The Effect of Cultivar and Tip Leaf Harvest Schedule to the Yield, Quality, Value, and Grade Distribution of Flue-Cured Tobacco

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Introduction – Tobacco Production in North Carolina

- FCV represents ≈6.3% of total farm receipts (7)
  - 668.5 million USD in 2016 (7)
- 54% of the total crop was exported in 2016 (4)
  - More than double the export volume from 1996 (3,10)
- US leaf serves a niche market for premium cigarette products due to flavor/aroma profiles

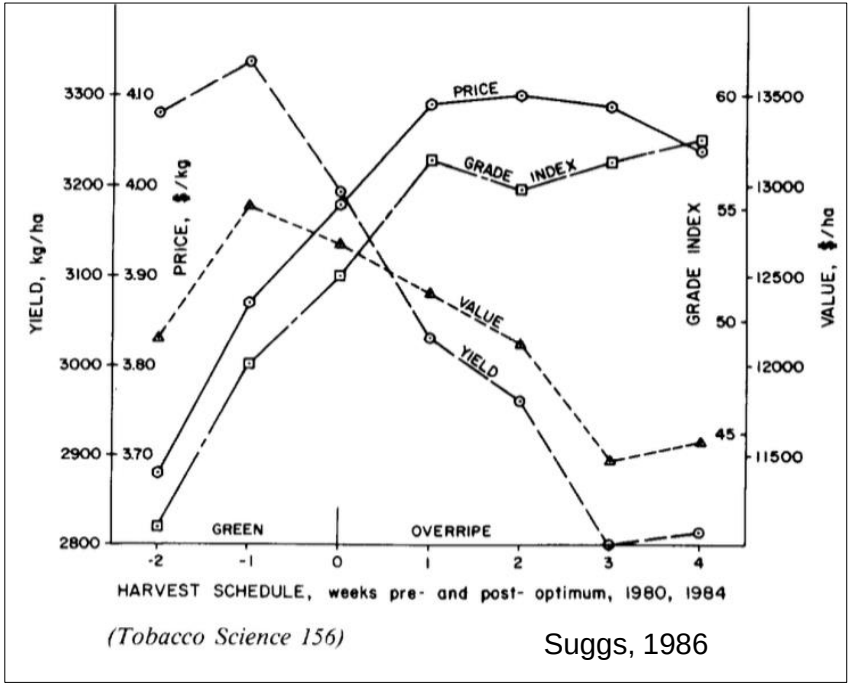
Introduction – Cured Leaf Grades

- Upper-stalk leaves are more desirable due to flavor value in cigarette blends (5)
- Leaf ripeness at the time of harvest dictates product usability (8)
  - Immature/under-ripe leaf = poor flavor/aroma and low value
  - Ripe/over-ripe = improved flavor/aroma and high value
- Changes in buying preference among merchants and manufacturers
  - Orange to Red (over-ripe) vs. Lemon (under-ripe, N starved)
  - Some US buyers have indicated that they will not purchase under-ripe leaf

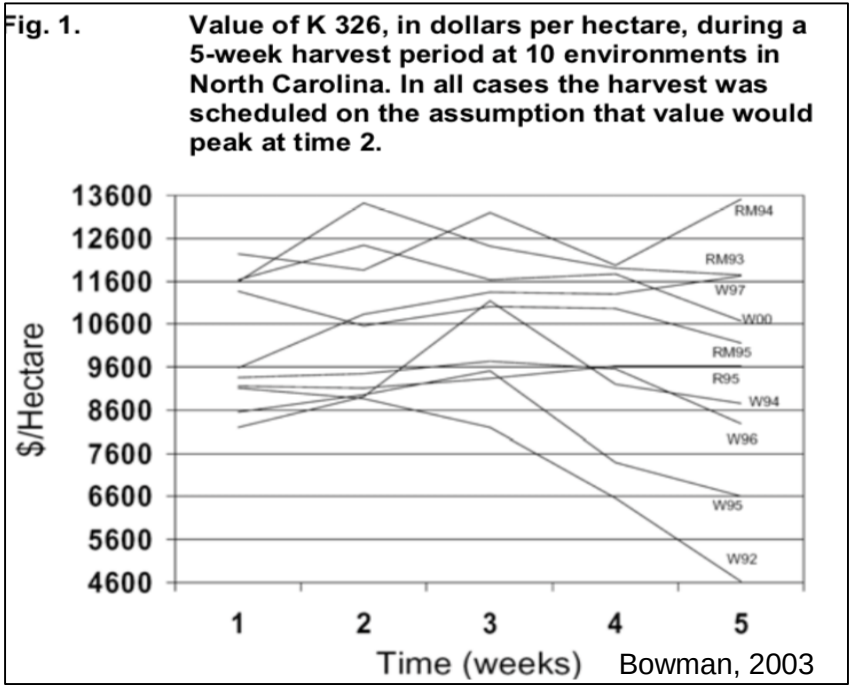
Introduction – Agronomic Implications

- Yield is maximized at the peak of physiological maturity and generally declines as ripening (senescence) advances
  - Suggs (9) documented a 17% yield reduction from one week under-ripe to three weeks over-ripe (3 to 4% per week).
  - Bowman (1) reported similar findings, but noted significant variation among environments.
- Leaf quality is increased due to the reduction of Green (G), Greenish (V), and Variegated (KL, KV, KD, KM, and KF) grades
- Value will improve with quality, despite slight reductions in yield
- Advanced ripening increases alkaloid concentration and lowers reducing sugar concentration, due to respiratory losses of carbohydrates (8)

The Influence of Harvest Schedule to Post-Curing Measurements



Suggs, 1986



Bowman, 2003

Introduction – Holding Ability

- Cultivars with good holding ability are able to maintain leaf quality and value for an extended period of time after peak ripeness (1).
- These cultivars allow for modification of harvest schemes that aid in curing capacity without major economic loss (1).
- In general, K326 and NC196 are considered to have good holding ability in the absence of adverse growing conditions.
- A secondary benefit of holding ability is the promotion of color change.

Objectives

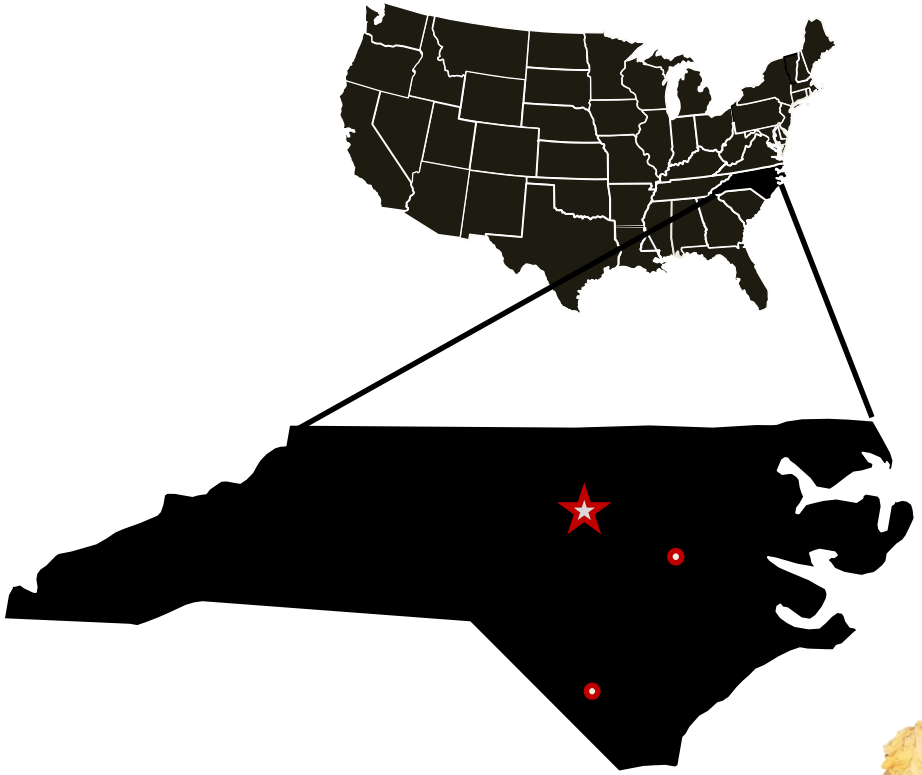
1. Identify changes in agronomic characteristics of upper-stalk positions as harvest is delayed.

2. Quantify the holding ability of K326 and NC196.

3. Provide generalized harvest recommendations to flue-cured tobacco producers in North Carolina.

Methods & Materials

- Four environments
- RCBD w/factorial treatment arrangement – four replications
  - Two Cultivars: K326 and NC196
  - 5 Tip Leaf Harvest Timings: 7 days under-ripe, 3 days over-ripe, 13 days over-ripe, 23 days over-ripe, and 33 days over-ripe
- Single row plots w/20 plants per row
- Plot Dimension:
  - LCPRS: 4.5 m x 13.8 m
  - BBTRS: 4.9 m x 13.8 m



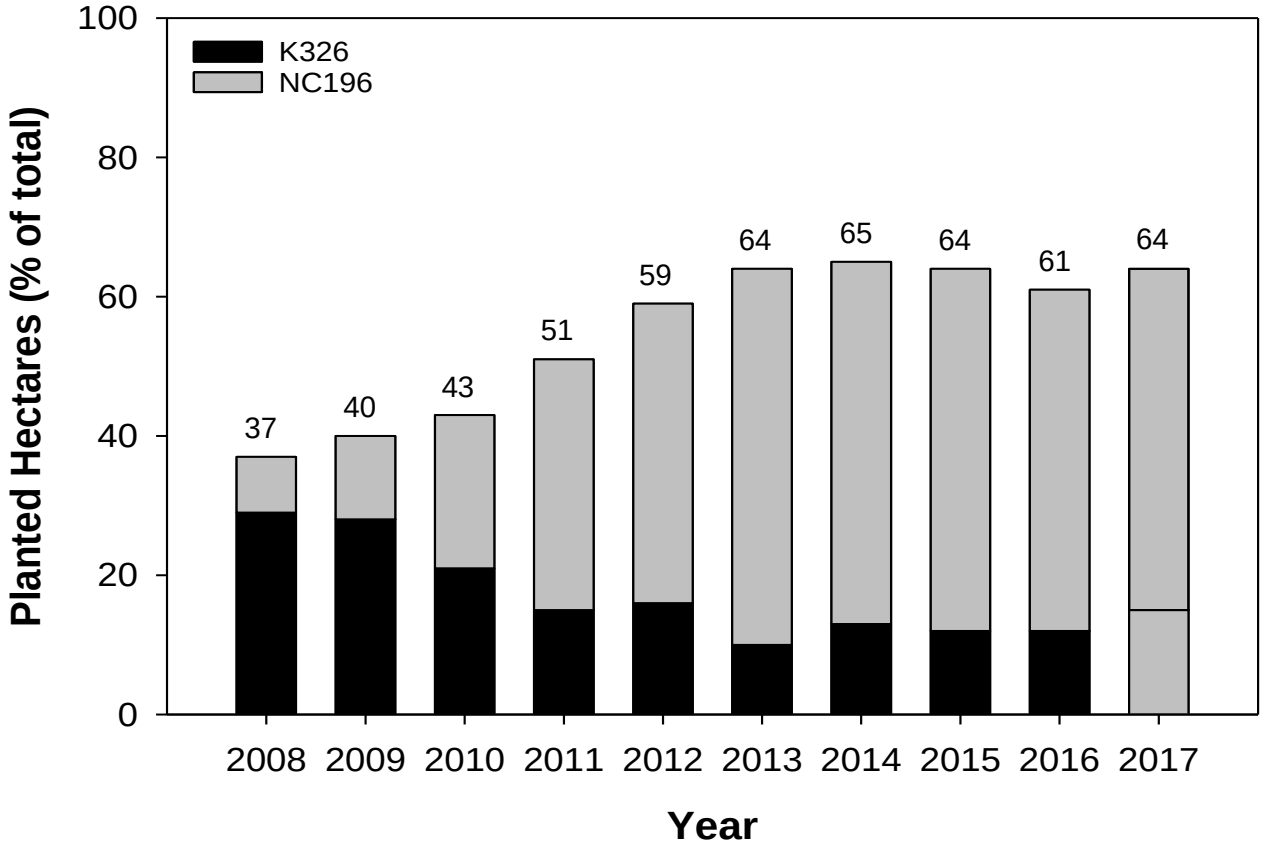


Figure 1. Estimated plantings of K326 and NC196 in North Carolina from 2008 to 2017. Data collected annually from Cooperative Extension Surveys.

Data Collection & Analysis – Analysis I

- Cured leaf yield from final harvest position (leaf + tip)
- Cured leaf quality based on USDA standard grades
- Price per kg
- Cured leaf value per hectare

- Proc Mixed procedure
  - SAS 9.4, $LSD_{0.10}$
  - Fixed Effects: Cultivar and Harvest Timing
  - Random Effects: Environment and Replication
- Variables Analyzed:
  - Cultivar
  - Harvest Schedule
  - Cultivar x Harvest Schedule

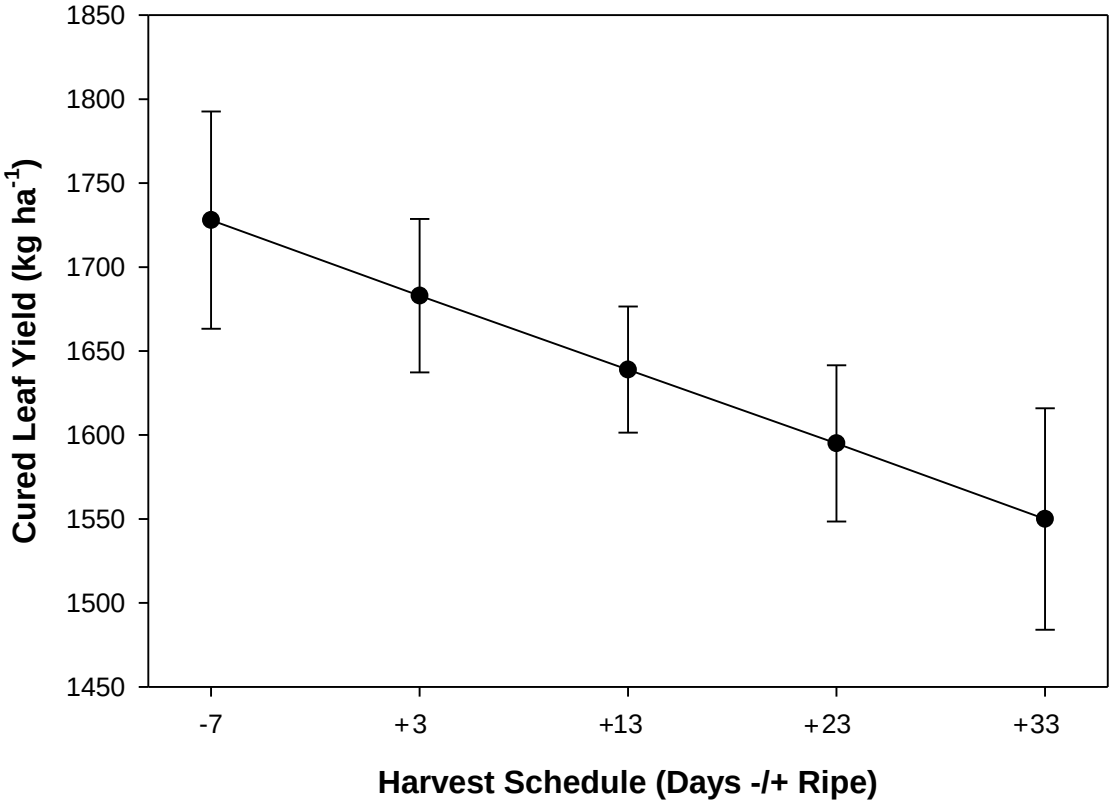
Table 1. The influence of flue-cured tobacco cultivar to tip leaf yield, quality, value per kilogram, and value per hectare[a]. Data are pooled across four growing environments and the main effect of harvest timing.

Cultivar	Tip Leaf Yield	Quality[b]	Price	Value
	kg ha^{-1}		\$ kg^{-1}	\$ ha^{-1}
K 326	1,619 a	80 a	3.58 a	5,723 a
NC 196	1,682 a	79 a	3.61 a	5,813 a

[a] Treatment means followed by the same letter within the same column are not significantly different at the α=0.10 level.
[b] Quality is assessed on a scale of 1-100, with 100 being of the highest quality.

Data Collection & Analysis – Analysis II

- Cured leaf yield from final harvest position (leaf)
- Cured leaf quality based on USDA standard grades
- Cured leaf value per kg
- Cured leaf value per hectare
- Proc Reg procedure
  - SAS 9.4
  - Harvest Schedule variable only



- Loss of 4.4 kg ha^{-1} day^{-1}
- Loss of 0.26% yield per day
- 10.3% reduction total

Figure 2. Cured tip leaf yield as influenced by harvest schedule. Data are pooled across four growing environments and the main effect of cultivar.

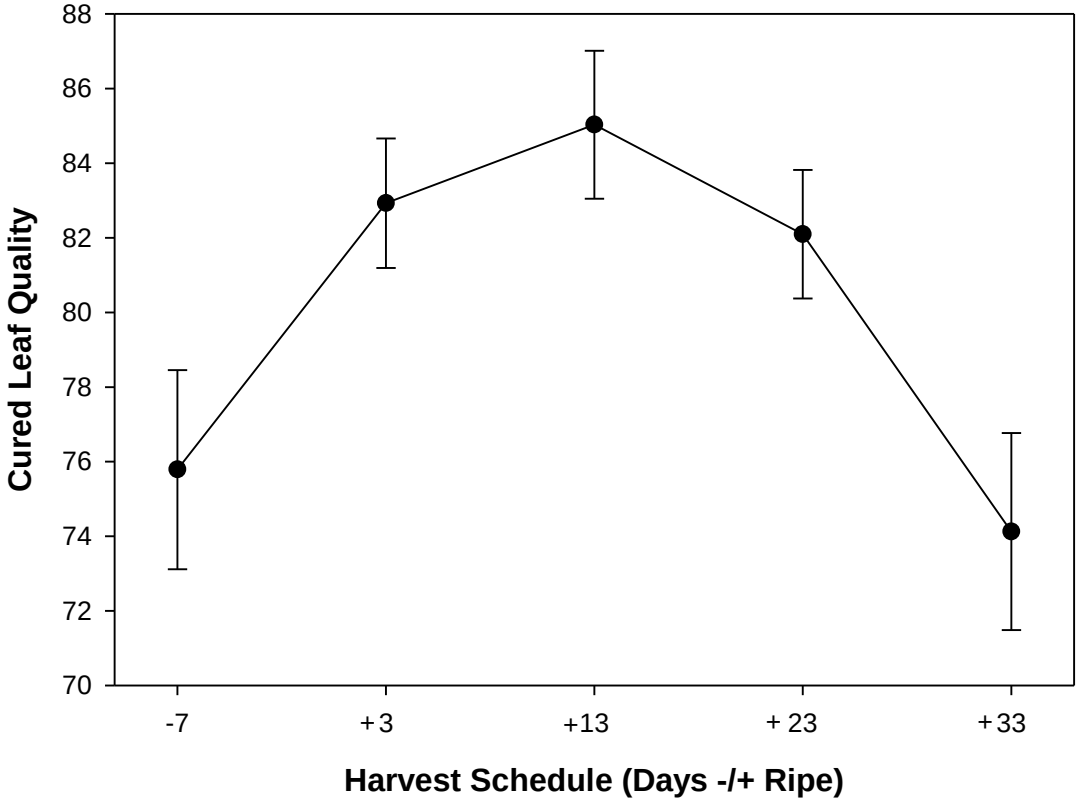
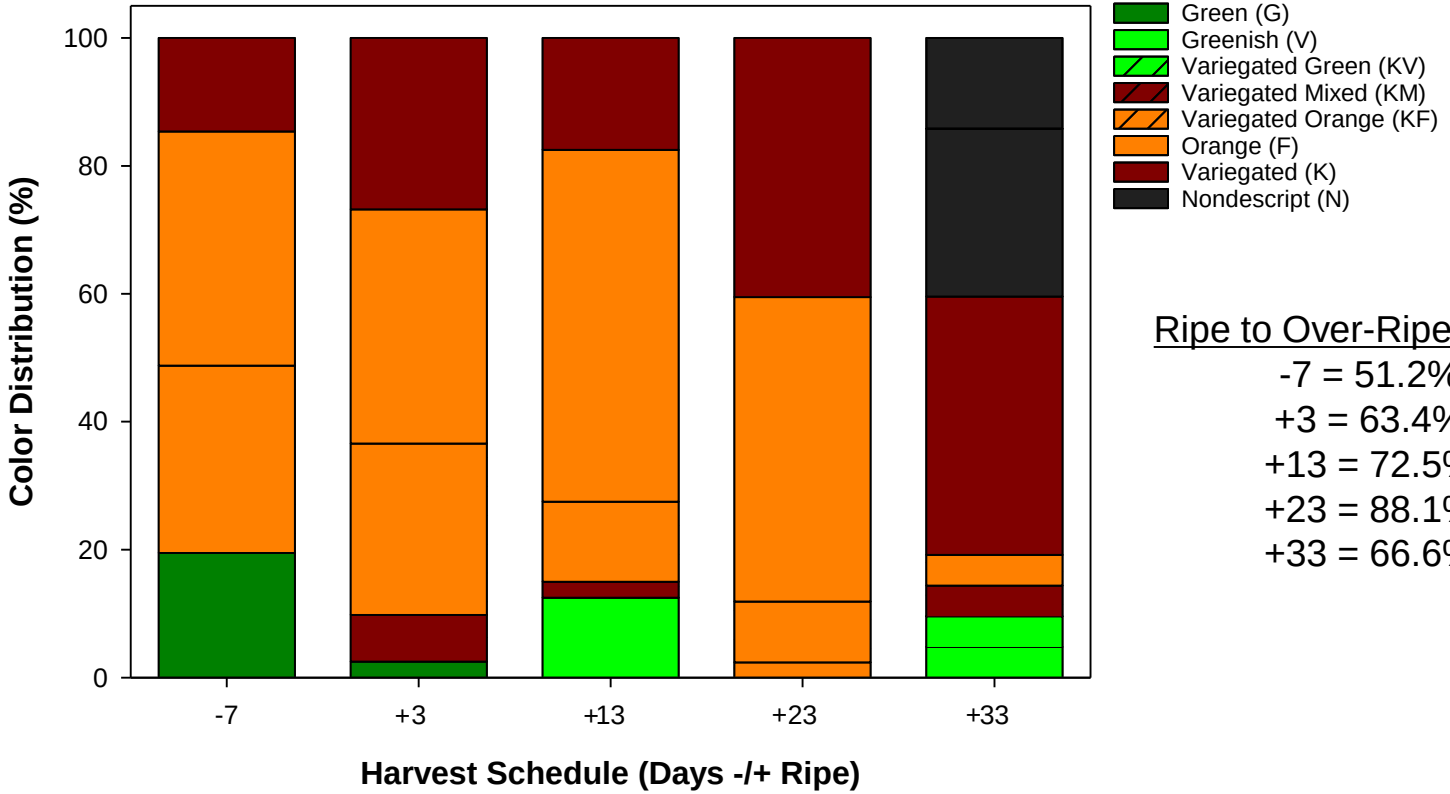


Figure 3. Cured tip leaf quality as influenced by harvest schedule. Quality assessed on a scale of 1-100, with 100 having the highest quality. Data are pooled across four growing environments and the main effect of cultivar.



Ripe to Over-Ripe Grades

-7 = 51.2%

+3 = 63.4%

+13 = 72.5%

+23 = 88.1%

+33 = 66.6%

Figure 4. Cured tip leaf color distribution as influenced by harvest schedule. Data are pooled across four growing environments and the main effect of cultivar.

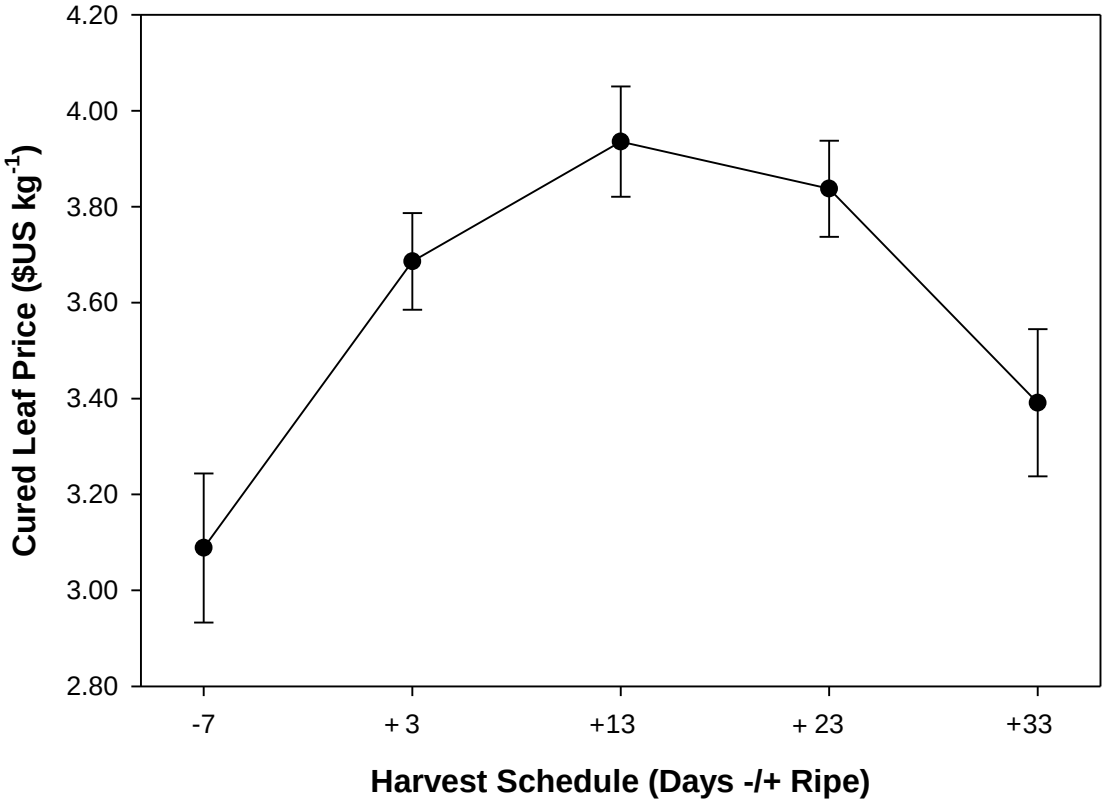


Figure 5. Cured tip leaf value per kilogram as influenced by harvest schedule. Data are pooled across four growing environments and the main effect of cultivar.

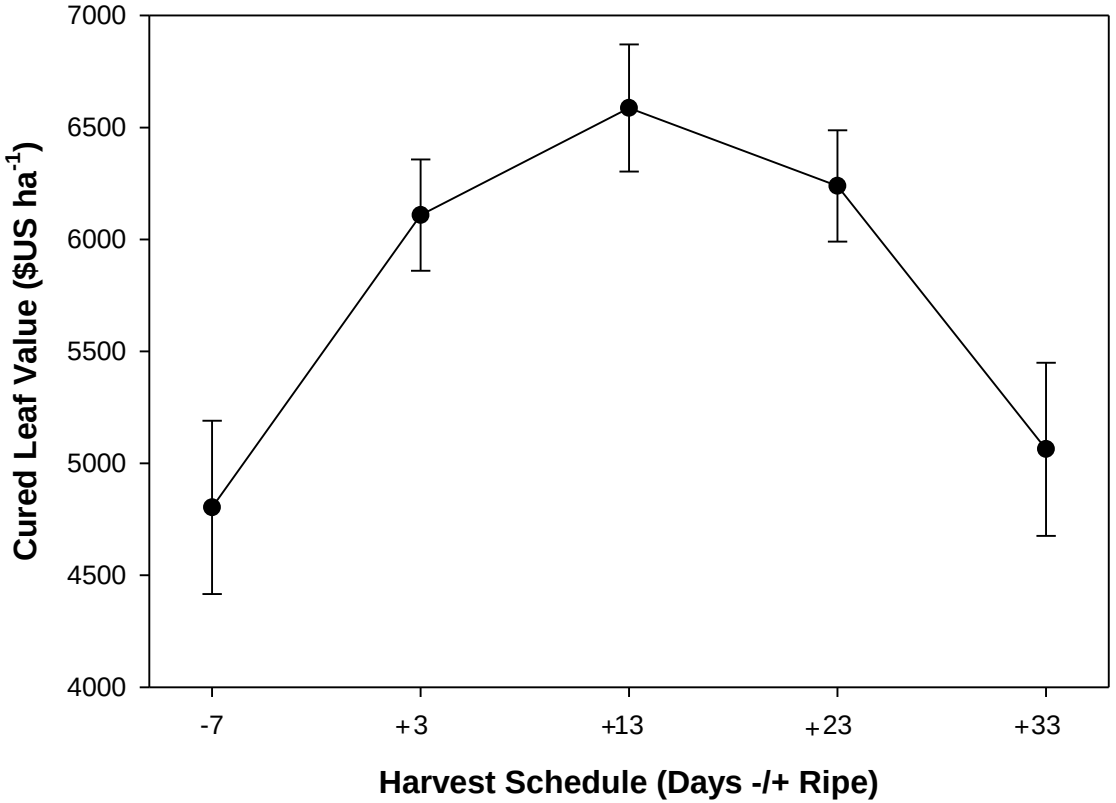


Figure 6. Cured tip leaf value per hectare as influenced by harvest schedule. Data are pooled across four growing environments and the main effect of cultivar.

Conclusions

- K326 and NC196 exhibit similar ripening patterns and holding ability.
  - Plausible that NC196 was developed using crosses from K326 (6).
  - Holding ability is a heritable trait (1).
  - Variety selection should be based upon disease resistance.

- Producers would benefit from delaying final harvest by as long as two weeks in order to promote the cured leaf characteristics desired by dealers and manufacturers.
  - Delays greater than two weeks may reduce cured leaf yield and lead to excessive deterioration.

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Questions??

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