Remediation of a crude oil spill using thermal desorption: agronomic implications

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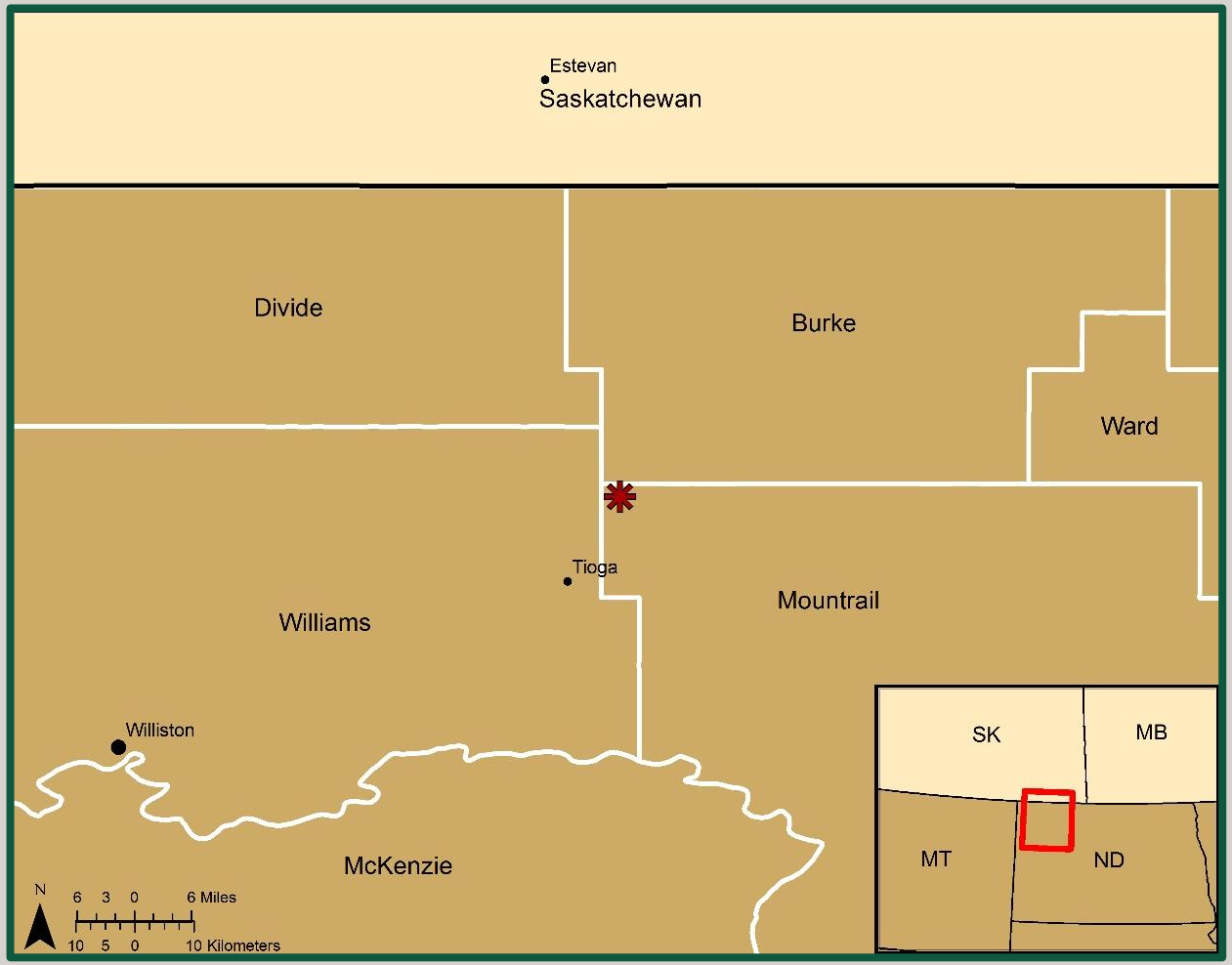
2013 Oil spill

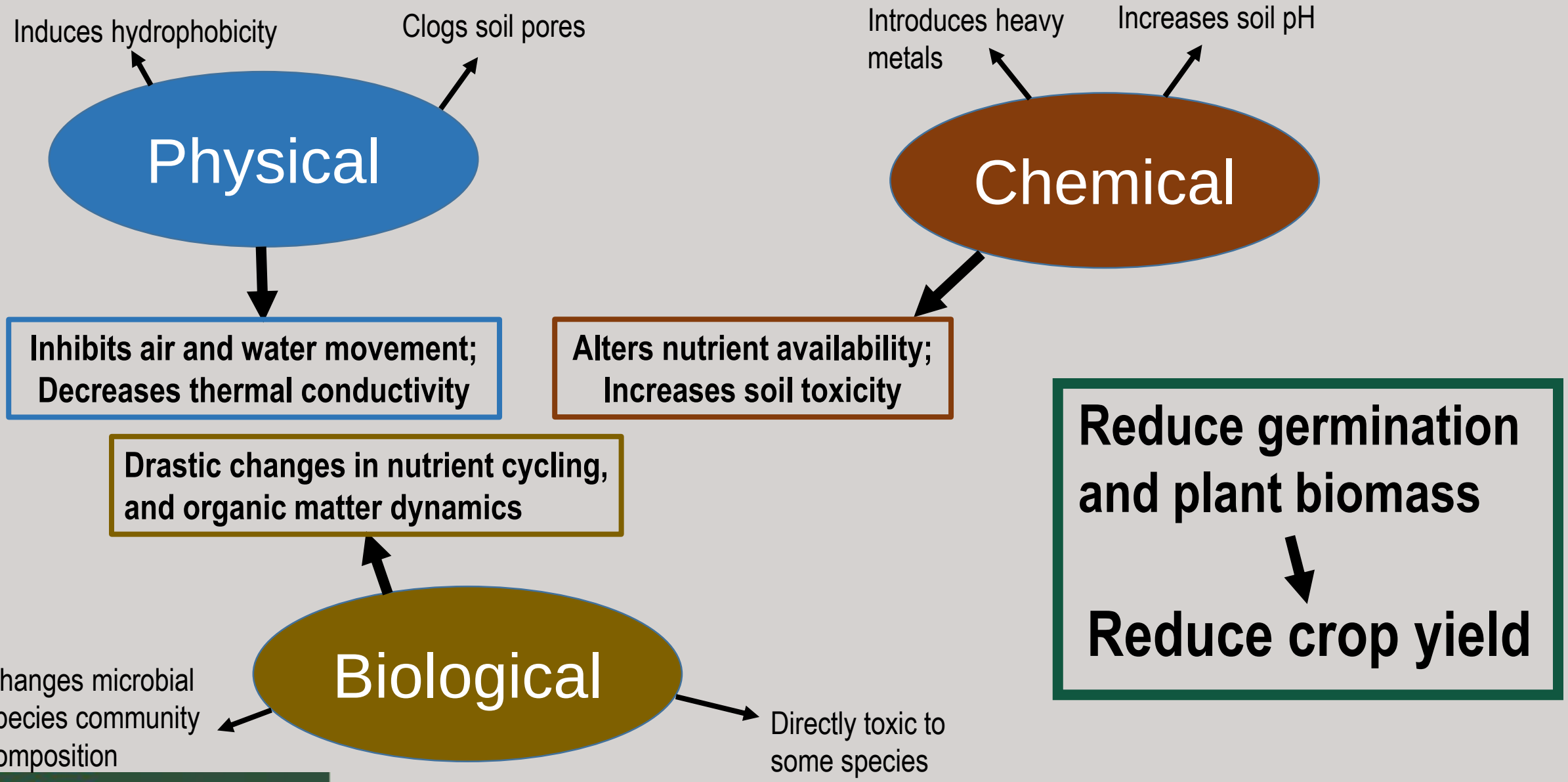


8.5 mm diameter hole released 21,000 barrels

Equivalent of 30 rail tankers

Spill site – October 2013

Impacts of crude oil pollution on soil health

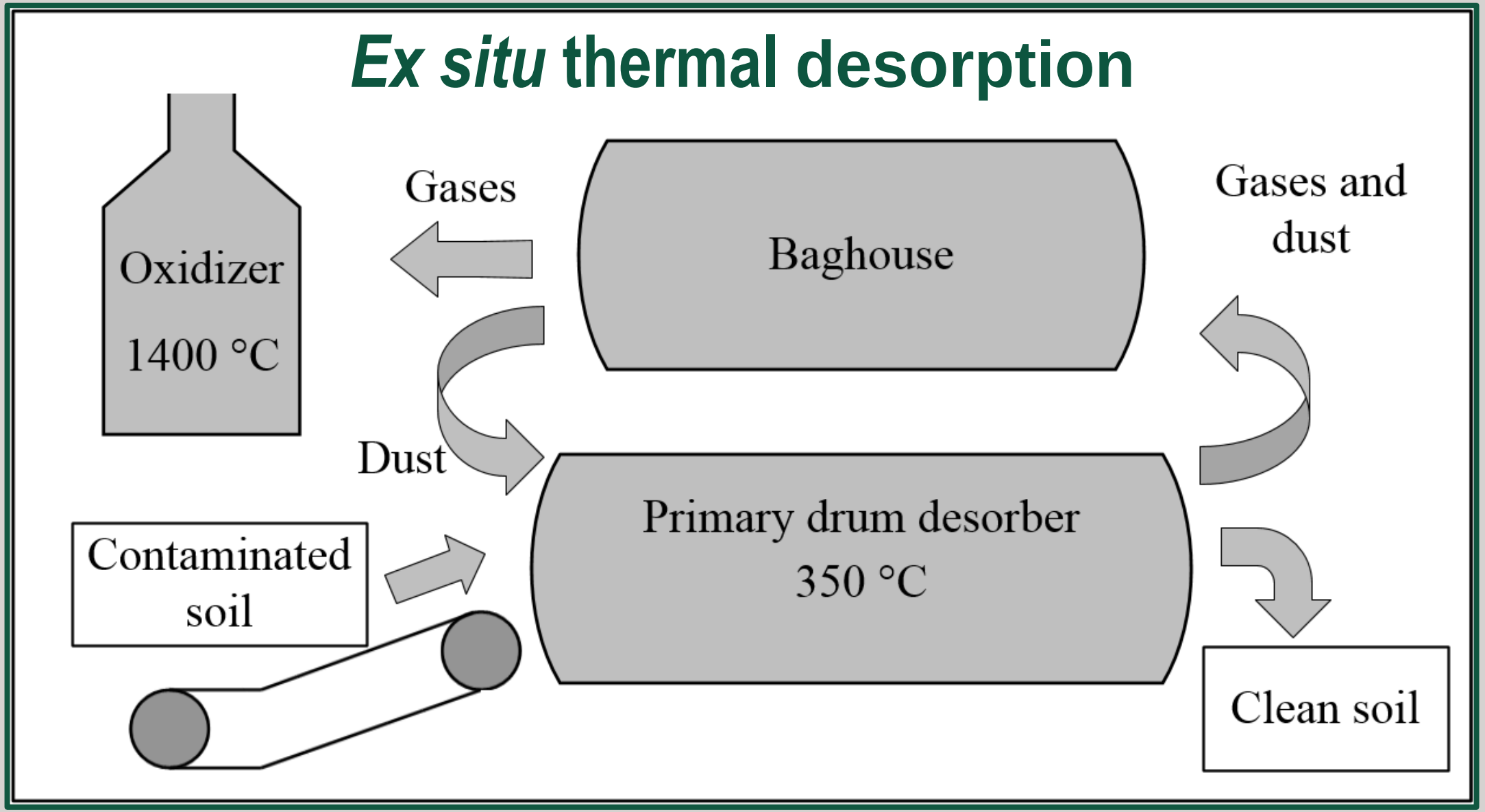


Reduce germination and plant biomass

↓

Reduce crop yield

Remediation technique



Thermal desorption process

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Remediation goals

1) Reduce total petroleum hydrocarbons to < 500 mg kg^{-1}

2) Return the land to pre-spill levels of agricultural productivity

Can we use TD soils for cropland production?

Laboratory analyses

Characterize the effect of TD on soil properties

Greenhouse experiments

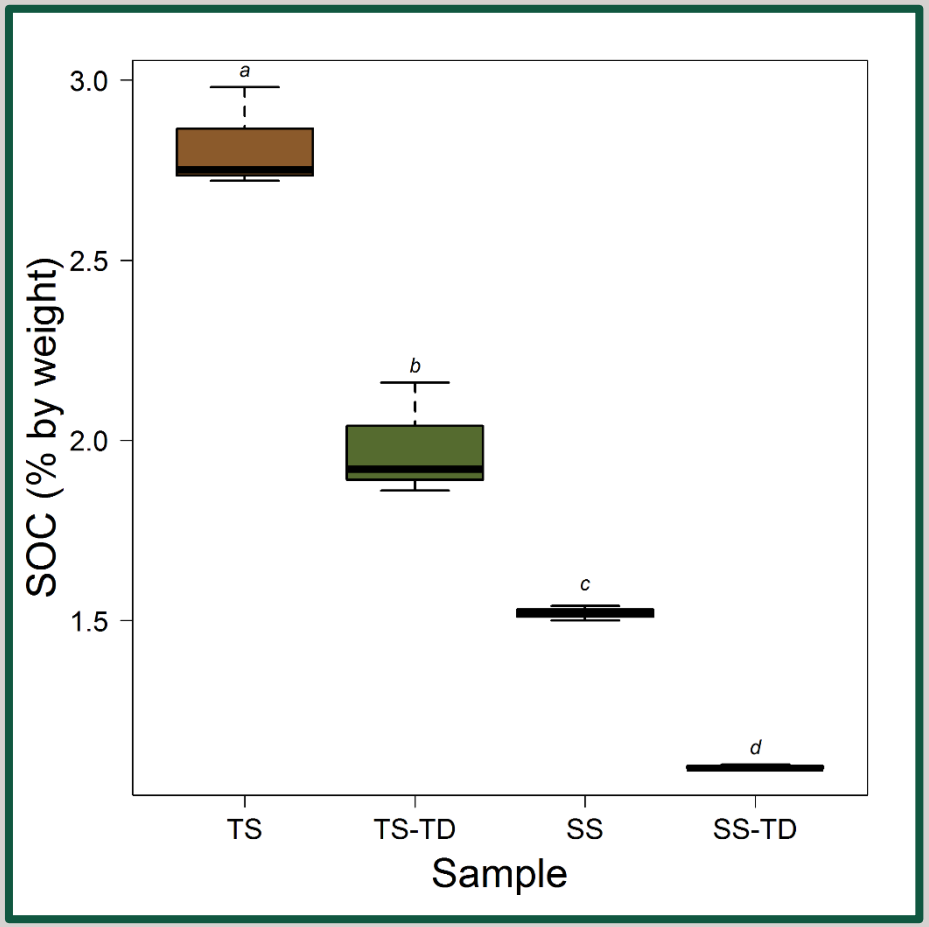
Experimental field plots

Investigate plant response to TD soils

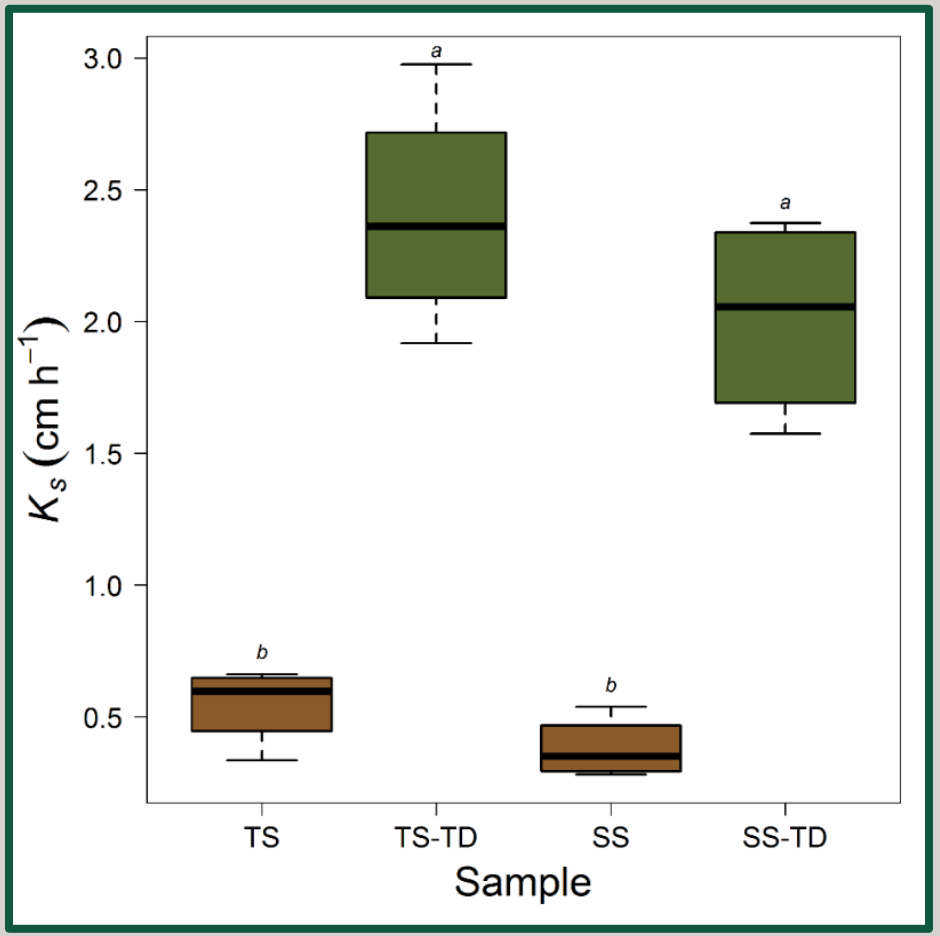
Identify strategies to increase the productivity of TD soils in agricultural settings

Laboratory analyses

Soil organic carbon



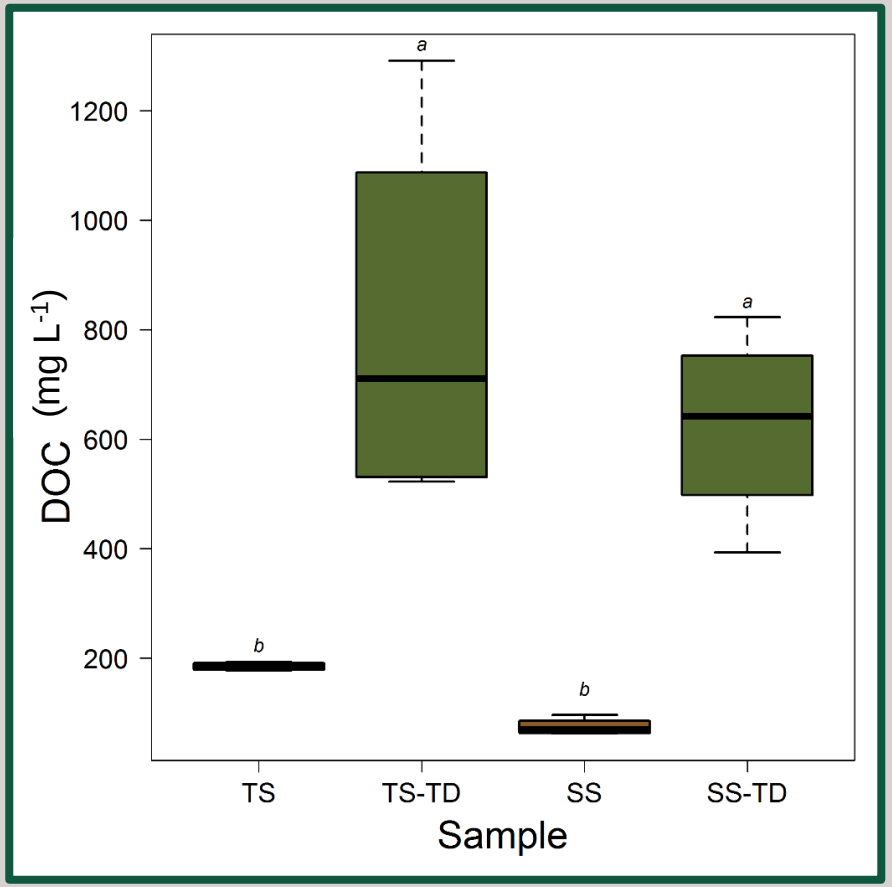
Saturated hydraulic conductivity



Laboratory analyses

TS SS TS-TD SS-TD

Dissolved organic carbon



Laboratory analyses

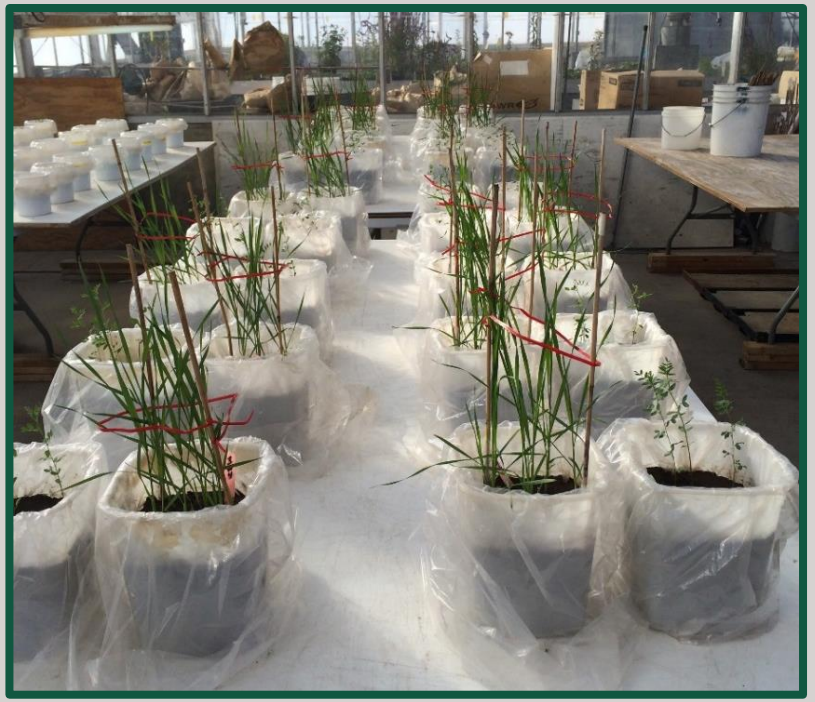
Plant available nutrients

	TS	TS-TD	SS	SS-TD
			(mg kg^{-1})	
NO_3^-	22	1	2.5	1
NH_4^+	16.3	79.9	12.3	60.3
P (Olsen)	14	65	5	47
K	262	301	164	218

Chemical parameters

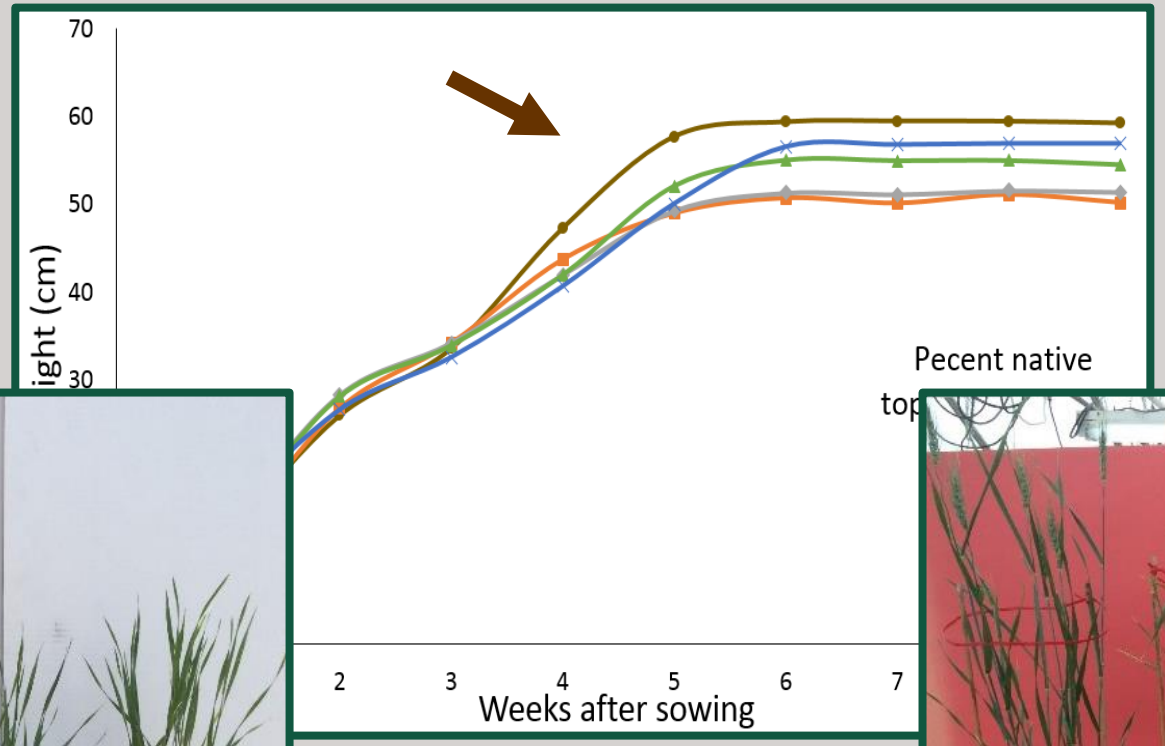
	TS	TS-TD	SS	SS-TD
pH	7.7	7.9	8.0	8.2
EC *(dS m^{-1})*	0.39	0.92	0.25	0.89
CEC (*cmol kg^{-1}*)	13.8	11.5	11.9	10.7

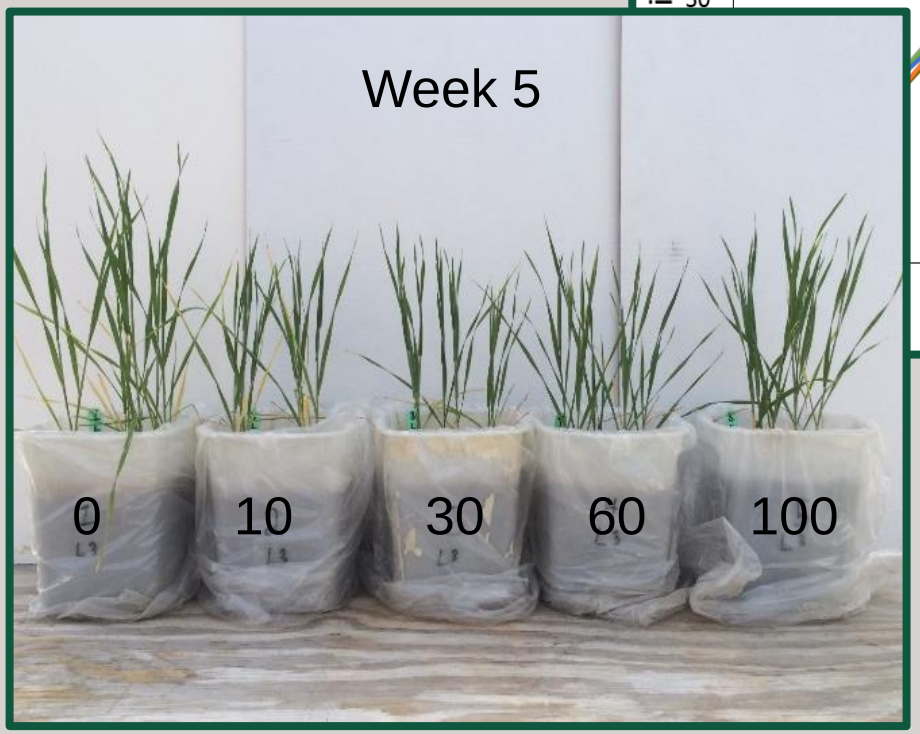
Greenhouse experiments

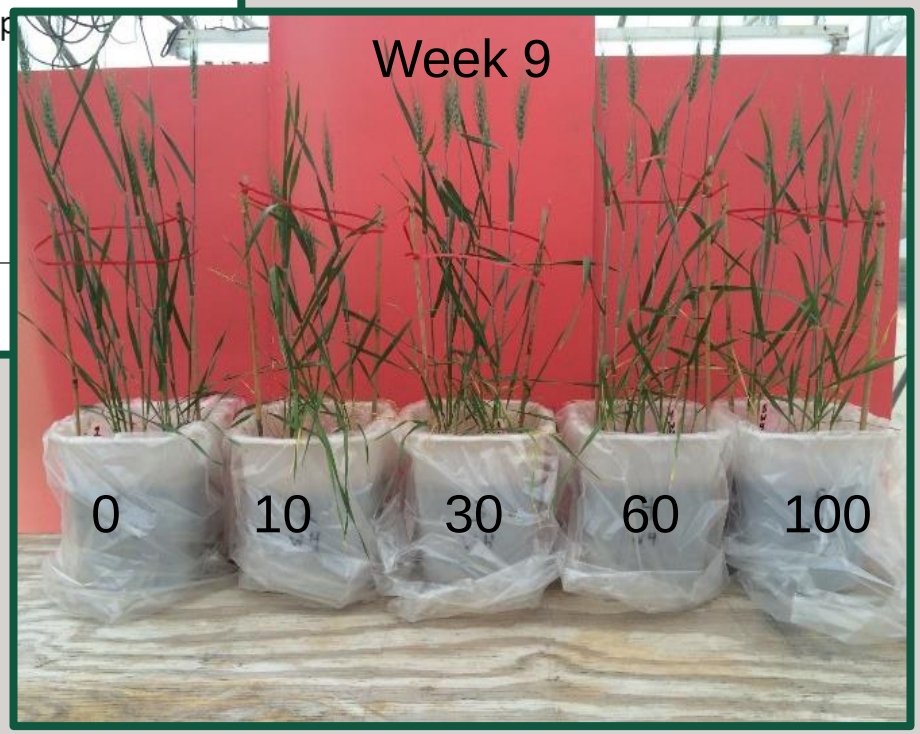


Treatment	TD treated soil	Native topsoil
A	100	0
B	90	10
C	70	30
D	40	60
E	0	100

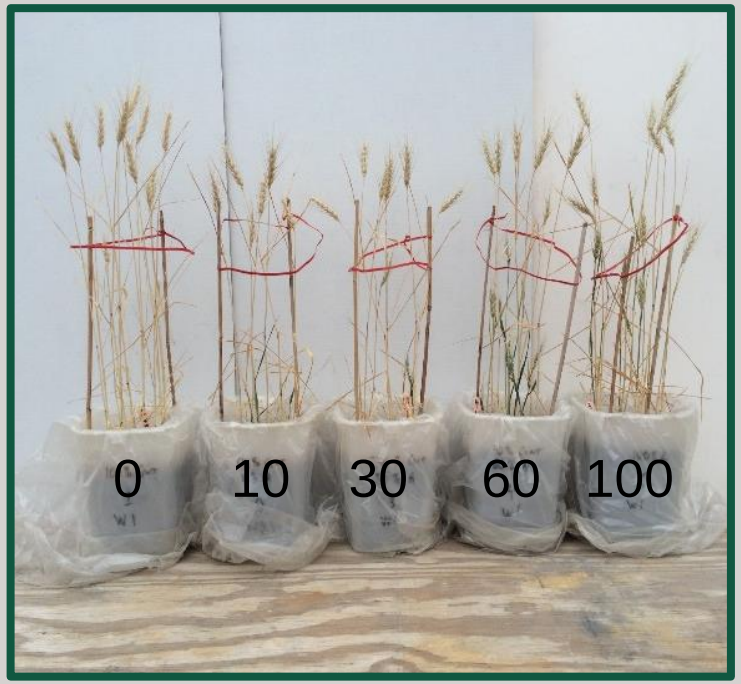
Greenhouse experiments

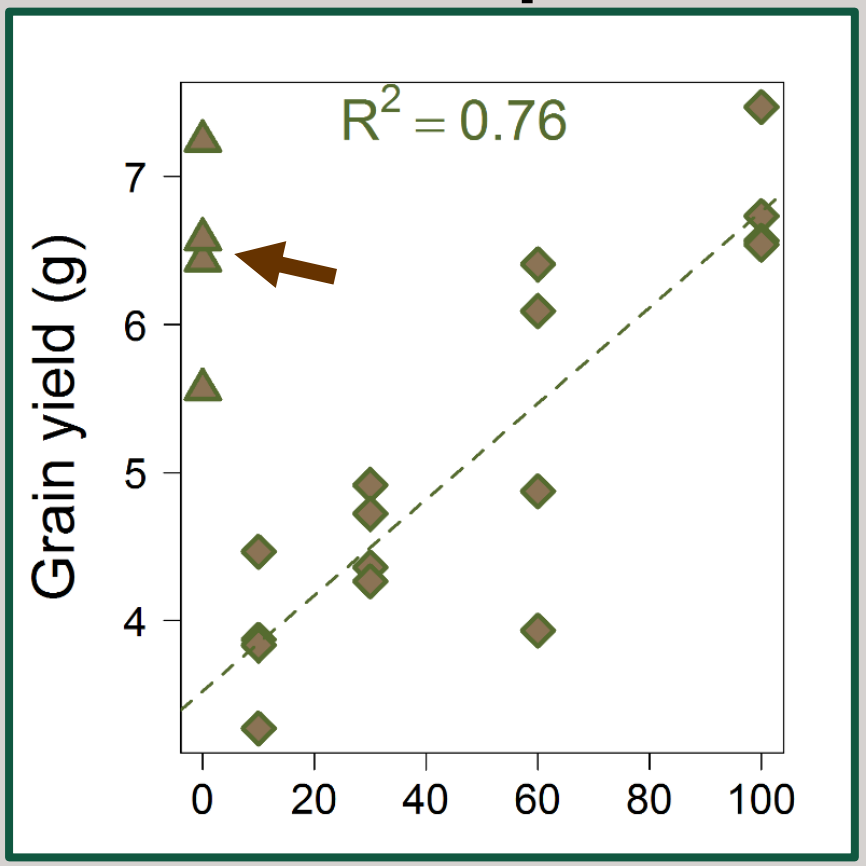


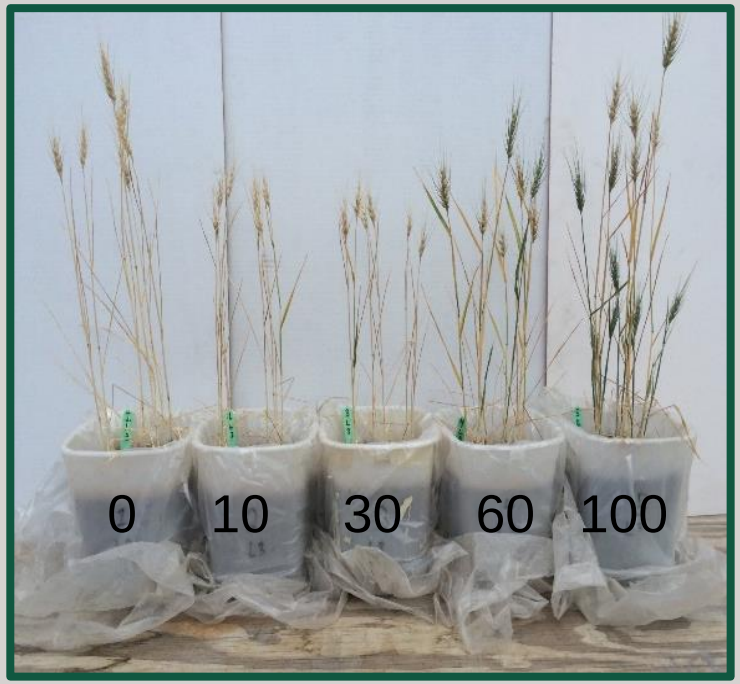




Greenhouse experiments







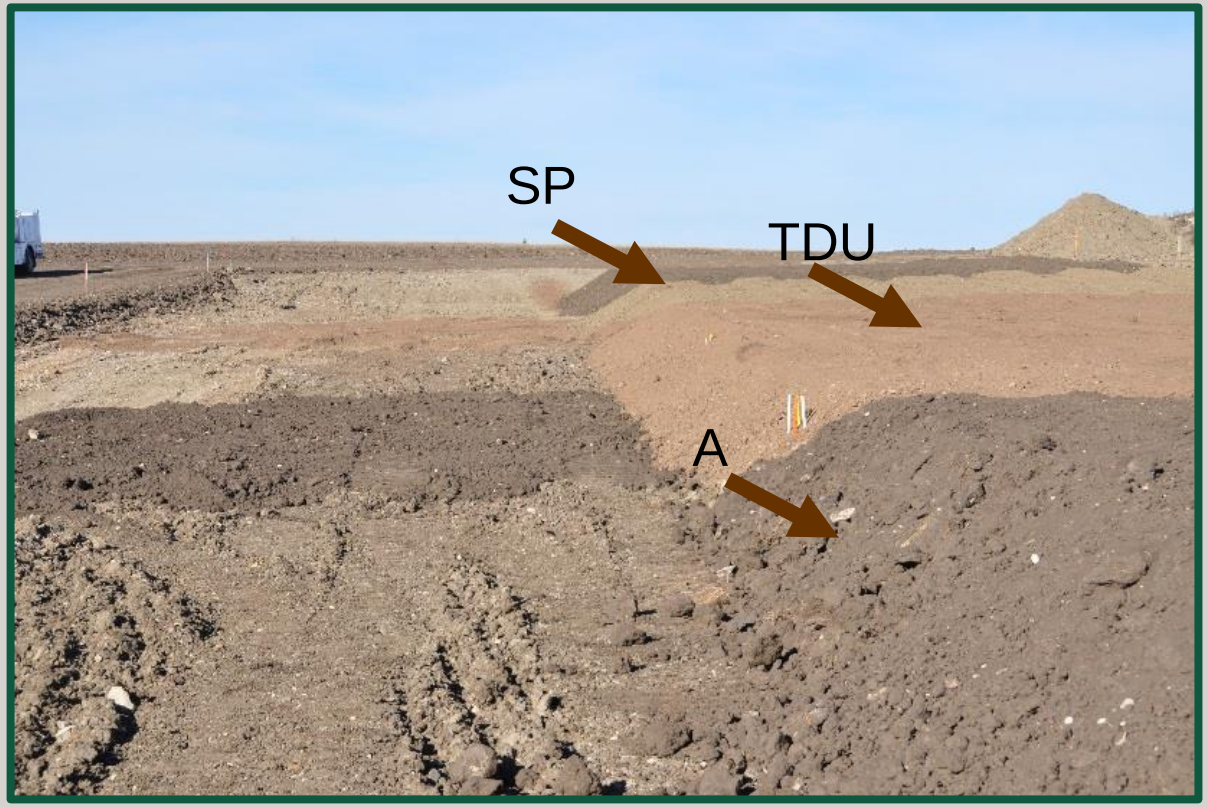
% Topsoil	0	10	30	60	100
	Grain protein content (%)				
	13.98	19.35	18.50	18.22	18.01

Experimental field plots

A: native, non-contaminated topsoil
(TPH < 50 mg kg^{-1})

TDU: contaminated soil that has been treated by TDU
(TPH approx. 500 mg kg^{-1})

SP: contaminated soil that has been excavated and stockpiled, but not yet treated
(TPH approx. 1400 mg kg^{-1})



Experimental field plots

Conclusions

1) TD treatment does alter some parameters related to soil health, notably a reduction in SOC and changes in water balances

2) Values of TD treated soils in these parameters is within range of many other soils used for agriculture

3) TD soils can sustain healthy crops throughout the life cycle of the plant

4) Adding organic amendments and customizing a fertilizer regime may offset some effects of TD treatment

Acknowledgements

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Thank you

Photo courtesy of Patty Jensen