 gal/A 40 gal/A 44 gal/A

- Variety: C33
- RCBD with 5 replications of treatments
- Hollow cone nozzles

2019 Connecticut Broadleaf Fungicide Trial

UKREC, Princeton KY

Variety: C33
N: 175 lbs N/A (75 PRE; 100 Sidedress)
Transplanted May 28
Harvested 3 wk after topping



% Wrapper: 33 39 42

LSD(0.10) for % wrapper = 10.2

Mean total yield for trial = 2318 lbs/A; mean % wrapper = 38%

CT Broadleaf C33 at 30 days after housing

Optimum Curing Conditions for CT Broadleaf?

- Ideal curing conditions for burley and dark air-cured:
  - 60 to 90 F average daily air temperature
  - 65 to 75% average daily relative humidity

- Curing conditions at Princeton barn in 2019
  - 45 days: early August to late September
  - Mean temperature = 74.7 F
  - Mean relative humidity = 67.2%
    - Very dry conditions in late August and September
    - Watered floor and walls of barn down during critical periods

- Could curing conditions also be involved in greenspeck?
- Should average RH be <65% for CT Broadleaf?

Tobacco Disease Control

Potassium Sources and TSNA

Potassium Source Restriction for KY

- Any potassium source can be used in Fall
  - 0-0-50 or 0-0-60

- After January 1, no more than 100 lbs 0-0-60/acre can be used, with remainder as 0-0-50
  - Concerns over leaf quality, combustibility, and high moisture from Cl in 0-0-60.

Potassium Source Research
Andrea Keeney M.S. Research – 2016-2018

- Potassium sulfate (0-0-50) vs. Potassium chloride (0-0-60)
- 0, 100, 200, or 300 lbs K_2O/A from each source
- Applications made within 7 days of transplanting
- Dark fire-cured, dark air-cured, and burley
- Princeton, Murray, Lexington on low K sites (<
- Yield, quality grade index, % Cl, % moisture, TSNA

Potassium Source Research
Andrea Keeney M.S. Research – 2016-2018

- Response to potash (either K source vs. check) in 5 of 12 trials.
- Only saw higher leaf moisture from KCl in 1 of 12 trials
  - Samples were pre air-dried (5-8% moisture)
  - Still looking at commercial big bale moisture further
- Cl levels were >1% where KCl was applied, but noa adverse effects on quality grade index.
  - Lower rates of KCl actually increases grade index in 3 of 12 trials

- **28% REDUCTION IN TSNA WHERE KCL WAS USED**

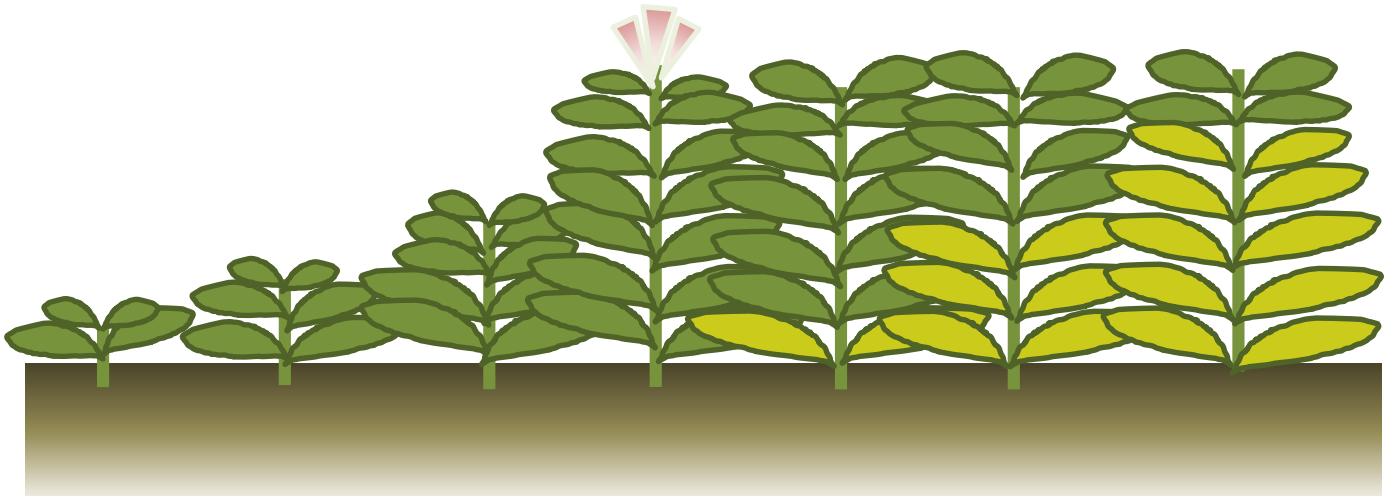
2020 Potassium Recommendation

- Use maximum allowable amount of 0-0-60 in potassium fertilizer blend
  - 100 lbs 0-0-60/acre (60 lbs K_2O, 50 lbs Cl)
  - Remainder of K requirement as 0-0-50

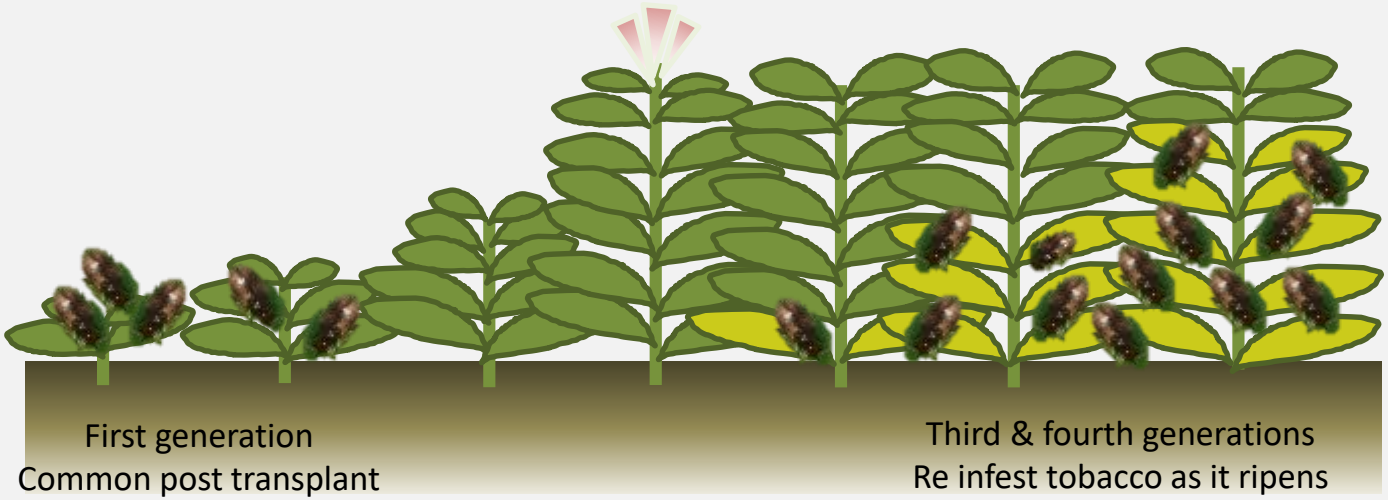
  - Saves about $30/acre on 200 lb K_2O/acre potash.
  - Shouldn't be any concern over quality or moisture
  - ***Still expect a 27% reduction in TSNA***

Flea Beetles

Flea beetle activity in tobacco



Flea beetle activity in tobacco

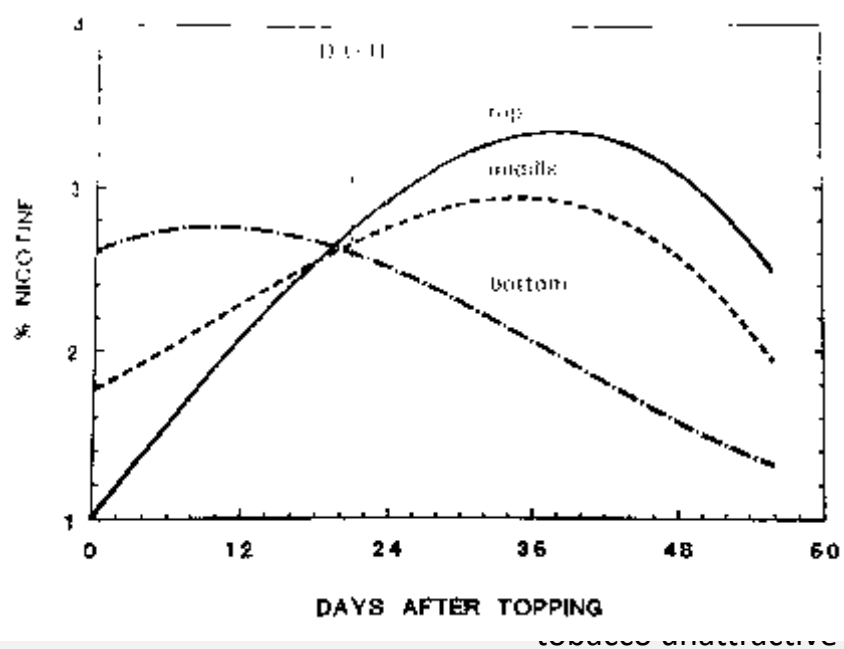


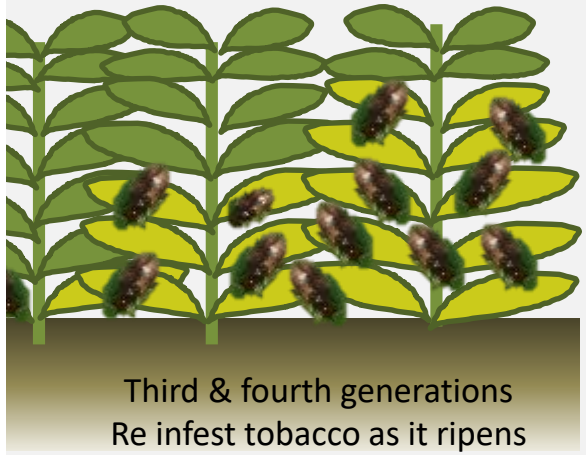
First generation
Common post transplant

Second generation
Non crop hosts,
tobacco unattractive

Third & fourth generations
Re infest tobacco as it ripens

Flea beetle activity in tobacco



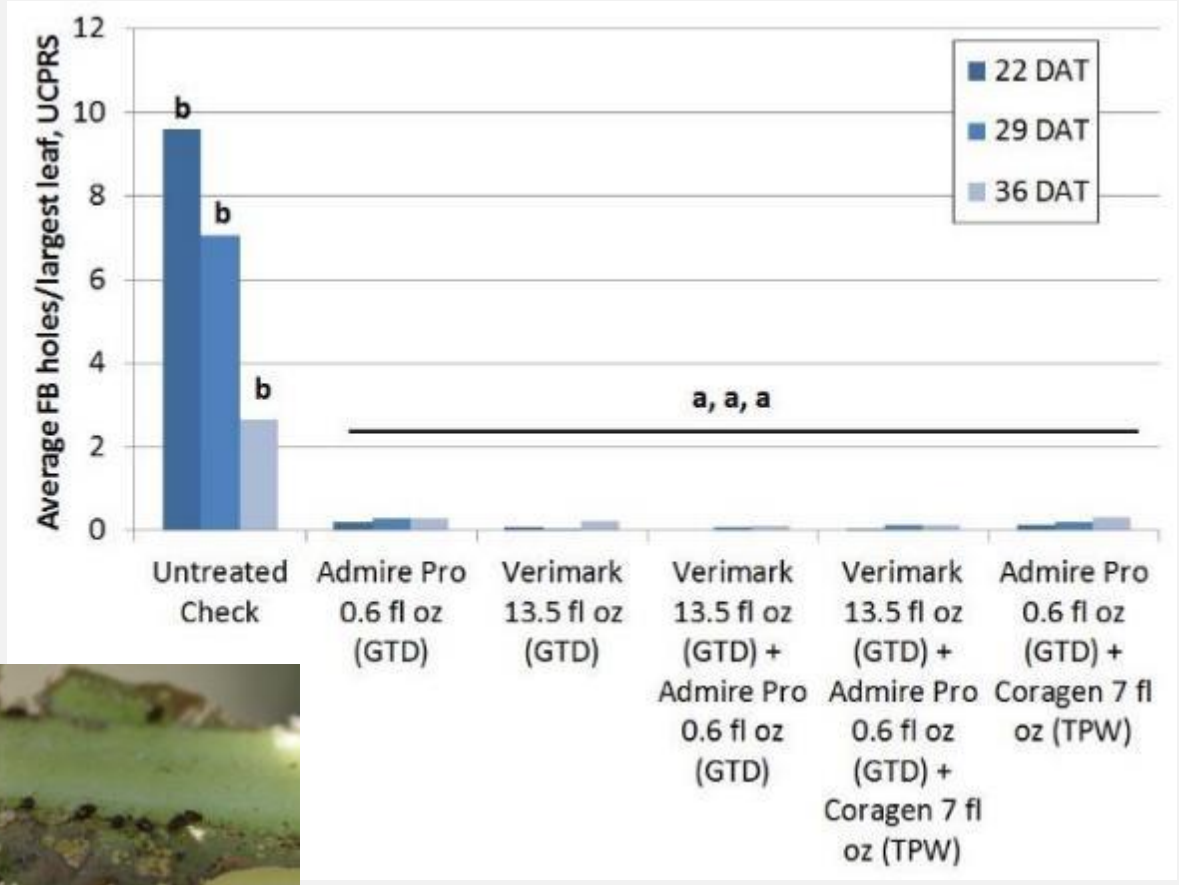


Third & fourth generations
Re infest tobacco as it ripens

Figure adapted from Davis & Nielsen. Tobacco: Production, Chemistry and Technology

Early season flea beetle control

Rocky Mount, 2014



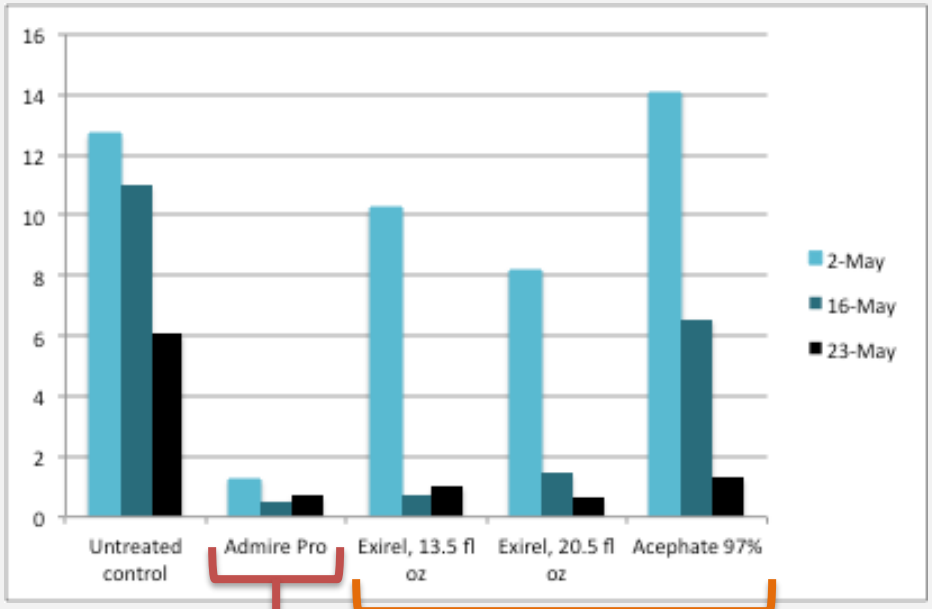
Imidacloprid & other 4A materials provide effective control

Verimark provides similar, but not additive flea beetle control

Foliar flea beetle treatments

Rocky Mount, 2019

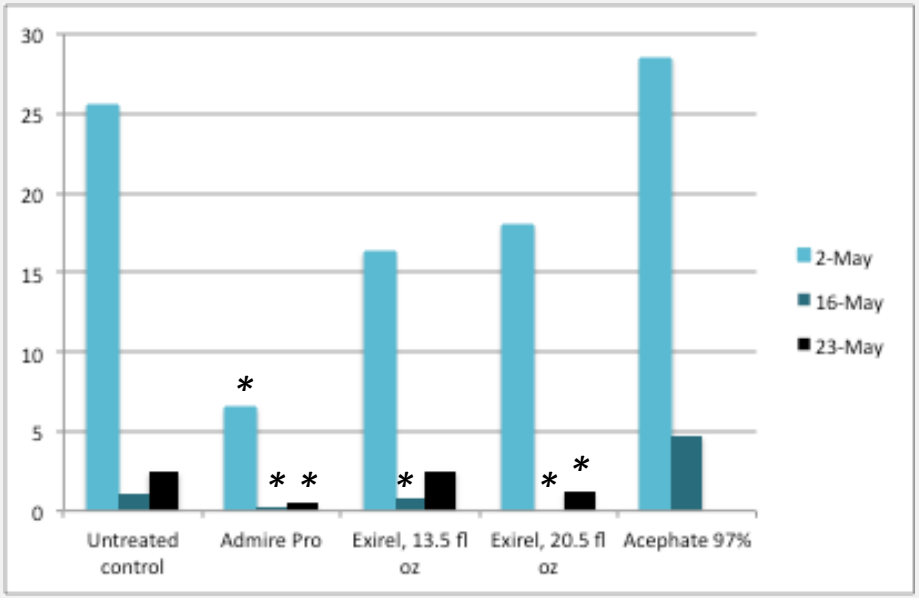
Flea beetles on plants



GTD Standard

Foliar treatments applied 2 May

Flea beetle holes

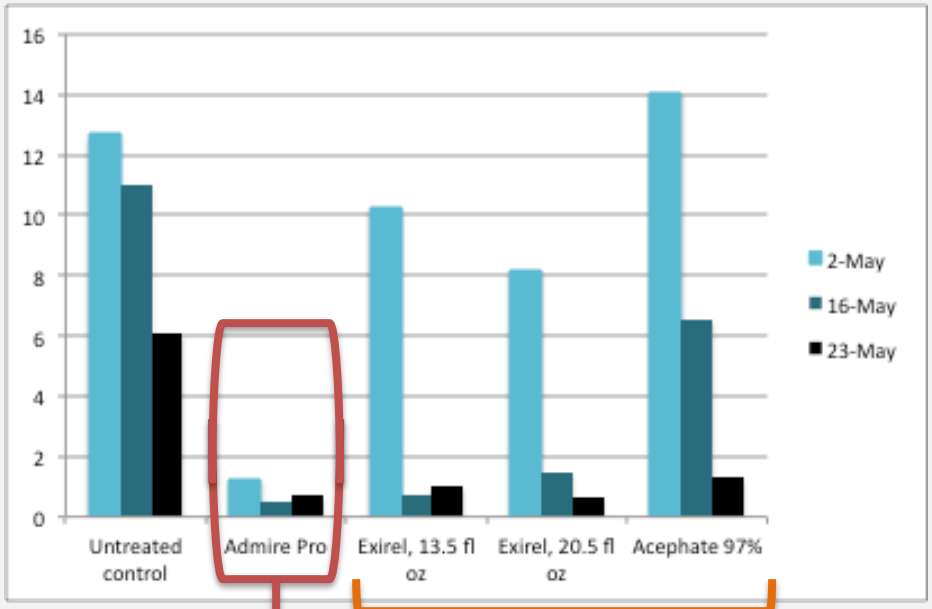


- *Exirel contains the same AI as Verimark (cyantraniliprole)*
- *Foliar treatments of Exirel reduced FB damage for up to 2 weeks at 20.5 fl oz/acre*

No evidence of resistance to neonicotinoids

Rocky Mount, 2019

Flea beetles on plants



GTD Standard

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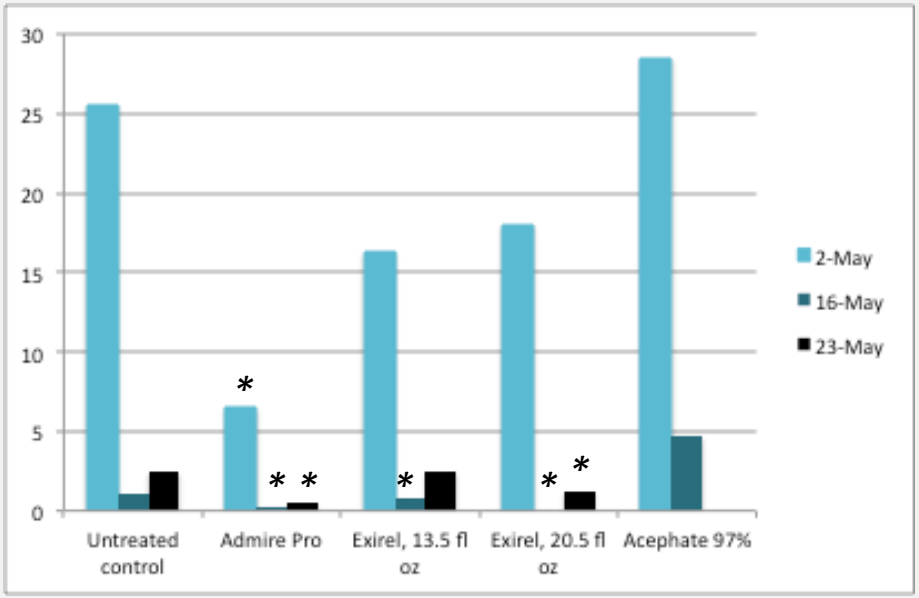


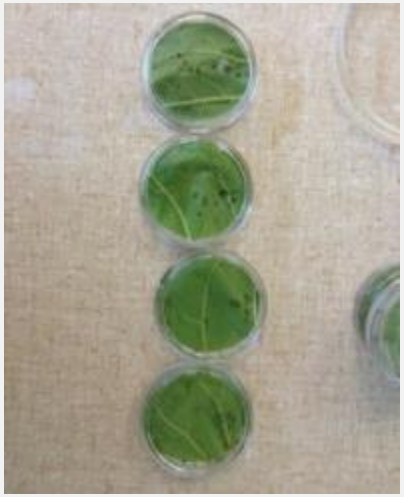
- *Exirel contains the same AI as Verimark (cyantraniliprole)*
- *Foliar treatments of Exirel reduced FB damage for up to 2 weeks at 20.5 fl oz/acre*

No evidence of resistance to neonicotinoids

Laboratory bioassays, 2011

Field collected beetles exposed to leaves dipped in field rate solutions, allowed to dry

Treatment	Live beetles, 24 hrs	Live beetles, 72 hrs
Actara (thiamethoxam), 3 oz	0.00 **a**	0.00 **a**
Assail (acetamiprid), 4 oz	0.83 **a**	0.17 **a**
Provado (imidacloprid), 4 fl oz	0.17 **a**	0.17 **a**
Orthene (acephate), 16 oz	6.00 **b**	1.33 **b**
UTC	9.33 **c**	7.83 **c**



Neonicotinoids effective as foliar treatments.
Orthene (acephate) less effective & associated with some residue concerns.
Coverage is key when managing flea beetles post topping.

2019 Flea Beetle Insecticide Trial

- UKREC, Princeton KY
- Dark tobacco – KT D17LC transplanted June 3
  - 40” rows, 32” plant spacing = 4900 plants/A
- No Admire Pro used to increase fleabeetle populations
- Plots 4-rows, 40 ft. long, RCBD with 4 replications
- Fleabeetle levels monitored weekly in plots

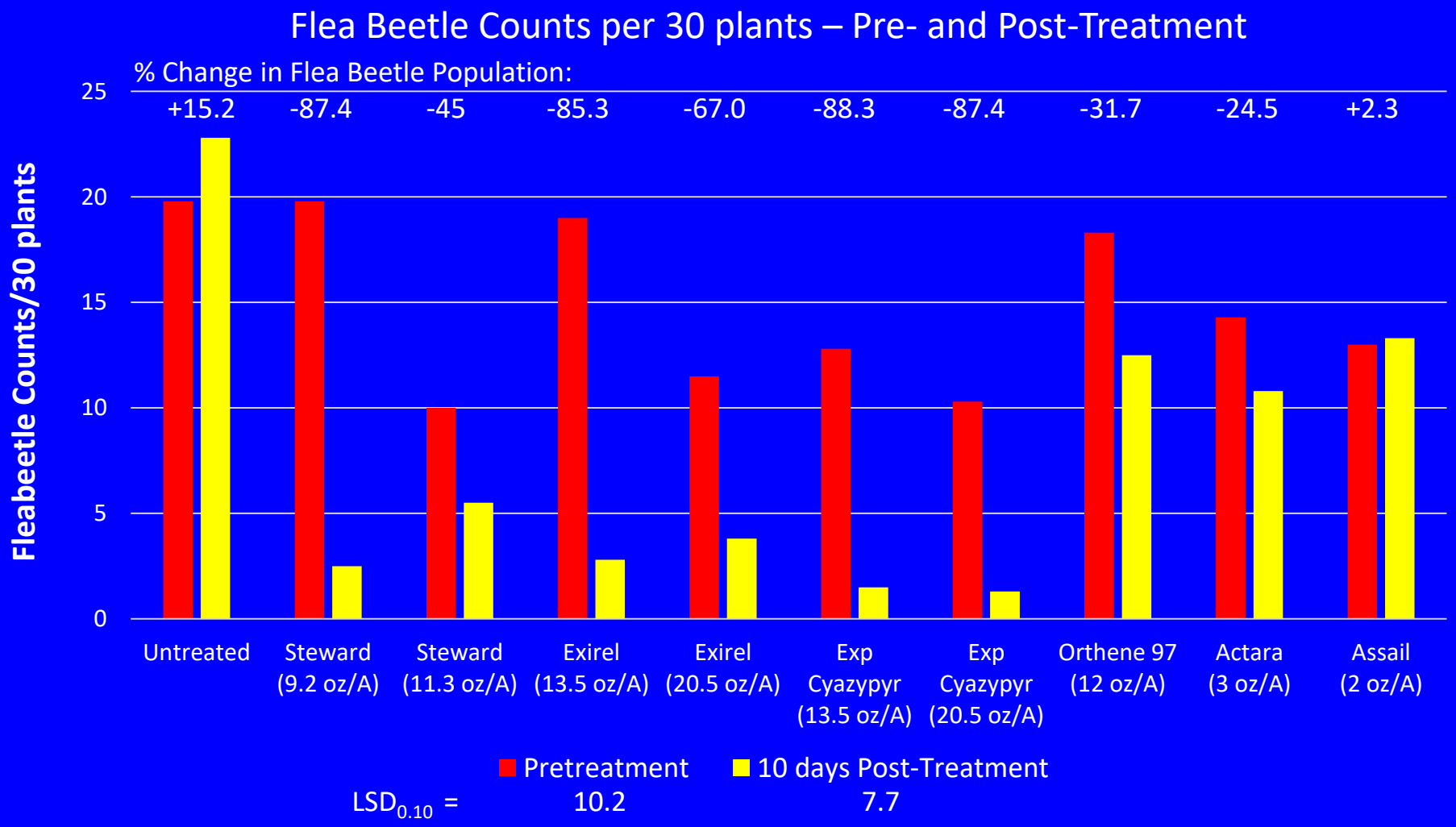
2019 Fleabeetle Treatments

Trt	Treatment	Rate/A	Timing
1	Untreated	-	-
2	Steward (indoxacarb)	9.2 oz/A	At threshold
3	Steward (indoxacarb)	11.3 oz/A	At threshold
4	Exirel (cyantraniliprole)	13.5 oz/A	At threshold
5	Exirel (cyantraniliprole)	20.5 oz/A	At threshold
6	HGW86-R050-957 (exp. cyan)	13.5 oz/A	At threshold
7	HGW86-R050-957 (exp. cyan)	20.5 oz/A	At threshold
8	Orthene 97 (acephate)	12 oz/A	At threshold
9	Actara (thiamethoxam)	3 oz/A	At threshold
10	Assail (acetamiprid)	2 oz/A	At threshold

*All applications made at threshold as broadcast spray at 15 gal/A and 22 psi using 12X hollow cone nozzles.

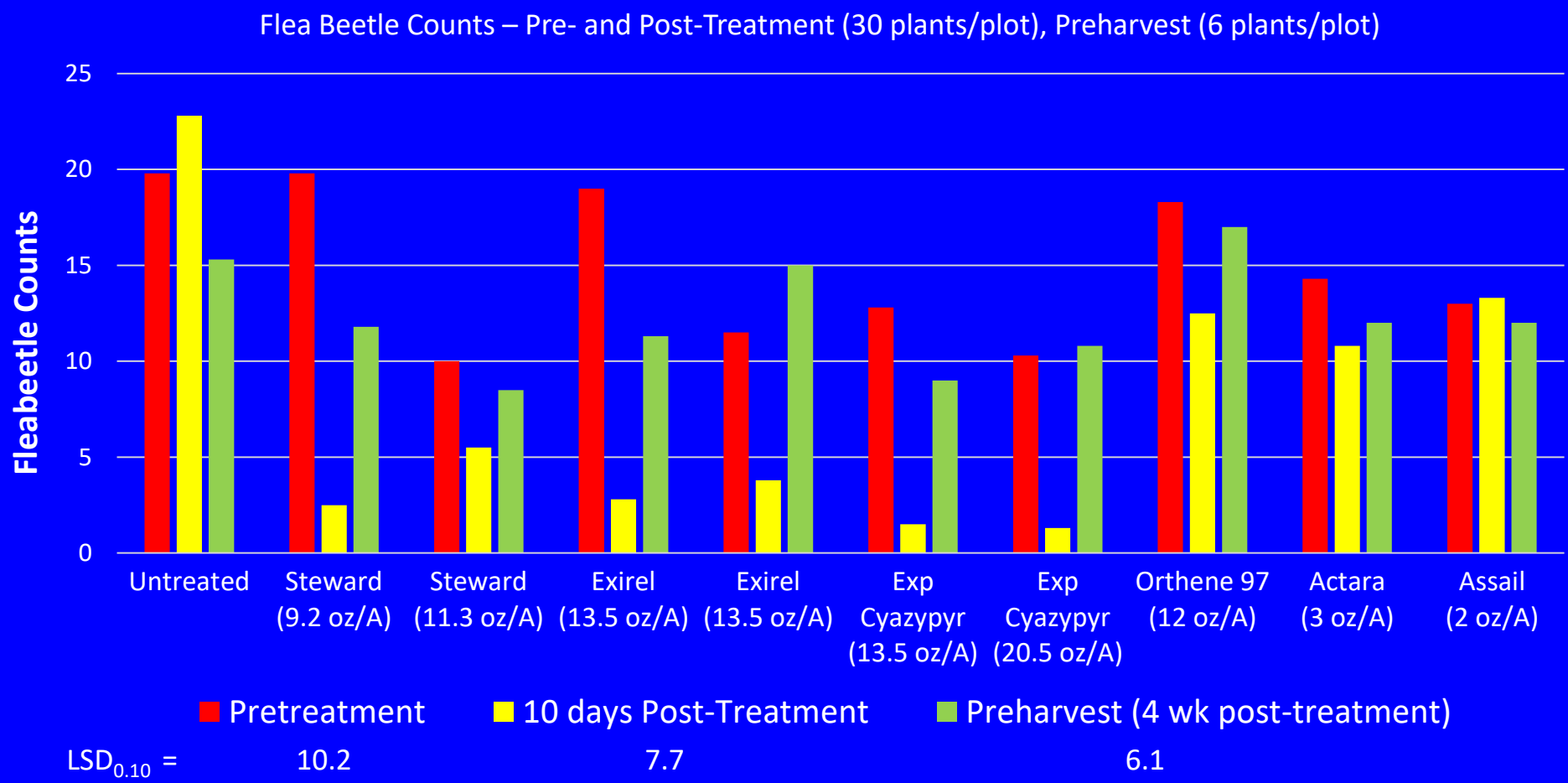
2019 Flea Beetle Insecticide Trial

UKREC, Princeton KY



2019 Flea Beetle Insecticide Trial

UKREC, Princeton KY



$LSD_{0.10}$ = 10.2 7.7 6.1

Tobacco flea beetle
Epitrix hirtipennis
(Coleoptera: Chrysomelidae)

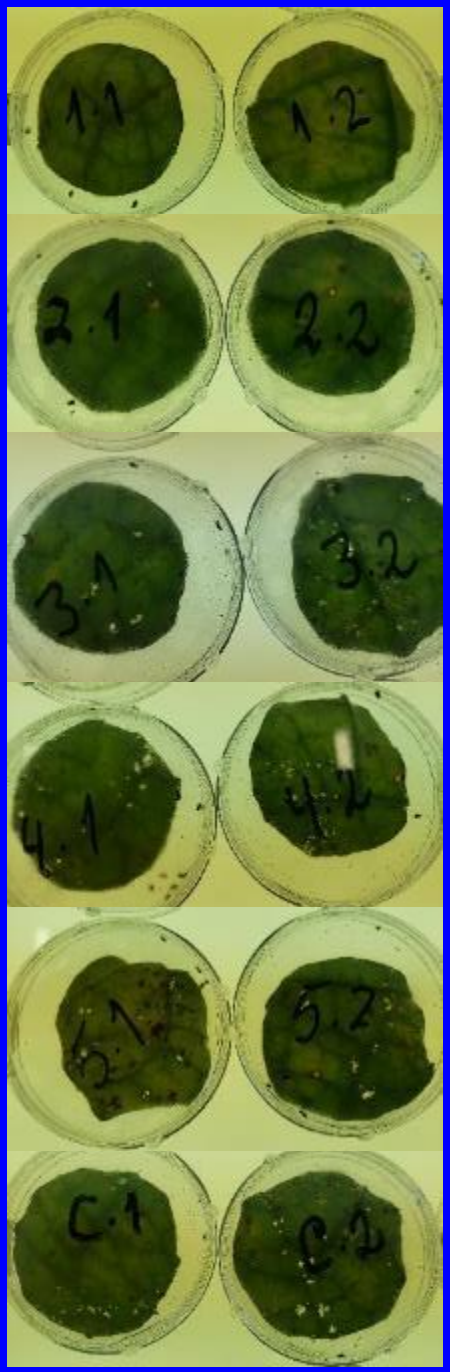
Imidacloprid solution

- The rate of Admire Pro represents a field rate of 1.0 fl oz/A.
- Solutions were prepared on aliquots that represent 5 different concentrations of imidacloprid as shown below:

ppm a.i. of imidacloprid
$5.73x10^{-1}$
$5.73x10^{-2}$
$5.73x10^{-3}$
$5.73x10^{-4}$
$5.73x10^{-5}$
Control

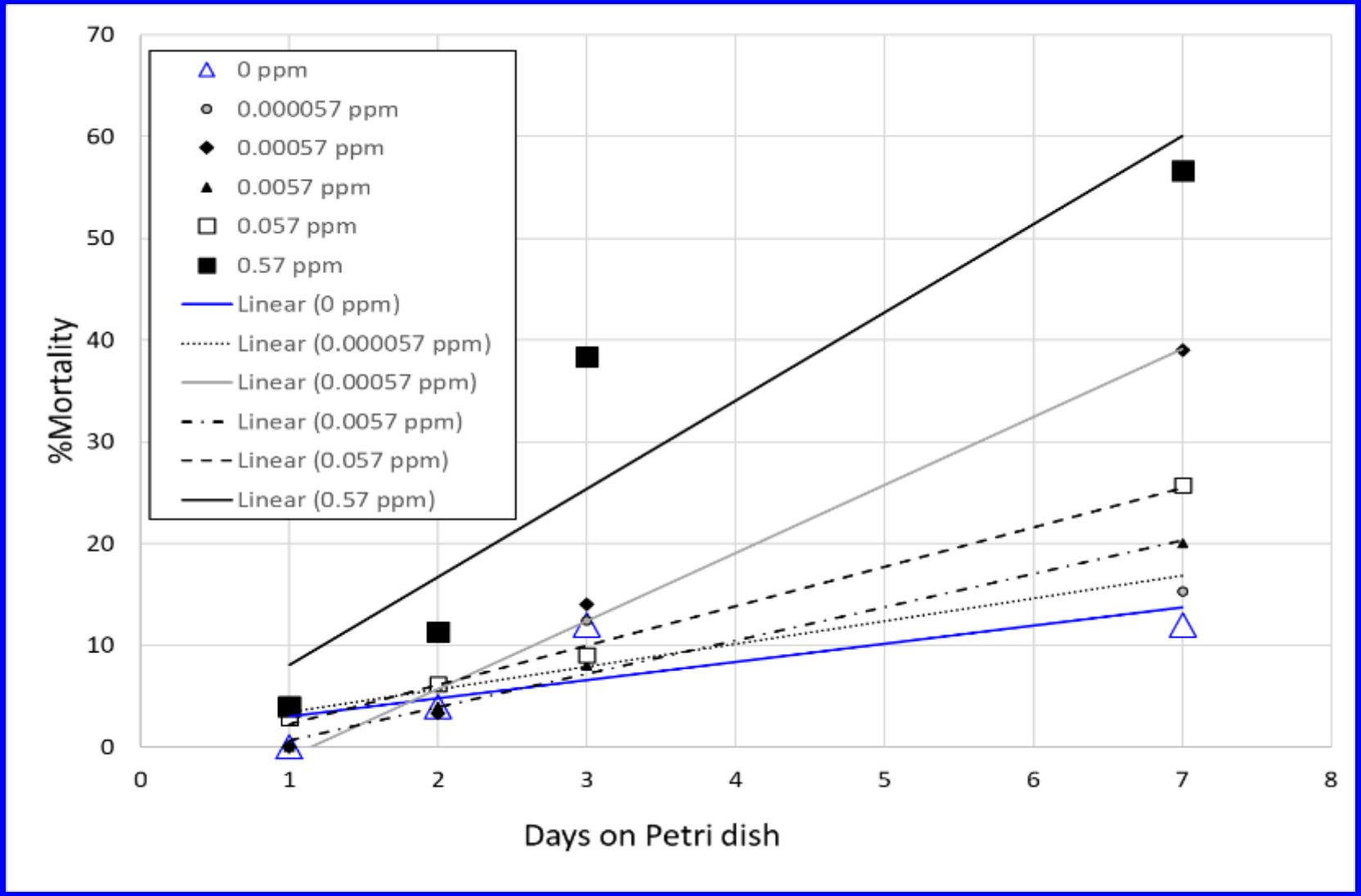
Tobacco Flea Beetle
Set up of Lab Bioassay

- 3-cm diameter leaf disks were prepared
- Leaf disks were dipped for 5 seconds in a solution
- Five leaf disks per solution were prepared (5 replications)
- Then, leaf disks were air dried and placed in a 5-cm petri dish
- Once air dried, 5 to 7 flea beetles were placed in each disk
- Mortalities of tobacco flea beetles were tallied at 1, 3 and 7 days
- Number of holes cause by tobacco flea beetles were evaluated a 7 days

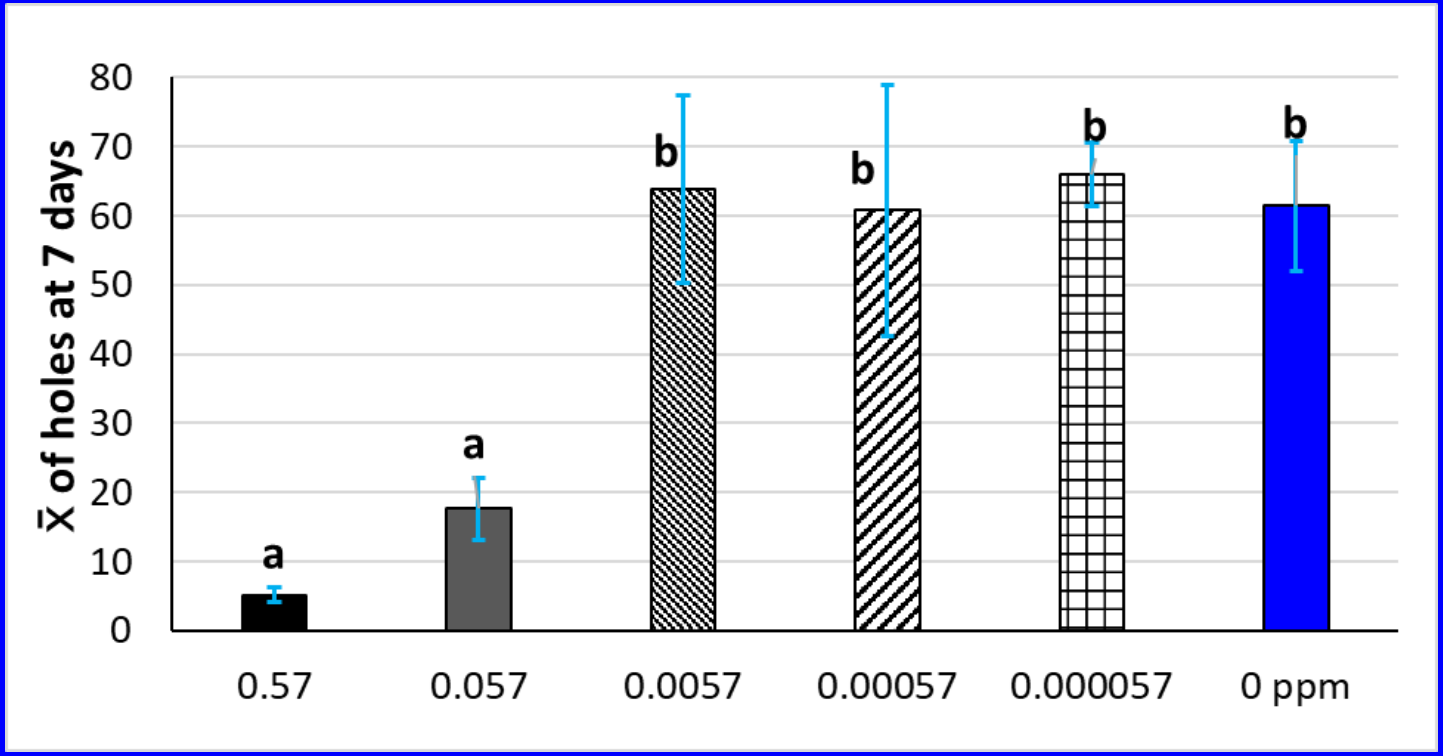


$5.73x10^{-1}$
$5.73x10^{-2}$
$5.73x10^{-3}$
$5.73x10^{-4}$
$5.73x10^{-5}$
Control

Flea Beetle Mortality from Imidacloprid



Feeding Damage caused by Tobacco Flea Beetle



Significant differences found after ANOVA and Fisher's LSD comparisons of means $F_{5,24}$= 6.77 and p <0.001

Precision Sucker Control Applications

Manual Sucker control

- **Very labor intensive**
  - **Manual stalk rundown**
  - **2 to 3 applications**
  - **MH discouraged for dark**
  - **Average 5 man hrs/acre**
- **Worker Protection Issues**
- **Research/Extension:**

  Develop spray methods
  - **Effective long-term sucker control**
  - **Preserve leaf quality**
    - **Timing and coverage**
    - **Spray volume**
    - **Reduced MH rates**

Dark Tobacco Sucker Control

- Biggest factor in sucker control:

  STRAIGHT TOBACCO

- Straight tobacco opens opportunities for spraying over-the-top, even without MH

  – Set tobacco as deep as possible

  – Top lower?? 16 leaves instead of 20?

Sucker Control Considerations

- Value in making contact applications prior to topping
  - Application while tobacco is smaller, straighter
  - Some control if tobacco blows over before topping

- Carryover problems (grasses) with flumetralin where pooling occurs at bottom on stalk?
  - Only takes ¾ oz of solution per stalk.

Dosimeter

- Application device to apply precise amount of liquid with each squeeze:
  - Can set to apply 10 mL to 27 mL (0.9 oz)
  - Potential to save 30 to 50% from over-application with standard dropline

  - One squeeze per plant on straight tobacco
  - More than once squeeze on crooked tobacco

2019 Drexel Dosimeter Research
MSU – Murray KY

- Dosimeter (0.9 oz/plant) vs backpack
- Treatments:
  - Sucker Plucker X 2, Plucker Plus - *Dosimeter*
  - Sucker Plucker X 2, Sucker Plucker + Drexalin Plus – *Dosimeter*
  - Sucker Plucker X 2, Sucker Plucker + Drexalin Plus – *Backpack*
  - Sucker Plucker X 2, Plucker Plus – *Backpack*
  - Sucker Plucker X 2, Sucker Plucker + Butralin – *Backpack*
  - TNS - Topped not suckered (no chemical)

2019 Drexel Dosimeter Research

MSU – Murray KY

Treatment	Application	% Sucker Control	Sucker Fr. Wt./plot (lbs/plot)	Lug Yld (lbs/A)	Leaf Yld (lbs/A)	Total Yld (lbs/A)
Sucker Plucker Sucker Plucker Plucker Plus	Dosimeter	**98**	**0**	428	2220	**2648**
Sucker Plucker Sucker Plucker SP + Drexalin Plus	Dosimeter	**97**	**0**	454	2108	**2562**
Sucker Plucker Sucker Plucker SP + Drexalin Plus	Backpack	**92**	**0.8**	433	2141	**2574**
Sucker Plucker Sucker Plucker Plucker Plus	Backpack	**92**	**0.9**	382	1803	**2184**
Sucker Plucker Sucker Plucker SP + Butralin	Backpack	**97**	**0**	407	1804	**2211**
Topped Not Suckered (check)	-	**0**	**15.7**	337	917	**1254**

49th Tobacco Workers Conference – Louisville KY - January 21, 2020 – Paper 48

Effect of Floor Insulation on Curing Efficiency in Dark Fired Tobacco

J. C. Rodgers and W. A. Bailey

University of Kentucky, Princeton KY

College of Agriculture, Food and Environment

Firing Dark Tobacco

16,000 acres in KY and TN
47 Million pounds
130 Million dollars value

Yellowing Tobacco

- Process takes 5-7 days
- Want maximum air flow
  - Better color
  - Avoid sweating tobacco

Starting Fires

Insulation

- Typical insulation is house wrap on walls
- House wrap is doubled on roof
- Maximize control of indoor environment
- Vents on roof and walls to help control air flow to achieve desired curing conditions.

Leaf Chemistry Concerns in Dark-Fired Tobacco

- Tobacco-specific nitrosamines (TSNA):
  - NNN, NNK, NAT, NAB
  - Tend to be higher in fire-cured tobacco than in air-cured tobacco
  - Tend to be higher with increased heat (>>>130 F) during firing

- Benzo-α-pyrene (BaP):
  - Poly-aromatic hydrocarbon (PAH) that is associated with levels of smoke residue on fire-cured leaf.

Objective

- To evaluate using insulation in barn floor
  - Monitor barn floor and air temperatures
  - Save materials?
  - Save in curing time?
  - Leaf chemistry ?
    - TSNA
    - BaP

Firing Procedure and Costs

Insulated barn - 3 acre (2400 sticks) – 6 rows of slabs/sawdust per firing
Control barn (no floor insulation) - 2 acre (1600 sticks) – 4 rows of slabs/sawdust per firing

Each row contains ½ bundle of slabs.
Each row got 5 buckets of sawdust except for last firing, only used 4 to get more heat.
Fired the tobacco 4 times.

Slabs $30 per bundle
Saw dust $550 per semi load = $2.80 per bucket

<u>3-acre barn firing costs:</u>

1st fire	$174
2nd fire	$174
3rd fire	$174
4th fire	$157.20

Total $679.20 (3-acre Barn) $226.40 (Per Acre)

Project Materials

Project Budget:

5 rolls outdoor double bubble foam insulation ($.84 /sq ft)	$1445
Tape for insulation seams (4 rolls x $18 per roll)	$ 72
4 thermocouples ($48 each)	$ 192
1 data logger to log temperature data	$ 275
1 protective case for data logger	$ 60
4 loads topsoil to cover insulation by 6 inches ($200 per load)	$ 800
Incidental expenses (staples for insulation, conduit, shipping, etc.)	$ 250
TOTAL:	**Approximately $3000**

*Approx. $2300 to install floor insulation (insulation, tape, topsoil)

Insulation

Thermocouple Wires

Taping Seams

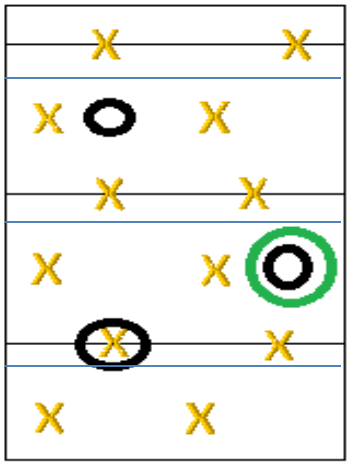
Laying Complete

Placing the Dirt

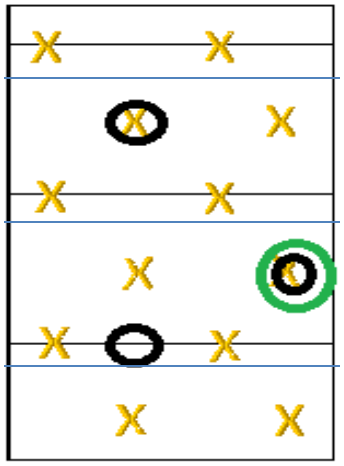
Finished Floor Insulated Floor

Thermocouple logger Box

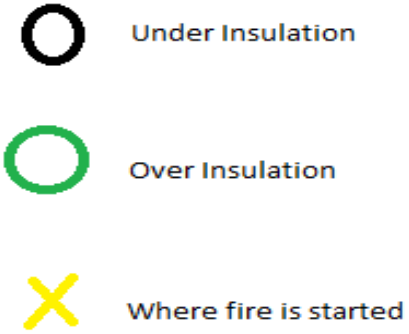
Fire & Thermocouple Placement in Insulated Barn Floor*

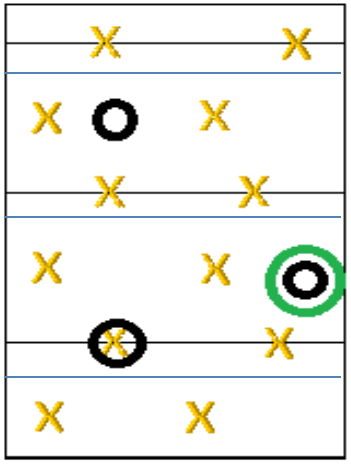


Fire 1

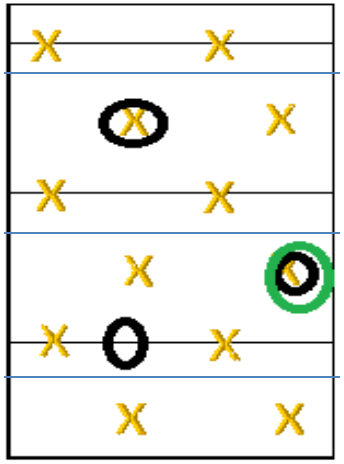


Fire 2



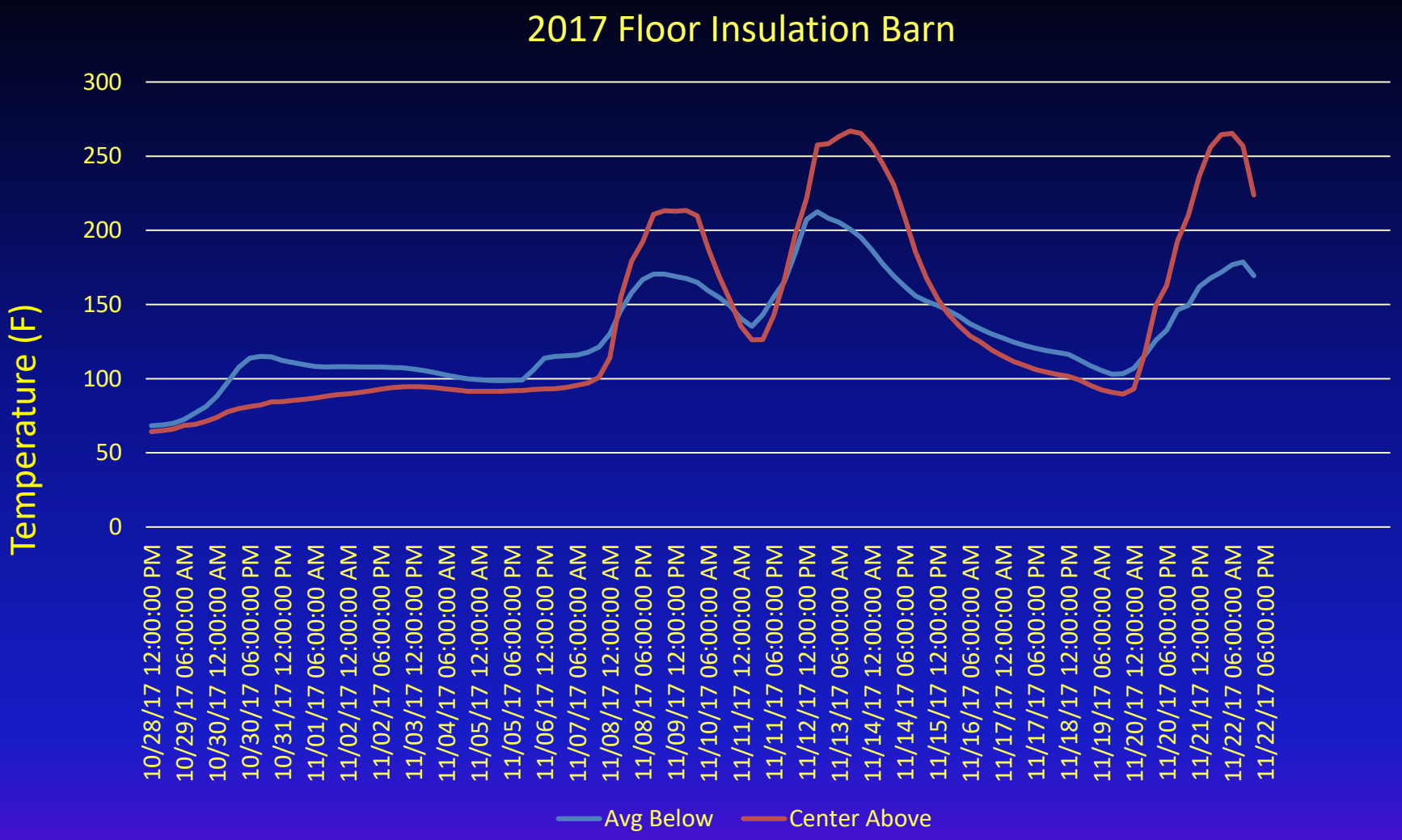


Fire 3



Fire 4

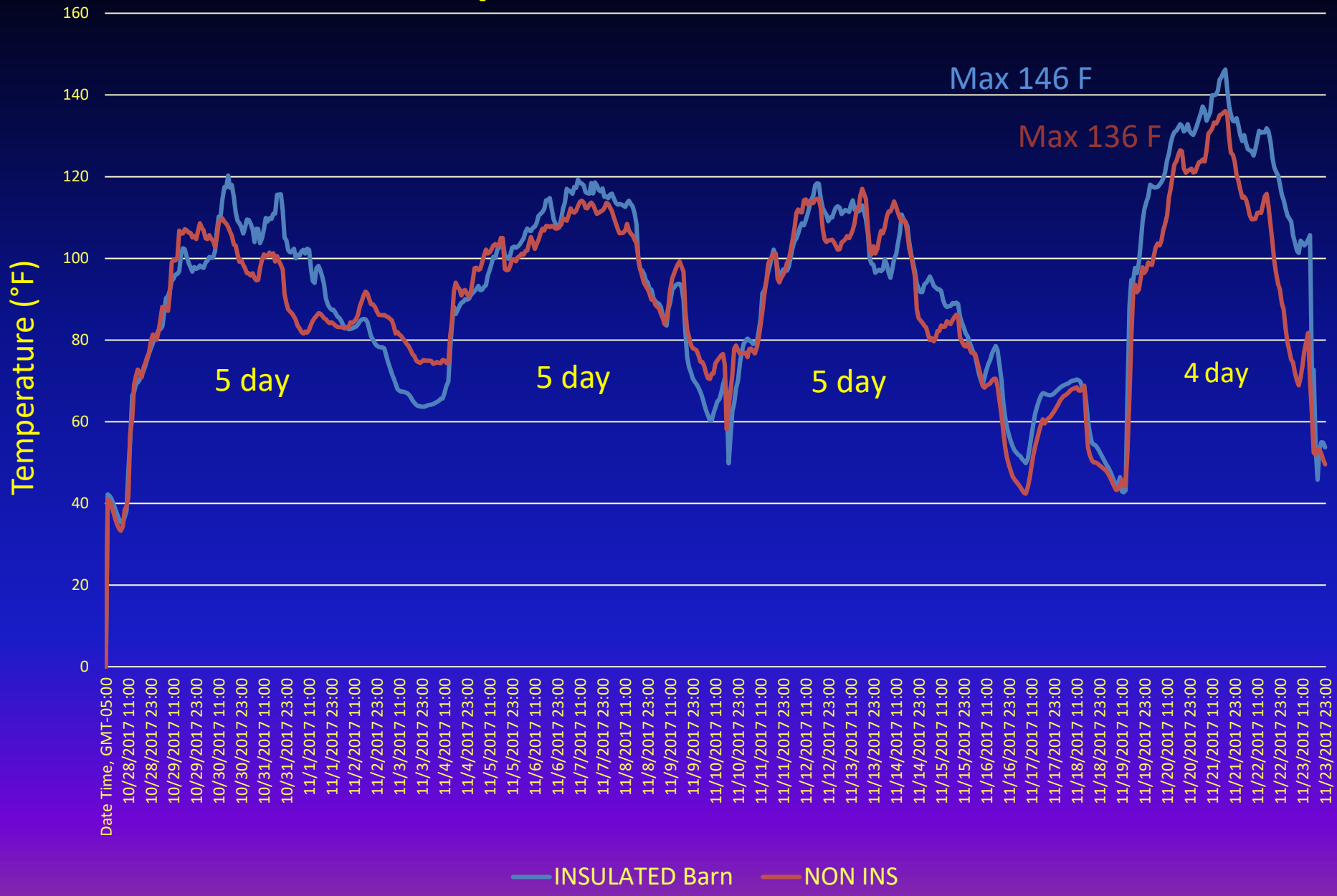
*Thermocouple and fire placement same in control barn floor.



Blue line is mean of 3 thermocouples under insulation in insulated barn

Red line is 1 thermocouple of top of insulation

2017 Air Temperature vs. Control Barn



2017 Relative Humidity

Post-Cure Sampling Procedure

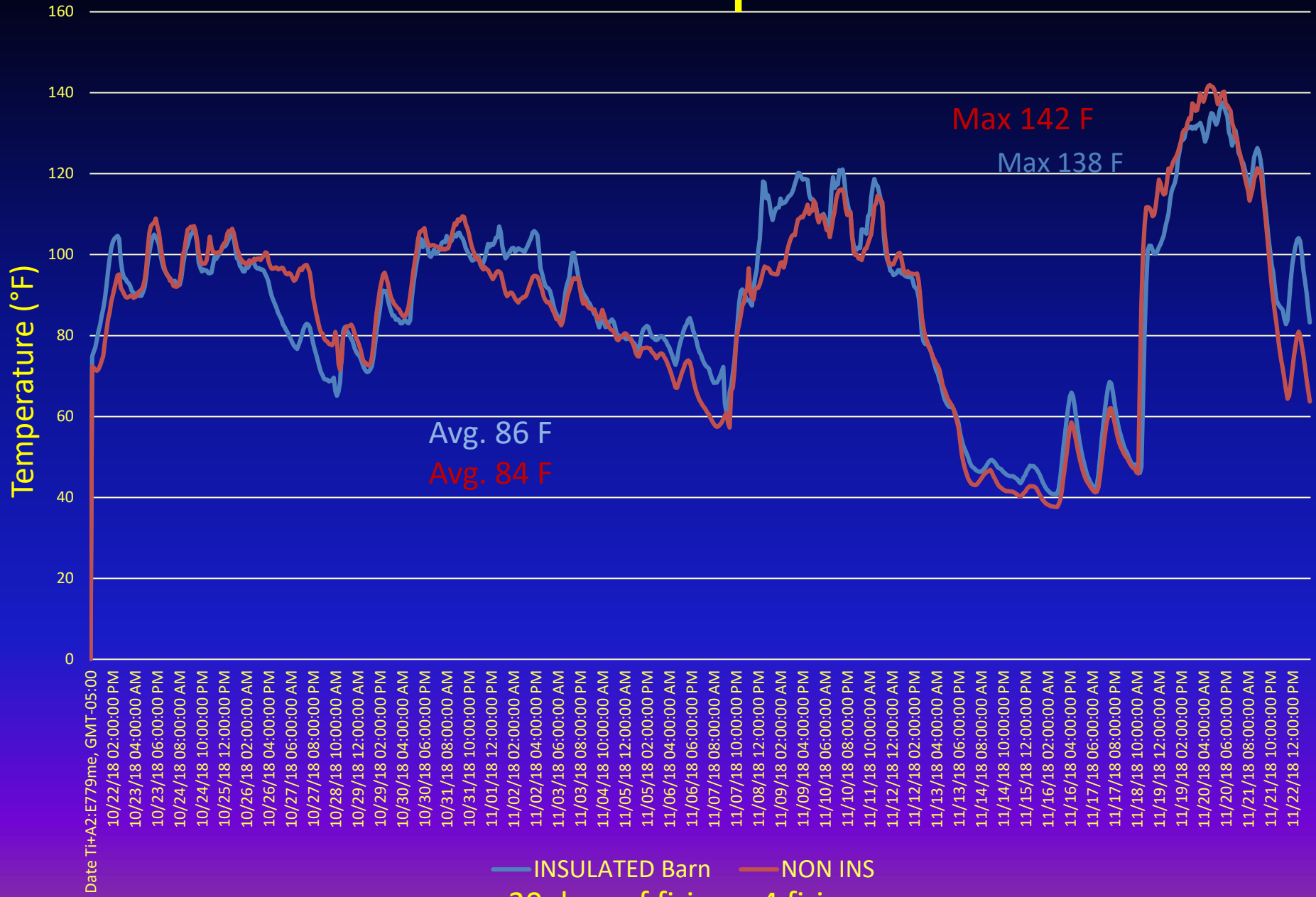
- 6 samples from each barn
- 4^{th} leaf from top
- Inside 4 plants/ 3 sticks
- 12 leaf samples
- Samples frozen immediately
- Sent to Altria for BaP and TSNA Analysis

2018-2019 Experiment

- Added thermocouples to floor of control barn
  - Same floor placement as in insulated barn
  - 6-in. depth

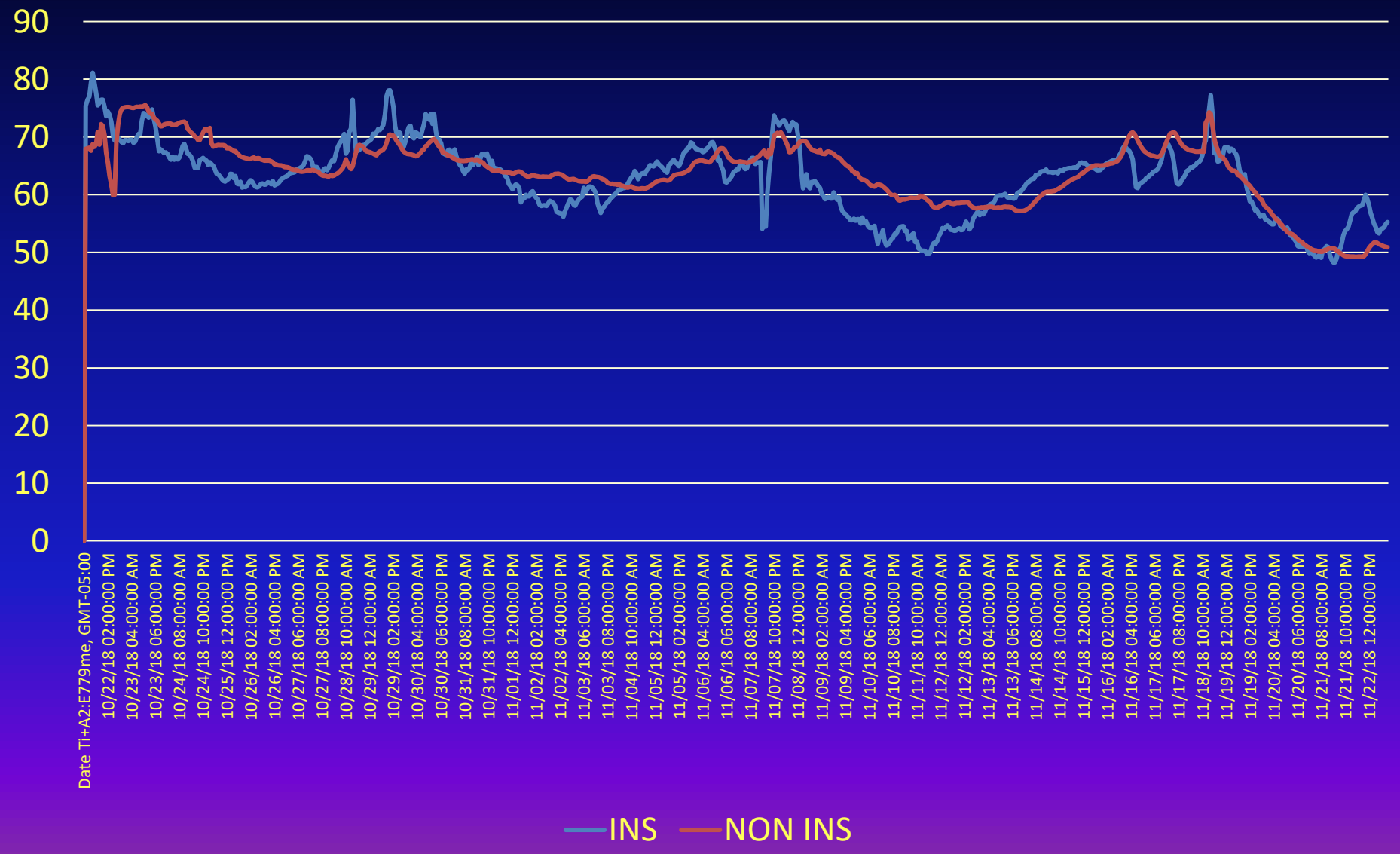
- Marked exact thermocouple placement in both barns so slab/sawdust row was always directly over thermocouple.

2018 Air Temperature

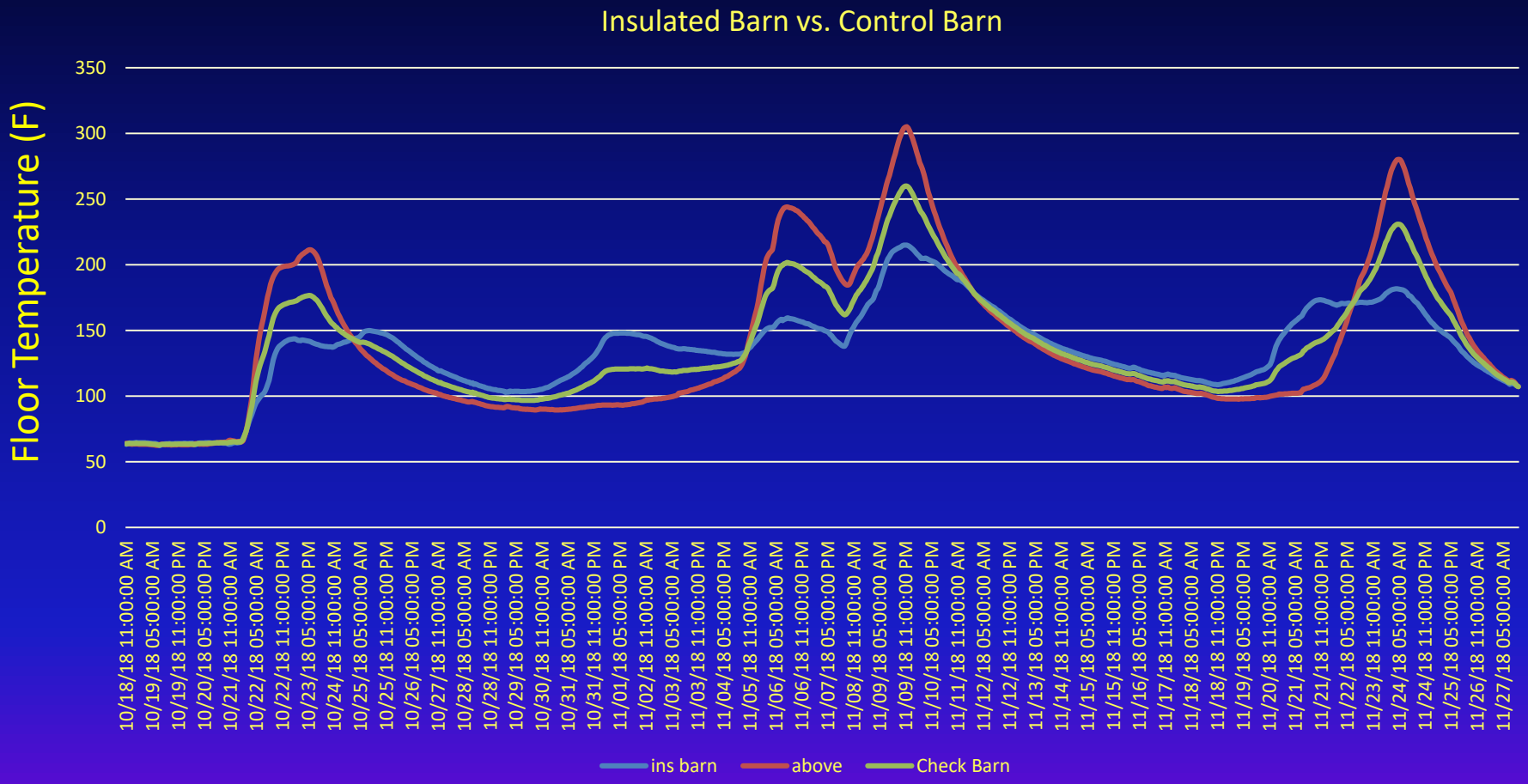


30 days of firing – 4 firings

2018 % Relative Humidity



2018 Floor Temperature Comparison

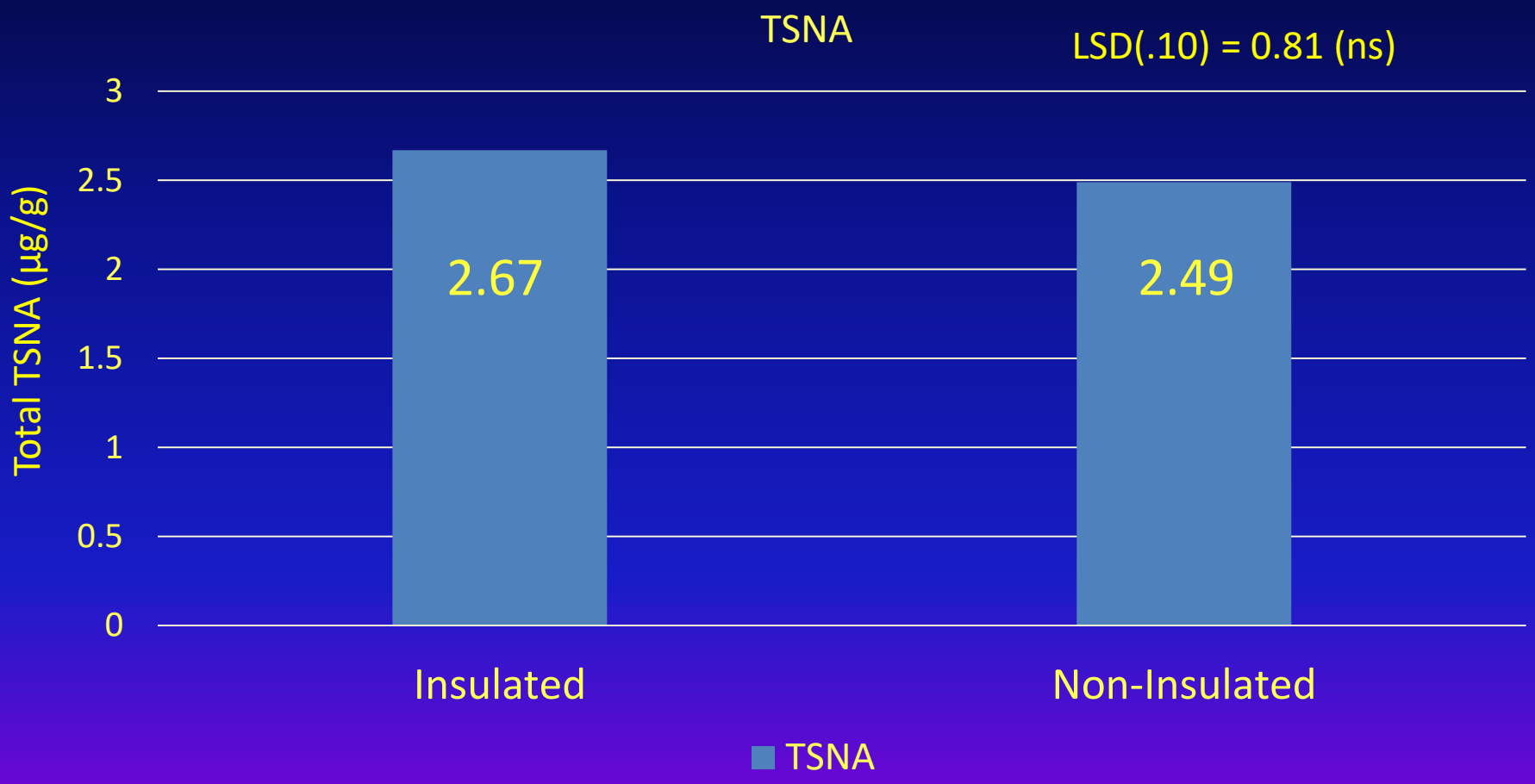


Blue line is mean of 3 thermocouples under insulation in insulated barn

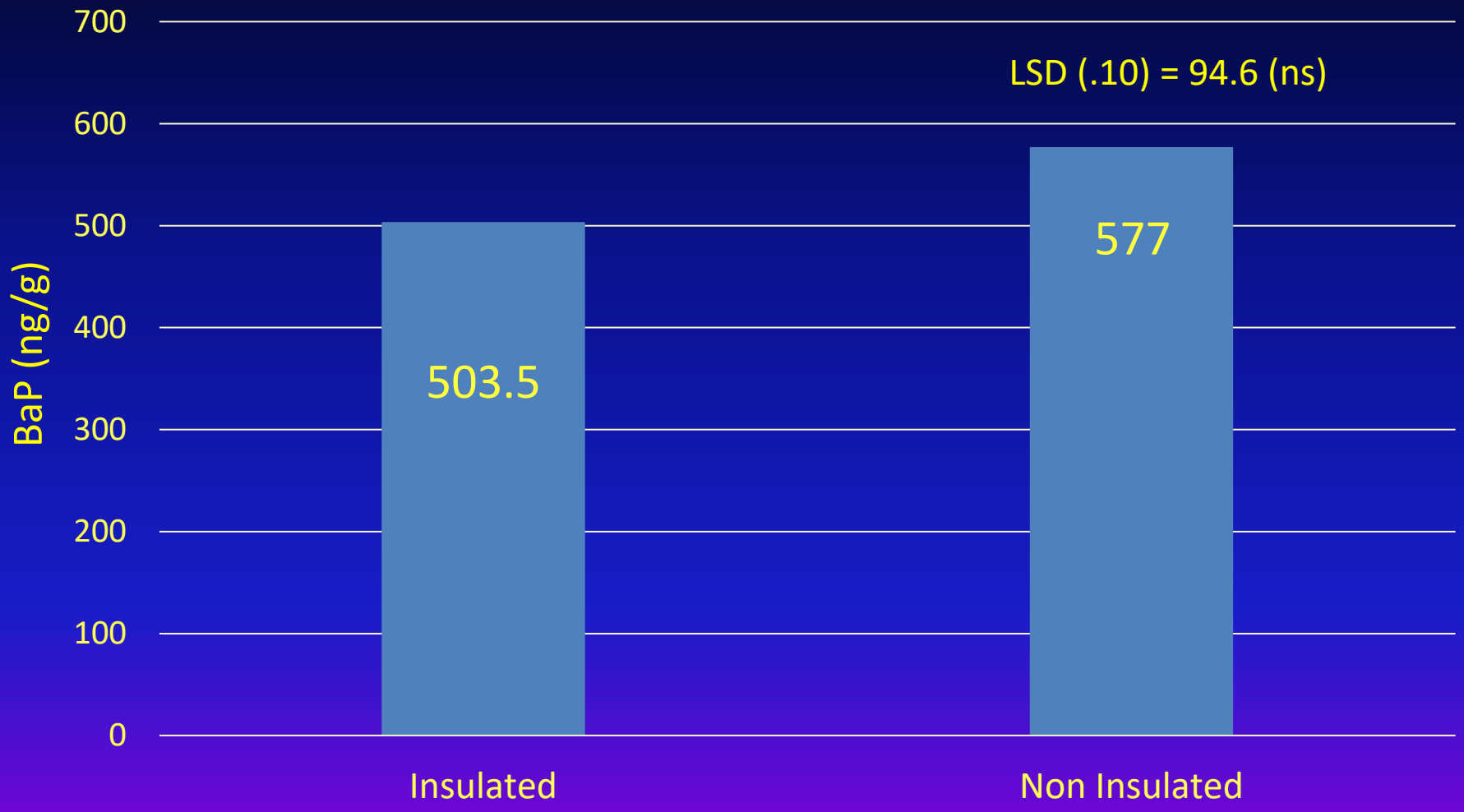
Red line is 1 thermocouple of top of insulation

Green line is mean of 3 thermocouples in control barn

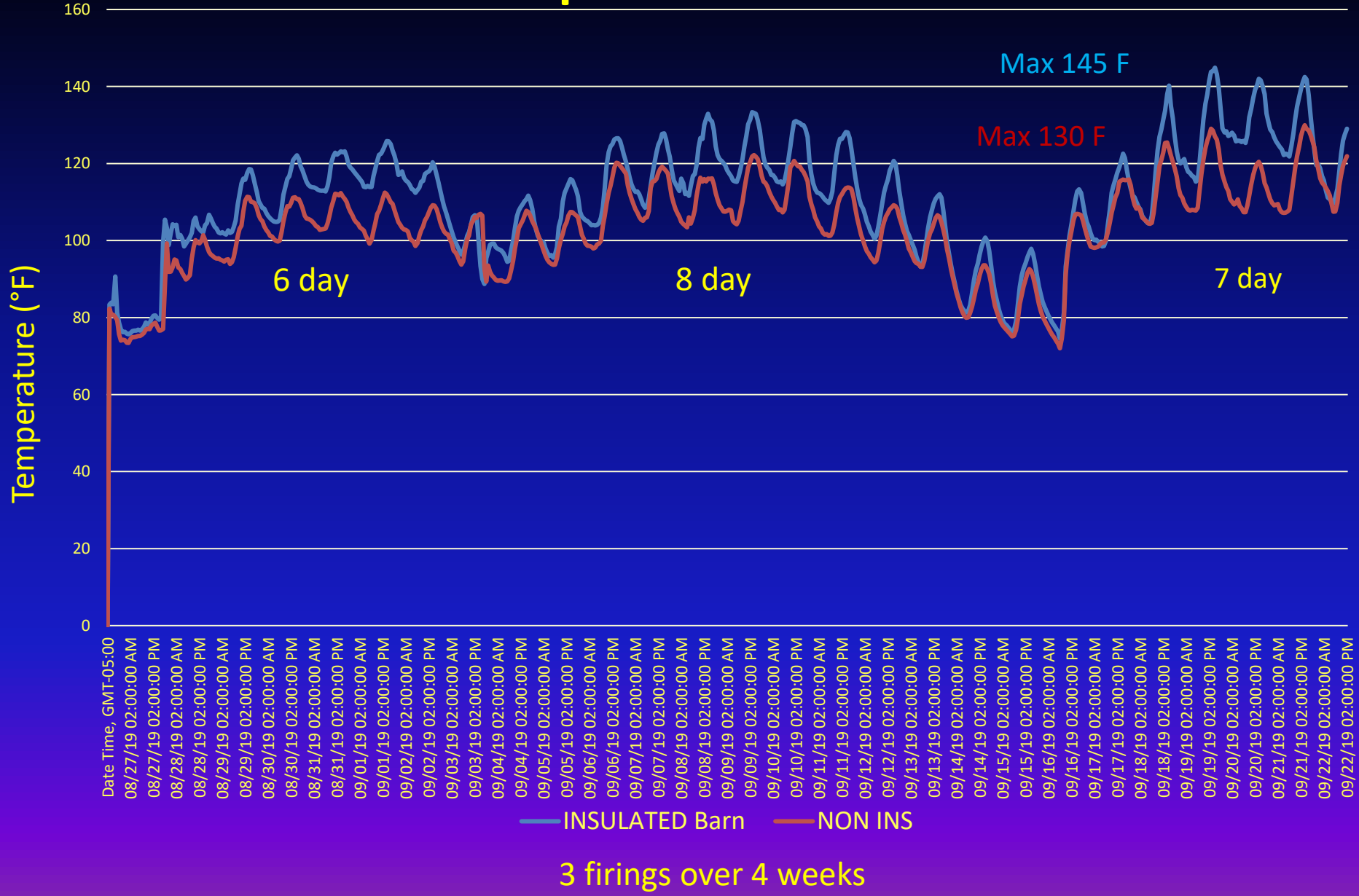
2018 TSNA


TSNA
LSD(.10) = 0.81 (ns)
Total TSNA (µg/g)
3
2.5
2
1.5
1
0.5
0
2.67
2.49
Insulated
Non-Insulated
TSNA

2018 BaP

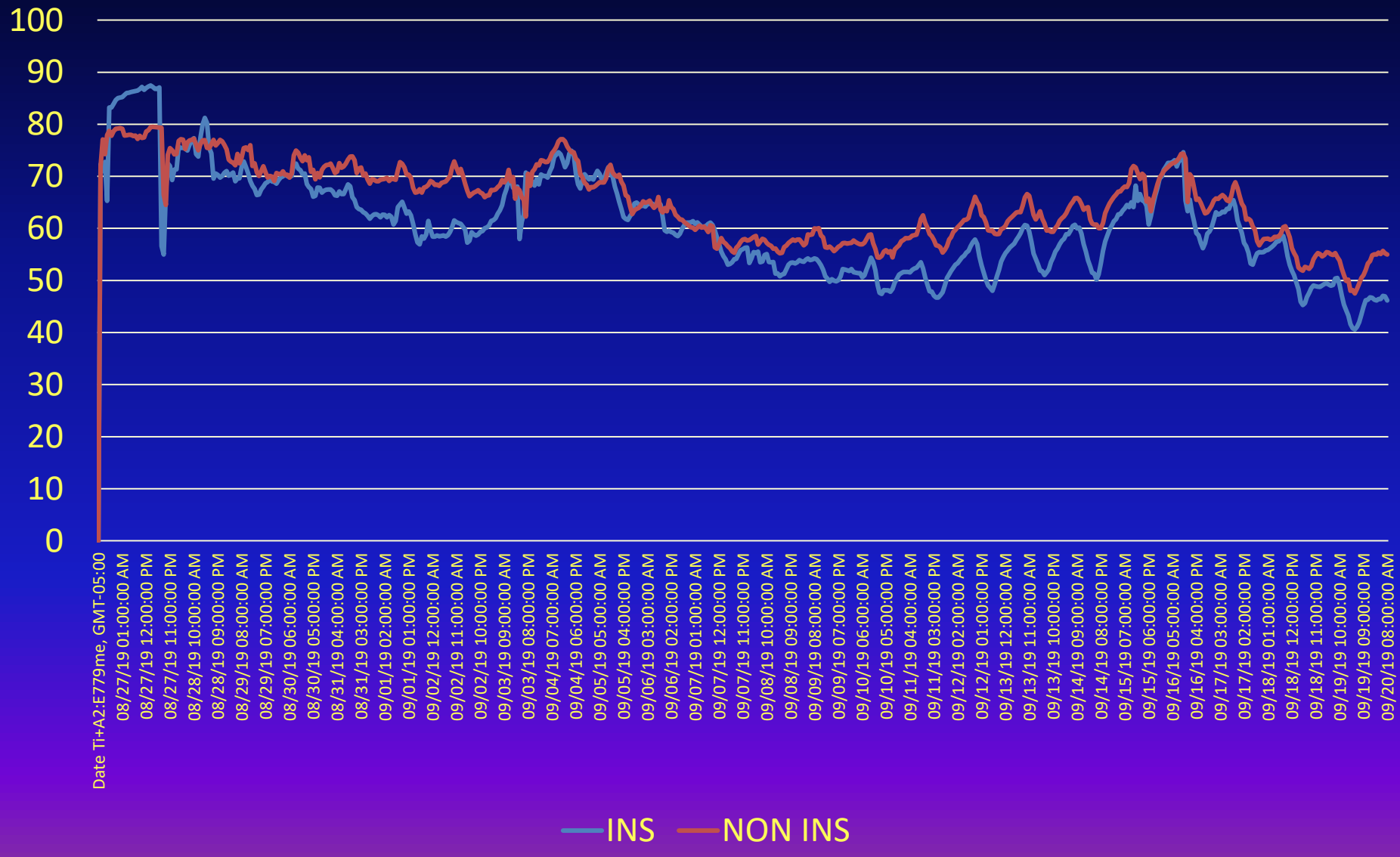

700
600
500
400
300
200
100
0
BaP (ng/g)
LSD (.10) = 94.6 (ns)
503.5
577
Insulated
Non Insulated

Air Temperature 2019

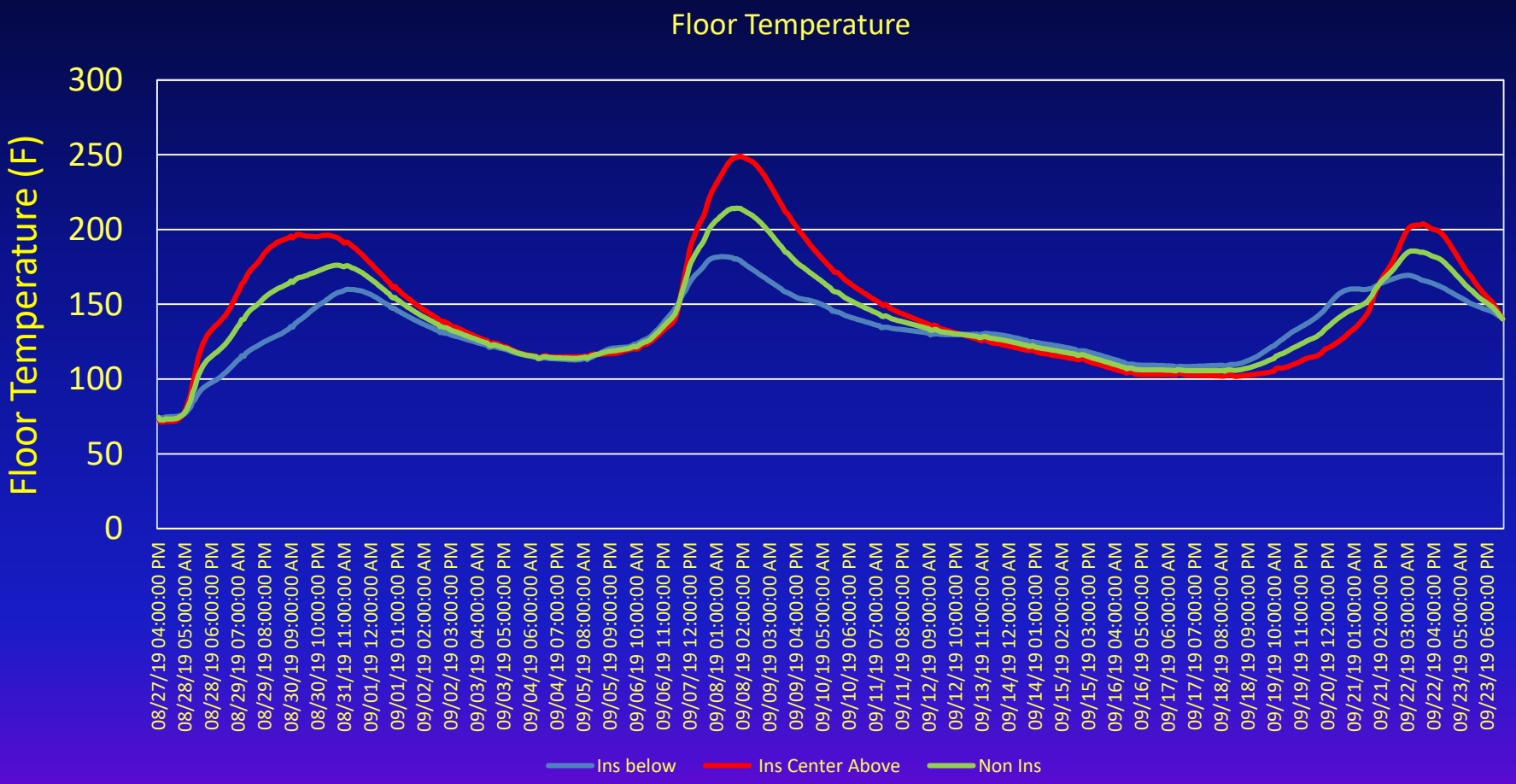


3 firings over 4 weeks

2019 Relative Humidity



Floor Temperature 2019



Blue line is mean of 3 thermocouples under insulation in insulated barn

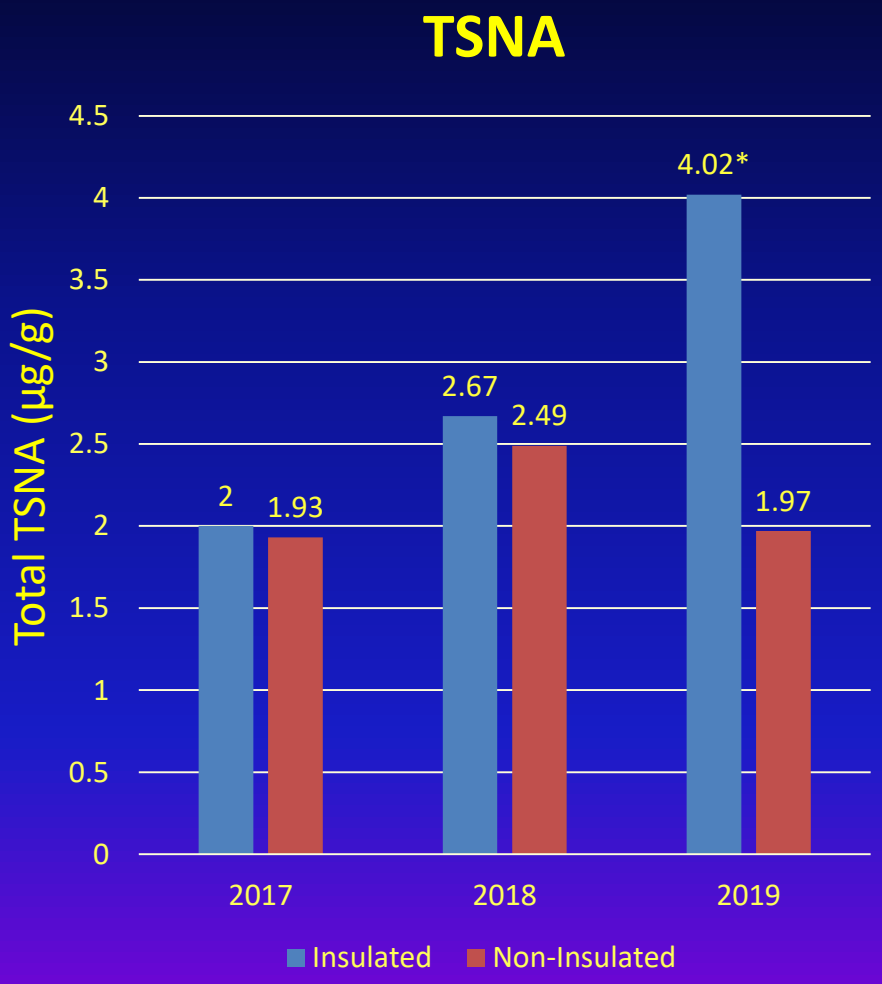
Red line is 1 thermocouple of top of insulation

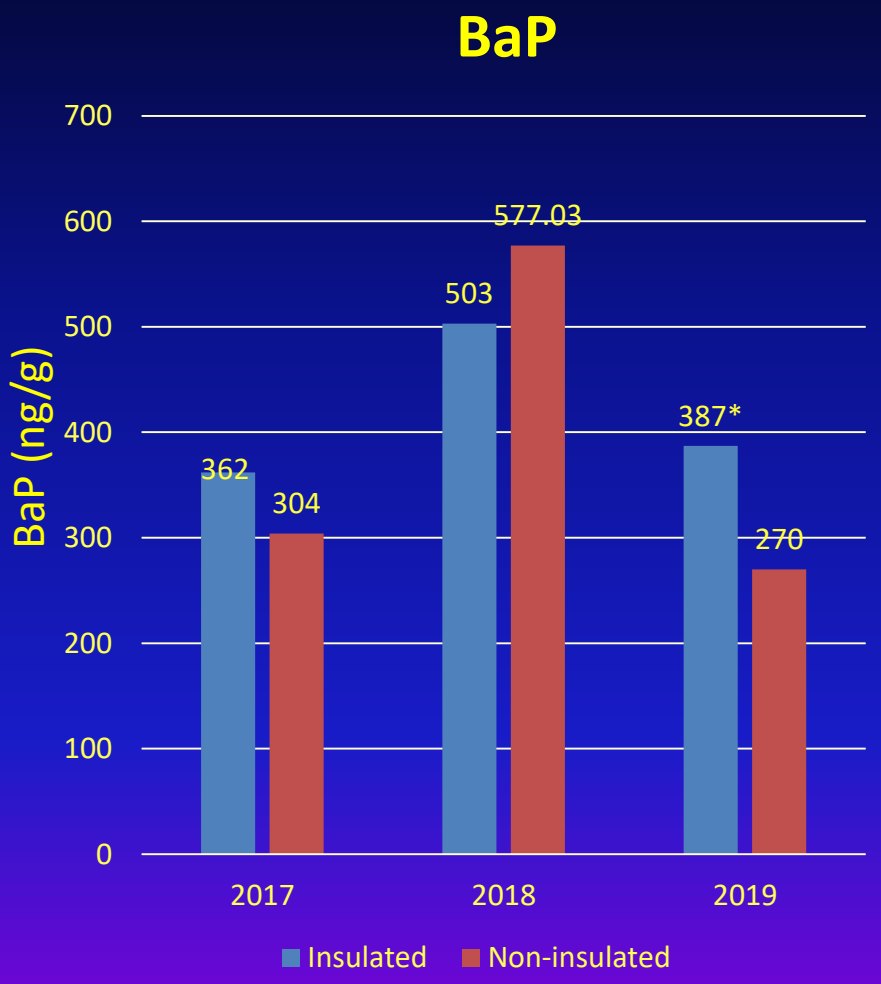
Green line is mean of 3 thermocouples in control barn

3-Year Summary

- Barns followed same heat and %RH trends
  - Higher air temperature and lower humidity in floor insulated barn
- Barns were fired very similarly each year
- Barns were fired earlier in 2019
  - October-November firing in 2017 and 2018
  - August-September firing in 2019

3-Year Chemistry Data Summary





Floor Insulation Experiment

- Why 2019 different?
  - 2019 high rain fall and disease pressure
    - Higher stem to lamina ratio
    - Insulated barn may have had more damage
  - 2019 earlier firing, only 1 fire per row
    - To help lower heat
  - Earlier fired crops may have higher TSNA
  - Green slabs and dust in 2018 may have contributed to higher BaP
    - 2017 and 2019 seasoned slabs and dust.

Floor Insulation Experiment

- If increased heat and drying from floor insulation allows one less fire to be required, or reduced material from same firings:
  - Reduced firing cost (save at least $55/acre)
  - Should reduce BaP, possibly reduce TSNA

Questions?