Managing wheat for yield and protein

Brian Arnall

Importance of Proper Fertility

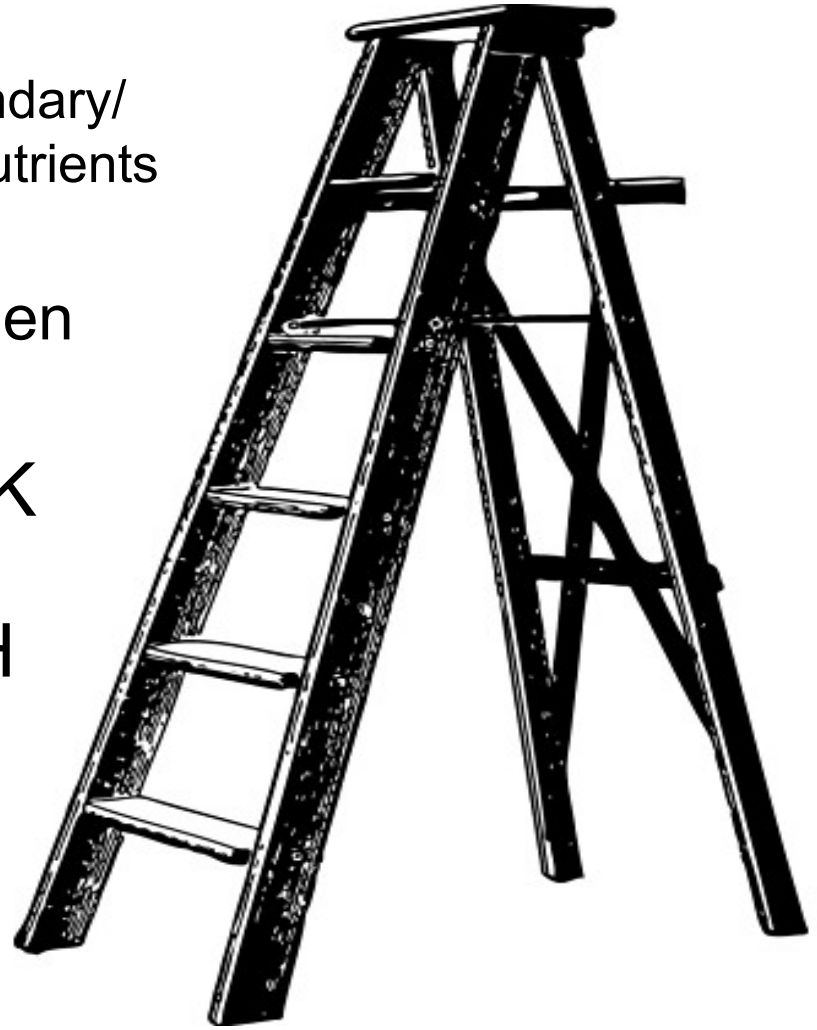
Secondary/
Micronutrients

Nitrogen

P & K

Soil pH

Soil Test



Grid data

- I requested grid sample data straight from producers.
- Have entered 394 fields
- The data you see is 371
- Goal 1000+ fields
- Multiple Labs

- Still Requesting data

Soil Test Results

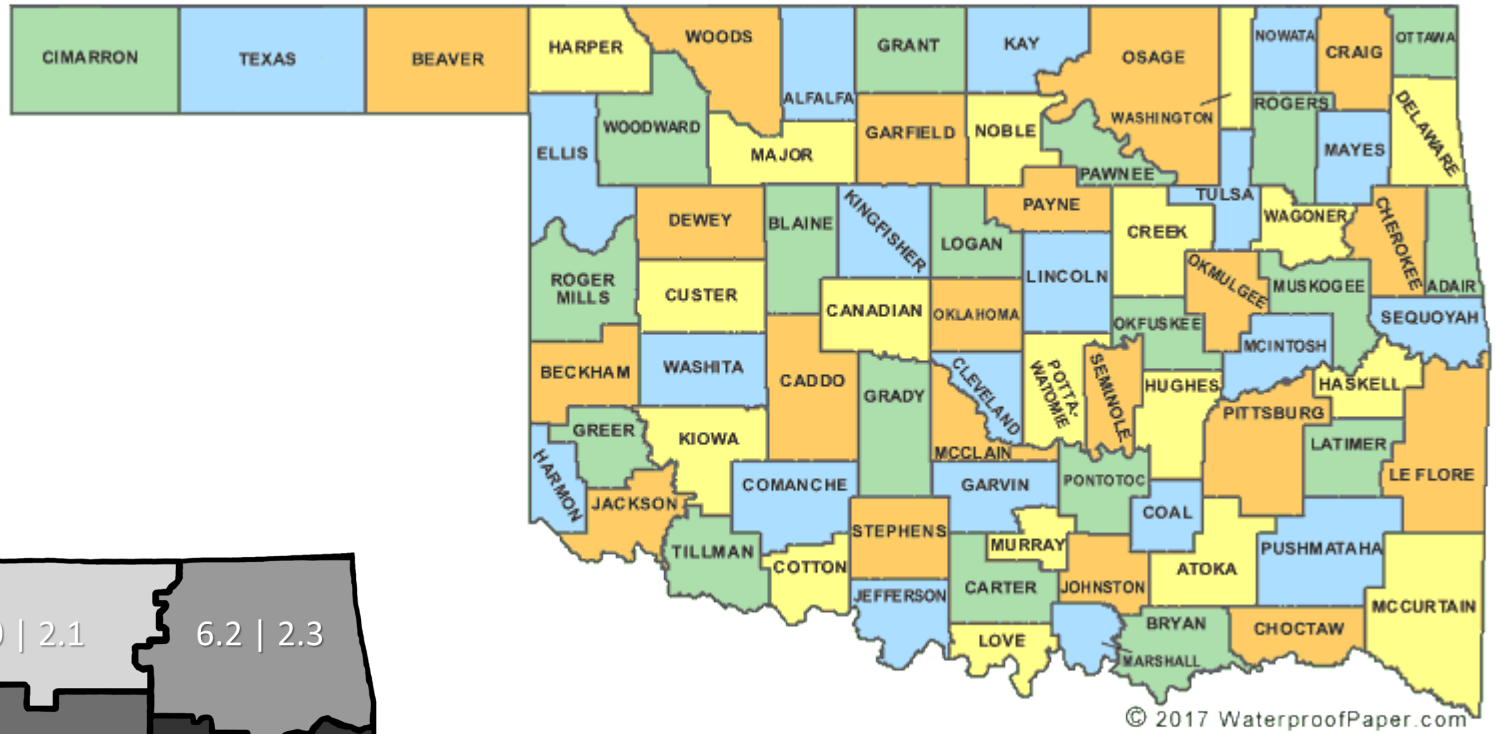
Grower: Knoche Farms
Farm: Craig
Field: BK
Area: 78.41 ac
Event Date(s): 3/6/2015

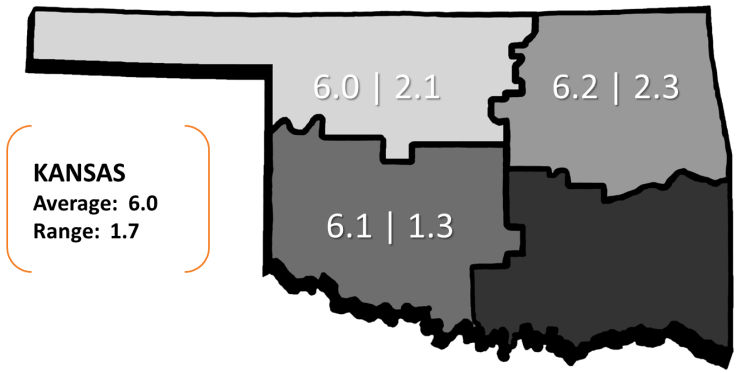
Min:	4.7	6.4	20.0	105.0	0.2
Max:	6.7	7.2	43.0	244.0	0.4
Avg:	5.3	6.6	33.2	184.7	0.3

Sample ID	pH	BpH	P Mehlich III	K	Zn
1	5.4	6.7	37.0	175.0	0.3
2	5.9	6.7	27.0	204.0	0.3
3	5.1	6.6	40.0	192.0	0.3
4	4.7	6.4	39.0	171.0	0.2
5	5.5	6.6	31.0	201.0	0.2
6	6.7	7.2	40.0	184.0	0.3
7	5.2	6.6	28.0	156.0	0.2
8	5.3	6.5	35.0	208.0	0.3
9	4.8	6.4	36.0	193.0	0.2
10	5.3	6.9	20.0	105.0	0.2
11	5.1	6.5	30.0	178.0	0.3
12	5.0	6.6	31.0	175.0	0.2
13	5.5	6.7	27.0	164.0	0.3

Data by County

Region	Number of fields	# samples	# Samples /per field
NW	150	4985	33.
NE	35	1302	37
SW	74	1798	24
KS	112	3265	29



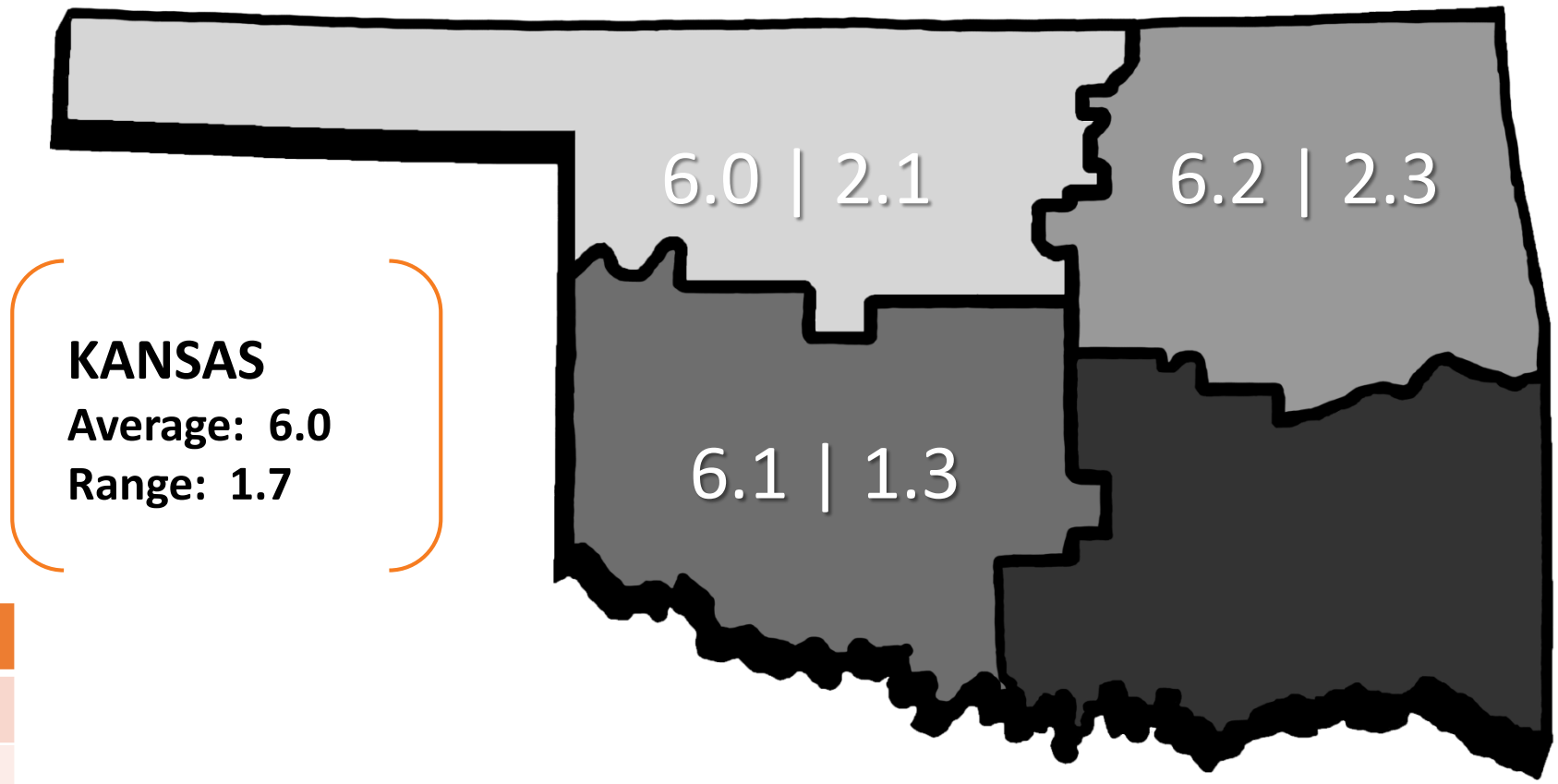


Grid Data Results

	Soil pH		CEC		P		K	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
# fields	371		313		360		360	
Average	6.0	1.8	13	11	30	58	194	193
Min	4.6	0.3	2.7	.6	4.0	4.0	28	14
Max	8.1	3.8	27.3	85	93	365	544	673

	OM		Ca		Mg		S	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Count	255		292		336		181	
Average	1.8	1.2	1569	1952	288	320	15	27
Min	0.5	.3	396	15	20	20.0	5.9	2
Max	3.5	7.0	5099	16746	1208	1201	87	597

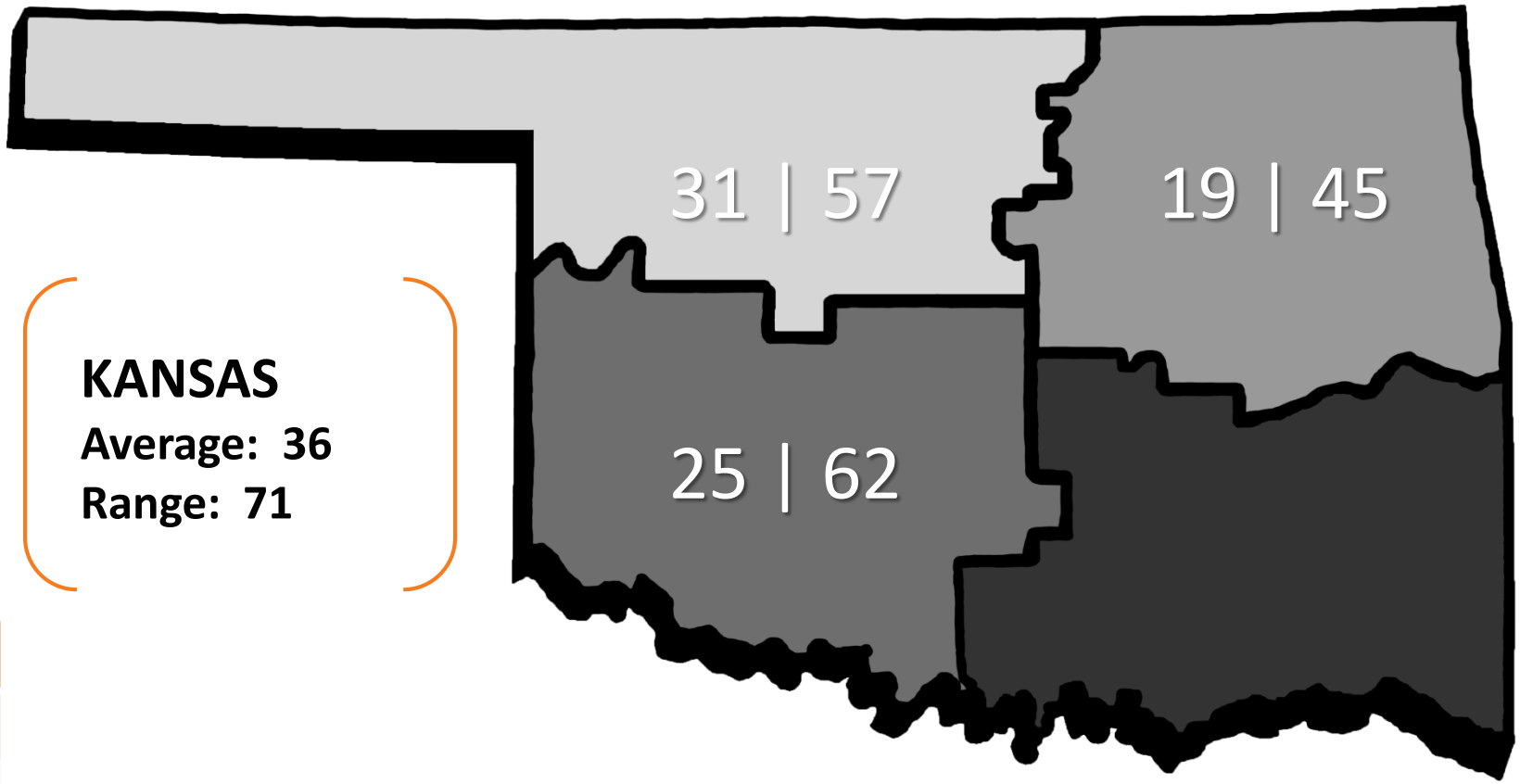
Grid Data Results Soil pH



KANSAS
Average: 6.0
Range: 1.7

Region	# of fields
NW	150
NE	35
SW	74
KS	112

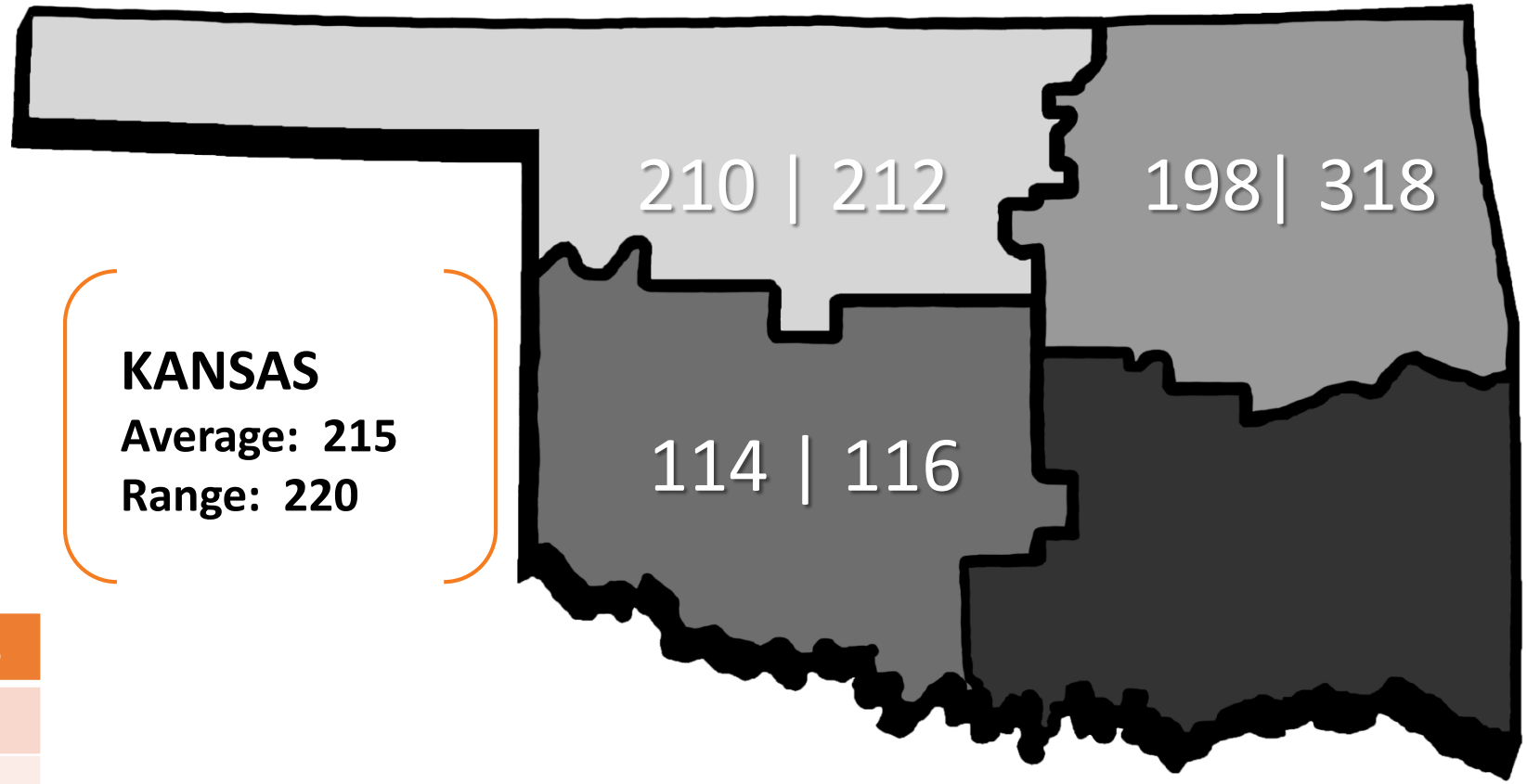
Grid Data Results M3P and Bray P1 ppm



KANSAS
Average: 36
Range: 71

Region	# of fields
NW	150
NE	35
SW	72
KS	103

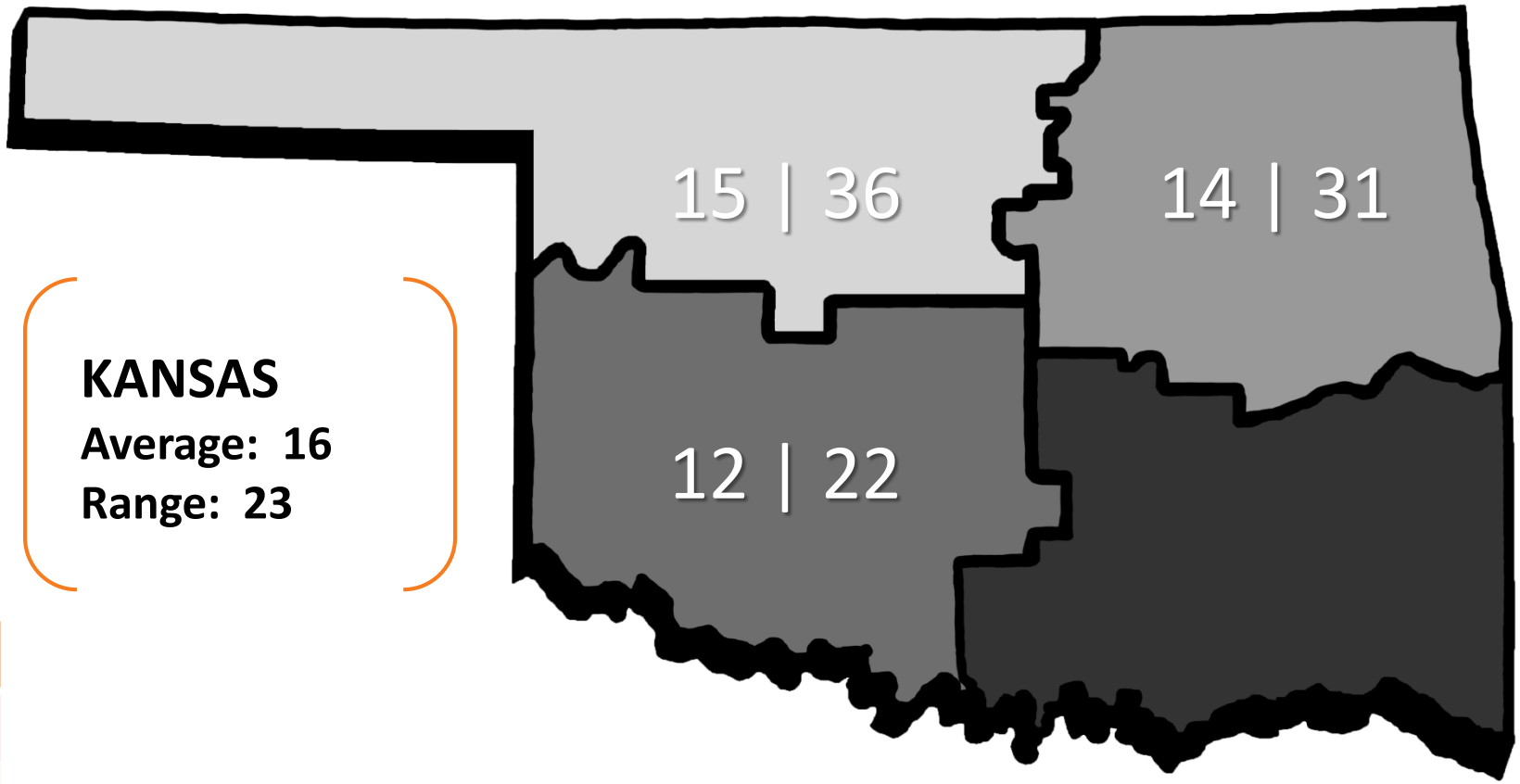
Grid Data Results Potassium



KANSAS
Average: 215
Range: 220

Region	# of fields
NW	140
NE	32
SW	45
KS	96

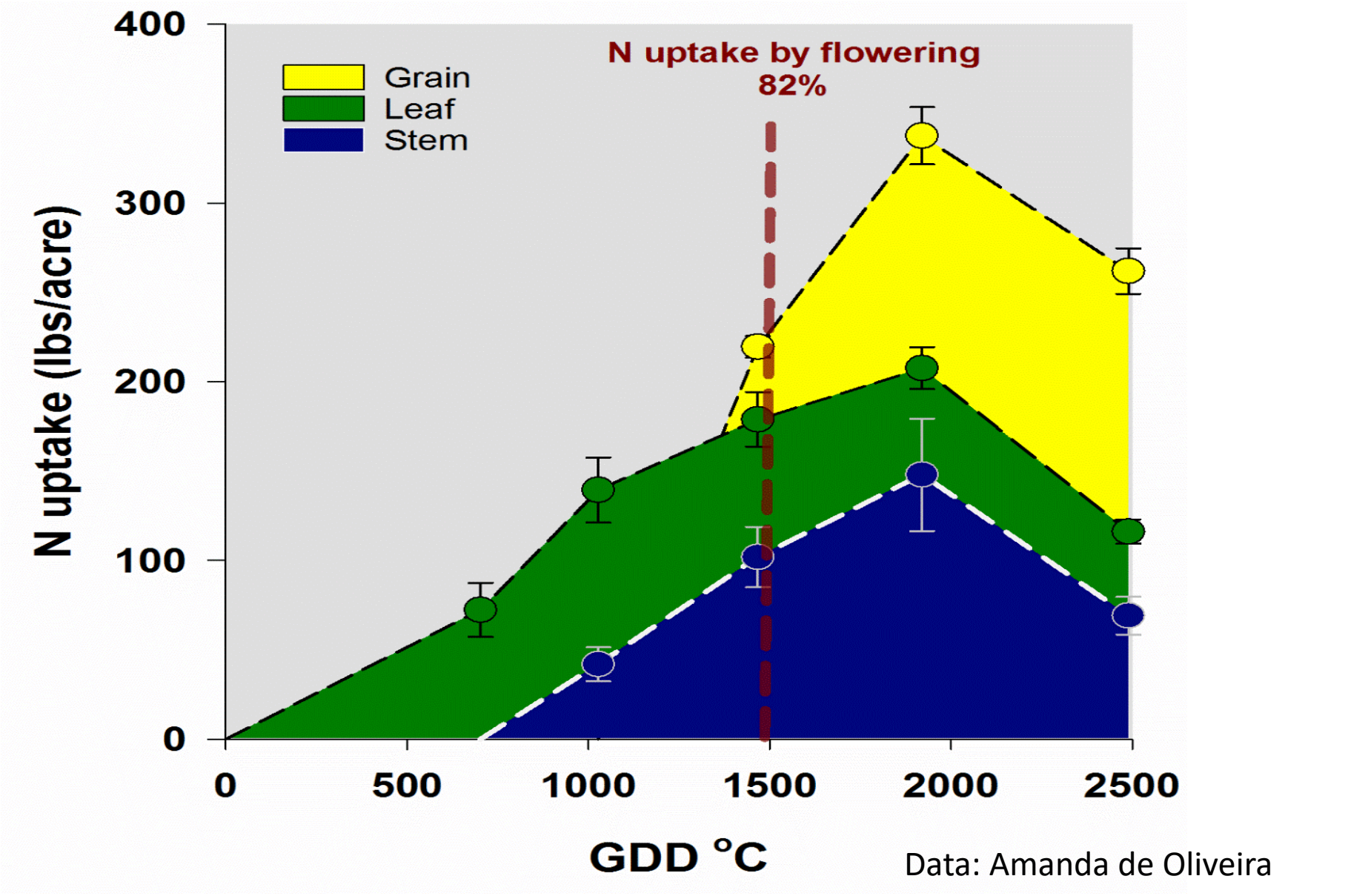
Grid Data Results Sulfur



KANSAS
Average: 16
Range: 23

Region	# of fields
NW	40
NE	10
SW	36
KS	95

Nitrogen timing



Data: Amanda de Oliveira

Starch and protein accumulation

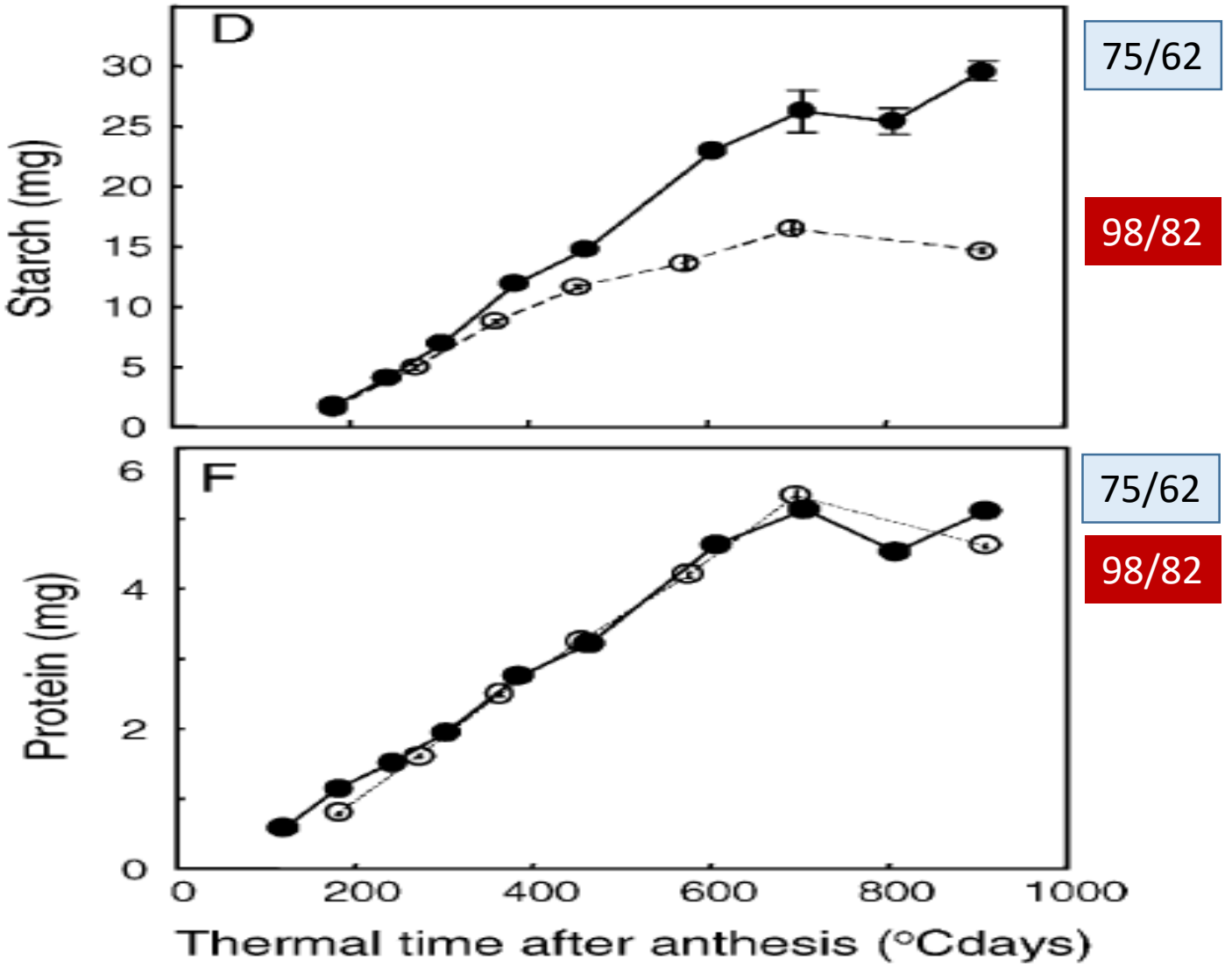
Starch

- Photosynthesis (> 60% fixed during grain filling)
- Limited supply (drought/diseases/etc.):
  - Soluble carbohydrates in the internodes mobilized to grain
- Sink-limited – limited by the grain's ability to receive sugar from leaves
- Very sensitive to environmental conditions

Protein

- Derived from N translocated from other plant parts:
  - 30% from leaves
  - 30% from stem
  - 10% from roots
  - 15% from glumes
- > 70% absorbed prior to grain filling
- Source-limited – increasing N availability increases protein
- Protein amount not sensitive to environmental conditions (but concentration is)

Heat and water stresses during grain fill



75/62

98/82

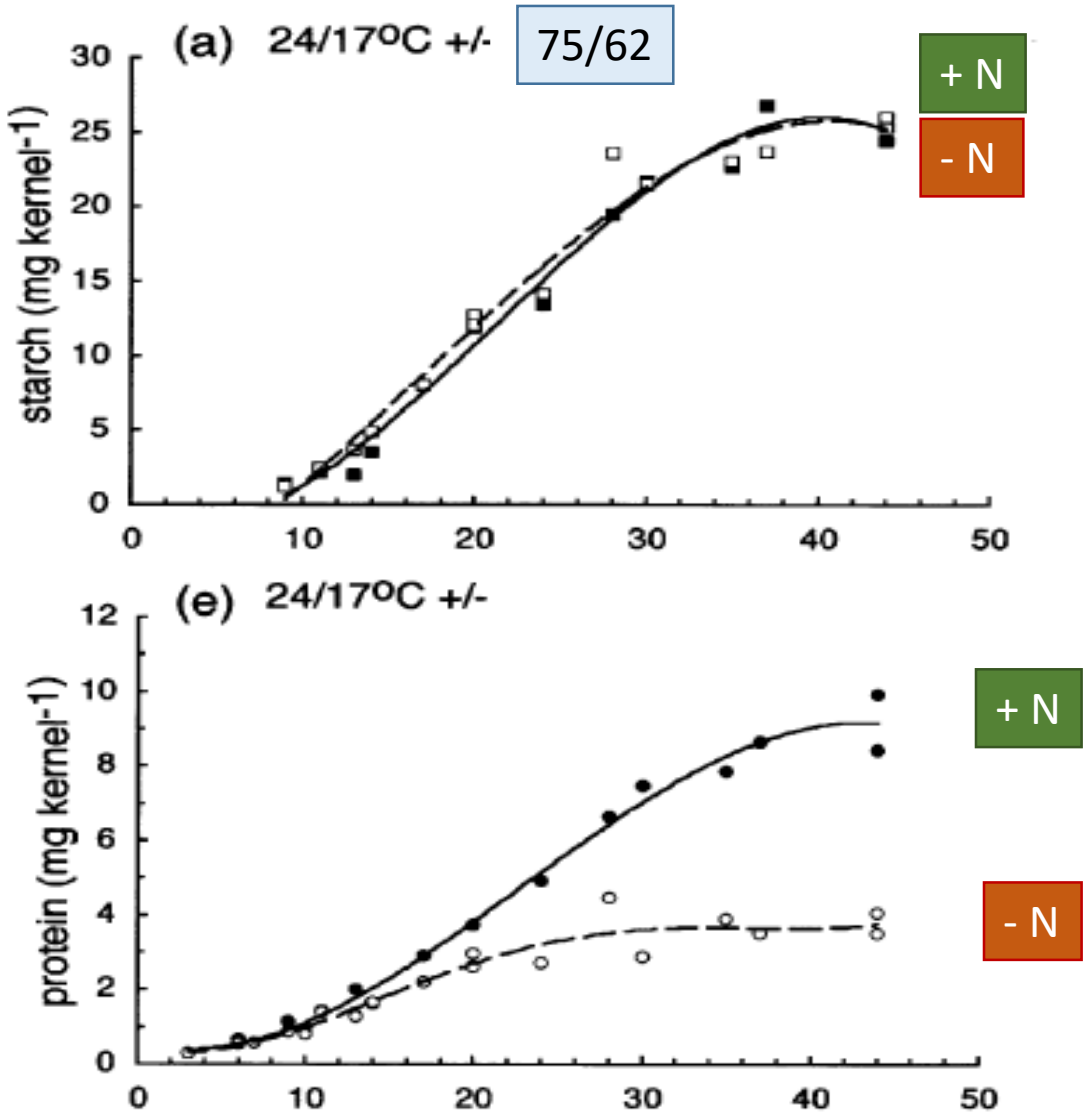
75/62

98/82

Decreases total starch accumulation more tha protein – increases protein %

DuPont et al., 2006

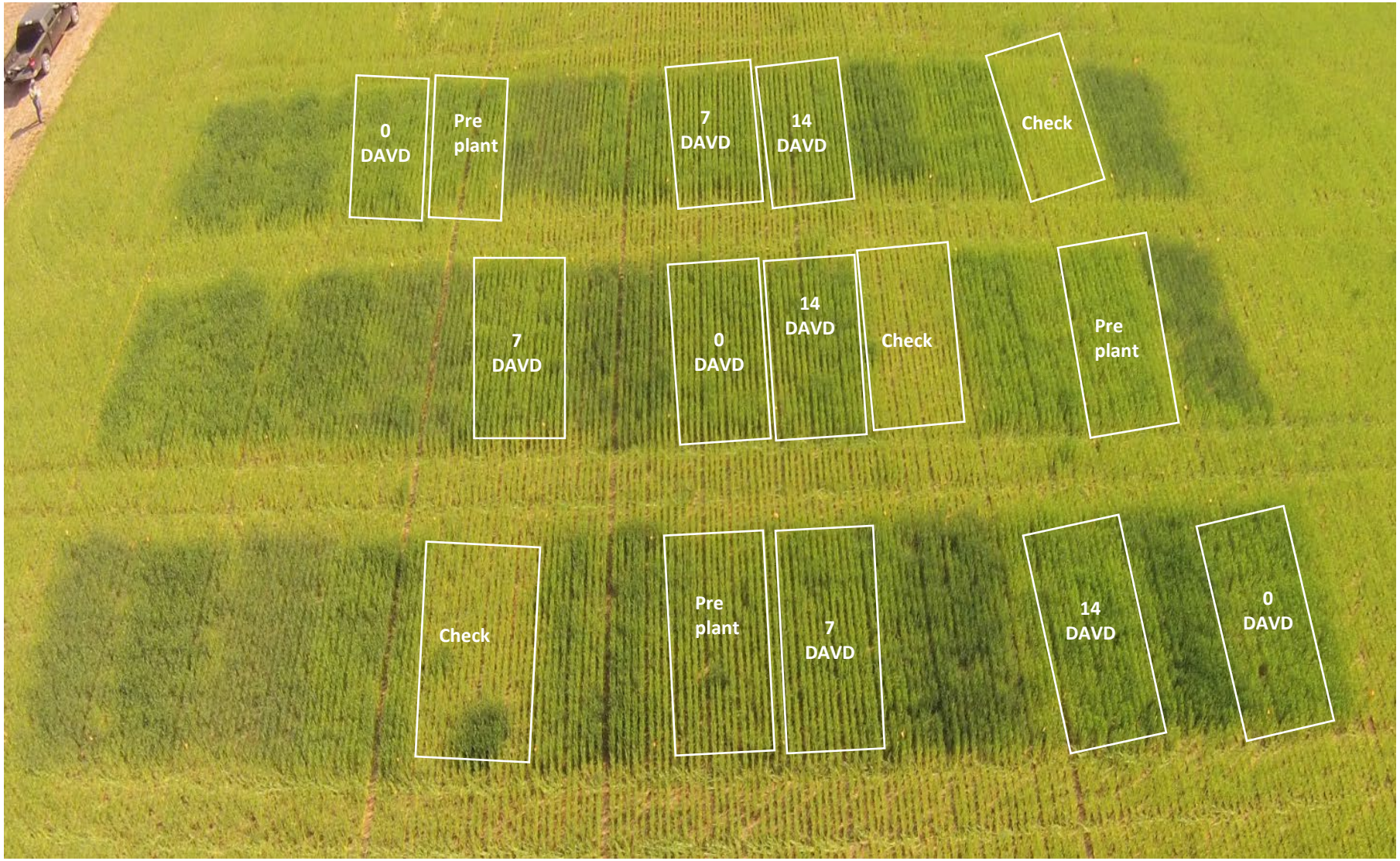
N availability affecting wheat protein and starch



Removing N fertilizer decreased protein but did not affect starch accumulation

Altenbach et al. (2003)

Delaying Nitrogen, for long time



Perkins


28 DAVD
35 DAVD
42 DAVD
56 DAVD
7 DAVD
49 DAVD
0 DAVD
14 DAVD
No N
21 DAVD
Pre plant
63 DAVD

Vs Pre

Trials			Treatments									
			3	4	5	6	7	8	9	10	11	12
	Check	Pre-plant	0 DAVD	7 DAVD	14 DAVD	21 DAVD	28 DAVD	35 DAVD	42 DAVD	49 DAVD	56 DAVD	63 DAVD
Perkins2017	23	47	47	53	55	na	56	57	58	60	60	57
Stillwater2017	21	36	44	45	46	na	53*	48	50	64*	50	58**
LCB2017a	38	60	73**	66	71*	69	72*	83***	87***	88***	84***	84***
LCB2017b	33	62	68	69	76*	85***	84***	84***	83***	71	60	47**
Perkins2018	50	57	56	57	58	53	54	56	50	50	45	51
Lahoma2018	31	54	51	55	57	53	51	53	45	42*	44	42*
LCB2018a	22	57	65	63	53	59	61	63	66	56	52	46
LCB2018b	38	57	63	70	43	71	68	49	48	47	39	42

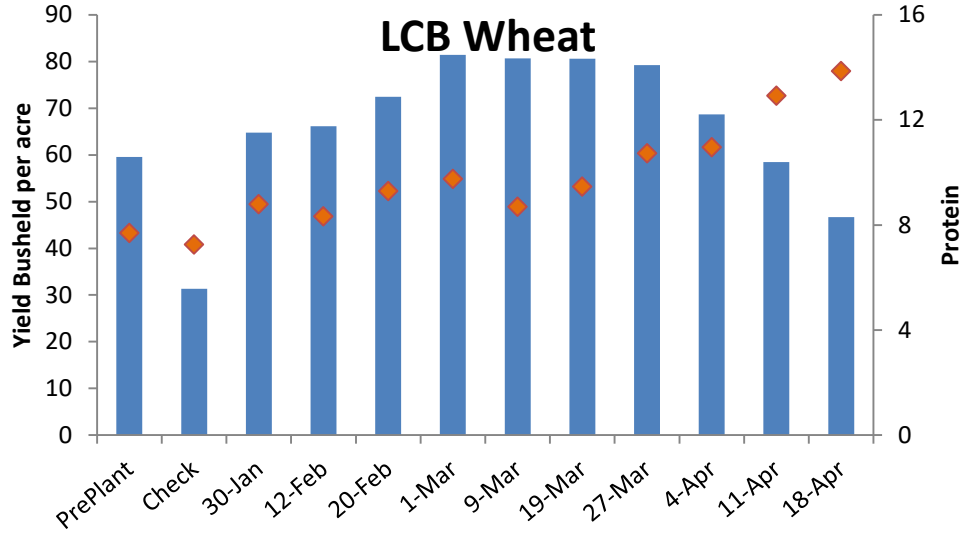
Trials	Treatments											
			3	4	5	6	7	8	9	10	11	12
	Check	Pre-plant	0 DAVD	7 DAVD	14 DAVD	21 DAVD	28 DAVD	35 DAVD	42 DAVD	49 DAVD	56 DAVD	63 DAVD
Perkins2017	11.9	12.7	13	13	13.5	na	13.3	11.8	12.8	13.4	12.5	13.2
Stillwater2017	10.4	10.5	10.7	11.1	10.8	na	11	11	11.5**	11.3**	11.2*	12.2***
LCB2017a	8.5	7.8	7.7	7.4	7.6	7.9	7.8	9	8.8	9.1	10.3***	10.8***
LCB2017b	7.3	7.7	8.8	8.3	9.3	9.8*	8.7	9.5	10.7***	11***	12.9***	13.9***
Perkins2018	9.7	12**	14.3**	13.8*	13.9*	13.5	15***	13.9*	15***	14.9***	15.5***	15.9***
Lahoma2018	9.5	11.5**	12.6	**12.2**	11.9	12.8	12	12.4	13.9**	14**	13.4*	13.8**
LCB2018a	9.5	11.5	11.7	11.6	12.1	12.8	11.6	12.9	12.8	13.2	14.5**	14.2**
LCB2018b	9.5	12.3***	12.3	12.6	12	12.4	13.1	14.5**	14.6**	15***	15.4***	10.1**

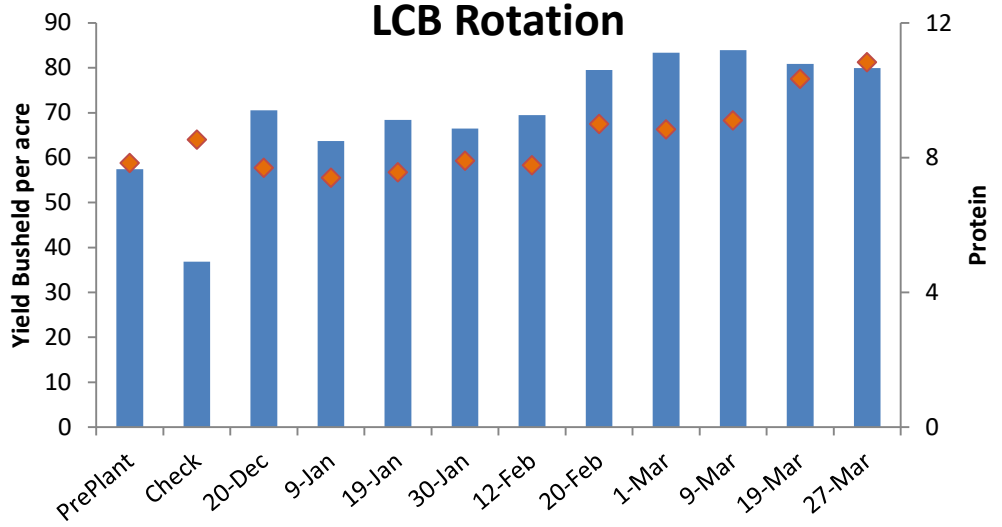
Vs 0DAVD

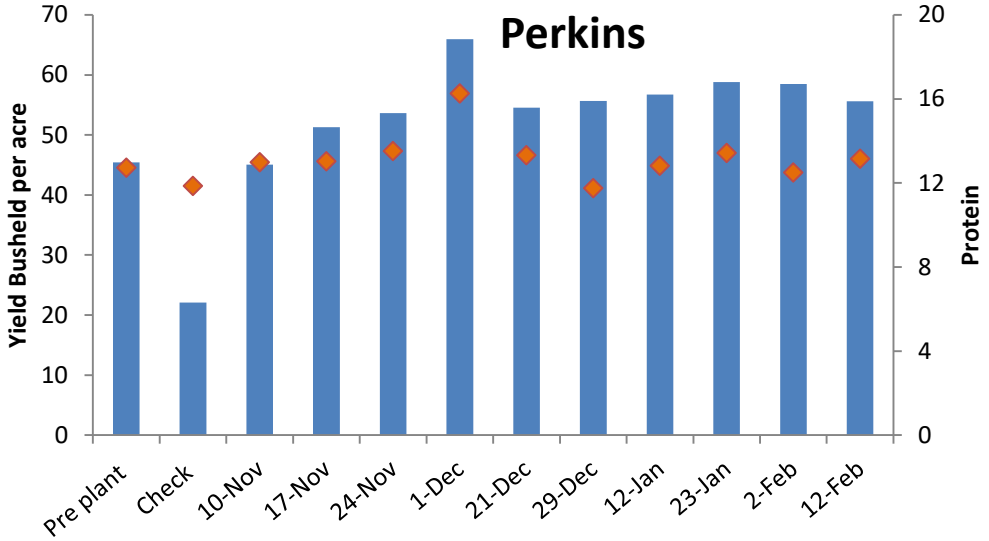
Table 10. Winter wheat grain yield (kg ha^{-1}) as affected by the timing of application of 100 kg N ha^{-1} at all trials locations in Oklahoma in 2016-2017 and 2017-2018 crop seasons. Multiple comparison utilizing Dunnett's test (N application timing at 0 growing degree days > 0 after visual symptom differentiation treatment as control) is demonstrated by the asterisks evaluating the effect of N application on winter wheat grain yield.

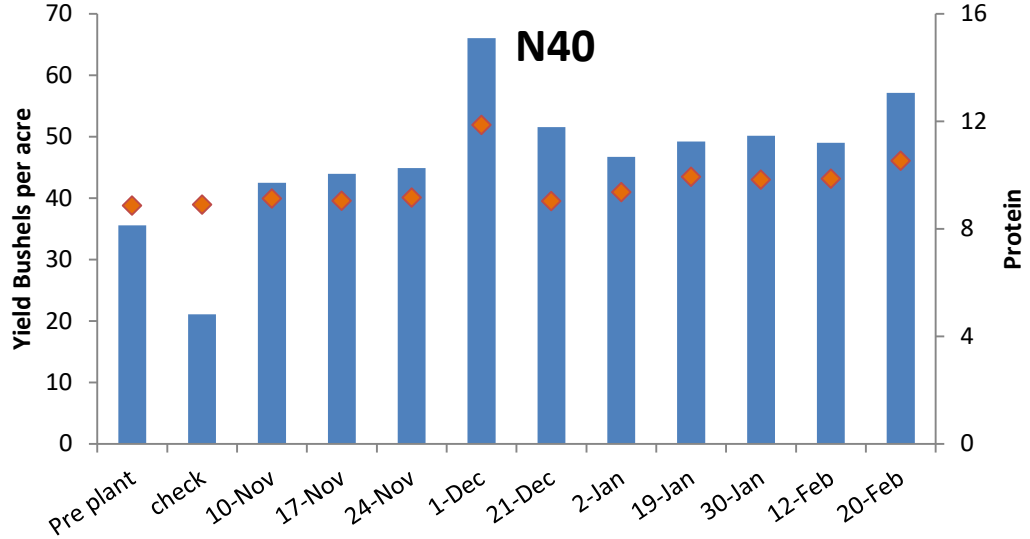
	1	4	5	6	7	8	9	10	11	12
Trials	Pre-plant	7 DAVD	14 DAVD	21 DAVD	28 DAVD	35 DAVD	42 DAVD	49 DAVD	56 DAVD	63 DAVD
Perkins2017	3144	3538	3676	na	3768	3858	3916	4029	4011	3797
Stillwater2017	2452	3032	3096	na	3547	3225	3389	43453	3381	3878*
LCB2017a	4022**	4457	4792	4661	4870	5580	5858**	5902**	5671*	5615
LCB2017b	4166	4637	5079	5702**	5655**	5651**	5552**	4796	4030	3156***
Perkins2018	3845	3844	3903	3576	3624	3781	3262	3345	3003	3399
Lahoma2018	3603	3676	3821	3559	3432	3546	3052	2811	2939	2830
LCB2018a	3846	4225	3577	3954	4113	4205	4402	3791	3484	3091
LCB2018b	3801	4696	2865	4755	4563	3321	3254	3139	2630	2792

2016-2017

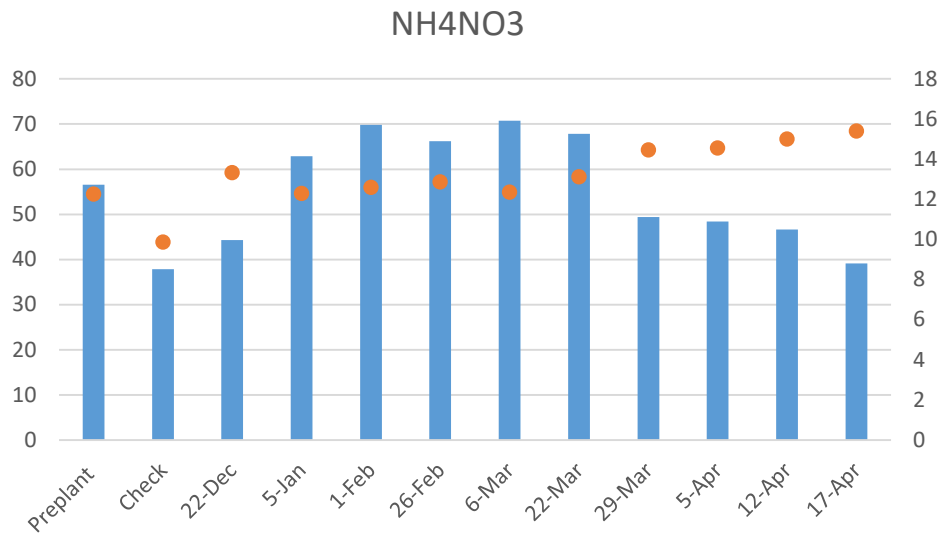

LCB Wheat
Yield Busheld per acre
Protein
0
10
20
30
40
50
60
70
80
90
0
4
8
12
16
PrePlant
Check
30-Jan
12-Feb
20-Feb
1-Mar
9-Mar
19-Mar
27-Mar
4-Apr
11-Apr
18-Apr

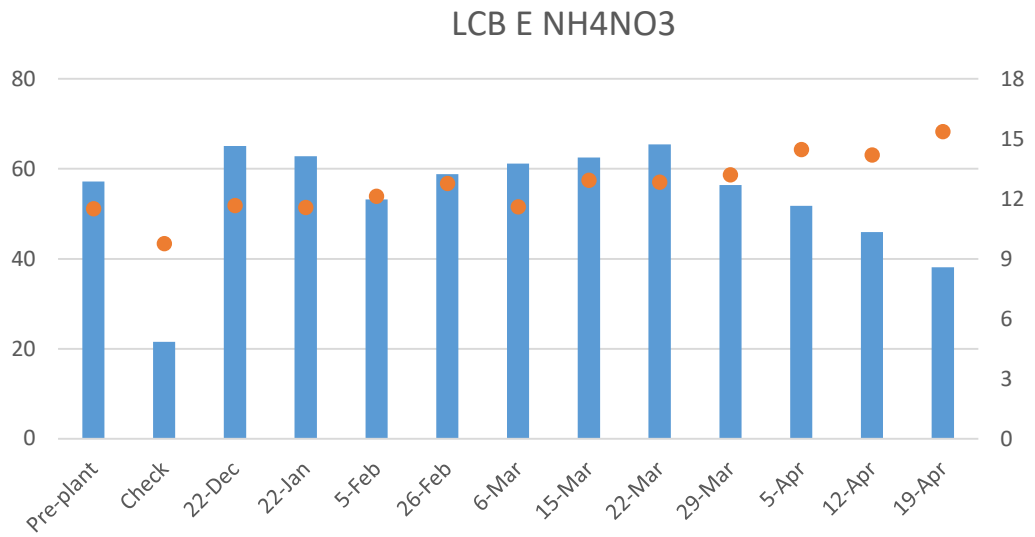

LCB Rotation
Yield Busheld per acre
Protein
0
10
20
30
40
50
60
70
80
90
0
4
8
12
PrePlant
Check
20-Dec
9-Jan
19-Jan
30-Jan
12-Feb
20-Feb
1-Mar
9-Mar
19-Mar
27-Mar

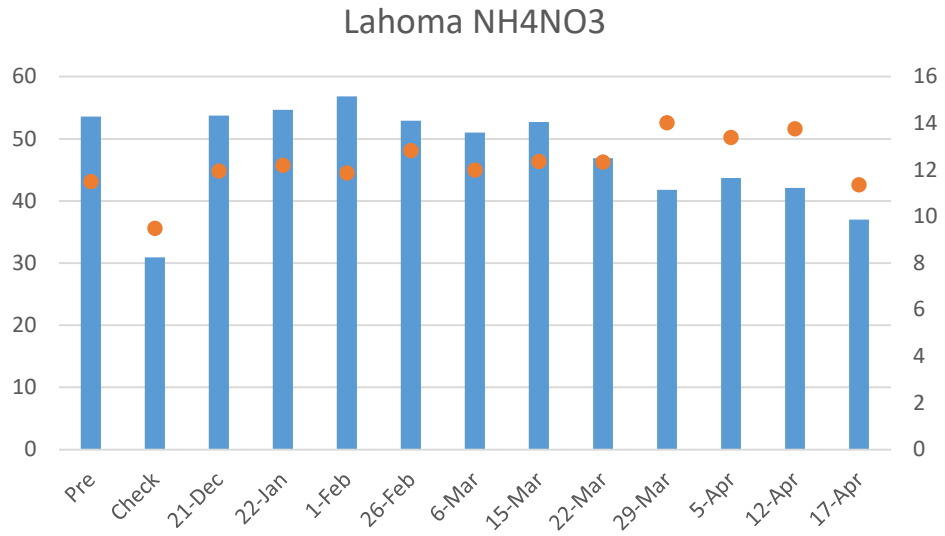

Perkins
Yield Busheld per acre
Protein
0
10
20
30
40
50
60
70
0
4
8
12
16
20
Pre plant
Check
10-Nov
17-Nov
24-Nov
1-Dec
21-Dec
29-Dec
12-Jan
23-Jan
2-Feb
12-Feb

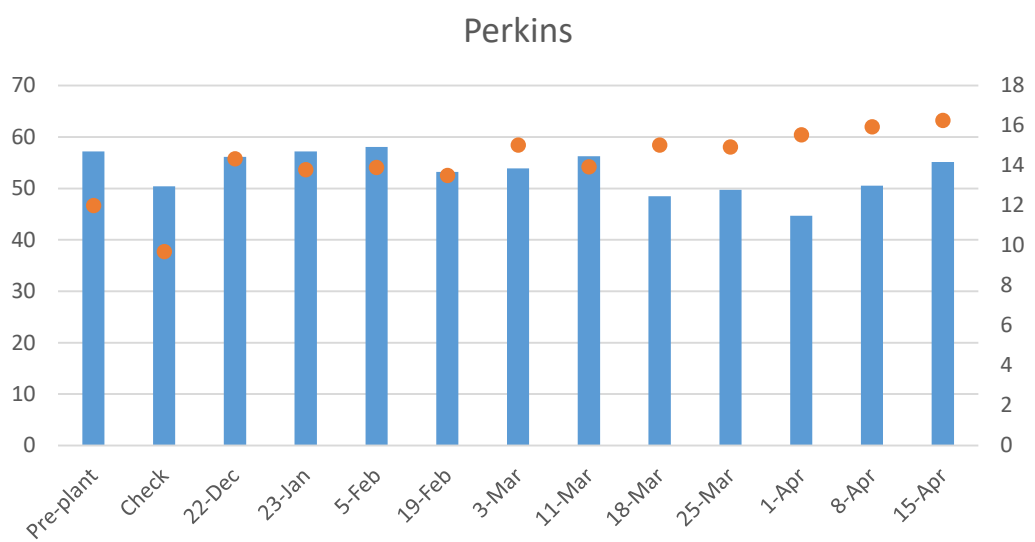

N40
Yield Bushels per acre
Protein
0
10
20
30
40
50
60
70
0
4
8
12
16
Pre plant
check
10-Nov
17-Nov
24-Nov
1-Dec
21-Dec
2-Jan
19-Jan
30-Jan
12-Feb
20-Feb

2017-2018

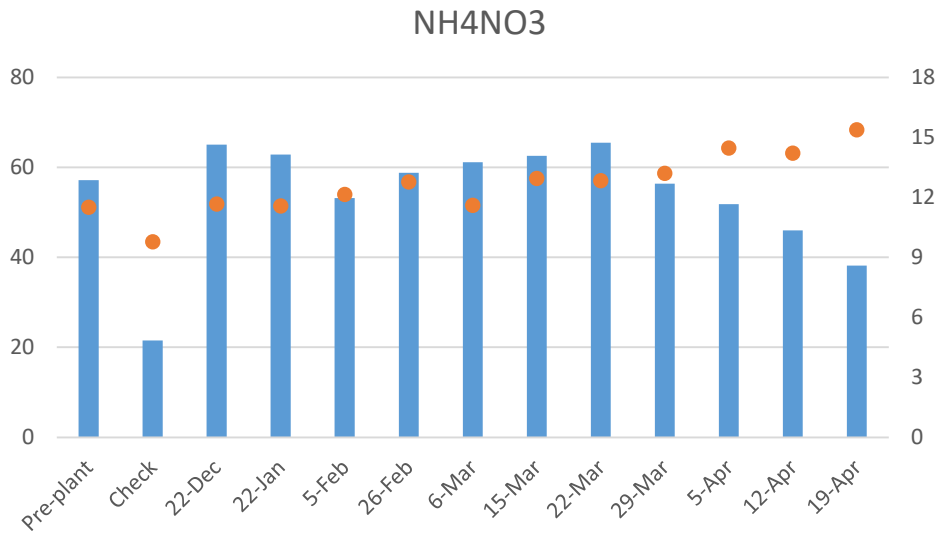

NH4NO3
80
70
60
50
40
30
20
10
0
18
16
14
12
10
8
6
4
2
0
Preplant
Check
22-Dec
5-Jan
1-Feb
26-Feb
6-Mar
22-Mar
29-Mar
5-Apr
12-Apr
17-Apr

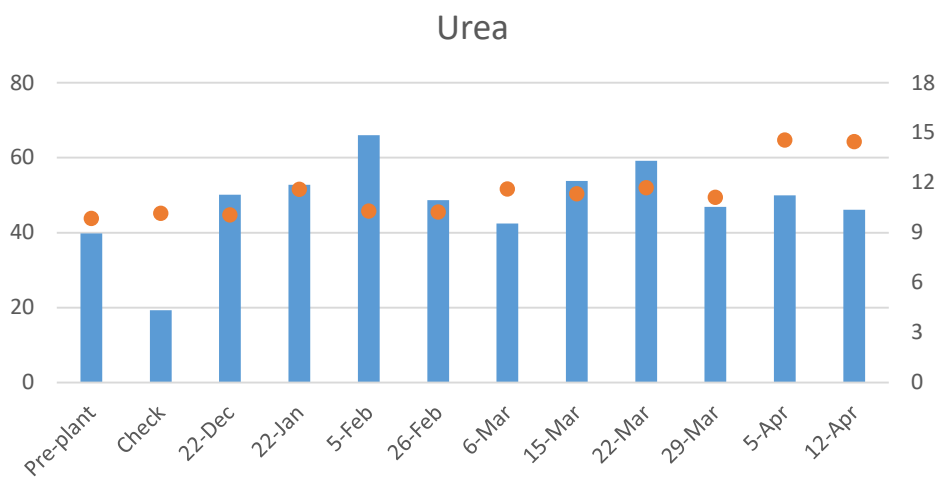

LCB E NH4NO3
80
60
40
20
0
18
15
12
9
6
3
0
Pre-plant
Check
22-Dec
22-Jan
5-Feb
26-Feb
6-Mar
15-Mar
22-Mar
29-Mar
5-Apr
12-Apr
19-Apr

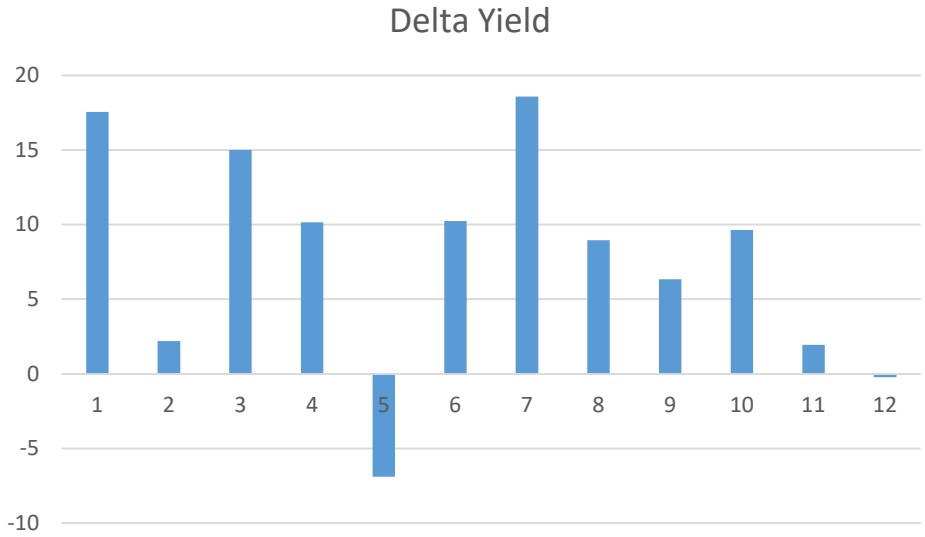

Lahoma NH4NO3
60
50
40
30
20
10
0
16
14
12
10
8
6
4
2
0
Pre
Check
21-Dec
22-Jan
1-Feb
26-Feb
6-Mar
15-Mar
22-Mar
29-Mar
5-Apr
12-Apr
17-Apr

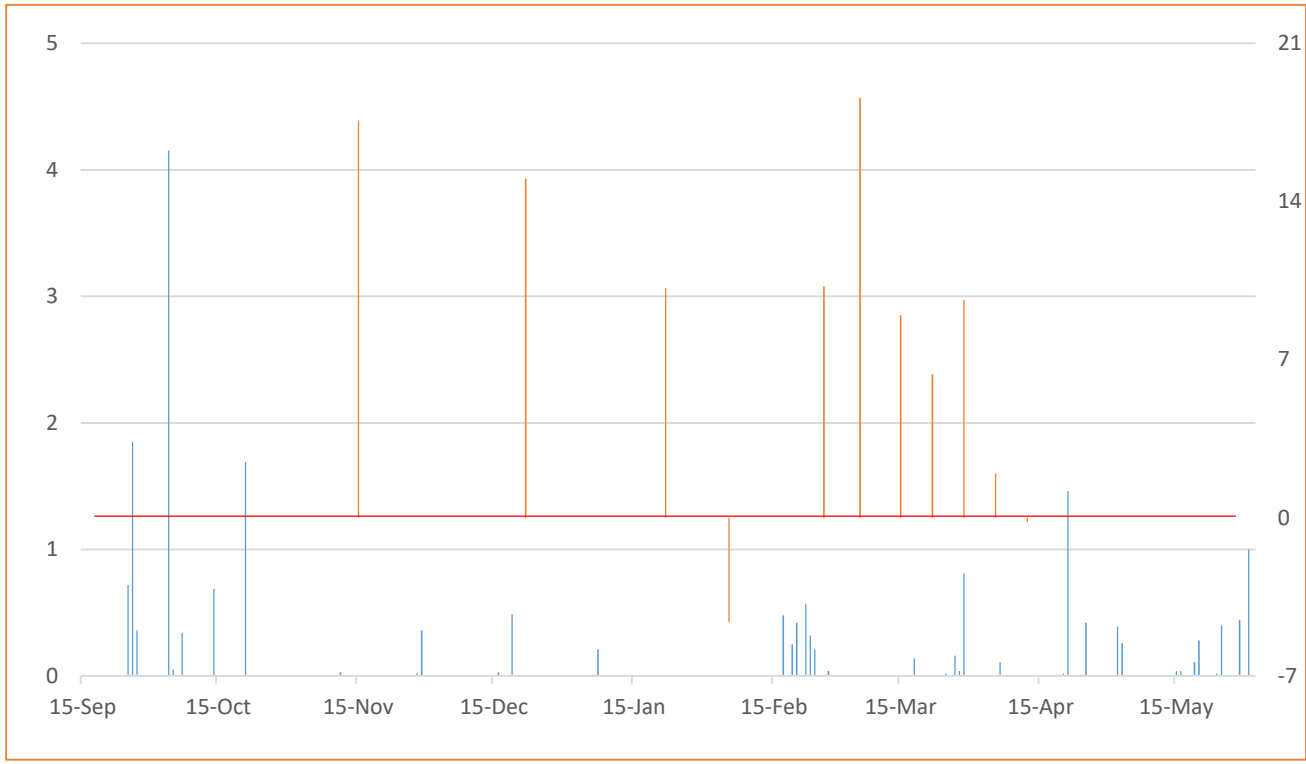

Perkins
70
60
50
40
30
20
10
0
18
16
14
12
10
8
6
4
2
0
Pre-plant
Check
22-Dec
23-Jan
5-Feb
19-Feb
3-Mar
11-Mar
18-Mar
25-Mar
1-Apr
8-Apr
15-Apr

LCB East

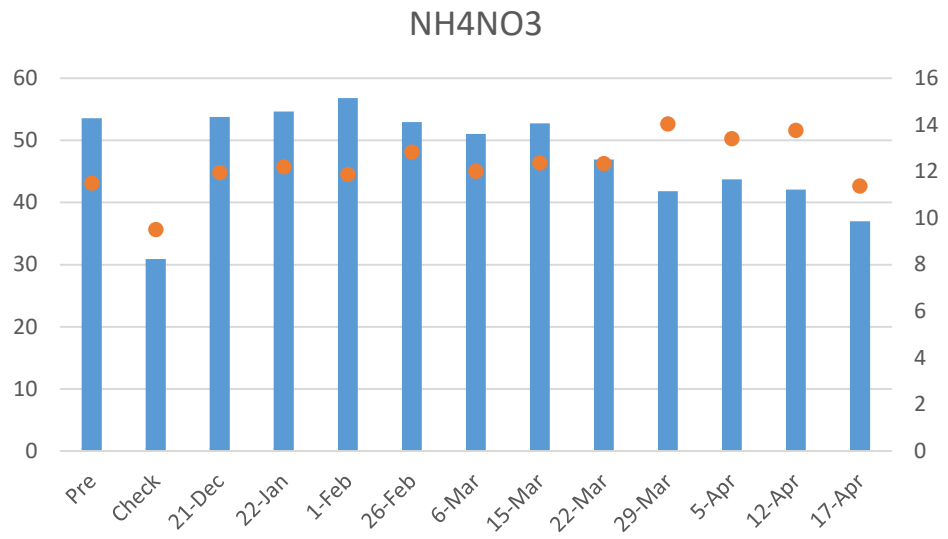

NH4NO3
80
60
40
20
0
18
15
12
9
6
3
0
Pre-plant
Check
22-Dec
22-Jan
5-Feb
26-Feb
6-Mar
15-Mar
22-Mar
29-Mar
5-Apr
12-Apr
19-Apr

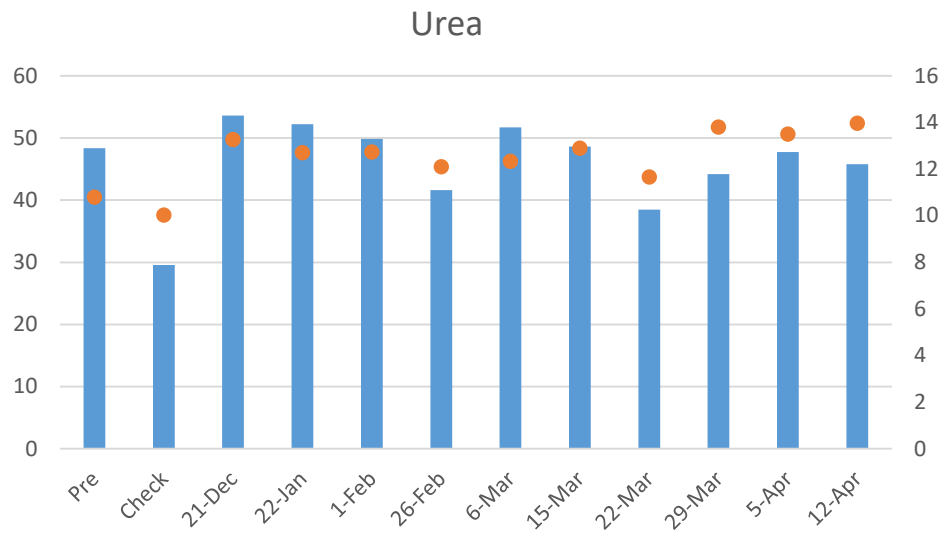

Urea
80
60
40
20
0
18
15
12
9
6
3
0
Pre-plant
Check
22-Dec
22-Jan
5-Feb
26-Feb
6-Mar
15-Mar
22-Mar
29-Mar
5-Apr
12-Apr


Delta Yield
20
15
10
5
0
-5
-10
1
2
3
4
5
6
7
8
9
10
11
12


5
4
3
2
1
0
21
14
7
0
-7
15-Sep
15-Oct
15-Nov
15-Dec
15-Jan
15-Feb
15-Mar
15-Apr
15-May

lahoma


NH4NO3
60
50
40
30
20
10
0
16
14
12
10
8
6
4
2
0
Pre
Check
21-Dec
22-Jan
1-Feb
26-Feb
6-Mar
15-Mar
22-Mar
29-Mar
5-Apr
12-Apr
17-Apr


Urea
60
50
40
30
20
10
0
16
14
12
10
8
6
4
2
0
Pre
Check
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22-Jan
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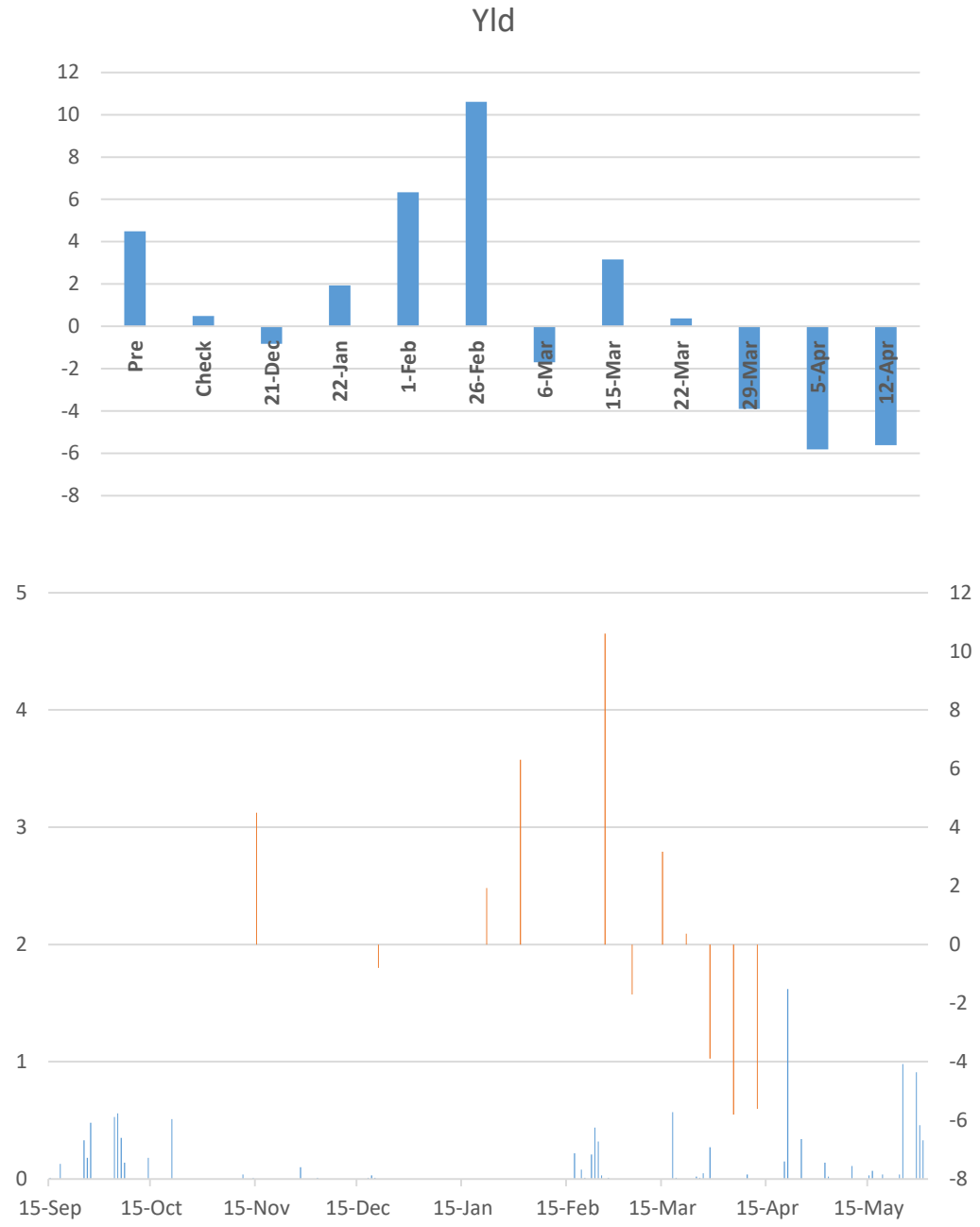
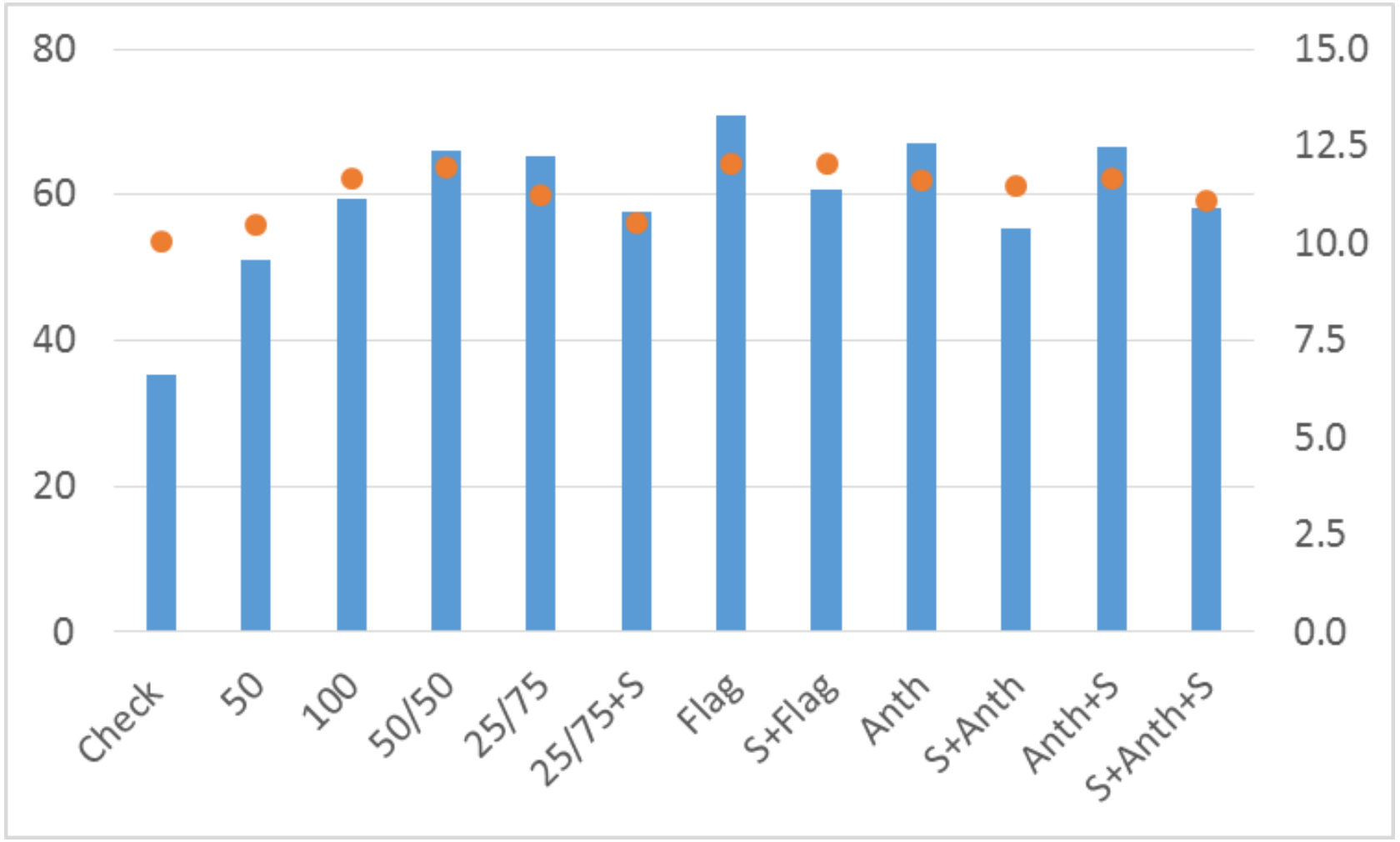
6-Mar
15-Mar
22-Mar
29-Mar
5-Apr
12-Apr


Yld
12
10
8
6
4
2
0
-2
-4
-6
-8
Pre
Check
21-Dec
22-Jan
1-Feb
26-Feb
6-Mar
15-Mar
22-Mar
29-Mar
5-Apr
12-Apr
5
4
3
2
1
0
12
10
8
6
4
2
0
-2
-4
-6
-8
15-Sep
15-Oct
15-Nov
15-Dec
15-Jan
15-Feb
15-Mar
15-Apr
15-May

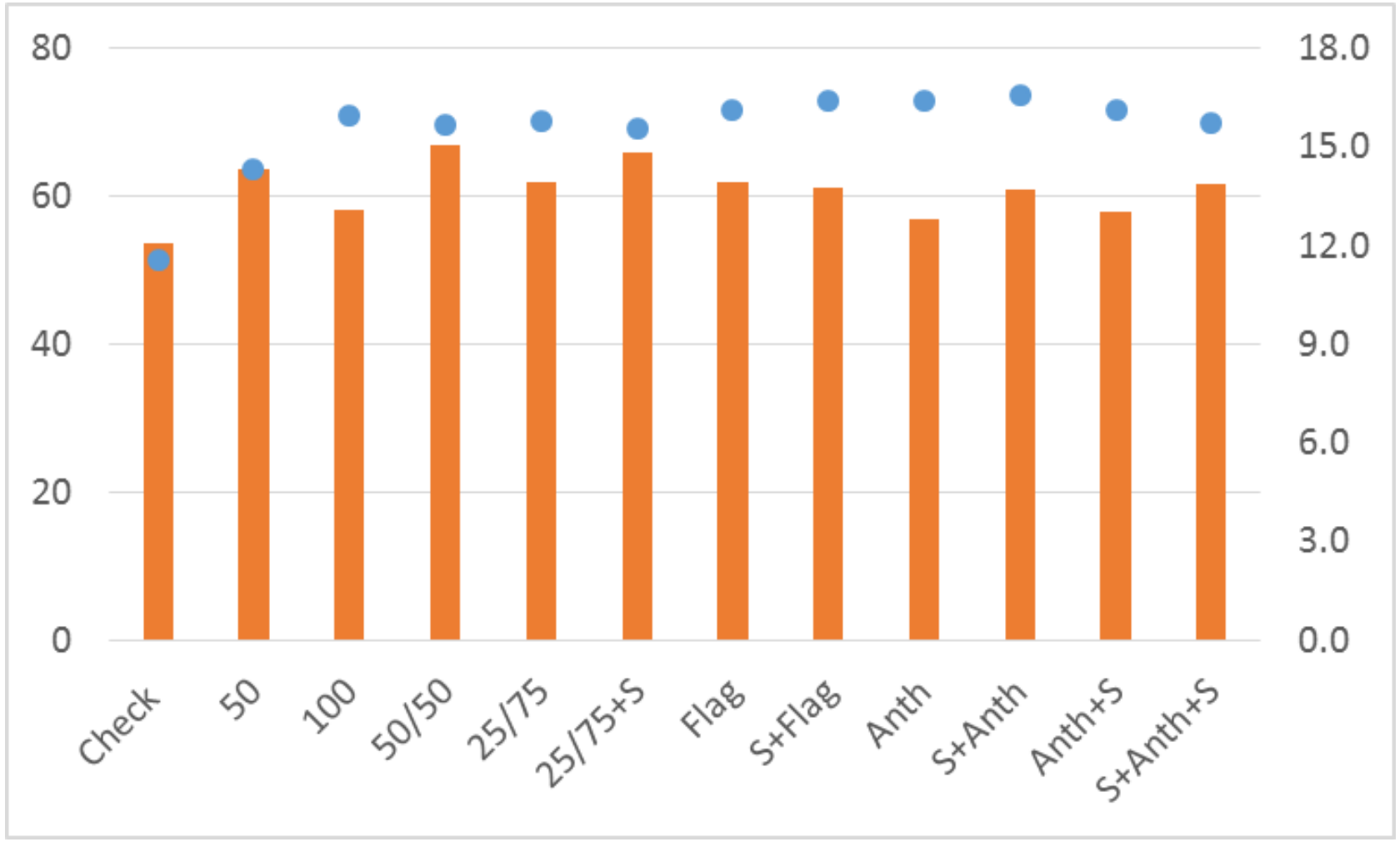
Protein Pro



Total N – 60 BPA = 120 N
Top-Dress S = 10 lbs
Flag Leaf N = 24 lbs
Anthesis = 10 lbs

Pre-Plant N : Urea
Top-dress N: UAN (28-0-0)
Top-dress S: Ammonium Thiosulfate (12-0-0-26)
Flag and Anthesis N: UAN + H20 (14-0-0)
Flag and Anthesis N + S: UAN + Ammonium Thiosulfate+ H2O
Anthesis- UAN 6.4 GPA, ATS 3.8 GPA H20 9.8 GPA

Protein Pro



S+ Anthesis Pro > 25/75 S

Total N – 60 BPA = 120 N
Top-Dress S = 10 lbs
Flag Leaf N = 24 lbs
Anthesis = 10 lbs

Pre-Plant N : Urea
Top-dress N: UAN (28-0-0)
Top-dress S: Ammonium Thiosulfate (12-0-0-26)
Flag and Anthesis N: UAN + H20 (14-0-0)
Flag and Anthesis N + S: UAN + Ammonium Thiosulfate+ H2O
Anthesis- UAN 6.4 GPA, ATS 3.8 GPA H20 9.8 GPA

Summary

- Timing matter and Yellow does not Mean Lost.
- Yields Maxed when N applied 80-100 GDD Days after planting March 1.
- Compared to Pre-plant could wait till early April (140 days). Don’t do it.
- Protein levels start consistently increasing after early march.

- Source Matters! But I cant always predict which one.

- Play the field. You have time.

N-Rich Strips

- ALL SEASON LONG- Watch trough Flag Leaf

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