Developing Agronomic Recommendations to Late Planted Maximize Wheat Yield and Quality in Kentucky

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Although wheat yields are maximized when planted in October in Kentucky, often wheat planting is delayed for a variety of reasons. Ideally there would be additional/different agronomic management practices that could be implemented for late-planted wheat to maximize yield potential.

In previous work, in-furrow phosphorus applications were found to increase yield by an average of 4 bushel per acre, with yield increases occurring almost 60% of the time, when planting was delayed until late November (Knott, 2021; Rod et al., 2020). From 2020 to 2021 this work was expanded to include four seeding rates, four planting dates, four fertilizer treatments.

Research trials were established in Princeton, KY at the University of Kentucky's Research and Education Center in the fall of 2019 and 2020. Four planting dates (October, early November, late November, and December) and seeding rates (18, 24, 35, 56 pure live seed ft^{-2}) were utilized on two different soil types (Crider silt loam and Zanesville silt loam). Trials were planted as no-till into corn stubble using Pembroke 2016 as the cultivar. Phosphorus treatments consisted of triple-super-phosphate (0-46-0) at a rate of 42 pounds of P_2O_5 per acre with in-furrow, broadcast at planting and broadcast at Feekes 3 applications. Grain was harvested when grain moisture was between 13 and 15%. Yield was adjusted to 13.5% grain moisture. Grain quality samples were collected at harvest and analyzed for test weight, protein, deoxynivalenol (DON) and falling number. Thousand kernel weights were also measured.

For all four planting dates, wheat stands at Feekes 3 and spikes ft^{-2}increased as the seeding rate increased (Tables 1 and 2). In addition, wheat planted in December was tallest for the 56 seed ft^{-2} seeding rate (Table 3), grain yield was greatest for the same seeding rate for the late November and December planting dates (Table 4), thousand kernel weights were smallest for the 18 seed ft^{-2} seeding rate for the early November and December planting dates (Table 5). The only differences found among the four fertilizer treatments was that Feekes 3 stands were greatest for the in-furrow phosphorus treatment in December and grain yield was greatest for the in-furrow treatment for the late November planting date (Tables 1 and 4).

For the milling and baking quality, samples were analyzed at Siemer Milling in 2020. The results were within their preferred parameters and did not indicate that the experimental treatments

greatly impacted quality (Table 6 to 9). Therefore, samples were not submitted in 2021 to conserve resources.

Next, we wanted to determine whether phosphorus applied to thin wheat stands at Feekes 3 would mitigate the reduced stands and result in increased grain yield. The stands at Feekes 3, prior to the phosphorus application, were similar between the untreated control and the plots that were to receive broadcast phosphorus at Feekes 3 (Table 10). Following the Feekes 3 phosphorus application, the number of spikes ft^{-2}, wheat height, and grain yield were the same for the untreated control and the wheat that received the Feekes 3 phosphorus application (Tables 12 and 13). The only response we documented to broadcast phosphorus applied at Feekes 3 was increased thousand kernels weights when the seeding rate was 18 pure live seed ft^{-2} (Table 14).

Although this work provided further evidence that in-furrow phosphorus applications can increase yield when wheat is planted in late November, many producers are reluctant to incorporate this into their agronomic management. This is due to the cost for triple super phosphate (0-46-0), which is more expensive and typically difficult to find than other sources of phosphorus. Another disadvantage to in-furrow phosphorus applications is the additional labor needed to prepare the in-furrow phosphorus. Finally, alternative phosphorus sources, such as DAP (diammonium phosphate), have a greater salt index that can negatively impact the wheat seed and equipment when used in-furrow.

Future work is focusing on agronomic management practices that may benefit late-planted wheat such as nitrogen application on late planted wheat at planting.

Acknowledgements
Funding for this work was provided by Siemer Milling Company. This work would not have been possible without the assistance of Hunter Adams, Sloan Boren, Curtis Bradley, Chloe Brangers, Kinsey Hamby, and Blaine Parr.

Table 1. Wheat stand counts at Feekes 3 growth stage for four planting dates, four seeding rates, and four planting dates at the Crider location, 2020, and at both the Crider and Zanesville locations in 2021 at Princeton, KY.

	Stands at Feekes 3 growth stage (stems per square foot)			
Fertilizer Treatment [a]	October [b]	Early November	Late November	December [c]
None	44	27	26	20 b
In-Furrow	45	29	27	26 a
Broadcast at planting	43	29	26	20 b
Broadcast at Feekes 3	43	27	27	22 ab
P – value	0.9060	0.3243	0.8100	0.0086
Seeding Rate				
18 seed ft^{-2}	36 c [d]	20 d	19 d	17 d
24 seed ft^{-2}	42 bc	24 c	23 c	21 bc
35 seed ft^{-2}	44 b	29 b	28 b	23 ab
56 seed ft^{-2}	52 a	38 a	36 a	27 a
P – value	<0.0001	<0.0001	<0.0001	<0.0001

[a] Fertilizer applied was 42 lb P_2O_5 per acre (0-46-0).

[b] October planting dates were: 10 Oct 2020 (Zanesville soil type); 18 Oct 2020 (Crider soil type); 5 Oct 2020 (Zanesville soil type); 14 Oct 2020 (Crider soil type).
Early November planting dates for both sites were: 5 Nov 2020 and 9 Nov 2021.
Late November planting dates for both sites were: 20 Nov 2020 and 20 Nov 2021.
December planting dates for both sites were: 5 Dec 2020 and 10 Dec 2021.

[c] In 2021, the Zanesville soil type planted in December was a crop failure. No data were included for that site in the analyses.

[d] Means followed by different letters are significantly different ($P < 0.10$).

Table 2. Spikes ft^{-2} for wheat produced at two locations each year for four fertilizer treatments, four seeding rates, and four planting dates at Princeton, KY in 2020 and 2021.

	Spikes per square foot			
Fertilizer Treatment [a]	October [b]	Early November	Late November	December [c]
None	48	48	43	44
In-Furrow	47	48	42	45
Broadcast at planting	47	46	43	44
Broadcast at Feekes 3	48	47	42	45
P – value	0.9349	0.8427	0.8954	0.8127
Seeding Rate				
18 seed ft^{-2}	44 c [d]	44 b	40 b	41 b
24 seed ft^{-2}	47 bc	44 b	41 b	43 b
35 seed ft^{-2}	49 ab	48 ab	43 b	44 b
56 seed ft^{-2}	50 a	52 a	46 a	49 a
P – value	0.0004	<0.0001	<0.0001	<0.0001

[a] Fertilizer applied was 42 lb P_2O_5 per acre (0-46-0).

[b] October planting dates were: 10 Oct 2020 (Zanesville soil type); 18 Oct 2020 (Crider soil type); 5 Oct 2020 (Zanesville soil type); 14 Oct 2020 (Crider soil type).
Early November planting dates for both sites were: 5 Nov 2020 and 9 Nov 2021.
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[c] In 2021, the Zanesville soil type planted in December was a crop failure. No data were included for that site in the analyses.

[d] Means followed by different letters are significantly different ($P < 0.10$).

Table 3. Wheat height at two locations each year for four fertilizer treatments, four seeding rates, and four planting dates at Princeton, KY in 2020 and 2021.

	Height (inches)			
Fertilizer Treatment [a]	October [b]	Early November	Late November	December [c]
None	34	32	31	30
In-Furrow	34	33	32	31
Broadcast at planting	34	33	31	30
Broadcast at Feekes 3	34	33	31	30
P – value	0.3300	0.3798	0.6605	0.4168
Seeding Rate				
18 seed ft^{-2}	34	32	31	29 b [d]
24 seed ft^{-2}	34	32	31	30 ab
35 seed ft^{-2}	34	33	31	30 a
56 seed ft^{-2}	34	33	32	31a
P – value	0.9419	0.3511	0.1041	0.0101

[a] Fertilizer applied was 42 lb P_2O_5 per acre (0-46-0).

[b] October planting dates were: 10 Oct 2020 (Zanesville soil type); 18 Oct 2020 (Crider soil type); 5 Oct 2020 (Zanesville soil type); 14 Oct 2020 (Crider soil type).
Early November planting dates for both sites were: 5 Nov 2020 and 9 Nov 2021.
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[d] Means followed by different letters are significantly different ($P < 0.10$).

Table 4. Grain yield at two locations each year for four fertilizer treatments, four seeding rates, and four planting dates at Princeton, KY in 2020 and 2021.

	Grain Yield (bushels per acre)			
Fertilizer Treatment [a]	October [b]	Early November	Late November	December [c]
None	94	94	90 b [d]	78
In-Furrow	93	100	96 a	81
Broadcast at planting	94	97	91 ab	80
Broadcast at Feekes 3	95	97	91 ab	77
P – value	0.9807	0.1055	0.0391	0.2340
Seeding Rate				
18 seed ft^{-2}	92	96	88 c	78 b
24 seed ft^{-2}	94	97	89 bc	77 b
35 seed ft^{-2}	95	101	94 ab	78 b
56 seed ft^{-2}	95	99	97 a	85 a
P – value	0.7495	0.2171	<0.0001	0.0005

[a] Fertilizer applied was 42 lb P_2O_5 per acre (0-46-0).

[b] October planting dates were: 10 Oct 2020 (Zanesville soil type); 18 Oct 2020 (Crider soil type); 5 Oct 2020 (Zanesville soil type); 14 Oct 2020 (Crider soil type).
Early November planting dates for both sites were: 5 Nov 2020 and 9 Nov 2021.
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[c] In 2021, the Zanesville soil type planted in December was a crop failure. No data were included for that site in the analyses.

[d] Means followed by different letters are significantly different ($P < 0.10$).

Table 5. Thousand kernel weights at two locations each year for four fertilizer treatments, four seeding rates, and four planting dates at Princeton, KY in 2020 and 2021.

	Thousand Kernel Weights (g)			
Fertilizer Treatment [a]	October [b]	Early November	Late November	December [c]
None	39.8	39.3	37.5	37.4
In-Furrow	39.6	39.2	37.8	37.4
Broadcast at planting	39.8	39.2	38.0	37.7
Broadcast at Feekes 3	40.0	39.2	37.6	37.5
P – value	0.6469	0.9763	0.3896	0.5166
Seeding Rate				
18 seed ft^{-2}	39.9	38.7 b [d]	37.4	37.2 b
24 seed ft^{-2}	39.7	39.3 a	37.6	37.4 ab
35 seed ft^{-2}	39.7	39.4 a	37.7	37.7 ab
56 seed ft^{-2}	39.9	39.5 a	38.2	37.8 a
P – value	0.9106	0.0128	0.1020	0.0425

[a] Fertilizer applied was 42 lb P_2O_5 per acre (0-46-0).

[b] October planting dates were: 10 Oct 2020 (Zanesville soil type); 18 Oct 2020 (Crider soil type); 5 Oct 2020 (Zanesville soil type); 14 Oct 2020 (Crider soil type).
Early November planting dates for both sites were: 5 Nov 2020 and 9 Nov 2021.
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Table 6. Grain test weight for a composite of all Crider location reps. Analyzed at Siemer Milling Company, 2020.

Treatment			Crider			
Seeding Rate	Fertilizer Placement	Fertilizer Timing	Oct 18	Nov 5	Nov 20	Dec 5
35 seeds ft^{-2}	None	None	60.9	58.6	58.3	58.6
35 seeds ft^{-2}	In-Furrow	Planting	61.1	57.8	58.3	58.6
35 seeds ft^{-2}	Broadcast	Planting	61.1	58.4	58.3	58.3
35 seeds ft^{-2}	Broadcast	Feekes 3	60.4	58.6	58.4	58.6
18 seeds ft^{-2}	None	None	60.4	58.3	57.9	58.3
18 seeds ft^{-2}	In-Furrow	Planting	59.8	58.0	58.1	57.9
18 seeds ft^{-2}	Broadcast	Planting	60.2	57.5	57.1	58.2
18 seeds ft^{-2}	Broadcast	Feekes 3	60.4	57.8	58.1	58.2
24 seeds ft^{-2}	None	None	60.0	58.1	58.4	58.3
24 seeds ft^{-2}	In-Furrow	Planting	60.3	58.3	57.9	58.4
24 seeds ft^{-2}	Broadcast	Planting	60.5	58.6	58.2	58.4
24 seeds ft^{-2}	Broadcast	Feekes 3	60.5	58.2	57.9	58.5
56 seeds ft^{-2}	None	None	61.0	58.3	58.6	58.6
56 seeds ft^{-2}	In-Furrow	Planting	60.7	58.4	58.2	58.5
56 seeds ft^{-2}	Broadcast	Planting	60.7	58.3	58.7	n/a
56 seeds ft^{-2}	Broadcast	Feekes 3	60.6	58.4	58.7	58.5

Table 7. Grain protein for a composite of all Crider location reps. Analyzed at Siemer Milling Company, 2020.

Treatment			Crider			
Seeding Rate	Fertilizer Placement	Fertilizer Timing	Oct 18	Nov 5	Nov 20	Dec 5
35 seeds ft^{-2}	None	None	12.1	11.3	11.1	10.9
35 seeds ft^{-2}	In-Furrow	Planting	12.2	11.4	10.7	10.9
35 seeds ft^{-2}	Broadcast	Planting	12.0	11.1	10.8	11.1
35 seeds ft^{-2}	Broadcast	Feekes 3	11.6	11.1	11.0	11.0
18 seeds ft^{-2}	None	None	12.0	11.0	10.9	10.9
18 seeds ft^{-2}	In-Furrow	Planting	11.7	11.1	10.9	11.0
18 seeds ft^{-2}	Broadcast	Planting	11.8	11.4	10.9	10.9
18 seeds ft^{-2}	Broadcast	Feekes 3	11.9	11.1	11.0	11.0
24 seeds ft^{-2}	None	None	11.8	11.0	11.0	10.8
24 seeds ft^{-2}	In-Furrow	Planting	11.9	10.9	11.1	10.8
24 seeds ft^{-2}	Broadcast	Planting	12.3	11.1	10.9	11.1
24 seeds ft^{-2}	Broadcast	Feekes 3	12.0	11.2	11.4	11.0
56 seeds ft^{-2}	None	None	12.0	11.0	11.3	10.8
56 seeds ft^{-2}	In-Furrow	Planting	12.3	11.1	11.3	11.1
56 seeds ft^{-2}	Broadcast	Planting	12.4	11.0	11.1	11.0
56 seeds ft^{-2}	Broadcast	Feekes 3	12.1	11.1	11.2	10.9

Table 8. Vomitoxin for a composite of all Crider location reps. Analyzed at Siemer Milling Company, 2020.

Treatment			Crider			
Seeding Rate	Fertilizer Placement	Fertilizer Timing	Oct 18	Nov 5	Nov 20	Dec 5
35 seeds ft^{-2}	None	None	0.3	0.7	0.9	1.1
35 seeds ft^{-2}	In-Furrow	Planting	0.7	0.8	0.9	1.1
35 seeds ft^{-2}	Broadcast	Planting	0.6	0.8	0.9	1.1
35 seeds ft^{-2}	Broadcast	Feekes 3	1.0	0.9	0.8	1.0
18 seeds ft^{-2}	None	None	0.7	1.2	1.7	1.2
18 seeds ft^{-2}	In-Furrow	Planting	0.9	1.1	1	1.3
18 seeds ft^{-2}	Broadcast	Planting	1.1	0.8	1.4	1.4
18 seeds ft^{-2}	Broadcast	Feekes 3	0.3	1.2	1.4	1.1
24 seeds ft^{-2}	None	None	1.2	0.7	0.7	0.5
24 seeds ft^{-2}	In-Furrow	Planting	1.0	1.0	1.0	1.4
24 seeds ft^{-2}	Broadcast	Planting	1.0	1.0	1.0	1.0
24 seeds ft^{-2}	Broadcast	Feekes 3	0.6	1.1	1.1	0.8
56 seeds ft^{-2}	None	None	1.1	0.9	0.9	1.0
56 seeds ft^{-2}	In-Furrow	Planting	0.5	1.0	0.8	1.3
56 seeds ft^{-2}	Broadcast	Planting	0.4	0.9	1.2	1.0
56 seeds ft^{-2}	Broadcast	Feekes 3	0.7	0.9	0.7	0.9

Table 9. Falling number for a composite of all Crider location reps. Analyzed at Siemer Milling Company, 2020.

Treatment			Crider			
Seeding Rate	Fertilizer Placement	Fertilizer Timing	Oct 18	Nov 5	Nov 20	Dec 5
35 seeds ft^{-2}	None	None	418	366	464	329
35 seeds ft^{-2}	In-Furrow	Planting	424	399	417	411
35 seeds ft^{-2}	Broadcast	Planting	416	364	417	434
35 seeds ft^{-2}	Broadcast	Feekes 3	429	428	419	385
18 seeds ft^{-2}	None	None	397	411	409	364
18 seeds ft^{-2}	In-Furrow	Planting	396	366	320	437
18 seeds ft^{-2}	Broadcast	Planting	403	419	357	425
18 seeds ft^{-2}	Broadcast	Feekes 3	415	389	415	398
24 seeds ft^{-2}	None	None	394	377	348	435
24 seeds ft^{-2}	In-Furrow	Planting	394	420	346	376
24 seeds ft^{-2}	Broadcast	Planting	408	382	408	426
24 seeds ft^{-2}	Broadcast	Feekes 3	408	406	388	402
56 seeds ft^{-2}	None	None	398	432	408	405
56 seeds ft^{-2}	In-Furrow	Planting	468	378	387	436
56 seeds ft^{-2}	Broadcast	Planting	414	384	419	410
56 seeds ft^{-2}	Broadcast	Feekes 3	426	427	412	384

Table 10. Wheat stand counts at Feekes 3 growth stage for two fertilizer treatments, four planting dates and four seeding rates at the Crider location, 2020, and at both the Crider and Zanesville locations in 2021 at Princeton, KY.

	Stands (stems per square foot)			
Fertilizer Treatment [a]	18 seed ft^{-2}	24 seed ft^{-2}	35 seed ft^{-2}	56 seed ft^{-2}
None	32	36	44	53
Broadcast at Feekes 3	32	38	42	53
P – value	0.8791	0.4530	0.8107	0.9545
Planting Date [b]				
October	52 a [d]	61 a	64 a	75 a
Early November	23 b	26 b	36 b	45 b
Late November	20 b	24 b	30 b	40 b
December [c]	- [e]	-	-	-
P – value	<0.0001	<0.0001	<0.0001	<0.0001

[a] Fertilizer applied was 42 lb P_2O_5 per acre (0-46-0).

[b] October planting dates were: 10 Oct 2020 (Zanesville soil type); 18 Oct 2020 (Crider soil type); 5 Oct 2020 (Zanesville soil type); 14 Oct 2020 (Crider soil type).
Early November planting dates for both sites were: 5 Nov 2020 and 9 Nov 2021.
Late November planting dates for both sites were: 20 Nov 2020 and 20 Nov 2021.
December planting dates for both sites were: 5 Dec 2020 and 10 Dec 2021.

[c] In 2021, the Zanesville soil type planted in December was a crop failure. No data were included for that site in the analyses.

[d] Means followed by different letters are significantly different ($P < 0.10$).

[e] Stand data were not collected for the December planting date.

Table 11. Spikes ft^{-2} for wheat produced at two locations each year for two fertilizer treatments, four seeding rates, and four planting dates at Princeton, KY in 2020 and 2021.

	Spikes ft^{-2}			
Fertilizer Treatment [a]	18 seed ft^{-2}	24 seed ft^{-2}	35 seed ft^{-2}	56 seed ft^{-2}
None	28	30	33	36
Broadcast at Feekes 3	28	29	31	33
P – value	0.6973	0.5118	0.4074	0.1669
Planting Date [b]				
October	27 b [d]	31 ab	32 ab	32 b
Early November	34 a	34 a	38 a	41 a
Late November	27 b	29 bc	30 ab	33 b
December [c]	24 b	24 c	27 b	30 b
P – value	0.0072	0.0003	0.0309	<0.0001

[a] Fertilizer applied was 42 lb P_2O_5 per acre (0-46-0).

[b] October planting dates were 10 Oct 2020 (Zanesville soil type); 18 Oct 2020 (Crider soil type); 5 Oct 2020 (Zanesville soil type); 14 Oct 2020 (Crider soil type).
Early November planting dates for both sites were: 5 Nov 2020 and 9 Nov 2021.
Late November planting dates for both sites were: 20 Nov 2020 and 20 Nov 2021.
December planting dates for both sites were: 5 Dec 2020 and 10 Dec 2021.

[c] In 2021, the Zanesville soil type planted in December was a crop failure. No data were included for that site in the analyses.

[d] Means followed by different letters are significantly different ($P < 0.10$).

Table 12. Wheat height at two locations each year for two fertilizer treatments, four seeding rates, and four planting dates at Princeton, KY in 2020 and 2021.

	Height (inches)			
Fertilizer Treatment [a]	18 seed ft^{-2}	24 seed ft^{-2}	35 seed ft^{-2}	56 seed ft^{-2}
None	30	31	32	32
Broadcast at Feekes 3	30	32	32	32
P – value	0.9332	0.4251	0.5159	0.4868
Planting Date [b]				
October	36 a [d]	36 a	36 a	36 a
Early November	32 b	33 b	34 b	33 b
Late November	29 b	30 c	31 c	31 b
December [c]	22 c	27 d	28 c	28 c
P – value	<0.0001	<0.0001	<0.0001	<0.0001

[a] Fertilizer applied was 42 lb P_2O_5 per acre (0-46-0).

[b] October planting dates were: 10 Oct 2020 (Zanesville soil type); 18 Oct 2020 (Crider soil type); 5 Oct 2020 (Zanesville soil type); 14 Oct 2020 (Crider soil type).
Early November planting dates for both sites were: 5 Nov 2020 and 9 Nov 2021.
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[c] In 2021, the Zanesville soil type planted in December was a crop failure. No data were included for that site in the analyses.

[d] Means followed by different letters are significantly different ($P < 0.10$).

Table 13. Grain yield at two locations each year for two fertilizer treatments, four seeding rates, and four planting dates at Princeton, KY in 2020 and 2021.

	Grain Yield (bushels per acre)			
Fertilizer Treatment [a]	18 seed ft^{-2}	24 seed ft^{-2}	35 seed ft^{-2}	56 seed ft^{-2}
None	68	70	78	81
Broadcast at Feekes 3	73	71	78	85
P – value	0.2049	0.8303	0.8465	0.2158
Planting Date [b]				
October	89 a [d]	90 a	96 a	101 a
Early November	74 b	76 ab	85 ab	89 ab
Late November	69 b	67 bc	75 b	80 b
December	49 c	49 c	55 c	62 c
P – value	<0.0001	0.0001	<0.0001	<0.0001

[a] Fertilizer applied was 42 lb P_2O_5 per acre (0-46-0).

[b] October planting dates were: 10 Oct 2020 (Zanesville soil type); 18 Oct 2020 (Crider soil type); 5 Oct 2020 (Zanesville soil type); 14 Oct 2020 (Crider soil type).
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[c] In 2021, the Zanesville soil type planted in December was a crop failure. No data were included for that site in the analyses.

[d] Means followed by different letters are significantly different ($P < 0.10$).

Table 14. Thousand kernel weights at two locations each year for two fertilizer treatments, four seeding rates and four planting dates at Princeton, KY in 2020 and 2021.

	Grain Yield (bushels per acre)			
Fertilizer Treatment [a]	18 seed ft^{-2}	24 seed ft^{-2}	35 seed ft^{-2}	56 seed ft^{-2}
None	38.9 b [d]	39.2	39.8	39.9
Broadcast at Feekes 3	39.7 a	39.8	39.9	39.7
P – value	0.0476	0.2852	0.9659	0.7589
Planting Date [b]				
October	40.8 a	40.7 a	40.4	40.7 a
Early November	39.7 b	41.2 a	40.8	40.5 a
Late November	38.5 bc	38.2 b	39.2	39.5 ab
December	38.3 c	37.9 b	39.1	38.6 b
P – value	<0.0001	<0.0001	0.0664	0.0045

[a] Fertilizer applied was 42 lb P_2O_5 per acre (0-46-0).

[b] October planting dates were: 10 Oct 2020 (Zanesville soil type); 18 Oct 2020 (Crider soil type); 5 Oct 2020 (Zanesville soil type); 14 Oct 2020 (Crider soil type).
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[c] In 2021, the Zanesville soil type planted in December was a crop failure. No data were included for that site in the analyses.

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REFERENCES

Knott, C. 2021. Agronomic strategies to mitigate yield loss of late-planted wheat in Kentucky. Crop, Forage, Turfgrass Management. 7:e201030. https://doi.org/10.1002/cft2.20103

Rod, K.S., C.A. Bradley, D.A. Van Sanford, C.A. Knott. 2020. Integrating management practices to decrease deoxynivalenol contamination in soft red winter wheat. Frontiers in Plant Science. 11:1158. doi: 10.3389/fpls.2020.01158