

# Moss Impacts and Control Efforts in Cranberry

Feb 18, 2021

PNW Cranberry Congress

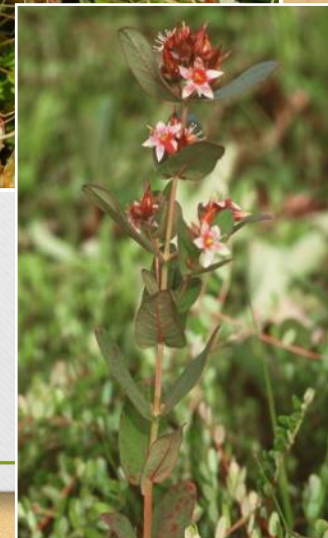
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Katherine Ghantous  
UMass Cranberry Station

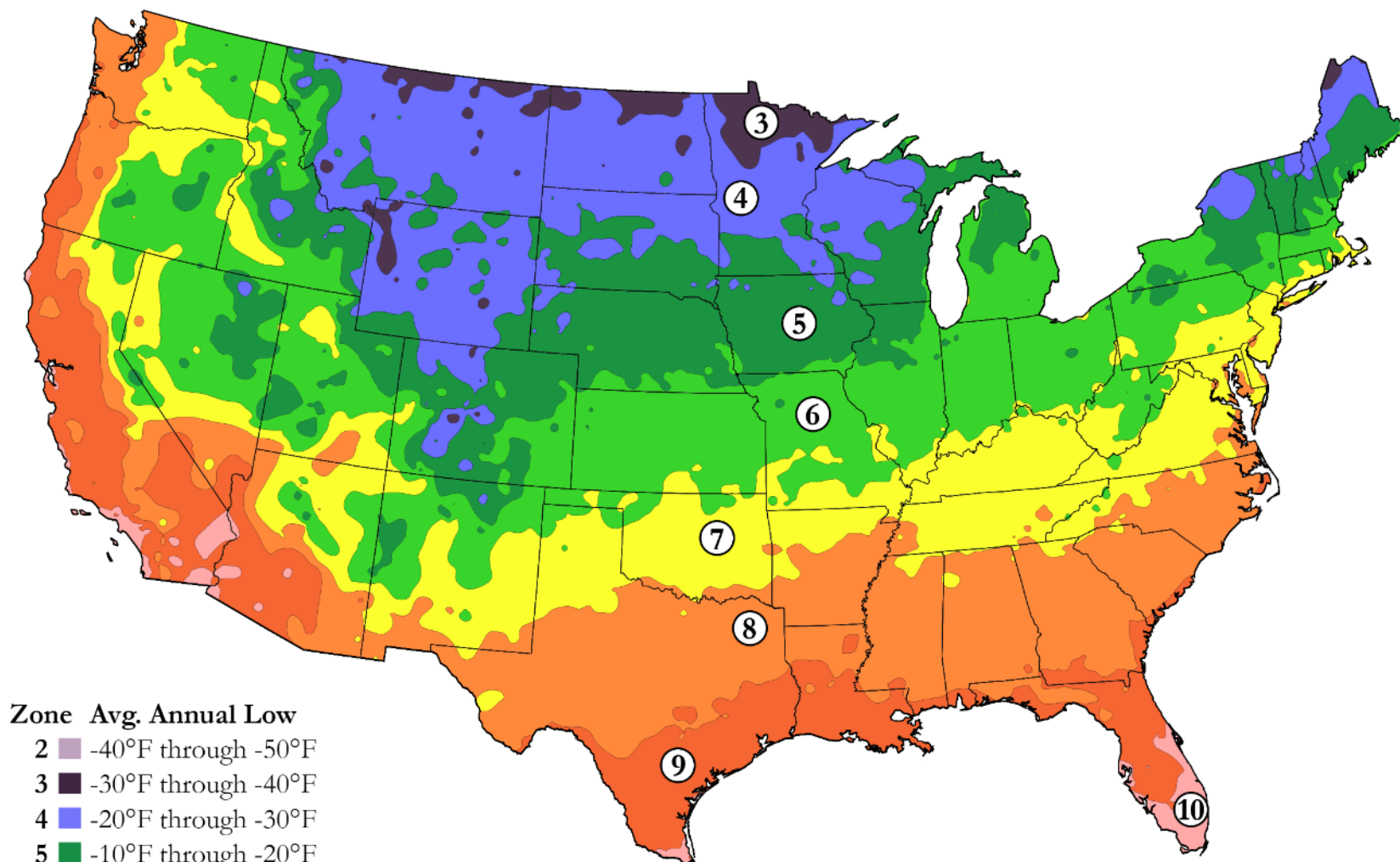
University of  
Massachusetts  
Amherst

# Shifting weed populations

- Gaps from newer herbicides
  - Good control of previously widespread weeds leaves room for new players to move into
- Changes in management
  - Water use
  - Nutrients
  - Sanding
- Changes in climate



# 2015 arborday.org Hardiness Zones Map

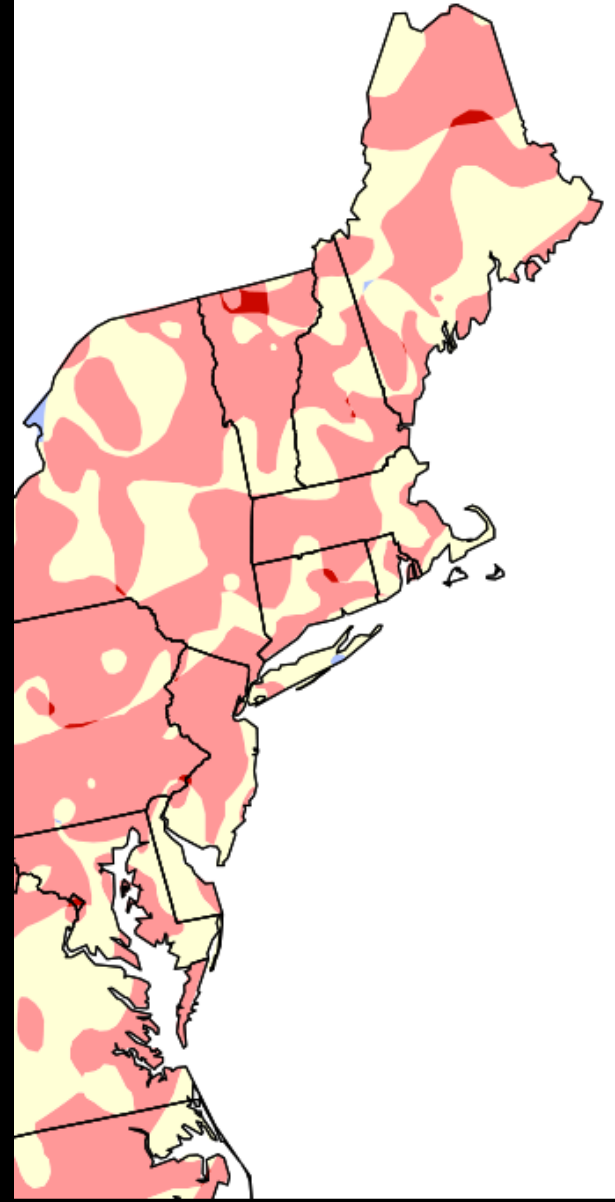
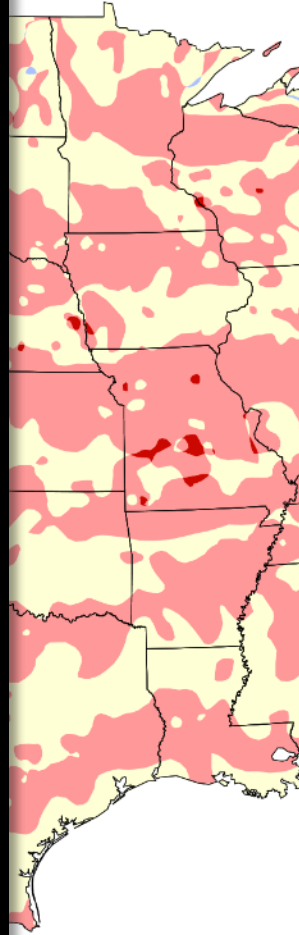
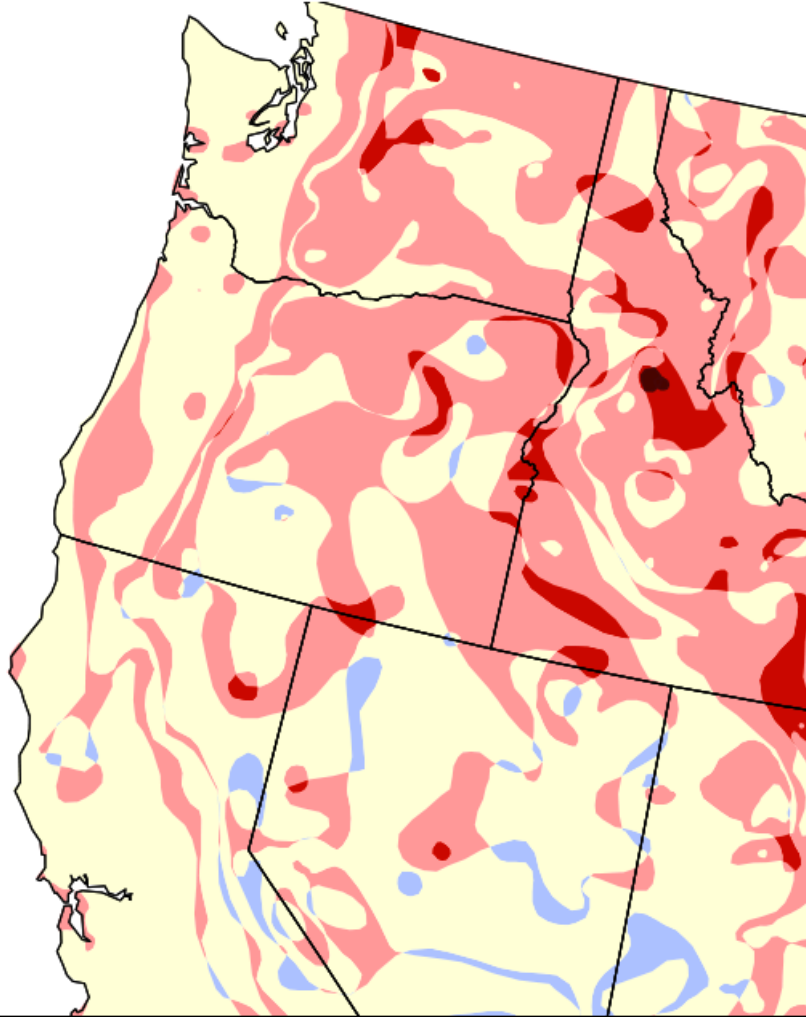


| Zone | Avg. Annual Low     |
|------|---------------------|
| 2    | -40°F through -50°F |
| 3    | -30°F through -40°F |
| 4    | -20°F through -30°F |
| 5    | -10°F through -20°F |
| 6    | 0°F through -10°F   |
| 7    | 10°F through 0°F    |
| 8    | 20°F through 10°F   |
| 9    | 30°F through 20°F   |
| 10   | 40°F through 30°F   |

**Go to [arborday.org](http://arborday.org)**  
**to find the zone for your zip code.**  
**You can also find trees for planting in your zip code.**

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Differences Between 1990 USDA  
Forest Inventory and  
Saturday.org Hardwood  
Forest Inventory



■ -2  
■ -3

Massachusetts State College  
United States Department of Agriculture and  
Plymouth County and Cape Cod Extension  
Services Co-operatingCO-OPERATIVE EXTENSION WORK  
IN  
AGRICULTURE AND HOME ECONOMICS  
STATE OF MASSACHUSETTSExtension Service  
County Agent  
Home Demonstration  
4-H Club Work

## 1938 CRANBERRY WEED CONTROL CHART

| NAME OF WEED                                                                                                                                                                                                                               | WHEN TO TREAT                                                            | WHAT TO USE                                            | REMARKS                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WOODY WEEDS, such as<br>Poison Ivy, Horse Brier,<br>Hardhack, Red Maple,<br>Chokeberry, Leather Leaf,<br>Sheep Laurel, Brake, etc.                                                                                                         | After the harvest,<br>and before growth<br>starts in the<br>spring.      | Weed hook.                                             | No satisfactory chemical treatment has been found for<br>this kind of weed. In severe cases the bog should be re-<br>made and all roots be removed before replanting.                                                                                                                                                                                                                                                     |
| DITCH WEEDS<br>1. Bur-reed<br>2. Pond Lilies<br>3. Pickerel-Weed<br>4. Water Smart Weed<br>5. Water Willow                                                                                                                                 | Mid-summer.                                                              | Sodium arsenite.<br>15 lbs. in 100 gals. of water.     | Drain the bog ditches and spray the weeds. CAUTION: This<br>solution is very caustic. Protect the eyes with goggles<br>and the hands with rubber gloves. Do not allow the spray<br>to touch the cranberry vines, as it will kill them.                                                                                                                                                                                    |
| SEDGES, RUSHES, & GRASSES<br>(Weeds with bases of<br>leaves surrounding the<br>stem like a sheath.)<br>Early Hair Grass<br>Quaking Grass<br>Panicum species<br>Carex species<br>Spike Rush or Needle<br>Grass<br>Wood Grass or Bunch Grass | After the harvest,<br>or just as vines<br>start growth in<br>the spring. | Water white kerosene,<br>200 to 400 gals. to the acre. | Apply the kerosene when the vines are dry, with only 50<br>to 75 lbs. pressure. Use enough to thoroughly wet the<br>crowns of the weeds.<br>Pour about half a cupful of kerosene into a clump of<br>Bunch Grass.<br>Kerosene is effective in killing 3-Square Grass only if<br>applied before the weed is half-grown, and 600 to 800 gals.<br>per acre must be used. (This plant seems to be root-tender<br>to kerosene.) |

|                      |                                                                        |                                                                                                                                                                                                                        |                                                            |
|----------------------|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
|                      |                                                                        | 2. Ammonium sulphate or<br>nitrate of soda.                                                                                                                                                                            | (Choice of these treatments)                               |
| MOSS (Hair-cap Moss) | After the harvest<br>or before vines<br>start growth in the<br>spring. | <u>Treatment No. 1</u><br>800 lbs. of iron sulphate and<br>400 lbs. of ammonium sulphate<br>to the acre, or<br><u>Treatment No. 2</u><br>800 lbs. of iron sulphate and<br>400 lbs. of calcium chloride<br>to the acre. | No. 1 for sand-bottom bogs.<br>No. 2 for peat-bottom bogs. |
| BEGGAR-TICKS         | Mid-summer.                                                            | 75 lbs. salt to 100 gals. of                                                                                                                                                                                           | Use 200 gals.                                              |

|                               |                                                                                                 |                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                    |
|-------------------------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PARTRIDGE PEA                 | As soon as the weed<br>grows above the<br>cranberry vines.<br>2nd treatment early<br>in August. | 1-1/2 lbs. sodium arsenate in<br>100 gals. water.                                                                                                                                                                      | Do not spray will not injure the tender cranberry vines,<br>buds, flowers, or berries.<br>Do not use the sodium arsenate spray before August.<br>Spray only enough to wet the leaves. CAUTION: Be sure to<br>use sodium arsenATE and not arsenITE. |
| PERNS<br>Feather<br>Sensitive | July or Early<br>August.                                                                        | Apply one or two handfuls of<br>a mixture of 1 part of cal-<br>cium chloride and 9 parts of<br>iron sulphate.                                                                                                          | Iron sulphate does not act until dissolved. Calcium<br>chloride helps to dissolve it by absorbing moisture from<br>the air. On hard-bottom bogs, ammonium sulphate may be<br>used instead of calcium chloride.                                     |
| Royal<br>Cinnamon<br>Chain    | July or Early<br>August.                                                                        | 1. Apply 1/4 to 1/2 pt. of<br>salt solution (2 lbs. of salt<br>in 1 gal. of water) or<br>2. Ammonium sulphate or<br>nitrate of soda.                                                                                   | 1. Pour solution around stalks.<br>2. Two or three handfuls thrown directly around the<br>stalks.<br>(Choice of these treatments)                                                                                                                  |
| MOSS (Hair-cap Moss)          | After the harvest<br>or before vines<br>start growth in the<br>spring.                          | <u>Treatment No. 1</u><br>800 lbs. of iron sulphate and<br>400 lbs. of ammonium sulphate<br>to the acre, or<br><u>Treatment No. 2</u><br>800 lbs. of iron sulphate and<br>400 lbs. of calcium chloride<br>to the acre. | No. 1 for sand-bottom bogs.<br>No. 2 for peat-bottom bogs.                                                                                                                                                                                         |
| BEGGAR-TICKS                  | Mid-summer.                                                                                     | 75 lbs. salt to 100 gals. of<br>water.                                                                                                                                                                                 | Use 200 gals. per acre.                                                                                                                                                                                                                            |
| TEAR THUMB                    | Late summer.                                                                                    | Dry iron sulphate,<br>1600 to 3000 lbs. per acre.                                                                                                                                                                      |                                                                                                                                                                                                                                                    |
| FIRE WEED                     | When weeds appear.                                                                              | 75 lbs. salt to 100 gals. of<br>water.                                                                                                                                                                                 | Use 200 gals. per acre.                                                                                                                                                                                                                            |
| ASTERS                        | When weeds appear.                                                                              | Sodium ArsenITE, 1/2 lb. to<br>100 gals. of water.                                                                                                                                                                     | Use 400 gals. per acre.                                                                                                                                                                                                                            |
| SAND SPURNEY                  | July or August.                                                                                 | 1600 lbs. of iron sulphate to<br>the acre.                                                                                                                                                                             |                                                                                                                                                                                                                                                    |
| OTHER PLANT                   | July or August.                                                                                 | Iron or copper sulphate.                                                                                                                                                                                               |                                                                                                                                                                                                                                                    |
| WINTER FLOOD                  | Hold winter flood<br>till early June.                                                           |                                                                                                                                                                                                                        | This treatment kills 90% of the weed.                                                                                                                                                                                                              |

All chemical sprays for weed control should be applied as a fine mist at 50 to 75 lbs. pressure.

# Moss & MA Cranberry

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- Increasing # of MA growers calls about moss infestations over the past few years
- Growers self-reporting moss issues
  - Appearing on more farms
  - Weed pressure increasing
- Other regions now having similar trends

# Most common and “weedy” mosses in MA cranberry



**Haircap**  
(*Polytrichum commune*)



**Sphagnum**  
(Multiple *Sphagnum* spp.)

# Moss Species – lots of diversity!

2017 survey of a single cranberry bed at State Bog  
at least three additional moss species present



*Aulacomnium palustre*  
(Bog groove-moss)



*Ceratodon purpureus*



*Entodon seductrix*

# Moss Species – lots of diversity!

2018 survey of 2<sup>nd</sup> bed cranberry bed at State Bog

at least four additional moss species identified



*Atrichum crispum*

<http://northernforestatlas.org>



*Callicladium baldanianum*

<http://northernforestatlas.org>



*Ditrichum pallidum*

<http://bryophytes.plant.siu.edu>, Li Zhang



*Pohlia nutans* <http://northernforestatlas.org>

# Most common and “weedy” mosses in MA cranberry



**Haircap**  
(*Polytrichum commune*)



**Sphagnum**  
(Multiple *Sphagnum* spp.)



# Sphagnum

“Peat mosses”, 300+ species



- Lack root-like rhizoid structures
- Specialized cells covered with pores to absorb water and hold it like a sponge
- In cranberry, found in wet areas
  - bed and ditch edges
  - areas w/drainage problems and high soil moisture



# Haircap Moss

*(Polytrichum commune)*

- Stems attached to the soil by rhizoids (structures that resemble roots)
- Found in diverse habitats
- Large clonal patches interconnected underground
- Can reproduce vegetatively from buds on the rhizomes, or by spores that result from sexual reproduction







# Haircap Impacts? Is it just cosmetic?

Two beds of 'Stevens' were sampled

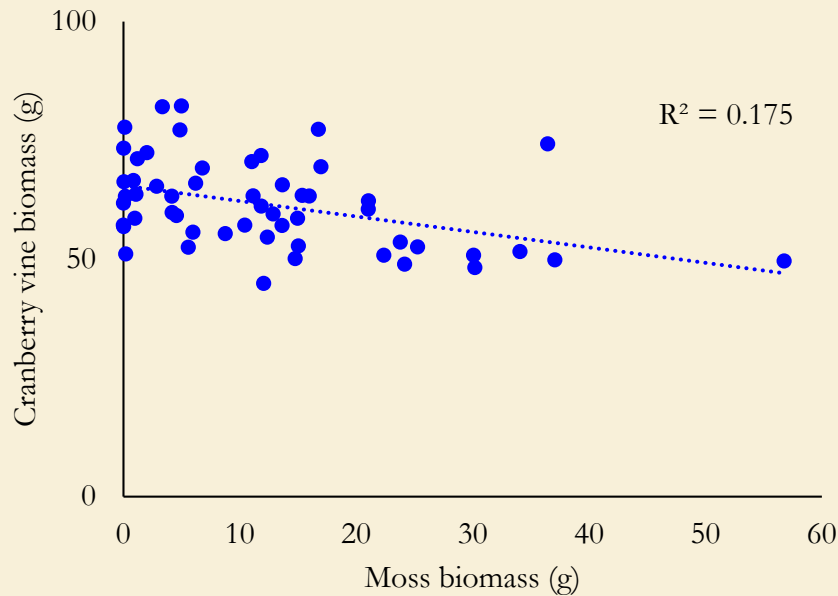
- 15 small sections (930-cm<sup>2</sup> squares) excised w/pruners
  - clipped all plant material to the soil level
- Fruit sorted, counted, and weighted
- Cranberry tissue dried and weighed
- Moss tissue dried and weighed



# Documenting Impact of Haircap Moss

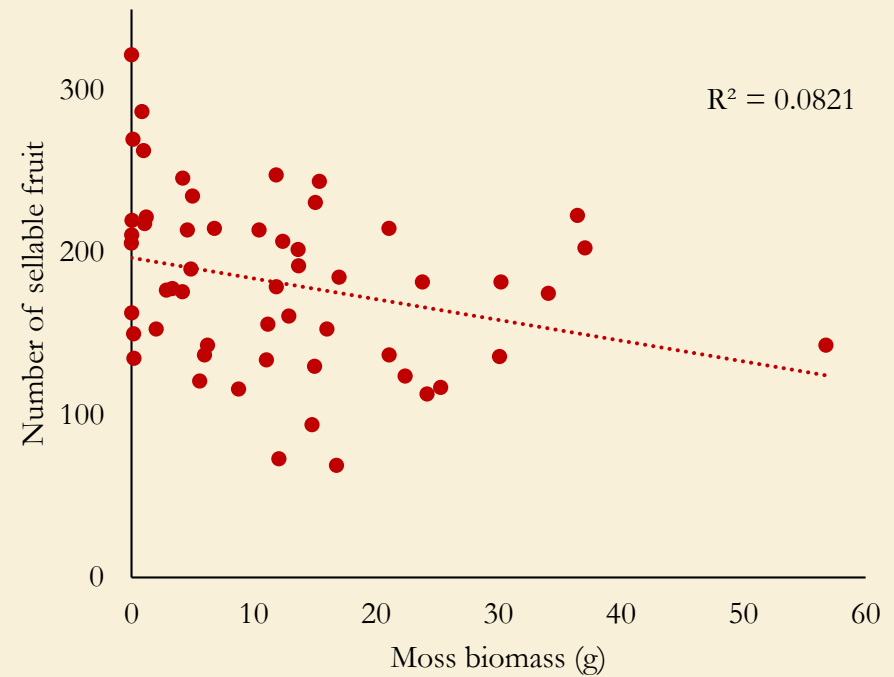
## Direct competition between moss and cranberry

Cranberry vine biomass vs moss biomass



Cranberry biomass negatively correlated with moss biomass

Number of sellable fruit vs moss biomass



The weight of sellable fruit negatively correlated with moss biomass

# It IS a problem, now what do we do?

- Moss in turf, ornamentals, surfaces
  - Not common weed in food crops
  - Not “food-use” herbicides
  
- Non-vascular plant (some of the oldest on planet)
  - Different than all of our other weeds
  - Doesn't respond same way to herbicides



# Conventional Herbicides

Recent work has confirmed that currently registered herbicides provided little to no control of moss

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- Casoron (60 lb/A)
- Evital (80 lb/A)
- Devrinol 2-XT (18 qt/A)
- QuinStar (8.4 oz/A x2)
- Callisto (8 oz/A x2)

# Historical recommendations

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- Ammonium sulfate (100 lbs/A)
- Casoron (high rates, 100 lbs/A)
- Iron sulfate (ferrous sulfate)
  - Old chart book recommendation was for VERY high rates
  - 3 oz/sq ft as spot treatment ~ over 8,000 lbs and acre!

# Iron sulfate

Historical recommendation

It (kind of) works **BUT**...

- Not registered as a pesticide in cranberry
- Difficult to apply, not practical for treating large areas (we have acres of moss)
- May require multiple applications yearly



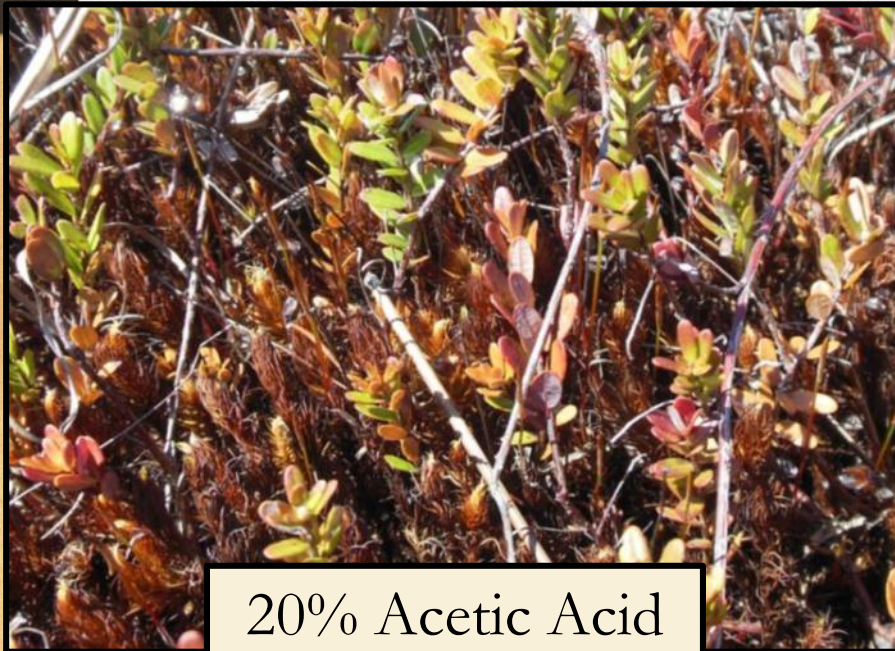
# Looked into Iron (ferrous) sulfate products as a pesticide – no good options

- Powdered form via drop spreader (92% ferrous sulfate)
- Powdered form dissolved in water and applied by chemigation
- Large granules (fertilizer sized) turf product
- Small granules (similar to sand) turf products
- Liquid turf products

Screened lots of other products over the years

## Horticultural Vinegar (acetic acid)

- Injurious to cranberry
- (5%, 10%, and 20% acetic acid)
- Moss recovers, needs multiple apps



20% Acetic Acid

5% and 10% acid did not  
have lasting moss control

20% controlled moss, but  
injured vines

# Herbicidal soap (22% Ammoniated Soap of Fatty Acids)

- Injurious to cranberry



Herbicidal soap



Good moss control, Lots of cranberry damage

# Moss product (22% potassium salts of fatty acids)

Safe on cranberry but....

- Moss recovers, needs multiple apps
- Very cost prohibitive
- Would need hundreds of gallons (1:9 dilution)



Moss Product

# Potassium Salts of Fatty Acids

M-pede (insecticidal soap, 49% potassium salts of fatty acids)

- Already labeled for cranberry
  - Would only need a 2ee to use for moss
- More concentrated, more economical
- **BUT DOESN'T WORK!**

Potassium salts may include: potassium laurate, potassium oleate, potassium myristate, and potassium ricinoleate.



# Screening trials identify two promising herbicides

Preemergence (applied before cranberry bud-break)

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- Registered in other food crops
  - Including blueberry
- Effective for moss
- Safe on cranberry (if applied correctly)

Untreated



Moss injured by all treatments  
photos 5 months after treatment

A 6 oz - SD



B 12 oz - SD



# Herbicide A

WI trials had more injury than MA...why?

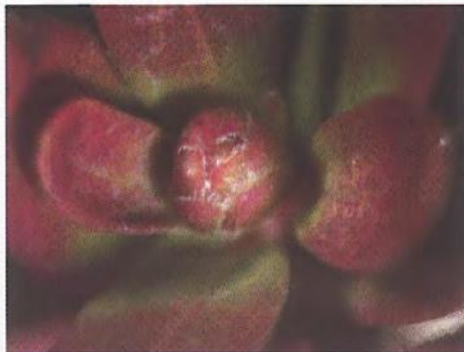
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- **Timing?**

- “dormancy” covers a range of stages
- Climate differences between regions could influence how quickly cranberry emerges from dormancy

- **Application method?**

# Cranberry bud development



Tight Bud



White Bud



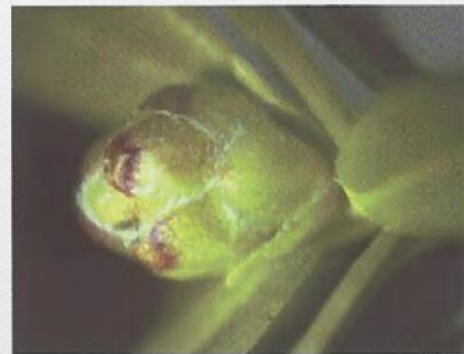
Bud Swell



Cabbage Head



Late Cabbage Head



Early Bud Elongation

Ben Lear  
Stevens

# Does Application Method Impact Crop Safety?

## Chemigation

Delivered in  $\sim 400$  gpa ( $3,740 \text{ L water ha}^{-1}$ )



# Boom Sprayer

Delivered in  $\sim 20\text{-}30$  gpa ( $187 - 280$  L water ha<sup>-1</sup>)



# Can we increase crop safety by washing soil-active herbicides off foliage and into soil?

Boom + Wash-off



- Most soil-active herbicides call for “sufficient” rainfall or irrigation with 2 weeks of application for incorporation/activation
- Wash-offs used in other crops like strawberry with some herbicides

# Study Design

2 Sites – MA and NJ, 4 reps/site

Chemical B 2019, 2020

Chemical A 2021

- Early

- Chemigation
- Boom
- Boom fb wash-off (~ 1 hr irrigation, 0.1" water)

spring dormant, tight buds



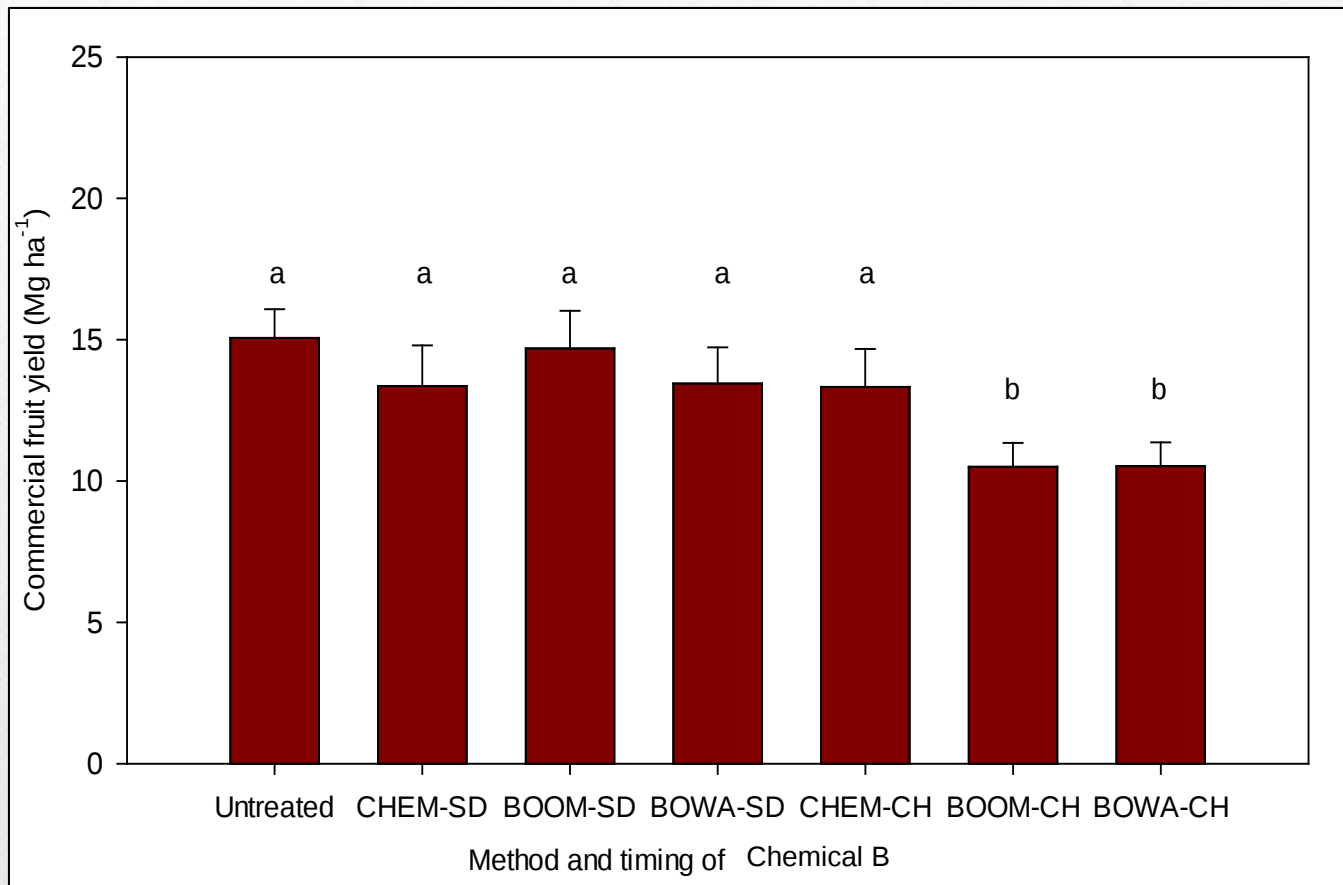
- Late

- Chemigation
- Boom
- Boom fb wash-off

cabbage head, buds swelling



# Timing and application method are important factors for crop safety



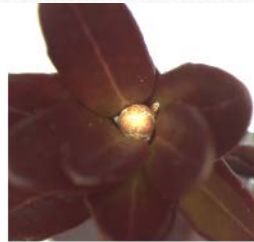
## Special Local Needs Label (24c) Massachusetts and New Jersey

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- Active Ingredient: a PPO inhibitor Group 14
- For control of moss and other susceptible weeds
- **NO FULL LABEL YET!**



Howes  
Spring Dormant 18°F



Howes  
White Bud Stage 20°F



Howes  
Bud Swell Stage 22°F



Howes  
Cabbage Head Stage 25°F

- Apply prior to cranberry breaking dormancy
  - Apply **before** cabbage head
- Potential for injury if not applied at the correct time (uprights stunted, new foliage injured)

## **Moss injury will develop over time – not fast acting!**

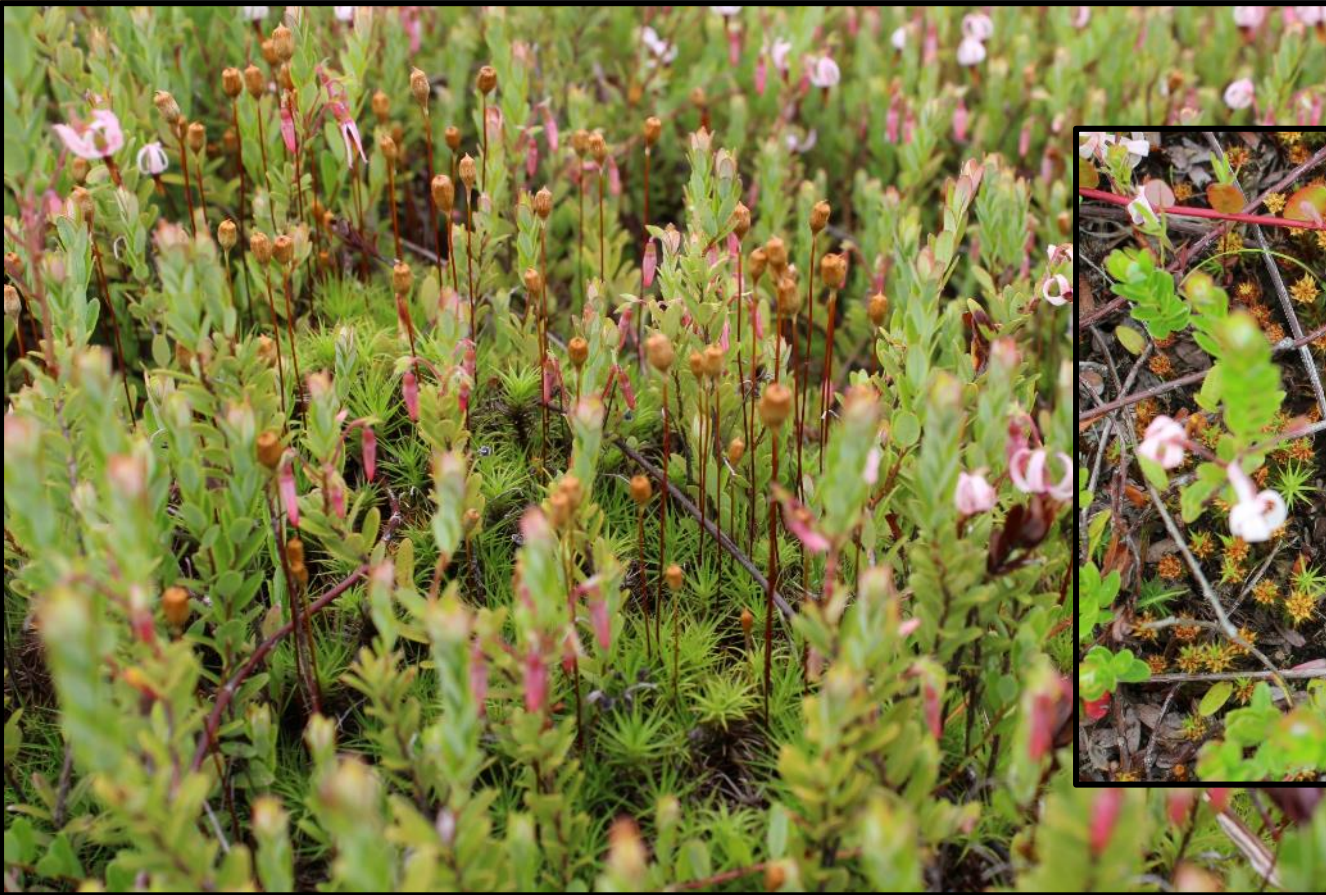
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- Some effects on moss apparent within a month of treatment, but full effects take months to develop
- Worked faster on sphagnum than haircap moss
- Treated haircap moss did not make reproductive structures

# Untreated Moss in June

## Haircap moss - lush and making spores

(State Bog 6/25/20)



# Treated Moss in June

(State Bog Moss Treated 4/15/20)

May / 1 Month after Trt



June / 2.5 Months after Trt



# Control lasts for whole season

## Moss on State Bog 8 months after treatment

Treated 4/15/20, photos 12/13/20

Treated w/ 12 oz/A in April



Untreated



A close-up photograph of a lush green moss carpet. Interspersed among the moss are several small, low-growing plants with light green, rounded leaves and thin, reddish-brown stems. Some of these plants have small, pale flowers or buds. The overall scene is a vibrant, textured natural ground cover.

# Questions?