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2024 Update Mtg Jan 30: Changes in Cranberry Phenology From 1958 to 2022 Implications for Spring Frost

Sandeep Bhatti

University of Massachusetts Amherst, sandeepbhatti@umass.edu

Peter Jeranyama

UMass Cranberry Station, peterj@umass.edu

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University of
Massachusetts
Amherst

CHANGES IN CRANBERRY PHENOLOGY FROM 1958 TO 2022: IMPLICATIONS FOR SPRING FROST

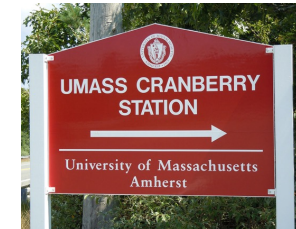
Sandeep Bhatti

Team: Peter Jeranyama, Casey Kennedy, Anthony Buda, Katherine Ghantous,
David Millar, Carolyn DeMoranville

Jan 30, 2024

Acknowledgements

- Funding sources
 - UMass Center for Agriculture, Food, and the Environment
 - USDA-ARS
- Cape Cod Cranberry Growers Association
 - Data acquisition



Background

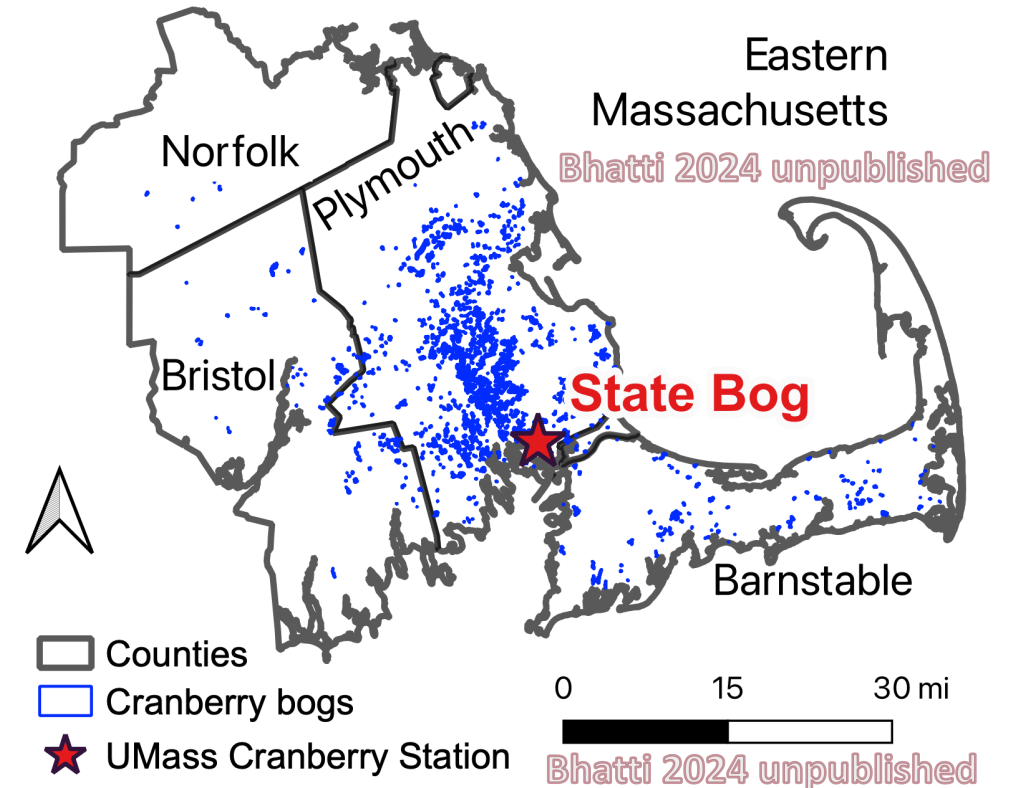
- Limited study of changes in cranberry phenology
 - Ellwood et al. (2014) used timing of fungicide application to estimate changes in the timing of flowering in MA between 1981 and 2011.
- In absence of local records, growing degree day (GDD) models are used to estimate occurrence of growth stages.
- Weather data is used to estimate plant phenology at a regional scale using GDD based models.

Research Objectives

- Evaluate temporal variation in the occurrence of white bud, bud swell and cabbage head stages using local records between 1958 and 2022.
- Estimate spatiotemporal patterns in cabbage head stage for cranberry growing region of eastern Massachusetts for 65 years.
- Explain observed trends in phenology using air temperature and GDD.

Methods

- Local records of cranberry phenology (1958-2022) from State bog (~11 ac) in East Wareham
- Growth stage data estimated using GDD for 982 cranberry bogs in Norfolk, Bristol, Plymouth, and Barnstable counties



Growth Stage Observations

- Growth stage occurrence was expressed in day of year (DOY).
- Team of 10 or more university researchers, growers and handlers
- Buds were visually inspected for assignment of growth stage on a weekly basis

FROST WARNING SERVICE: DATE: May 10

FORECAST INDICATES A: Possible if it stays clear
Probable
Rather Dangerous
Dangerous
Very Dangerous

MINIMUM BOG TEMPERATURE: 28

TOMORROW NIGHT: Probably Warmer
About As Cold
Probably Colder

TOLERANCE FOR EARLY BLACKS 27, HOWES 27, B.L. 29.5, STEVENS 27

LOCAL BALANCE: 1 In Our Favor ___ Even ___ Against Us

EAST WAREHAM DEW POINT: 46

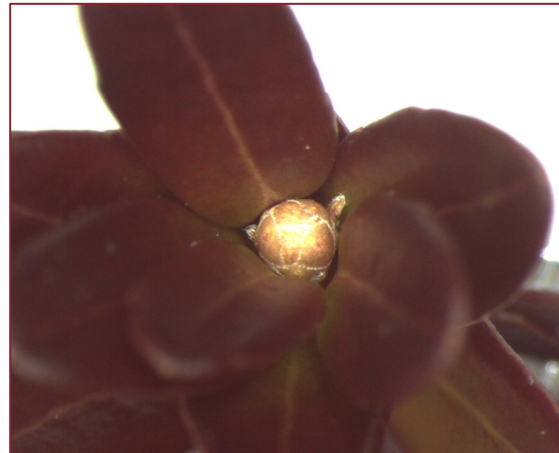
fall hybrids

Growth Stage Observations (April- June)

Early Black



Howes



White bud – Tolerance 20°F

Bud swell – Tolerance 22°F

Cabbage Head – Tolerance 25°F

Meteorological Data

- Air temperature data on daily basis acquired from NOAA for East Wareham
- Weather data from Hortau station at State Bog
- Gridded weather data with resolution of 2.8-mile on a daily time step from NOAA for the four counties



Growing Degree Day Based Day of Year

Dee model for GDD computation with base temperature of 44°F and accumulation from January 1

For a day, $GDD = T_{mean} - 44^{\circ}\text{F}$

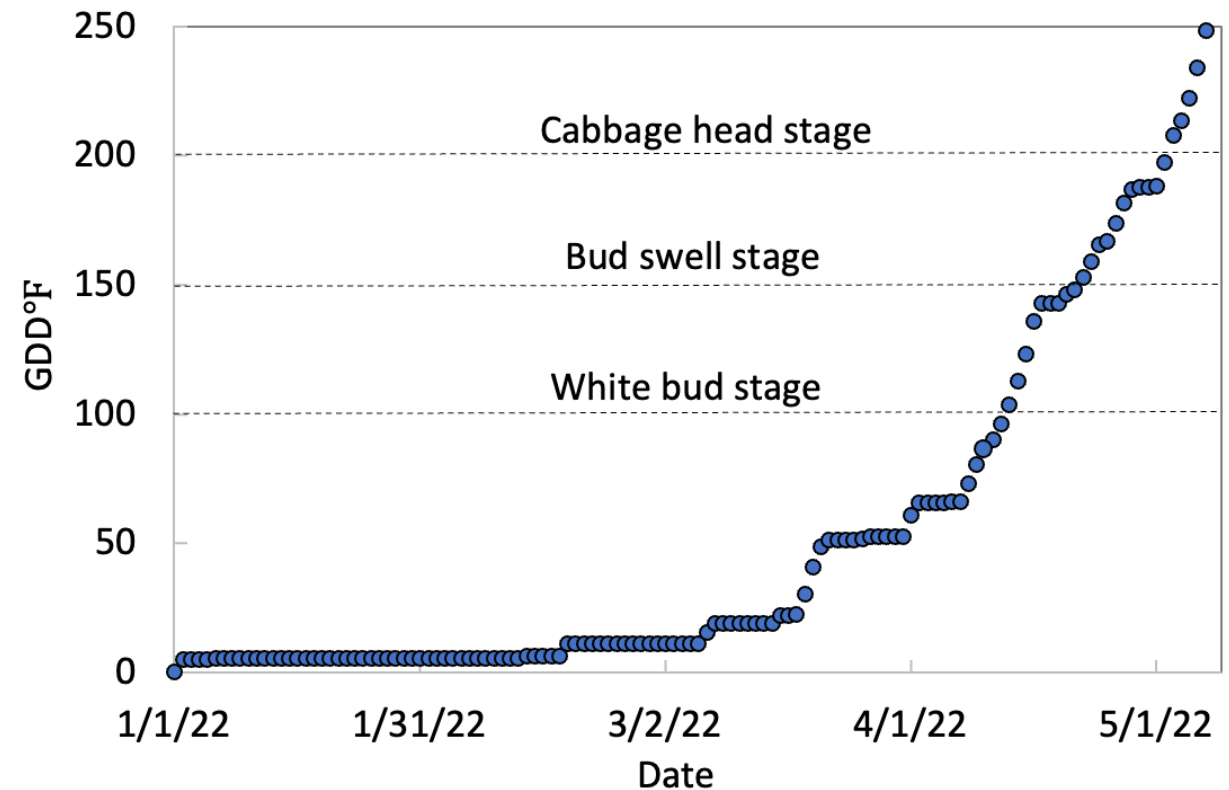
If $T_{mean} < 44^{\circ}\text{F}$, $GDD = 0$ for that day

T_{mean} is **daily mean air temperature**

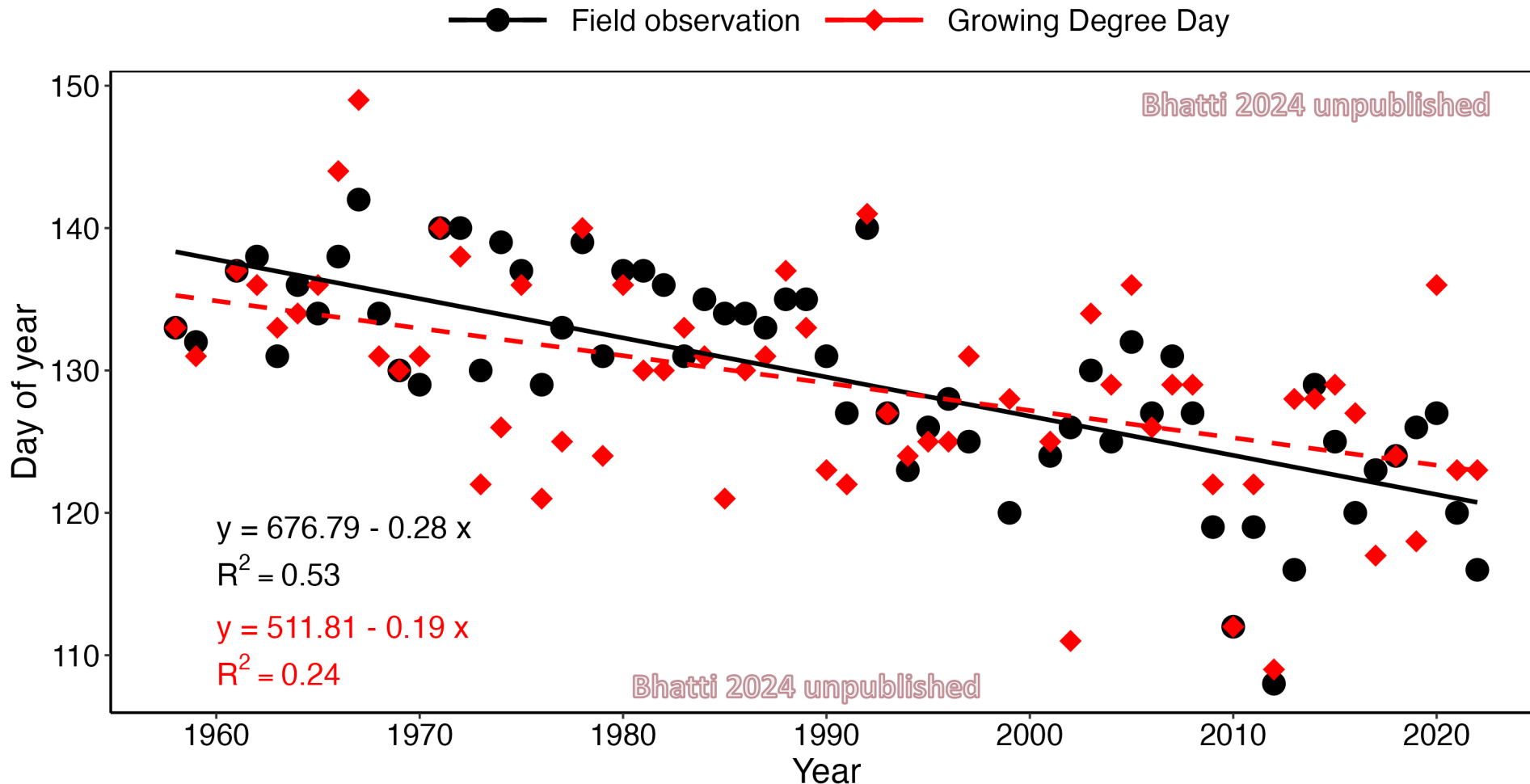
100 GDD – White bud stage

150 GDD – Bud swell stage

200 GDD – Cabbage head stage

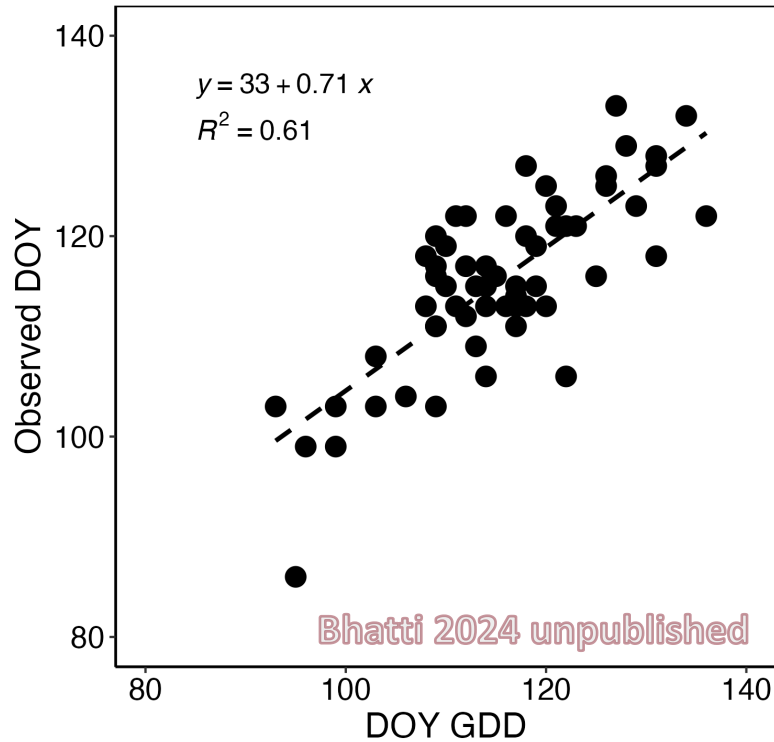


Cabbage Head Stage

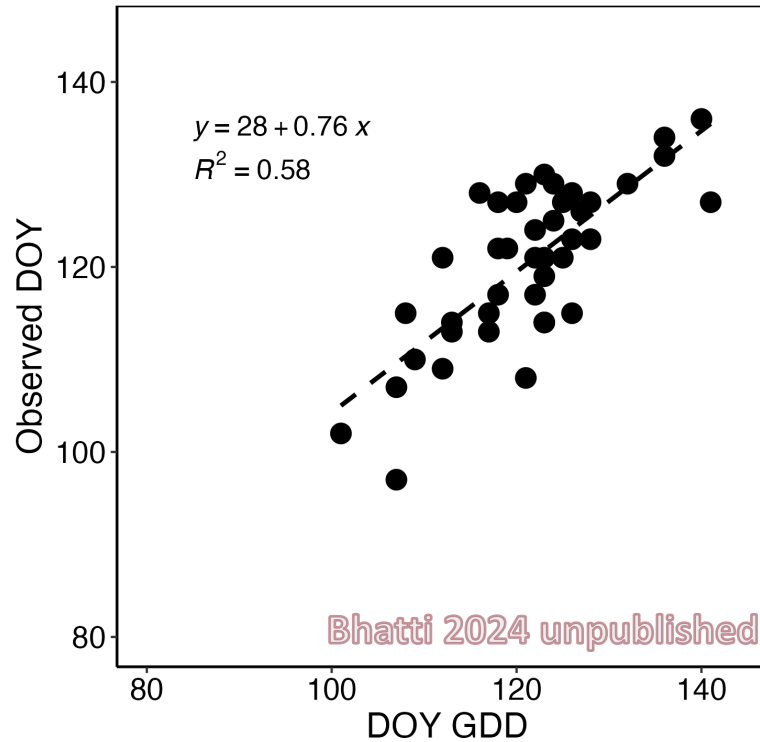


Observed vs Estimated Day of Year

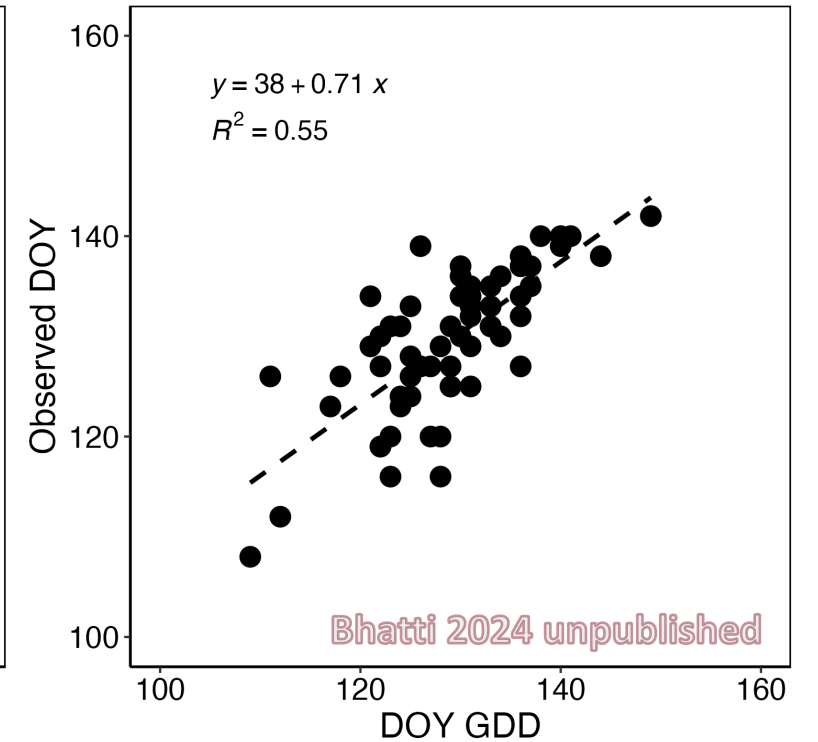
White bud stage



Bud swell stage

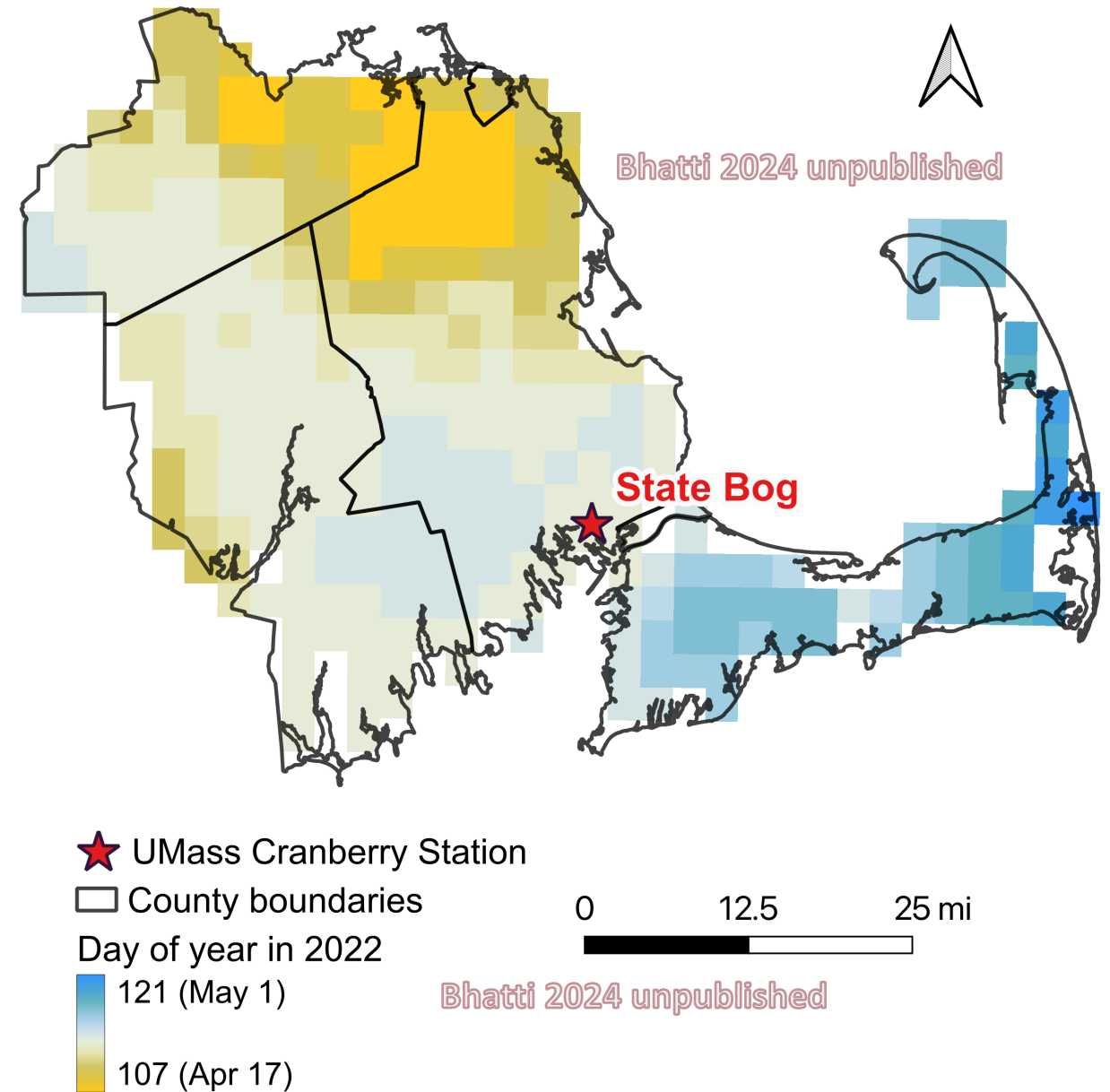


Cabbage head stage



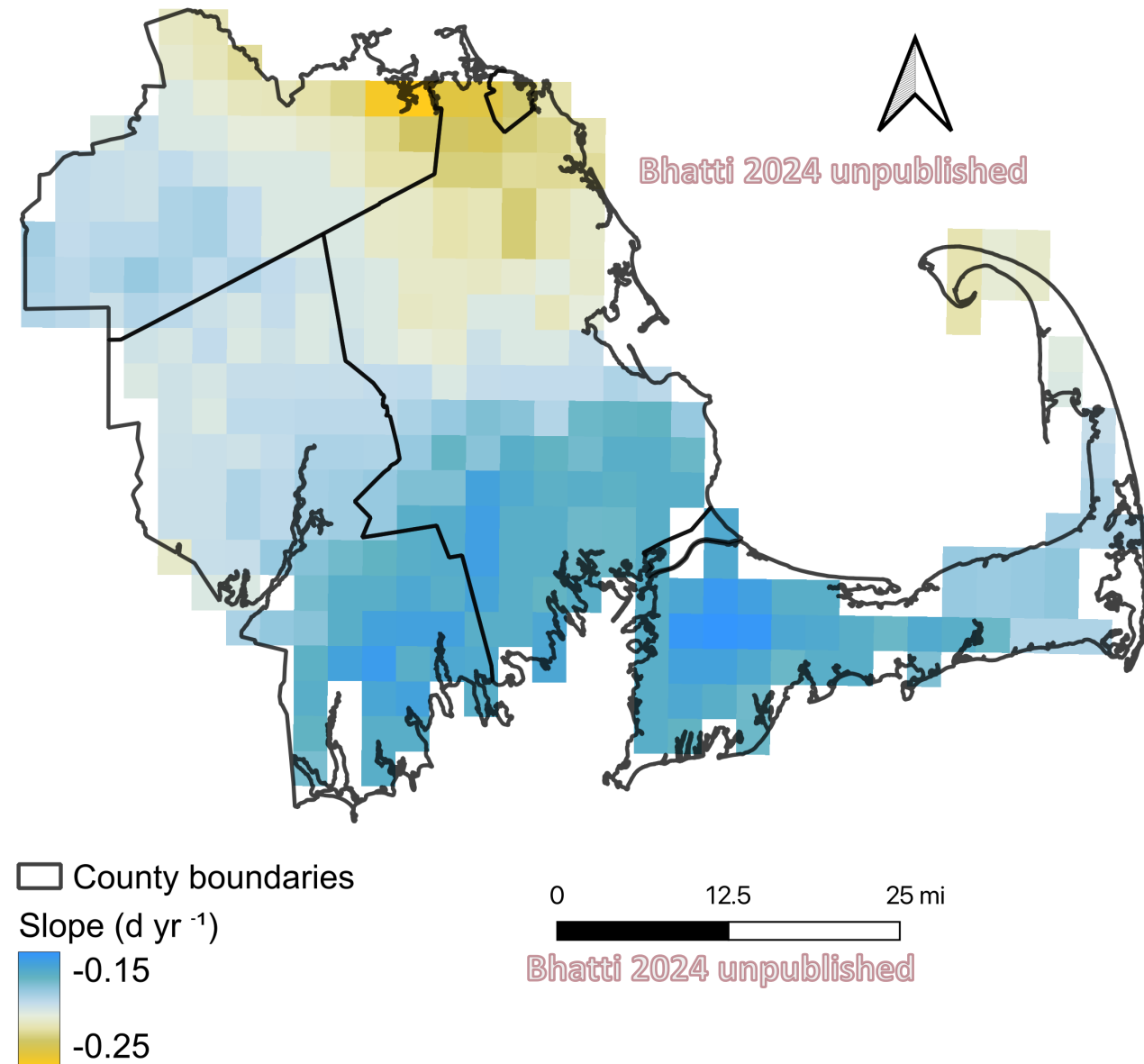
Day of Year in 2022

- Timing of cranberry phenology for different areas
- Occurrence of cabbage head stage ranged from April 14 to May 1 (14 days) for the study area
- Cabbage head stage was observed later for Cape Cod



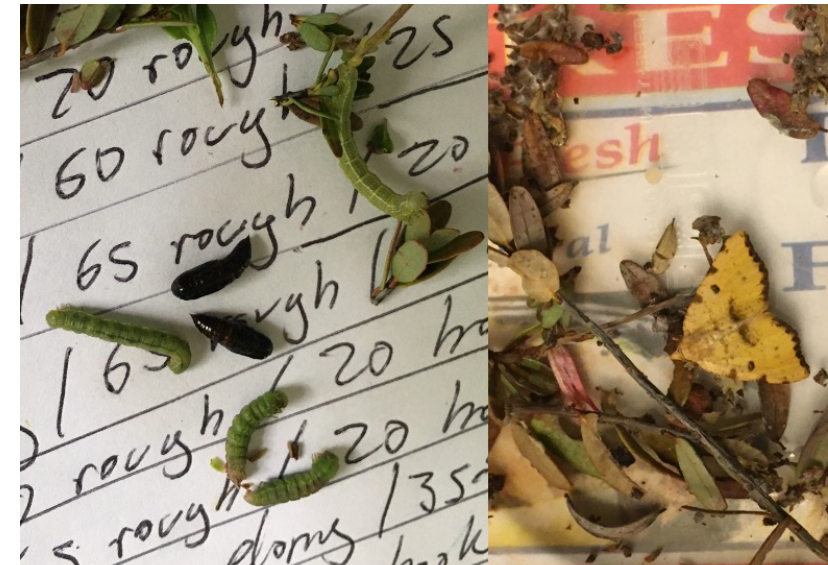
65-Year trend

- Changes in DOY of occurrence for cabbage head stage for 65-year period
- Significant slope (Mann-Kendall test) ranged between -0.25 and -0.15 day year⁻¹
- Estimated advancement in cabbage head stage between 10 to 16 days for 65-year period



Management Implications

- Monitoring and preparation for spring frost earlier in the season
- Higher risk for the advanced crop from late frost events
- Need for spatial component in frost forecasting system
- Higher fruit rot and sun scald in summer
- Changes in life cycle of different species in cranberry ecosystem
 - Green spanworm hatch and fly earlier by up to a month since 1950 (Marty Sylvania)



Conclusions

- Direct impact of rising air temperature on cranberry plants
- Temporal changes in growth stage occurrence by 20 days in spring
- Temporal changes between 10 and 16 days were also observed at a county level
- Increased probability of frost damage due to advancement in crops
- Future research should focus on efficient frost management in a changing climate and studying changes in phenology for different hybrid cultivars.

QUESTIONS & ANSWERS
email: sandeep.bhatti@umass.edu

University of
Massachusetts
Amherst

