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Maturity Dates and Freeze Risks Based on Growing Degree Days

Explanation of growing degree days (GDD) necessary for crop maturity and tables showing estimated maturity dates and freeze risks for different GDD accumulations for different planting times in regions of Nebraska.

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The concept of growing degree days (GDD) resulted from observations that:

- There is a base temperature below which plants do not grow.
- The rate of growth increases with temperature above this base.
- Crop hybrids require different GDD accumulations to reach maturity.

A base temperature of 50°F is used for warm season crops such as sweet corn, grain sorghum, and field corn. *Table I* presents GDD requirements for different crop hybrids. Also shown are the "days to maturity" or the time needed to accumulate the GDD requirements in different regions in Nebraska for a planting on May 15. The days to maturity will be greater or less when the season is cooler or warmer than normal and, as shown later, varies with planting time. The different regions designated as A, B, C, and D are shown in *Figure 1*.

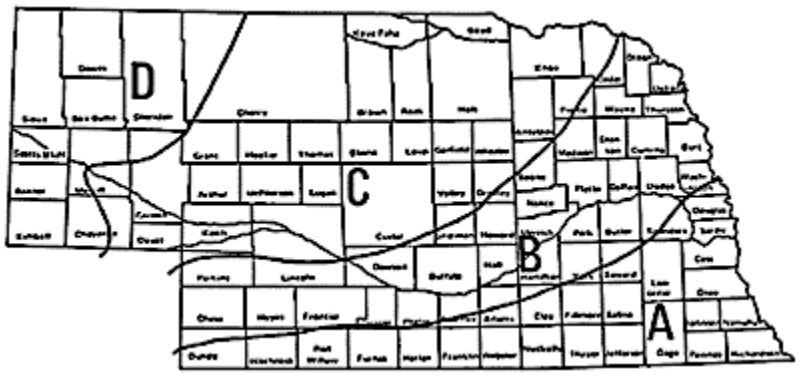

Figure 1. Growing degree day regions in Nebraska.

Table I. Growing degree day requirements and days to maturity for certain warm season crops in Nebraska.

				Region--days to maturity			
			GDD*	A	B	C	D
		Sweet Corn	1400-1500	60-65	65-70	70-75	80-85
			1600-1700	70-75	75-80	80-85	90-100
	Sorghum		1800-1900	75-80	85-90	90-100	105-120
			2000-2100	85-90	90-100	100-110	120-135
Field Corn			2200-2300	90-95	100-110	110-125	145+
			2400-2500	95-100	110-120	130-145	--
			2600-2700	105-110	120-130	150+	--
			2800-2900	115-125	135-150	--	--
			3000-3100	130-140	155+	--	--
			3200-3300	145+	--	--	--

For example, a sorghum or field corn hybrid requiring 2400 GDD above 50°F would need 95-100 days to accumulate this requirement in region A; 110-120 days in region B; 130-145 days in region C; and may not accumulate the necessary amount or it may freeze before it does in region D. These "days to maturity" reflect the temperature and season across Nebraska which becomes cooler and shorter from southeast to northwest.

A computer analysis of long term daily weather records was used to simulate the response of crop hybrids in different regions. Daily GDD were accumulated for different plantings every five days between April 25 and July 29. Determined for each planting time were the average date when different GDD accumulations were reached and the freeze risk or the percent of years when the season was so cool that sufficient GDD were not accumulated before a 32°F freeze occurred.

Stations with 70 to 81 seasons of crop growing history were analyzed. For example, the record for Franklin in region A was for a 75-year period from 1900 through 1974; David City in region B, a 74-year period, Broken Bow in region C, an 80-year period; and Kimball in region D, an 81-year period.

Tables A1 and A2 through D1 and D2 show the estimated maturity dates and freeze risks for different GDD accumulations for different planting times in various regions. For example, Table B1 shows a 2400-GDD sorghum or field corn hybrid planted on April 25 in region B would be expected to accumulate sufficient temperature to mature by August 24, 121 days from planting; if planted on May 15 it would be expected to be mature by September 1 or 109 days after planting. A planting on May 30 would be expected to be mature by September 11 or 104 days after planting.

These comparisons show the affect of planting time on "days of maturity". The freeze risk for this 2400-GDD hybrid in region B begins to increase as planting time is delayed into June. Table B2 shows that a June 4 planting date has 13% freeze risk, this increases to 36% by June 14, 66% by June 24 and is 87% on July 4. Tables A1 and A2 through D1 and D2 allow similar comparison between other hybrid planting dates and regions.

Table A1 (below). Estimated maturity dates for warm season crops of different maturity planted on different dates.

	Planting date																			
GDD	**4/25**	**4/30**	**5/5**	**5/10**	**5/15**	**5/20**	**5/25**	**5/30**	**6/4**	**6/9**	**6/14**	**6/19**	**6/24**	**6/29**	**7/4**	**7/9**	**7/14**	**7/19**	**7/24**	**7/29**
1400.	7/12	7/13	7/15	7/16	7/18	7/20	7/23	7/26	7/29	8/1	8/5	8/9	8/13	8/18	8/23	8/29	9/4	9/12	9/20	10/2
1600.	7/19	7/20	7/22	7/23	7/25	7/27	7/30	8/2	8/5	8/8	8/12	8/16	8/21	8/26	9/1	9/7	9/15	9/26	10/8	0/0
1800.	7/26	7/27	7/29	7/30	8/1	8/4	8/6	8/9	8/12	8/16	8/20	8/24	8/29	9/4	9/11	9/20	10/1	10/19	0/0	0/0
2000.	8/2	8/3	8/5	8/7	8/8	8/11	8/13	8/16	8/20	8/24	8/28	9/2	9/8	9/15	9/25	10/7	10/25	0/0	0/0	0/0
2200.	8/10	8/11	8/12	8/14	8/16	8/18	8/22	8/25	8/28	9/2	9/6	9/13	9/21	10/1	10/15	0/0	0/0	0/0	0/0	0/0
2400.	8/17	8/18	8/20	8/22	8/24	8/27	8/30	9/3	9/7	9/13	9/19	9/27	10/9	10/23	0/0	0/0	0/0	0/0	0/0	0/0
2600.	8/25	8/27	8/29	9/1	9/3	9/6	9/10	9/14	9/19	9/27	10/6	10/17	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
2800.	9/4	9/6	9/8	9/10	9/14	9/17	9/23	9/28	10/6	10/14	10/28	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
3000.	9/15	9/17	9/20	9/24	9/28	10/2	10/10	10/17	10/26	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
3200.	10/2	10/4	10/8	10/12	10/16	10/22	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0

Table A2 (below). Freeze risk (%) for warm season crops of different maturities planted on different dates.

	Planting date																			
GDD	**4/25**	**4/30**	**5/5**	**5/10**	**5/15**	**5/20**	**5/25**	**5/30**	**6/4**	**6/9**	**6/14**	**6/19**	**6/24**	**6/29**	**7/4**	**7/9**	**7/14**	**7/19**	**7/24**	**7/29**
1400.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	21	40
1600.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	12	32	47	73
1800.	0	0	0	0	0	0	0	0	0	0	0	3	5	7	8	20	36	60	83	91
2000.	0	0	0	0	0	0	0	0	0	4	5	7	8	13	29	44	69	88	93	96
2200.	0	0	0	0	1	1	3	5	5	7	8	11	24	36	55	77	88	93	97	100
2400.	3	3	3	3	3	5	7	8	9	13	19	35	43	61	84	91	95	99	100	100
2600.	4	4	5	5	8	9	12	15	23	32	40	53	75	88	91	95	100	100	100	100
2800.	8	9	11	12	15	19	25	36	41	51	67	84	89	93	97	100	100	100	100	100
3000.	20	20	23	27	32	40	44	52	65	80	88	89	95	99	100	100	100	100	100	100
3200.	37	40	43	48	51	57	71	80	85	89	95	96	99	100	100	100	100	100	100	100

Table B1 (below). Estimated maturity dates for warm season crops of different maturities planted on different dates.

	Planting date																			
GDD	**4/25**	**4/30**	**5/5**	**5/10**	**5/15**	**5/20**	**5/25**	**5/30**	**6/4**	**6/9**	**6/14**	**6/19**	**6/24**	**6/29**	**7/4**	**7/9**	**7/14**	**7/19**	**7/24**	**7/29**
1400.	7/15	7/16	7/18	7/19	7/21	7/23	7/26	7/29	8/1	8/4	8/8	8/12	8/17	8/22	8/27	9/2	9/9	9/18	9/29	10/19
1600.	7/22	7/23	7/25	7/27	7/28	8/1	8/2	8/5	8/8	8/12	8/16	8/20	8/25	9/1	9/6	9/13	9/24	10/7	10/28	0/0
1800.	7/30	8/1	8/2	8/3	8/5	8/7	8/10	8/13	8/16	8/20	8/25	8/30	9/4	9/10	9/18	10/1	10/20	0/0	0/0	0/0
2000.	8/7	8/8	8/9	8/11	8/13	8/15	8/18	8/22	8/25	8/29	9/3	9/9	9/16	9/26	10/10	10/28	0/0	0/0	0/0	0/0
2200.	8/15	8/16	8/18	8/20	8/22	8/24	8/28	9/1	9/4	9/9	9/15	9/24	10/6	10/18	0/0	0/0	0/0	0/0	0/0	0/0
2400.	8/24	8/25	8/27	8/29	9/1	9/3	9/7	9/11	9/17	9/24	10/3	10/14	10/29	0/0	0/0	0/0	0/0	0/0	0/0	0/0
2600.	9/3	9/4	9/7	9/9	9/12	9/16	9/21	9/27	10/5	10/14	10/27	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
2800.	9/15	9/17	9/21	9/24	9/28	10/2	10/9	10/17	10/27	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
3000.	10/2	10/5	10/8	10/12	10/18	10/23	10/30	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
3200.	10/22	10/25	10/29	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0

Table B2 (below). Freeze risk (%) for warm season crops of different maturities planted on different dates.

	Planting date																			
GDD	**4/25**	**4/30**	**5/5**	**5/10**	**5/15**	**5/20**	**5/25**	**5/30**	**6/4**	**6/9**	**6/14**	**6/19**	**6/24**	**6/29**	**7/4**	**7/9**	**7/14**	**7/19**	**7/24**	**7/29**
1400.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	10	22	53
1600.	0	0	0	0	0	0	0	0	0	0	0	0	1	3	4	6	18	43	66	83
1800.	0	0	0	0	0	0	0	0	0	0	1	4	5	8	12	29	56	78	87	94
2000.	0	0	0	0	0	0	0	0	4	4	5	6	10	18	43	65	82	87	94	99
2200.	0	0	0	0	1	4	5	5	5	6	10	18	36	56	74	84	92	96	99	100
2400.	4	4	5	5	5	5	6	8	13	18	36	47	66	79	87	94	96	100	100	100
2600.	5	5	6	6	9	14	19	26	36	48	61	78	82	88	95	99	100	100	100	100
2800.	16	17	18	23	29	31	39	52	62	74	82	87	94	97	99	100	100	100	100	100
3000.	31	36	40	49	53	62	65	75	83	86	91	94	99	100	100	100	100	100	100	100
3200.	55	60	65	66	70	73	83	88	92	94	97	99	100	100	100	100	100	100	100	100

Table C1 (below). Estimated maturity dates for warm season crops of different maturities planted on different dates.

	Planting date																			
GDD	**4/25**	**4/30**	**5/5**	**5/10**	**5/15**	**5/20**	**5/25**	**5/30**	**6/4**	**6/9**	**6/14**	**6/19**	**6/24**	**6/29**	**7/4**	**7/9**	**7/14**	**7/19**	**7/24**	**7/29**
1400.	7/23	7/24	7/25	7/26	7/28	7/30	8/1	8/4	8/6	8/9	8/13	8/17	8/22	8/27	9/2	9/9	9/19	10/4	10/24	0/0
1600.	8/1	8/1	8/2	8/4	8/5	8/7	8/9	8/12	8/15	8/18	8/22	8/27	9/1	9/8	9/16	10/1	10/16	0/0	0/0	0/0
1800.	8/9	8/10	8/11	8/12	8/14	8/16	8/18	8/21	8/24	8/28	9/2	9/7	9/14	9/26	10/11	10/30	0/0	0/0	0/0	0/0
2000.	8/18	8/19	8/20	8/22	8/23	8/26	8/29	9/1	9/4	9/9	9/16	9/26	10/9	10/25	0/0	0/0	0/0	0/0	0/0	0/0
2200.	8/28	8/29	9/1	9/2	9/4	9/7	9/11	9/17	9/22	9/29	10/10	10/21	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
2400.	9/11	9/12	9/15	9/18	9/21	9/24	9/28	10/6	10/13	10/25	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
2600.	9/27	9/29	10/1	10/4	10/9	10/14	10/22	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
2800.	10/20	10/23	10/26	10/30	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
3000.	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
3200.	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0

Table C2 (below). Freeze risk (%) for warm season crops of different maturities planted on different dates.

	Planting date																			
GDD	**4/25**	**4/30**	**5/5**	**5/10**	**5/15**	**5/20**	**5/25**	**5/30**	**6/4**	**6/9**	**6/14**	**6/19**	**6/24**	**6/29**	**7/4**	**7/9**	**7/14**	**7/19**	**7/24**	**7/29**
1400.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	19	44	68	90
1600.	0	0	0	0	0	0	0	0	0	0	0	1	1	9	16	31	57	79	93	97
1800.	0	0	0	0	0	0	0	1	1	1	1	9	15	26	51	71	88	96	99	99
2000.	0	1	1	3	3	3	3	4	7	12	19	28	46	65	79	93	97	99	99	100
2200.	3	3	4	7	7	12	18	18	24	34	44	59	76	88	94	99	99	100	100	100
2400.	15	15	18	19	21	26	34	41	47	66	74	84	93	96	99	99	100	100	100	100
2600.	32	34	35	38	46	50	59	69	79	87	91	96	99	99	100	100	100	100	100	100
2800.	60	60	65	68	74	76	85	91	93	97	99	99	100	100	100	100	100	100	100	100
3000.	82	84	87	88	91	91	93	97	99	100	100	100	100	100	100	100	100	100	100	100
3200.	91	91	93	96	97	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Table D1 (below). Estimated maturity dates for warm season crops of different maturities planted on different dates.

	Planting date																			
GDD	**4/25**	**4/30**	**5/5**	**5/10**	**5/15**	**5/20**	**5/25**	**5/30**	**6/4**	**6/9**	**6/14**	**6/19**	**6/24**	**6/29**	**7/4**	**7/9**	**7/14**	**7/19**	**7/24**	**7/29**
1400.	8/1	8/2	8/3	8/4	8/5	8/6	8/8	8/11	8/13	8/16	8/20	8/24	8/29	9/6	9/16	10/2	10/21	0/0	0/0	0/0
1600.	8/10	8/11	8/12	8/13	8/15	8/16	8/19	8/21	8/24	8/28	9/2	9/8	9/17	10/1	10/20	0/0	0/0	0/0	0/0	0/0
1800.	8/21	8/21	8/23	8/24	8/26	8/29	9/2	9/5	9/10	9/14	9/22	10/1	10/17	0/0	0/0	0/0	0/0	0/0	0/0	0/0
2000.	9/5	9/6	9/7	9/9	9/12	9/15	9/21	9/25	10/2	10/10	10/23	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
2200.	9/26	9/27	9/29	10/2	10/6	10/10	10/17	10/23	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
2400.	10/20	10/22	10/27	10/30	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
2600.	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
2800.	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
3000.	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
3200.	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0

Table D2 (below). Freeze risk (%) for warm season crops of different maturities planted on different dates.

	Planting date																			
GDD	**4/25**	**4/30**	**5/5**	**5/10**	**5/15**	**5/20**	**5/25**	**5/30**	**6/4**	**6/9**	**6/14**	**6/19**	**6/24**	**6/29**	**7/4**	**7/9**	**7/14**	**7/19**	**7/24**	**7/29**
1400.	0	0	0	0	0	0	0	0	0	0	0	0	5	12	25	48	66	80	94	100
1600.	0	0	0	0	0	0	0	0	2	6	11	17	25	46	63	77	91	98	100	100
1800.	0	0	2	3	5	9	11	14	17	22	32	48	63	69	86	97	98	100	100	100
2000.	17	18	18	20	20	23	32	40	49	54	65	72	85	95	98	100	100	100	100	100
2200.	38	38	42	46	51	51	58	63	71	74	86	91	97	100	100	100	100	100	100	100
2400.	60	62	65	68	71	72	80	85	89	91	97	100	100	100	100	100	100	100	100	100
2600.	82	82	86	86	88	91	92	95	98	100	100	100	100	100	100	100	100	100	100	100
2800.	92	95	95	95	95	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
3000.	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
3200.	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

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