

# Responding to Climate Change Impacts to Agriculture: The Cornell Climate Smart Farming

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Cornell University



**MARRAKECH** COP22 | CMP12 | CMA1  
UN CLIMATE CHANGE CONFERENCE

# Cornell Climate Change Capacity

## Research, Teaching and Extension:

- New/Adapted Crops
- Pests and IPM
- Animal Agriculture
- Climate Modeling/Extreme Weather
- Communicating Climate Change
- Crop Yield Risks
- Carbon Sequestration & Policy
- Northeast Regional Climate Center
- Water Management
- Renewable/Bioenergy
- Nutrient Management
- Stakeholder Risks & Needs
- Teaching: Climate Change Minor and Courses

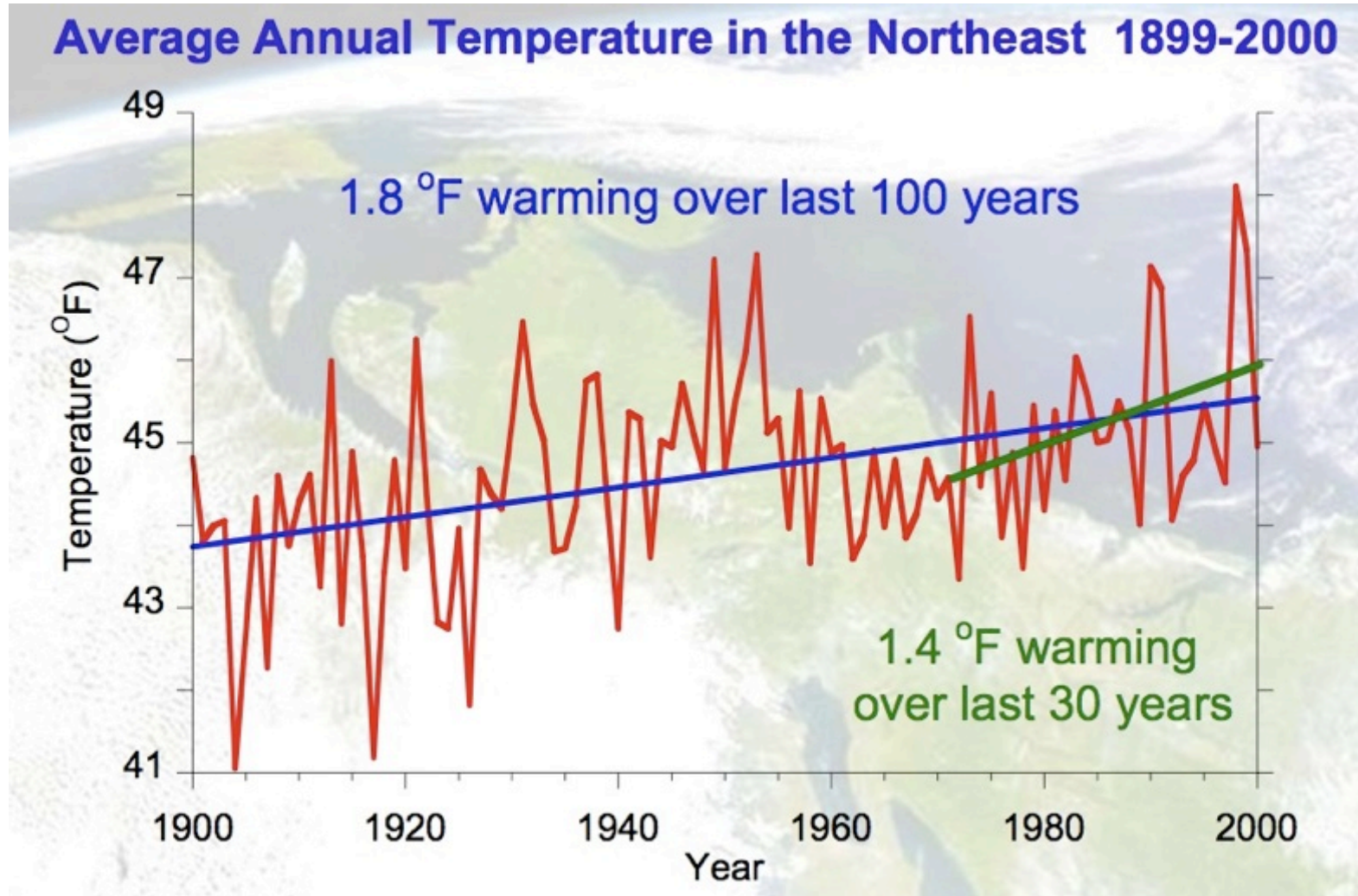
*And Many Partnerships: NYS Ag and Markets, DEC, NRCS, SWCC, USDA Climate Hubs, NGOs and Foundations.*



- Formed in 2013
- Working toward resilient and sustainable agricultural, ecological, and social systems in the face of a rapidly changing climate
- Research, Extension Outreach and Partnerships
- Launched Climate Smart Farming (CSF) Program and CSF Extension Team in 2015

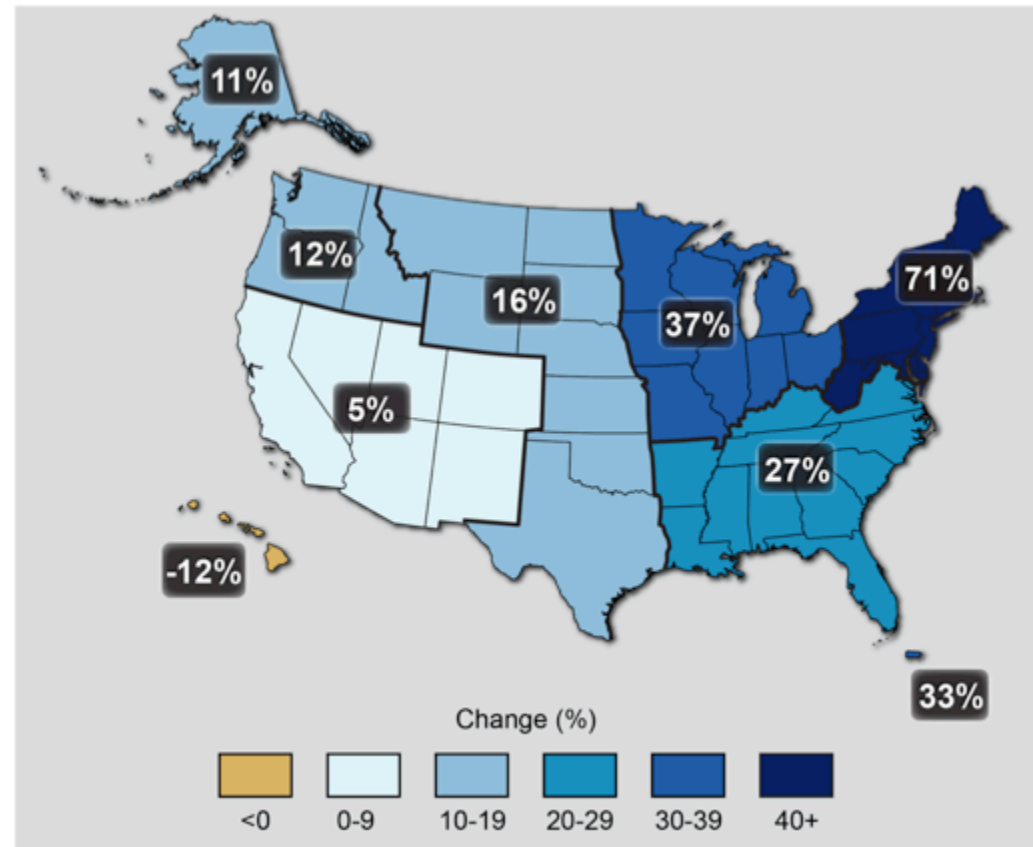
[climateinstitute.cals.cornell.edu/](http://climateinstitute.cals.cornell.edu/)

# Temperature



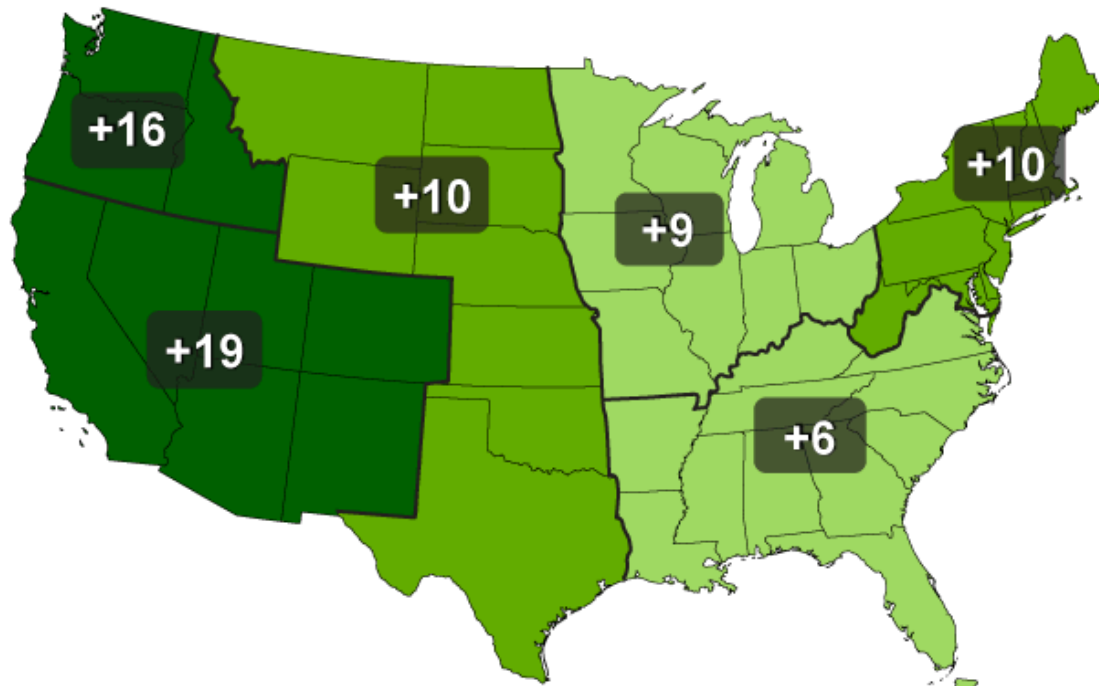
# Extreme Precipitation

- Observed Trends in 1-day Very Heavy Precipitation (1958 to 2012)
- The Northeast has had the greatest increase in heavy precipitation in the United States.

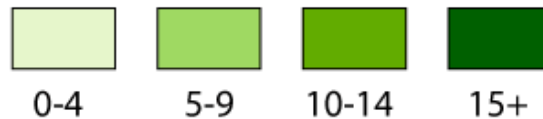


# Changes in Seasons

## Observed Increase in Frost-Free Season Length

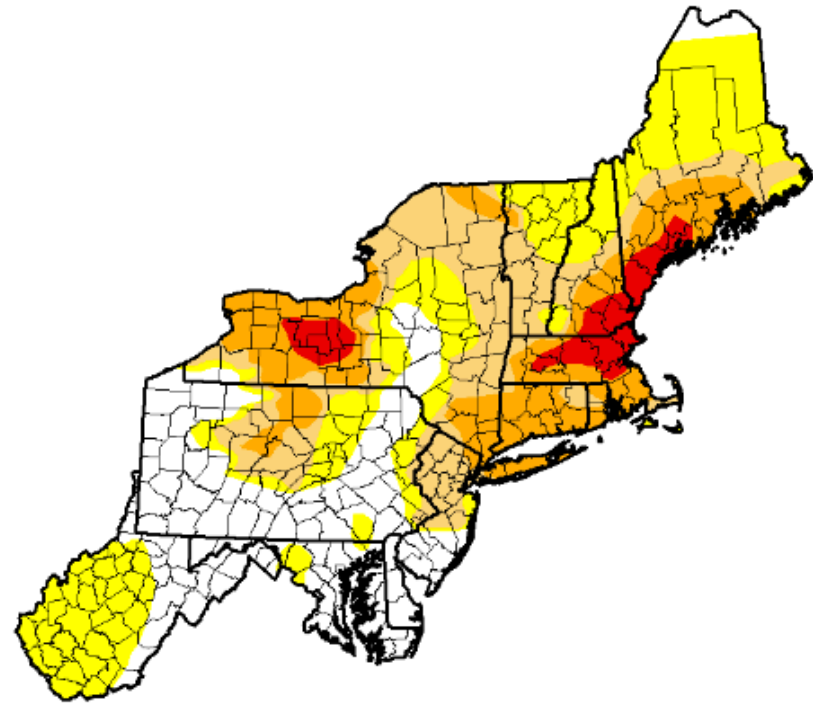


Change in Annual Number of Days



# Short Term Drought

- As of Oct 11th, 72% of the NE is abnormally dry
- 5% is in extreme drought (Including Tompkins County)
- Short-term drought is a part of climate variability we must be prepared for



Intensity:

 D0 (Abnormally Dry)

 D2 (Severe Drought)

 D4 (Exceptional Drought)

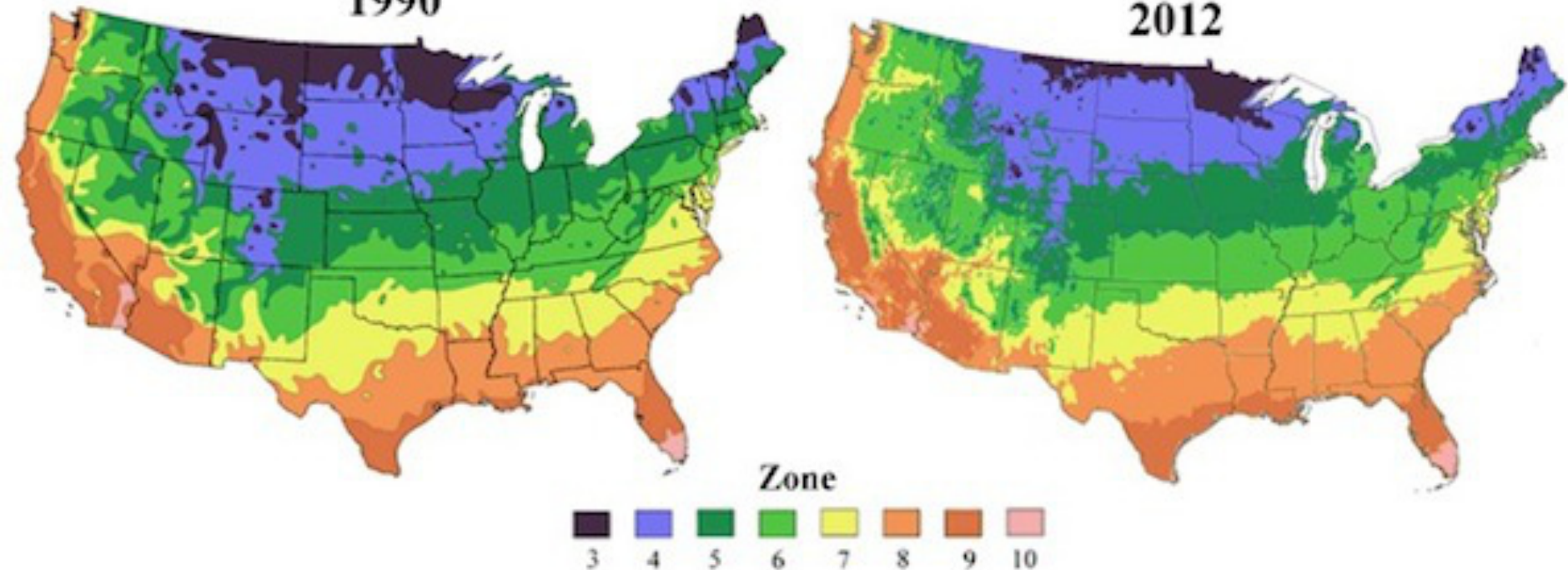
 D1 (Moderate Drought)

 D3 (Extreme Drought)

## USDA Plant Hardiness Zone Maps

1990

2012



Red River Valley, Manitoba  
2005-8:, 20,000 acres grain  
Today: 1.1 million & expanding



# Phenological Responses:



Grapes are blooming 6 days earlier



Apples are blooming 8 days earlier than they were in the 1960s



Lilacs are blooming 4 days earlier

Spring arrival dates of 103 migrant birds in NY and MA arriving 4 to 13 days earlier 1951-1993 compared to 1903-1950 (Butler 2003)

[Source: Wolfe DW et al. 2005. Internat J Biometeor 49:303-309.]  
National Phenology Network: <http://www.usanpn.org>

# Climate Change and Northeast Agriculture

## Challenges:

- Temperature: Increased frequency of high temperature causes heat stress for both livestock and crops
- Water: Too much or too little; lack of efficient water management
- Pest, Disease & Weed Pressure
- Climate change much more complicated than just “warming”:  
Uncertainty, Variability & Extremes

## But also Opportunities:

- Heat stress challenges less severe than some other regions
- Relative to other regions: we have water!
- Longer growing seasons allow farmers to explore with different crop varieties and double-cropping
- Close proximity to many markets: 22% U.S. population

# Reducing GHG Emissions: Mitigation in Agriculture

- GHG Accounting and Reductions
- Energy Conservation and Fuel efficiency
- Renewable Energy
  - Biomass
  - Solar and wind power
  - Anaerobic Digestion
- Nutrient management
- Reduced tillage, cover crops
- Carbon Sequestration: Forest and Soils

# CLIMATE CHANGE & AGRICULTURAL IMPACTS

- Agriculture in the Northeast is characterized by a diversity of products and production systems, scales of operations, and landscapes.
- Farmers need a variety of specific practices and tools to help them with climate change adaptation and mitigation.

Agricultural Products	Climate Change Impacts	Toolkit of Adaptation & Mitigation Practices
Dairy and Livestock	Heat stress, water impacts from heavy precipitation	Increased cooling, energy efficiency and renewables, water management
Vegetables and Field Crops	Disease, weed and pest pressure, flooding and short-term drought, longer growing seasons, heat stress	Integrated pest management, drainage or irrigation, soil health, cropping systems, shifting dates and new varieties
Tree Fruit, Berries, and Grapes	Unexpected freeze, short-term drought, reduced winter chill	Monitoring weather and protecting crops, siting, soil health and cropping systems, new varieties
Maple Syrup	Changing seasons, variable weather, contamination, tree health	Earlier tapping, new technologies, shifting production

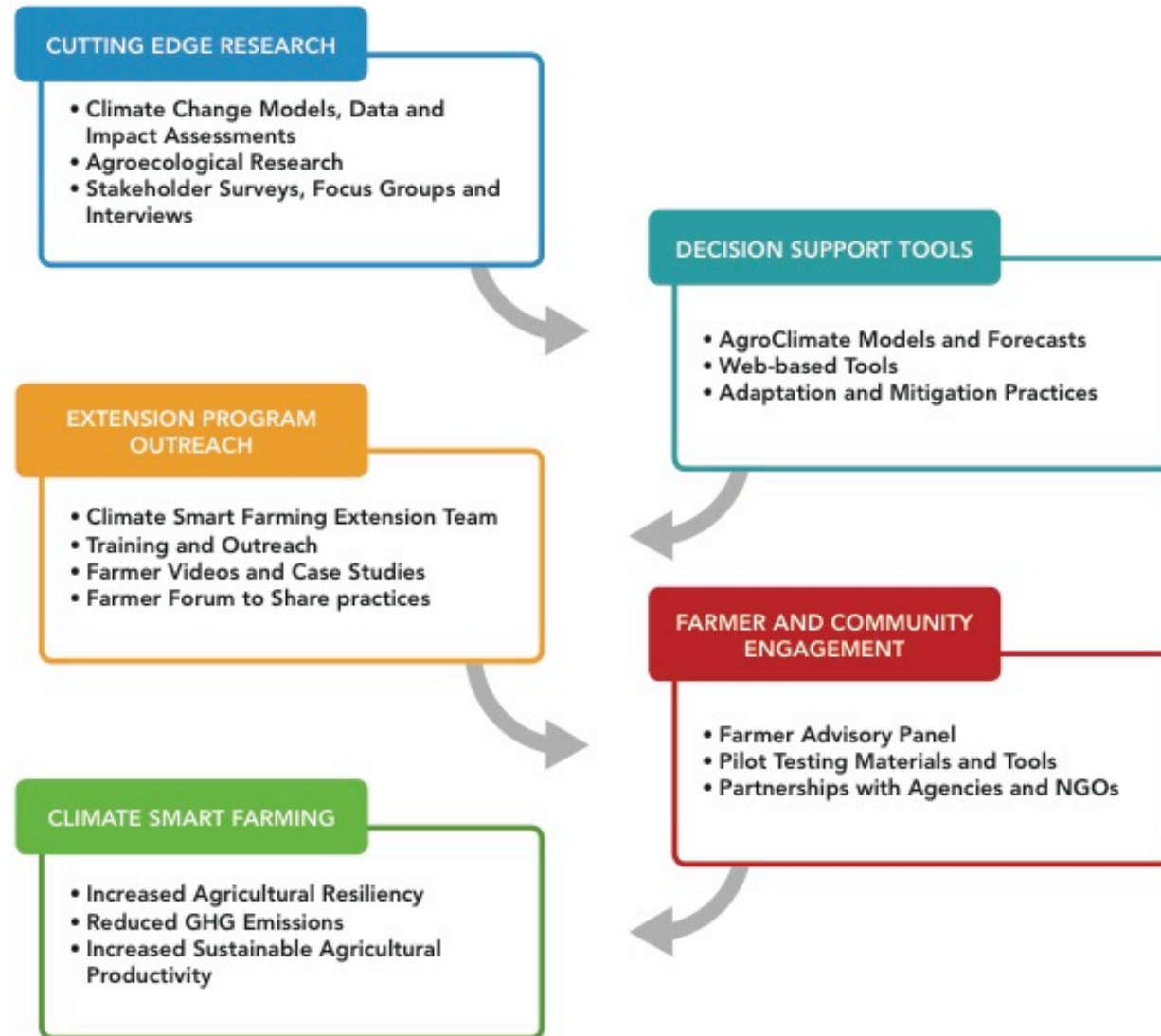
# Climate Smart Farming Program Goals

- Sustainably increase agricultural productivity, farming incomes, and food security
- Increase energy efficiency and renewable energy capacity to reduce operating costs and GHG emissions
- Increase farm resiliency to extreme weather and climate variability through adoption of BMPs for climate change adaptation.

# US Farmer CC Perceptions

- US Ag Producers: Belief in CC ranged between 58% and 80% (VT study); on average 65%. Only 31% farmers believed that CC is mostly or entirely human-caused.
- US General Public: 73% of Americans believe CC is occurring, and 33% agree it is mostly or entirely human caused.
- Of ten studies in sample, farmer belief in CC appears to be lowest to highest from the Southeast, Southwest, Midwest, Northeast (Caveat: small sample sizes, not regionally representative studies)
- Farmers still high degree of uncertainty about CC; human causation.
- Need for further research – regionally representative studies with larger sample size!!

# Stakeholder-Driven Research & Extension





news

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Powerful and user-friendly climate tools for farmers in the Northeast

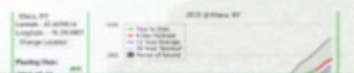
How is the changing climate affecting your farm?

## Climate Smart Farming Decision Tools

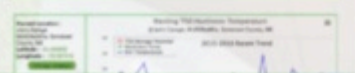
Cutting-edge tools to help farmers manage climate risk.

See more Tools

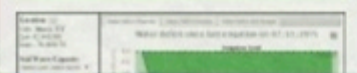
CSF Growing Degree Day Calculator



Grape Hardiness & Freeze Risk



CSF Irrigation Scheduler



Climate Normals - Northeast Regional Climate Center







## Extension Team



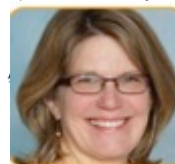
Dr. Kitty O'Neil, Field Crops & Soil Health



Dr. Kim Morrill, Dairy Management



Luke Haggerty, Viticulture



Laura McDermott, Small Fruit



Dr. Darcy Telenko, Vegetables & IPM



Jesse Strzok, Ag Economics

Cornell Cooperative Extension System: 1000s Educators/Every County:

<http://climatesmartfarming.org/climate-smart-farming-extension-team/>



# Climate Smart Farming Resources

CSF Resources and Best Management Practices

Climate Tools Team Resources Forum Videos

**Categories**

- Agricultural Sectors
  - Dairy, Poultry, and Livestock
  - Field Crops
  - Grapes
  - Greenhouse, Nursery, and Sod
  - Maple
  - Specialty Crops
  - Tree Fruit and Berries
  - Vegetables
- Media Types
  - Decision Support Tool
  - Fact Sheet
  - Online Courses
  - Reports and Studies
  - Videos
  - Weather Map
  - Workshop Presentations
- Vulnerability Types
  - Drought
  - Flooding
  - Frost Risk
  - Heat Stress
  - Insects
  - Multiple Vulnerabilities
  - Weeds
- Adaptation Strategies
  - Conservation Tillage
  - High-Residue Cover Crops
  - Irrigation

**Science for a Hungry World**  
  
The NASA, "Science for a Hungry World" video series covers the challenges surrounding feeding an ever growing population and how  
[Read more >](#)

**Maine's Climate Future: Assessment Report**  
  
Published by the University of Maine, Maine's Climate Future is a comprehensive assessment of climate change in Maine. The report  
[Read more >](#)

**NRCS Technical Publications**  
  
The Plant Materials Program is an extensive listing of technical publications organized by topics such as Climate Change, Cover Crops and  
[Read more >](#)


**Connecticut Ag Impact Report**  
  
Published by the Connecticut Governor's Steering Committee on Climate Change, this report analyses the potential impacts of climate change on  
[Read more >](#)

**New Jersey Ag Impact Report**  
  
Published by Rutgers Climate Institute, this report examines the potential impacts of climate change on agriculture, aquaculture and fisheries throughout  
[Read more >](#)

**Vermont Ag Impact Report**  
  
Published by the Vermont Agency of Natural Resources, this report provides an overview of potential climate change impacts on agriculture  
[Read more >](#)

**Building soils for better crops manual**  
  
The third edition of *Building Soils*  
[Read more >](#)

**Small Farm Adaptation Guidebooks**  
  
Preserving smallholder farms  
[Read more >](#)

**Cool Farm Tool**  
  
Developed by the University of  
[Read more >](#)

<http://climatesmartfarming.org/resources/>

# CSF Decision Support Tools



The screenshot displays the 'Climate Smart Farming Tools' website. At the top, a green header contains the title 'Climate Smart Farming Tools'. Below this is a navigation bar with tabs for 'Climate', 'Tools', 'Team', 'Resources', 'Forum', and 'Videos'. The 'Tools' tab is selected. The main content area features a grid of tool cards. Each card includes a title, a small image or chart, and a brief description. The tools shown are: CSF Growing Degree Day Calculator, Grape Hardiness & Freeze Risk, CSF Water Deficit Calculator, Climate Normals - Northeast Regional Climate Center, Network for Environment and Weather Applications, U.S. Drought Monitor, NOAA Seasonal Outlook - Precipitation, NOAA Seasonal Outlook - Temperature, USDA Plant Hardiness Map, and Adapt-N Nitrogen Management Tool. A pagination control shows '1 2 →'.

## Climate Smart Farming Tools

Climate Tools Team Resources Forum Videos

### CSF Growing Degree Day Calculator

Growing Degree Days (GDD) are a measure heat accumulation used to predict plant development and pest/disease outbreaks.

### Grape Hardiness & Freeze Risk

Charts hardiness temperature vs. daily observed/forecast temperatures for several varieties of grapes.

### CSF Water Deficit Calculator

Monitor current and forecasted soil water deficit at your location to allow smart scheduling of irrigation.

### Climate Normals - Northeast Regional Climate Center

Climate normals are an arithmetic average of a variable such as temperature over a prescribed 30-year period.

### Network for Environment and Weather Applications

NEWA makes it possible for farmers to share resources for weather data collection, analysis, distribution, and archiving

### U.S. Drought Monitor

The map is based on measurements of climatic, hydrologic and soil conditions as well as reported impacts and observations from more than 350 contributors around the country.

### NOAA Seasonal Outlook - Precipitation

A seasonal forecast is the best available prediction of what our climate will be like in the next few months.

### NOAA Seasonal Outlook - Temperature

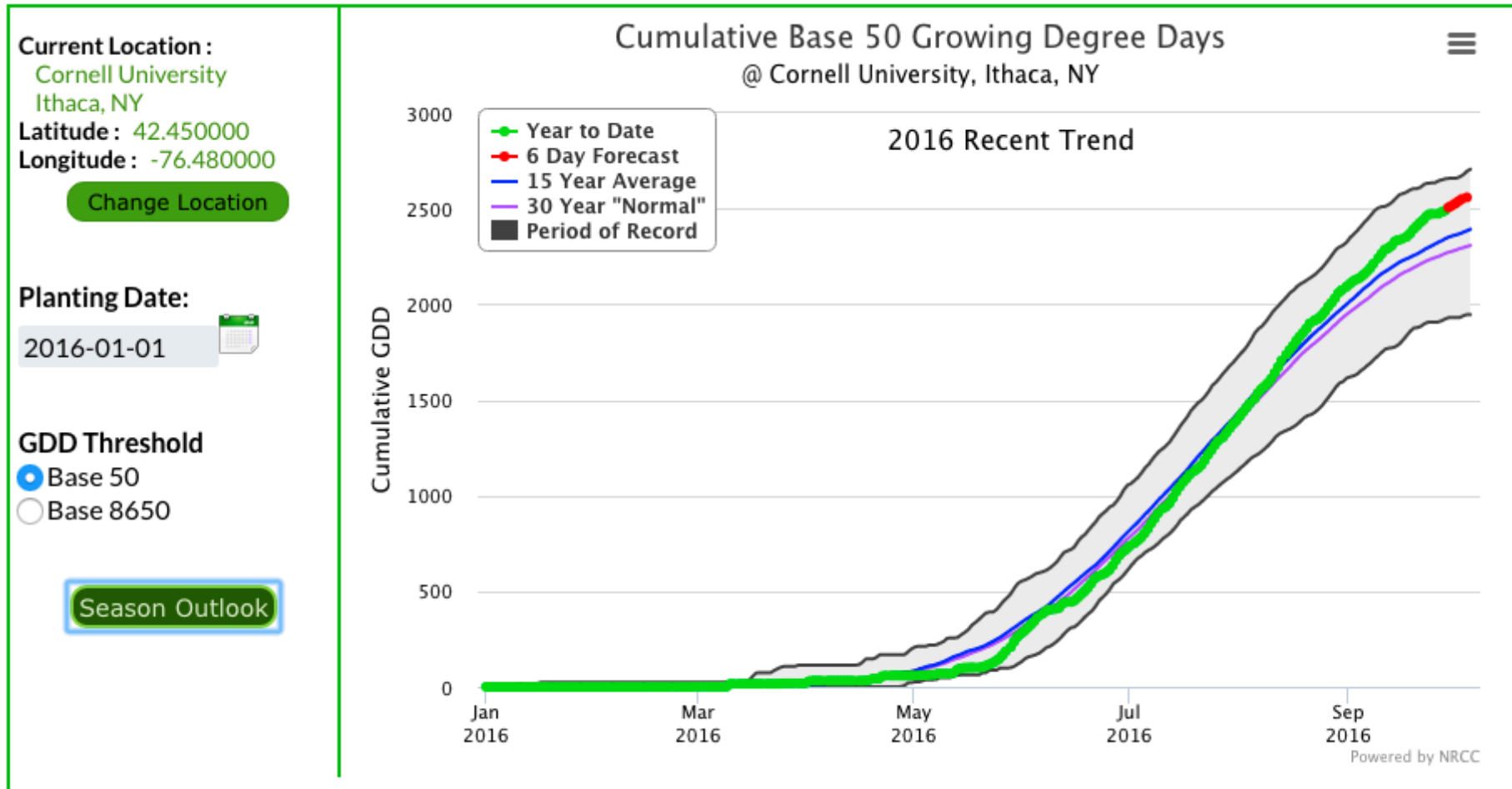
A seasonal forecast is the best available prediction of what our climate will be like in the next few months.

### USDA Plant Hardiness Map

### Adapt-N Nitrogen Management Tool

# Growing Degree Day Tool

- GDD Measures heat accumulation over the season
- Tool can be used to predict important stages in plant growth and predict pest and disease outbreaks



# Freeze Risk Tools

- Grape and Apple

## Grape Hardiness & Freeze Risk

Climate

Tools

Team

Resources

Forum

Videos

### Current Location :

Joe's Garage  
MidlONoWhe, Somerset  
County, ME

Latitude : 45.450908

Longitude : -70.487016

Change Location

### Date of Interest:

2016-02-25



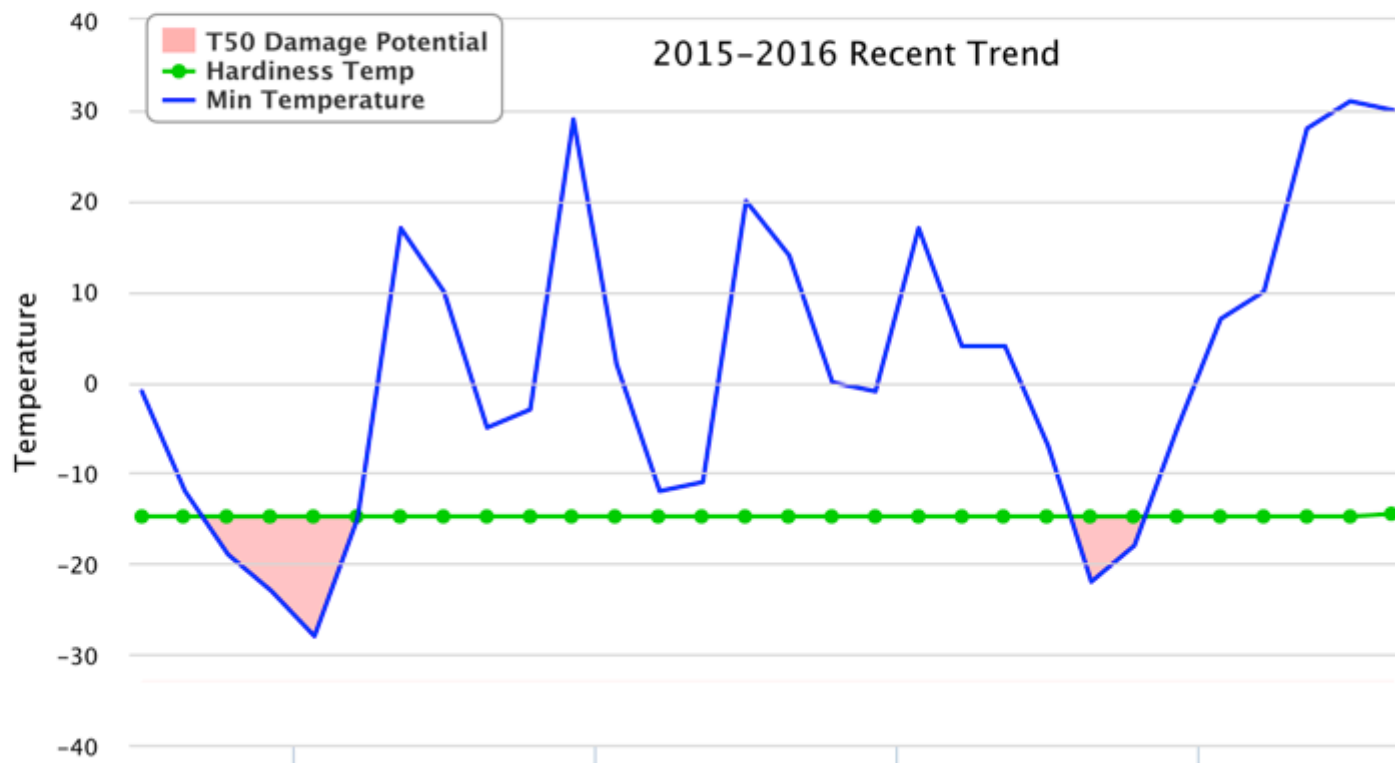
### Grape Variety

- Cabernet Franc  
 Concord  
 Riesling

Season To Date

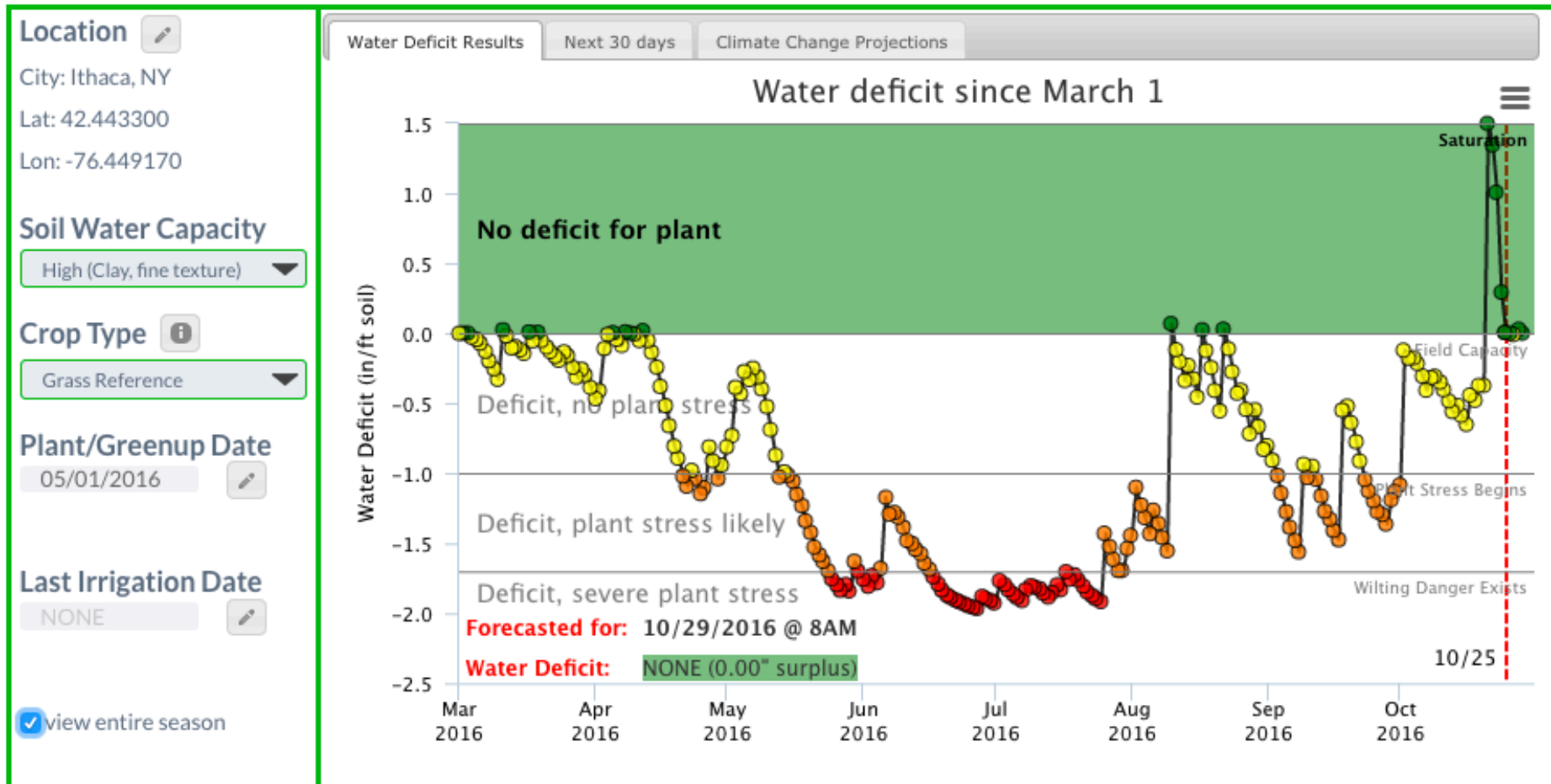
### Riesling T50 Hardiness Temperature

@ Joe's Garage, MidlONoWhe, Somerset County, ME



# Water Deficit Calculator

- Estimates effective root zone soil water content to inform decision makers about current and forecasted water deficits
- Uses precipitation, evapotranspiration, drainage, and runoff



## Climate Smart Farming Forum

Ask questions. Get answers. Share Information.

Join or Search the Forum

### RECENT TOPICS

*Precipitation changes in NE and other regions?*

*Details about more frost-free days during the year?*

*Irrigation on my farm*

*Installing more renewable energy on my farm*

*What are the GDD measures for corn?*

*Soil runoff in large rainfall events*

Create a Free Account: Get Answers, Share Information!

[climatesmartfarming.org/forum/](https://climatesmartfarming.org/forum/)

# Resources

- Cornell Institute for Climate Smart Solutions:  
<http://climateinstitute.cals.cornell.edu>
- Cornell Climate Smart Farming Program:  
[www.climatesmartfarming.org](http://www.climatesmartfarming.org)
- Cornell Climate Change Resources:  
[www.climatechange.cornell.edu](http://www.climatechange.cornell.edu)
- US National Climate Assessment:  
<http://nca2014.globalchange.gov/>



# Questions? Thank You!

**Allison Chatrchyan**

Cornell Institute for Climate Smart Solutions

Climate Smart Farming Program

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[www.climatesmartfarming.org](http://www.climatesmartfarming.org)