


University of Kentucky
College of Agriculture, Food and Environment
Cooperative Extension Service

March 24, 2023 Volume 27, Issue 1

Research & Education Center
Princeton, KY 42445

Wheat Science News

What's inside

How Could the Potential Warmest Winter on Record Affect Kentucky's Wheat Crop?

Conner Raymond— Grain Crops Extension Associate
Dr. Carrie Knott—Grain Crops Extension Specialist

As the 'meteorological' winter ends (Dec 1 to Feb 28) for 2023, we are projected to have the warmest winter on record. This is impressive considering the **sub-zero temperatures** in late December 2022.

This has many people, including us, wondering:
What does this mean for Kentucky's 2023 winter wheat crop?

First: We are fortunate that our current wheat crop is not excessively large, with excessive stands and tillers and at an advanced growth stage for this early in the season. Wheat with 'excessive growth' and at an advanced growth stage typically is at a much greater risk to be damaged by a spring freeze than moderate/acceptable stands. This year, we likely do not have excessive growth and advanced growth stages because the fall conditions were quite dry, which resulted in delayed emergence in most situations. In addition, the sub-zero temperatures during late December seems to have slowed down wheat growth enough to keep stands from becoming excessively thick.

Figure 1: Winter wheat in Princeton, KY 2/24/23. Despite the bitter cold temperatures in late December 2022, the wheat stands are good. Weed populations are equally "nice".

Second: To compare how warm this winter has been, we examined the growing degree days (base temperature of 32°F) from December 1 to February 28 for this year and the

years that the National Weather Service has identified as the "Top 10 Warmest" Winters for Paducah and Lexington. We chose these sites because the National Weather Service has a record of the top 10 warmest winters and because they likely represent the range of weather differences across the potential wheat growing regions within Kentucky.

Rank	Average Temperature (˚F)	Season 2022/2023
--	44.0	2022/2023
1	43.0	2016/2017
2	42.4	1949/1950
3	41.8	1991/1992
4 (tie)	41.6	2015/2016
4 (tie)	41.6	2011/2012
6	41.2	2019/2020
7	41.1	1951/1952
8 (tie)	40.6	2018/2019
8(tie)	40.6	1998/1999
10 (tie)	40.5	2021/2022
10 (tie)	40.5	1997/1998

Table 1. Ten warmest meteorological winters (December to February) since records began in December 1937 for Paducah, Kentucky (Source: https://www.weather.gov/pah/PaducahSeasonalRecords) and an "unofficial" estimate for the 2022/2023 meteorological winter from data available at the University of Kentucky's Ag Weather Center. Source: http://weather.uky.edu/ky/data.php#KY_Climate_Data.

Table 2. Ten warmest meteorological winters (December to February) since records began in 1872 for Lexington, Kentucky (Source: https://www.weather.gov/media/lmk/climate/clilex/Top_Ten_Warmest_and_Coldest_Seasons.pdf)

Rank	Average Temperature (˚F)	Season 2022/2023
--	42.9	2022/2023
1	43.9	1931/1932
2	41.4	2016/2017
3 (tie)	40.7	2019/2020
3 (tie)	40.7	1875/1876
4	40.5	1949/1950
5	39.9	1948/1949
6	39.6	2015/2016
7	39.3	2011/2012
8(tie)	39.1	2018/2019
8(tie)	39.1	1997/1998
8(tie)	39.1	1952/1953
9	38.9	1991/1992
10	38.8	2001/2002

Third: Since the winter of 2011-2012, seven of the last twelve winters have had above average GDD's. Of those seven, three have resulted in late spring freeze events that have harmed the wheat crop (Table 3).

What contributes to a significant freeze event? Temperature, duration of temperature and plant growth stage are all factors to be considered. The majority of yield limiting damage occurs to wheat after Feekes 6, or jointing, when the growing point of the plant moves above the soil surface. Plants can withstand cold and even sub-freezing temperatures at this stage. However, if temperatures fall at or below 24°F for two or more hours moderate to severe yield damage can occur. If freeze damage is suspected it is important to wait seven to ten days with good growing temperatures, 40°F or above, before scouting. Even with above normal GDD's, most of the wheat in the state has not reached jointing yet but will be approaching soon. Refer to AGR 253 and ID 125 if freeze damage is suspected.

	GDD December 1 - February 28		
	Princeton	Lexington	State Avg
2022-23	1038	959	990
2021-22	NA	714	783
2020-21	552	390	485
2019-20	751	565	656
2018-19	788	691	746
2017-18	840	822	624
2016-17	1087	1013	1069
2015-16	950	903	957
2014-15	479	370	475
2013-14	474	468	480
2012-13	845	715	825
2011-12	903	769	897
AVG	792	698	749

Table 3. Growing degree days from December 1, 2022, through February 28, 2023 at Princeton, Lexington, and the Kentucky state average. Years highlighted in gray are years freeze damage was documented for wheat. Temperature data acquired from KYMesonet.org. Princeton 2022 data was not available.

We are painfully aware that this year our GDD's rank second to the 2016-2017 season. Most of us recall vividly the late freeze that had us very concerned for the impact to our wheat crop (link here). Although multiple freeze events occurred that season, final wheat yields averaged 77 bu/A (the record breaking state average was the 2020-2021 season at 87 bu/A). This highlights the importance of closely monitoring wheat growth and development, particularly if freeze events are forecast. Should a freeze event occur, refer to AGR 253 and ID 125. (*This article was originally posted on KyGrains.info on March 6, 2023.)*

March 15 and 17 to 21 Temperatures MAY Damage Wheat Crop

Conner Raymond— Grain Crops Extension Associate
Dr. Carrie Knott—Grain Crops Extension Specialist

This winter has quite possibly been the warmest in recorded history for Kentucky. We have been lucky that we have not had a year with excessive wheat growth and development due to our environmental conditions (presented in a previous article and available online). But, there are still many acres of wheat in Kentucky that are jointed (Feekes 6) and possibly some pockets in the state with wheat crops that have two nodes (Feekes 7).

On March 15 and again from March 17 to 21, temperatures plummeted across the state. Minimum air temperatures dropped into the teens and low 20°F across the entire state overnight from March 19 to 20 (Table 1). Clinton, Cumberland, Grayson, Harrison, Lewis, Meade and Taylor counties all dipped to about 13°F while Ballard, Boone, Calloway, Campbell, Crittenden, Fulton, Henderson, Mason, Metcalfe, Oldham, Simpson and Union counties all remained in the 20s.

For wheat fields that are Feekes 5 or less advanced, these temperatures should not harm the wheat. The growing point was still below the soil surface and well protected by the soil temperatures. This is evidenced by soil surface temperatures that we recorded at University of Kentucky's Research and Education Center in Princeton (Figure 1). Throughout this period, soil temperatures remained above 31°F.

For wheat fields that were at Feekes 6 or later, there is a real concern that damage may have occurred. The national rule of thumb is that wheat at this growth stage would be damaged when temperatures are less than or equal to 24°F for 2 or more hours. Although there are certainly more factors that contribute to severity of freeze damage than simply duration of a threshold temperature (many of which we are investigating), this is still the most widely accepted mechanism to predict wheat freeze damage and 'trigger' a need to scout fields for damage.

There were five of the 63 Mesonet locations we examined that temperatures dipped to or below 24°F for all five nights: Butler, Cumberland, Harrison, Meade, and Pulaski. There were also five locations that temperatures dropped to 24°F or less for only one night: Calloway, Campbell, Christian, Crittenden, and Fulton. So scouting for freeze damage in wheat is going to be essential to understand if and how this freeze could impact final yield (Figure 2).

When scouting for freeze damage in wheat, it is important to remember that ***a minimum*** of four to five days of good growing conditions (high temperatures exceeding 40°F) are needed before damage becomes visible. Holding to that standard, Saturday March 25 would be the earliest scouting should occur, but it is recommended to wait until Monday March 27 to ensure plants have plenty of time to grow and more time for signs of freeze damage to develop if it has occurred.

Even if freeze damage is found, this does not immediately indicate that final grain yield will be impacted. Wheat has a great ability to redistribute its resources to living tillers and therefore compensate for primary stems and tillers that may be lost in the freeze. This can result in little to no yield impact (Figure 2).

For more information on scouting for freeze damage and estimating yield impact of freeze damaged wheat refer to AGR-253: Identifying Damage and Estimating Yield Reductions following a Spring Freeze in Winter Wheat.

Figure 1: Soil surface temperatures from 3/15/23 to 3/21/23 at Princeton, KY

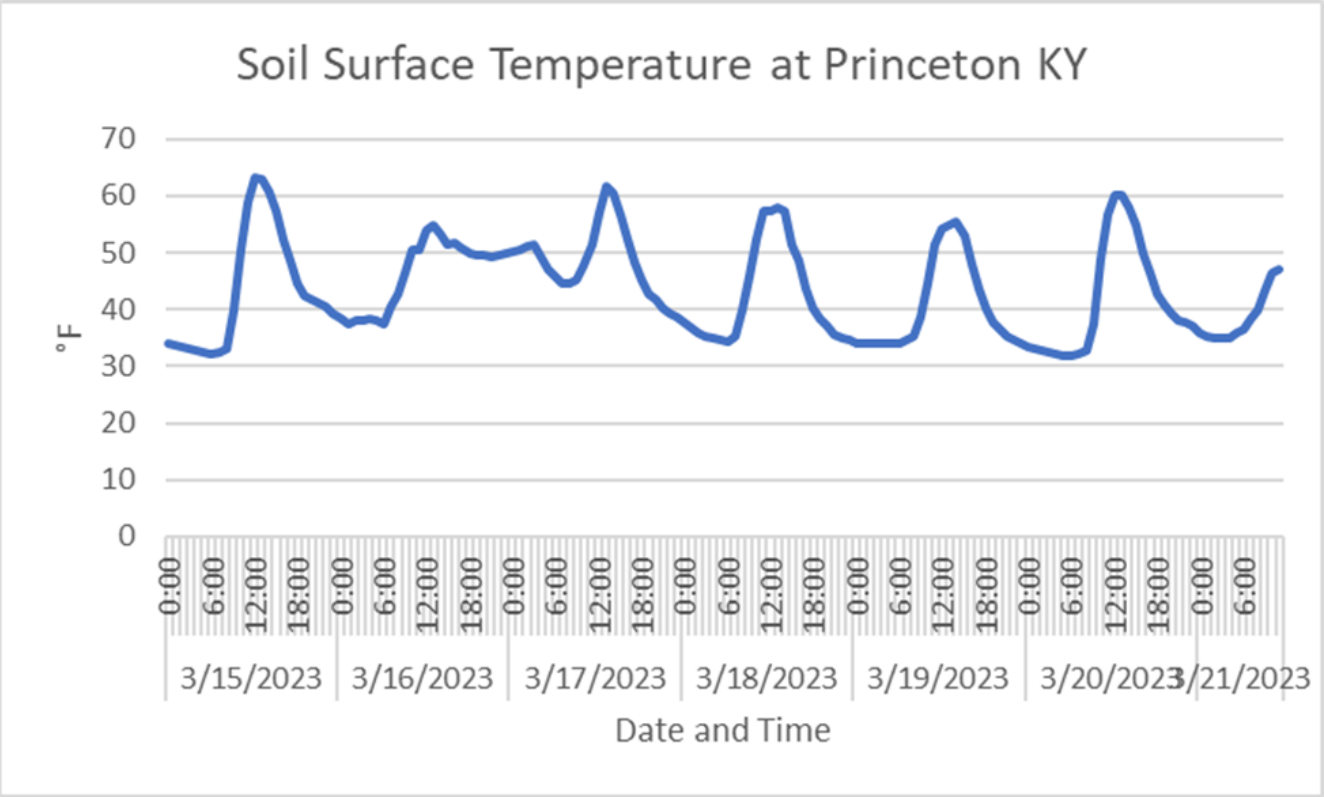

Figure 2: Estimated yield loss following spring freezes at different growth stages

Growth Stage	Feekes	Zadoks	Temp. Injury can Occur (≥ 2 hrs)	Primary Symptoms	Visual Damage	Estimated Yield Effect (% Reduction)
Stem Elongation	4 to 9	30 to 39	24°F	• Death of growing point • Leaf burning and yellowing • Lesions, splitting, bending of stems • Odor	Minor Moderate Severe	0 0 – 10 0 – 20
Boot	10	40 to 49	28°F	• Floret sterility • Spike trapped in boot • Damage to stems and peduncles • Leaf discoloration	Minor Moderate Severe	0 – 20 n/a n/a
Heading	10.1 to 10.5	50 to 58	30°F	• Floret sterility • Bleached or white awns or spikes • Damage to stems and peduncles • Leaf discoloration	Minor Moderate Severe	0 – 20 0 – 45 30 – 50
Flowering	10.5.1 to 10.5.3	60 to 68	30°F	• Floret sterility • Bleached or white awns or spikes • Damage to stems and peduncles • Leaf discoloration	Minor Moderate Severe	n/a n/a 60 – 85

Source: Knott, 2020. https://acsess.onlinelibrary.wiley.com/doi/10.1002/cft2.20080

Table 1: Minimum air temperatures across available KY Mesonet sites during recent nights of below freezing temperatures.

KY Mesonet Site	Minimum Air Temp (F)				
	3/14 to 3/15	3/17 to 3/18	3/18 to 3/19	3/19 to 3/20	3/20 to 3/21
Adair	20.3	21.4	21.4	15.0	24.3
Allen	20.7	22.8	22.8	15.6	30.3
Ballard	22.0	22.8	22.8	22.5	31.2
Barren	22.7	24.3	24.3	17.6	28.8
Bath	17.0	24.5	24.5	15.3	20.8
Boone	21.7	24.5	24.5	22.1	32.8
Boyle	18.7	24.3	24.3	16.2	23.3
Breathitt	19.6	27.7	27.7	16.9	25.5
Breckinridge	21.2	23.8	23.8	18.1	28.1
Bullitt	21.4	23.0	23.0	18.6	26.0
Butler	18.8	22.4	22.4	14.8	23.2
Caldwell	19.5	24.0	24.0	18.3	31.9
Calloway	23.6	27.8	27.8	20.8	35.2
Campbell	22.6	24.6	24.6	21.0	29.4
Carroll	19.3	23.1	23.1	17.3	22.5
Casey	19.4	23.9	23.9	14.9	22.6
Christian	25.5	25.4	25.4	19.5	32.7
Clark	18.6	22.9	22.9	18.1	26.5
Clinton	19.6	21.7	21.7	12.6	26.1
Crittenden	22.5	29.4	29.4	20.6	35.3
Cumberland	18.3	20.1	20.1	12.6	20.2
Fayette	22.6	24.8	19.5	17.5	28.2
Franklin	17.7	24.1	20.8	17.9	24.0
Fulton	24.2	28.2	25.8	21.8	34.8
Graves	21.0	23.3	23.7	18.2	32.3
Grayson	17.9	20.3	22.1	13.4	25.9
Hardin	21.7	23.2	21.9	16.5	24.3
Harrison	14.5	20.4	17.7	13.7	18.2

Harrison	14.5	20.4	17.7	13.7	18.2
Hart	24.3	25.7	22.4	16.0	25.3
Henderson	20.8	26.2	24.3	20.2	26.9
Hopkins	24.2	27.3	23.1	18.4	35.3
LaRue	22.5	24.5	21.7	18.9	33.9
Lewis	14.9	22.1	21.1	12.7	-
Lincoln	18.6	23.4	23.0	16.7	27.6
Logan	20.0	24.0	23.4	17.2	33.0
Madison	17.8	22.2	21.1	14.9	19.8
Marion	20.5	23.3	21.6	16.9	25.7
Marshall	20.2	26.0	24.1	17.7	34.9
Mason	18.3	24.1	17.8	20.4	22.9
McLean	20.3	0.0	23.0	19.5	27.1
Meade	15.7	20.2	22.1	13.4	20.1
Mercer	18.7	21.7	20.8	19.2	27.6
Metcalfe	26.3	25.8	21.3	22.1	33.5
Monroe	21.0	25.7	22.3	16.4	25.7
Morgan	17.2	27.3	19.2	15.3	21.9
Muhlenberg	20.5	25.5	23.9	17.5	29.2
Nicholas	15.8	23.5	17.4	15.2	29.5
Ohio	20.3	24.1	23.6	17.0	29.9
Oldham	21.9	24.2	20.9	22.0	31.7
Owen	18.9	23.2	16.1	16.8	26.0
Owsley	17.5	25.2	21.9	14.1	19.5
Pike	18.7	24.4	13.9	17.7	36.2
Pulaski	16.0	19.3	20.8	10.4	19.4
Rowan	17.0	26.3	18.7	15.4	20.4
Shelby	18.1	22.9	20.1	16.6	27.1
Simpson	23.7	26.8	21.7	22.1	30.7
Taylor	-	21.6	21.9	12.5	-
Todd	19.0	24.3	18.4	16.7	27.7

Trigg	19.7	26.0	23.8	15.9	30.6
Union	21.0	26.0	24.6	20.7	30.1
Warren	22.0	25.3	23.0	17.5	26.7
Wayne	21.4	26.2	21.7	17.1	29.9
Webster	18.8	22.5	24.3	-	29.8

Table 2: Duration of temperature in hours at or below 24°F for five days with temperatures that could cause wheat freeze damage in Kentucky. Data obtained from KY Mesonet http://www.kymesonet.org/.

KY Mesonet Site	Duration of Temps ≤24°F (hrs)				
	3/14 to 3/15	3/17 to 3/18	3/18 to 3/19	3/19 to 3/20	3/20 to 3/21
Adair	4	2	2	9	0
Allen	3	2	2	8	0
Ballard	3	2	2	1	0
Barren	2	0	0	8	0
Bath	9	0	0	9	4
Boone	3	0	0	2	0
Boyle	9	0	0	8	0
Breathitt	6	0	0	8	0
Breckinridge	5	0	0	8	0
Bullitt	5	2	2	8	0
Butler	8	3	3	11	2
Caldwell	5	0	0	7	0
Calloway	1	0	0	4	0
Campbell	1	0	0	2	0
Carroll	7	1	1	9	1
Casey	7	0	0	0	2
Christian	0	0	0	4	0
Clark	5	2	2	9	0
Clinton	4	2	2	11	0
Crittenden	3	0	0	0	0
Cumberland	7	4	4	11	4

Fayette	2	0	13	5	0
Franklin	8	0	10	7	0
Fulton	0	0	0	2	0
Graves	4	0	1	8	0
Grayson	6	3	7	9	0
Hardin	4	2	9	8	0
Harrison	11	2	11	11	8
Hart	0	0	6	8	0
Henderson	7	0	0	8	0
Hopkins	0	0	2	3	0
LaRue	2	0	9	7	0
Lewis	10	1	9	12	-
Lincoln	8	0	3	10	0
Logan	7	0	4	10	0
Madison	10	1	10	11	7
Marion	4	1	8	8	0
Marshall	3	0	0	5	0
Mason	9	0	13	8	1
McLean	6	0	3	8	0
Meade	8	3	10	10	6
Mercer	5	2	11	8	0
Metcalfe	0	0	9	3	0
Monroe	4	0	8	9	0
Morgan	8	0	10	10	2
Muhlenberg	4	0	1	8	0
Nicholas	10	1	12	8	0
Ohio	3	0	3	9	0
Oldham	3	0	12	5	0
Owen	5	1	12	6	0
Owsley	9	0	6	11	6

Pike	14	0	16	13	0
Pulaski	9	2	9	13	4
Rowan	10	0	11	11	6
Shelby	6	2	11	8	0
Simpson	0	0	7	4	0
Taylor	-	2	7	9	-
Todd	7	0	6	10	0
Trigg	6	0	1	9	0
Union	4	0	0	6	0
Warren	4	0	3	8	0
Wayne	2	0	8	8	0
Webster	6	3	0	-	0


UK WHEAT FIELD DAY
UKREC Farm, Princeton KY
Save the Date
05-09-2023

Upcoming Events

March 27, 2023	KATS Drone Sprayer Workshop (Princeton, KY)
March 29, 2023	KATS Drone Sprayer Workshop (Lexington, KY)
May 09, 2023	**UK Wheat Field Day**
May 18, 2023	KATS Crop Scouting Clinic
June 7-8, 2023	KATS Drone Pilot Certification Prep Course
June 29, 2023	Pest Management Field Day - Princeton (IPM-Grain Crops)
July 13, 2023	KATS Spray Clinic
Jul 25, 2023	UK Corn, Soybean and Tobacco Field Day

USEFUL RESOURCES

UK College of Agriculture, Food and Environment
WHEAT SCIENCE GROUP

UK Wheat Science Group

UK KyGrains.info

KyGrains

KATS Kentucky Agriculture Training School

Kentucky Agriculture Training School

Kentucky Pest News
Entomology · Plant Pathology · Weed Science

Kentucky Pest News

Cooperative Extension Service
Agriculture and Natural Resources
Family and Consumer Sciences
4-H Youth Development
Community and Economic Development

LEXINGTON, KY 40546