

Agricultural Applications of North Dakota Agricultural Weather Network

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31st National Sunflower Association Research Forum

January 13, 2009

Fargo, ND

Organizational Chart

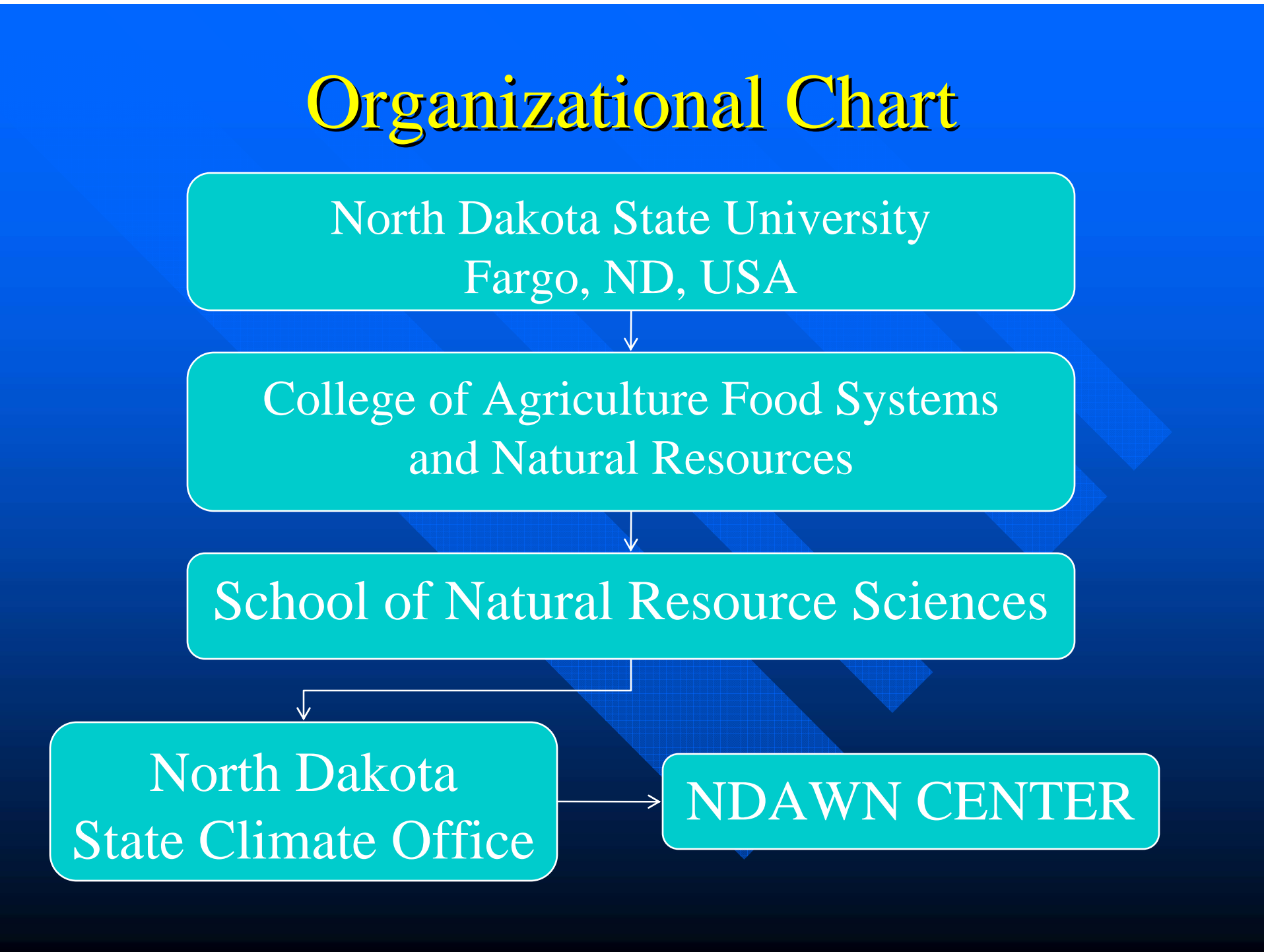
North Dakota State University
Fargo, ND, USA

College of Agriculture Food Systems
and Natural Resources

School of Natural Resource Sciences

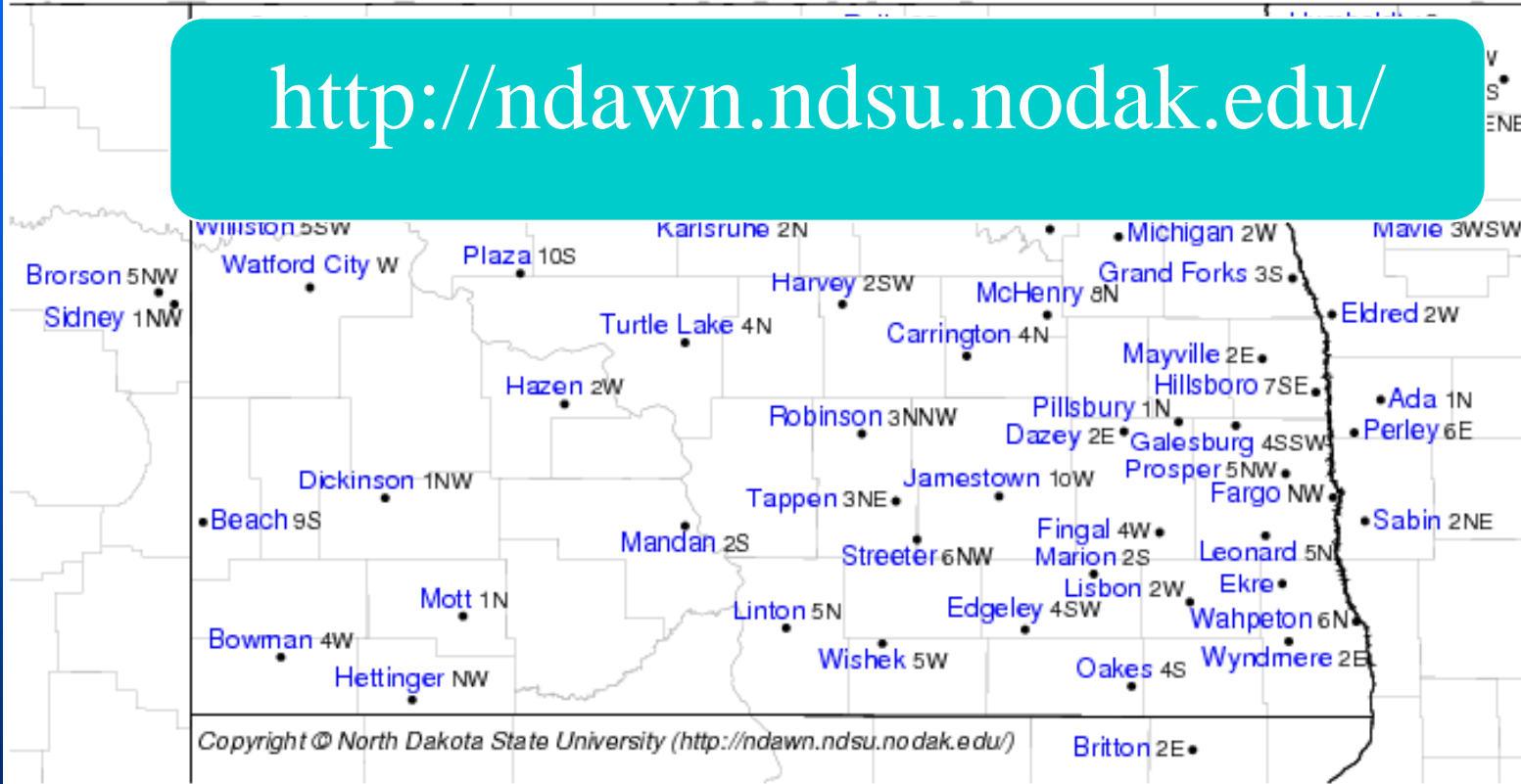
North Dakota
State Climate Office

NDAWN CENTER



NDAWN Station Locations (2008-08-05)

<http://ndawn.ndsu.nodak.edu/>



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Key: Station Name 9S = 9 Miles South of Town

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| Select Weather Variable for August 5, 2008: | | |
|---|----------------|-------------------|
| Stations | Wind Speed | Solar Radiation |
| Temp: Air Max/Min | Wind Direction | Relative Humidity |
| Temp: Air Avg | Wind Chill | Dew Point |
| Temp: Soil | Rainfall | Potential ET |

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NDAWN Station: Fargo, ND

Yesterday Historical Details Sponsor history

Data for 2009-01-11

[View yesterday's hourly data](#)

Max air temp: 12 °F / -11 °C (at 3:13 PM CST)
Min air temp: 4 °F / -15 °C (at 9:31 AM CST)
Avg air temp: 8 °F / -13 °C
Avg bare soil temp: 24 °F / -4 °C
Avg turf soil temp: 30 °F / -1 °C
Avg wind speed: 7.5 mph / 3.4 m/s
Max wind speed: 19.3 mph / 8.6 m/s (at 6:43 AM CST)
Wind direction: 344 deg
Wind direction SD: 64 deg
Total solar radiation: 139 Lys / 6 MJ/m²
PET (Penman): 0.02 inch / 0.38 mm
Total rainfall: Missing
Avg dew point: 3 °F / -16 °C
Avg wind chill: -3 °F / -20 °C
Min wind chill: -10 °F / -23 °C
Min battery voltage: 12.74 volts

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NDAWN Station: Fargo, ND

Yesterday **Historical** Details Sponsor history

Normals

Normal Max Temp: 15 °F / -9 °C
 Normal Avg Temp: 6 °F / -14 °C
 Normal Min Temp: -3 °F / -19 °C
 Normal Accumulated HDD: 641 °F / 356 °C
 Normal Accumulated CDD: 0 °F / 0 °C

Extremes

Temperatures

Highest Daily Max Temp: 103 °F (40 °C)
[2006-07-30 at 3:59 PM CST](#)

Lowest Daily Max Temp: -26 °F (-32 °C)
[\(estimated\) 1996-02-01 at 1:05 PM CST](#)

Highest Daily Min Temp: 79 °F (26 °C)
[1996-06-28 at 5:01 AM CST](#)

Lowest Daily Min Temp: -35 °F (-37 °C)
[1994-01-18 at 8:36 AM CST](#)

Highest Daily Dew Point Temp: 76 °F (25 °C)
[2001-08-04](#)

Lowest Daily Dew Point Temp: -40 °F (-40 °C)
[1996-02-01](#)

Lowest Daily Wind Chill Temp: -49 °F (-45 °C)
[1994-01-18](#)

Wind

Highest 5-Second Avg Wind Speed: 63.4 mph (28.3 m/s)
[1993-08-01 at 2:19 PM CST](#)
[1993-09-12 at 6:30 PM CST](#)

Highest Avg Hourly Wind Speed: 41.9 mph (18.7 m/s)
[\(estimated\) 1993-09-09 for hour ending at 4:00 PM CST](#)

Highest Avg Daily Wind Speed: 26.1 mph (11.7 m/s)
[1997-11-02](#)

Rainfall

Highest Daily Rainfall: 4.91 inch (124.7 mm)
[2000-06-19](#)

Variables Measured



Temperature, Relative Humidity, Dew Point Temperature, Vapor Pressure

Sensor

HMP45C

Specifications

- **Accuracy:** $\pm 2\%$ over 10-90% RH;
 $\pm 3\%$ over 90-100% RH
- **Weight:** 0.6 lbs (0.27 kg)
- **Sensor length:** 12" (30.5 cm)
- **Sensor diameter:** 0.8" (2.0 cm)
- **Operating Temperature Range:** -
40° to +60°C

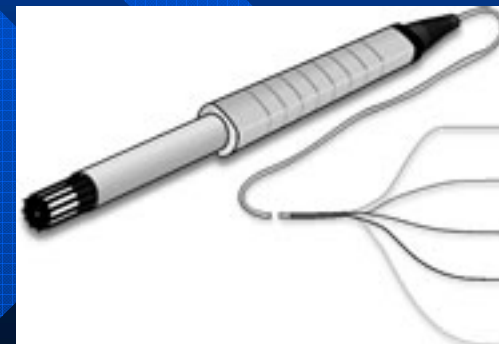


Photo Credit: Campbell Scientific Inc.

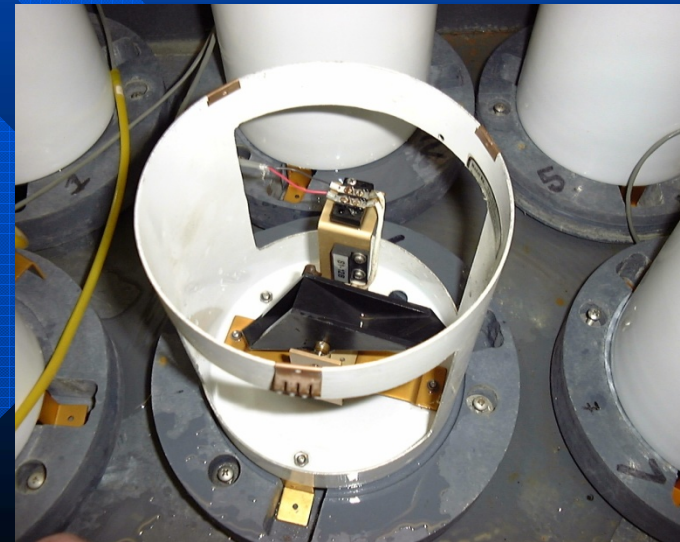
Rainfall

Sensor

TE525 6" Tipping Bucket

Specifications

- **Temperature:** 0° to +50°C
- **Resolution:** 1 tip
- **Rainfall per tip:** 0.01" (0.254 mm)
- **Orifice diameter:** 6.06" (15.4 cm)
- **Height:** 9.5" (24.1 cm)
- **Weight:** 2.5 lbs. (1.1 kg)
- **Accuracy:** varies with rainfall intensity



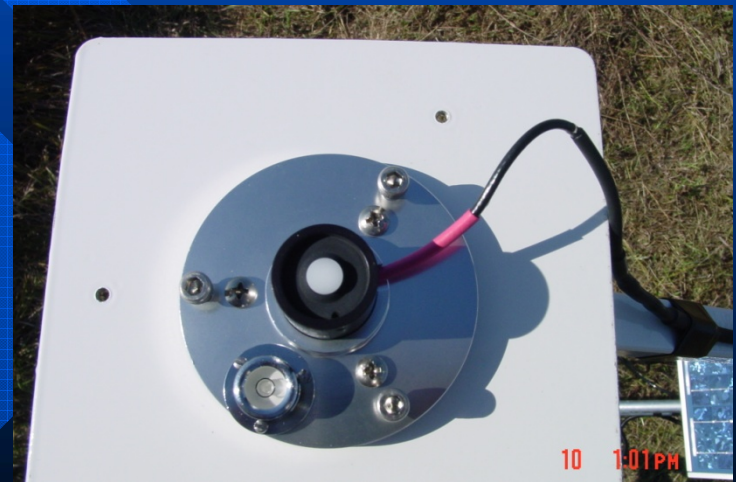
Solar Radiation

Sensor

Li-Cor Silicon Pyranometer

Specifications

- **Light Spectrum Waveband:** 400 to 1100 nm
- **Accuracy:** Absolute error in natural daylight is $\pm 5\%$ maximum; $\pm 3\%$ typical
- **Sensitivity:** $0.2 \text{ kW m}^{-2} \text{ mV}^{-1}$
- **Operating Temperature:** -40° to $+65^\circ \text{C}$
- **Relative Humidity:** 0 to 100%
- **Size:** 0.94" dia x 1.00" H (2.38 x 2.54 cm)
- **Weight:** 1 oz (28 g)



Wind Speed

Sensor

014A Met One Anemometer

Specifications

Range: 0-100 mph (0-45 m/s)

Starting Threshold: 1.0 mph (0.45 m/s)

Accuracy: 0.25 mph (0.11 m/s) or 1.5%

Distance Constant

Standard: Less than 15 feet (4.5 m)

Optional Fast Response: Less than 5 feet (1.5 m)

Contact Rating: 10 mA maximum

Temperature Operating Range: -50°C to +70°C

Sensor Cable: Quick-connect connector with vinyl jacketed, shielded cable

Weight (Shipping): 14 ounces (3 lbs)



Wind Direction

Sensor

024A Met One Wind Vane

Specifications

Range: 0 - 360°

Starting Threshold: 1.0 mph

Accuracy: $\pm 5^\circ$

Electrical Range: 0 - 360°

Operating Range: -50°C to $+70^\circ\text{C}$

Weight: 1 lb 2 oz

Delay Distance: $< 5'$



Barometric Pressure

Sensor

Vaisala PTB110 Barometer

Specifications

- **Dimensions:** 2.7" x 3.5" x 1.1" (6.8 x 9.0 x 2.8 cm)
- **Accuracy:** ± 0.3 mb @ +20°C
- **Temperature Range:** -40° to 60°C

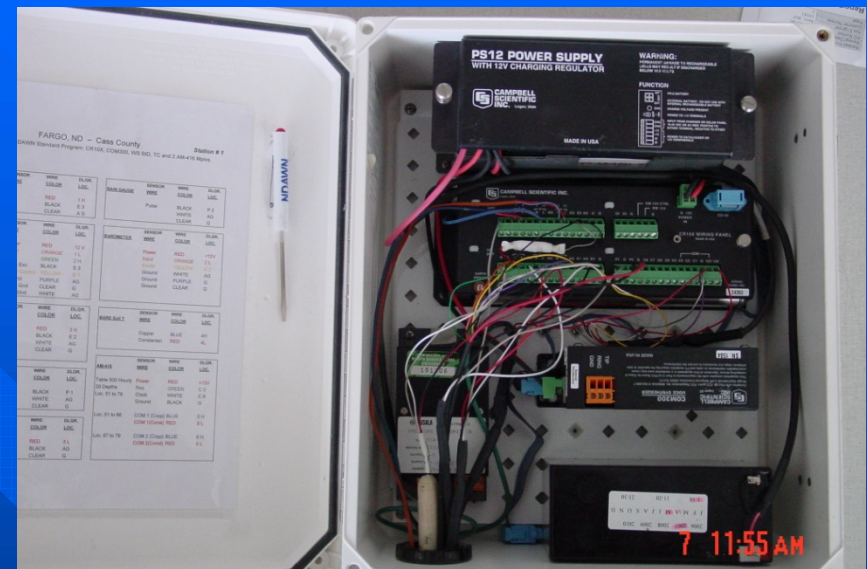


Photo Credit: Campbell Scientific Inc.

Soil Temperature (Bare/Turf)

Sensor

Type TX Thermocouple

Specifications

- Soil Depth: 4" (10cm)
- Dissimilar Metals: Copper/Constantan
- Temperature Range : -150 to 200°C
- Insulation: Polyvinyl
- Type Wire: Solid



Enclosure

Product ENC16

Specifications

Internal Dimensions:
14.0" x 16.0" x 5.5"
(35.6 x 40.6 x 14.0 cm)



Solar Panel

Product

SP10R 10W with Regulator

Specifications

- **Current at peak: 0.59 A**
- **Voltage at peak: 16.8 V**
- **Weight: 3.3 lbs (1.5 kg)**
- **Dimensions: 17" x 11" x 1"**
(42 x 26.9 x 2.3 cm)



Telecommunication

Product

COM310 Voice-Synthesized Modem

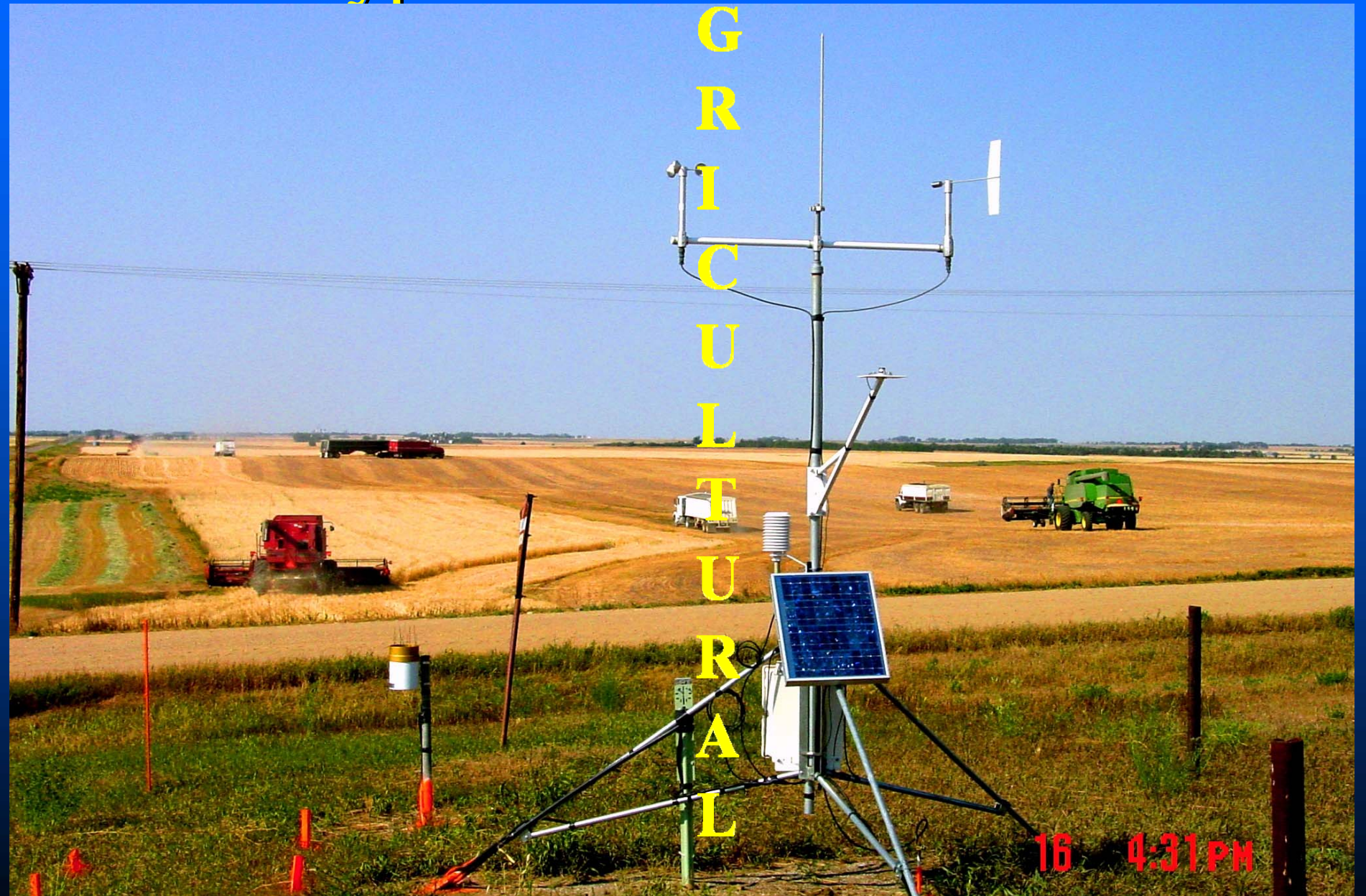
Specifications

- **Current drain:** 100 μ A quiescent, 140 mA voice transmitting
- **Weight:** 10 oz (272 g)
- **Dimensions:** 6.3" x 1.7" x 3.6"
(16.0 x 4.3 x 9.1 cm)
- **Standard Operating Temperature Range:** -25° to +50°C
- **Extended Operating Temperature Range:** -55° to +85°C



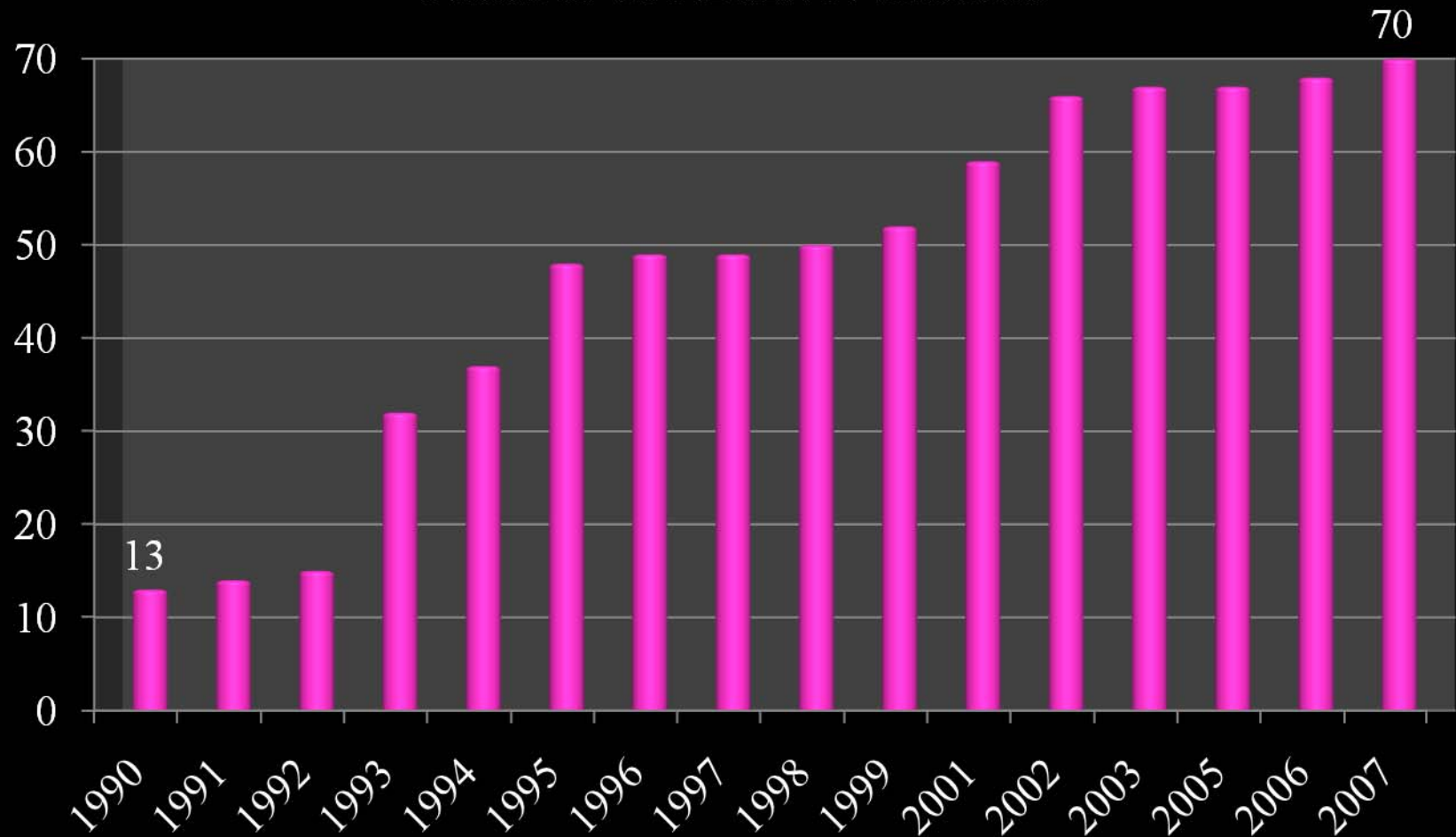
Photo Credit: Campbell Scientific Inc.

A Typical NDAWN Station



Chronological Development

Number of NDAWN Stations



Economic Benefits

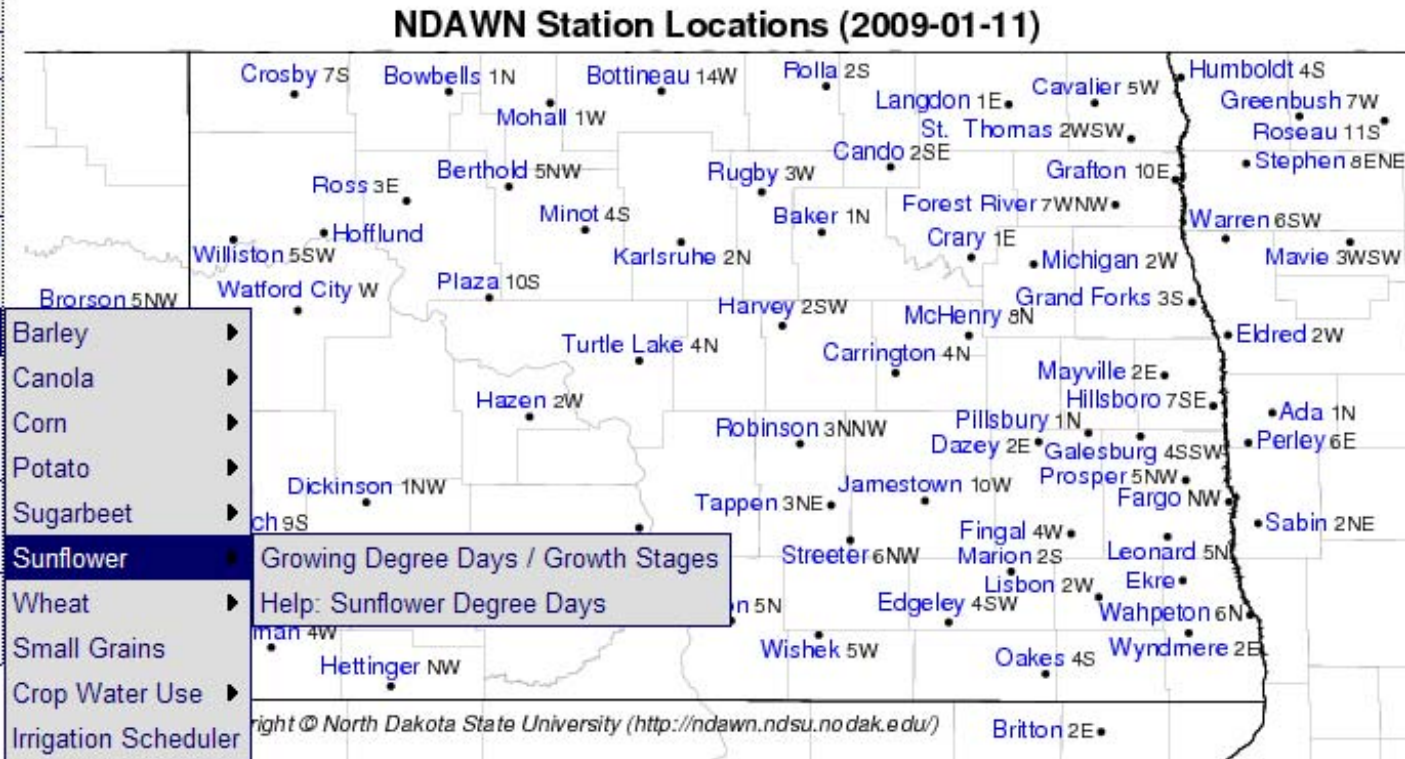
- American Crystal Sugar (ACS) harvests 500,000 Acres of land in the Red River Valley. There are 2 to 4 applications of herbicide per growing season depending on the weather. ACS utilizes 11 NDAWN weather stations to determine when and if the application is necessary. Each application costs \$10M (\$20 per acre times 500,000 acres) to ACS. That is the profit per application that ACS would make just for skipping an application based on NDAWN data. NDAWN also recommends application timing for efficient yield whose economic benefits are not estimated yet. (Greg Richards, Ag strategy development manager, American Crystal Sugar)
- ND Potato Growers can avoid one to two applications of fungicide using NDAWN data through which the farmers can realize 1 to \$2M per year (N. Gudmestad, Plant Pathology Prof., NDSU)

Agricultural Applications



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- Barley ▶
- Canola ▶
- Corn ▶
- Potato ▶
- Sugarbeet ▶
- Sunflower ▶**
 - Growing Degree Days / Growth Stages
 - Help: Sunflower Degree Days
- Wheat ▶
- Small Grains ▶
- Crop Water Use ▶
- Irrigation Scheduler ▶
- Insect ▶
- Heating/Cooling ▶

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9S = 9 Miles South of Town

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| Select Weather Variable for January 11, 2009: | | |
|---|----------------|-------------------|
| Stations | Wind Speed | Solar Radiation |
| Temp: Air Max/Min | Wind Direction | Relative Humidity |
| Temp: Air Avg | Wind Chill | Dew Point |
| Temp: Soil | Rainfall | Potential ET |
| Min Batt Volt | | |

Agricultural Applications



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Sunflower Growing Degree Days / Growth Stages

To get a table:

1. Select station(s):

- Ada, MN 1N (2007-)
- Baker 1N (1993-)
- Beach 9S (1993-)
- Berthold 5NW (2001-)
- Bismarck 6NE (1994-1999)
- Bottineau 14W (1993-)
- Bowbells 1N (2001-)
- Bowman 4W (1993-)
- Britton, SD 2E (1998-)
- Brorson, MT 5NW (1995-)
- Cando 2SE (1994-)
- Carrington 4N (1990-)
- Cavalier 5W (1993-)
- Columbus 8S (1993-2001)
- Crary 1E (1999-)
- Crosby 7S (2002-)
- Dazey 2E (1993-)
- Dickinson 1NW (1990-)
- Edgeley 4SW (1993-)
- Egeland 1W (1993-1994)

[select all](#)

2. Select time period:

Enter planting and end dates
(YYYY-MM-DD):

Planting date: 2009-01-10 ...

End date: 2009-01-11 ...

3. Select comparisons:

- Daily normals/departures
- Departure from a previous year: 2008 ▾
- Departure from 5 year average

4. Get data:

To get a map:

1. Select time period:

Enter planting and end dates
(YYYY-MM-DD):

Planting date: 2008-05-01 ...

End date: 2008-09-30 ...

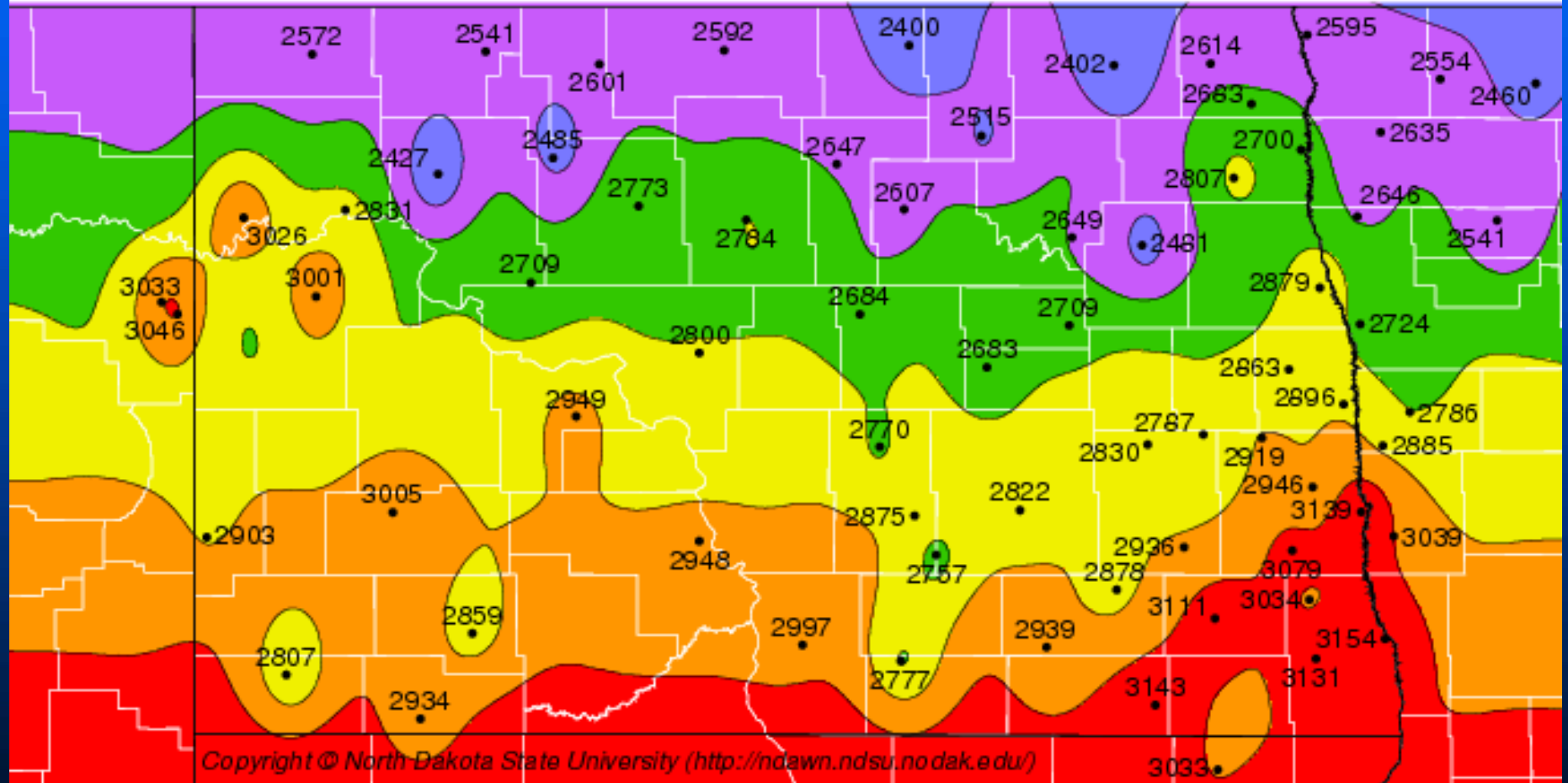
2. Select one map type:

- Growing degree days (GDD)
- Estimated growth stages
- Departure from normal GDD
- Departure from previous year: 2007 ▾
- Departure from 5-year avg

3. Get data:

Agricultural Applications

Sunflower Accumulated Daily Growing Degree Days (°F) (2008-05-02 - 2008-09-30)

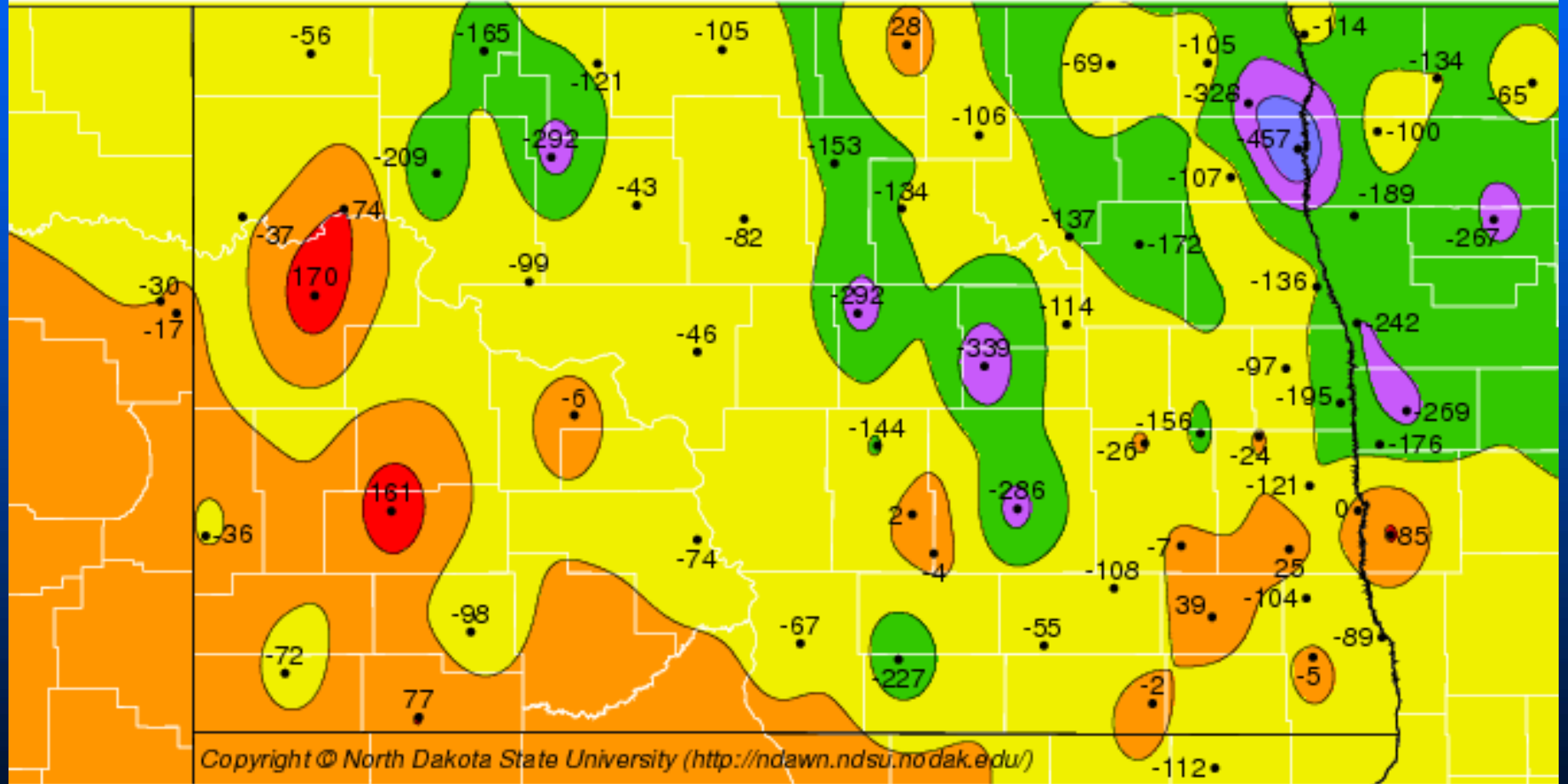


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2400 to 2528 2528 to 2656 2656 to 2785 2785 to 2913 2913 to 3041 3041 to 3154

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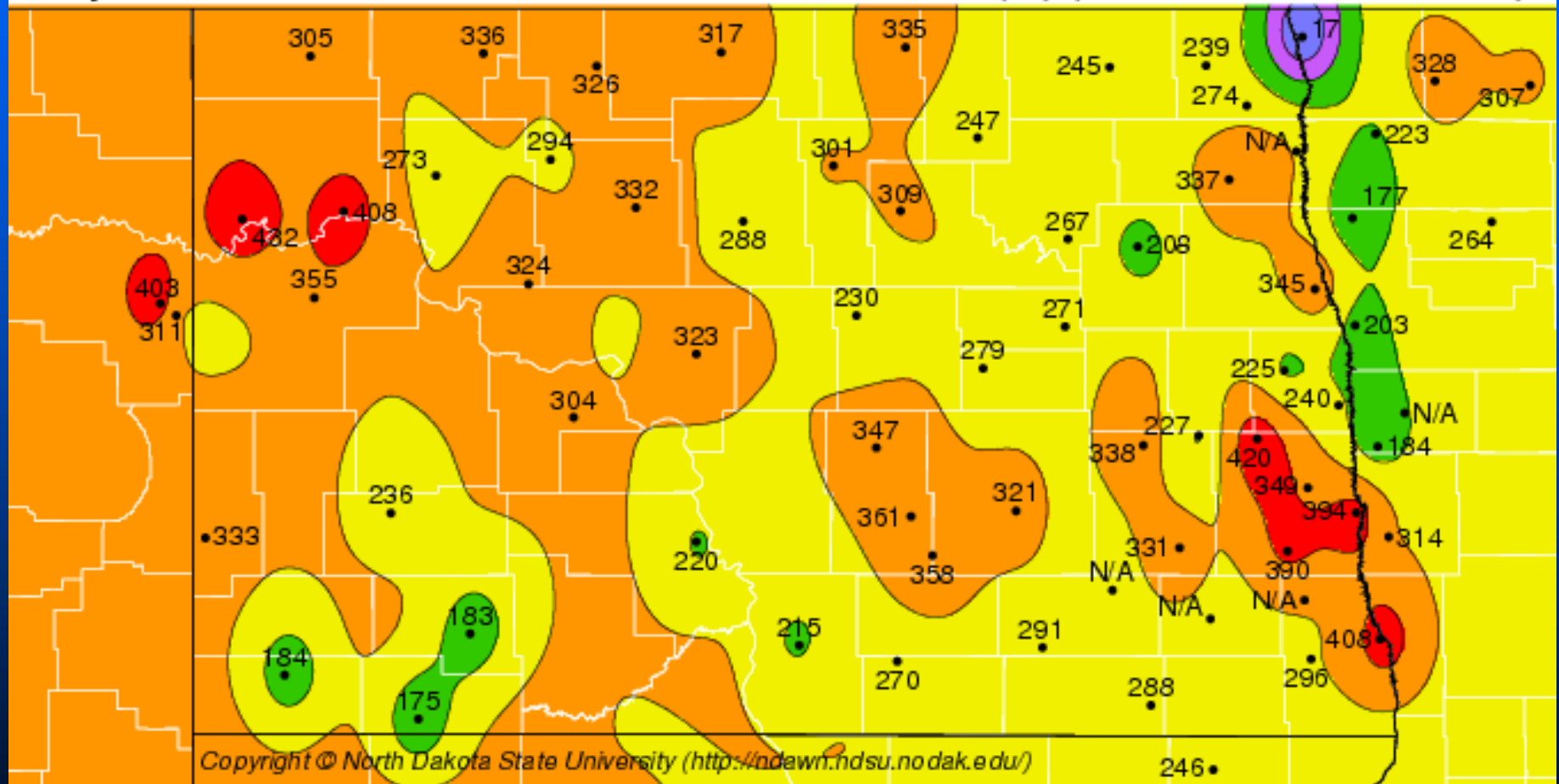
Departure From Normal Sunflower Accumulated GDD ($^{\circ}$ F) (2008-05-02 - 2008-09-30)



■ -457 to -350 ■ -350 to -244 ■ -244 to -137 ■ -137 to -31 ■ -31 to 76 ■ 76 to 170

Agricultural Applications

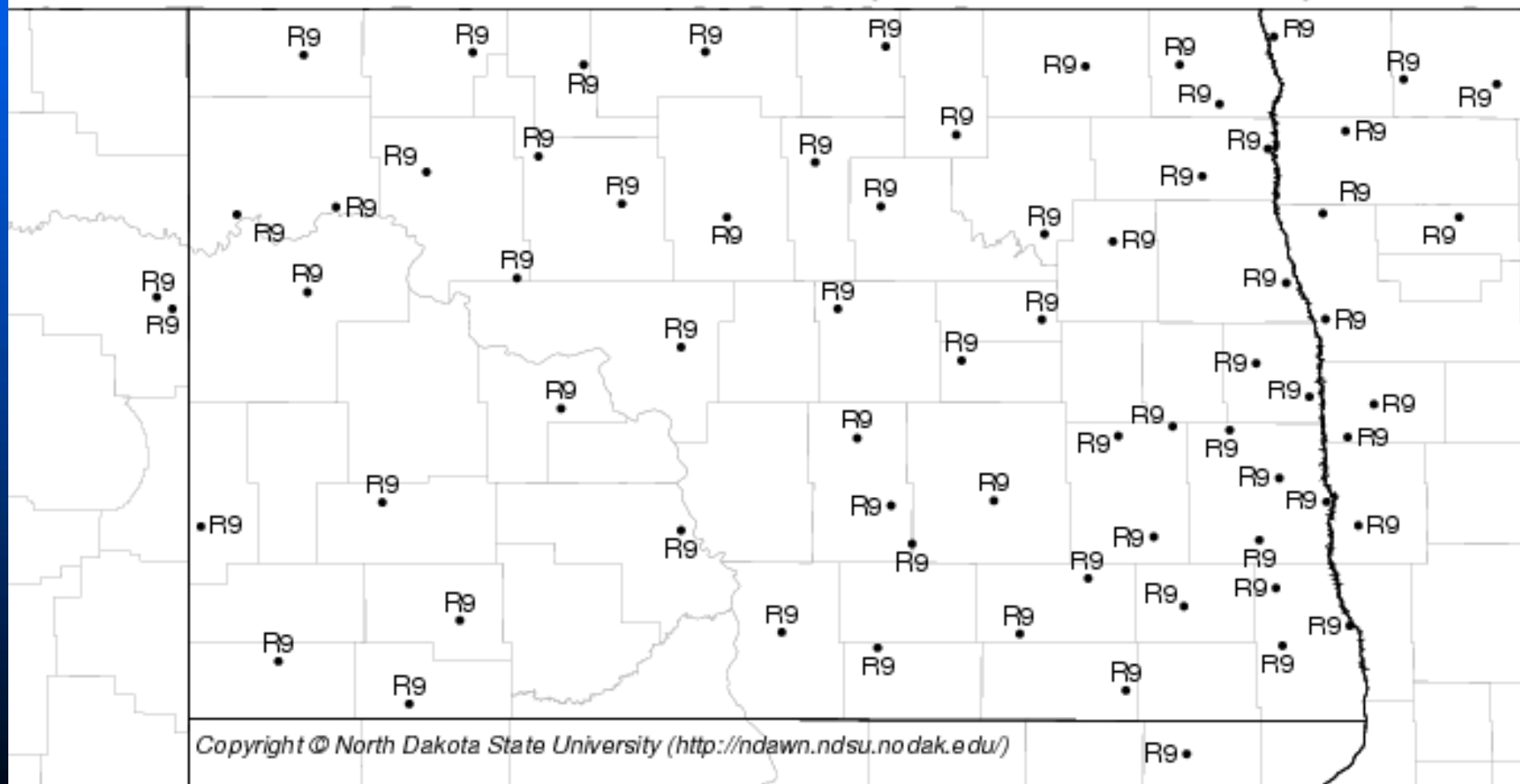
Departure From 2004 Sunflower Accumulated GDD ($^{\circ}$ F) (2008-05-02 - 2008-09-30)



17 to 88 88 to 158 158 to 229 229 to 299 299 to 370 370 to 432

Agricultural Applications

Sunflower Estimated Growth Stage (2008-05-02 - 2008-09-30)



Sunflower GDD & DDD Help

Sunflower Growing Degree Day Calculation

Sunflower growing degree days (GDD) are calculated by subtracting the plant's lower base or threshold temperature of 44 °F (6.7 °C) from the average daily air temperature in °F or °C. Average daily air temperature is calculated by averaging the daily maximum and minimum air temperatures measured in a 24 hour period. All daily NDAWN data are based on a midnight to midnight period.

In Formula Form

The Daily Average Temp (°F) = (Daily Max Temp °F + Daily Min Temp °F) / 2

Daily Sunflower GDD (°F) = Daily Average Temperature °F - 44 °F

Sunflower GDD & DDD Help

| Growth Stage | Accumulated* GDD Range | Growth Stage | Accumulated* GDD Range |
|----------------|---------------------------|--------------|---------------------------|
| VE (Emergence) | 206 | R1 | 1048 |
| V1 | 241 | R2 | 1188 |
| V2 | 276 | R3 | 1328 |
| V3 | 311 | R4 | 1469 |
| V4 | 347 | R5.1 | 1609 |
| V5 | 382 | R5.5 | 1749 |
| V6 | 417 | R6 | 1889 |
| V7 | 452 | R7 | 2030 |
| V8 | 487 | R8 | 2170 |
| V9 | 522 | R9 | 2310 |
| V10 | 557 | | |
| V11 | 592 | | |
| V12 | 627 | | |
| V13 | 662 | | |
| V14 | 697 | | |
| V15 | 732 | | |
| V16 | 767 | | |
| V17 | 802 | | |
| V18 | 837 | | |
| V19 | 872 | | |
| V20 | 908 | | |

**A. A. Schneiter and J. F. Miller in 1981 (Schneiter and Miller, 1981, Description of Sunflower Growth Stages. Crop Science 11: 635-638).*

Agricultural Applications

1. Canola

- Growing Degree Days
- Growth Stages
- Sclerotinia

2. Corn

- Growing Degree Days

3. Potato

- Late Blight

4. Sugarbeet

- Growing Degree Days
- Growth Stages
- Multiple Planting Dates
- Herbicide Timing
- Cercospora Infection Values

Agricultural Applications

5. Sunflower

- Growing Degree Days
- Growth Stages

6. Wheat

- Growing Degree Days
- Growth Stages
- Multiple Planting Days
- Midge Degree Days
- Disease Forecaster

7. Crop Water Use

- Tables
- Maps

8. Irrigation Scheduler

9. Insect

- Degree Days

Energy Applications

1. Heating Degree Days
2. Cooling Degree Days

GIS-BASED IRRIGATION SCHEDULER



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Irrigation Scheduler

The NDAWN Irrigation Scheduler was funded by:



Producer: Adnan

Field:

[Add new field to list](#)

Crops

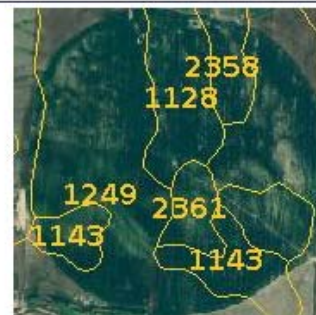
Year:

Crop:

Planting date: 2008- -

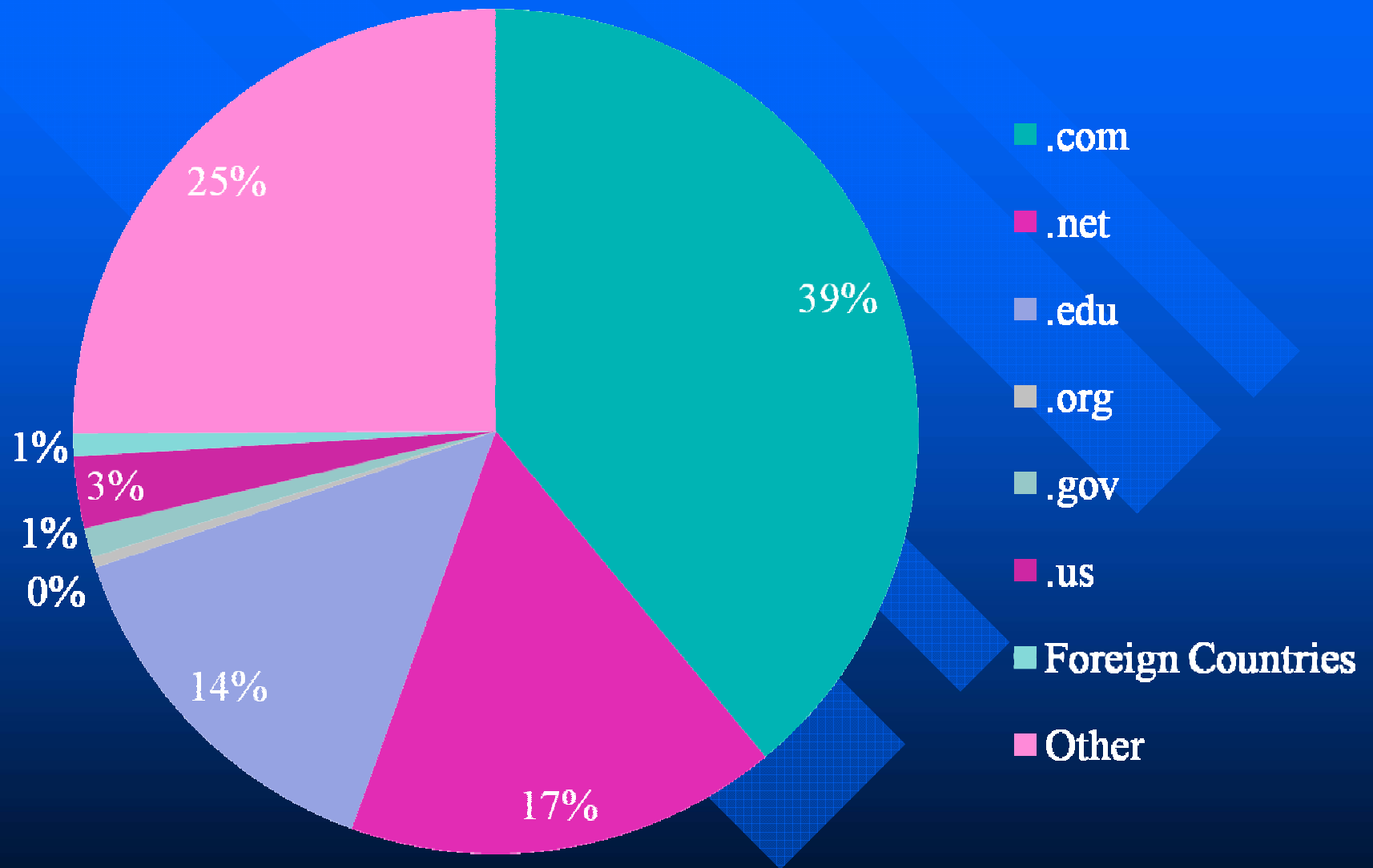
Emergence date: 2008- -

NDAWN Station:



| Date | Historical Crop Water Use (inches) | Crop Water Use (inches) | Irrigation Amount (inches) | Rain (inches) | Map Unit: 1249: Appam... (59%) Major Component: Appam (73%) | | | Map Unit: 1143: Lihen... (11%) Major Component: Lihen (75%) | | | Map Unit: 1128: Lehr... (11%) Major Component: Lehr (68%) | | |
|------------------------|------------------------------------|-------------------------|----------------------------|---------------|--|----------------------|-------------------------------|--|----------------------|-------------------------------|--|----------------------|-------------------------------|
| | | | | | Moisture Deficit (inches) | Moisture Deficit (%) | Measured Moisture Deficit (%) | Moisture Deficit (inches) | Moisture Deficit (%) | Measured Moisture Deficit (%) | Moisture Deficit (inches) | Moisture Deficit (%) | Measured Moisture Deficit (%) |
| June 1 | 0.03 | 0.05 | | | 0.05 | 6% | | 0.05 | 4% | | 0.05 | 8% | |
| June 2 | 0.04 | 0.01 | | | 0.06 | 7% | | 0.06 | 5% | | 0.06 | 8% | |
| June 3 | 0.04 | 0.02 | | | 0.08 | 8% | | 0.08 | 6% | | 0.08 | 11% | |
| June 4 | 0.04 | 0.03 | | | 0.11 | 11% | | 0.11 | 8% | | 0.11 | 14% | |

Our Data Community



Foreign Countries

Requests in
2006

| | |
|----------------------|------|
| .nl (Netherlands) | 1458 |
| .au (Australia) | 965 |
| .mil (USA Military) | 949 |
| .ca (Canada) | 919 |
| .it (Italy) | 352 |
| .br (Brazil) | 189 |
| .de (Germany) | 157 |
| .fr (France) | 109 |
| .gr (Greece) | 81 |
| .uk (United Kingdom) | 80 |
| .jp (Japan) | 58 |
| .ar (Argentina) | 51 |
| .cz (Czech Republic) | 37 |
| .in (India) | 31 |
| .be (Belgium) | 30 |
| .ru (Russia) | 28 |

| | |
|----------------------------|----|
| .no (Norway) | 26 |
| .bw (Botswana) | 22 |
| .es (Spain) | 21 |
| .sa (Saudi Arabia) | 20 |
| .ae (United Arab Emirates) | 18 |
| .co (Costa Rica) | 18 |
| .mx (Mexico) | 14 |
| .se (Sweden) | 7 |
| .yu (Yugoslavia) | 6 |
| .pl (Poland) | 4 |
| .tw (Taiwan) | 4 |
| .th (Thailand) | 2 |
| .ch (Switzerland) | 2 |
| .fi (Finland) | 2 |
| .cn (China) | 2 |
| .ro (Romania) | 1 |
| .za (South Africa) | 1 |
| .lv (Latvia) | 1 |

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