SOIL C AND N CYCLING UNDER REDUCED-TILLAGE AND COVER CROPPING IN THE SOUTHERN HIGH PLAINS AGROECOSYSTEMS

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Background

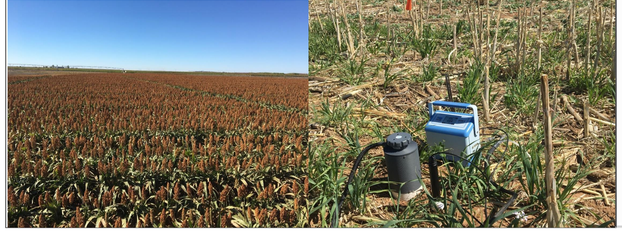
- Cover crops can benefit agroecosystems by reducing soil erosion, improving soil quality, and conserving soil water in dry areas.
- Effects of cover cropping and other conservation practices has not been studied extensively in a dry, hot agroecosystems of the southern High Plains.

Objectives

- To evaluate soil organic matter dynamics and soil CO_2 emissions in (a) a limited-irrigated winter wheat-sorghum-fallow, and (b) a corn-sorghum rotation with cover cropping and diverse tillage systems.

Materials and Methods

- ***Study Site*:** NMSU Agricultural Science Center, Clovis.
- ***Soil type:*** Olton clay loam ((Fine, mixed, superactive, thermic Aridic Paleustolls)
- ***Cropping system:***
  - ***Study 1:*** Winter wheat-sorghum-fallow under limited-irrigation and no-tillage management.
  - ***Study 2:*** Corn-sorghum rotation under dryland condition and strip-tillage and no-tillage management.
- ***Experimental design and treatments:*** Randomized complete block design with split plot arrangement of treatments.
  - **Study 1 treatments:** Fallow (F) and Pea (P), Oat (O), Canola (C), Pea+Oat (PO), Pea+Canola (PC), Pea+Oat+Canola (POC), and six species mixture (Canola, Pea, Oat, Barley, Vetch, and Forage Radish – SSM) as cover crop treatments in a winter wheat-sorghum-fallow rotation.
  - **Study 2 treatments:** Conventional tillage, strip-tillage, and no-tillage with and without cover cropping in a corn-sorghum rotation.
- **Observations:** Weekly CO_2 emissions, soil and air temperature, soil water content, soil organic matter pools, nutrients, weed suppression, and crop yields of the following winter wheat and sorghum.



Results

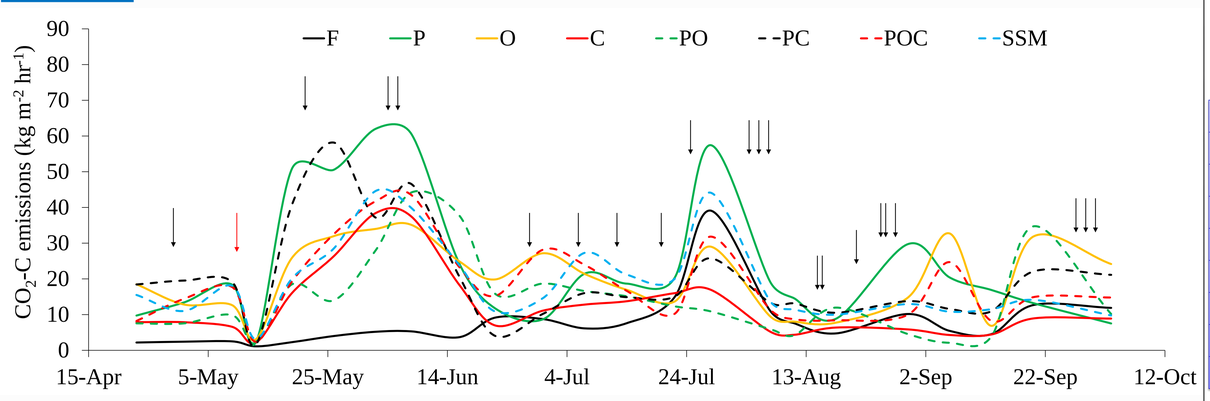


Fig. 1. Effects of cover cropping on soil CO_2-C emissions during cover crops growth, and residual effects after termination. F, fallow, P, pea, O, oat, C, canola, PO, pea and oat, PC, pea and canola, POC, pea, oat and canola, SSM, six species mixture of POC, barley, hairy vetch, and forage radish.

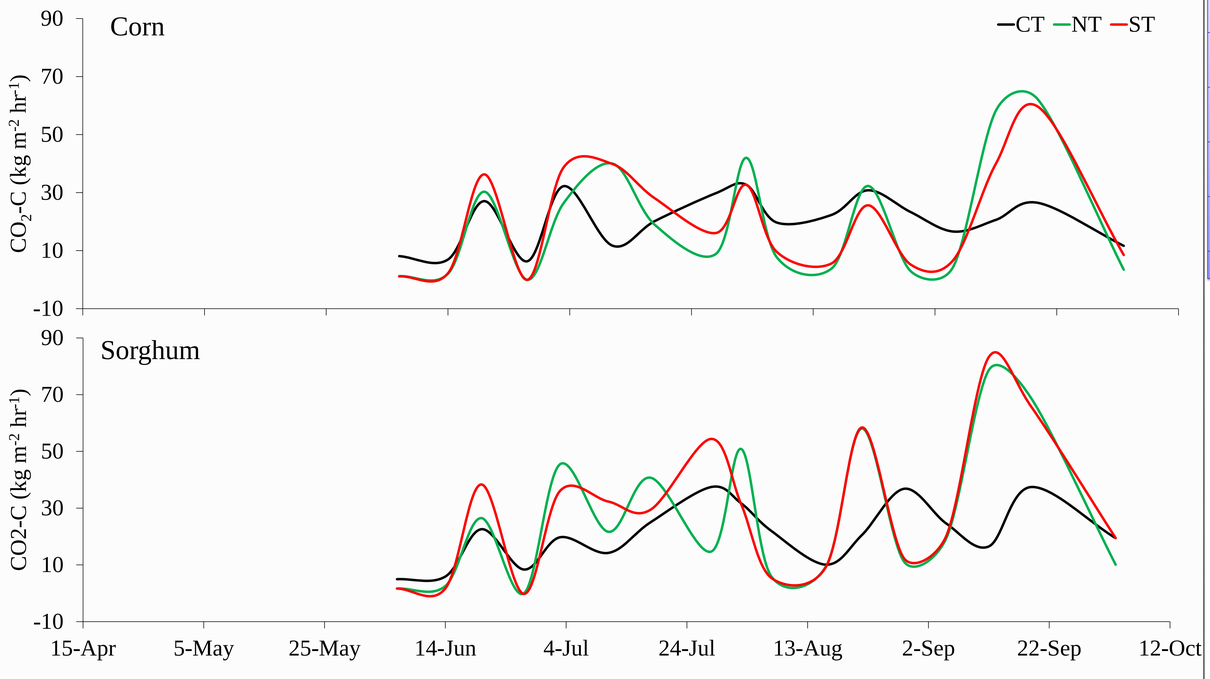


Fig. 2. Effects of tillage systems on soil CO_2-C emissions during corn and sorghum growing season in a dryland corn-sorghum rotation. CT, conventional tillage, ST, strip tillage, NT, no-tillage.

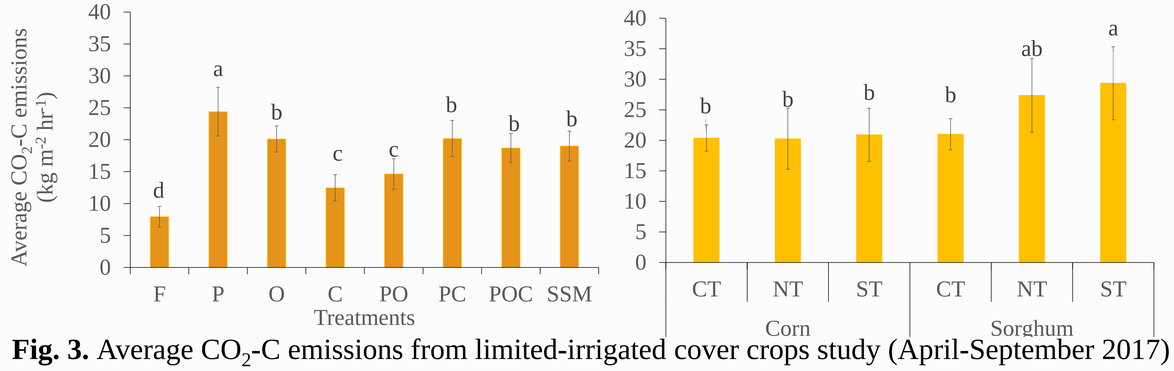


Fig. 3. Average CO_2-C emissions from limited-irrigated cover crops study (April-September 2017) and dryland corn-sorghum rotation (May-September 2017).

Table 1. Available nitrogen (N), potentially mineralizable N (PMN) and C (PMC) at the time of cover crop termination in a limited-irrigation winter wheat-sorghum-fallow.

Treatment	Available N (mg/kg)	PMN (mg/kg)	PMC (mg/kg)
F	7.83a	4.85a	109.1a
P	3.53b	4.20a	90.8ab
O	2.71b	3.54a	84.6b
C	3.08b	3.68a	100.7a
PO	3.22b	2.11a	84.5b
PC	2.82b	4.52a	104.8a
POC	2.44b	3.37a	97.5ab
SSM	3.44b	2.22a	81.4b

Table 2. Available N, potentially mineralizable N (PMN) and C (PMC) at the time of cover crop termination in a dryland corn-sorghum rotation.

Cropping system*	Cover crops	Available N (mg/kg)	PMN (mg/kg)	PMC (mg/kg)
NTC	No	10.1d	14.5de	70.3c
	Yes	6.97d	10.1d	109b
STC	No	19.7c	26.9cd	115b
	Yes	66.9b	53.4b	121b
NTS	No	10.2d	17.6d	92.4bc
	Yes	47.8b	39.4c	115b
STS	No	31.8c	52.2b	64.6c
	Yes	130a	82.5a	86.5c
CTC	No	12.0d	21.0d	182a

*NTC and NTS represent no-till corn and sorghum, STC and STS represent strip-till corn and sorghum, and CTC is conventional tillage corn.

Discussion and Conclusions

- Greater CO_2 emissions in cover crop plots than fallow plots in a limited-irrigation winter wheat-sorghum-fallow, and strip-tillage sorghum plots than other plots in a dryland corn-sorghum rotation suggest improvements in microbial activity under these practices.
- Available N and PMN increased and PMC decreased in strip tillage and no-tillage systems than in a conventional system.
- Reduced-tillage systems and cover cropping reveal the potentials of improving soil quality through their effects on soil C dynamics and nutrient cycling.
- Long-term monitoring will further our understanding of the effects of conservation systems on soil health and agroecosystem resilience in the semiarid drylands.

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