

Flue-Cured Tobacco Response to Sub-lethal Doses of HPPD-inhibiting Herbicides

Matthew Vann, Charlie Cahoon, Joseph Cheek, & Jeremy Machacek
Department of Crop & Soil Sciences
NC State University

Presentation Outline



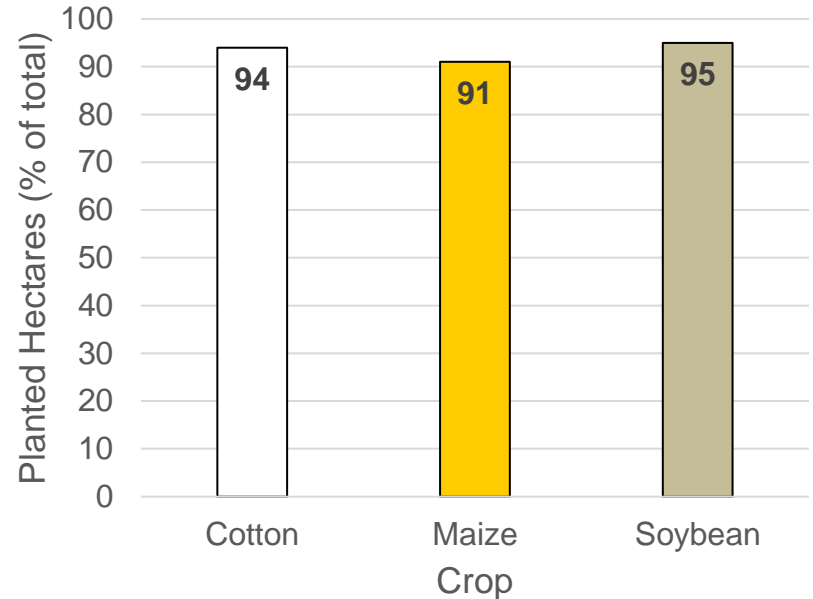
1. Project background
2. Research overview
3. Preliminary findings
4. Preliminary conclusions

Table 1. Total hectares and estimated herbicide-tolerant (HT) hectares planted in North Carolina in 2023.¹

Crop	Total ha	HT ha ^a
Cotton	153,846	144,615
Maize	384,615	350,000
Soybean	668,016	634,615
Flue-Cured Tobacco	45,749	0

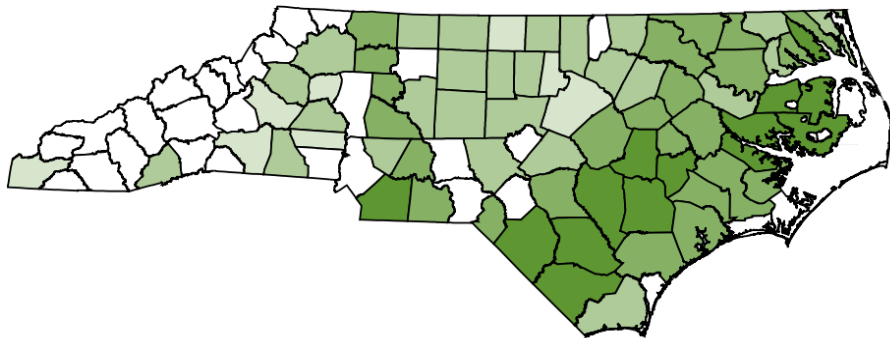
^a Estimated HT hectares are based on NC crop acreage and the US adoption rates (%) of HT traits for the referenced crop species.

Adoption of Herbicide-Tolerant Crops (US average)²



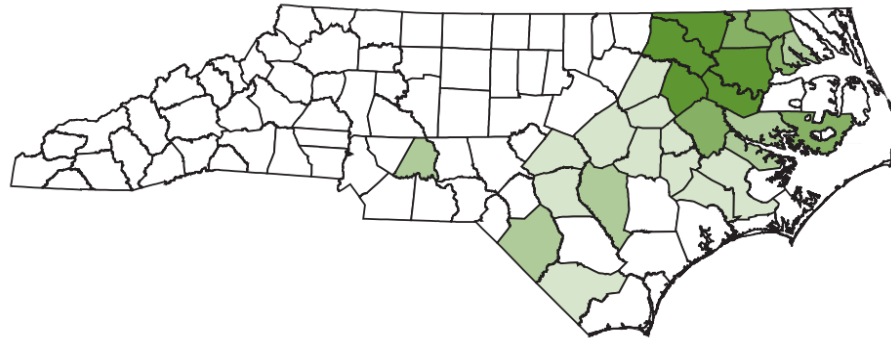
CORN FOR GRAIN

2021 Production



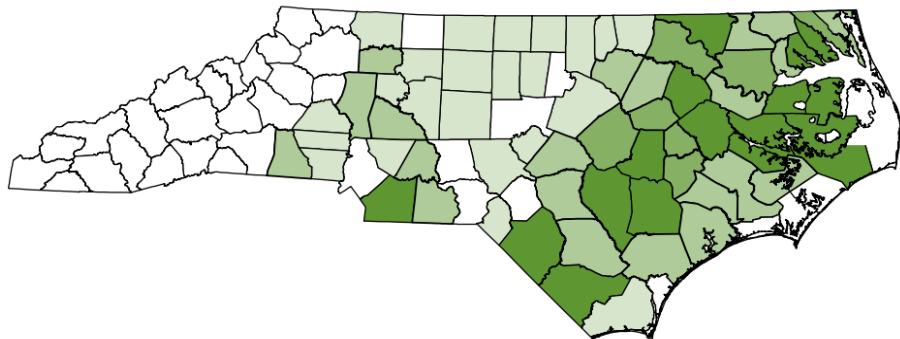
COTTON

2021 Production



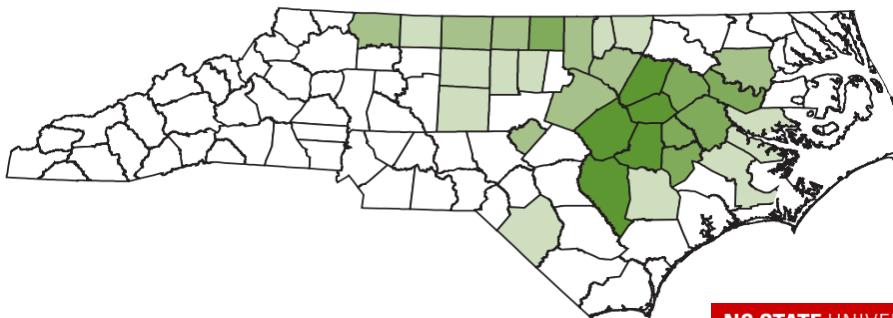
SOYBEANS

2021 Production



FLUE-CURED TOBACCO

2015 Production




HPPD-inhibiting Herbicides

- 4-hydroxyphenylpyruvate dioxygenase inhibitor
- HPPD-inhibitors are “bleaching” herbicides
 - prevent breakdown of tyrosine → carotenoid and chlorophyll degradation
 - PRE and POST applications
- Largely used in corn production for annual broadleaf weed suppression
 - Mesotrione, Callisto[®], Syngenta Crop Protection, LLC
 - 10 month plant back restriction for tobacco

HPPD-inhibiting Herbicides

- Current HT traits: glyphosate, glufosinate, dicamba, 2,4-d
- HPPD-inhibitors are likely to be within the next generation of traits
- Isoxaflutole, Alite™ 27, BASF
 - PRE application ONLY
 - Soybean planting: April – July

RESTRICTED USE PESTICIDE
 May injure susceptible non-target plants.
 For retail sale to and use only by certified applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification. Commercial and certified applicators must ensure that all persons involved in these activities are informed of the precautionary statements.



We create chemistry

ISOXAFLUTOLE	GROUP	27	HERBICIDE
--------------	-------	----	-----------

Alite™ 27

Herbicide

For: weed control in isoxaflutole-resistant soybean grown in select counties in certain states.
Crops not containing a gene expressing an HPPD protein will not be tolerant to Alite 27 Herbicide

ACTIVE INGREDIENT(S):	
Isoxaflutole [5-cyclopropyl-4-(2-methylsulfonyl-4-trifluoromethylbenzoyl) isoxazole]	40.50%
OTHER INGREDIENTS:	59.50%
TOTAL:	100.00%

Contains 4.00 pounds isoxaflutole per U.S. gallon

Objectives

1. Quantify FCV injury following exposure to two HPPD-inhibiting herbicides
2. Determine when exposure risk is the greatest
3. Gain a better understanding for off target movement of HPPD-inhibiting herbicides

Trial Establishment

- Cunningham & Upper Coastal Plain Research Stations
- RCBD with 4 replications
- One treated row/plot
- CO₂-pressurized backpack
 - 167 L/ha
 - Single AIXR110025 nozzle
- Applications: 5 and 10 WAT

Data Collection & Analysis

- 6-9 & 11-14 WAT
 - Visual injury rating (0-100%)
 - Plant height and leaf spread (n=5)
- Yield, visual quality, and value
- Data analysis:
 - R studio
 - nlme package

Isoxaflutole (Alite™ 27)

Mesotrione (Callisto®)

5 Weeks After Transplanting

- 1.) 1/4 rate (26.25 g ai/ha)
- 2.) 1/20 rate (5.25 g ai/ha)
- 3.) 1/100 (1.05 g ai/ha)
- 4.) 1/500 (0.21 g ai/ha)
- 5.) 1/1,000 (0.11 g ai/ha)

- 6.) 1/4 rate (26.25 g ai/ha)
- 7.) 1/20 rate (5.25 g ai/ha)
- 8.) 1/100 (1.05 g ai/ha)
- 9.) 1/500 (0.21 g ai/ha)
- 10.) 1/1,000 (0.11 g ai/ha)

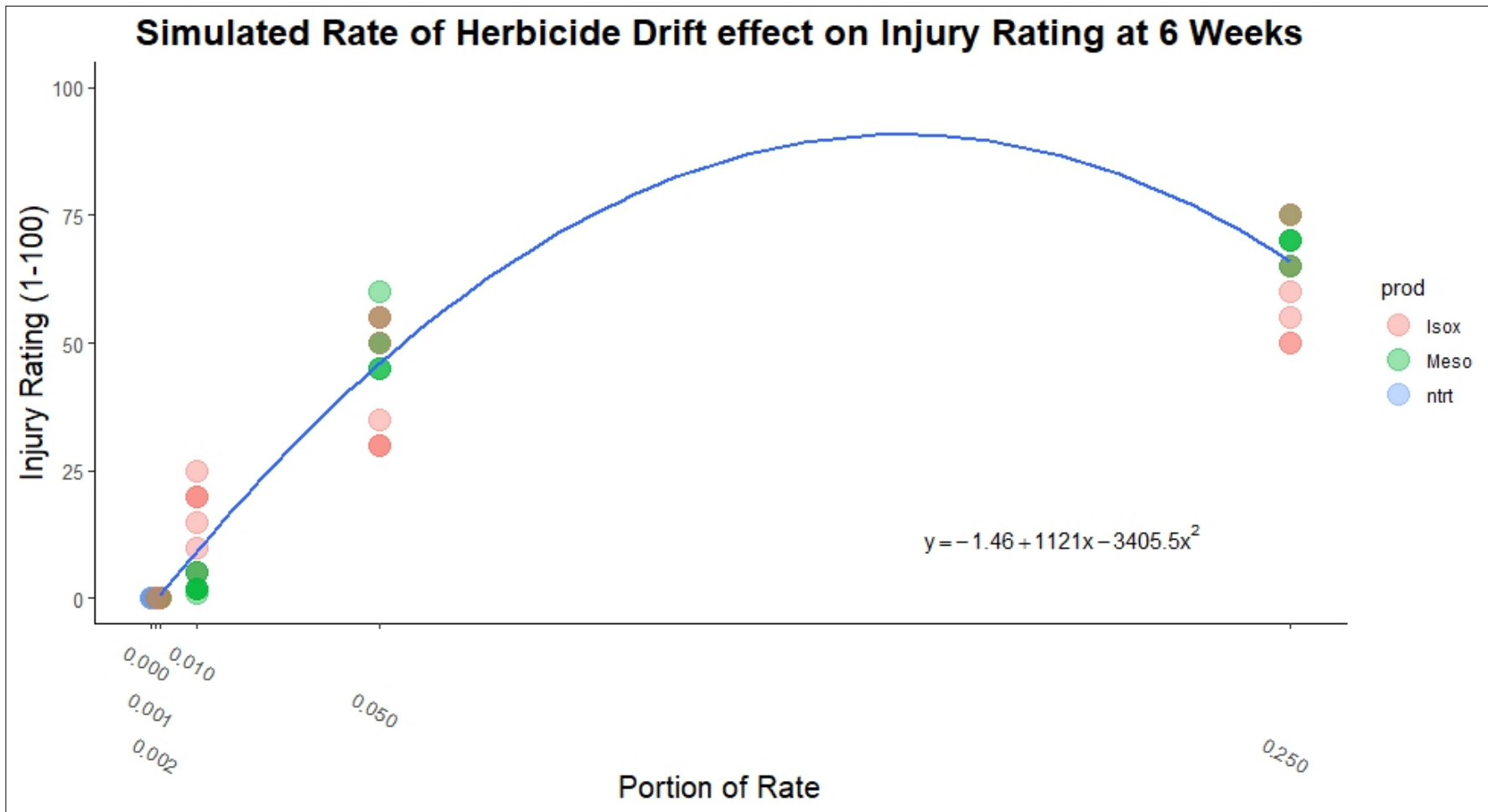
10 Weeks After Transplanting

- 11.) 1/4 rate (26.25 g ai/ha)
- 12.) 1/20 rate (5.25 g ai/ha)
- 13.) 1/100 (1.05 g ai/ha)
- 14.) 1/500 (0.21 g ai/ha)
- 15.) 1/1,000 (0.11 g ai/ha)

- 16.) 1/4 rate (26.25 g ai/ha)
- 17.) 1/20 rate (5.25 g ai/ha)
- 18.) 1/100 (1.05 g ai/ha)
- 19.) 1/500 (0.21 g ai/ha)
- 20.) 1/1,000 (0.11 g ai/ha)

21.) Non-treated Control

^a 1x use rate of isoxaflutole and mesotrione is 105 g ai/ha or 0.22 L/ha



Isoxaflutole



1/4 rate 54% injury
1/20 rate 31% injury

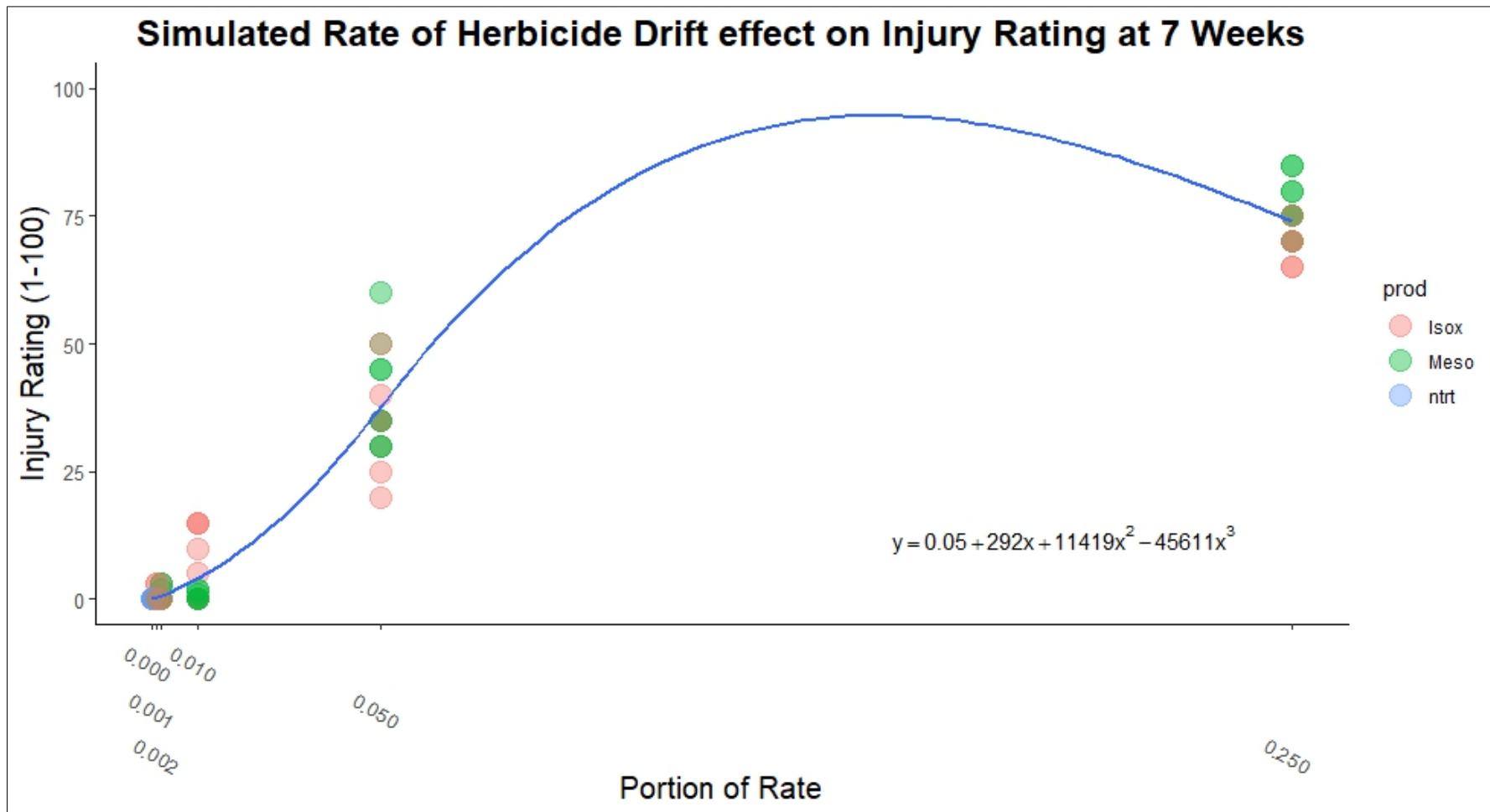
Mesotrione

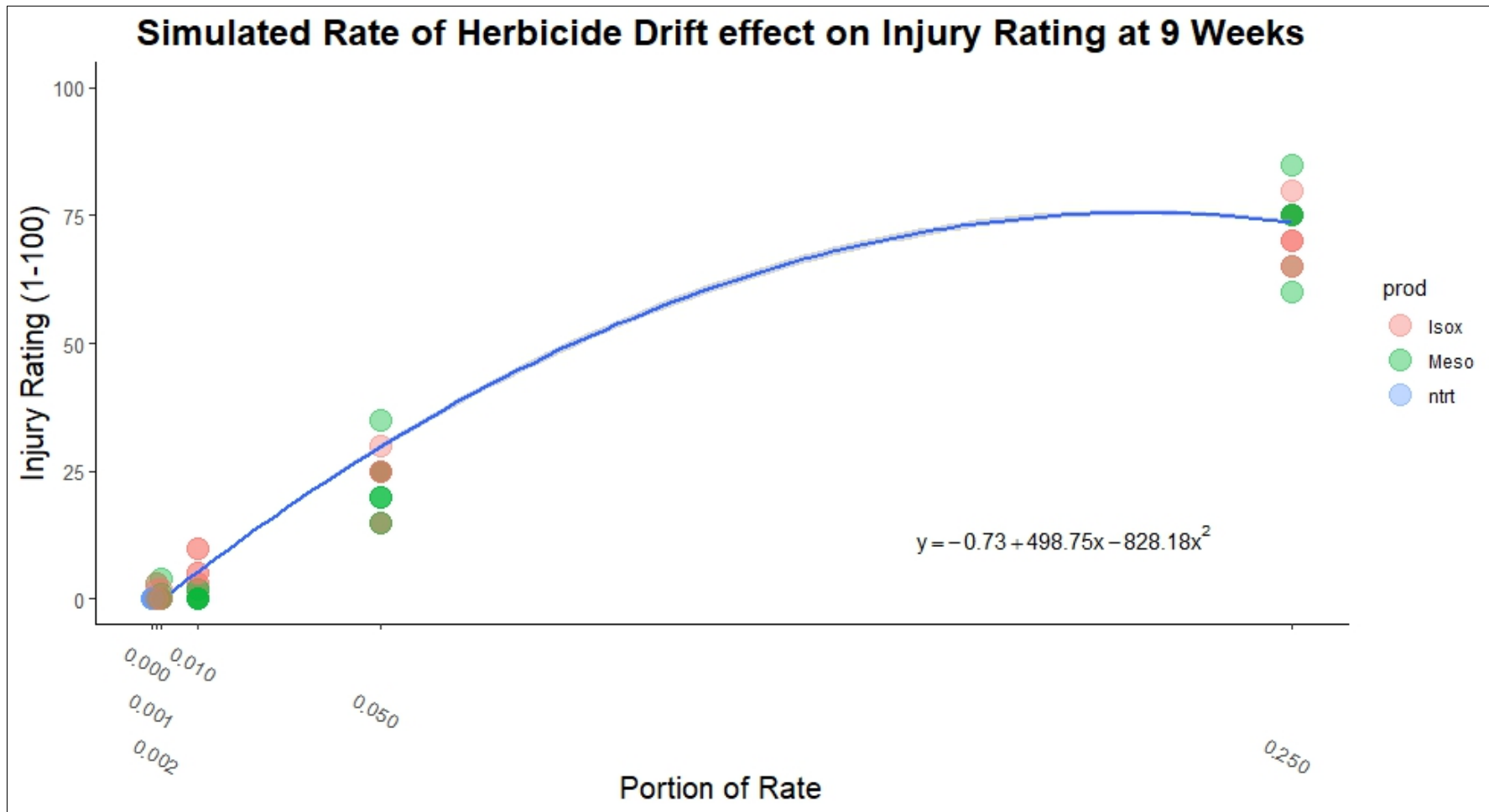


1/4 rate 70% injury
1/20 rate 46% injury

Non-treated

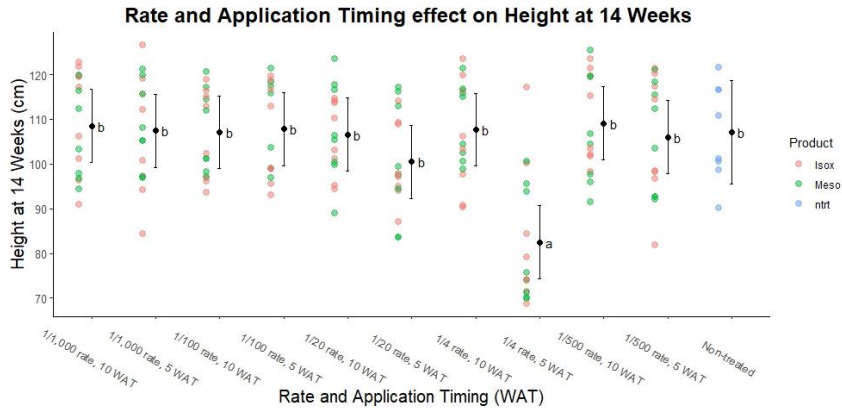




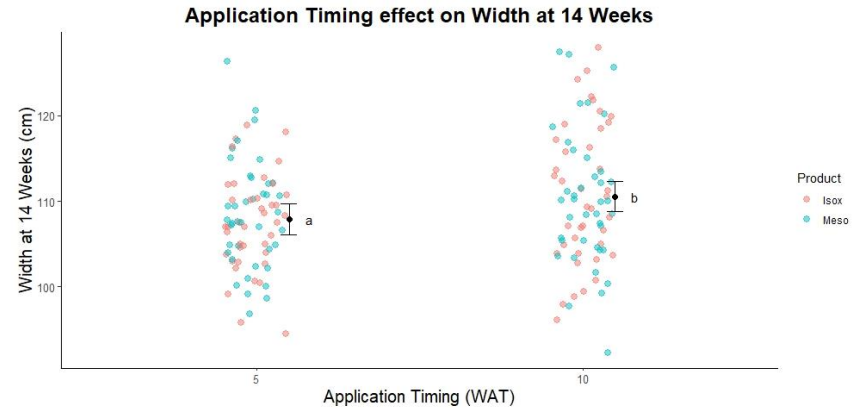


Stalk Height

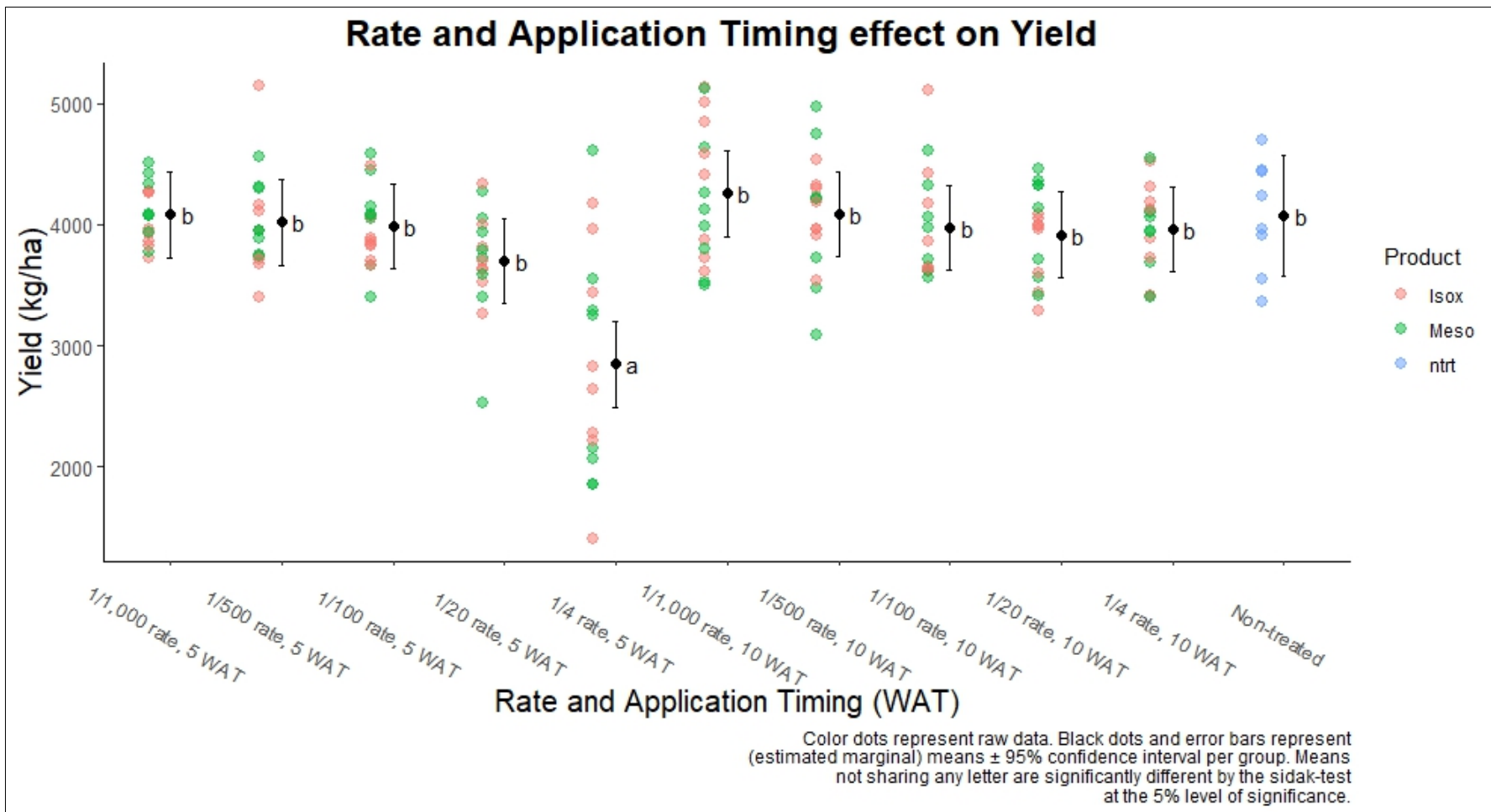
Leaf Spread

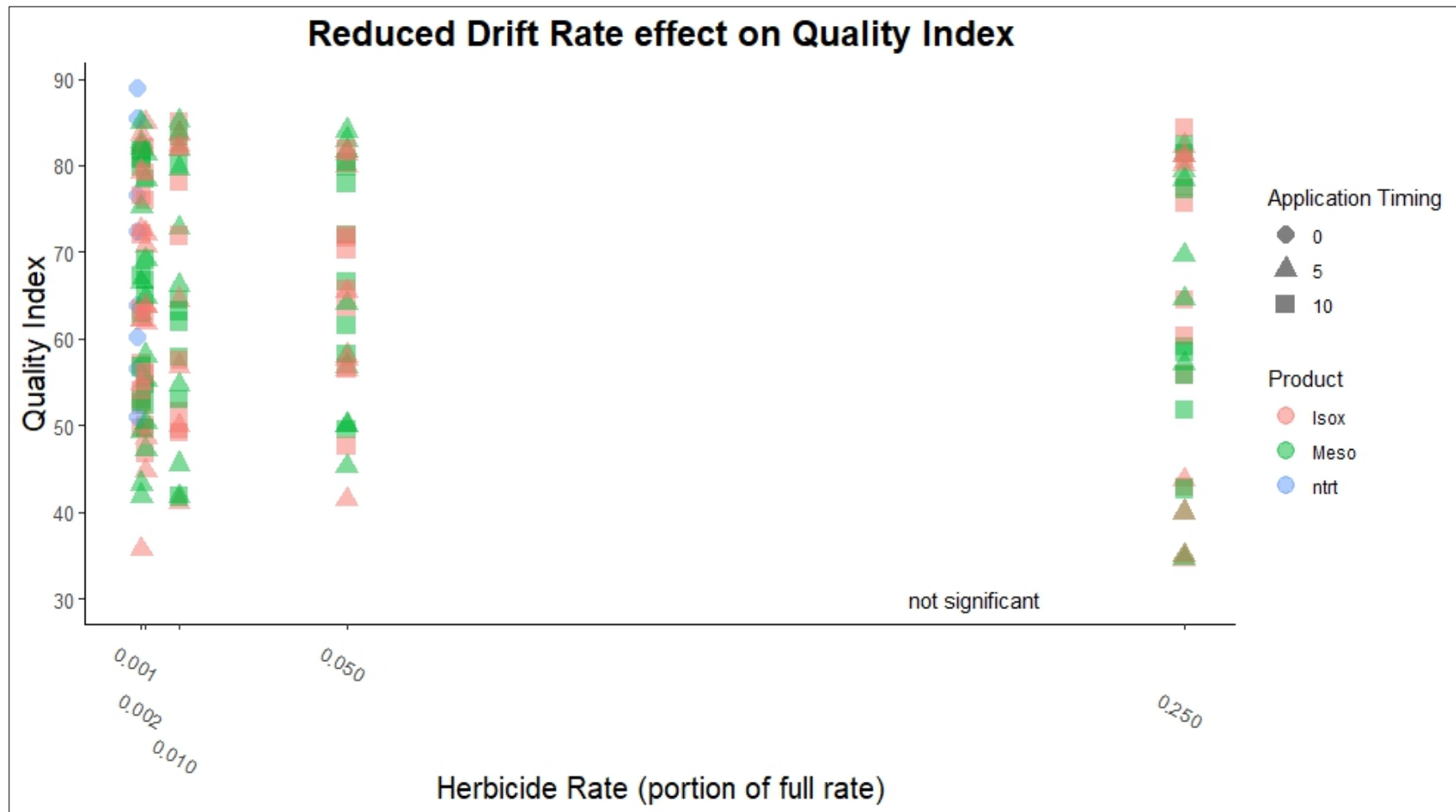


Color dots represent raw data. Black dots and error bars represent (estimated marginal) means ± 95% confidence interval per group. Means not sharing any letter are significantly different by the sidak-test at the 5% level of significance.



Color dots represent raw data. Black dots and error bars represent (estimated marginal) means ± 95% confidence interval per group. Means not sharing any letter are significantly different by the sidak-test at the 5% level of significance.

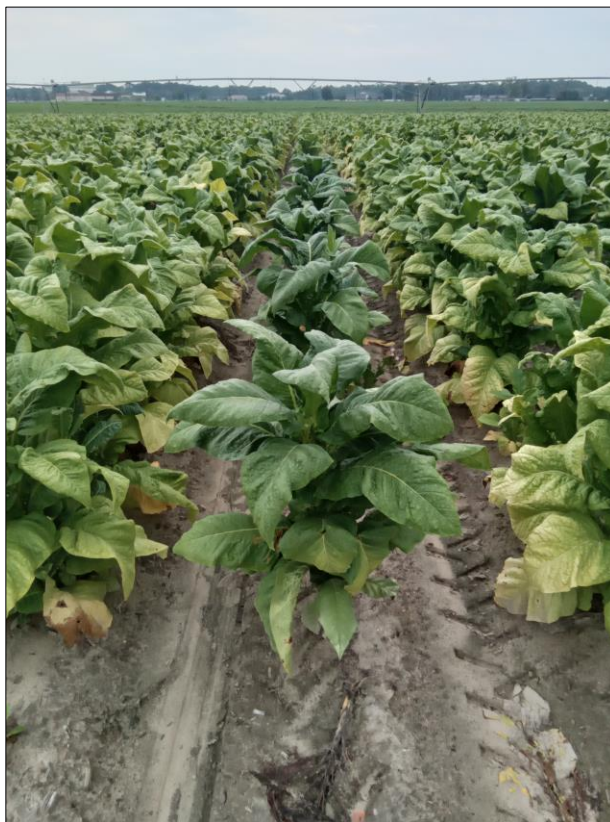




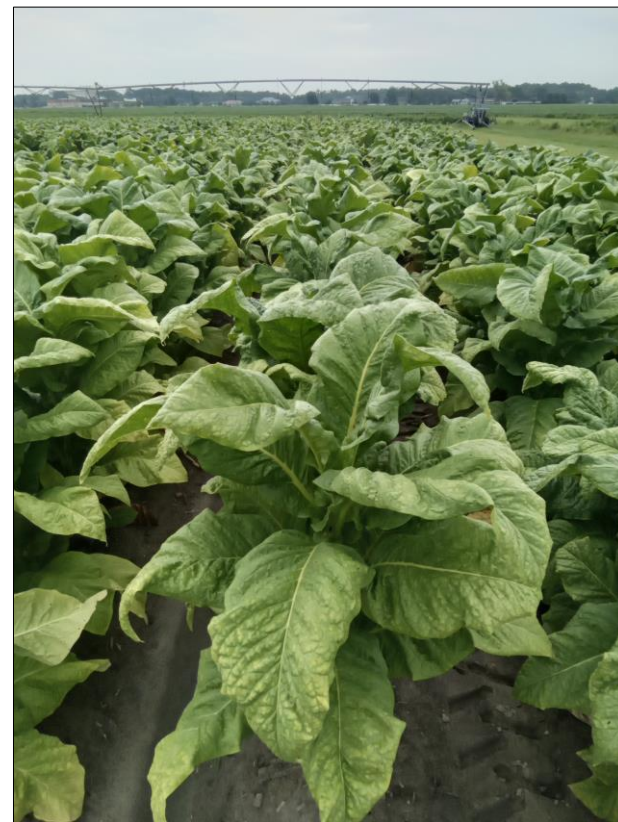
Isoxaflutole @ ¼ Rate



Mesotrione @ ¼ Rate



Non-treated Control

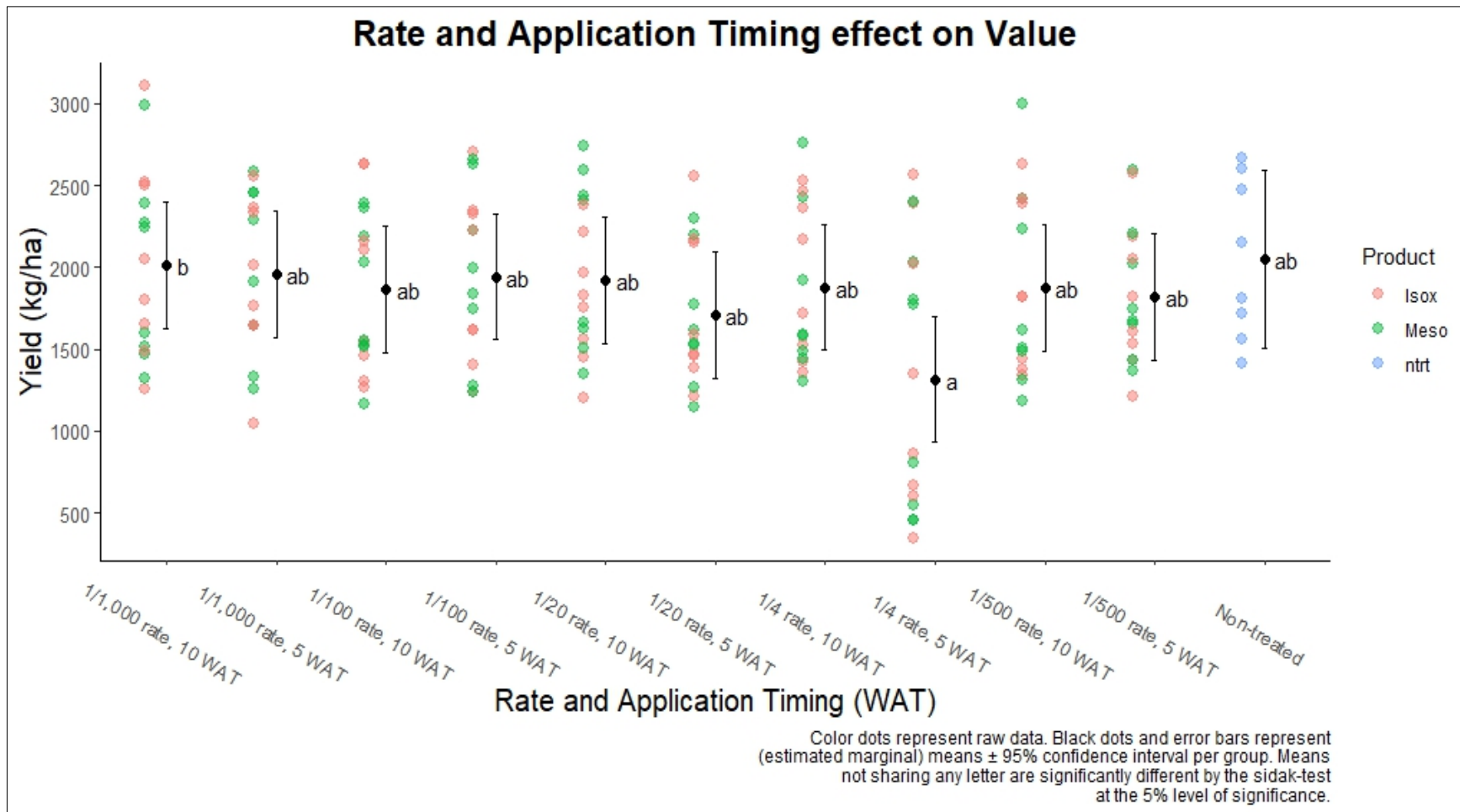


Applications made 5 Weeks After Transplanting



Significant leaf deterioration leading up to harvest, where leaves expressed HPPD symptomology





- Earlier exposure is more detrimental
- Rates lower than $\frac{1}{4}$ the full rate may not be detrimental to yield or economic value
- No yield difference between herbicide products
 - Visual injury differences at certain stages of growth
 - Mesotrione injury is more obvious
- 2023: late-season injury visible when exposure is pre-topping
- Unlikely that foliar drift will be anymore concerning than glufosinate or glyphosate
- Far less concerning that 2,4-d and/or dicamba

References

1. USDA-NASS. 2023. Quick Stats. <https://quickstats.nass.usda.gov/>
2. Dodson, L. 2023. Recent Trends in GE Adoption. USDA-ERS. 04 Oct., 2023. <https://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-u-s/recent-trends-in-ge-adoption/>
3. NCDA&CS. North Carolina Agricultural Statistics 2022. https://www.nass.usda.gov/Statistics_by_State/North_Carolina/Publications/Annual_Statistical_Bulletin/AgStat/NCaStatBook.pdf
4. NCDA&CS. North Carolina Agricultural Statistics 2017. https://www.nass.usda.gov/Statistics_by_State/North_Carolina/Publications/Annual_Statistical_Bulletin/AgStat2017.pdf

Acknowledgements

- North Carolina Tobacco Research Commission
- Maggie James – statistical analyses
- Grayson Wells, former Extension Agent – Greene County
- NC State Tobacco Agronomy Team
- Cunningham & Upper Coastal Plain Research Station
- Mr. Bobby Wellons – USDA Tobacco Grader
- Product Support: Syngenta Crop Protection, LLC & BASF Corporation

Questions??

mcvann@ncsu.edu

Website: tobacco.ces.ncsu.edu

Facebook: NC State Tobacco Information

Instagram: @ncstate_tobacco

Twitter (X): @ncstatetobacco

