State of Weed Emergence Prediction

Ed Luschei

UW – Madison, Dept of Agronomy

Why study emergence?

- Two general approaches to weed control
  - "One size fits all"
  - Tailor to specific situation
    - Need to know:
      - What species?
      - When susceptible?
      - What options?
    - Control timing relative to emergence is directly related to success or failure

Emergence
Past, Present and Future

- Past
  - Monitoring
  - Record keeping
  - Experience, Intuition

Robert Marcham (UK)
Indications of Spring
1736

Recordkeeping has improved…

Weed Emergence Sequences

Knowledge to guide scouting and control

Knowing when weeds begin to emerge can improve weed management by helping to determine when to scout fields and implement control tactics. Although the initial emergence date for weeds varies from year to year, the emergence sequence of different weeds is fairly constant. Each group below includes weeds that begin to emerge at similar dates. Most weeds emerge over a prolonged time period, so weeds from earlier groups may still be emerging when later groups begin to emerge. The GDD (base 48) information is an estimate of heat units required to reach 10% emergence. However, weed emergence is influenced by several other factors than air temperature, including cloud cover, soil type and moisture, and crop residue.

For some species, the majority of emergence occurs in a short time period (2-3 weeks), whereas other species may emerge over a prolonged period (8-10 weeks).

Short **Medium** **Long**

The duration of emergence for species is indicated by the color background where its name appears.

Early

Emergence Date

Late

Group 0

Emergence occurs in fall or early spring.

Winter annuals normally complete emergence prior to planting of corn or soybeans.
Examples: Horseweed (marestail), white cockle, field pennycress, shepherd's purse.

Group 1

Emergence begins several weeks prior to corn planting.

GDD < 150


Giant ragweed


Lambsquarters


Penn. smartweed


Common sunflower

Group 2

Emergence begins soon before or at corn planting.

GDD = 150-300


Woolly cupgrass


Common ragweed


Velvetleaf


Giant foxtail

Group 3

Emergence begins at end of corn planting season.

GDD = 250-400


Yellow foxtail


Black nightshade


Common cocklebur


Wild proso millet

Group 4

Emergence begins after corn emergence.

GDD > 350


Large crabgrass


Fall panicum


Waterhemp


Morningglory sp.

IOWA STATE UNIVERSITY
University Extension

Integrated Pest Management
IPM-44

This poster is a joint project of:

Iowa State University Extension
University of Wisconsin Cooperative Extension
University of Illinois
United States Department of Agriculture Agricultural Research Service
University of Minnesota Extension Service

Funding provided by:

North Central Region Integrated Pest Management Program
Leopold Center for Sustainable Agriculture

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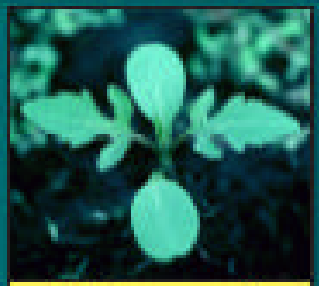
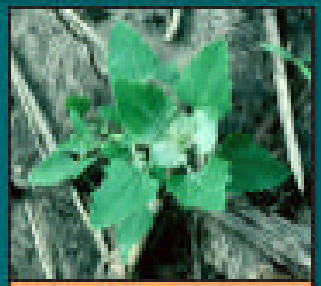
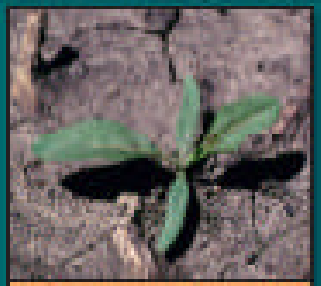
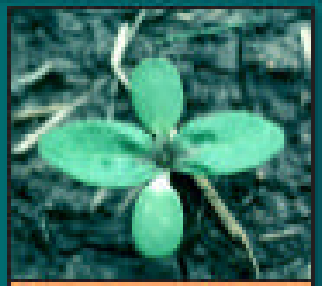

Giant ragweed


Lambsquarters

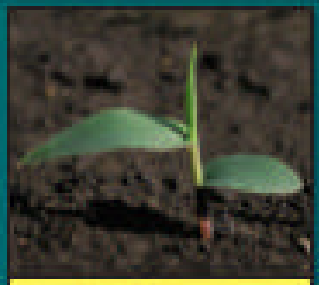

Penn. smartweed


Common sunflower

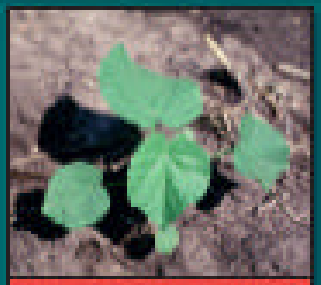
Group 2

Emergence begins soon before or at corn planting.

GDD = 150-300


Woolly cupgrass


Common ragweed


Velvetleaf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Emergence begins at end of corn planting season.

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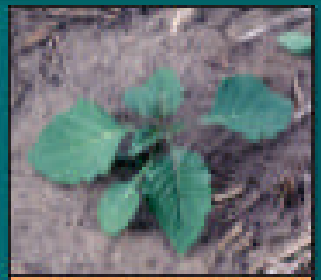
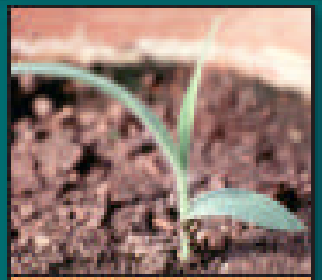
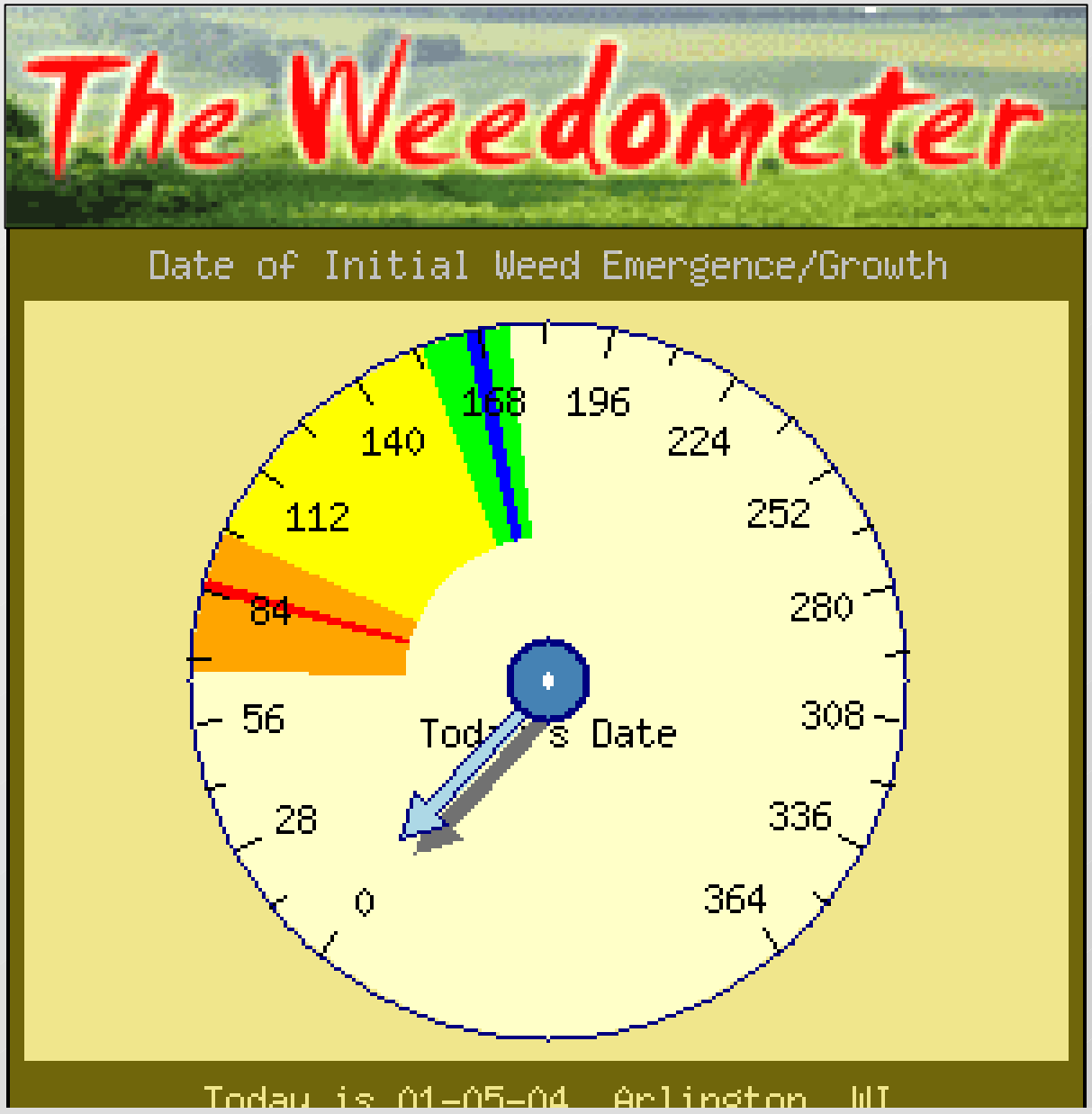
Yellow foxtail


Black nightshade


Common cocklebur


Wild proso millet

ISU Extension

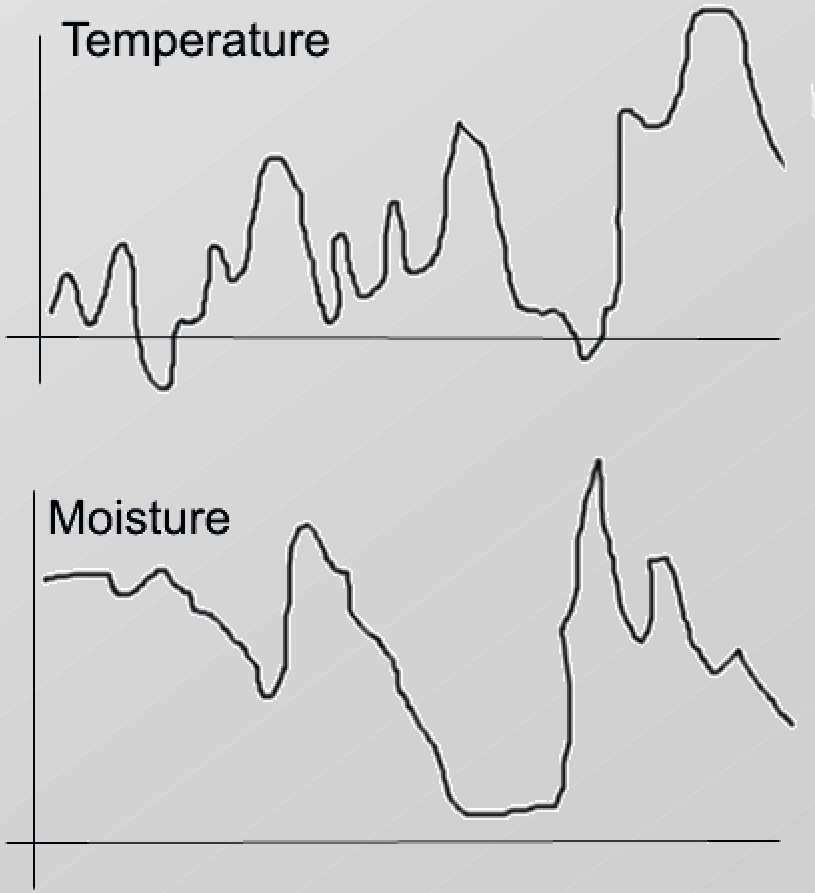


Data from:
Weed Garden
Arlington, WI
Collected by
Dr Jerry Doll

http://weedecology.wisc.edu/weedometer

The Present: Accumulator Models

- Thermal: GDD
- HydroThermal
- Limiting-Factor Accumulators



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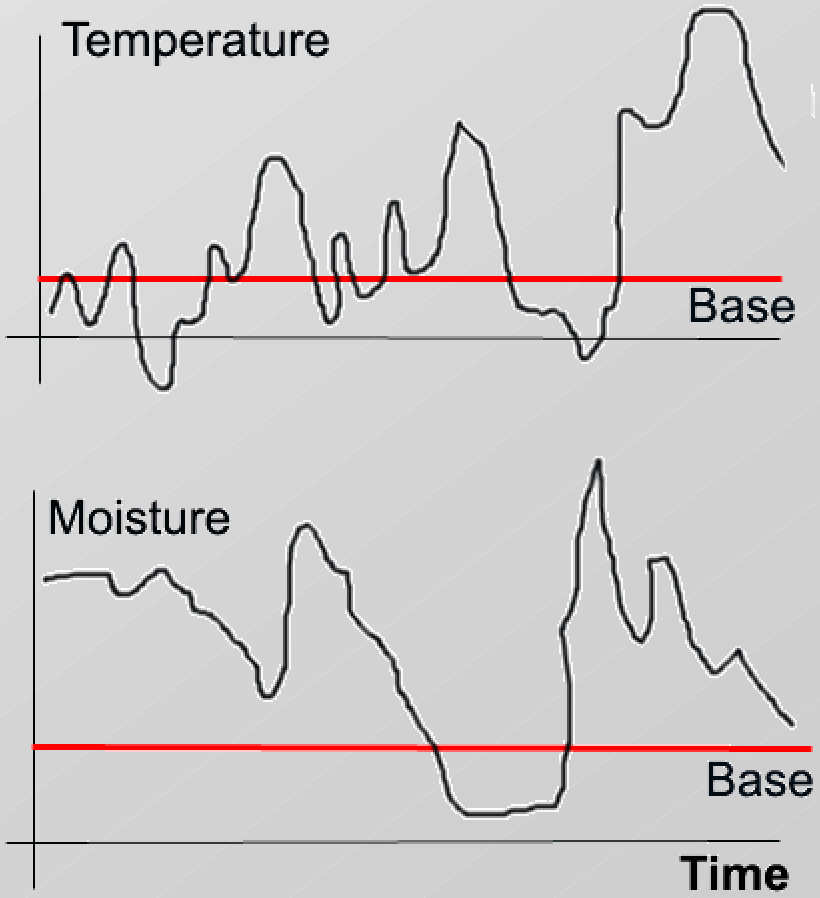

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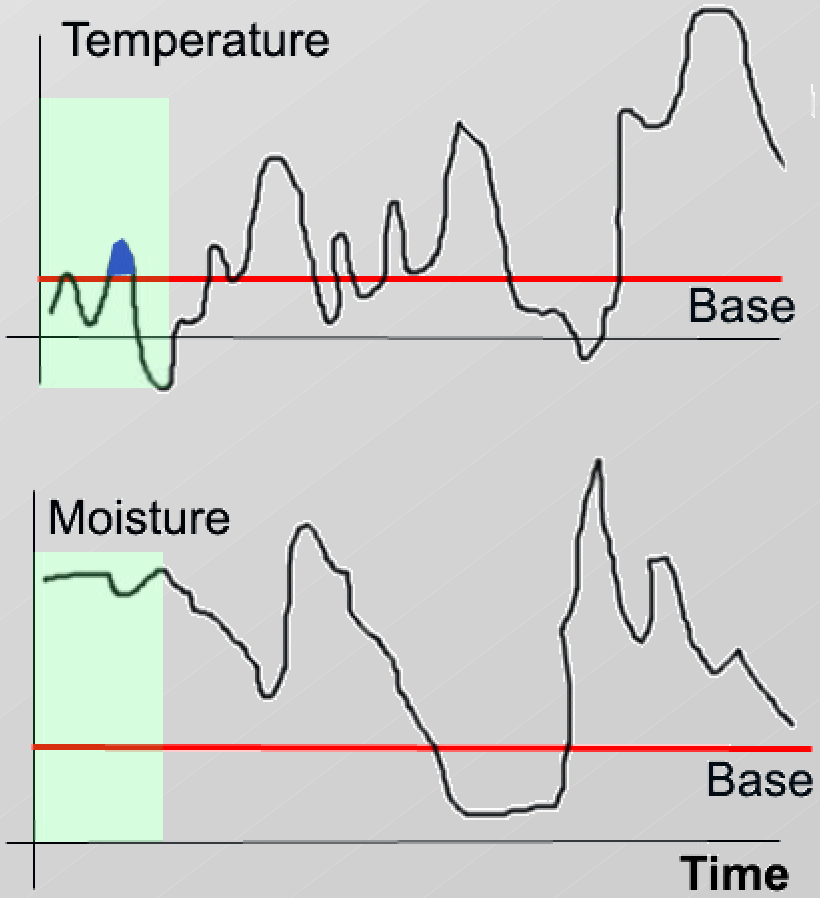

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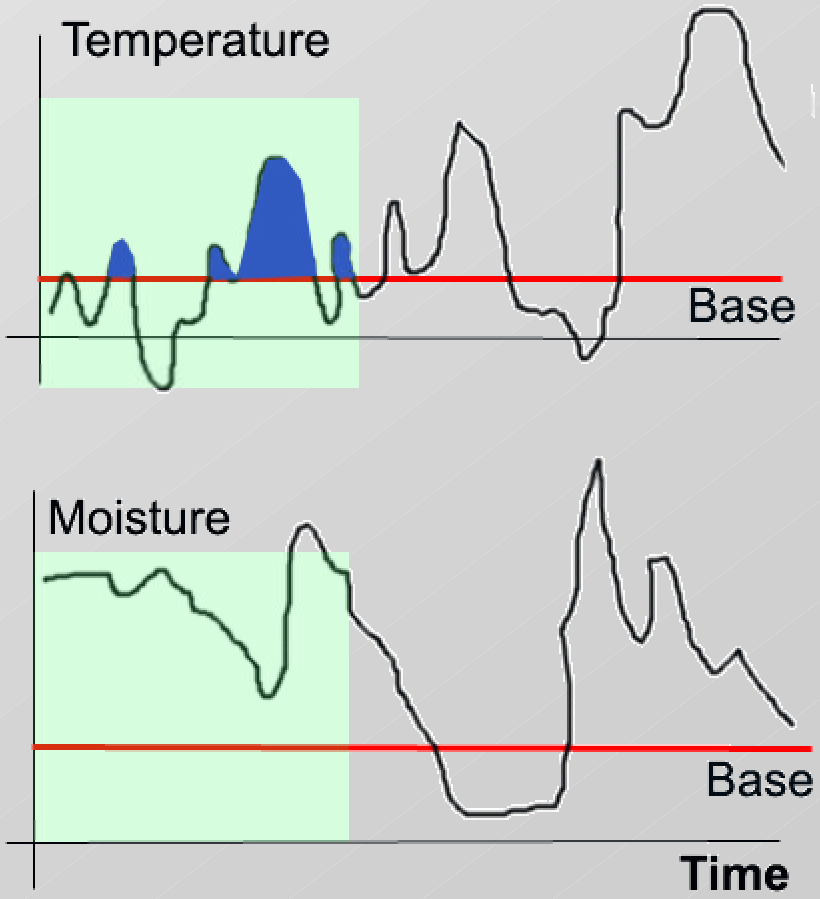

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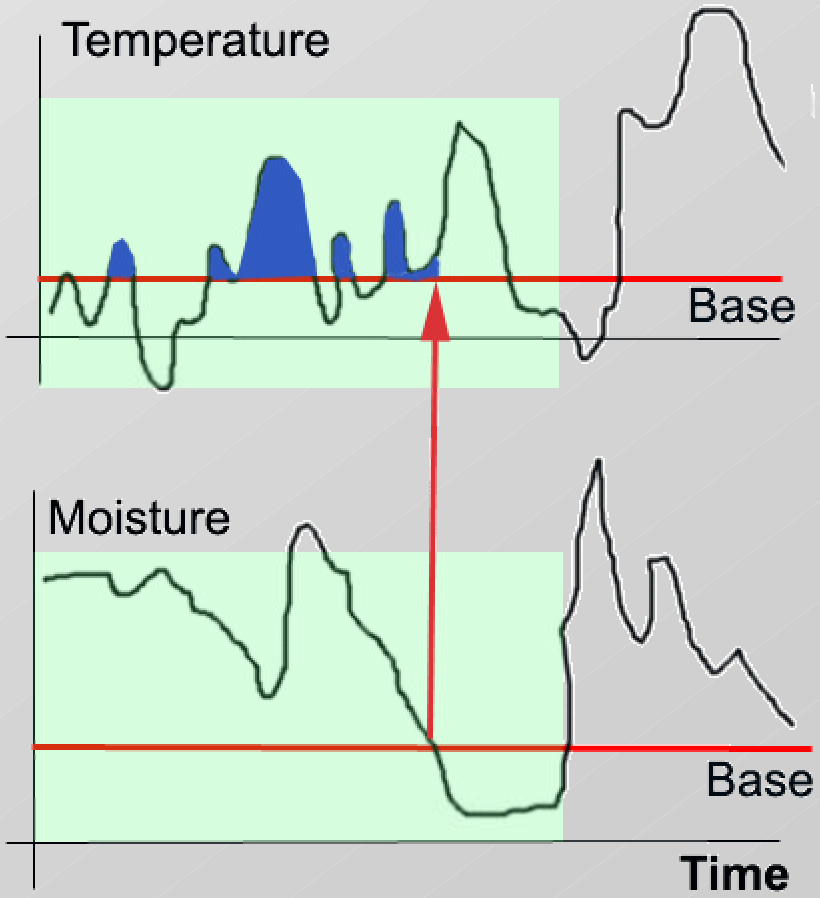

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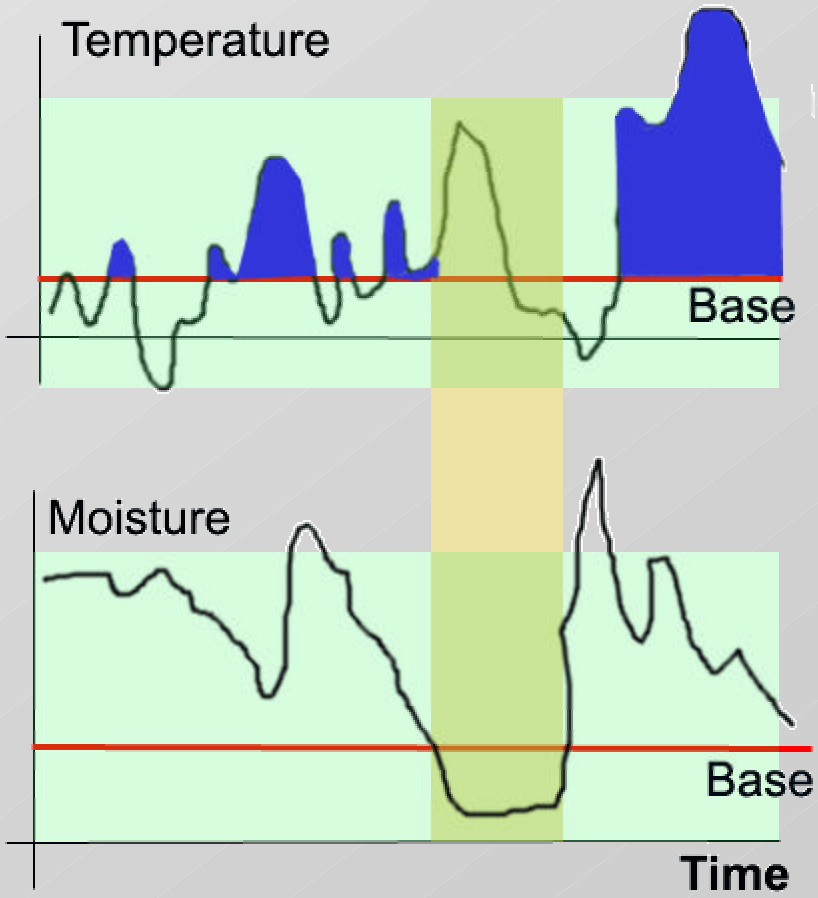
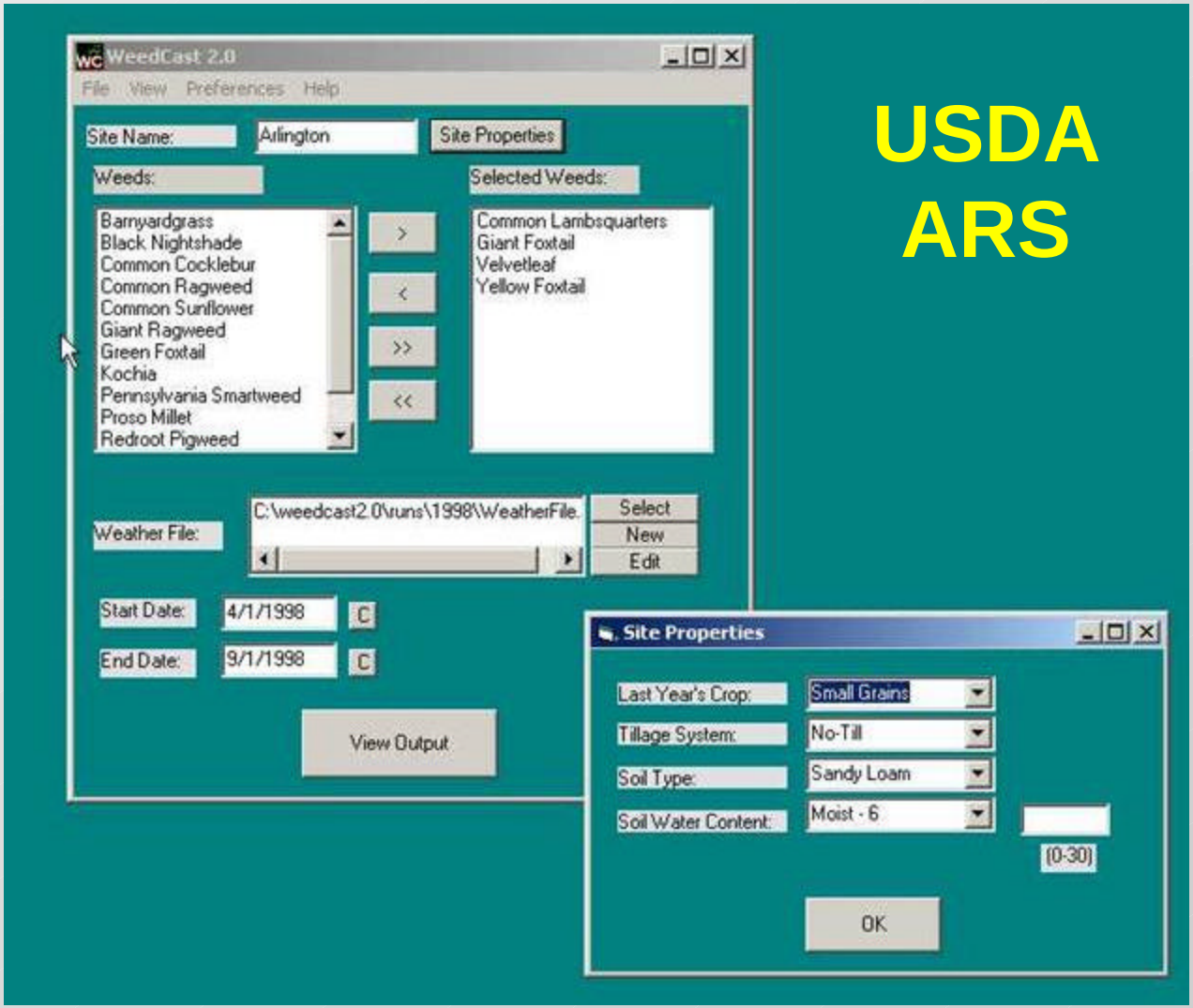
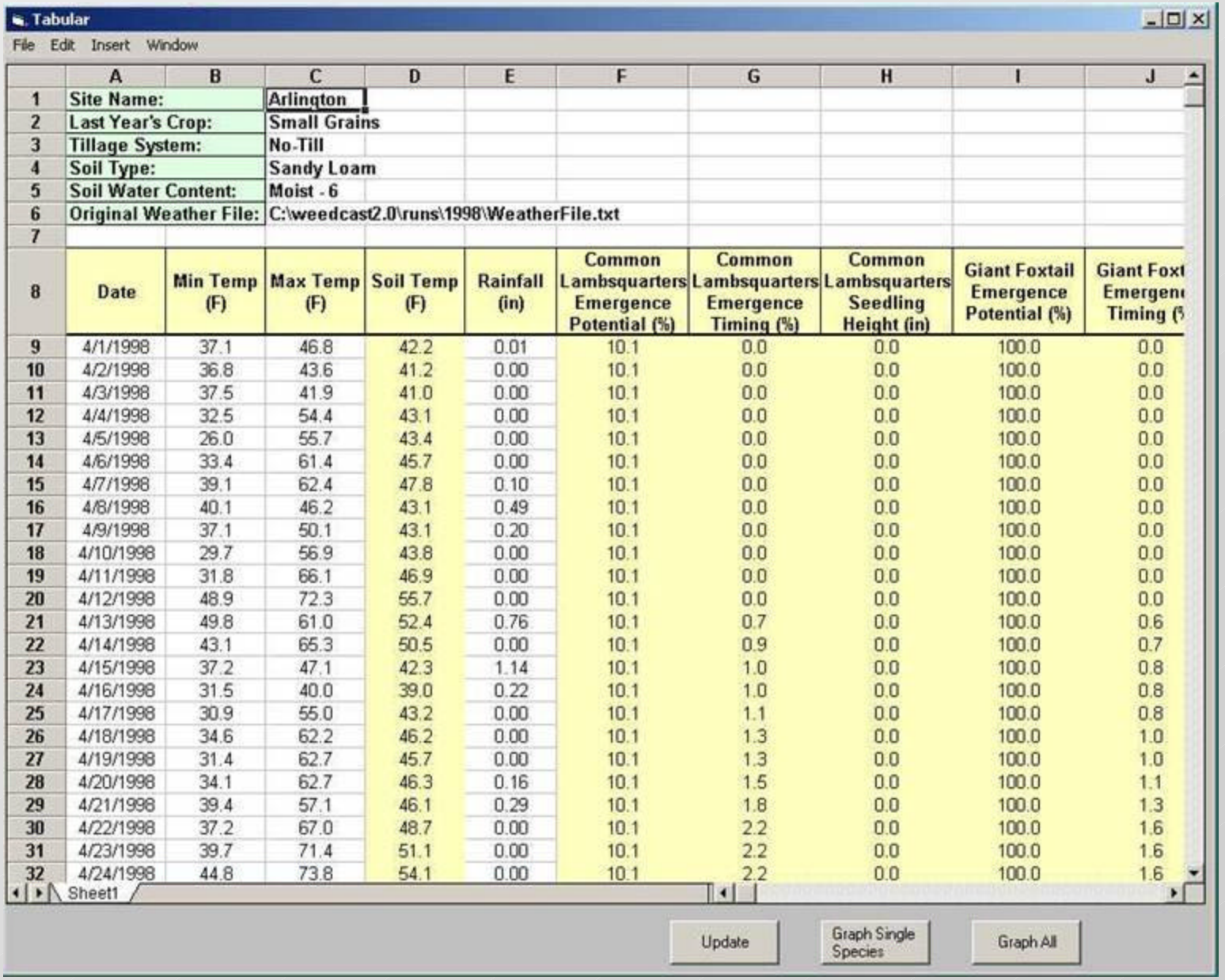


WeedCast – The Windows GUI

Hydro-Thermal Time Accumulator



Spreadsheet View


Tabular

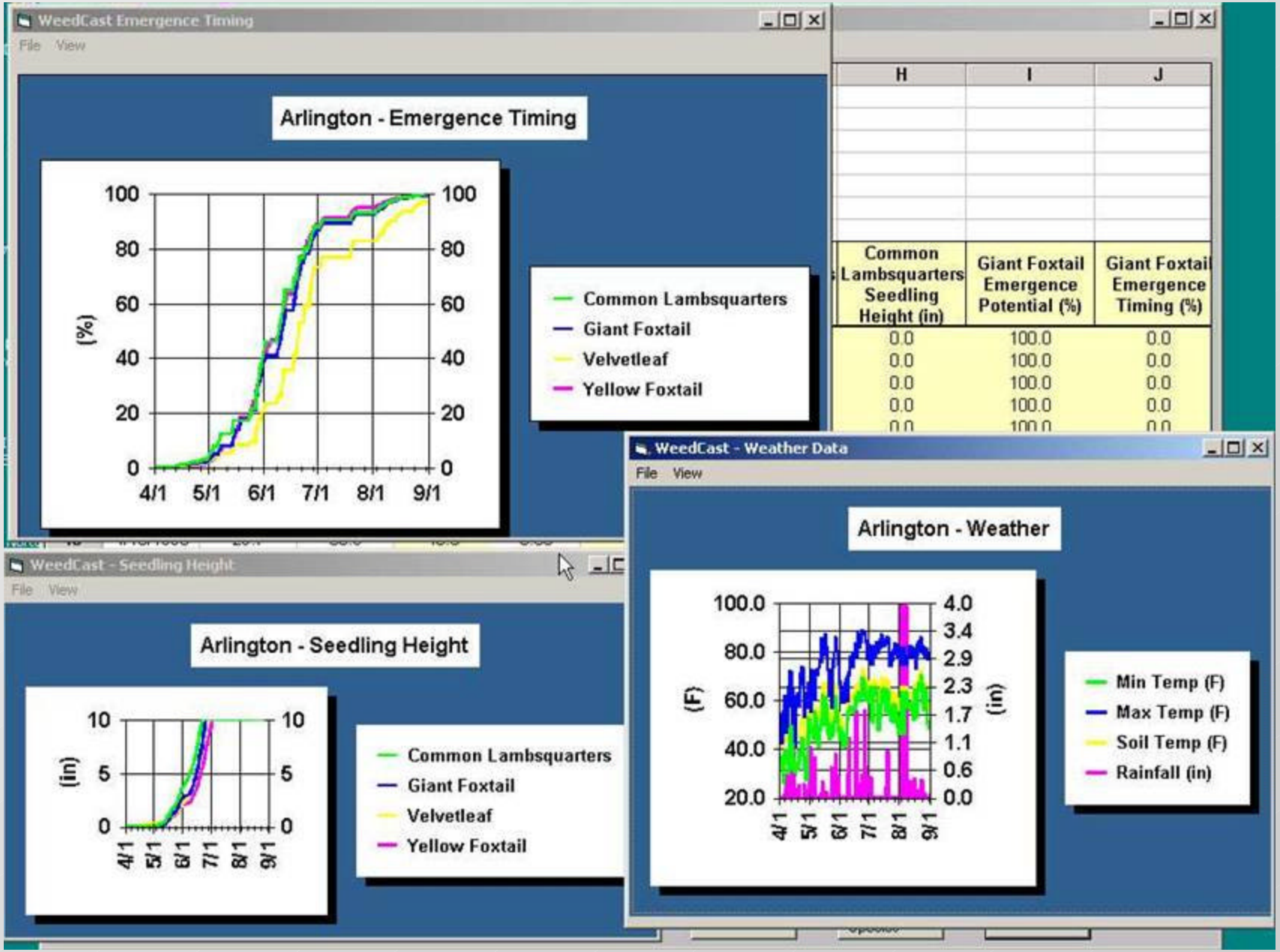
File Edit Insert Window

	A	B	C	D	E	F	G	H	I	J
1	Site Name:		Arlington							
2	Last Year's Crop:		Small Grains							
3	Tillage System:		No-Till							
4	Soil Type:		Sandy Loam							
5	Soil Water Content:		Moist - 6							
6	Original Weather File:		C:\weedcast2.0\runs\1998\WeatherFile.txt							
7										
8	Date	Min Temp (F)	Max Temp (F)	Soil Temp (F)	Rainfall (in)	Common Lambsquarters Emergence Potential (%)	Common Lambsquarters Emergence Timing (%)	Common Lambsquarters Seedling Height (in)	Giant Foxtail Emergence Potential (%)	Giant Foxt Emergen Timing (%
9	4/1/1998	37.1	46.8	42.2	0.01	10.1	0.0	0.0	100.0	0.0
10	4/2/1998	36.8	43.6	41.2	0.00	10.1	0.0	0.0	100.0	0.0
11	4/3/1998	37.5	41.9	41.0	0.00	10.1	0.0	0.0	100.0	0.0
12	4/4/1998	32.5	54.4	43.1	0.00	10.1	0.0	0.0	100.0	0.0
13	4/5/1998	26.0	55.7	43.4	0.00	10.1	0.0	0.0	100.0	0.0
14	4/6/1998	33.4	61.4	45.7	0.00	10.1	0.0	0.0	100.0	0.0
15	4/7/1998	39.1	62.4	47.8	0.10	10.1	0.0	0.0	100.0	0.0
16	4/8/1998	40.1	46.2	43.1	0.49	10.1	0.0	0.0	100.0	0.0
17	4/9/1998	37.1	50.1	43.1	0.20	10.1	0.0	0.0	100.0	0.0
18	4/10/1998	29.7	56.9	43.8	0.00	10.1	0.0	0.0	100.0	0.0
19	4/11/1998	31.8	66.1	46.9	0.00	10.1	0.0	0.0	100.0	0.0
20	4/12/1998	48.9	72.3	55.7	0.00	10.1	0.0	0.0	100.0	0.0
21	4/13/1998	49.8	61.0	52.4	0.76	10.1	0.7	0.0	100.0	0.6
22	4/14/1998	43.1	65.3	50.5	0.00	10.1	0.9	0.0	100.0	0.7
23	4/15/1998	37.2	47.1	42.3	1.14	10.1	1.0	0.0	100.0	0.8
24	4/16/1998	31.5	40.0	39.0	0.22	10.1	1.0	0.0	100.0	0.8
25	4/17/1998	30.9	55.0	43.2	0.00	10.1	1.1	0.0	100.0	0.8
26	4/18/1998	34.6	62.2	46.2	0.00	10.1	1.3	0.0	100.0	1.0
27	4/19/1998	31.4	62.7	45.7	0.00	10.1	1.3	0.0	100.0	1.0
28	4/20/1998	34.1	62.7	46.3	0.16	10.1	1.5	0.0	100.0	1.1
29	4/21/1998	39.4	57.1	46.1	0.29	10.1	1.8	0.0	100.0	1.3
30	4/22/1998	37.2	67.0	48.7	0.00	10.1	2.2	0.0	100.0	1.6
31	4/23/1998	39.7	71.4	51.1	0.00	10.1	2.2	0.0	100.0	1.6
32	4/24/1998	44.8	73.8	54.1	0.00	10.1	2.2	0.0	100.0	1.6

Sheet1

Update | Graph Single Species | Graph All

Graphical Display of Calculations

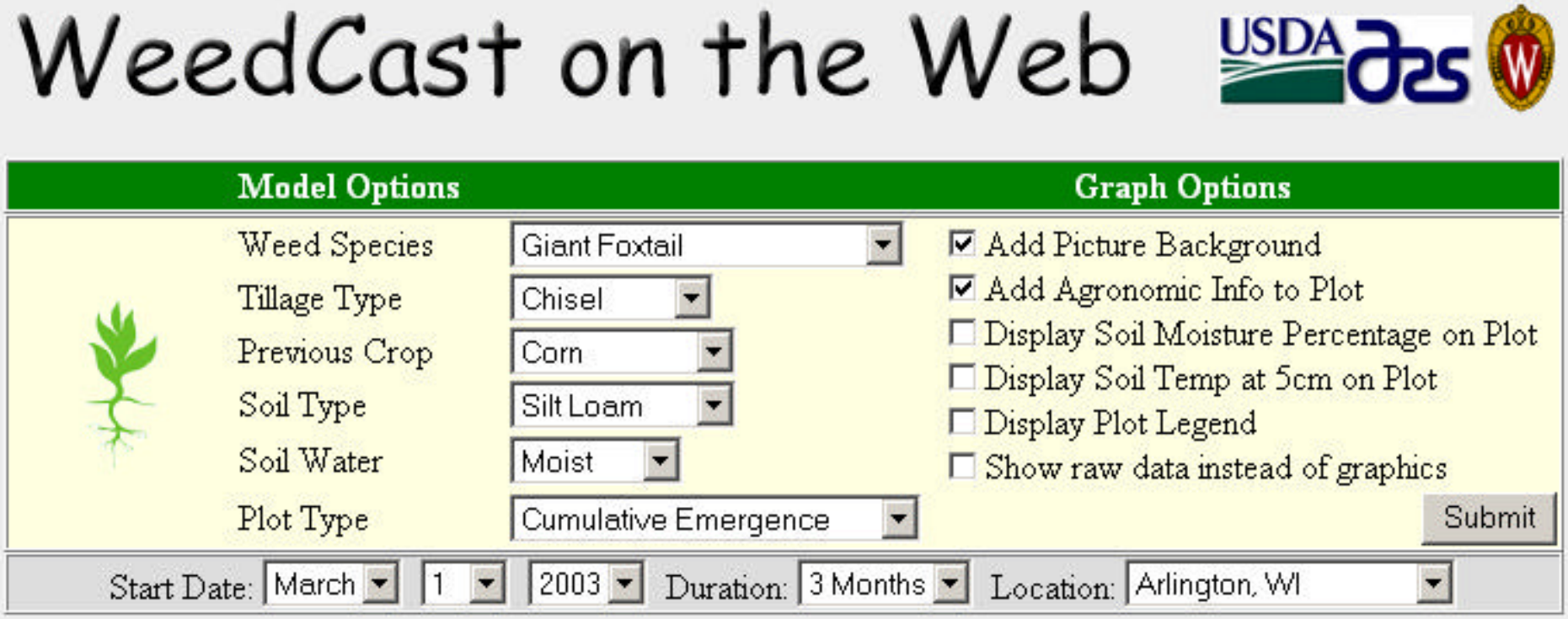


The Present: Web Technology

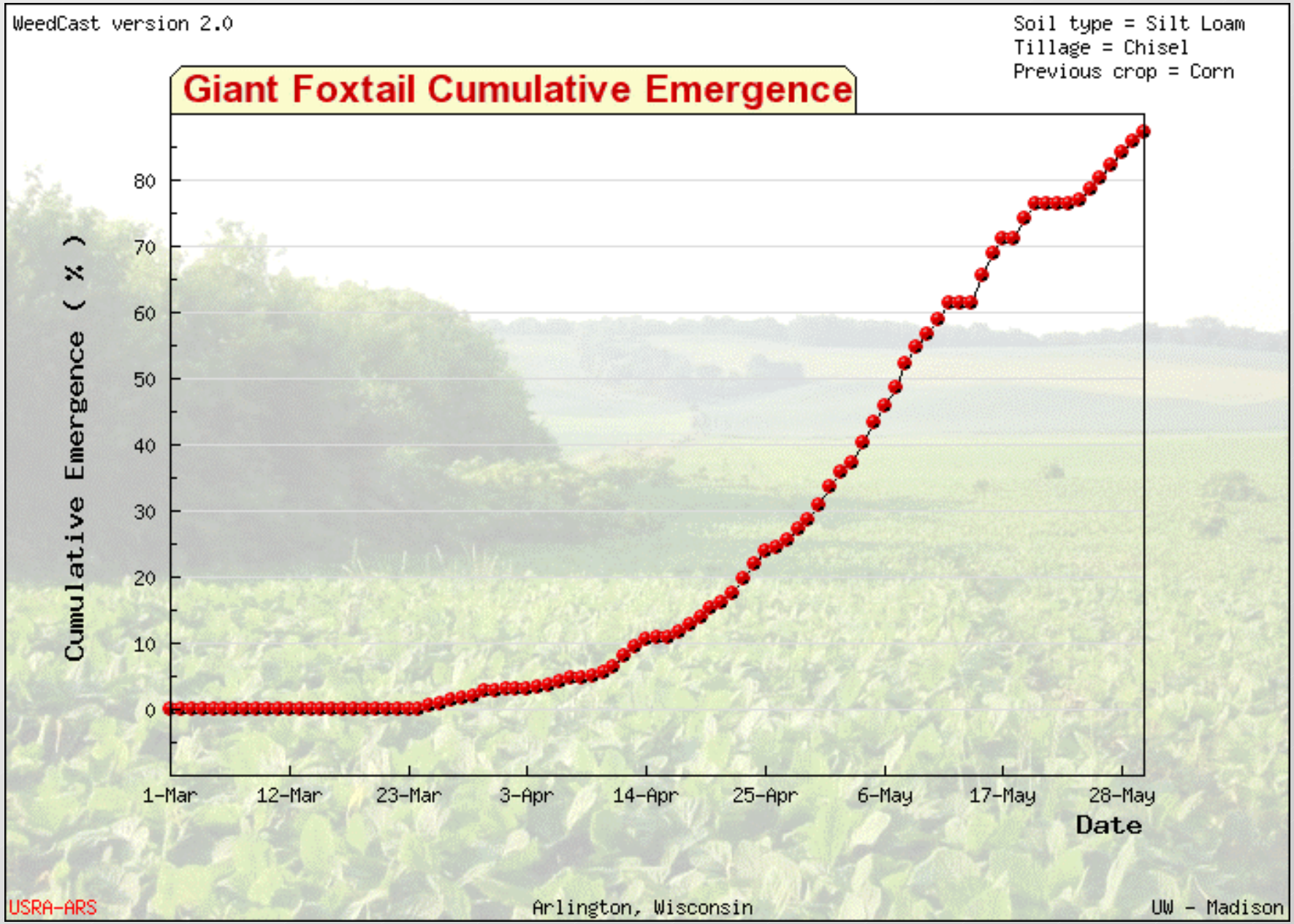
- No software installation issues
- Always have the “Latest update”
- No gathering weather data files
- No cost
- Feedback and communication

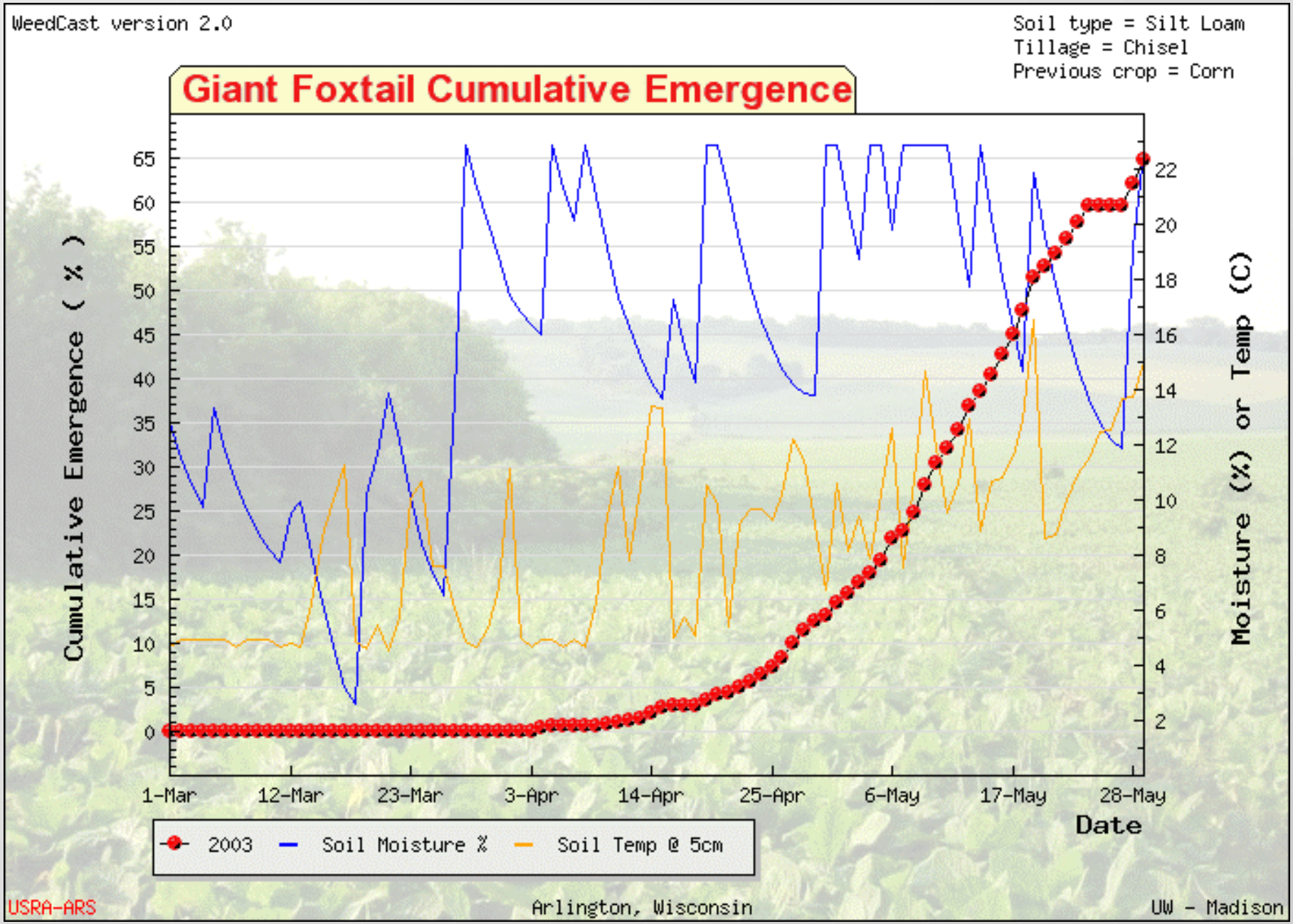
- CAUTION: Many companies investing heavily in this area. Real-time weather-dependent information delivery.

Web Version of WeedCast (Beta!)



http://weedcast.net


WeedCast version 2.0
Soil type = Silt Loam
Tillage = Chisel
Previous crop = Corn
Giant Foxtail Cumulative Emergence
Cumulative Emergence (%)
0
10
20
30
40
50
60
70
80
1-Mar
12-Mar
23-Mar
3-Apr
14-Apr
25-Apr
6-May
17-May
28-May
Date
USRA-ARS
Arlington, Wisconsin
UW - Madison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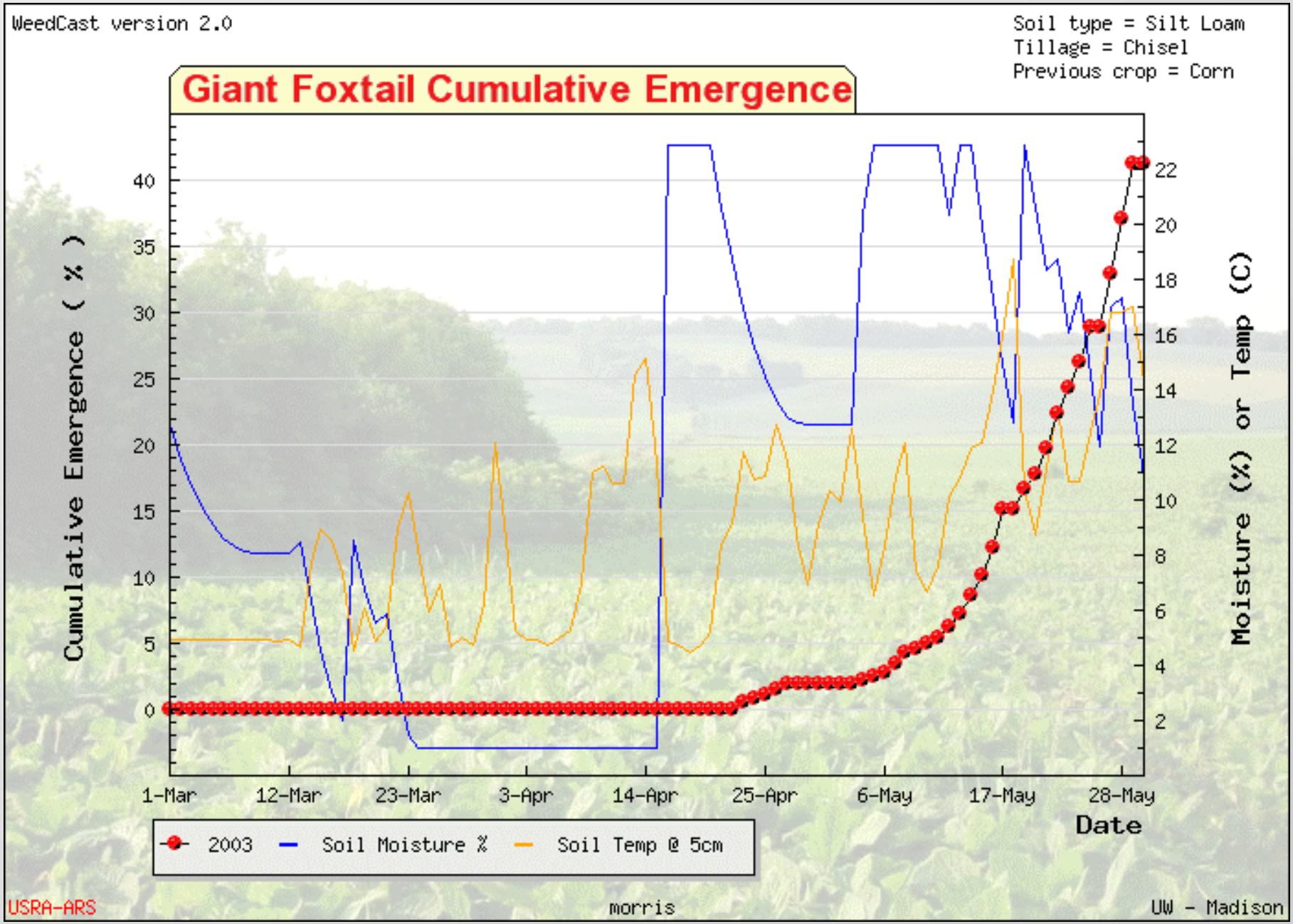
Giant Foxtail Cumulative Emergence
Cumulative Emergence (%)
Moisture (%) or Temp (C)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
2
4
6
8
10
12
14
16
18
20
22
1-Mar
12-Mar
23-Mar
3-Apr
14-Apr
25-Apr
6-May
17-May
28-May
Date
2003
Soil Moisture %
Soil Temp @ 5cm
USRA-ARS
Arlington, Wisconsin
UW - Madison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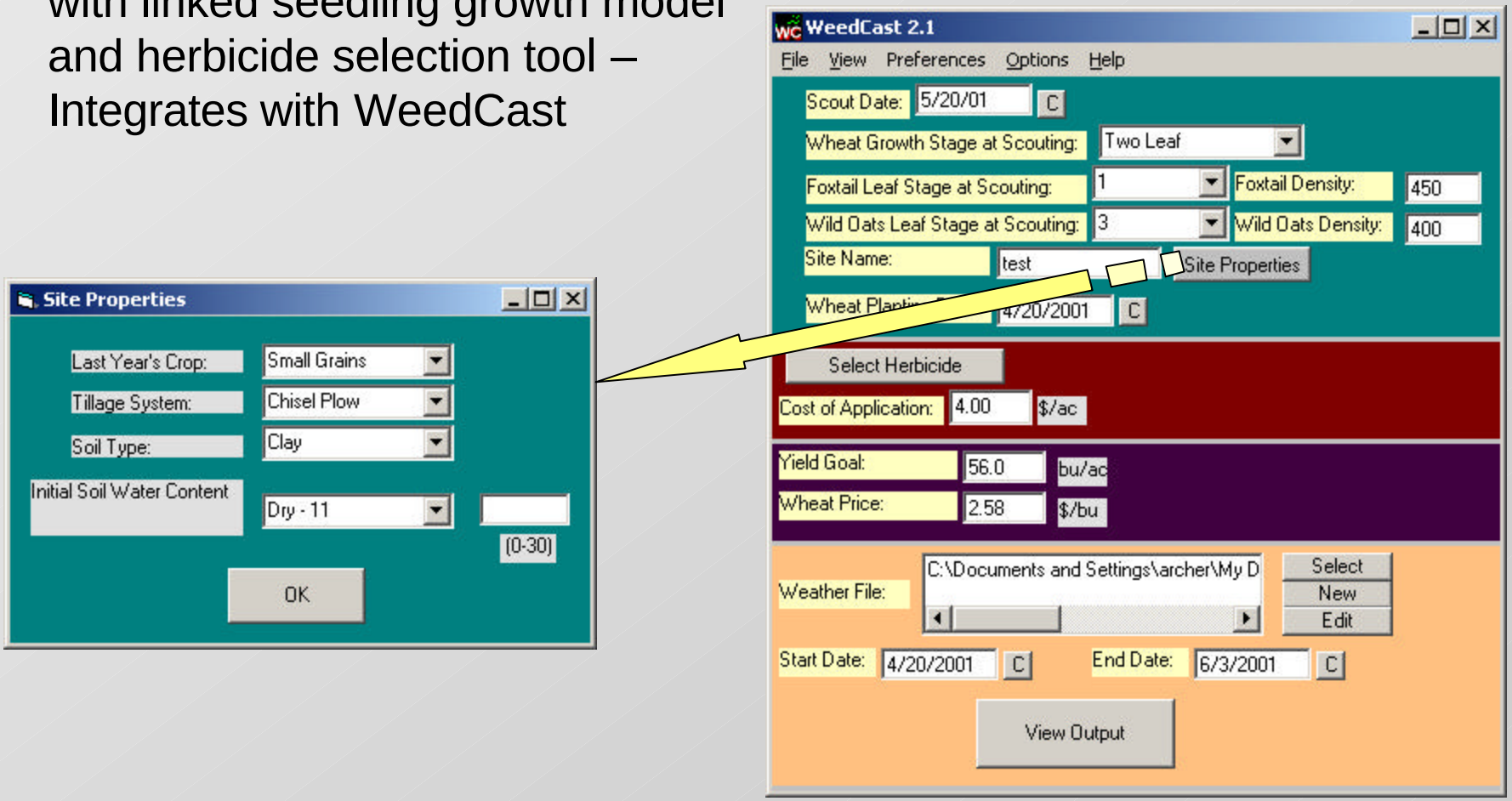
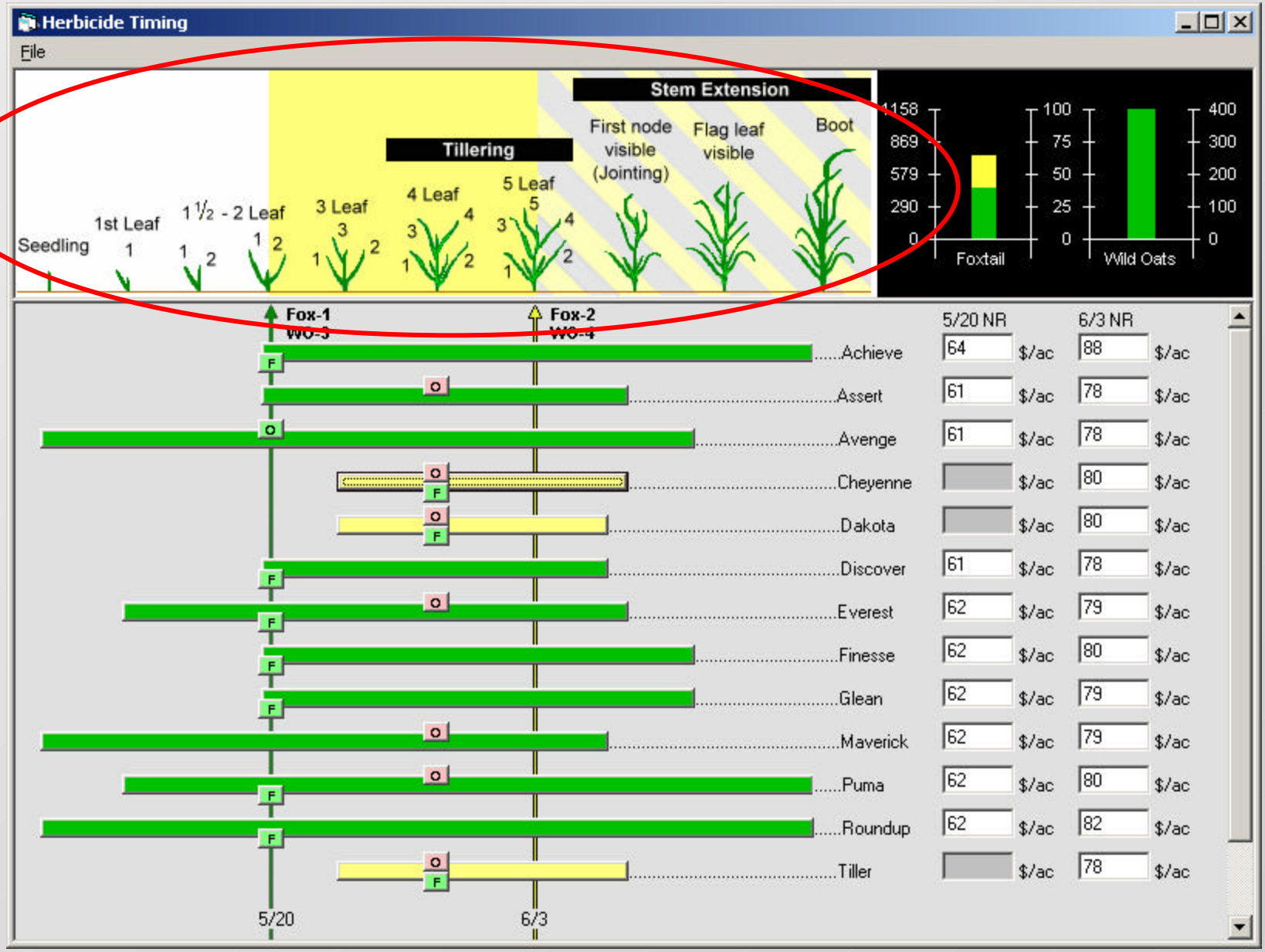
Date
2003
Soil Moisture %
Soil Temp @ 5cm
USRA-ARS
morris
UW - Madison

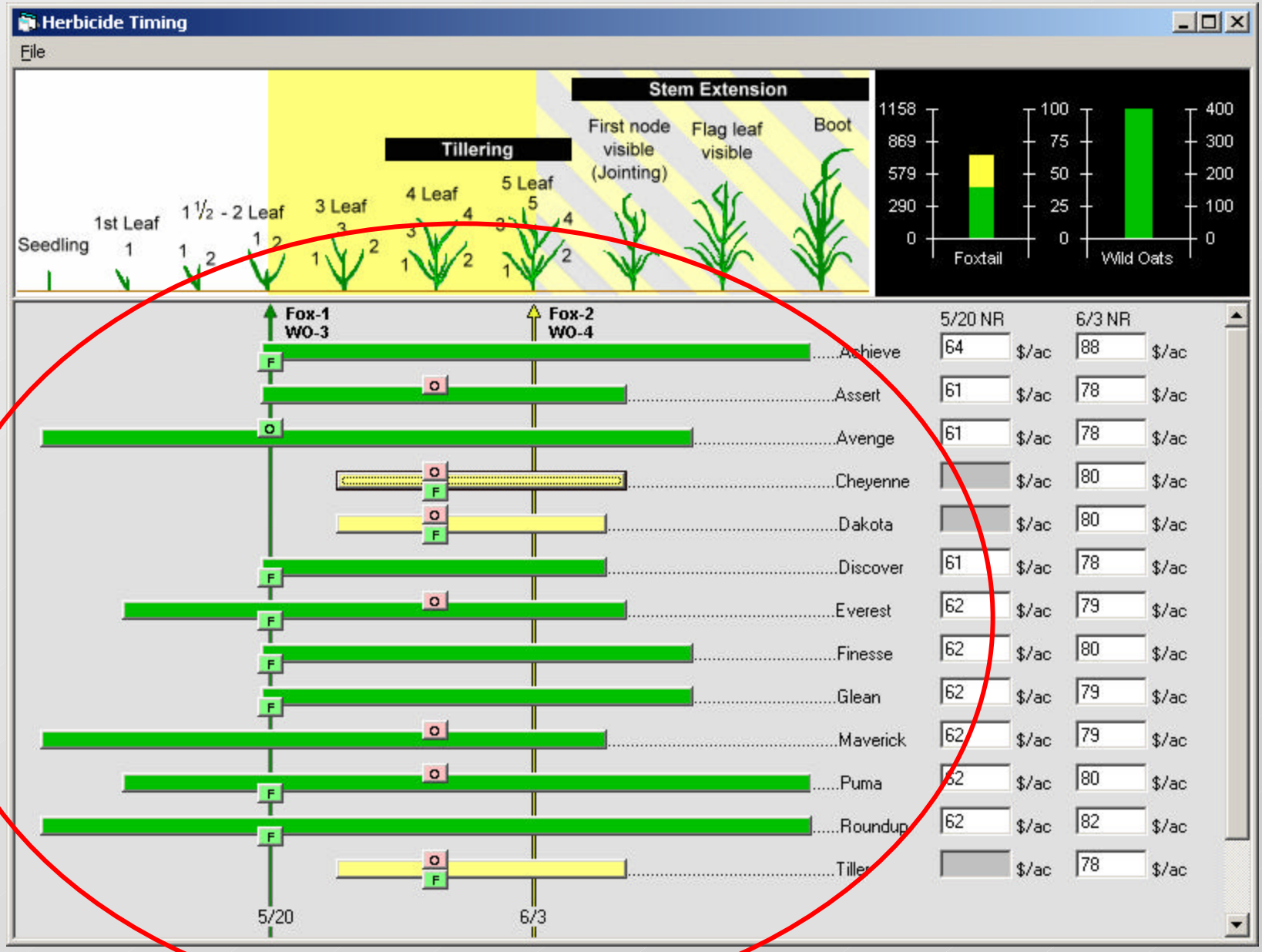
WheatScout (USDA-ARS)

- HydroThermal Accumulator (Pre-release)

with linked seedling growth model and herbicide selection tool – Integrates with WeedCast




Herbicide Timing
File
Stem Extension
Tillering
Seedling
1st Leaf
1 ½ - 2 Leaf
3 Leaf
4 Leaf
5 Leaf
First node visible (Jointing)
Flag leaf visible
Boot
1158
869
579
290
0
Foxtail
100
75
50
25
0
Wild Oats
400
300
200
100
0
Fox-1
WO-3
Fox-2
WO-4
5/20 NR
6/3 NR
Achieve 64 $/ac 88 $/ac
Assert 61 $/ac 78 $/ac
Avenge 61 $/ac 78 $/ac
Cheyenne $/ac 80 $/ac
Dakota $/ac 80 $/ac
Discover 61 $/ac 78 $/ac
Everest 62 $/ac 79 $/ac
Finesse 62 $/ac 80 $/ac
Glean 62 $/ac 79 $/ac
Maverick 62 $/ac 79 $/ac
Puma 62 $/ac 80 $/ac
Roundup 62 $/ac 82 $/ac
Tiller $/ac 78 $/ac
5/20
6/3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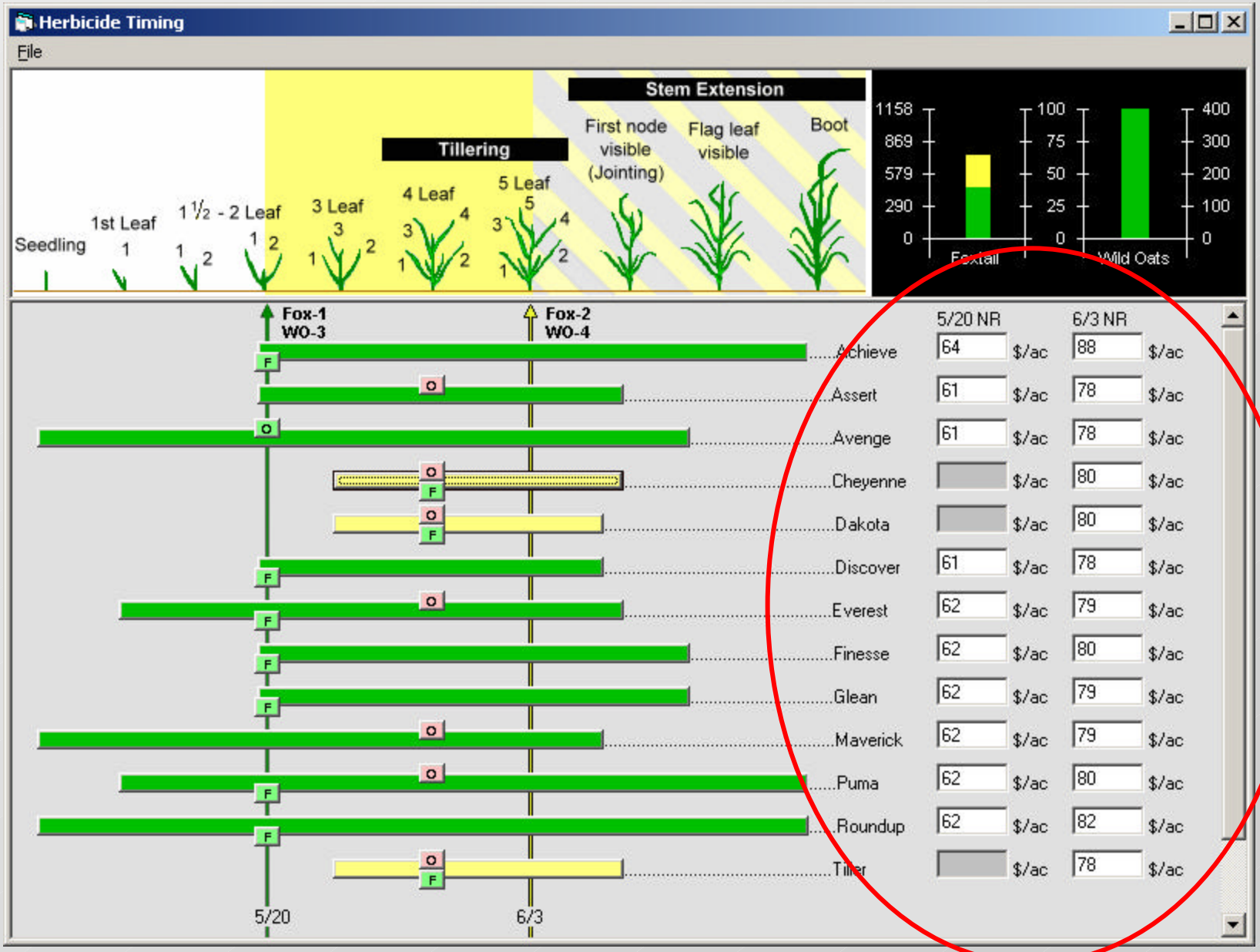
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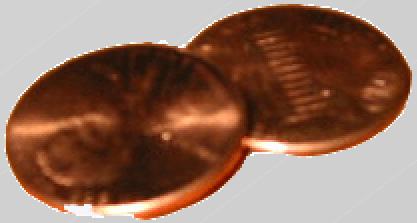
Maverick 62 $/ac 79 $/ac
Puma 62 $/ac 80 $/ac
Roundup 62 $/ac 82 $/ac
Tiller $/ac 78 $/ac
5/20
6/3

The Future

- Low-tech: real time “tracking” of seasonal biological signal with biological events
- High-tech: Limiting-factor accumulators (e.g. Oxy-hydro thermal time); will require a lot of information
  - My two cents: Challenge will not be realism of model but quality of feedback…



Appendix: How Accurate?

- Sources of variability
  - Small scale difference in environment
  - Differences in distribution in soil
  - Present? How abundant?
  - Different phenotypes/genotypes/biotypes?
    - Different responses to identical environment
    - If responses were identical then always 0 or 100%
  - To our advantage: we can take averages over large areas!