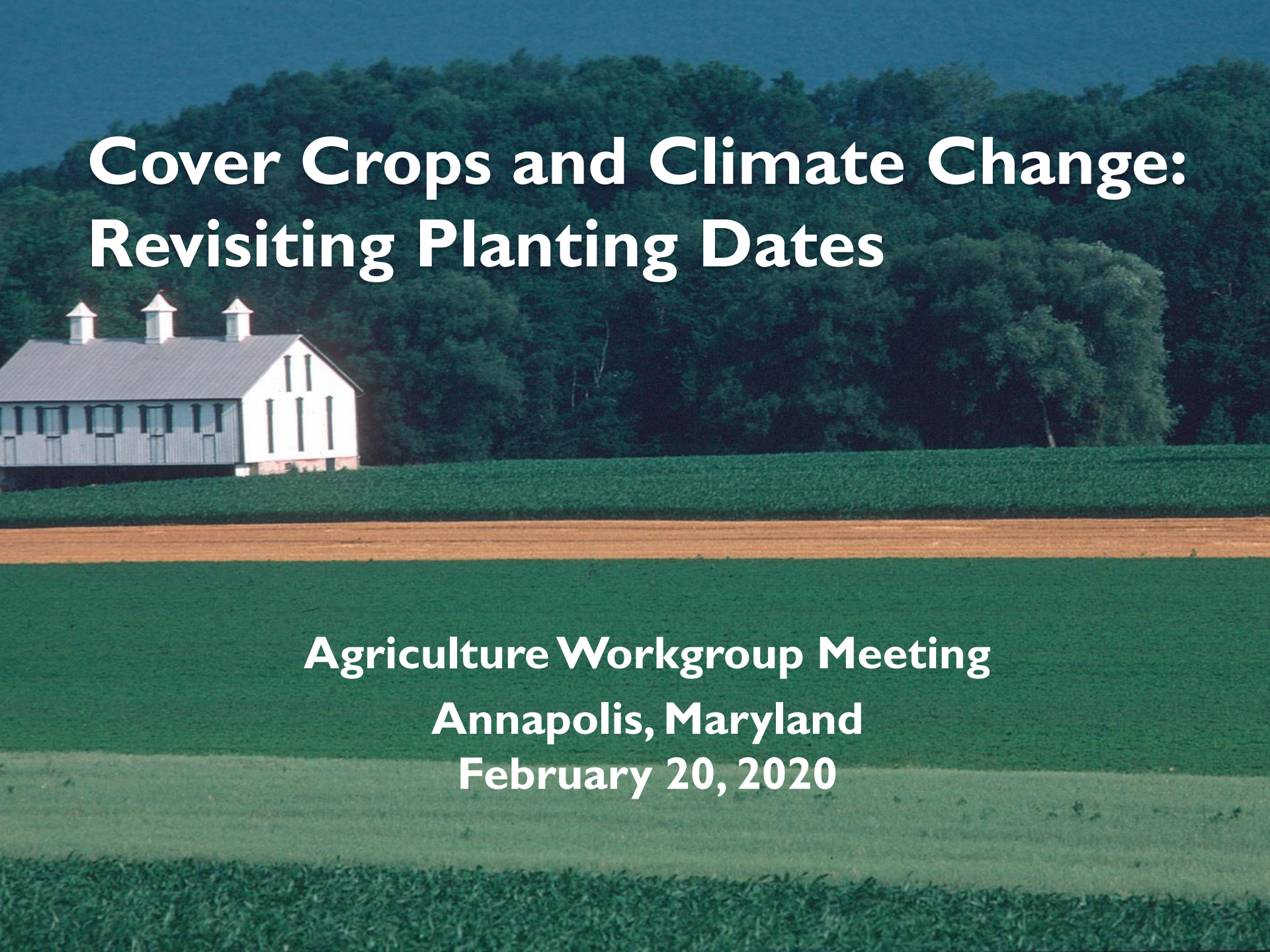

# Cover Crops and Climate Change: Revisiting Planting Dates

**Agriculture Workgroup Meeting**

**Annapolis, Maryland**

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# Cover Crops and Climate Change: Revisiting Planting Dates

- **Topic Highlights:**
  - Defining "Cover Crops"
  - Cover Crop (CC) Types
  - CC Establishment
  - CC and Water Quality
  - Average Frost Dates versus Heat Units
  - Questions

# Cover Crops and Climate Change: Revisiting Planting Dates

# Cover Crops and Climate Change: Revisiting Planting Dates

- Defining "Cover Crops"
  - Cover crops have been widely adopted by agricultural producers across the Chesapeake Bay watershed primarily for conserving valuable TN, but also because they provide other benefits for TP and TSS, as well as adding soil organic matter, improving soil structure, and improving soil health.

# Cover Crops and Climate Change: Revisiting Planting Dates

- Defining "Cover Crops"
  - Cover crops are one of the most valuable management practices available for protecting water quality, especially groundwater quality, which is a difficult resource to protect from non-point sources of soluble nutrients like nitrate N.

# Cover Crops and Climate Change: Revisiting Planting Dates

- Defining "Cover Crops"
  - Cover crops also provide some habitat benefits provided by an actively growing offseason crop compared to the traditional fallow-weed cover, as well as some social benefits derived from maintaining "green" landscapes during the fall-winter seasons.

# Cover Crops and Climate Change: Revisiting Planting Dates

- Defining "Cover Crops"
  - A cover crop is generally defined as a short term crop grown after the main cropping season. Winter annuals such as Chickweed and Henbit are not considered a planted "crop".
  - Important elements of the practice include selection of the cover crop species, the planting time, the seeding method, and nutrient applications.

# Cover Crops and Climate Change: Revisiting Planting Dates

- Defining "Cover Crops"
  - Traditional Cover Crops
    Defined as a short term crop grown after the main cropping season to reduce nutrient losses to ground and surface water by sequestering excess nutrients. No additional nutrients are applied in either the fall or spring, and the cover crop is terminated without harvesting.

# Cover Crops and Climate Change: Revisiting Planting Dates

- Defining "Cover Crops"

The following traditional cover crop species have associated nitrogen (N) reduction efficiencies:

- Rye
- Wheat
- Barley
- Annual Ryegrass
- Annual Legumes
- Annual Legume plus Grass Mixtures
- Brassica (winter hardy)
- Forage Radish
- Forage Radish plus Grass Mixtures
- Triticale
- Oats (winter hardy)
- Oats (winter killed

# Cover Crops and Climate Change: Revisiting Planting Dates

- Defining "Cover Crops"
  - Traditional Cover Crops with Manure
    A cover crop applicable to crop land that receives unavoidable fall manure applications due to limits on storage capacity at rates not to exceed 50 lb. plant available N (PAN)/acre.
  - The reduction credit is less than for traditional cover crops because increases in the soil N pool reduce the potential for cover crop uptake before leaching occurs. This option only is available for full rate grass and brassica cover crop options, or grass and brassica mixtures.

# Cover Crops and Climate Change: Revisiting Planting Dates

- Defining "Cover Crops"
  - Commodity Cover Crops
    Defined as a short term crop grown after the main cropping season to reduce nutrient losses to ground and surface water by sequestering excess nutrients. No additional nutrients are applied in the fall, however additional nutrients can be applied in the spring after March 1 and the commodity cover crop can be harvested.

# Cover Crops and Climate Change: Revisiting Planting Dates

- Defining "Cover Crops"

The following commodity cover crops have an associated N reduction efficiency:

- Rye
- Wheat
- Barley
- Triticale

# Cover Crops and Climate Change: Revisiting Planting Dates

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop Types
  - Winter Cereals – Wheat – Barley – Rye
    Cool season annual cereal varieties that are winter hardy in the Bay watershed. Wheat, barley, and rye are primarily used as N scavengers with secondary benefits of reducing soil erosion. In circumstances where biomass management is a concern, wheat and barley are often preferred over rye. Rye is often preferred for forage quality to other winter-hardy cereal covers (USDA, SARE, 2007).

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop Types
  - Triticale

    A cool season annual cereal that is a cross between wheat and rye, giving it characteristics from each parent. It serves the dual purpose roles of being a N scavenger and an erosion fighter. It grows almost as well as rye in cold months, but is easier to manage in the spring because it is less subject to the rapid spring growth that can present management difficulties with rye.

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop Types
  - Oats (winter-hardy and winter-killed)
    A cool season annual cereal having varieties that are winter hardy in some areas of the Bay watershed, and some varieties that are winter killed. Oats are primarily used as a short-term N scavenger with secondary benefits of reducing soil erosion. In circumstances where herbicides are not used, a winter-killed oat variety is often preferred to winter-hardy cereal covers (USDA, SARE, 2007).

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop Types
  - Annual Ryegrass:
    Also known as Italian Ryegrass, is a cool season annual grass that does a good job of accumulating nutrients, although it does not grow as well as rye during the colder months in the Bay watershed. It has an extensive soil holding root system that establishes quickly, which is the basis for its reputation as a soil erosion fighter. It is a common component of mixtures, where it is often aerial seeded (USDA, SARE 2007).

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop Types
  - Brassicas (winter-hardy) – Canola and Rape
    Both are technically rapeseed, and both can take up significant amounts of N, often comparable to rye, but only if planted early. The winter-hardy Brassicas provide full fall-winter-spring crop growth and residue cover that avoids possible residue decomposition losses while providing fall-spring soil cover to manage erosion (USDA, SARE, 2007).

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop Types
  - Forage Radish
    Also known as tillage radish, is a popular deep-rooted cover crop that grows fast with warm temperatures and an ample supply of N. It can recover substantial quantities of residual N, and often accumulates as much N as rye during the fall season. However, it is subject to winter killing following a few days below 25 F. After winter-kill the radish residues decompose rapidly, leaving the soil bare and vulnerable to erosion. The decomposing residues may also release N that can contribute to nitrate-N leaching depending on weather and soil conditions over the winter and early-spring seasons (USDA, SARE, 2007).

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop Types
  - Annual Legumes and Grass Legume Mixtures
    Include winter annuals that are primarily used to supply N to the next crop due to their ability to fix significant quantities of atmospheric N. However, they also provide a living crop that can scavenge small amounts of residual nutrients as well as provide some erosion protection during the spring runoff season (USDA, SARE, 2007).

  - In the Bay watershed, the most common annual legumes are Hairy Vetch and Crimson Clover.

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop Types
  - Forage Radish and Grass
    Listed as a separate group because: i) it combines two distinctly different species, each contributing their own advantages to the resulting mixture, and ii) there are good data available for estimating an initial relative nitrogen reduction efficiency (RNRE) for this mixture. The general biological characteristics and uses of Forage Radish and Grass cover crops can be gleaned from their accompanying descriptions in the Forage Radish and Triticale species descriptions.

# Cover Crops and Climate Change: Revisiting Planting Dates

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop Establishment - Timing
  - Early Establishment
    More than two weeks before the average first frost date.
  - Normal Establishment
    Between the average first frost date and two weeks before that date.
  - Late Establishment
    Within three weeks after the average first frost date.

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop Establishment - Seeding
  - Drilled
    Direct seeding methods with high seed to soil contact normally offers the highest establishment rates.
  - Other
    In-direct seeding methods such as broadcast offer intermediate establishment rates. Establishment rates can be improved with incorporation.
  - Aerial Soybean or Corn
    In-direct aerial seeding methods typically offer lower establishment rates on an annual basis.

# Cover Crops and Climate Change: Revisiting Planting Dates

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop and Water Quality – Land Uses

| Land Use | Description |
|---|---|
| Full Season Soybeans | Soybeans ineligible for double cropping |
| Grain with Manure | Corn or sorghum for grain eligible for manure application and ineligible for double cropping |
| Grain without Manure | Corn or sorghum for grain ineligible for manure application and ineligible for double cropping |
| Silage with Manure | Corn or sorghum for silage eligible for manure application and ineligible for double cropping |
| Silage without Manure | Corn or sorghum for silage ineligible for manure application and ineligible for double cropping |
| Small Grains and Grains | Small grains and grains other than corn or sorghum eligible for manure and ineligible for double cropping |
| Small Grains and Soybeans | Soybeans double cropped with small grains and ineligible for manure |
| Specialty Crop High | Specialty crops with relatively high nutrient inputs with some crops eligible for manure |
| Specialty Crop Low | Specialty crops with relatively low nutrient inputs with some crops eligible for manure |
| Other Agronomic Crops | Other high commodity row crops such as tobacco, cotton, etc., with some crops eligible for manure |

- Average Relative N Reduction Effectiveness (RNRE), number of individual studies contributing to the average, and recommended planting times for the new cover crop species and species mixtures.

| | | |
|---|---|---|
| ◦ Cereal Rye | 1.00 | Early, Normal, Late |
| ◦ Annual Ryegrass | 0.66 | Early and Normal |
| ◦ Annual Legume | 0.16 | Early and Normal |
| ◦ Annual Legume + Grass | | Early and Normal |
| ◦ Early and Normal Brassica (winter hardy) | 0.70 | Early and Normal |
| ◦ Forage Radish | 0.58 | Early |
| ◦ Forage Radish + Grass | | Early and Normal |
| ◦ Triticale | 0.86 | Early, Normal, Late |
| ◦ Oats (winter hardy) | 0.55 | Early and Normal |
| ◦ Oats (winter killed) | 0.40 4 | Early |

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop and Water Quality
  - Previously, no cover crop practice was eligible for use on crop land where manure was applied in the fall. Phase 6 now includes a new traditional cover crop following a fall manure application BMP.
  - Determining the credit for a traditional cover crop planted following a fall manure application is simply a matter of multiplying the appropriate traditional cover crop N reduction credit times 0.7.

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop and Water Quality
  - In example, for early drilled rye in the Coastal Plain/Piedmont region, the current N reduction credit is 0.45 for settings where no manure is applied in the fall. In Phase 6, early drilled rye following a manure application will receive an N reduction credit of 0.7 x 0.45, or 0.31.
  - All traditional full rate grass and brassica cover crop options, and grass/brassica mixtures currently identified will be eligible for N reduction credit where manure is applied in the fall with the adjustment being 0.7 in all cases. This cover crop practice will be applied to Phase 6 land uses identified as eligible for manure applications.

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop and Water Quality
  - Annual Legume plus Grass Mixtures
    A mixture that includes at least 25% of the recommended planting rate of grass cover equals a N reduction effectiveness of 50% of the full rate of the grass component.
  - A mixture that contains at least 50% of the full grass planting rate equals and N reduction efficiency of 70 % of the full grass efficiency, or the average grass reduction efficiency if no grass is specified.

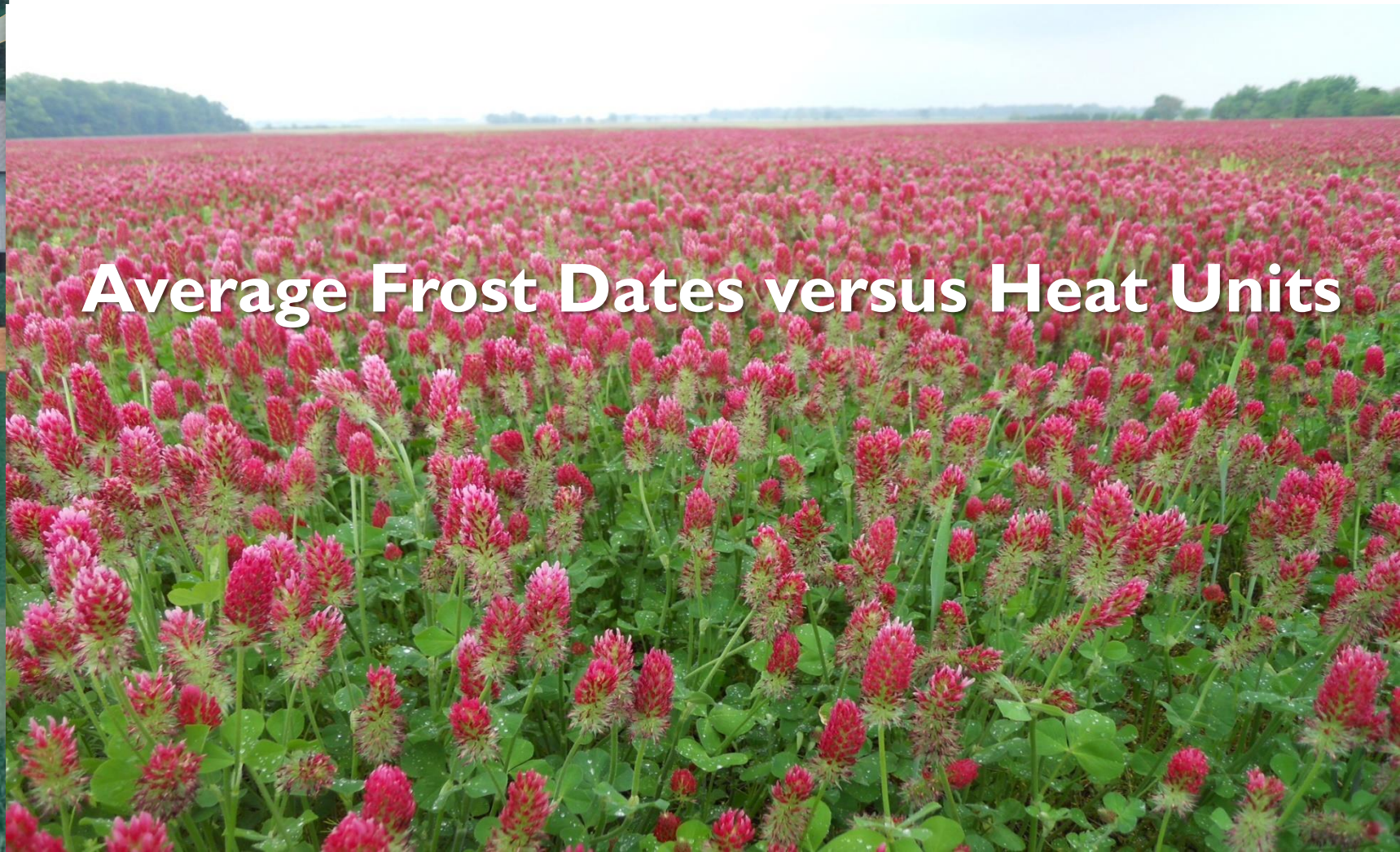
# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop and Water Quality
  - Grass Cover Crops – Lower Seeding Rate
    Monoculture grass cover crops planted between 50 and 100 % of the full grass rate is considered as 70% as effective for N reduction effectiveness as full rate grass plantings for early and standard planting dates.

# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop and Water Quality
  - Commodity Cover Crops
    Winter cereals are planted for harvest but which are not fertilized in the fall should receive a 5, 10, and 15% N reduction credit for the early, normal, and late planting period.
  - Commodity cover crops are equally effective at taking up soil nitrate as traditional cover crops, but the credit is reduced because the baseline condition is standard winter cereal production with a fall N fertilizer application.
  - Although comprehensive data are lacking, the assumed past standard practice for winter cereal production included a 30 lb./acre N application just prior to fall planting.

# Cover Crops and Climate Change: Revisiting Planting Dates



# Cover Crops and Climate Change: Revisiting Planting Dates

- Average First Frost Dates versus Heat Units
  - Phase 6 - Planting Dates Based on First Frost Dates
    - Early Establishment
      More than two weeks before the average first frost date.
    - Normal Establishment
      Between the average first frost date and two weeks before that date.
    - Late Establishment
      Within three weeks after the average first frost date.
    -
  - NOAA Frost Dates
    - The "frost" date is the date of the minimum temperature being 36 degrees Fahrenheit or below.
    - Note: Frost is also dependent on moisture so this "frost" date is just an estimate.

# Cover Crops and Climate Change: Revisiting Planting Dates

- Average First Frost Dates versus Heat Units
  - NOAA Climate Normals
    - Three-decade averages of climatological variables including temperature and precipitation.
    - This product is produced once every 10 years. The 1981–2010 U.S. Climate Normals dataset is the latest release of NCEI's Climate Normals.
    - This dataset contains daily and monthly Normals of temperature, precipitation, snowfall, heating and cooling degree days, frost/freeze dates, and growing degree days.
    - Calculated from observations at approximately 9,800 stations operated by NOAA's National Weather Service.

## Median Dates for the First 32°F Freezes

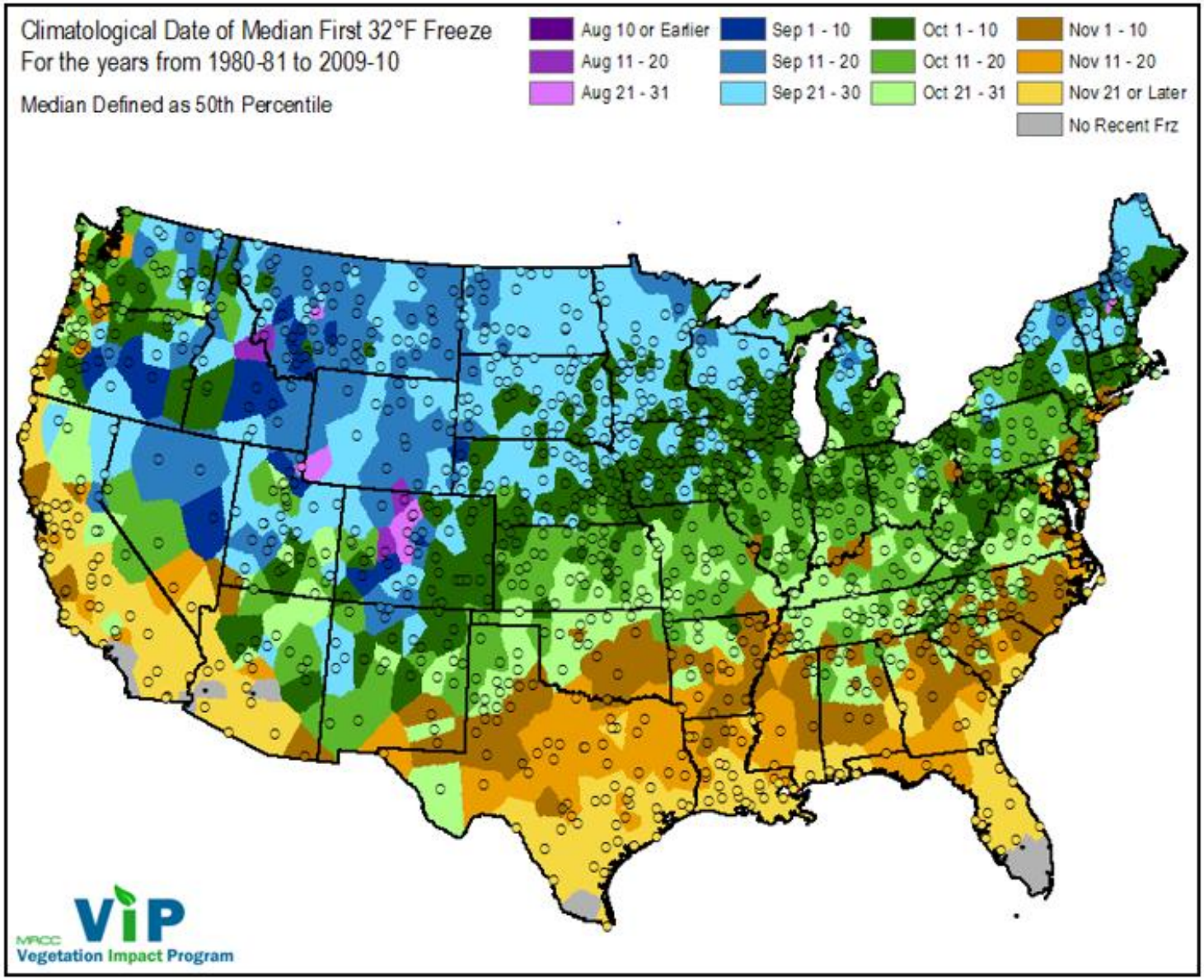



***Fig. 1.*** *Climatological Date of Median First 32°F freeze for the United States.*

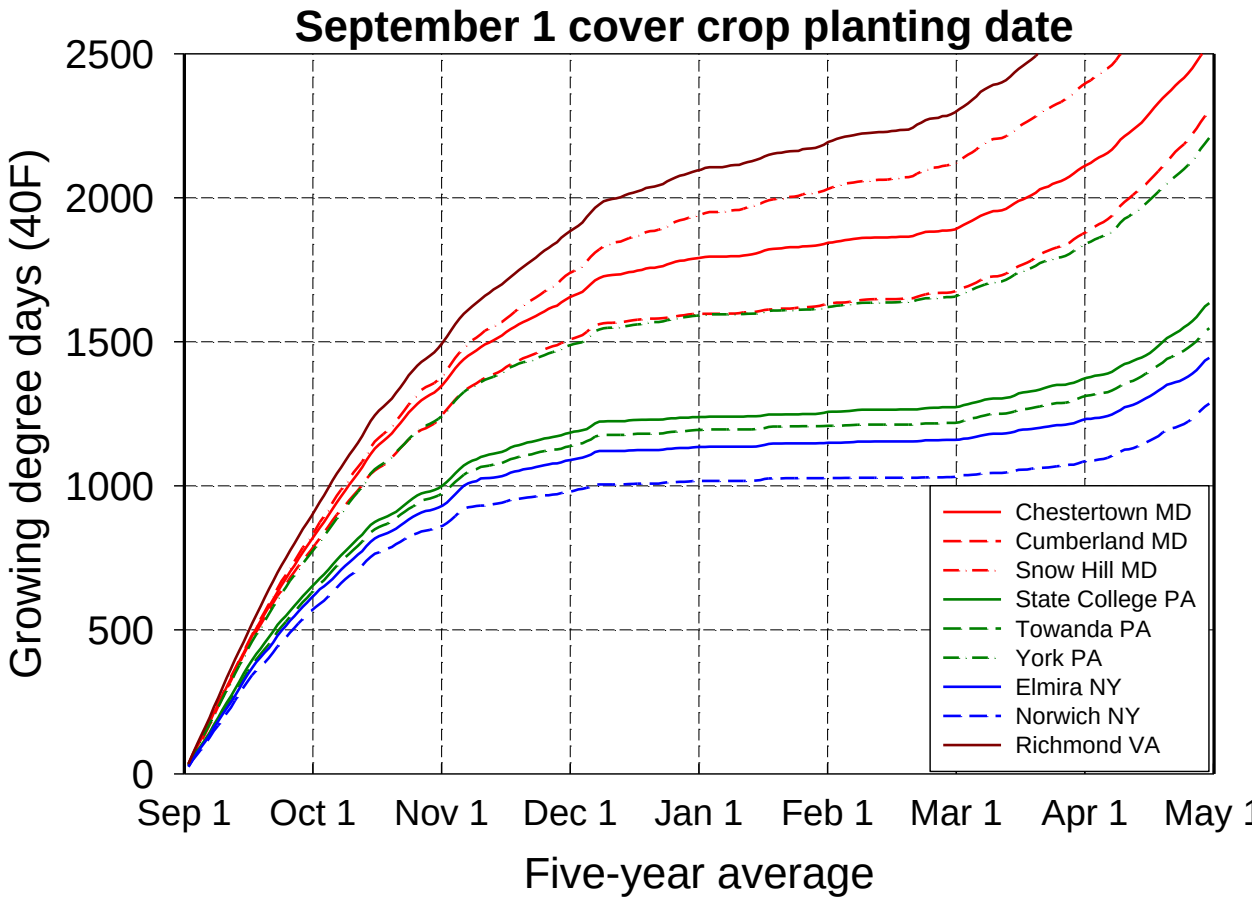
# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop Establishment – Seeding Dates
  Phase 6 Chesapeake Bay Watershed Model (CBWM)

| Region | Last Frost Date | First Frost Date |
|---|---|---|
| DE | 4/19-5/7 | 10/2-10/15 |
| MD Zone 6 | 3/26-4/27 | 10/12-11/13 |
| MD Zone 7 | 3/30-4/28 | 10/14-11/14 |
| Western MD | 3/26-4/27 | 10/12-11/13 |
| NY | 5/4-5/30 | 9/16-10/18 |
| PA Zone 1 | 4/27-6/2 | 9/20-10/14 |
| PA Zone 2 | 4/27-5/27 | 9/11-10/15 |
| PA Zone 3 | 4/17-4/27 | 10/14-10/21 |
| VA W of Blue Ridge | 4/28-5/17 | 9/28-10/13 |
| VA Piedmont | 4/7-4/24 | 10/15-11/4 |
| VA Eastern | 3/23-4/14 | 10/24-11/17 |
| WV | 4/25-5/21 | 9/26-10/14 |

**The Bay watershed has large north-south differences in growing season, how do fall heat units vary within the watershed?**

**(Staver, Pers. Comm. 2008)**



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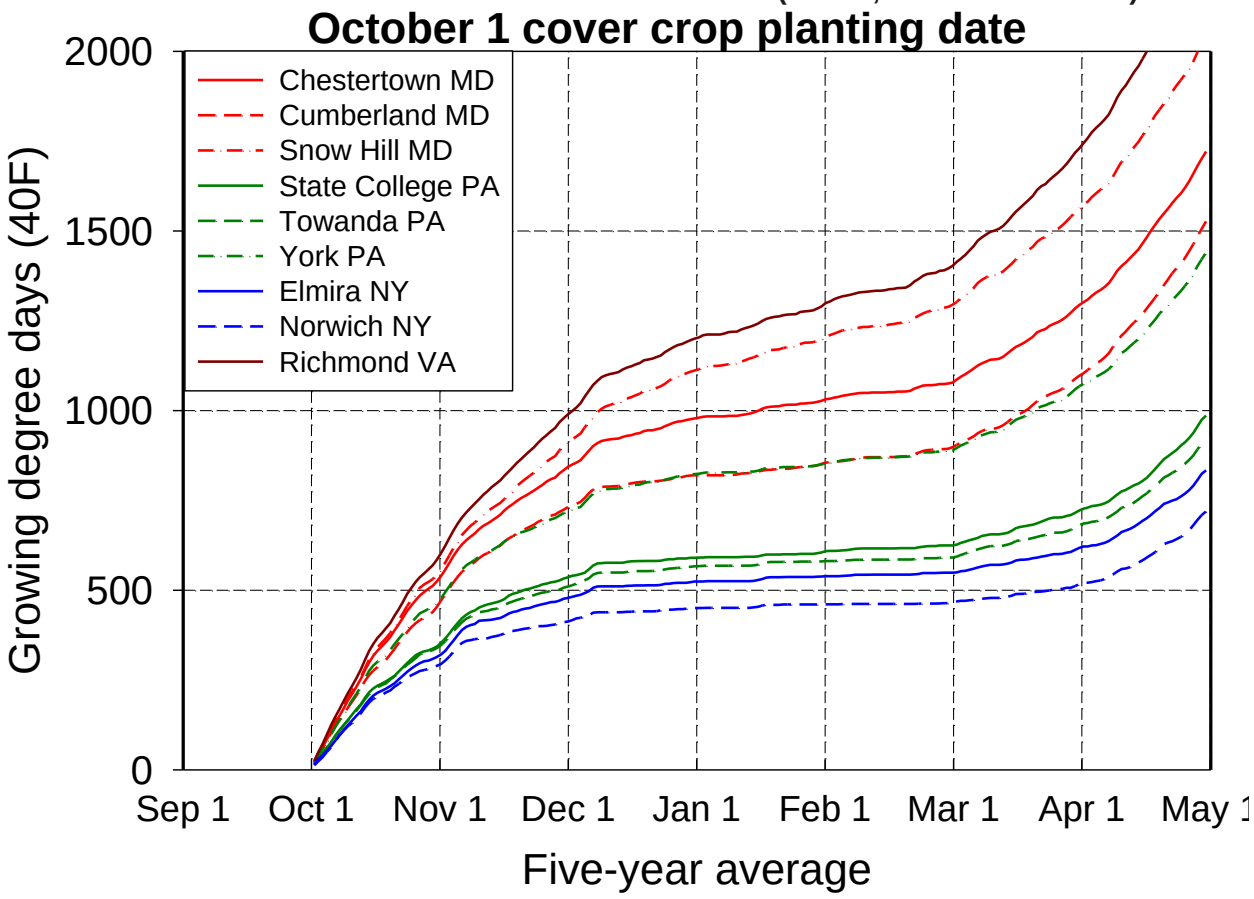

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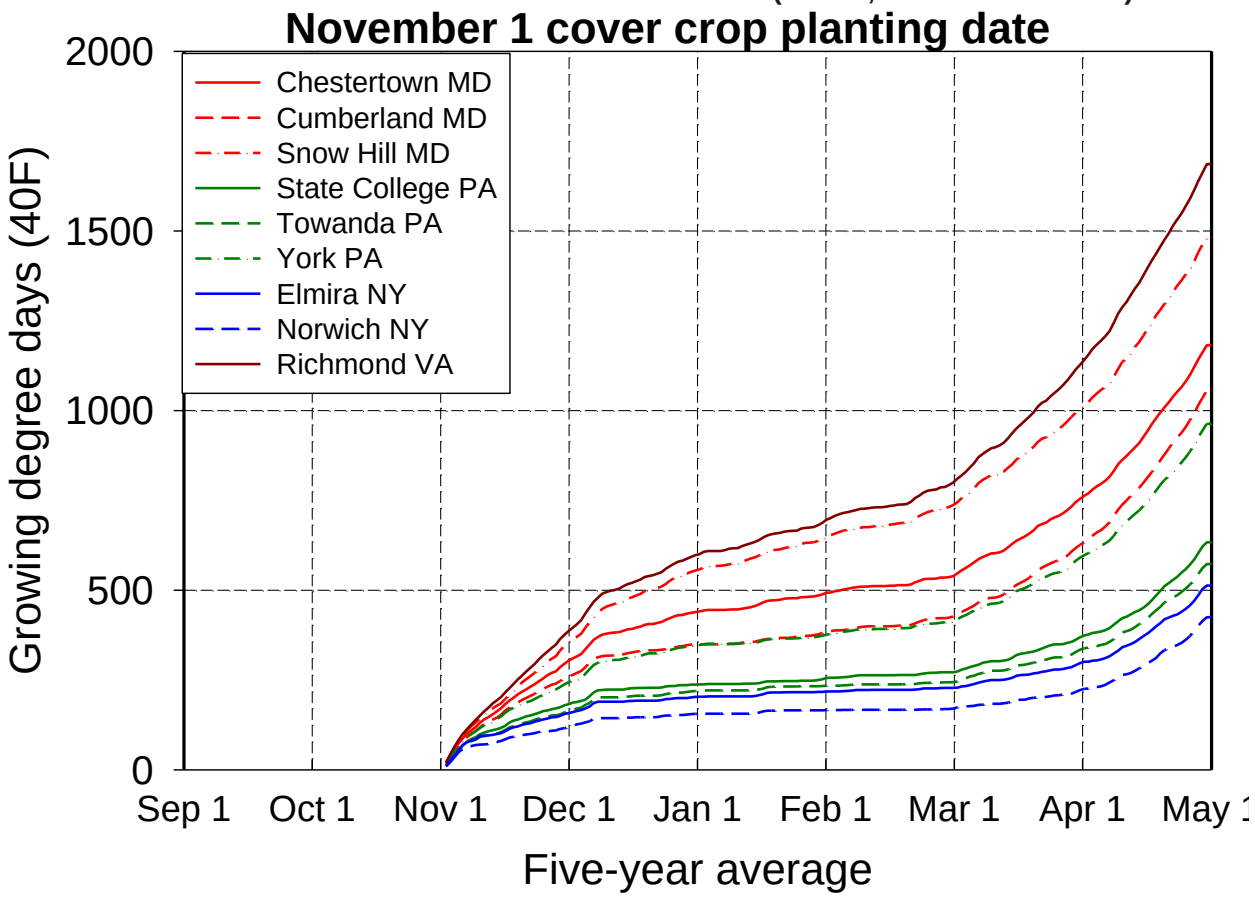
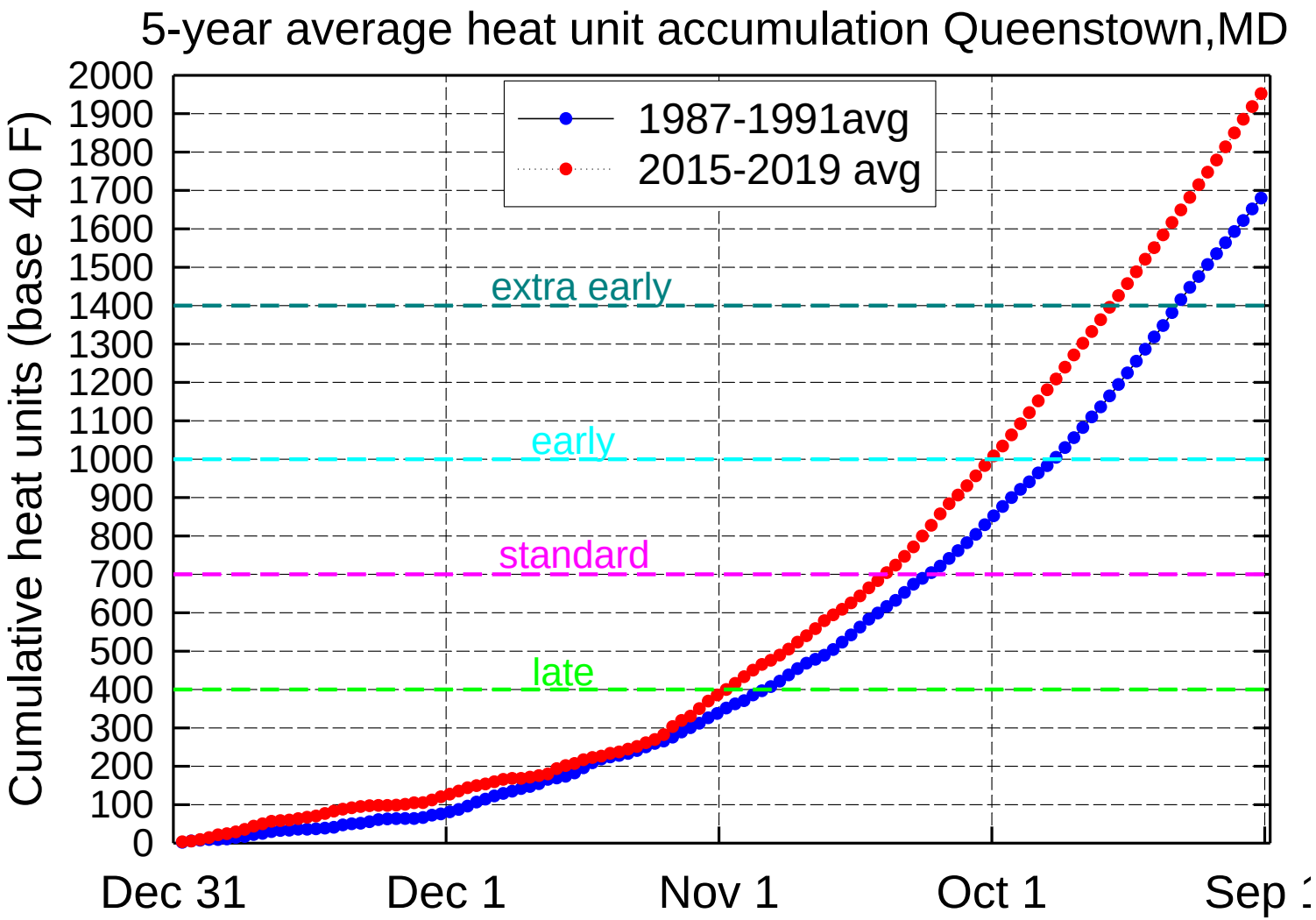


# Cover Crops and Climate Change: Revisiting Planting Dates



# Cover Crops and Climate Change: Revisiting Planting Dates

- Cover Crop Establishment – Seeding Dates
  Growing Degree Days (GDD)

| | | chestertown | cumberland | snow hill | state college | towanda | york | elmira | norwich | richmond |
|---|---|---|---|---|---|---|---|---|---|---|
| | | MD | MD | MD | PA | PA | PA | NY | NY | VA |
| | | Lastest planting | Lastest planting | Lastest planting | Lastest planting | Lastest planting | Lastest planting | Lastest planting | Lastest planting | Lastest planting |
| | cumulative | date to achieve | date to achieve | date to achieve | date to achieve | date to achieve | date to achieve | date to achieve | date to achieve | date to achieve |
| | 40 F Growing DD | by December 31 | by December 31 | by December 31 | by December 31 | by December 31 | by December 31 | by December 31 | by December 31 | by December 31 |
| | | | | | | | | | | |
| late | 400 | 3-Nov | 27-Oct | 11-Nov | 13-Oct | 12-Oct | 26-Oct | 8-Oct | 5-Oct | 15-Nov |
| standard | 700 | 14-Oct | 7-Oct | 22-Oct | 24-Sep | 23-Sep | 7-Oct | 18-Sep | 16-Sep | 25-Oct |
| early | 1000 | 30-Sep | 22-Sep | 6-Oct | 10-Sep | 9-Sep | 22-Sep | 5-Sep | 2-Sep | 10-Oct |
| extra early | 1400 | 14-Sep | 8-Sep | 19-Sep | 26-Aug | 24-Aug | 8-Sep | 20-Aug | 17-Aug | 23-Sep |

| | | Queenstown, MD | Queenstown, MD |
|---|---|---|---|
| | | 1987-1991 avg | 2015-2019 avg |
| | | Lastest planting | Lastest planting |
| | cumulative | date to achieve | date to achieve |
| | 40 F Growing DD | by December 31 | by December 31 |
| | | | |
| late | 400 | 26-Oct | 31-Oct |
| standard | 700 | 8-Oct | 13-Oct |
| early | 1000 | 24-Sep | 1-Oct |
| extra early | 1400 | 10-Sep | 17-Oct |


Questions?