

## Introduction

There is increasing interest in utilizing no-till systems and cover crops to improve soil quality. This study at the SDSU Southeast Research Farm near Beresford, SD focused on evaluating optimum nitrogen (N) management in corn as follows:

- Long term no-till (NT) versus conventional till (CT).
- Varied N rates, with and without a cover crop.
- Corn/Soybean (C/S) and Corn/Soybean/Oat (C/S/O) rotation plots within a larger rotation study.

## Objective

Evaluate whether N requirements continue to be greater under long-term NT versus CT production systems, while also considering effects from cover crops and crop rotation in southeastern South Dakota.

## Materials and Methods

**Table 1. Fertilizer treatments applied to corn near Beresford, SD, 2014-2015.**

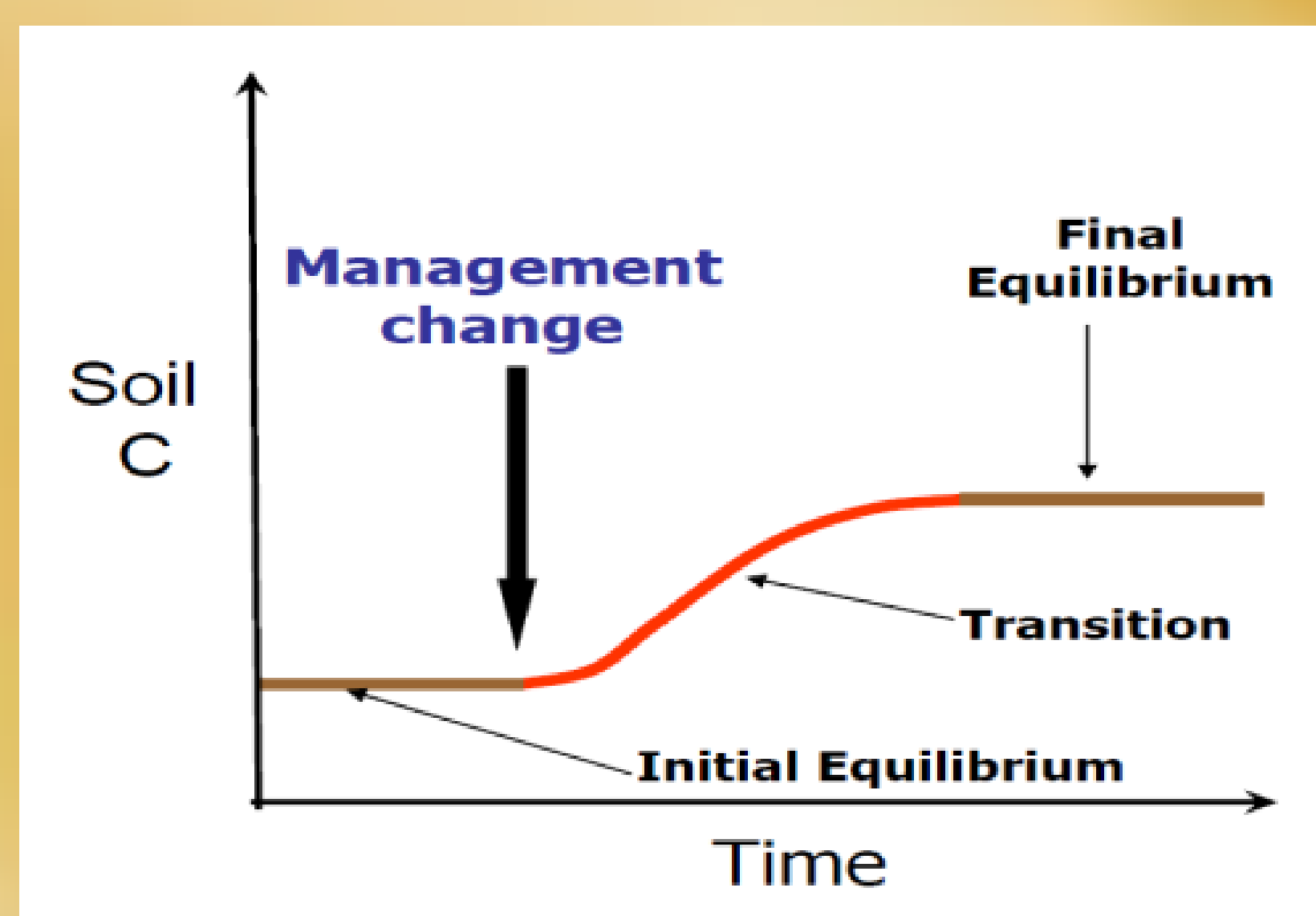
Rot.	N Rate <sup>1</sup>	Till <sup>2</sup>	C. Crop <sup>3</sup>	Rot. <sup>4</sup>	N Rate	Till	C. Crop
C/S	0	NT	N	C/S/O	0	NT	N
		CT				CT	Y
C/S	40	NT	N	C/S/O	40	NT	Y
		CT				CT	Y
C/S	80	NT	N	C/S/O	80	NT	Y
		CT				CT	Y
C/S	120	NT	N	C/S/O	120	NT	Y
		CT				CT	Y
C/S	160	NT	N	C/S/O	160	NT	Y
		CT				CT	Y
C/S	200	NT	N	C/S/O	200	NT	Y
		CT				CT	Y

<sup>1</sup>Applied 4/10/14 and 4/15/15 as UAN using streamer bar application method.

<sup>2</sup>'NT' indicates no-till since 1991, 'CT' indicates conventional till since 1991.

<sup>3</sup>'N' and 'Y' indicate 'no cover crop' and 'cover crop' respectively.

<sup>4</sup>3 year rotation was switched from wheat to oat in 2013.



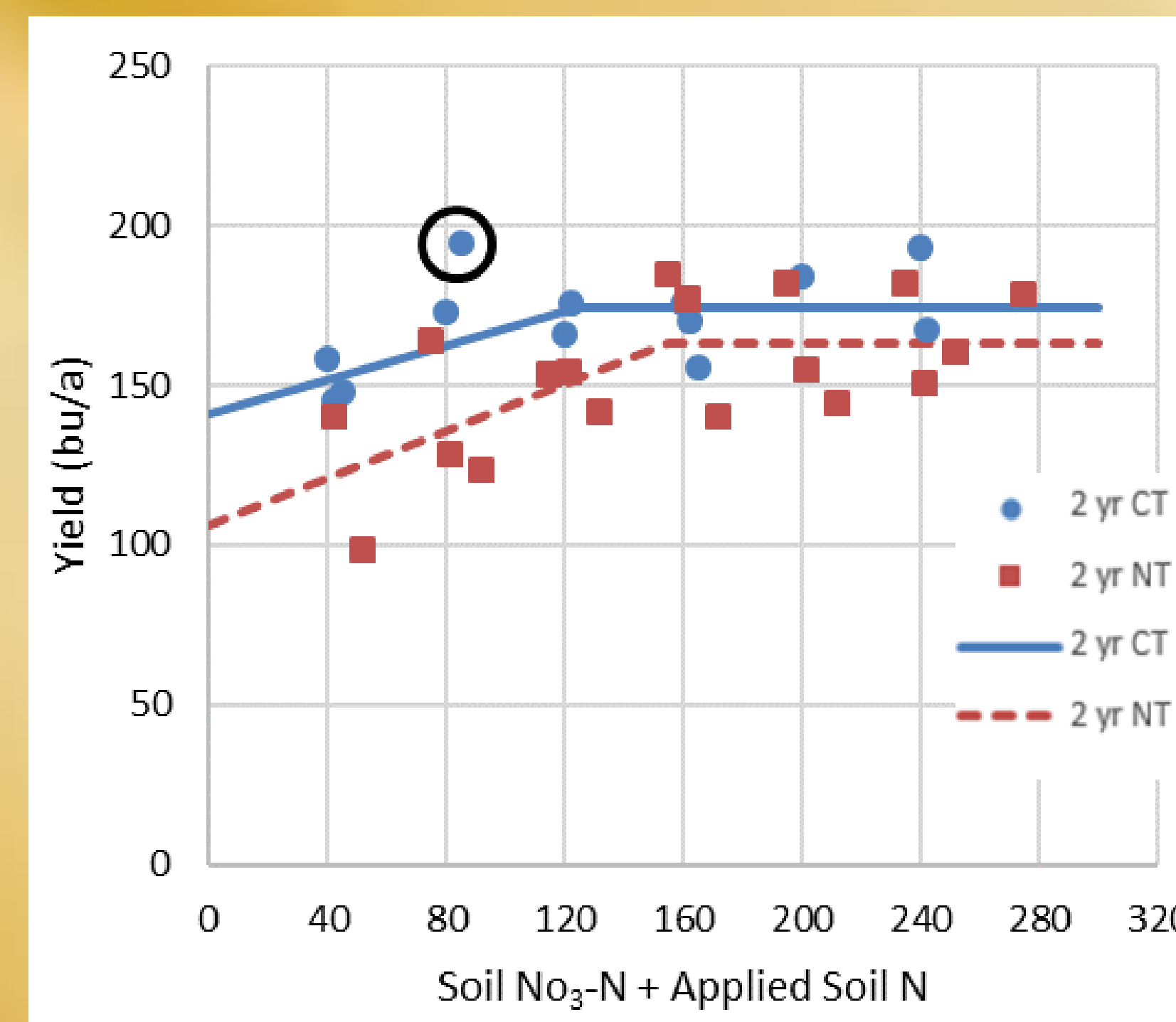
**Figure 1. Change in tillage and cropping system effects on soil carbon equilibrium (Goulding et al., 2013).**

**Table 2. Field information and parameters measured on corn near Beresford, SD, 2014-2015.**

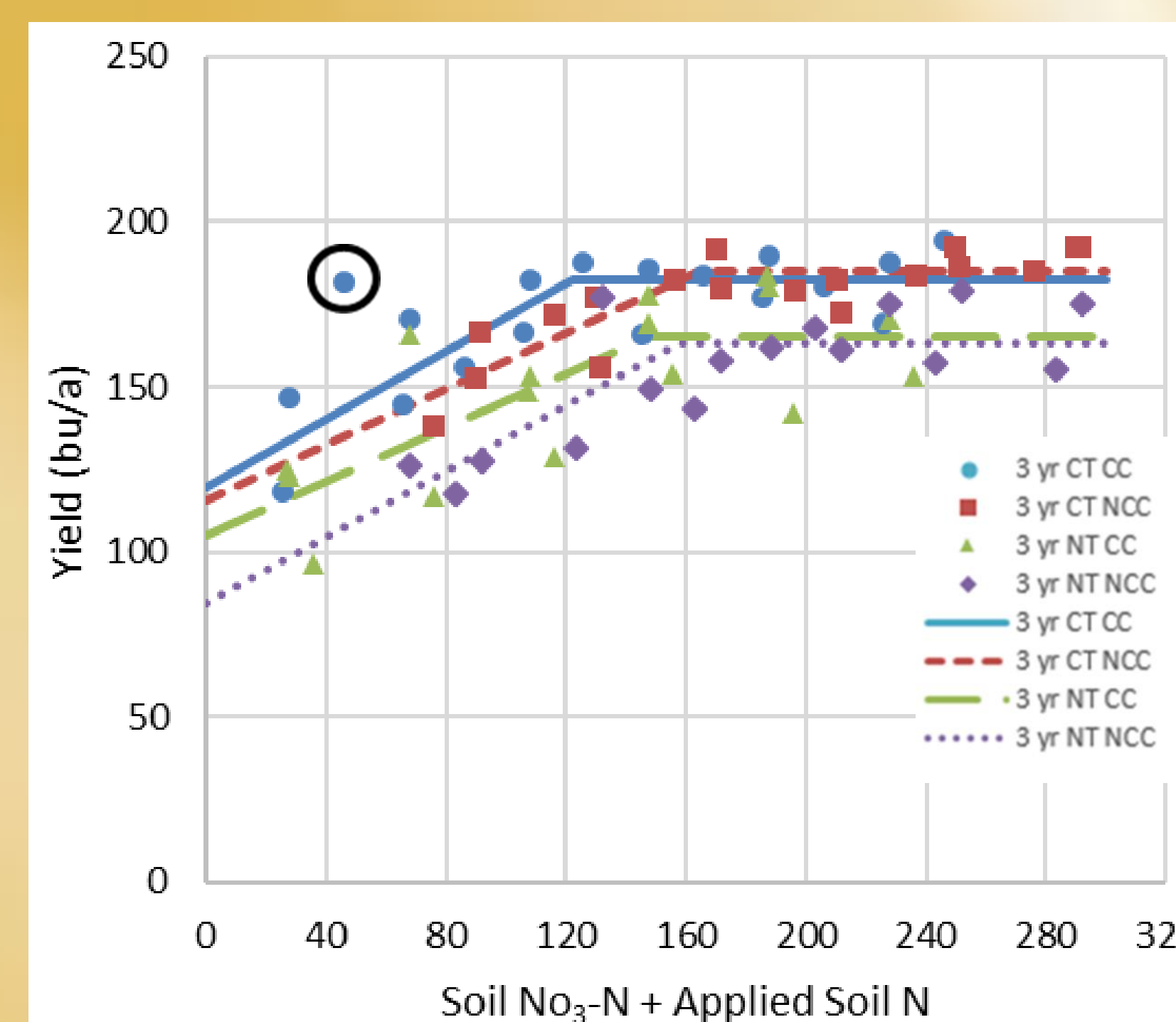
Item	Description
Cover Crop	Cover Crops were added to the 3 year rotation after small grain/before corn beginning in 2013. Blend: radish, dwarf essex rape, turnip, pea, lentil, oat, cowpea, millet, vetch
Plant Date <sup>1</sup>	2014: 16 May- 101 day corn at 32,300 seeds/a 2015a: 5 May- 111 day corn at 27,900 seeds/a 2015b: 2 June- 91 day corn at 33,000 seeds/a
Plot Size	2 year rotation: 45'x60' 3 year rotation: sup plots split by cover crop trt, 45'x30'
Harvest Date	2014: 30 October 2015a/b: 22 October
Variables Measured	SPAD, NDVI, ear leaf N, plant N, yield, test weight, moisture, grain protein
Exp. Des.	RCBD: strip split or strip strip strip

<sup>1</sup>Due to cutworms and poor stand establishment, the east 1/2 of all 2015, C/S plots and all C/S/O plots were sprayed out with SelectMax on 5/27/15 and replanted 6/2/15.

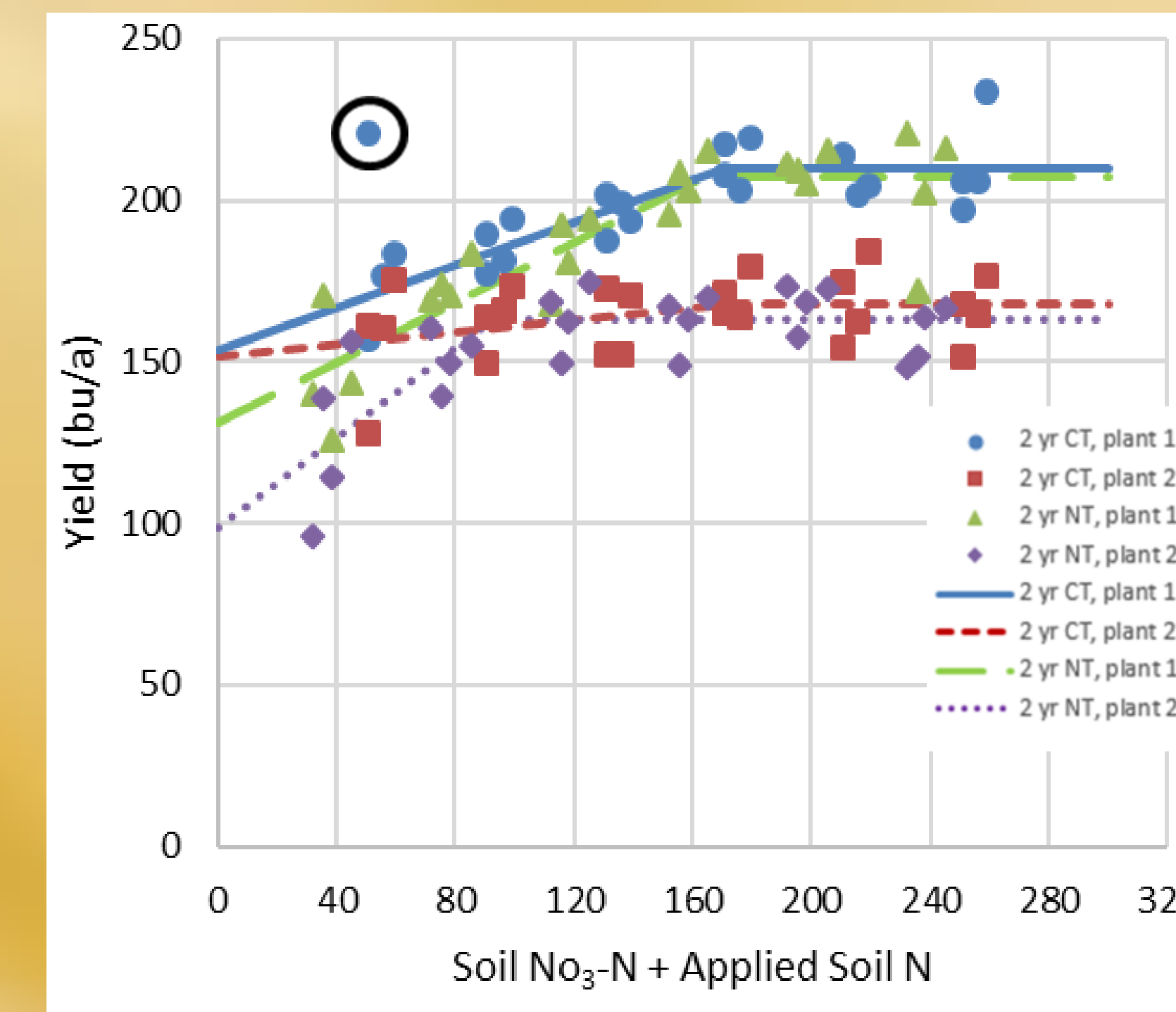
## Results



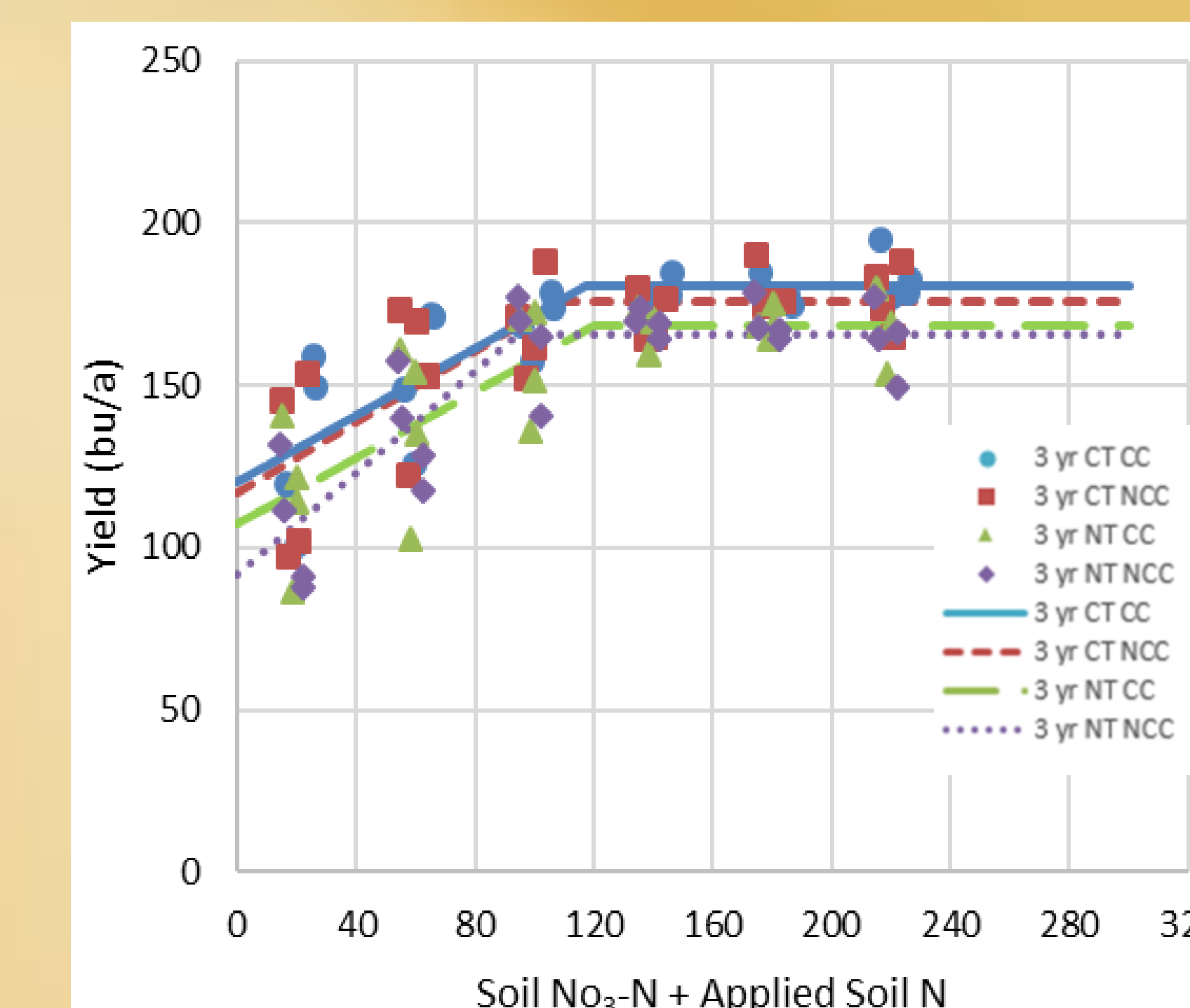
**Figure 2. 2014- Corn grain yield vs. soil N on a C/S rotation planted 5/16/14 near Beresford, SD. Circled data point treated as outlier.**



**Figure 3. 2014- Corn grain yield vs. soil N on a C/S/O rotation planted 5/16/14 near Beresford, SD. Circled data point treated as outlier.**



**Figure 4. 2015- Corn grain yield vs. soil N on a C/S rotation with two planting dates (5/5/15-plant 1) and (6/2/15- plant 2) near Beresford, SD. Circled data point treated as outlier.**



**Figure 5. 2015- Corn grain yield vs. soil N on a C/S/O rotation planted 6/2/15 near Beresford, SD.**

**Table 3. Spring soil tests and nitrogen recommendations on corn near Beresford, SD, 2014-2015.**

Year	Rotation	Tillage	Cover Crop	Plant Date	NO <sub>3</sub> -N	NH <sub>4</sub> -N	Haney N <sup>1</sup>	Legume Credit	SDSU N Rec. <sup>2</sup>	Haney Rec. <sup>3</sup>	Obs. Opt. N Rate <sup>4</sup>	
					---lbs/a (0-2')---	---	lbs/a (0-6")	---	-----lbs/a-----	-----		
2014	C/S	CT	--	--	42.3	23.7	48.0	40.0	126.7	126.2	83.1	
		NT	--	--	56.2	31.1	58.0	40.0	100.0	105.4	102.2	
	C/S/O	CT	CC	--	33.1	28.3	45.6		184.0	135.3	78.8	
		NT	NCC	--	85.9	22.8	62.1		136.3	123.1	81.4	
2015	C/S	CT	--	5-May-15	54.1	62.9	54.5	40.0	157.4	155.2	120.0	
		NT	--	2-Jun-15	54.1	62.9	54.5	40.0	105.7	112.0	59.9	
	C/S/O	CT	CC	--	5-May-15	37.8	66.7	38.5	40.0	170.0	168.0	121.1
		NT	NCC	--	2-Jun-15	37.8	66.7	38.5	40.0	117.7	124.4	59.0
	C/S/O	CT	CC	--	--	22.0	57.9	33.7		194.4	146.7	100.3
		NT	NCC	--	--	19.2	50.7	31.7		191.9	144.3	89.2
		CT	CC	--	18.5	58.4	32.2		183.5	136.2	99.8	
		NT	NCC	--	18.6	56.6	31.7		182.6	136.0	85.6	

<sup>1</sup>Haney N<sup>1</sup> indicates plant available soil N according to the Haney Method (Haney, et al., 1995-2012) which adds soil H3A nitrate, H3A ammonium, and organic N release together to develop a 0-6" plant available soil N value.

<sup>2</sup>SDSU N recommendations (Gerwing and Gelderman, 2005) are calculated by: ('yield goal'\*1.2)-0-2' soil test nitrate-legume credit.

<sup>3</sup>Haney recommendations are calculated by: 'yield goal'-Haney soil N calculation.

<sup>4</sup>Observed optimum N rate reflects the observed optimum N rate when plotted against yield using linear plateau statistics.

## Conclusions

- Optimum N rates tended to be similar under both CT and NT management, suggesting an update to current SD N recommendations.
- Under high early summer rainfall in 2014, CT plots had lower optimum N rates than NT plots.
- Winter annual weeds in NT plots may have effected the following corn crop yield in the C/S/O rotation.
- Where cover crops draw down soil N, both SDSU and Haney tests tended to over-predict corn N requirements, therefore soil nitrate testing should be further investigated.

## References

- Gerwing, J., and R. Gelderman. 2005. Fertilizer Recommendation Guide. EC750. South Dakota State University Plant Science Dep., Brookings.
- Goulding, K., D. Powlson, and A. Whitmore. 2013. The potential for soil carbon sequestration, including the role of nitrogen. FCRN Soil Carbon Workshop, SoilCIP, Rothamsted Research.
- Haney, R.L. et al. 1995-2012. Several Publications.

## Acknowledgements

