Moisture management is key for cover crop success in South Texas

Stephanie Kasper [1], Lindsey Richards [2], Fallon Fraustro [2], Alexis Racelis [1,2]

[1] *Department of Biology, University of Texas Rio Grande Valley*
[2] *School of Earth, Environmental, and Marine Sciences, University of Texas Rio Grande Valley*

Highlights

- Year 1 - Insufficient recharge (11 days, 7 mm rain) between cover crop termination and cash crop seeding caused sorghum crop failure
- Year 2 - A 71-day recharge between cover crop termination and cash crop planting resulted in better moisture recharge (43 mm rain) and cash crop success
- Year 3 - In-ground moisture sensors installed in the sorghum root zone provide fine grain insights into cover crop water usage and soil moisture response to rainfall events and drought periods
- In all seasons, cover cropped areas showed lower soil moisture than control plots at cover crop termination, but with longer soil recharge periods, moisture lags can be overcome before cash crop seeding

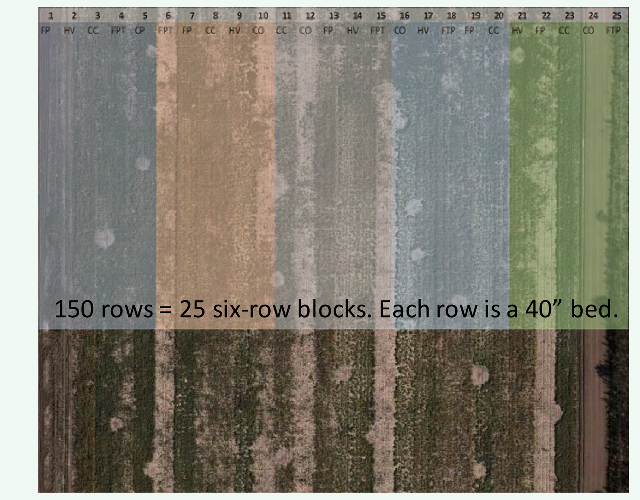
Introduction

Cover crops are a heavily-promoted soil health management tool with demonstrated abilities to suppress weeds and improve soil health.[1] They can be a low-input way for farmers to manage soil health, but adoption rates in South Texas remain low due to concerns about moisture usage by cover crops. The risk of poor germination and yield loss in subsequent cash crops has been validated in our work and under similar moisture constraints in other semi-arid regions. [2]

Monitoring soil moisture is key for successful cover crop integration, especially in moisture-limited regions. Appropriate recharge gaps between cover crop termination and cash crop seeding vary in length depending on rainfall received and cover crop species grown. If careful attention is paid to soil moisture recharge, major yield losses can be avoided and some of the short-terms costs of improving soil health through cover cropping may be lessened.

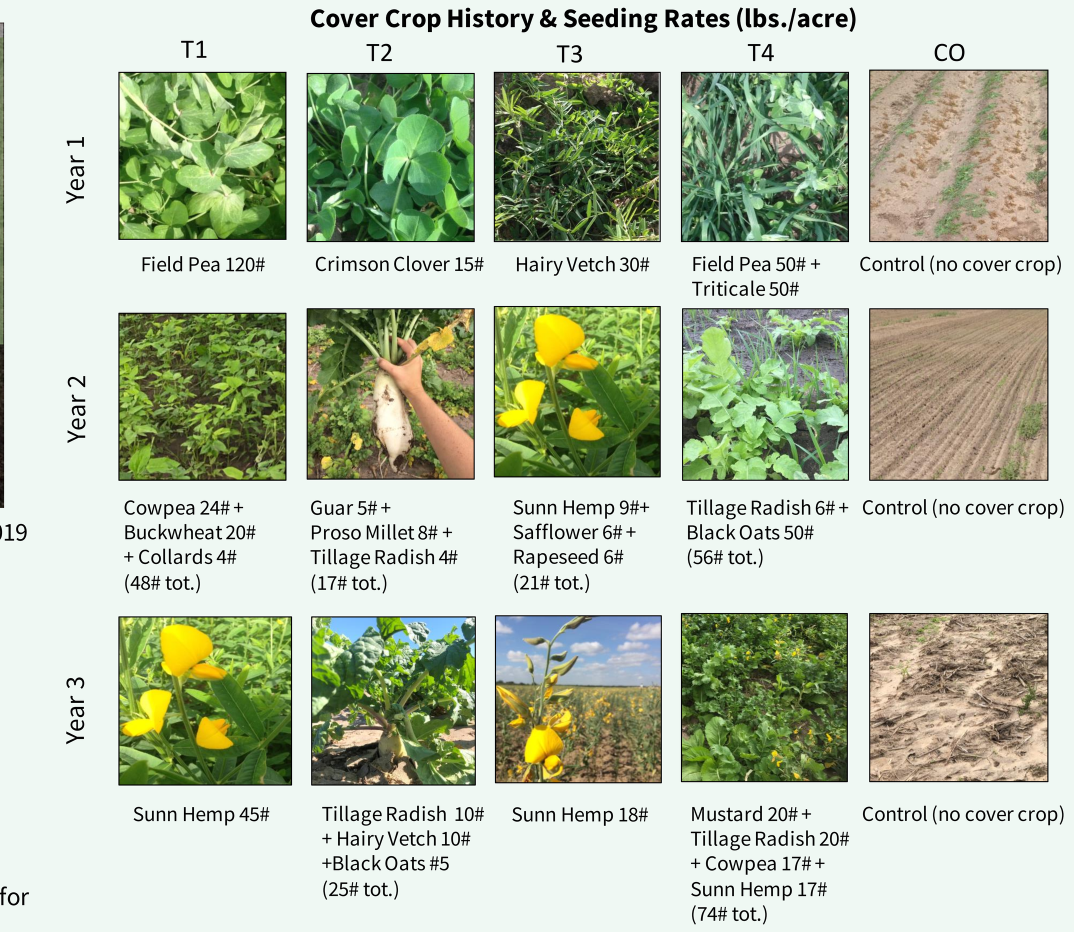
Methods

- 12-acre dryland grain sorghum plot in Lyford, TX
- Complete randomized block design
  - 4 cover crop treatments + control
- Years 1-3: Soil surface moisture (0-5 cm) with TEROS 12 probe weekly during cover crop season, monthly otherwise
- Year 3: 25 TEROS 11 moisture sensors installed for constant in-situ monitoring at 10 cm depth
- One-way ANOVAs in R for each measurement date for surface moisture and on weekly averages of sub-surface moisture values
  - Post-hoc comparisons with Holm-Sidak method
- Correlations between biomass and moisture using Spearman's method for nonparametric data
- Participatory research with farmer-influenced cover crop selection



Aerial Imagery of Hilltop Gardens, Block 15 - M. Kutugata 2019

Installation of Teros 11 in-ground soil moisture sensors for root zone moisture measurements at 10 cm depth.



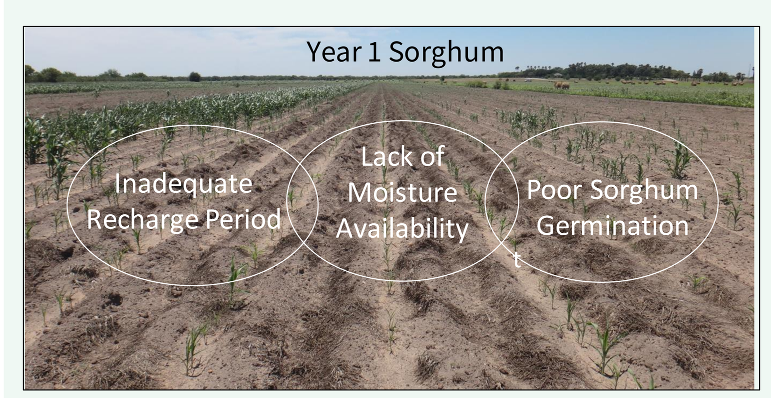
Results

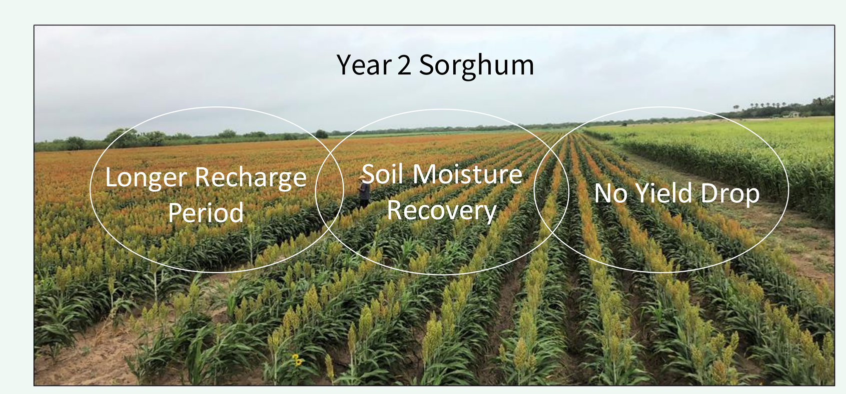
Planting Calendar and Rainfall

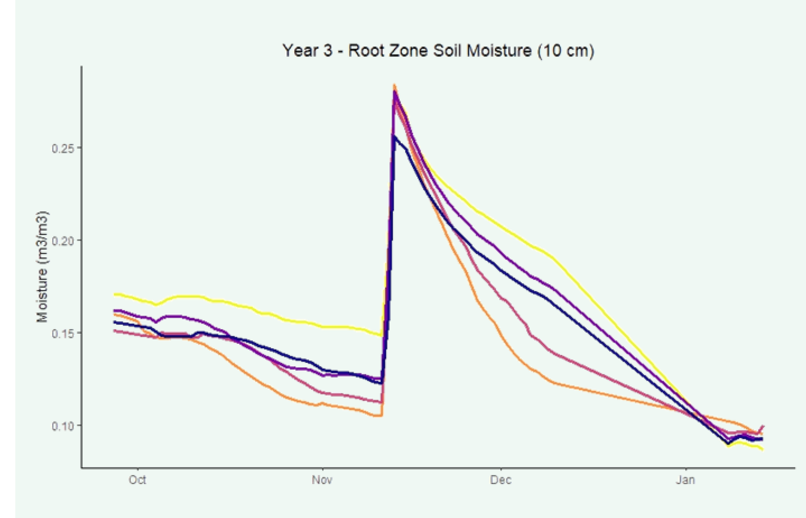
		Dates	Days	Rain (mm)
Year 1	Cover crop	11/17/17 - 2/24/18	100	24.40
	Recharge	2/25/18 – 3/7/18	11	7.30
	Sorghum	3/8/18 – 6/12/18	97	56.60
	Fallow	6/13/18 – 9/24/18	115	332.10
	Total			420.40
Year 2	Cover crop	9/25/18 – 12/17/18	84	146.10
	Recharge	12/18/18 – 2/26/19	71	43.30
	Sorghum	2/27/19 – 9/3/19	189	169.12
	Fallow	9/4/19 – 9/17/19	34	32.60
	Total			391.12
Year 3	Cover crop	9/18/19 – 12/30/19	104	112.60
	Recharge	12/31/19 - present	15	7.60
	Sorghum	-	-	-
	Fallow	-	-	-
	Total			120.20

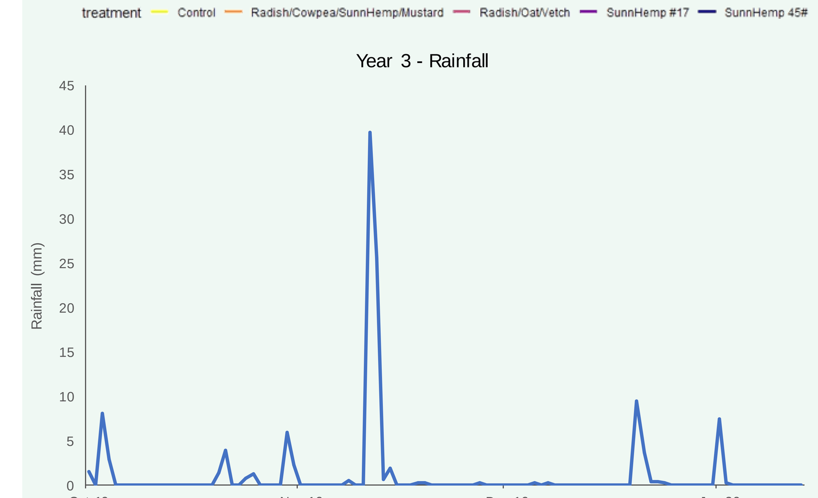
Surface Moisture (0-5 cm)

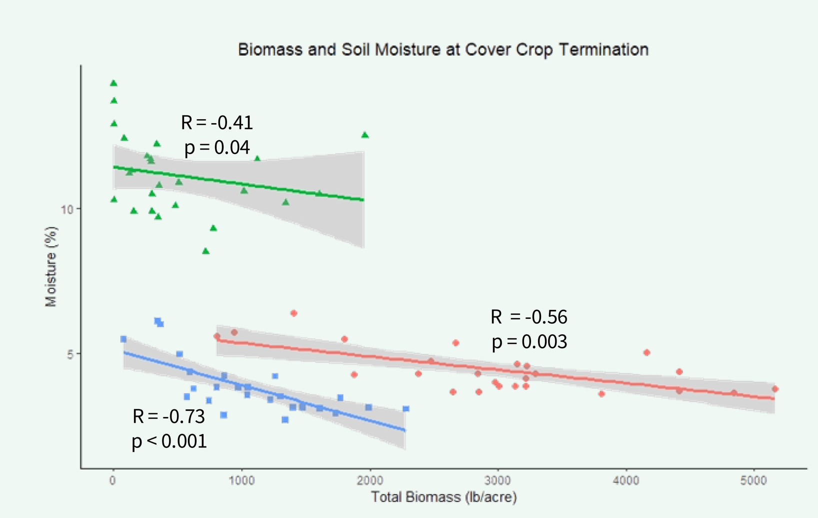
	Period	Treatment Differences
Year 1	Cover crop seeding	
	Cover crop termination	CO > T1 / T2 / T4 T3 > T4
	Recharge	
	Sorghum seeding	CO > T2 > T1 / T3 / T4
Year 2	Cover crop seeding	CO < T1 / T2 / T3 / T4
	Cover crop termination	CO > T1 / T4
	Recharge	
	Sorghum seeding	CO < T1 / T2 / T3 / T4
Year 3	Cover crop seeding	
	Cover crop termination	CO > T2 / T4 T2 < T1 / T3
	Recharge	-
	Sorghum seeding	-











- Control had highest moisture at cover crop termination in all 3 seasons
- Control moisture remained higher than cover crop during sorghum season in year 1 causing crop failure
- Cover cropped areas recovered adequate moisture levels by sorghum seeding in year 2, eliminating yield drop
- Dry years (1 & 3) showed stronger moisture decreases from cover crop biomass

Discussion

Termination by Tillage Enhances Moisture Loss

- Cover crop residue can help conserve soil moisture after termination
- Termination by disking and bedding buries residue and disturbs soil, increasing soil moisture losses

No-Till Organic Termination a Challenge in Subtropics

- Reduced tillage conserves moisture
- Conventional growers can terminate with herbicides and northern organic growers rely on winter-kill
- No-till organic termination options (crimper-rollers and mower) have issues with cover crop regrowth

Short-term Costs vs Long-term Benefits

- Over time, cover cropping may increase organic matter and provide benefits to water holding capacity
- Short-term costs, including risk of cash crop failure, can be difficult for many farmers to justify

References & Acknowledgements

[1] Snapp et al. (2005). Evaluating cover crops for benefits, costs, and performance within cropping system niches. *Agron. J.* 97: 322-332.

[2] Nielsen et al. (2016). Cover crop effect on subsequent wheat yield in the Central Great Plains. *Agron. J.* 108: 243-256.

The Subtropical Soil Health Initiative is supported by the Conservation Innovation Grants program of the USDA NRCS, under grant #69-3A75-17-281 with additional funding from an NRCS Soil Science Collaborative Research Grant. Special thanks to our farm collaborators at Hilltop Gardens in Lyford, TX.

UTRGV AGROECOLOGY

USDA NRCS U.S. Department of Agriculture Natural Resources Conservation Service

HILLTOP GARDENS

NCAT NATIONAL CENTER FOR APPROPRIATE TECHNOLOGY