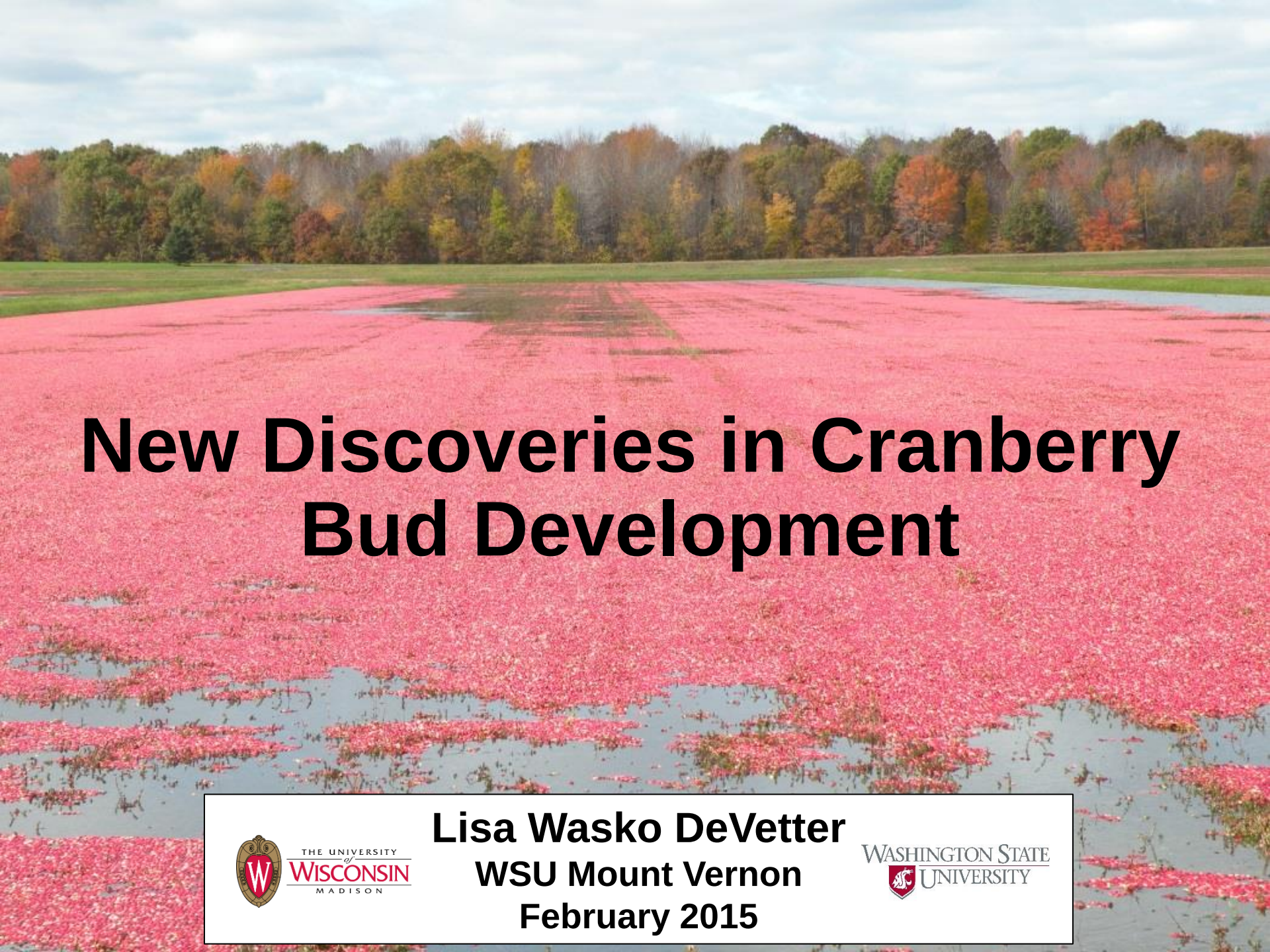

New Discoveries in Cranberry Bud Development

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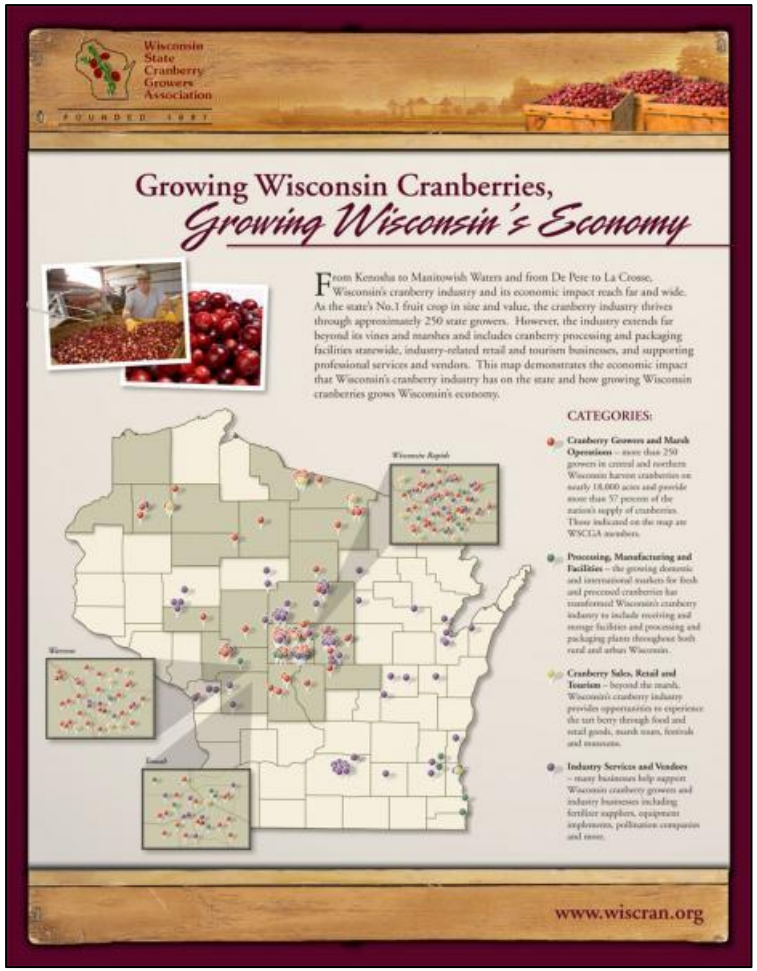
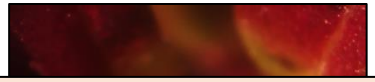
Cranberries in Wisconsin



- Wisconsin provides 50-60% of the nation's supply of cranberries
  - 21,100 acres harvested in 2013
  - Total value ~$1.9 million
- Grown in "marshes", not "bogs"
- Increasing acreage of new cultivars
- How do these new cultivars differ in yield traits, especially bud development?

(NASS, 2014)

Cranberry Bud Biology 101



- Anecdotal reports of enhanced yield and return bloom among new cultivars
- Most recent studies on cranberry bud development date back to early-to-mid 1900s

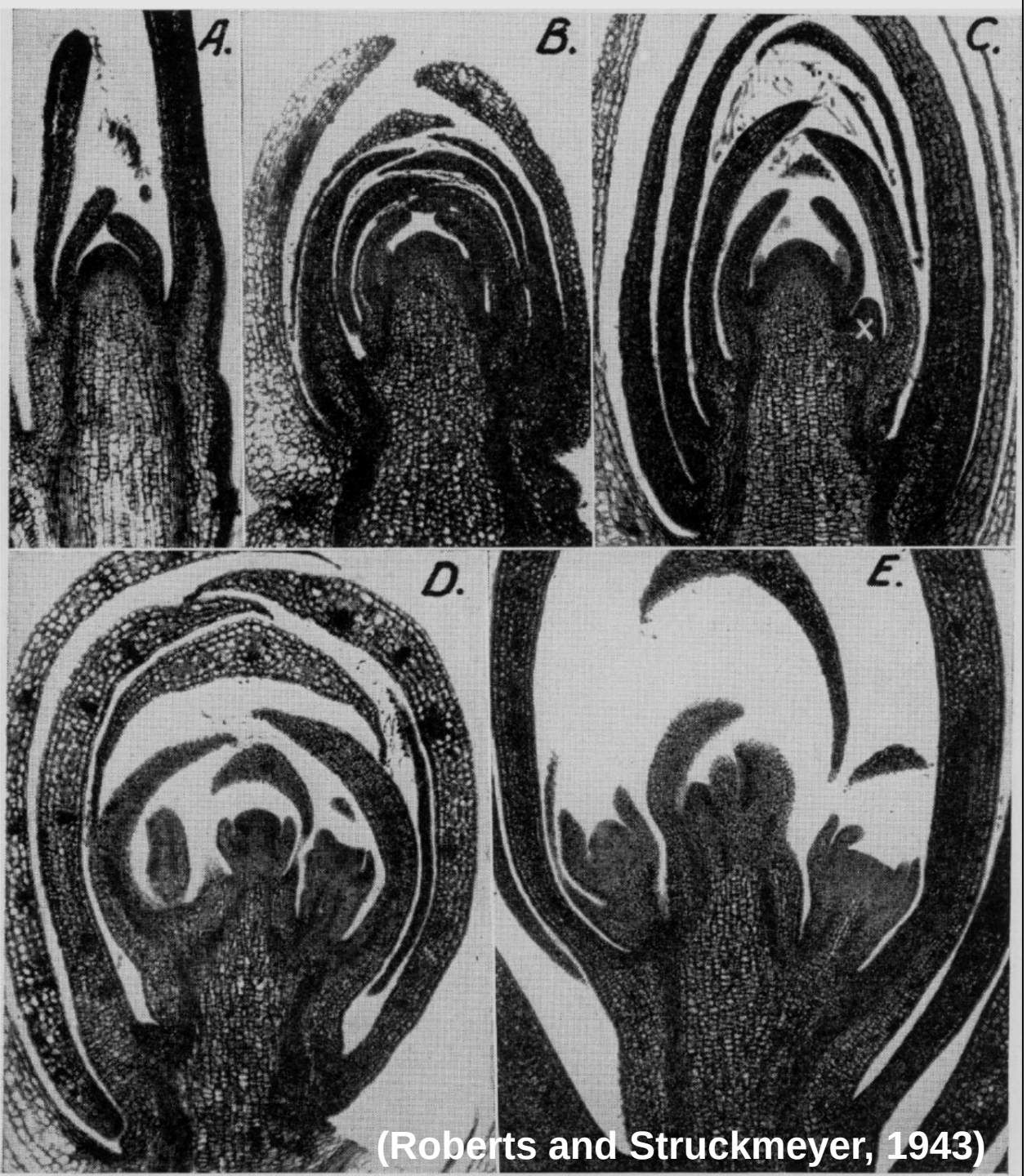
Vegetative Upright

Reproductive Upright

vegetative meristem and, in some instances, flower initials

What Did We Formerly Know?

- Goff (1901)
  - Flower initials begin to form in early September in WI
- Lacroix (1926)
  - Flower buds of ‘Howes’ and ‘Early Blacks’ visible by mid-August in MA; no bud growth occurs during winter, but resumes in spring
- Roberts and Struckmeyer (1943)
  - Flower initials identifiable by 29 July



(Roberts and Struckmeyer, 1943)

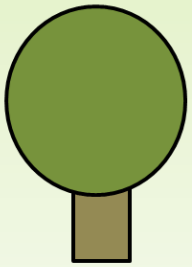
Reproductive Bud Induction in ‘McFarlin’

A. 19 June
B. 21 July
C. 29 July
D. 17 Aug.
E. 8 Sept.

Yield Prediction and the Role of Buds

Yield prediction often relies on visual assessment of bud set during the year prior to harvest

Terminal bud shapes, descriptors, and assumed reproductive/fruiting potential.



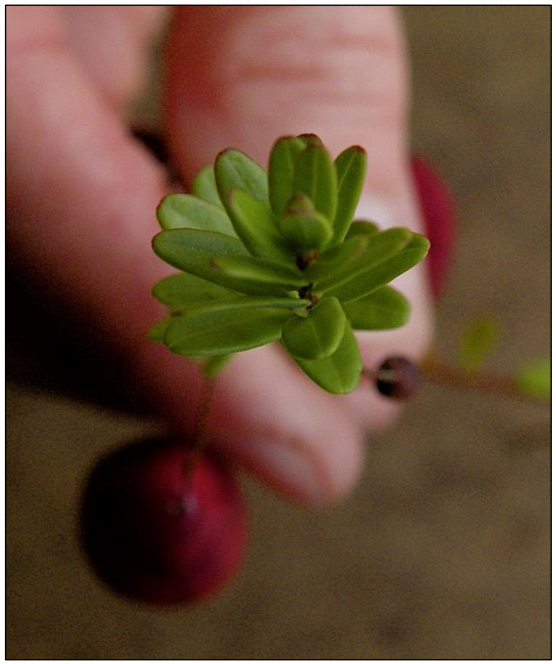
"Big and Wide"

- Mixed/"reproductive" bud
- Assumed to contain flower initials

"Small and Narrow"

- Vegetative bud
- Assumed to contain **no** flower initials (i.e. nonfruiting)

Project #1 Objectives



Compare, across cultivars:

1. Bud development and floral initiation throughout an entire growing season

2. Relationship between bud external appearance and the presence/ absence of floral initials

3. Potential for return bloom (i.e., “rebud”)

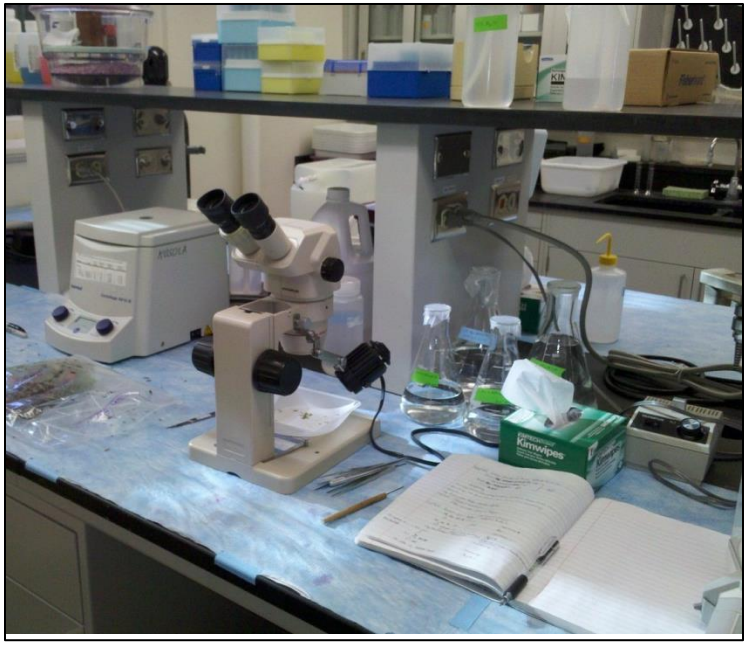
Methodology

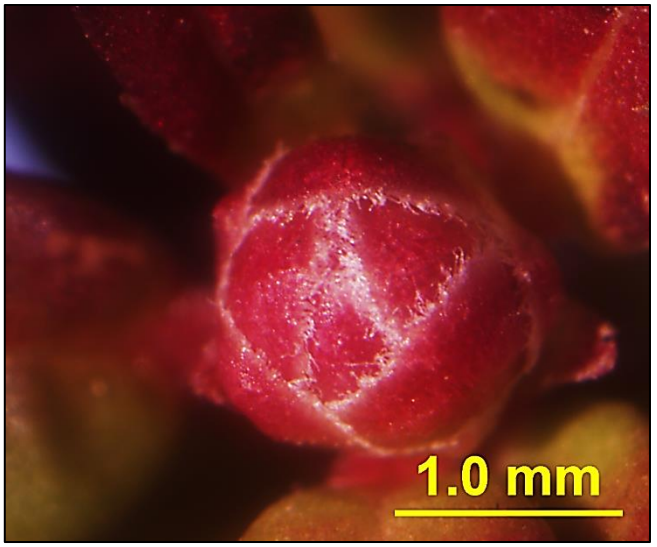
- **2011** → 100 uprights/bed every two weeks from 5 March to 7 Dec.
- **2012** → 70 uprights/bed, twice per week from 5 July to 30 Aug.; then collected 14 Sept. & 26 Oct.
  - Separate samples based on fruiting status
  - Bud dissections
  - Relate development to Growth Degree Days (GDD)
    - Base = 45 °F and Max = 86 °F

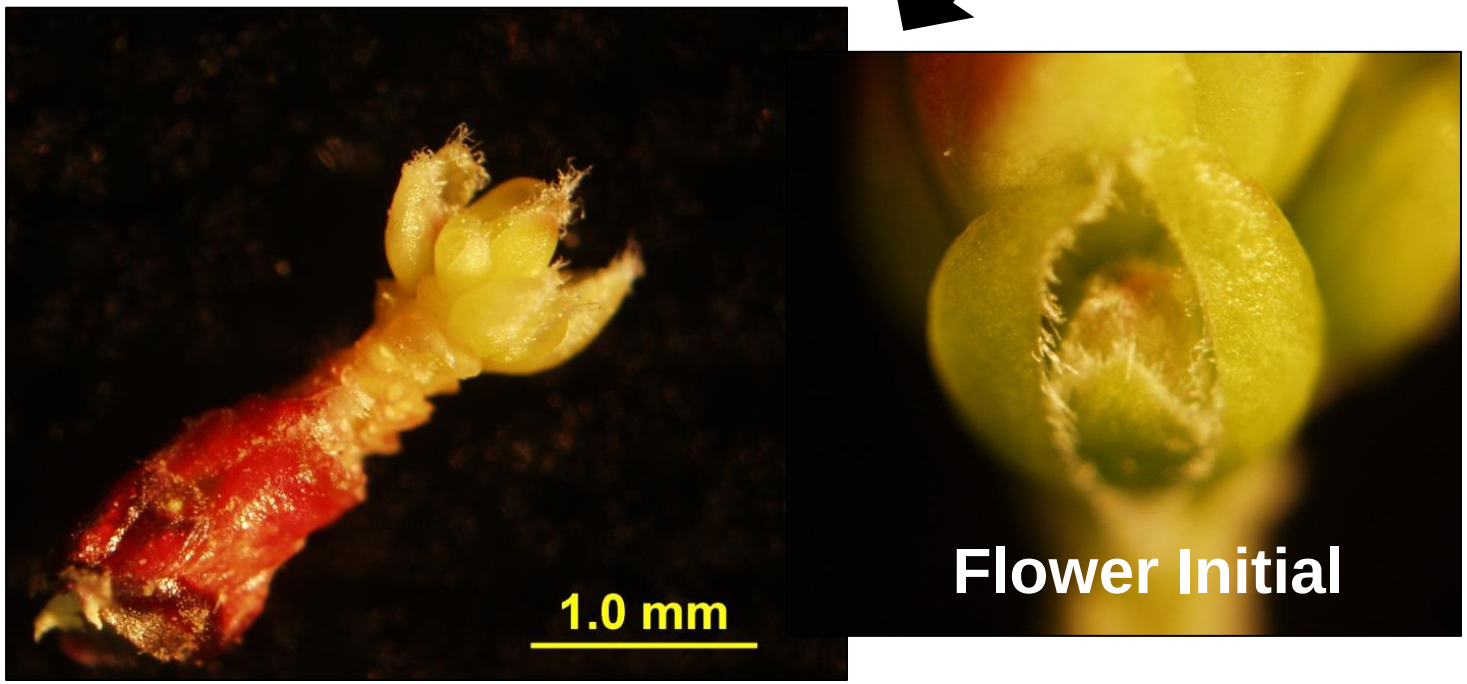
(Perry et al. 1986; DeMoranville et al., 1996)

Cultivars Sampled

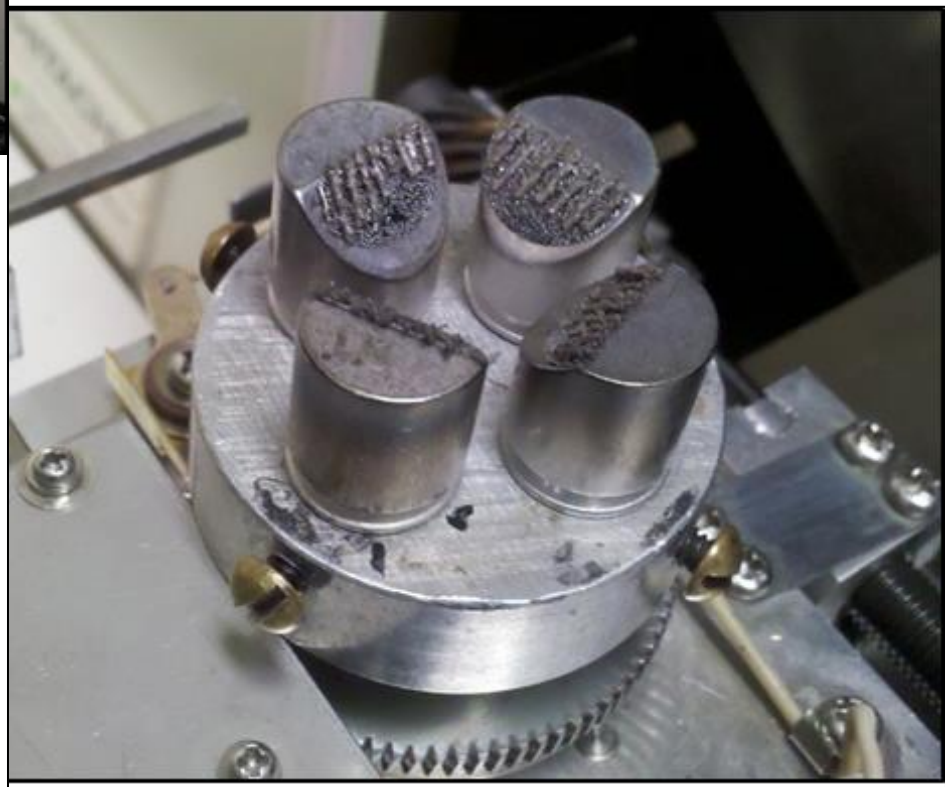
Cultivar	Release date	Parentage	Origin
Searles	1893	Native selection	Wisconsin
Stevens	1950	McFarlin x Potter	New Jersey
HyRed	2003	Stevens x Ben Lear	Wisconsin
Crimson Queen	2006	Stevens x Ben Lear	New Jersey



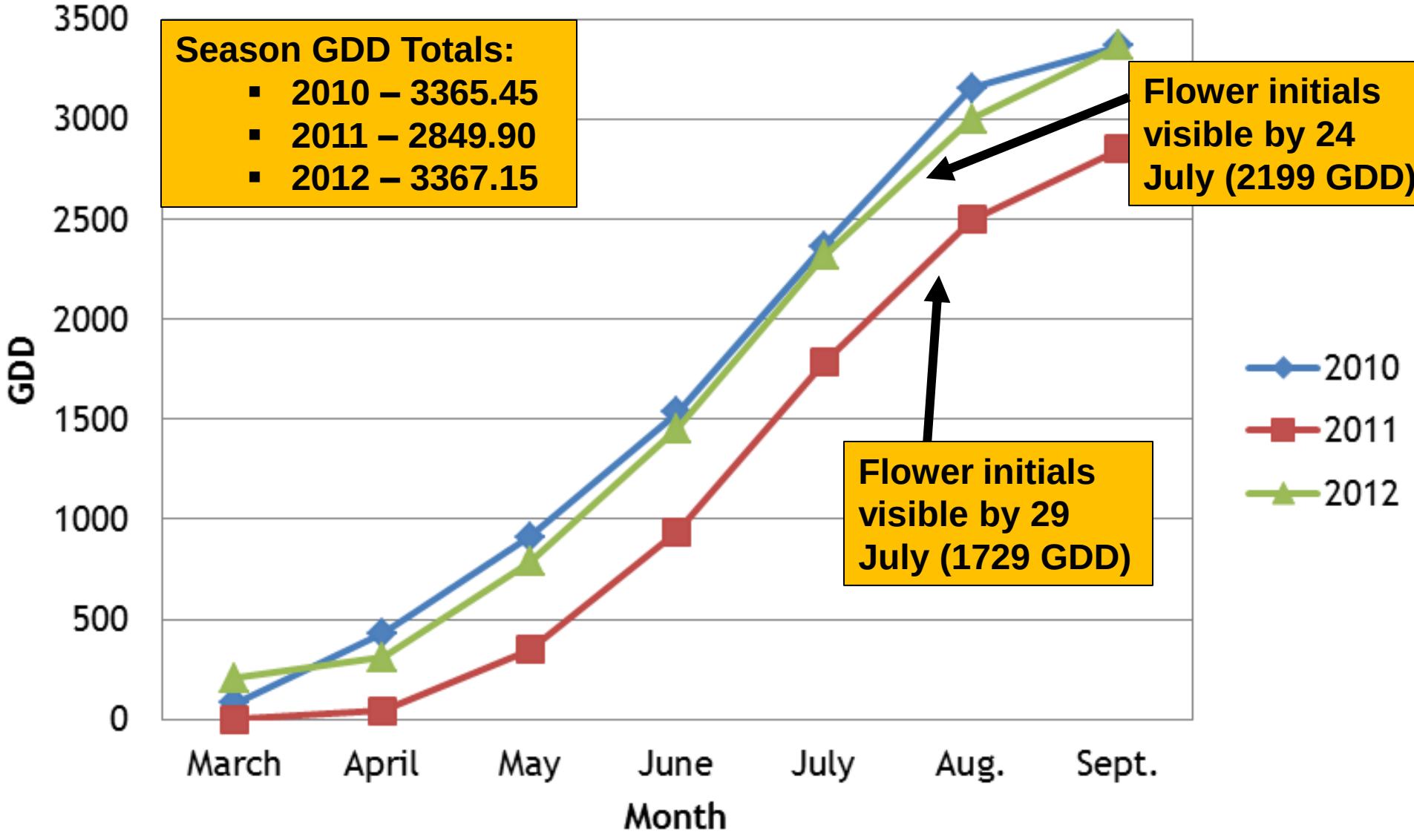

1.0 mm


1.0 mm
Flower Initial

Scanning Electron Microscopy (SEM)

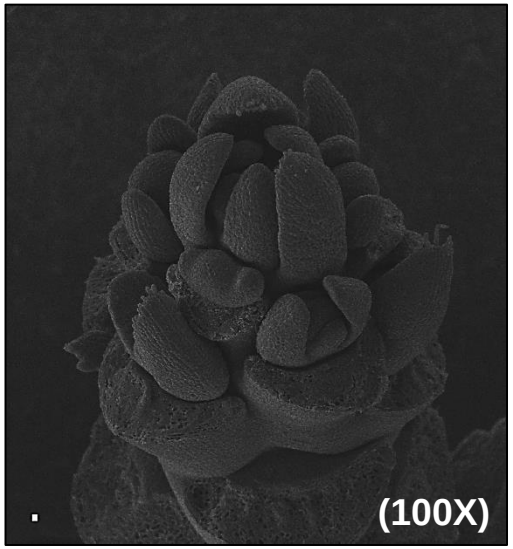


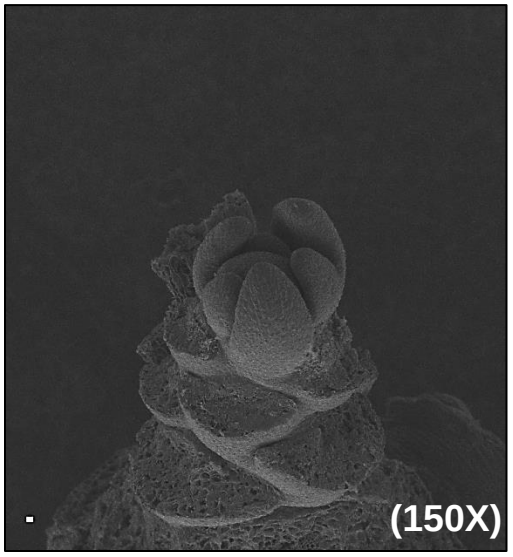
Cumulative Growth Degree Days (GDD) 2010-2012



(Base = 45 °F; Max = 86 °F)

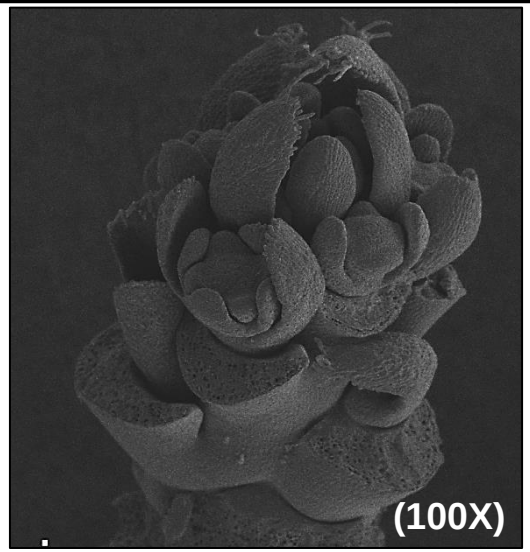
Vegetative Uprights

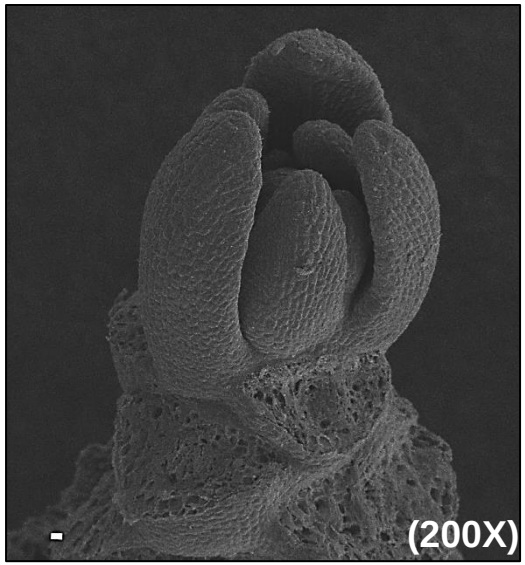




‘HyRed’ 2011

Reproductive Uprights

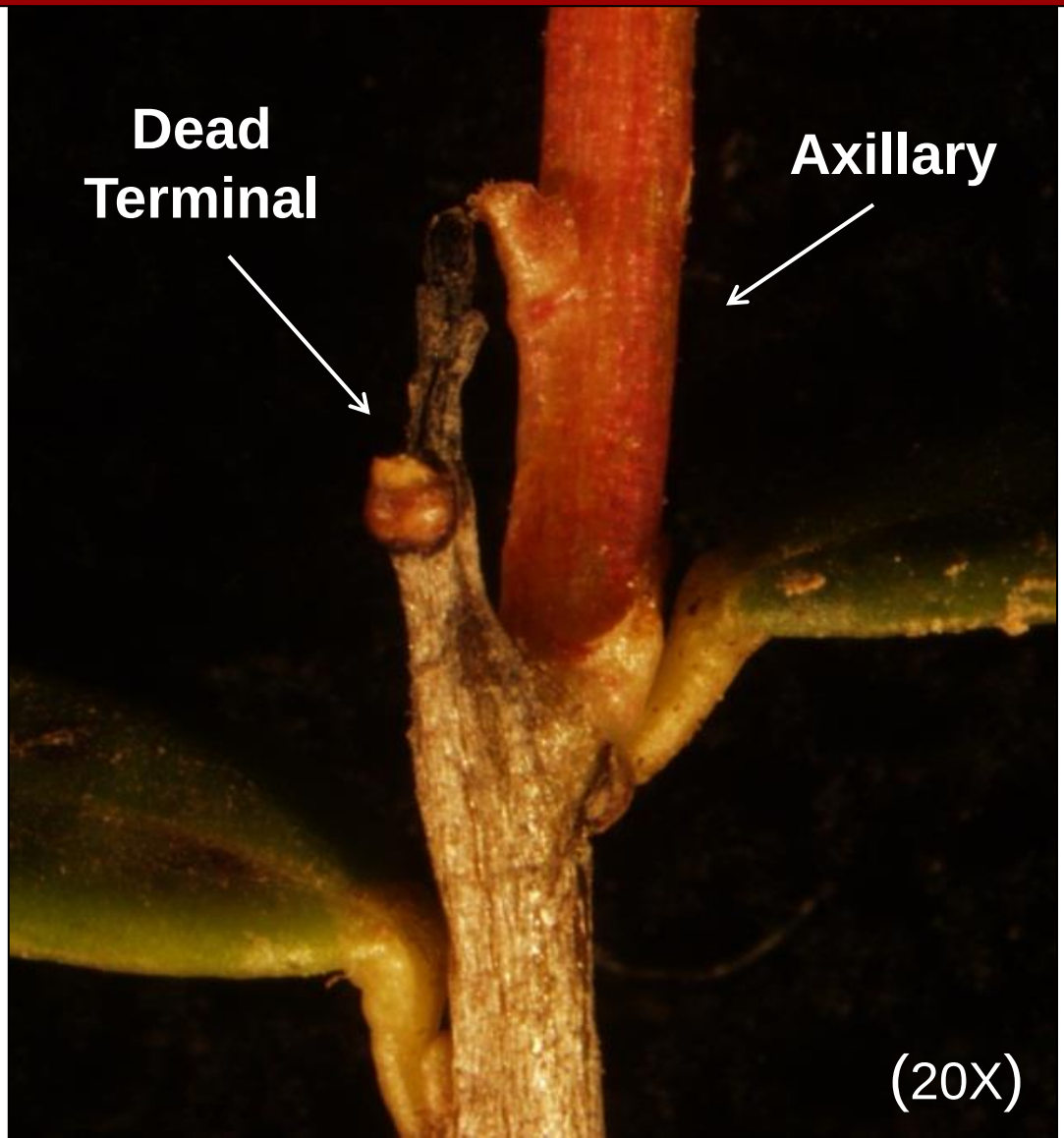




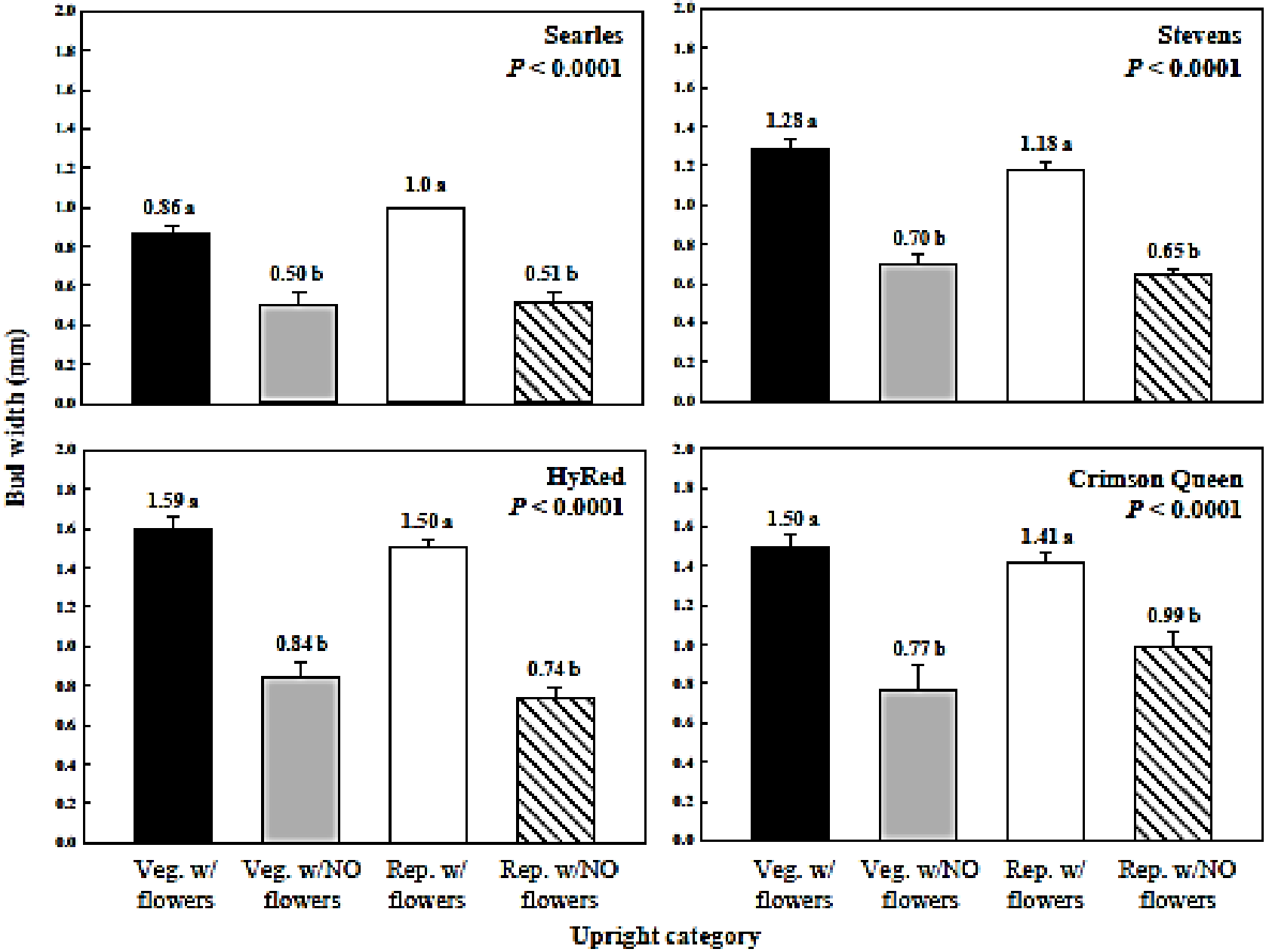
- Many assumed vegetative buds actually contained flower initials (excludes ‘Searles’)

(Bar = 10 microns)

‘Searles’



Mean Bud Width, Upright Status, and Presence of Flower Initials



Rebud Potential

Rebud = % reproductive uprights with flowers in terminal buds

Cultivar	Rebud potential [mean ± SE (%)]*
Searles	5.6 ± 4.3 b
Stevens	24.8 ± 5.1 ab
HyRed	41.1 ± 2.0 a
Crimson Queen	38.8 ± 5.5 a
P-value	0.0008

*No interaction due to year, 2011 and 2012 data combined.

Conclusions & Applications

- Time more strongly related to floral initiation, not GDD
- Cultivars differ in external bud appearance
- Wider buds are more likely to contain flower initials
- New cultivars have a greater potential for rebud

What is the role of carbohydrates across cultivars that differ in rebud?

Project #2 Objectives

1. Measure plant carbohydrates across different cultivars that differ in rebud potential

2. Assess if carbohydrate limitations within an upright contributes to biennial bearing

Methodology

- Cultivars – ‘GH1’, ‘Stevens’, and ‘HyRed’
- Location – Juneau county, WI
- Sampled six growth stages in 2013:

1. Prebloom (4 June)
2. Full bloom (2 July)
3. Late bloom/early fruit set (30 July)
4. Fruit and bud development (27 Aug.)
5. Fruit harvest (19 Sept.)
6. Postharvest (30 Oct.)

Methodology

- Compared total plant carbohydrates:
  - Total nonstructural carbohydrates (TNSC)
  - Soluble sugars (SS)
  - Starch
- Tissues:
  - Uprights and roots
  - Current and previous season's growth pooled
  - Fruit
- Also collected yield and rebud data

Results

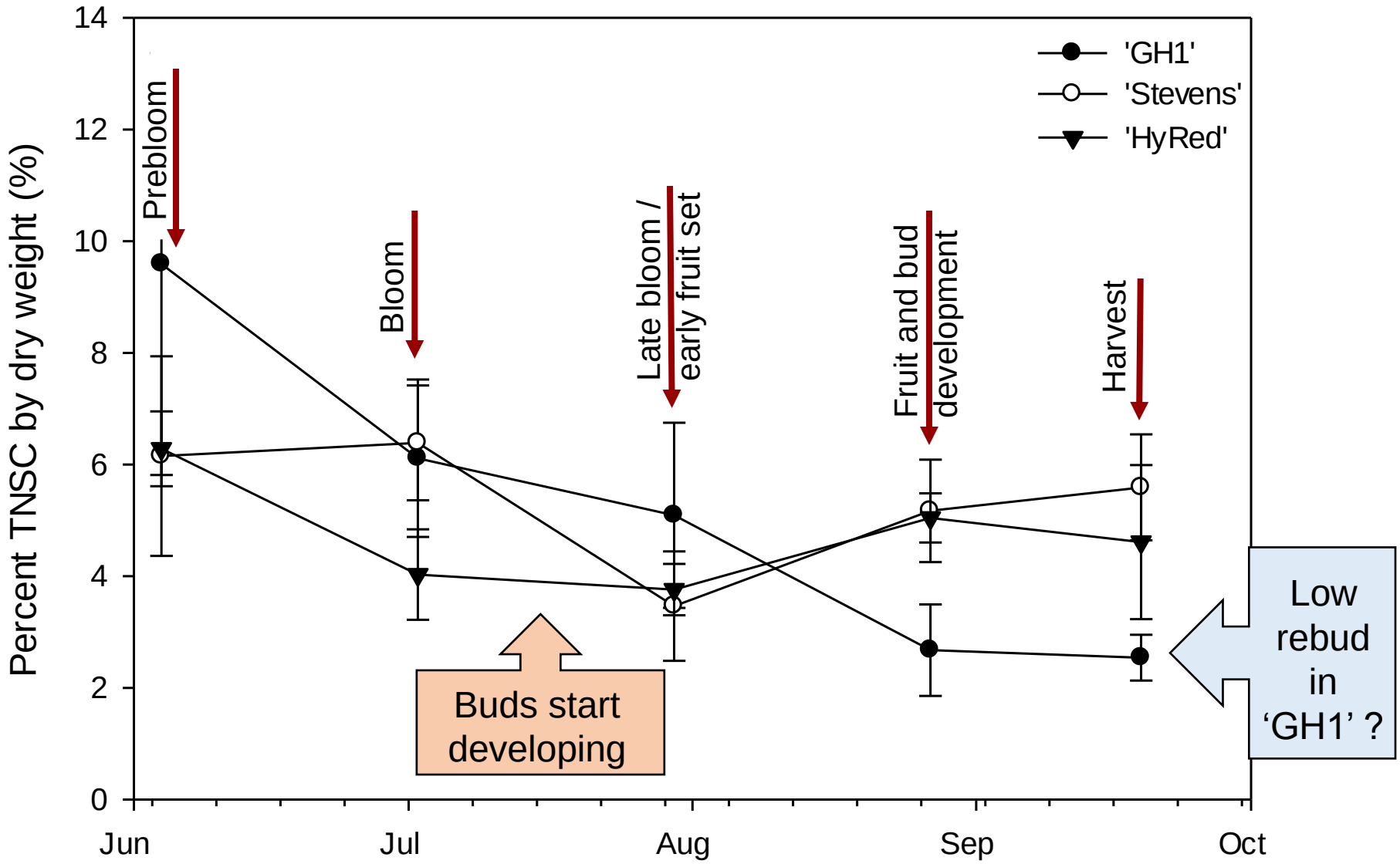
- Carbohydrate concentrations:
  - Uprights > Roots
  - Vegetative > Reproductive
  - No differences in fruit across cultivars

Yield and Return Bloom Results

- No differences in yield across cultivars
- Differences in rebud potential (*P*-value < 0.05):

  - ‘GH1’ – 1%
  - ‘Stevens’ – 20%
  - ‘HyRed’ – 19%

Reproductive Upright TNSC



Conclusions & Applications

- Cultivars differ in rebud potential and carbohydrate concentrations
- Carbohydrate limitations during fruit set and development ***may*** contribute to biennial bearing by reducing rebud
- *How do some cultivars circumvent biennial bearing?*
- *How do we manage these new cultivars with enhanced rebud potential?*

Acknowledgements

- Wisconsin cranberry growers
- Wisconsin State Cranberry Growers Association
- Biological & Biomaterials Preparation, Imaging, and Characterization Laboratory at the University of Wisconsin – Madison
- The Harbut Lab


Questions & Discussion