

A Weather Summarization Tool for Data Comparisons:



Stoneville, Mississippi



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INTRODUCTION

The National Weather Service (NWS) Cooperative Observing Station located in Stoneville, Mississippi, is in the center of multiagency agricultural research units. Researchers often utilize weather data to explain and predict biological responses of agricultural systems. Growth and reproductive responses of plants, animals, soil microbial populations, pathogens, and insects can

be affected by ambient air temperature, soil temperature, precipitation, evaporation, wind, and solar radiation. Although weather data can now be obtained easily, researchers would use the data more if comparisons of weather data and calculated weather parameters could easily be made and summarized by months, years, or other specified time periods.

OBJECTIVES

The main objective was to develop a useful tool that will allow agricultural researchers or other interested parties to quickly access local weather data and quickly compile tables, graphs, and charts of various weather parameters that would aid in explaining differences observed in yield, growth, fruit retention, insects, diseases, and other biological phenomena from year to year. A secondary objective was to develop the tables, graphs, and charts of a quality that could easily be utilized in simple documents and presentations or that

would allow the data to be easily transferred and used in the development of higher quality tables, graphs, and charts. Each table, graph, and chart developed in English units has a corresponding table, graph, and chart converted to metric (International System [SI] units). This tool would be useful in the interpretation, analysis, and presentation of agricultural research data in the Stoneville area. This tool could be adapted or modified for any location where historical weather data have been recorded.

DATASET

The National Weather Service Cooperative Observing Station located at the Delta Research and Extension Center in Stoneville, Mississippi, is in the center of multiagency research units. Its location is 33.43° latitude, -90.91° longitude. The Stoneville station (Figure 1) officially became a NWS cooperative observing station in 1948, but since 1915 the entire dataset has been archived by the National Climatic Data Center (NCDC). Station location, history, and metadata can be found at: <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?WWDI~StnSrch#DIGITAL>.

This weather station was established, operated, and maintained as noted in the National Weather Service Handbook No. 2 Cooperative Station Observations, U.S. Department of Commerce /NOAA/NWS 1989. Observational measurements of air temperature, soil temperature, precipitation, evaporation, and wind were measured once daily at 7 a.m. Solar radiation (SR) and relative humidity (RH) are observed but are not standard climatic measurements made at cooperative stations. Solar radiation is measured with a LI-COR pyranometer, whereas relative humidity is measured with a

Campbell Scientific HMP 45 temperature and humidity sensor. The historical observational dataset from this site includes rainfall dating back to January 1915. Maximum and minimum air temperatures were first observed during February 1930. By April of 1959, pan evaporation, wind run, and maximum, and minimum 2-inch soil temperatures had been added to the observations followed by solar radiation in September 1959. Maximum and minimum 4-inch soil temperatures were added in August 1970. Maximum and minimum relative readings were added to the recordings in April 1996.



Figure 1. National Weather Service Cooperative Observing Station located at the Delta Research and Extension Center, Stoneville, Mississippi.

The latest 30-year monthly norms (NOAA/NESDIS/NCDC, 2002) and daily norms (Boykin and Ballard, 2002) were included in this dataset for comparisons with yearly data.

Most of the summary parameters in Table 1 are computed as arithmetic means or totals of the daily data collected. The difference between air temperature or rain is calculated and given as a departure-from-norm (DFN) value. Some parameters are a count of the number of days certain conditions occurred at some level X as specified by the user (e.g., the number of days air temperature °F, max > X = 95°F).

Degree-days values are calculated as follows: average of daily maximum and minimum air temperature minus a user-defined value (e.g., 50 if calculating DD50's), or 0 if a negative value. Degree-day limited values are calculated in a way similar to degree-day

values, but user-defined upper and lower limits can be set. In this case, if maximum air temperature exceeded the upper limit, then the calculation would use the upper limit value for the maximum temperature. Likewise, if the minimum air temperature observed was below the lower limit value, then the calculation would use the lower limit value for minimum temperature.

Reference crop evapo-transpiration (Eto), a well-watered grass reference, is a more complicated calculation. The Eto is computed daily for this location using the FAO 56 Penman-Monteith equation as described by Allen et. al. (1998), which utilizes weather data (air temperature, relative humidity, solar radiation, and wind) collected at the station. These calculations are computed separately and added to the Stoneville dataset from 1996 to present.

Individual daily climatic measurements.

Maximum air temperature, °F
 Minimum air temperature, °F
 Rainfall, in
 Pan Evaporation, in
 Wind Run, miles/day
 Solar Radiation, langleys/day

Maximum 2" soil temperature, °F
 Minimum 2" soil temperature, °F
 Maximum 4" soil temperature, °F
 Minimum 4" soil temperature, °F
 Maximum relative humidity, %
 Minimum relative humidity, %

Table 1. Summary parameters that are calculated and presented in tables and charts.

Air temperature °F, average max	Pan Evaporation (in), total
Air temperature °F, average mean	Pan Evap-Rainfall (in)
Air temperature °F, average min	Rain (in), Cumulative
Air temperature °F, DFN max	Rain (in), DFN
Air temperature °F, DFN mean	Rain (in), Limited
Air temperature °F, DFN min	Rain (in), total
Air temperature °F, max <= Level X °F, Days	Rain events <= X (in), Days
Air temperature °F, max > Level X °F, Days	Rain events > X (in), Days
Air temperature °F, min <= Level X °F, Days	RHmax %, average
Air temperature °F, min > Level X °F, Days	RHmin %, average
Degree Days	Soil temperature °F, 2(in) average max
Degree Days Limited	Soil temperature °F, 2(in) average min
Degree Days Limited, Cumulative	Soil temperature °F, 4(in) average max
Degree Days, Cumulative	Soil temperature °F, 4(in) average min
Eto – Rainfall, (in)	Solar Radiation (langleys/day) <= Level X, Days
Eto (in), Average	Solar Radiation (langleys/day), average
Eto (in), Total	Wind Run (miles/day), average
Pan Evaporation (in), average	Wind Run (miles/day), total

Note: X refers to user-defined values.

METHODS

Microsoft Excel 2003 was chosen as the platform for the development of this weather tool. In this product, there are four main worksheets that contain compiled tables, graphs, and charts of various weather parameters. Several other worksheets were used to calculate the different parameters and summarizations and are hidden in the background. Math, logical, date and time, lookup and reference, information, and array functions were utilized in the calculation, development, and arrangement of the data for the tables, graphs, and charts. No macros are used in this weather tool.

In the tables, graphs, and charts produced in the worksheets (Figure 2-5), cells highlighted in blue are cells that either contain various options: (1) drop-down lists to select/deselect a parameter, (2) a hyperlink that takes you to a cell containing a drop-down list to select/deselect a parameter, or (3) a number that can be changed to a user-defined number using the numeric keys. (*Note:* To deselect a parameter, select a blank line in the drop down list.)

In Figure 2, the Month_Years worksheet, a table is produced in which the user can interactively select a calculated weather parameter (Summary parameters, Table 1) to be displayed along with entering values for select parameters to adjust to the user's needs. The months (January to December) and up to six different years of interest can be selected or turned off in the worksheet. Monthly normal data is displayed on the

right side of the table when available. Daily weather data used to calculate the weather parameter selected is graphed for the months and years selected to the right of the table along with daily norms and user-defined constants if applicable. Each year in the graph can be toggled on or off for visual presentation and comparisons. The calculated weather parameter data from the table are charted below the table, while the summary data (average, total) of interest from the table can be selected and charted in the bottom right chart.

As selections are being made in the Month_Years worksheet (Figure 2), data are being updated and converted to International System (SI) units simultaneously in the Metric Month_Years worksheet (Figure 3), which includes the same table, graph, and charts found in the Month_Years worksheet. To make changes or new selections to Metric Month_Years worksheet (Figure 3), return to the Month_Years worksheet (Figure 2) and make the new selections or changes in the appropriate highlighted blue cells. User-defined numbers will need to be made in the appropriate English value that will convert to the desired metric value. To expedite changes, when one clicks on the cell to be changed (months, years, calculated parameters, or user-defined numbers) in the Metric Month_Years worksheet (Figure 3), it will automatically hyperlink to the appropriate cell in the Month_Years worksheet (Figure 2) where the selection or change can be made.

After all changes are made, then select the Metric Month_Years worksheet (Figure 3) to see the results in metric units.

In the Date_Years worksheet (Figure 4), the user selects a specified time period of interest for the table by selecting a start date (month and day) and an end date (month and day). The user can also select a calculated weather parameter and enter user-defined values for select parameters. Year selection cannot be made in the Date_Years worksheet (Figure 4), but clicking on any of the year values in the table in this worksheet will automatically hyperlink back to the Month_Years worksheet (Figure 2), where year selections can be made. Again, daily weather data used to calculate the weather parameter selected are graphed for the specified time period of interest to the right of the table along with daily norms and user-defined constants if applicable. Summary data of interest from the table are charted below the table, just as in the Month_Years worksheet (Figure 2).

The table, graph, and chart are updated simultaneously in SI units in the Metric Date_Years worksheet (Figure 5) as changes are made in the Date_Years worksheet (Figure 4). Changes cannot be made directly in the Metric Date_Years worksheet (Figure 5), just as in the Metric Month_Years worksheet (Figure 3). To make changes or new selections to the Metric Date_Years worksheet (Figure 5), return to the Month_Years worksheet (Figure 2) (years) and the Date_Years worksheet (Figure 4) (start and stop date, calculated parameters, and user-defined numbers) and make the new selections or changes in the appropriate highlighted blue cells. User-defined numbers will need

to be made in the appropriate English value that will convert to the desired metric value. Again, to expedite changes, click on the cell to be changed (months, years, calculated parameters, or user defined numbers) in the Metric Date_Years worksheet (Figure 5). It will automatically hyperlink to the appropriate cell in the Month_Years worksheet (Figure 2) or the Date_Years worksheet (Figure 4), where the selection or change can be made. After all changes are made, then select the Metric Date_Years worksheet (Figure 5) to see the results in metric units.

Any of the tables, graphs, and charts can be selected and printed or easily copied to other word processors and presentation software as a picture (Windows or Enhanced Metafile) or bitmap. Selected data from a table on the worksheets can be copied, formatted if necessary, and inserted into user-defined tables in a word processor for publication or into user-defined charts in presentation software for presentations. Daily data are also available for copying into graphic software for user-defined graphs.

Other historical weather datasets could be adapted to the same format in this weather tool and replace the Stoneville weather data set so that yearly comparisons could be performed for other locations.

This Microsoft Excel weather tool will be updated periodically and file transferred (ftp) to the Delta Agricultural Weather Center web site. There the most recent file will be available for download. This site is hosted by Mississippi State University / Mississippi Agricultural and Forestry Experiment Station / Delta Research and Extension Center/ Delta Agricultural Weather Center [<http://www.deltaweather.msstate.edu>].

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Figure 2. Month_Years Worksheet



Month-Year weather data comparisons
Stoneville, Mississippi^{1,2}

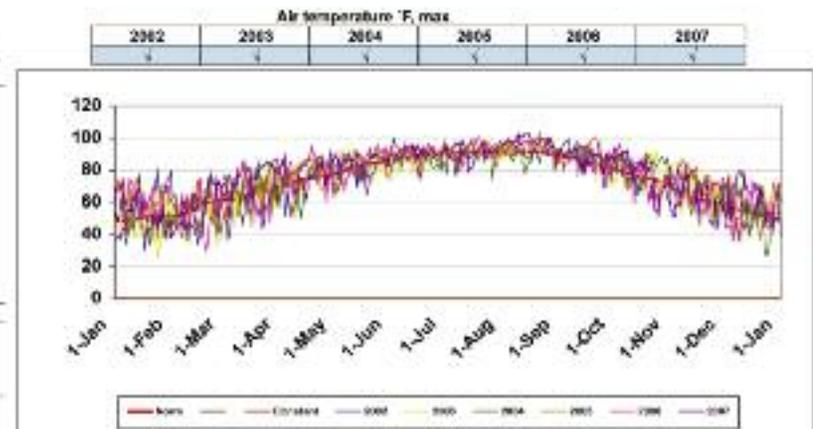
Air temperature °F, average max						
Month	2002	2003	2004	2005	2006	2007
Jan	55	49	53	55	61	53
Feb	56	51	51	58	63	55
Mar	61	63	69	64	67	76
Apr	76	77	75	76	80	73
May	83	84	83	83	84	85
Jun	89	87	87	90	91	91
Jul	83	81	80	91	93	89
Aug	83	83	89	85	89	82
Sep	89	86	89	81	87	83
Oct	74	78	82	78	77	79
Nov	61	69	67	70	65	67
Dec	55	55	54	54	57	61
Average Total	74	74	74	76	76	76

Monthly Normals

50
56
66
75
83
90
93
92
86
77
64
54

74

Stoneville, Mississippi^{1,2}



¹National Weather Service Cooperative Observing Station Located in Stoneville, MS

²NOAA/NESDIS/NCDC. 2002. Monthly station normals of temperature, precipitation, and heating and cooling degree days 1971-2000 (22 Mississippi). Climatology of the United States No. 81. Asheville, North Carolina, pp26.

¹National Weather Service Cooperative Observing Station Located in Stoneville, MS

²Boyle, D.L. and L.H. Boland. 2002. Weather Data Summary for 1971-2000 Stoneville, MS. On-line revision of Tech. Bul. 201. MAPES. [on-line]. Available at <http://msa.ars.usda.gov/stations/Weather.htm> (verified 20 Feb. 2008).

Average

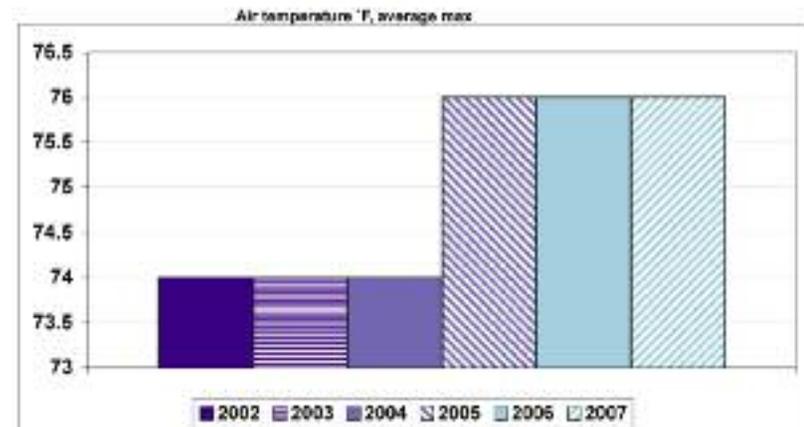
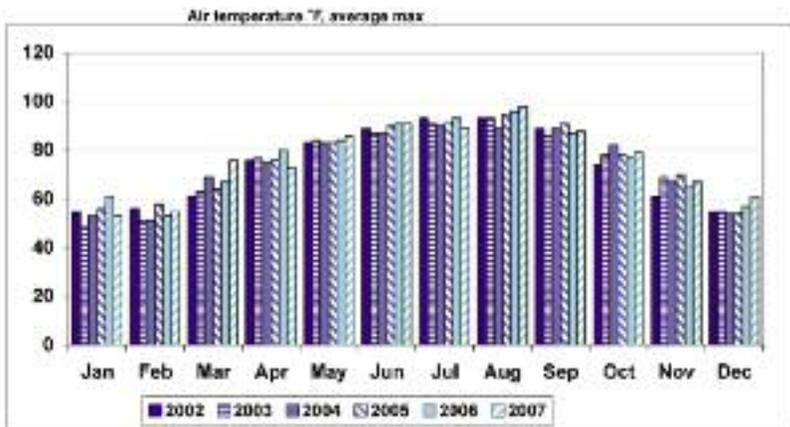


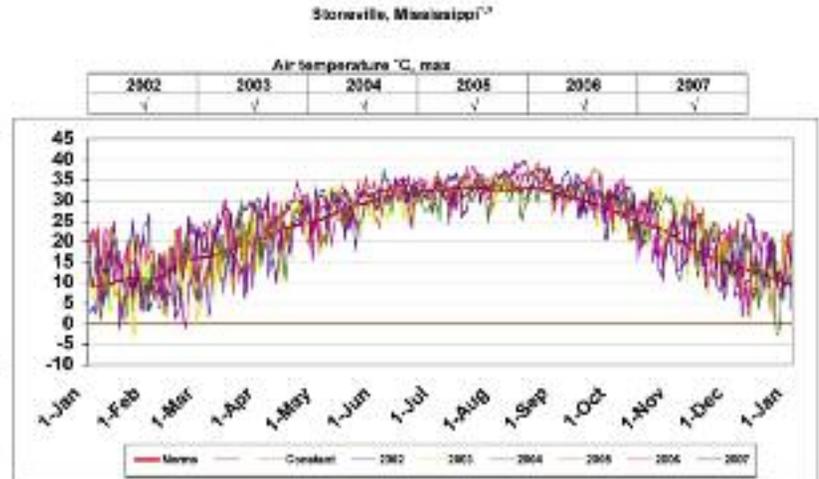
Figure 3. Metric Month_Years Worksheet

Metric Month*Year weather data comparison
 Stoneville, Mississippi^{1,2}



Air temperature °C, average max						
Month	2002	2003	2004	2005	2006	2007
Jan	13	9	12	13	16	12
Feb	13	11	11	14	12	13
Mar	18	17	21	18	19	24
Apr	24	25	24	24	27	33
May	28	29	28	28	29	30
Jun	32	31	31	32	33	33
Jul	34	33	32	33	34	32
Aug	34	34	32	35	36	37
Sep	32	30	32	35	31	31
Oct	23	26	28	26	25	26
Nov	19	21	19	21	18	19
Dec	13	13	12	12	14	16
Average	23	22	24	24	25	25
Total	278	279	282	289	294	293

Monthly Normals
10
13
18
24
28
32
34
33
30
28
18
12
23
277



¹National Weather Service Cooperative Observing Station Located in Stoneville, MS

²NOAA/NESDIS/NCDC. 2002. Monthly station normals of temperature, precipitation, and heating and cooling degree days 1971-2000 (22 Mississippi). Climatology of the United States No. 81. Asheville, North Carolina. pp25.

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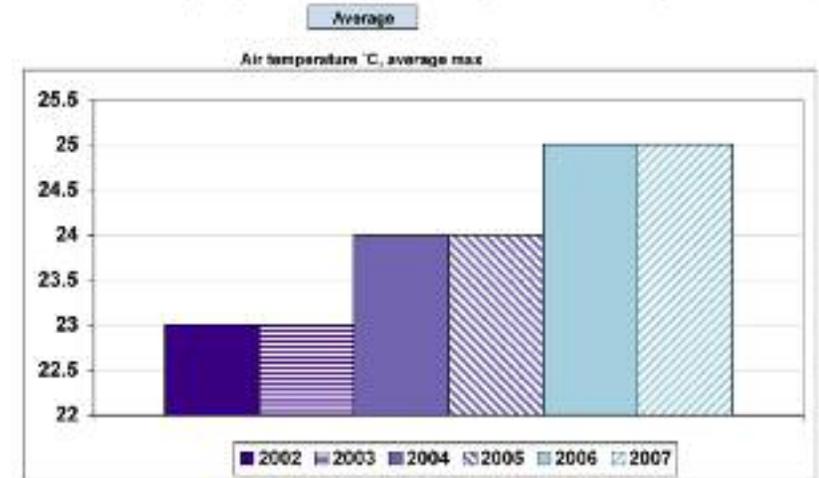
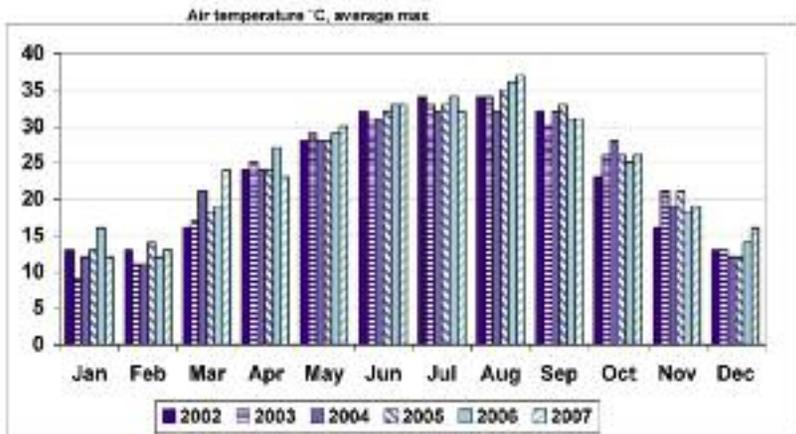
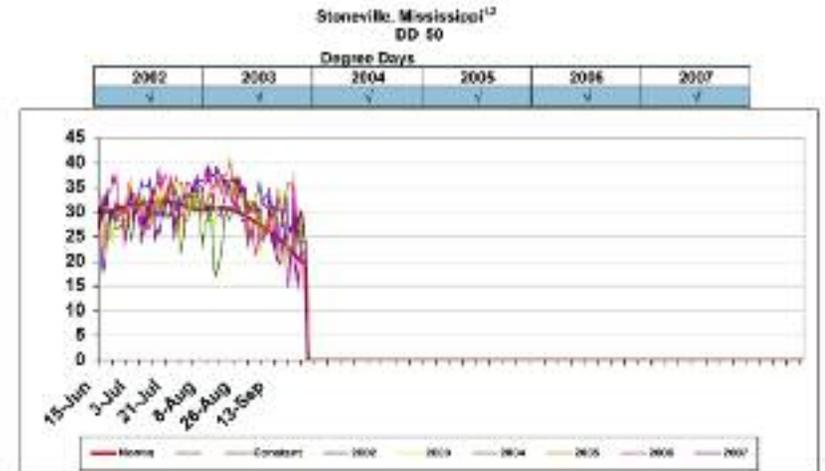
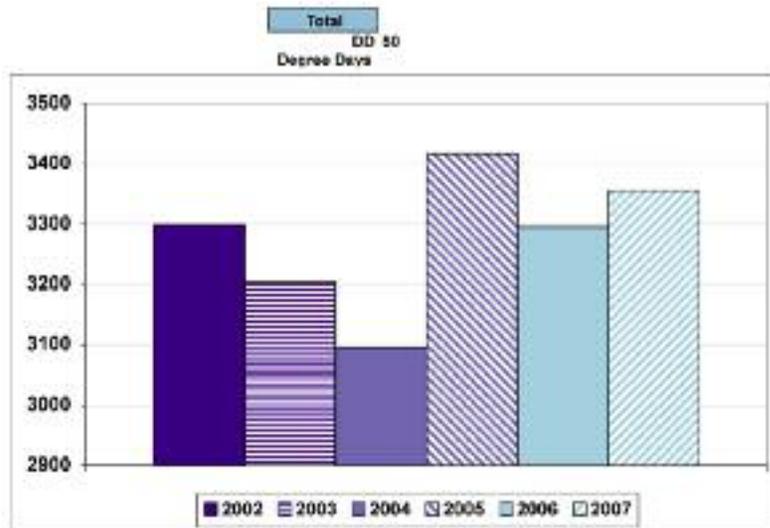


Figure 4. Date_Years Worksheet



¹National Weather Service Cooperative Observing Station Located in Stoneville, MS



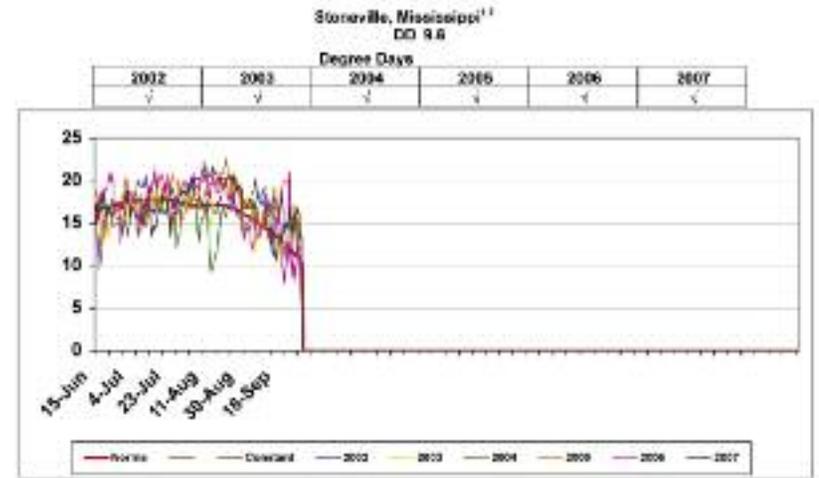
¹National Weather Service Cooperative Observing Station Located in Stoneville, MS

²Boyer, D.L. and L.H. Ballard. 2002. Weather Data Summary for 1971-2000 Stoneville, MS. On-line revision of Tech. Bul. 201. MAPES. On-line. Available at <http://msa.ars.usda.gov/sta/msa/Weather.htm> (verified 20 Feb. 2006).

Figure 5. Metric Date_Years Worksheet

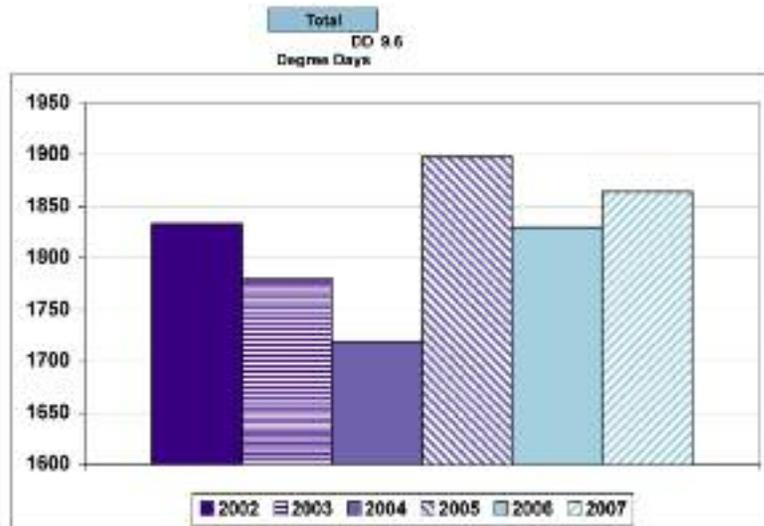


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²Boyles, D.L., and L.H. Beckler, 2002. Weather Data Summary for 1971-2000 Stoneville, MS. On-line revision of Tech. Bul. 201. MAFFS. (on-line). Available at: <http://www.ars.usda.gov/stoneville/Weather.htm> (verified 20 Feb. 2008).





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