The Variable Response of Dryland Corn Yield to Soil Water Content at Planting

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ABSTRACT

Farmers in the central Great Plains would like to diversify crop rotations from the monoculture of the traditional winter wheat-fallow system. Corn could work well as a rotation crop, but inputs are expensive and farmers would like to know the chances of producing a certain yield before investing in seed, fertilizer, herbicides, etc. Information on the yield response of corn to available soil water at planting could help guide the crop choice decision regarding corn. This study was conducted to determine if a predictive relationship exists between dryland corn yield and available soil water at planting time. Yield and soil water data from 10 years of an alternative crop rotation study at Akron, CO were analyzed by linear regression to determine predictive relationships. The yield-water content production function was found to be highly variable, ranging from 9.9 to 67.2 kg/ha per mm of available soil water in the 0-180 cm soil profile at planting. The differences in yield response to soil water were related to the amount and timing of precipitation that fell during the corn growing season. Because dryland corn yield is greatly dependent on rainfall during reproductive and grain-filling stages, soil water content at corn planting cannot be used to reliably determine whether corn should be planted in a flexible rotational system.

Introduction

- Reduced tillage systems have made more stored soil water available such that dryland cropping systems can be intensified from the traditional wheat-fallow system
- Corn is a potential crop to be included in intensified cropping systems, but input costs are high
- If corn yield is related to available soil water at planting, then a predictive relationship could be determined that would help farmers determine the potential for successfully producing a profitable corn crop before planting

Objective

- Quantify corn yield response to available soil water at planting to determine if a consistent predictive relationship exists that will aid farmers in making a crop choice at time of planting

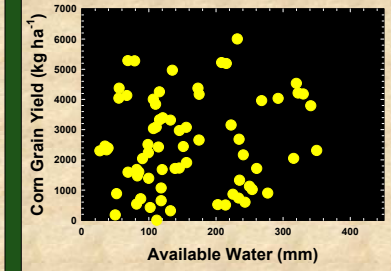
Materials and Methods

- Location: Akron, CO
- Source data: Alternative Crop Rotation Study (1992-2001)
- Soil water prior to corn planting by TDR (0-30 cm) and by neutron probe (30-60, 60-90, 90-120, 120-150, 150-180 cm). Available soil water computed by subtracting off Lower Limit (0.110, 0.135, 0.870, 0.740, 0.790, 0.101 cm^3 cm^{-3} for the respective six depths)
- Soil type: Weld silt loam (fine, smectitic, mesic Aridic Argiustolls)
- Variation in soil water content at corn planting resulted from intensity of rotation and previous crop water use

Rotation	Years
corn-dry bean	1995-1996
corn-millet	1996
corn-forage millet	1996
corn-sunflower	1992-1994
corn-oat-wheat	1995-1997
corn-pea-wheat	1998-2001
corn-millet-wheat	1992-2001
corn-fallow-wheat	1992-2001
corn-millet-pea-wheat	1997-2001
corn-millet-forage pea-wheat	1998-2001
corn-millet-wheat-wheat	1997-2001
corn-millet-fallow-wheat	1998-2001
corn-sunflower-fallow-wheat	1998-2001
opportunity cropping	1995-2000

Alternative Crop Rotation Experiment

24 July

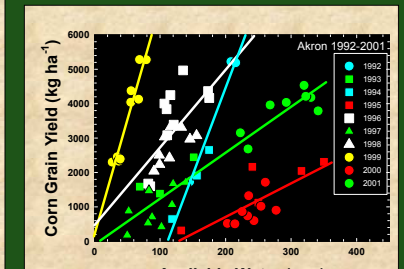


Data from all rotations and all years appear to show that there is no relationship between corn grain yield and available soil water content at planting.

Year	Planting Date	Hybrid	Population (seeds/ha)	Period Precipitation (mm) Planting-7/14	7/15-8/25	8/26-9/30	Total
1992	4 May	Pioneer 3732	36800	154	119	18	291
1993	29 April	Pioneer 3732	36800	96	112	24	232
1994	6 May	Pioneer 3732	39800	86	38	12	136
1995	18 May	Pioneer 3732	36800	159	70	64	293
1996	1 May	Pioneer 3732	36800	234	77	106	417
1997	1 May	Pioneer 3732	36800	138	72	43	253
1998	12 May	DK493Bt	39800	54	124	8	186
1999	7 May	DK493Bt	39800	121	107	80	368
2000	10 May	DKC49-92	39800	94	30	71	195
2001	16 May	NK4242Bt	41000	108	96	45	249

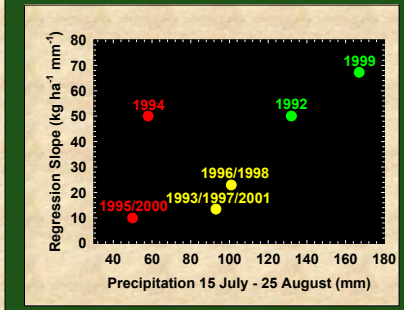
High
Medium
Low

Growing season precipitation varies widely in distribution and amount across years.



Years with similar rainfall during the critical 15 July to 25 August period had similar yield responses to available soil water at planting (except 1994).

Years	Intercept	Slope	R^2	# obs	7/15-8/25 precip class
1995/2000	-1274	9.9	0.57	14	Low
1993/1997/2001	-102	13.4	0.91	20	Medium
1996/1998	432	22.9	0.43	19	Medium
1992/1994	-5590	50.0	0.97	6	High/Low
1999	145	67.2	0.91	9	High



The response of corn grain yield to available soil water at planting (regression slope) increases as amount of critical period precipitation increases.

1994 did not fit the pattern, showing high yield response under low critical period precipitation.

Conclusions

- Corn grain yield was linearly correlated with available soil water content at planting (yield increasing with increasing available water).
- The linear relationship varied greatly depending on the amount of precipitation that occurred during the critical 6-week period of 15 July to 25 August (pre-tassel through mid-grain fill [R3-R4]).
- The slope of the response of grain yield to available soil water at planting increased with increasing amount of precipitation received from 15 July to 25 August.
- Although there is no consistent relationship between available soil water at planting and corn grain yield, dryland producers can be assured that all management decisions that reduce tillage, conserve surface residues, and increase available soil water at planting will increase yield.

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Alternative Crop Rotation Experiment

15 August