

2025 NC State Tobacco Extension Agronomy Update – Focusing on Variety Selection

Matthew Vann & Maggie James
Department of Crop & Soil Sciences



Presentation Outline

1. Historical Context
2. Data Analysis
3. Results
4. Current Observations



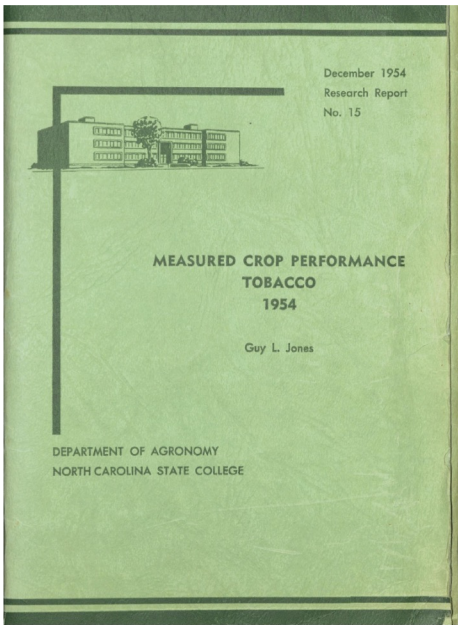
Flue-cured tobacco in
Stokes County, NC (1956)



NC STATE

EXTENSION

Historical Context



- NC State University maintains crop performance data
- FCV data archive from 1954 – 2023
- Robust dataset, likely the largest in the world
 - 334 unique varieties
 - 283 unique testing environments
 - 70 different production seasons
 - 7 different farm locations – 4 production belts
- Rare opportunity to monitor variety performance in a controlled environment
 - Impossible with federal or state level production statistics

NC STATE UNIVERSITY

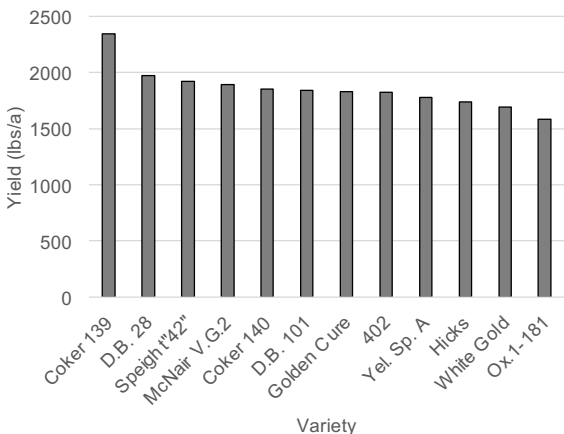
CROP AND SOIL SCIENCES

3

NC STATE

EXTENSION


Historical Context



- High yielding varieties released in mid-1950's
 - Rapid grower adoption due to quota system
 - High sugar, less than desired nicotine (12.8:1 reducing sugar to nicotine ratio)
 - Termed as “discount” varieties
- US FCV Minimum Standards Program
 - Initiated in 1963/1964
 - Provides oversight for chemical constituents and smoke sensory
- ALL** commercial varieties must meet Minimum Standards before release
- Program is perceived as a bottleneck for yield

Figure 1. Cured leaf yield of FCV varieties evaluated across three North Carolina environments in 1954.

HISTORY OF THE REGIONAL MINIMUM STANDARDS PROGRAM FOR THE RELEASE OF FLUE-CURED TOBACCO VARIETIES¹ IN THE UNITED STATES



Bowman, DT. 1996. History of the Regional Minimum Standards Program for the Release of Flue-Cured Tobacco Varieties in the United State. Tobacco Science, 40: 99-110.

4

NC STATE

EXTENSION

Recent Understanding

- **In 2018/2019:**
 - Dr. Ford Ramsey (Virginia Tech) led an effort to digitize historical data from NC State University.
 - Bayesian models were used to identify trends with yield and chemistry from 1954 - 2017
 - Presentation delivered at 49th TWC in Louisville, KY, USA (2020)
 - Publication: Journal of Agricultural & Applied Economics

Journal of Agricultural and Applied Economics (2021), 53, 563-586
doi:10.1017/aae.2021.25

RESEARCH ARTICLE

Bayesian Hierarchical Models for Measuring Varietal Improvement in Tobacco Yield and Quality

A. Ford Ramsey^{1*} and Roderick M. Rejesus²

¹Department of Agricultural and Applied Economics, Virginia Tech, Blacksburg, VA, USA and ²Department of Agricultural and Resource Economics, North Carolina State University, Raleigh, NC, USA
*Corresponding author. Email: af Ramsey@vt.edu

Abstract
We measure the economic impact of varietal improvement and technological change in flue-cured tobacco across quantity (e.g., yield) and quality dimensions under a voluntary quality constraint. Since 1961, flue-cured tobacco breeders in the United States have been subject to the Minimum Standards Program that sets limits on acceptable quality characteristics for commercial tobacco varieties. We implement a Bayesian hierarchical model to measure the contribution of breeding efforts to changes in tobacco yields and quality between 1954 and 2017. The Bayesian model addresses limited data for varieties in the trials and allows easy generation of the necessary parameters of economic interest.

Key words: Bayesian hierarchical model; crop quality; genetic improvement; technological change; tobacco; variety trials
JEL classifications: Q16; C11; D24

CAMBRIDGE
UNIVERSITY PRESS

NC STATE UNIVERSITY
CROP AND SOIL SCIENCES

5

NC STATE

EXTENSION

Recent Understanding

- Significant yield gains from 1954 to about 1980/81
- Yield plateau documented after 1981
 - Largely attributed to release of K326
- Slight increase in yield in the early 2000's
 - Increase of 5 lb/acre/year beginning in 2002
 - Possible relation to the release of NC 196
- No strong evidence that the US FCV Minimum Standards has been a limitation to quality enhancement

NC STATE UNIVERSITY
CROP AND SOIL SCIENCES

6

What About Today?

- Since 2017, new varieties have entered the testing program
- What contribution do they make to this dataset?
- Are there other things we can learn?
- How might other statistical models impact what we know?



NC960 in Wilson County, NC (2024)



NC991 in Johnston County, NC (2024)

Photos courtesy of Bryant Spivey and Norman Harrell, NC Cooperative Extension

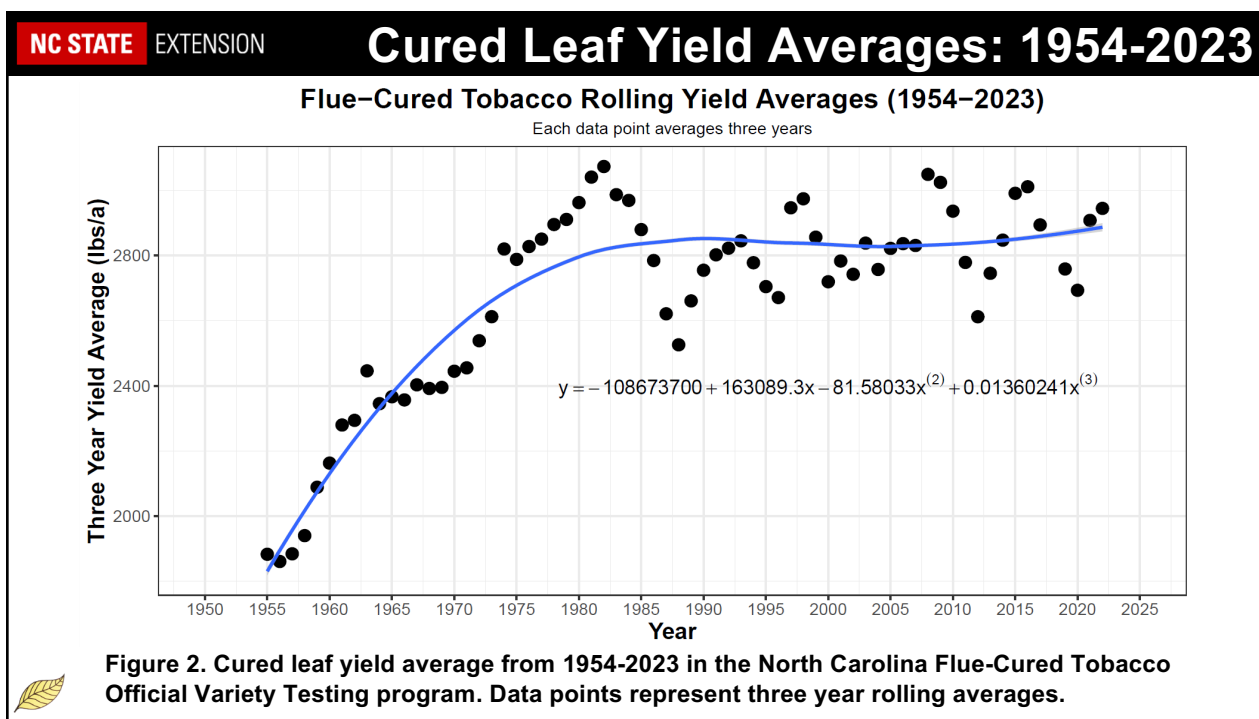
7

Objectives

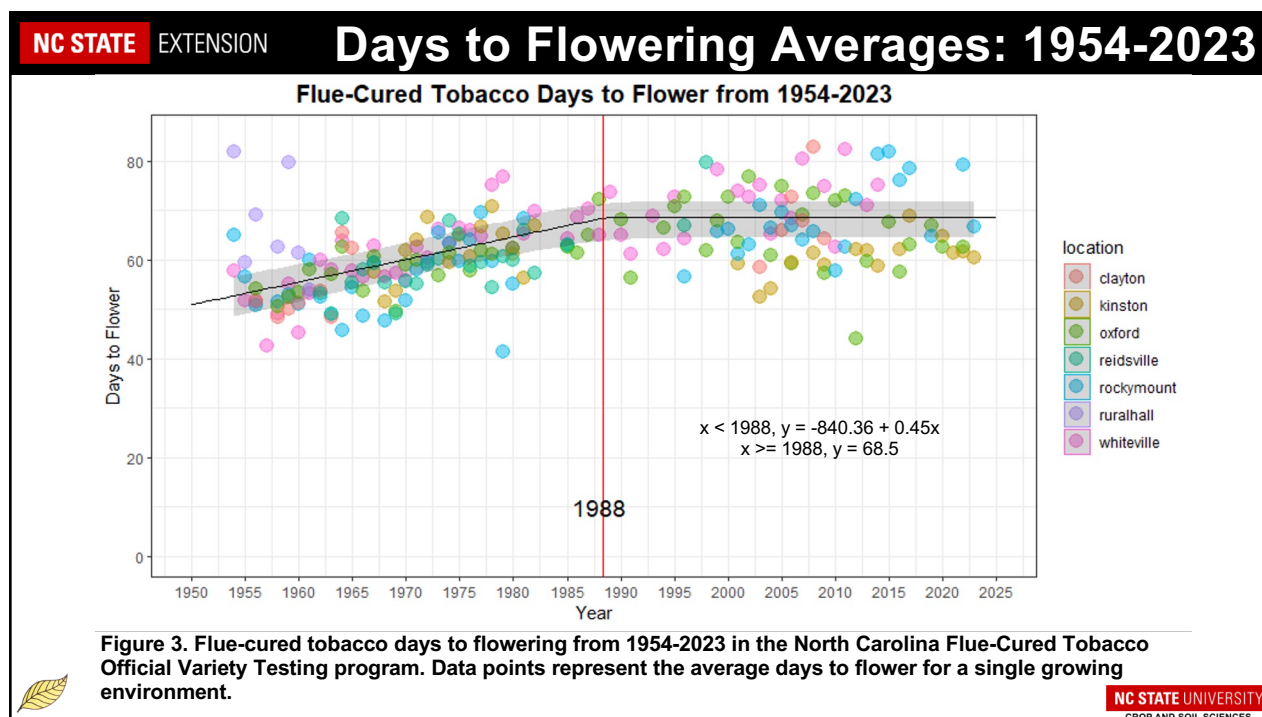
1. Re-evaluate the Ford Ramsey dataset
 - a) New statistical models (R package)
 - b) Adding data from 2019 – 2023
 - c) Analyzing chemical data from the 1950's and 2020's
2. Conduct a basic analysis of modern varieties planted from 2020 – 2024 and discuss commercial planting trends
3. Statistically evaluate the next generation of NC State varieties that are not yet available for purchase



8



9



10

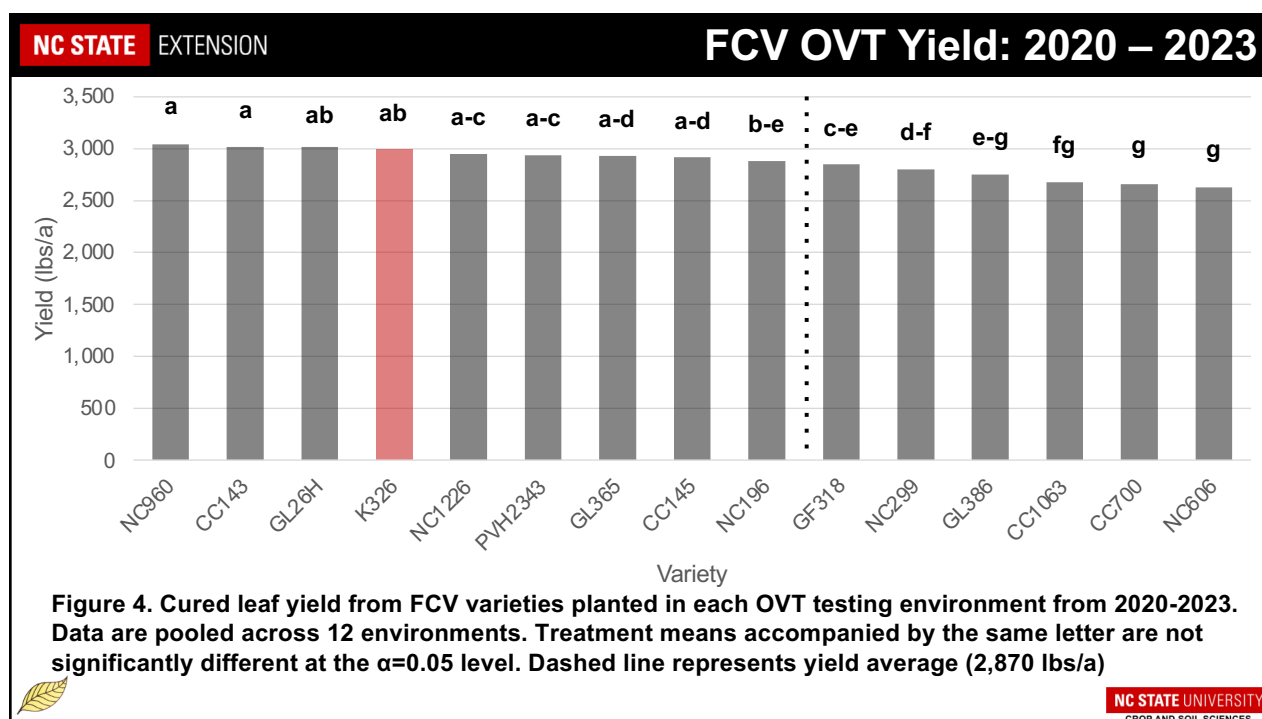
NC STATE EXTENSION *"I Wish Tobacco Yielded Like it Used To"*

Table 1. Comparison of cured leaf yield from the 1954-1957 and 2020-2023 production eras. Data represent individual commercial varieties.

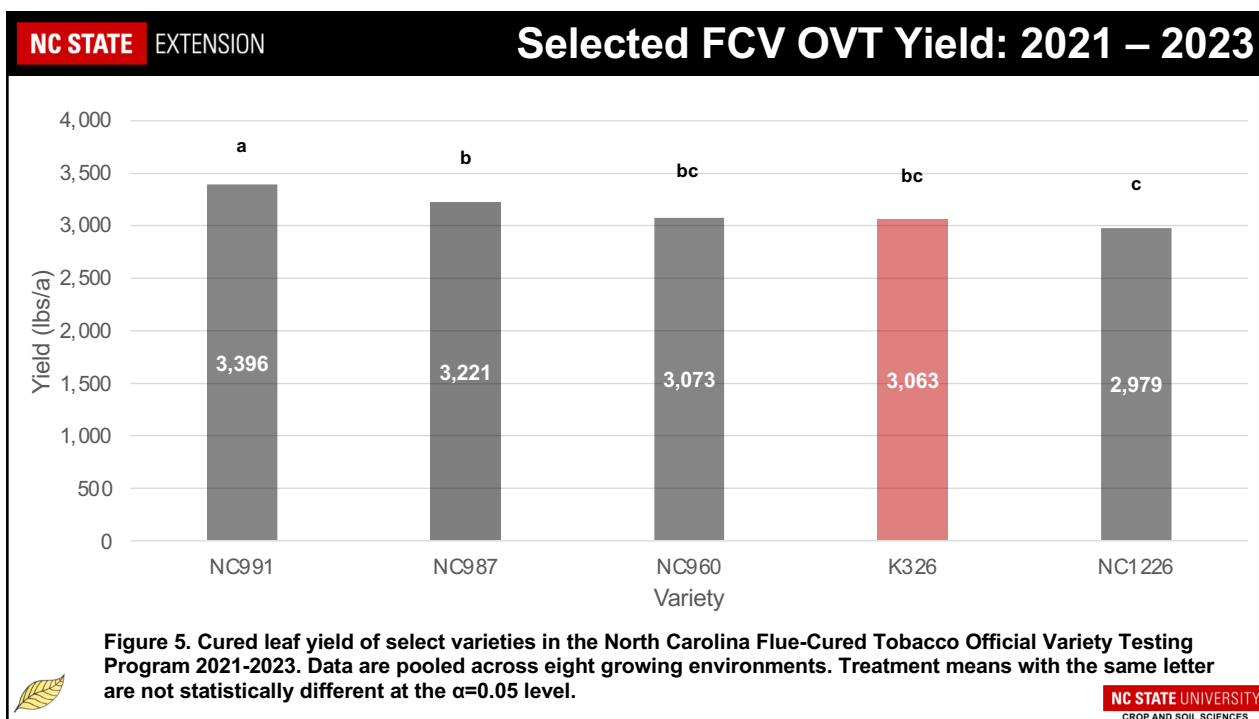
	1954-1957	2020-2023	Change
	lbs/a		%
Highest Yield vs. Highest Yield	2,306 (Coker 139)	3,043 (NC 960)	+32
Highest Yield vs. Lowest Yield	2,306 (Coker 139)	2,641 (NC 606)	+15

NC STATE UNIVERSITY
CROP AND SOIL SCIENCES

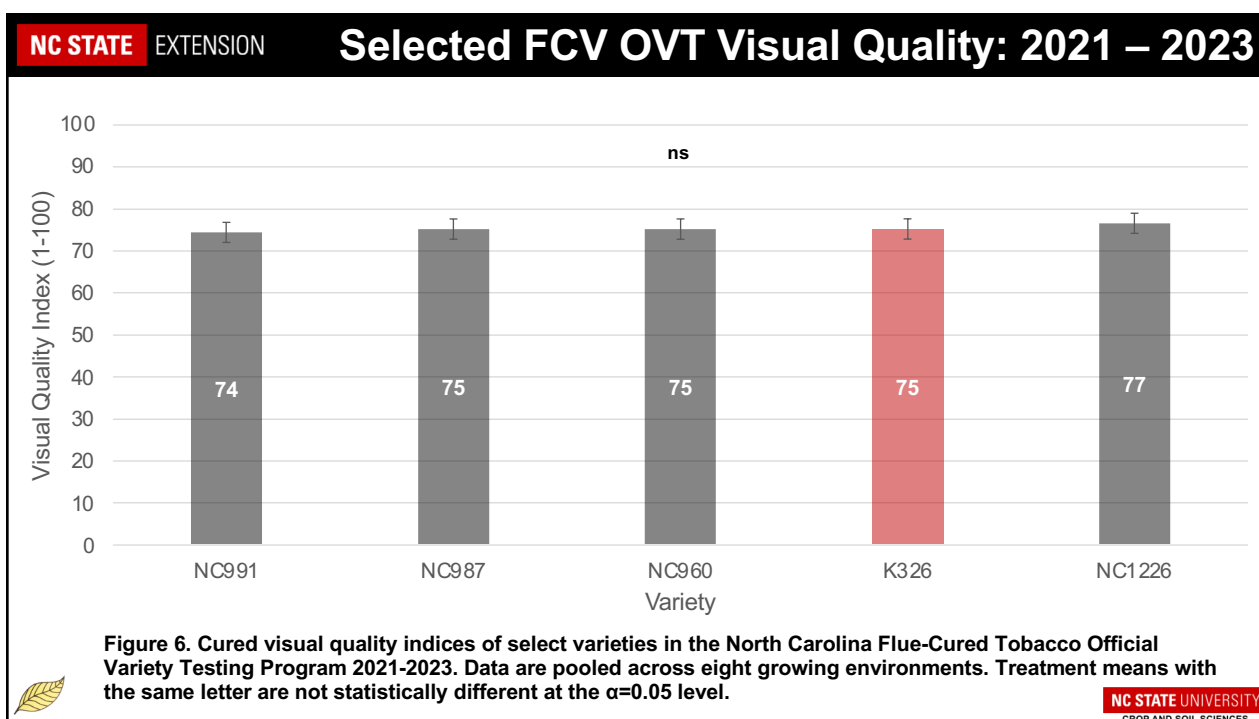
11



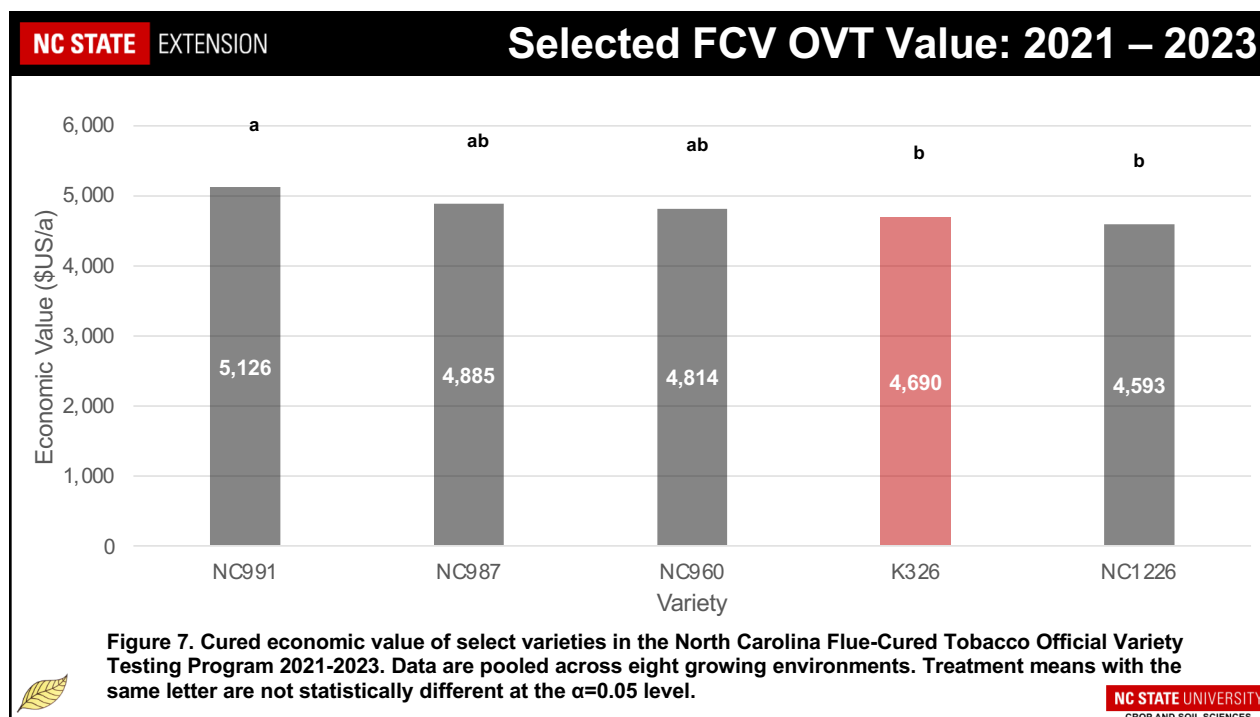
12



13



14




15

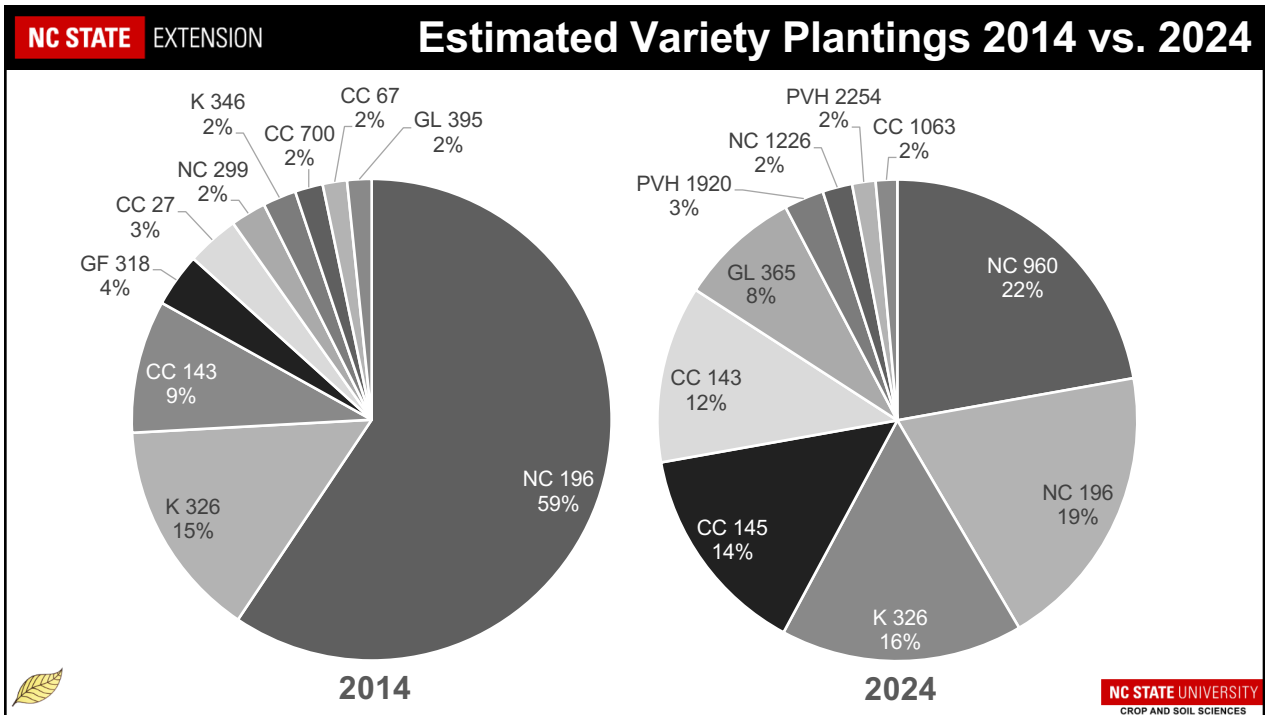
NC STATE EXTENSION

Objectives Revisted

1. Our data is somewhat similar to that reported by Ramsey and Rejesus (2021)
 - a) Yield increase after 2003
 - b) 15.6 day increase in time to flowering
 - c) CONSISTENT leaf chemistry
2. Modern varieties have similar or higher yield potential than K326, and better disease resistance
3. Next generation varieties have superior yield to K326



16



17

NC STATE EXTENSION

Do I Wish Tobacco Yielded Like It Used To??

NO!!! We wouldn't be in business!!!

18

NC STATE

EXTENSION

What Has Really Happened to Yield?

1. Increased acreage
2. Timeliness of management
3. Disease losses
4. Insect losses
5. Weed pressure
6. Harvest Timing
7. Planting into marginal areas
8. Poor curing management
9. Changes in crop rotation
10. Use of non-essential inputs
11. Adverse weather
12. Limited irrigation infrastructure
13. Planting date
14. Topping/sucker control

Death by 1,000 Cuts

BUT it's not poor genetics!

NC STATE UNIVERSITY
 CROP AND SOIL SCIENCES

NC STATE

EXTENSION






2024 OVT Data

Table 2. Performance of commercial varieties in the North Carolina Official Variety Test, combined over Kinston, Rocky Mount, and Oxford 2024.

Variety	Yield (lb/a)	Value (\$/a)	Price (\$/cwt)	Grade Index	Days to Flower	Leaves per Plant	Plant Height (in.)	Leaf Spacing (in.)	Sol. Sug. (%)	Total Alk. (%)	Ratio Sug. To Alk.
CC1063	2871	3179	111.67	57	57	21.5	42	1.94	17.62	2.26	7.81
CC143	3127	3346	108.44	57	56	22.4	41	1.84	20.04	2.19	9.16
CC145	3055	3294	109.27	57	54	21.8	43	1.97	18.61	2.30	8.09
CC603	3104	3369	110.01	57	58	22.7	41	1.82	20.02	2.28	8.79
CC607	2911	3290	114.62	59	56	21.9	41	1.89	18.67	2.10	8.89
CC700	2722	3055	112.94	57	53	21.3	39	1.83	17.76	2.39	7.43
GF318	2839	2917	103.07	53	54	22.2	42	1.88	19.88	2.22	8.95
GL26H	3119	3355	111.13	58	57	22.0	40	1.82	19.53	2.58	7.58
GL365	3123	3551	114.79	59	60	24.1	40	1.65	18.29	2.41	7.59
GL386	3031	3166	105.42	56	55	21.4	42	1.96	19.50	2.41	8.09
GL395	2707	2963	110.12	56	55	21.4	41	1.93	17.38	2.64	6.57
K326	3013	3288	109.37	56	53	22.4	40	1.78	20.87	2.19	9.53
K346	2658	2830	109.06	56	57	21.1	40	1.91	18.79	2.20	8.54
NC1006	3393	3661	109.29	57	53	20.9	41	1.97	19.91	2.19	9.09
NC1007	3303	3438	110.30	56	57	20.9	43	2.06	19.81	2.20	9.01
NC1111	3313	3599	110.88	57	55	21.4	41	1.90	21.01	2.43	8.65
NC1113	3227	3396	106.22	55	58	21.5	40	1.88	20.24	2.19	9.25
NC1226	3132	3191	103.99	54	59	22.1	40	1.82	17.94	2.10	8.54
NC196	3164	3557	112.96	58	54	22.2	43	1.93	20.10	2.37	8.49
NC299	3196	3381	106.07	54	55	22.0	41	1.84	19.31	2.19	8.82
NC606	2794	3166	114.29	58	56	21.0	42	1.98	20.32	2.60	7.82
NC71	3281	3445	106.22	55	57	21.8	39	1.77	19.38	2.53	7.65
NC960	3178	3193	102.02	52	60	21.5	42	1.94	19.77	2.14	9.22
NC991	3009	3278	110.29	56	57	21.2	39	1.86	19.79	2.27	8.70
NC993	3161	3251	105.56	55	59	22.5	40	1.77	18.67	2.00	9.33
NC996	3437	3418	99.91	52	56	20.8	43	2.05	20.61	2.22	9.27
PVH1920	2821	2973	110.38	56	55	22.7	40	1.77	18.84	2.33	8.08
PVH1940	2607	2950	113.72	59	56	22.2	41	1.83	14.28	2.64	5.40
PVH1980	2727	3044	111.82	58	53	22.4	41	1.82	16.22	2.36	6.89
PVH2233	3332	3629	110.80	57	60	23.1	41	1.79	20.32	1.88	10.62
PVH2254	3058	3143	103.34	53	57	22.7	42	1.86	18.15	2.36	7.70
PVH2310	2766	3222	116.86	60	54	21.5	42	1.96	16.93	2.09	8.11
PVH2343	3194	3209	102.43	53	58	22.2	42	1.88	19.11	2.00	9.56
PXH53	3256	3577	111.12	58	58	21.6	40	1.87	19.07	2.58	7.40
PXH70	3161	3566	113.23	58	58	21.6	41	1.90	20.00	2.40	8.33
Average	3051	3282	109.19	56	56	21.9	41	1.88	19.05	2.29	8.38

NC STATE EXTENSION				2024 OVT Data	
Variety	Yield (lb/a)	Variety	Yield (lb/a)	Variety	Yield (lb/a)
CC1063	2871	CC1063	2871	PVH2233	3332
CC143	3127	CC143	3127	NC71	3281
CC145	3055	CC145	3055	PXH53	3256
CC603	3104	CC603	3104	NC299	3196
CC607	2911	CC607	2911	PVH2343	3184
CC700	2722	CC700	2722	NC960	3178
GF318	2839	GF318	2839	NC196	3164
GL26H	3119	GL26H	3119	PXH70	3161
GL365	3123	GL365	3123	NC1226	3132
GL386	3031	GL386	3031	CC143	3127
GL395	2707	GL395	2707	GL365	3123
K326	3013	K326	3013	GL26H	3119
K346	2658	K346	2658	CC603	3104
NC1006	3393	NC1006	3393	PVH2254	3058
NC1007	3303	NC1007	3303	CC145	3055
NC1111	3313	NC1111	3313	GL386	3031
NC1113	3227	NC1113	3227	K326	3013
NC1226	3132	NC1226	3132	K346	2658
NC196	3164	NC196	3164	NC1226	3132
NC299	3196	NC299	3196	NC196	3164
NC606	2794	NC606	2794	NC299	3196
NC71	3281	NC71	3281	NC606	2794
NC960	3178	NC960	3178	NC71	3281
NC991	3009	NC991	3009	NC960	3178
NC993	3161	NC993	3161	PVH1920	2821
NC996	3437	NC996	3437	PVH1940	2607
PVH1920	2821	PVH1920	2821	PVH1980	2727
PVH1940	2607	PVH1940	2607	PVH2233	3332
PVH1980	2727	PVH1980	2727	PVH2254	3058
PVH2233	3332	PVH2233	3332	PVH2310	2766
PVH2254	3058	PVH2254	3058	PVH2343	3184
PVH2310	2766	PVH2310	2766	PXH53	3256
PVH2343	3184	PVH2343	3184	PXH70	3161
PXH53	3256	PXH53	3256	Average	2998
PXH70	3161	PXH70	3161		
Average	3051	Average	3051		

21

NC STATE EXTENSION	
<h1>Questions??</h1>	
Matthew C. Vann: matthew_vann@ncsu.edu	
Website: tobacco.ces.ncsu.edu	
	NC State Tobacco Information
	@NCSUtobacco
	@ncstate_tobacco
 <p>Text Message Sign Up QR</p>	
	

23