Bow Island Long-Term Rotation Study

Effects of management over 25 years on soil properties and crop productivity

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WESTERN AG INNOVATIONS

Alberta Government

Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada

Soil Health Objectives

Sustainable and Profitable Crop Production
Effective Use of Water and Nutrients

Soil

Physical
Chemical
Biological

Management

Crop Rotation
Fertilization
Tillage
Herbicides

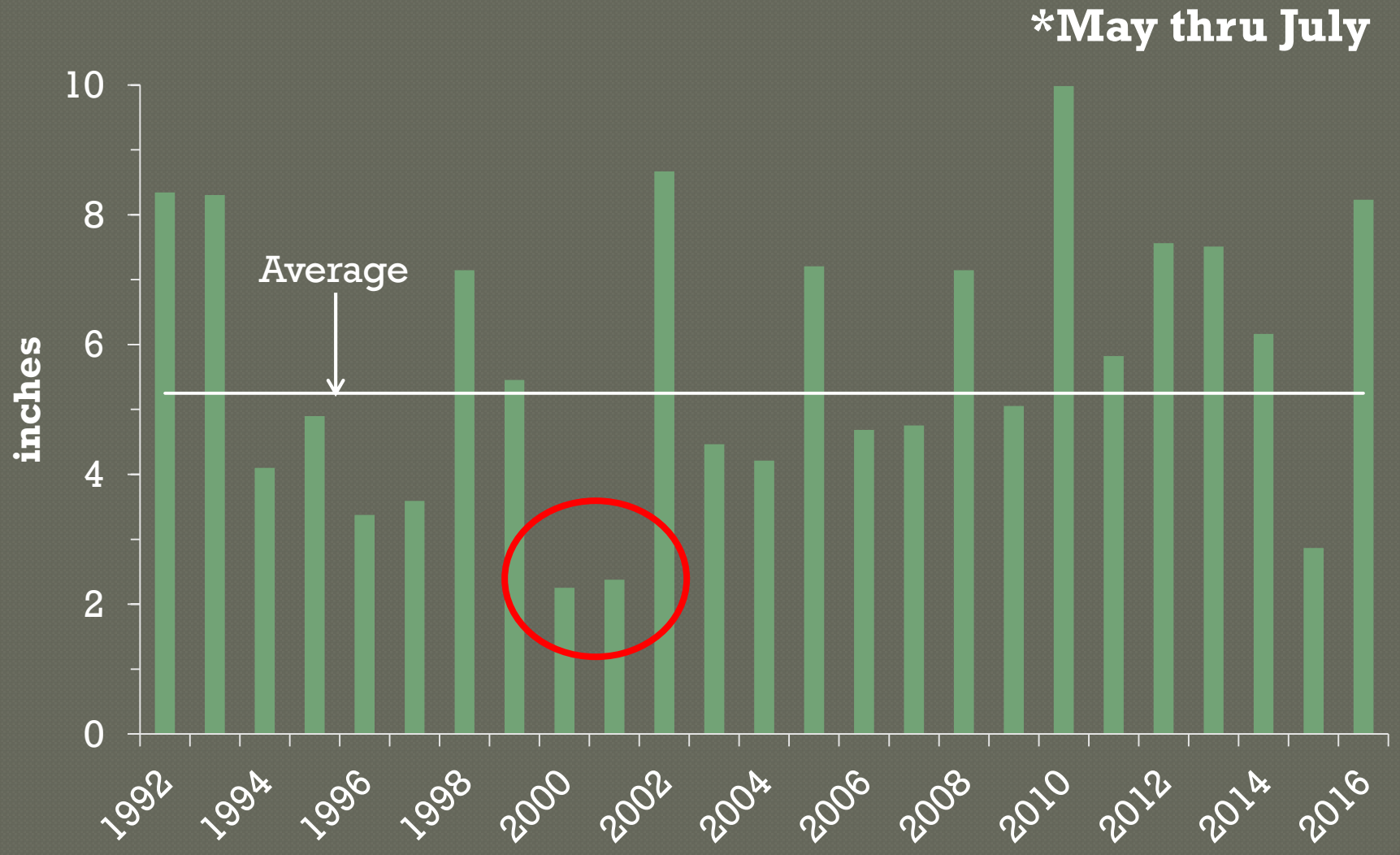
Bow Island LTRS Management Practices

- Wheat vs. Fallow-Wheat ± N, P, compost
- Oilseed crop in rotation ± N&P
- Pulse crop in rotation ± P/compost
- Grass hay ± N&P

History

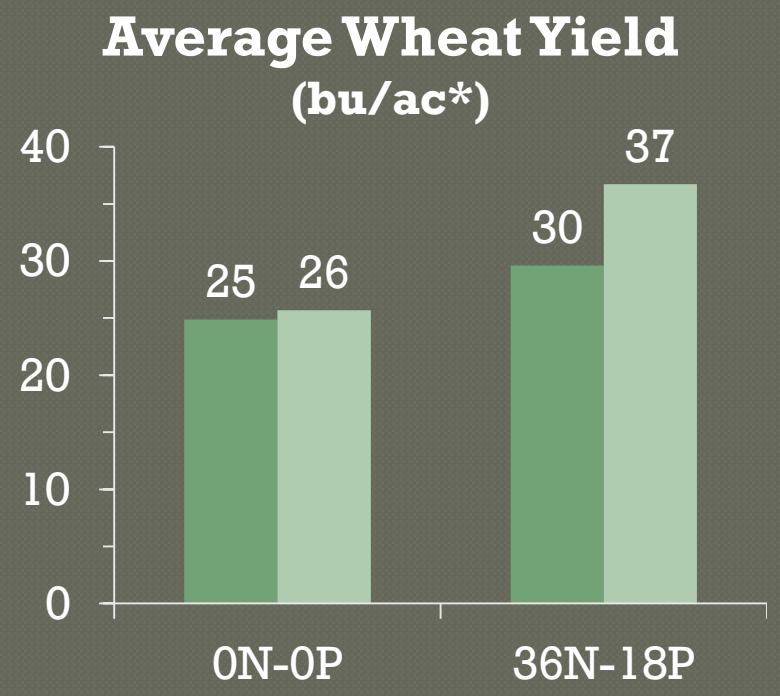
- Broken from native prairie ~1920
- 1920s to 60s: fallow – wheat
- 1970s & 80s: irrigated, primarily cereals
- 1991: unfertilized, non-irrigated wheat
- 1992-2015: Long-Term Rotation Study

Growing Season Precipitation

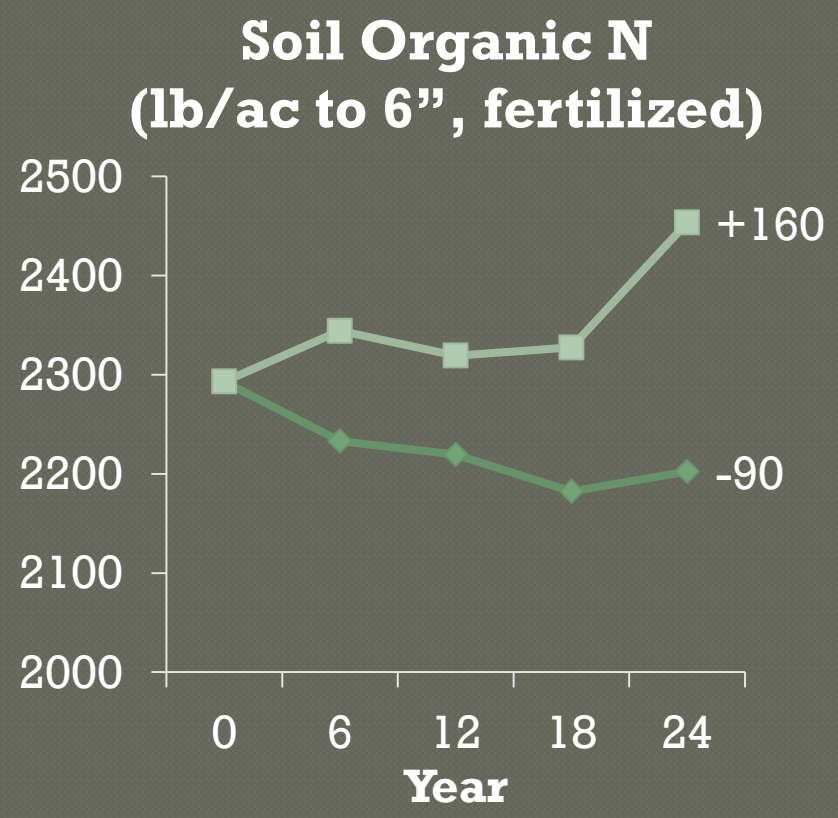


Summer Fallow

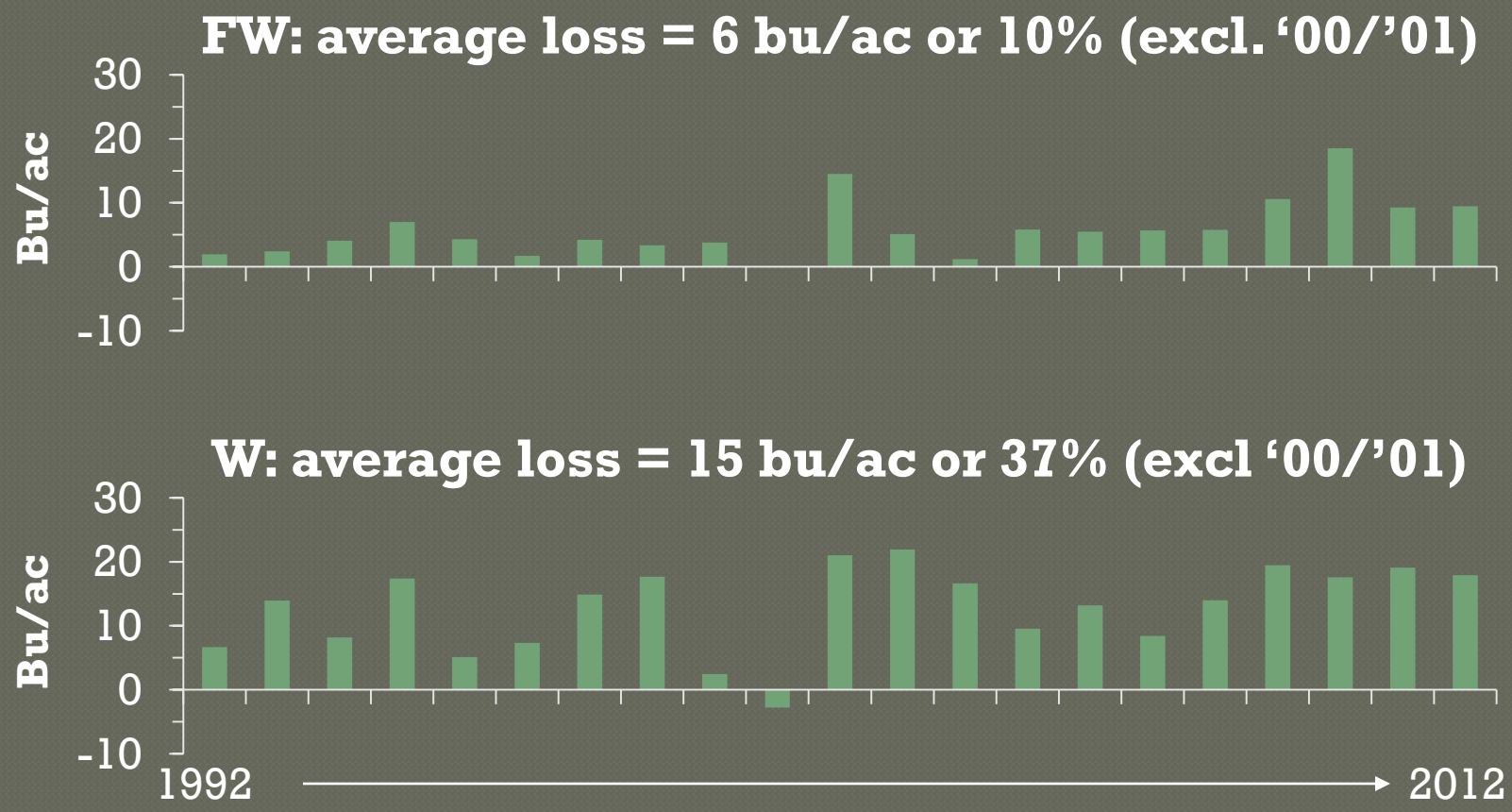
FW W



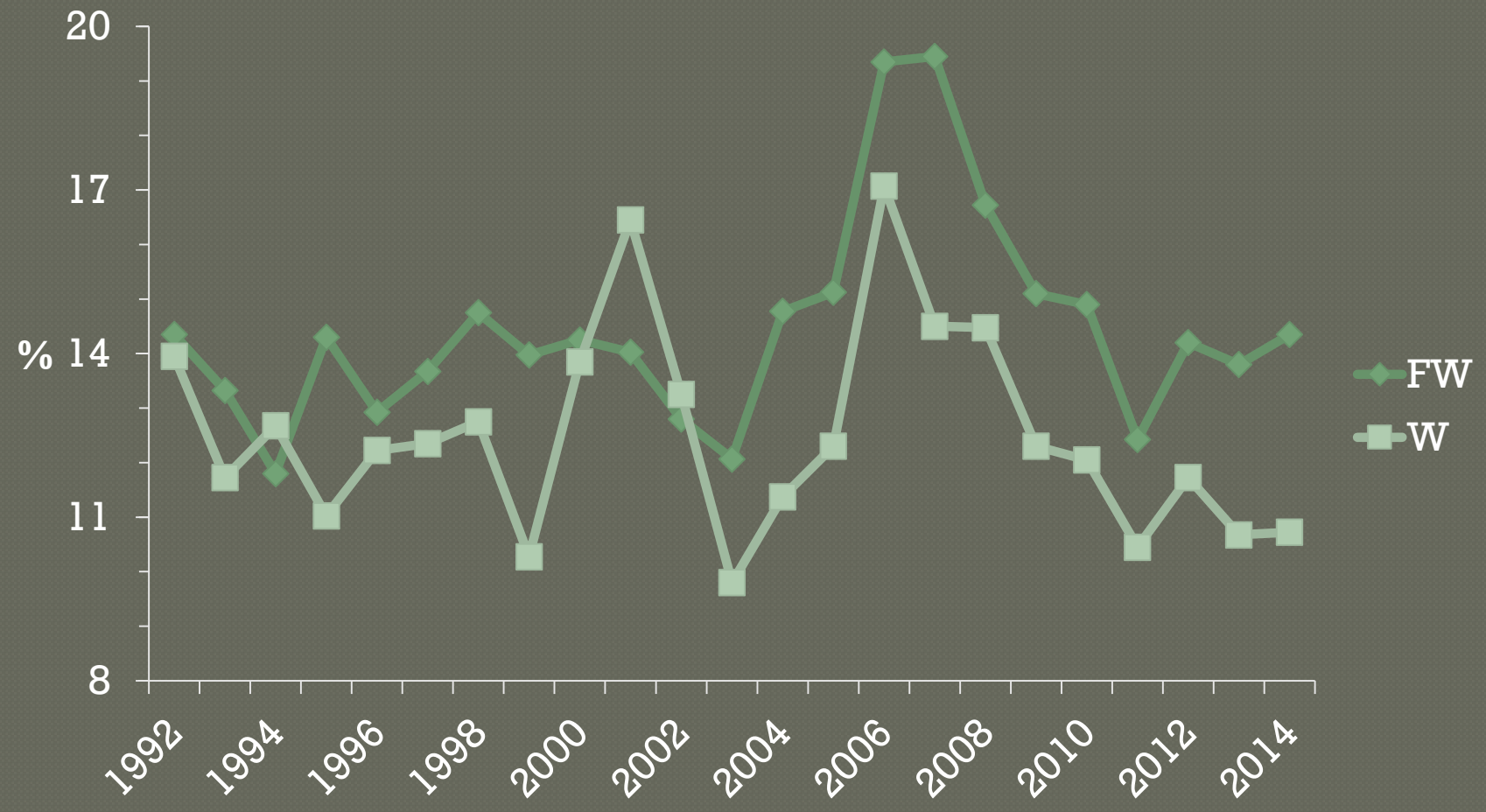
*Over whole rotation



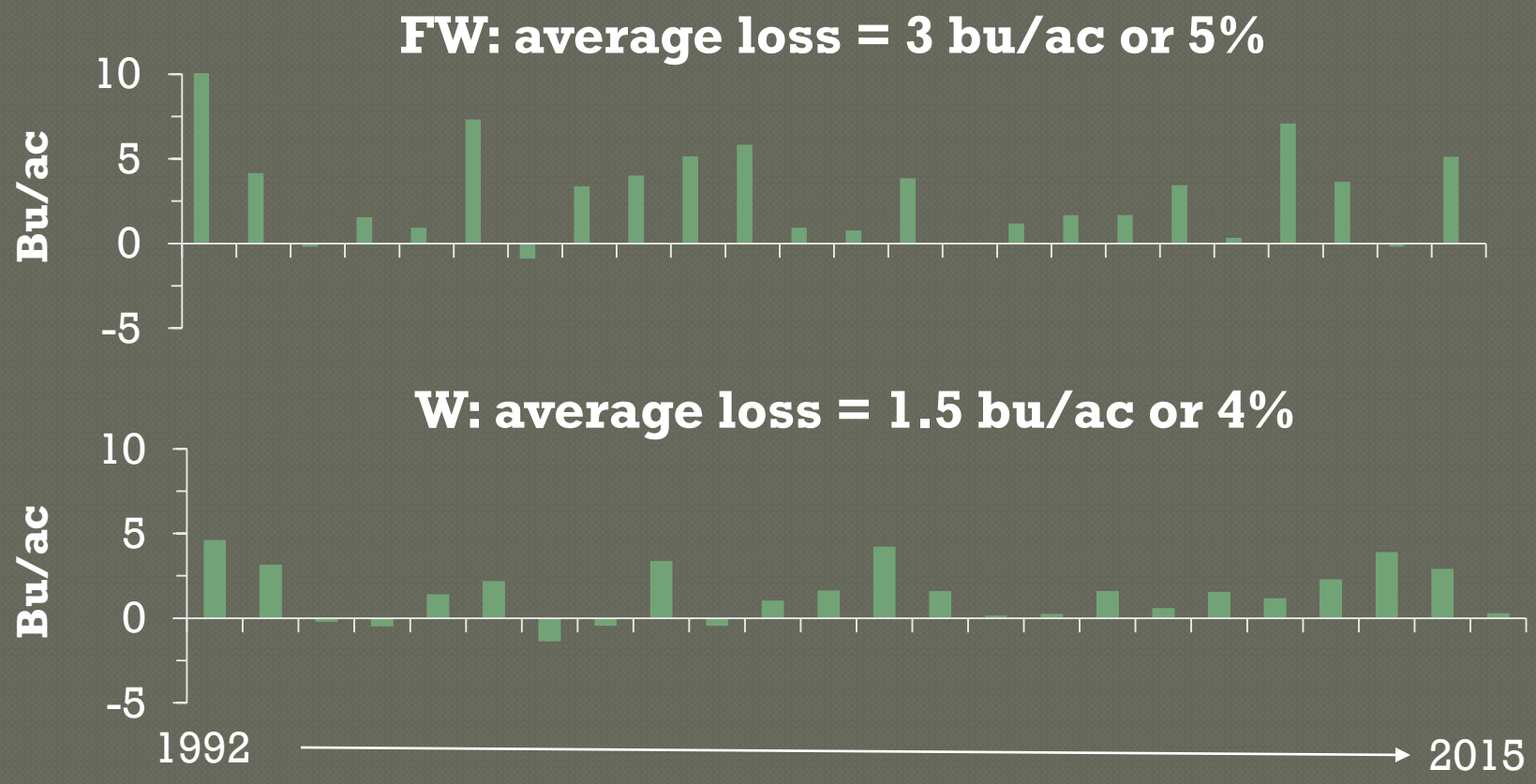
No N Yield Losses



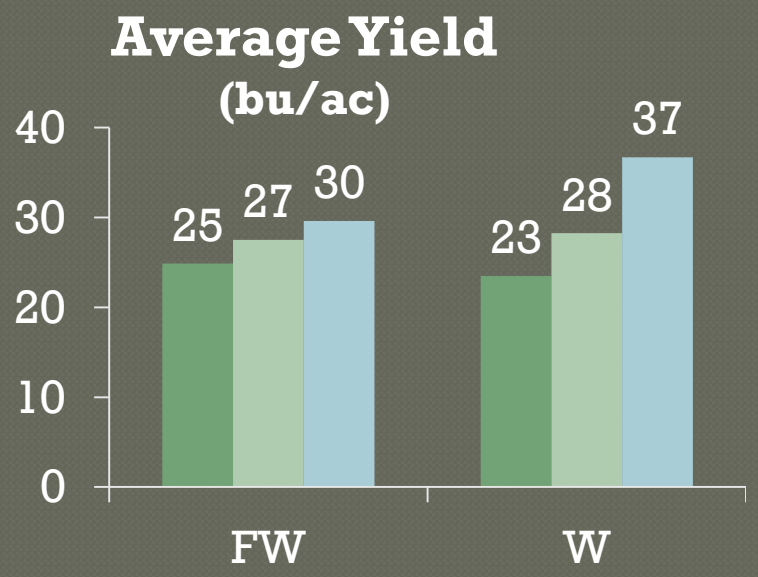
Protein Concentration (36 lb N/ac)

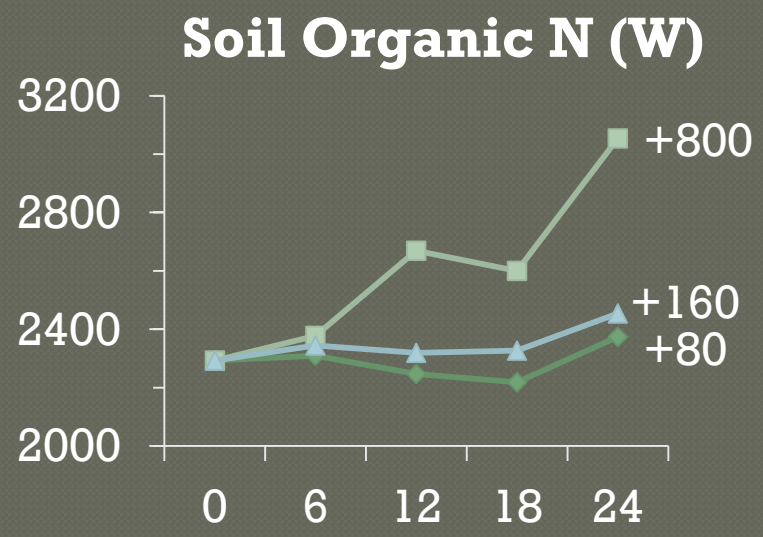


No P Yield Losses



Compost


0N-0P
Compost
36N-18P
Average Yield
(bu/ac)
40
30
20
10
0
25
27
30
23
28
37
FW
W


Soil Organic N (W)
3200
2800
2400
2000
0
6
12
18
24
+800
+160
+80

Soil Properties After 24 Years

	FW 36-18	FW 36-18	W 36-18	W comp
Av. Water (in)	3	1	3	ND
NO_3-N (lb/ac)	26	5	7	8
Min N (lb/ac)	24	29	29	34
PRS lb/ac				
N	31	12	20	24
P	12	11	15	53
K	68	84	85	150
Zn	.02	.03	.03	0.20
pH	5.9	6.1	5.7	7.0

Fallow

72 lb N/ac	0 lb N/ac
64 bu/ac	52 bu/ac

Wheat

72 lb N/ac	0 lb M/ac
54 bu/ac	31 bu/ac

*2016 yields not affected by previous fertility treatment

W 36-18

72 lb N/ac	0 lb N/ac
49 bu/ac	31 bu/ac

W Compost

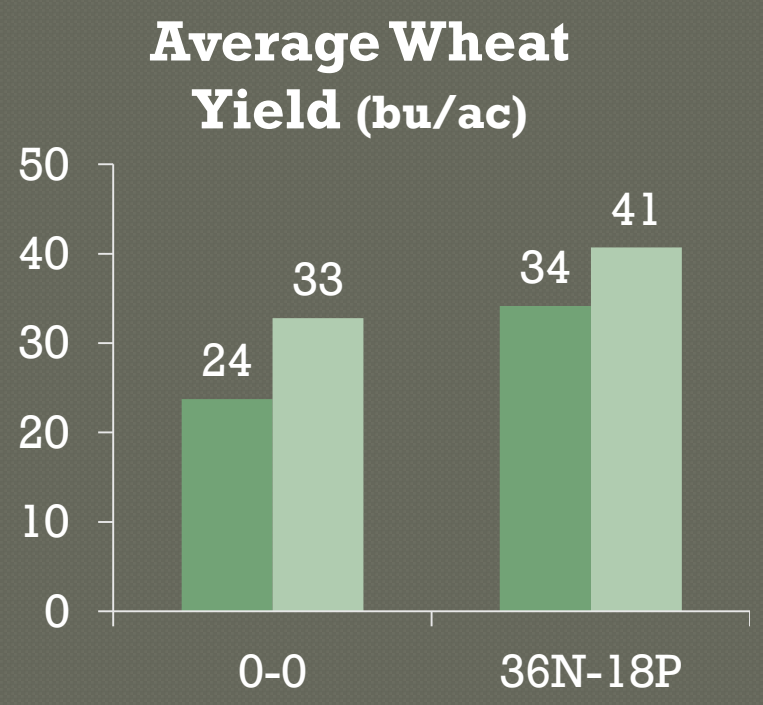
72 lb N/ac	0 lb N/ac
58 bu/ac	38 bu/ac

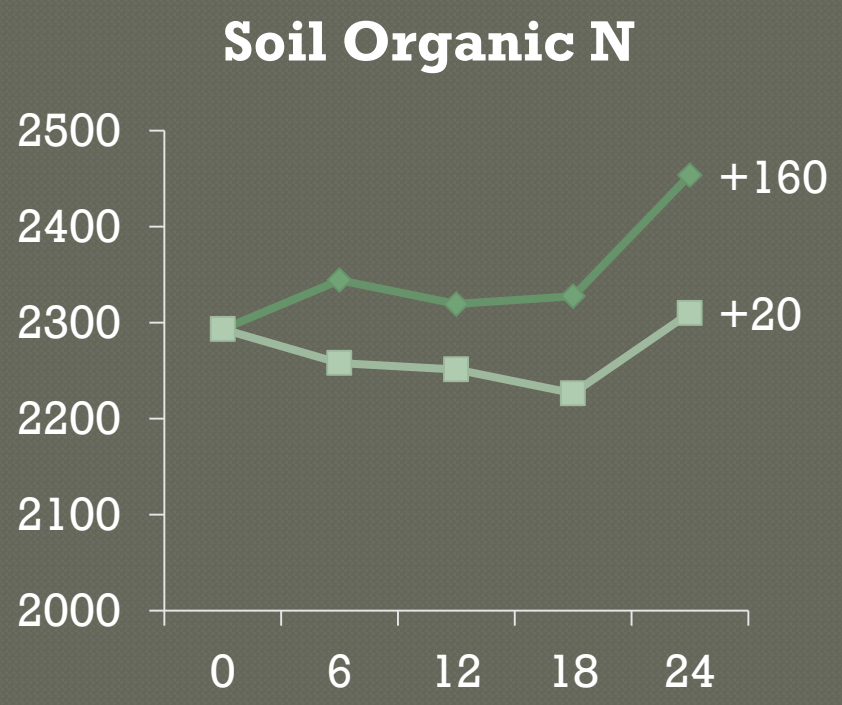
*2016 on unfertilized checks same as 36-18.

Flax ('92-'03), Mustard ('04-'15)

Oilseed in Rotation (F-O-W)

W FOW





Wheat Yields (bu/ac) following FOW

72 lb N/ac	0 lb N/ac
65 bu/ac	61 bu/ac

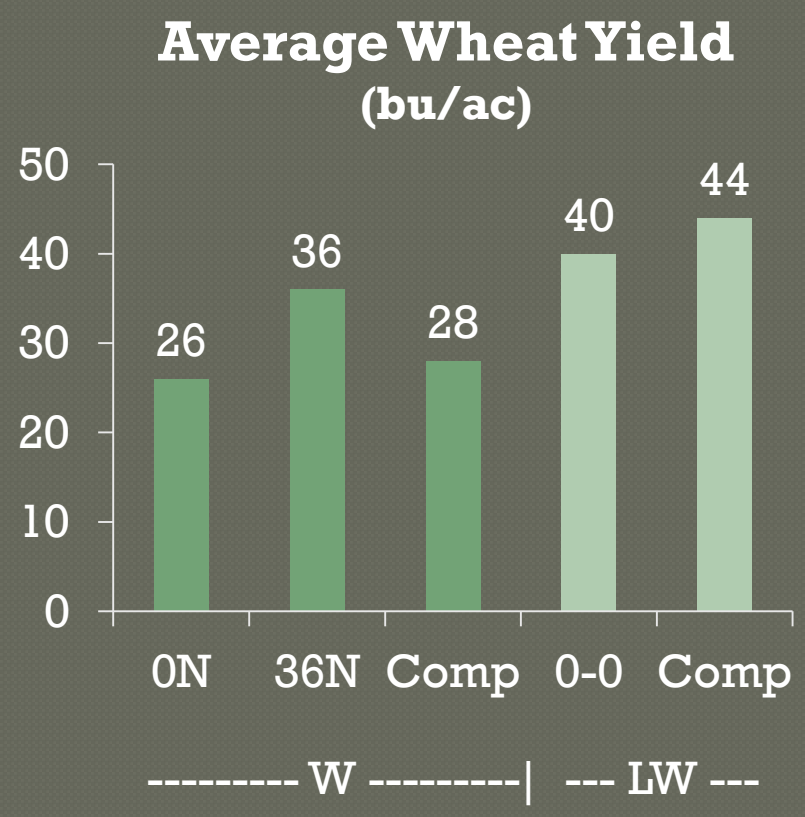
FOW

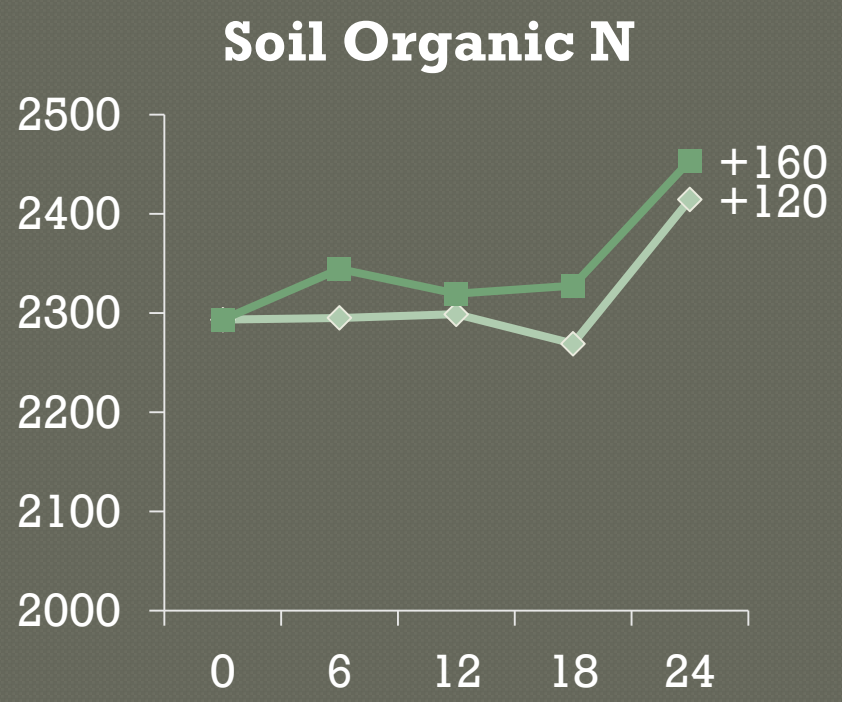
72 lb N/ac	0 lb N/ac
56 bu/ac	45 bu/ac

FOW

GM ('92-'95), Pea ('96-'12), Lentil ('13-15)

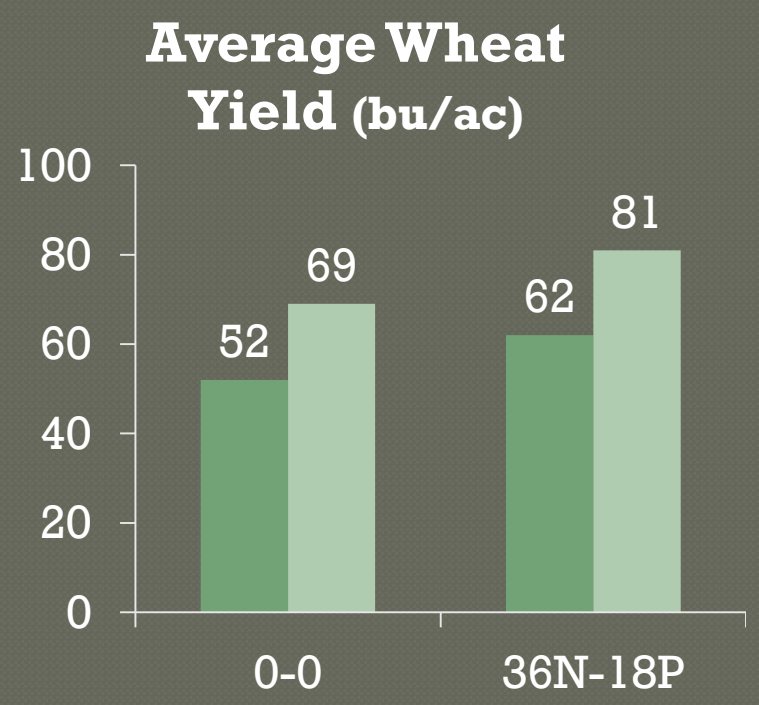
Pulse in Rotation (LW)

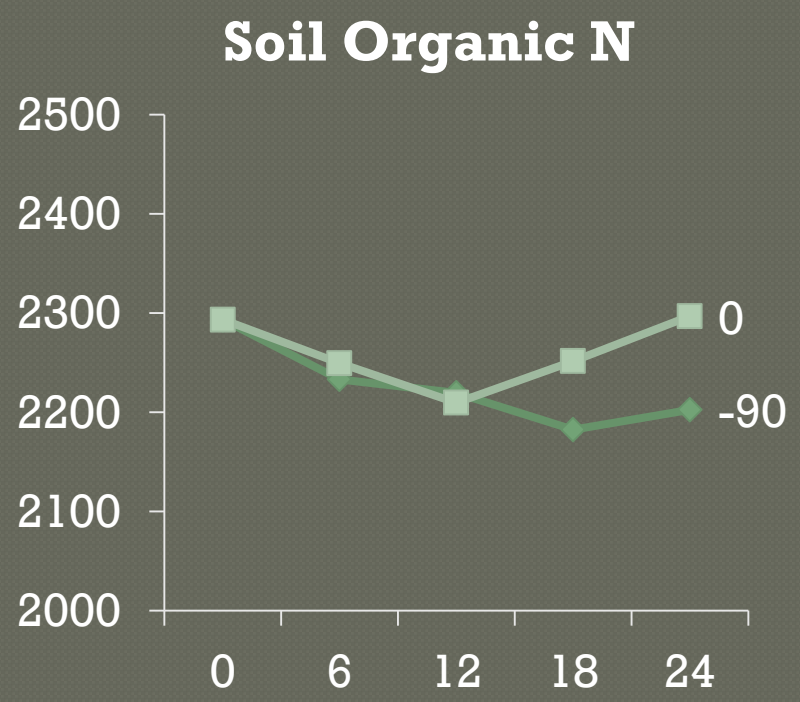




Chickpea ('04 & '05), Lentil ('06-'15)

Pulse in Rotation (F-WW-Len)

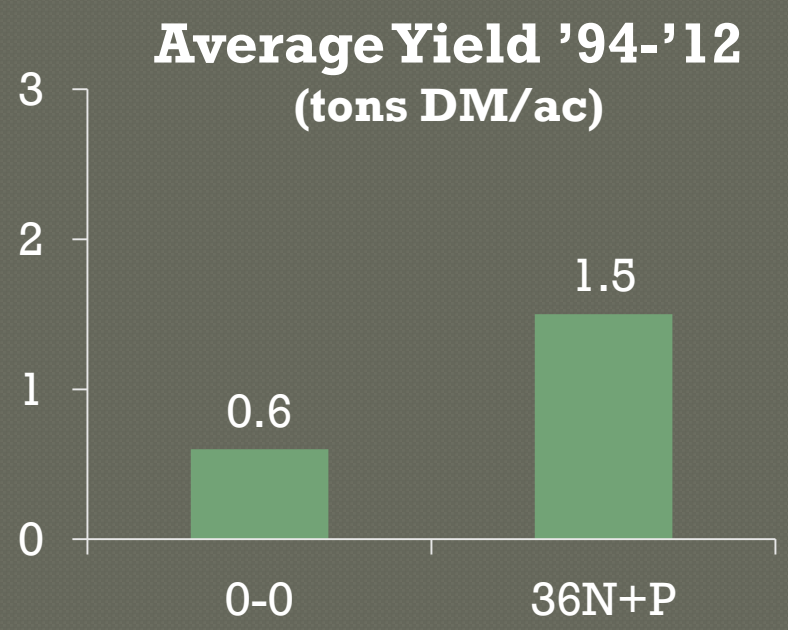


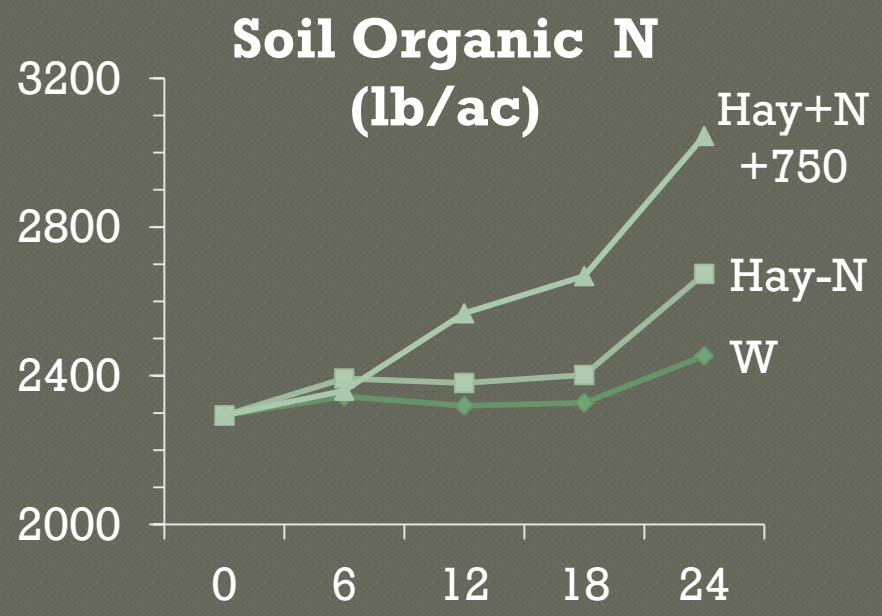


Pulse Impacts - 2016

	NO3-N (lb/ac)	Min.d N (lb/ac)	Yield with 0 lb N/ac (bu/ac)	Yield with 72 lb N/ac (bu/ac)
LW	29	48	50	61
F-WW-Len	50	35	65	67
FW 36-18	26	24	52	64
W 36-18	7	29	31	49

Grass Hay

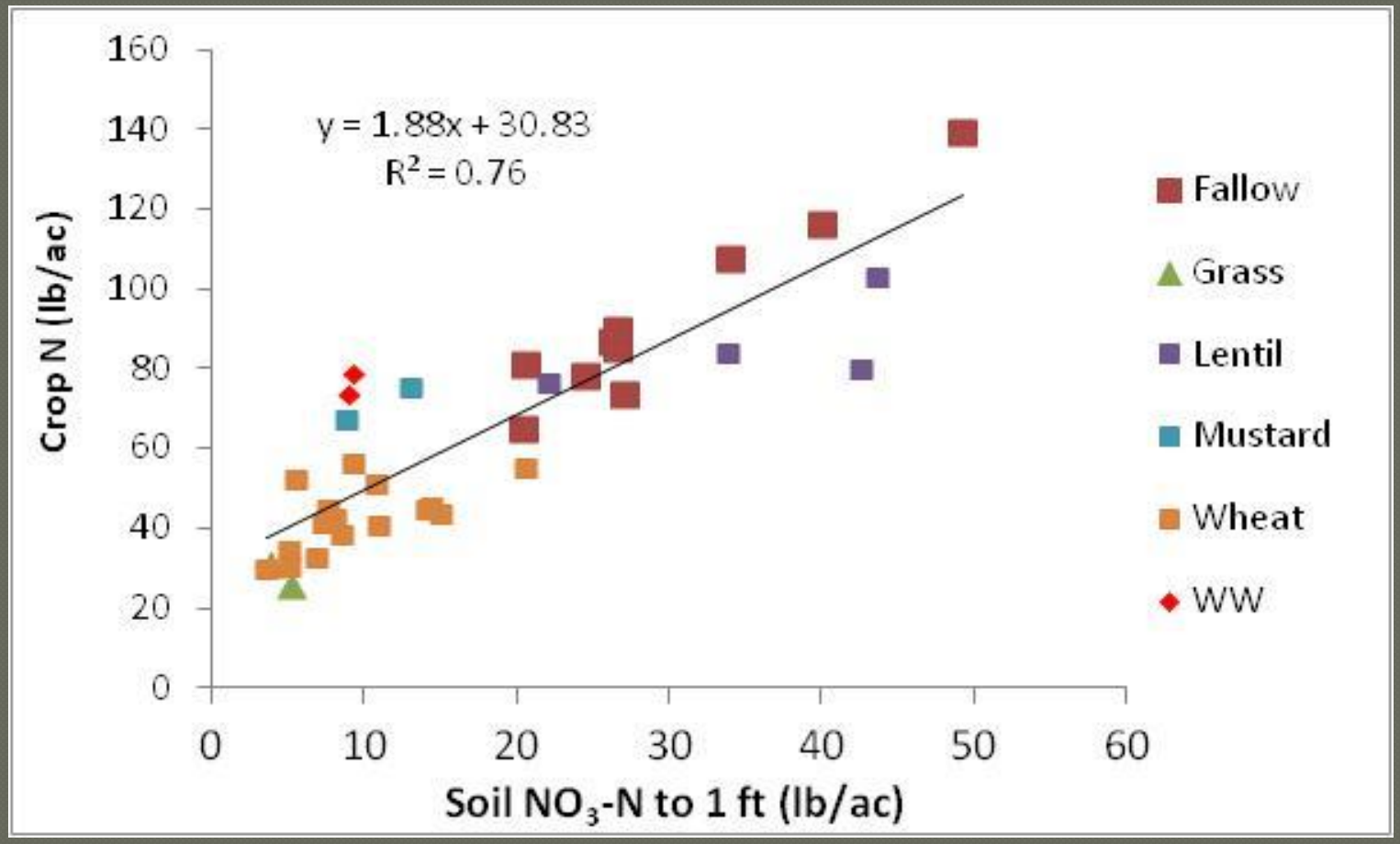

Average Yield '94-'12
(tons DM/ac)
3
2
1
0
0.6
1.5
0-0
36N+P


Soil Organic N
(lb/ac)
3200
2800
2400
2000
0
6
12
18
24
Hay+N
+750
Hay-N
W

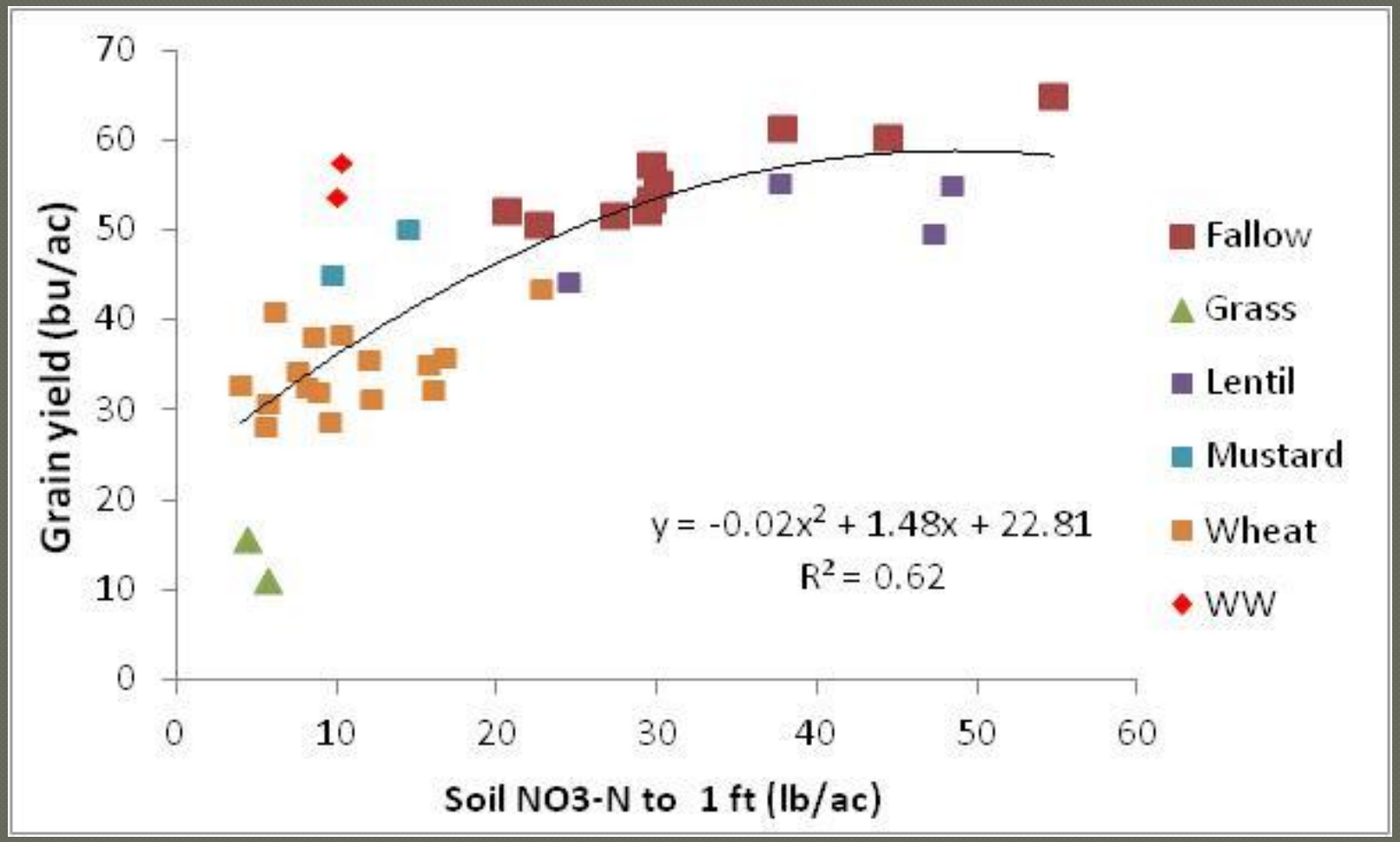
Wheat Yields Following Hay

lb N/ac	bu/ac
0	16
72	28

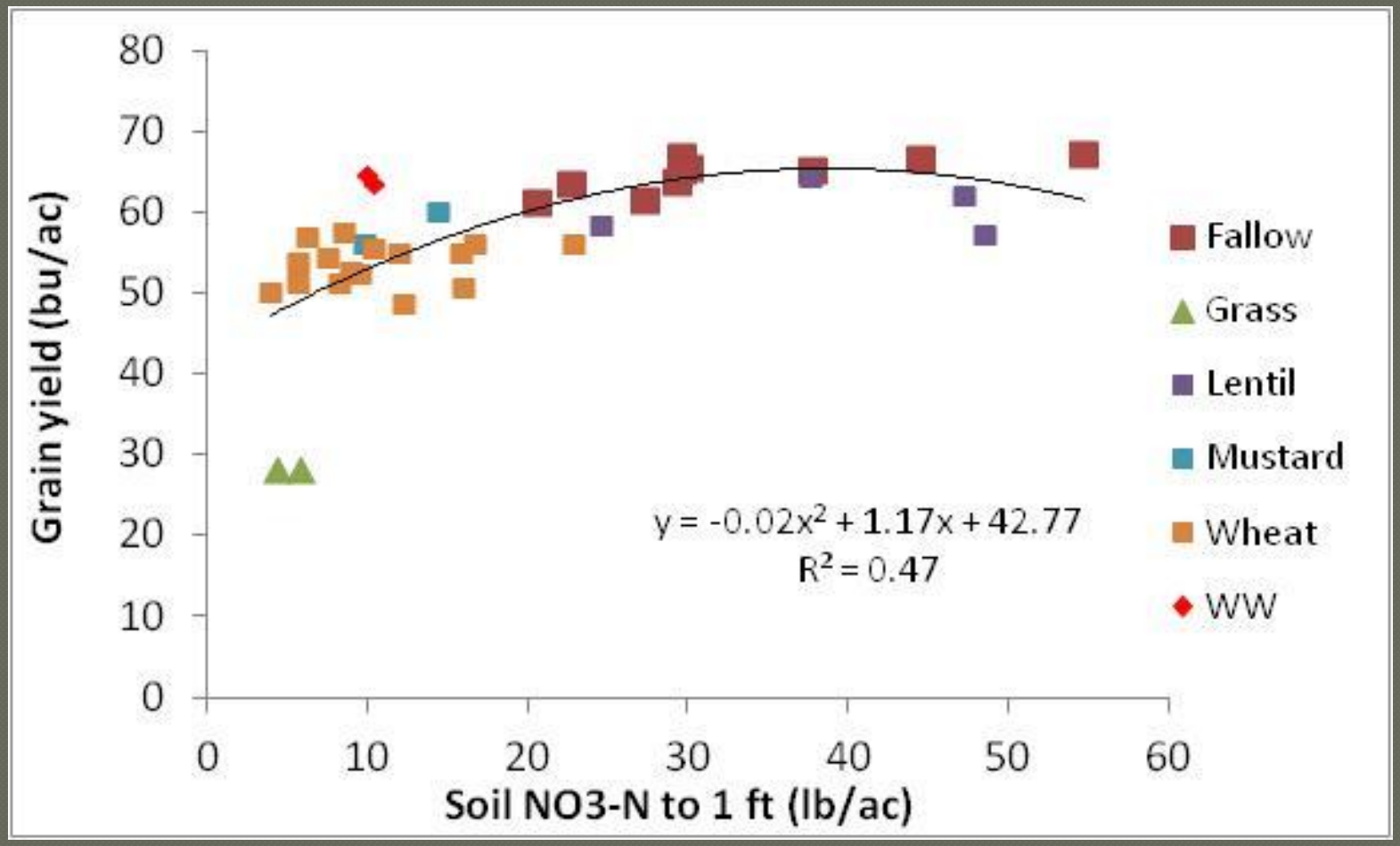
Crop N Uptake$_{0N}$ vs. Soil NO_3-N



Wheat $yield_{0N}$ vs. Soil NO_3-N



Wheat $yield_{72N}$ vs. Soil NO_3-N



Conclusions

- Benefits of oilseed and pulse crops
- Synergy of pulse crops and compost
- Increasing soil organic matter increases N fertilizer requirements
- Longer-term impacts?

Acknowledgements

Allan Middleton
Pat Pfiffner
Jared Neville
***et al*…**

Alberta Pulse Crop Growers