Analysis and Meta-Analysis of Long-Term Effect of Tillage on Yield and Water Use of Wheat and Sorghum.

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INTRODUCTION

Tillage is among the most important management decisions dryland crop producers have to make every cropping season.

Research reports on the yield benefit from no-till compared to conventional tillage has been mixed, i.e.,

- **a yield benefit from no-till compared to conventional tillage**
- **lower yields from no-till compared to conventional tillage**
- **and crop and management specific advantages of no-till or conventional till**

were all reported in literature.

Objective

To determine the impact of tillage on a dryland warm-season crop (grain sorghum) and dryland cool-season crop (winter wheat) yields, soil water at planting, water use, and water productivity.

MATERIALS & METHODS

1. Field experiment

- **Tribune, KS (38°28' N, 101°45'W)**
- **from 1991 through 2015**
- **three tillage intensities treatments were conventional (CT), reduced (RT), and no-till (NT).**

2. Meta analysis

- **Data from 24 other peer-reviewed published articles were collected objectively and meta-analyzed.**
- **Studies included in analysis ranged from 1984-2011 and were mostly from USA Great Plains Region.**

RESULTS and DISCUSSION

1. Field Experiment

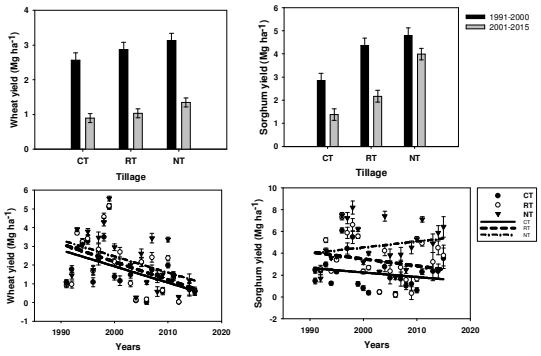

Figure 1 – Winter wheat and grain sorghum yields for conventional, reduced, and NT average over years (top panel) and trend in years from 1991-2015 (top panel) and in Tribune, KS.

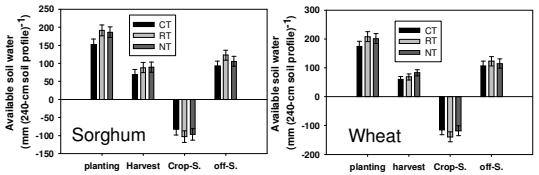

Figure 2. Available soil water at planting and at harvest of sorghum and wheat, and crop-season and off-season soil water changes in three tillage systems for the 0-240 cm soil profile.

2. Meta Analysis

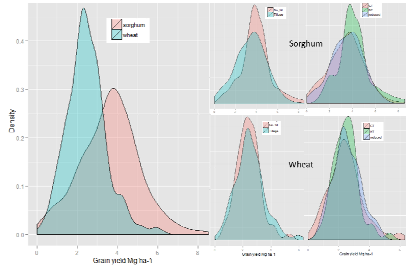

Figure 3. Over view of yield data distribution in the meta-data by crop, till and no-till, and by conventional, reduced, and no-till methods

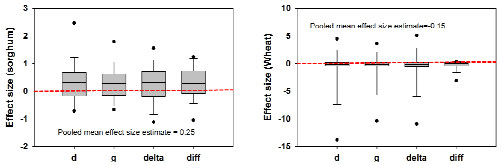

Figure 4. Effect size (standardize mean difference) based on Cohn's d (d), Hedge's (g), Glass' Δ (delta) and weighted mean differences (diff) of no-till compared to tillage on sorghum yield (a) and wheat yield (b).

Experiment

- **Averaged over all study years, there was a 31%, 16%, and 12% wheat yield advantage for NT over CT, NT over RT, and RT over CT, respectively and there was a decline in wheat yield over time for all tillage systems.**
- **There was a 120%, 41%, and 55% sorghum yield advantage for NT over CT, NT over RT, and RT over CT, respectively. There were no significant change over time for average yield of sorghum for all tillage systems.**

Meta-analysis

- **Sorghum yield, water use, and water productivity was greater in NT compared to tillage.**
- **Wheat yield, water use, and water productivity did not significantly differ between NT compared to tillage treatments.**

CONCLUSION

We concluded a yield benefit from NT for dryland sorghum and a moderate or no benefit for wheat, despite a soil water gain from NT for both crops. Perhaps the longer growing season for wheat and other environmental factors overwhelmed the effect of increased soil water at planting.