Conservation Tillage: A Best Management Practice to Overcoming Soil and Weather Limitations in Corn Production in the Coastal Plain

What is the problem?

Crop production in the southeastern Coastal Plain is often water limited due to periodic and at times severe droughts, and soils with low water holding capacities. Because of limited opportunities for profit and increased risk from higher production cost, corn production in Georgia declined over the past several decades (1.6 million acres in the 1970s to less than 300,000 in 2006, with most decline occurring in the 1980s).

Are there solutions?

We believe so.

First demand for corn in the U.S. has soared and corn price has doubled due to expansion of ethanol production. This demand gives growers in Georgia the opportunity to re-engage in profitable corn production.

Second by adopting conservation tillage in corn production growers can a) overcome weather and soil limitations that have hindered productivity, and b) make the most efficient use of available rainfall, improve irrigation efficiency, and minimize losses of soil water.

What is being done ?

A team of scientists and support personnel from USDA Agricultural Research Service and University of Georgia (list and affiliation at bottom right) are conducting research to provide farmers with practical, effective, and reliable tools for managing soil and water for corn by adopting high residue conservation tillage, and improving irrigation management strategies for better water use efficiency.

How?

Location: UGA Stripling Irrigation Research Park, Camilla, and Lang Farm, Tifton. Both have state-of-the-art sprinkler irrigation delivery systems.

Cropping: Corn-cotton-peanut rotation, with each crop present each year. Our research focuses on corn.

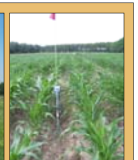
Experimental design: Conventional (**CT**) and strip-tillage with rye cover in winter (**ST**), with four irrigation treatments are being tested. The irrigation treatments are: (1) no-irrigation, relying on natural rain (except during stand establishment); (2) full irrigation, maintaining soil water tension at field capacity; (3) irrigation beginning at plant development stage V10; and (4) irrigation beginning at plant development stage V14. For the V10 and V14 treatments, soil moisture is maintained as in treatment (2) after the start of irrigation.

Measurements: Soil water content; rye and corn biomass and yield and associate with treatments. Remotely sensed data will be used to provide an instantaneous and non-destructive spatial representation of crop response as a function of plant available water content.


Treatment Differences – Early May 2007


Treatment Differences – June 2007


Irrigation System

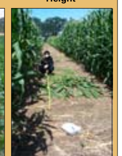

Measuring Soil Moisture

Treatment Differences – Early May 2007

Conventional Till – Early May 2007

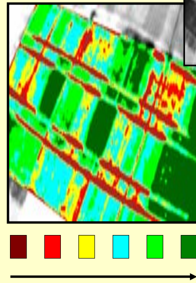
Strip Till – Early May 2007

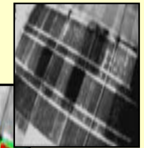
Measuring Plant Height



What was found - Preliminary results (2006 & 2007)

Below: Computer interpretation (Classification) of image on the right in terms of surface temperature




Thermal Image

5/18/07

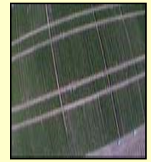
Hottest surfaces on straight lines are tracks that divide groups of plots.

Plots with least cover have hotter surfaces

Hot Surface --------------- Cool Surface

TRUE COLOR IMAGES OF PLOTS

5/18/07



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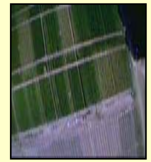


Darker (greener) color indicate plots with much reduced stress as a results of strip-tillage and/or full irrigation treatments.

The grey area at the bottom of the picture on the left is the south end of the plots and is under another crop

Summary : Remote Sensing

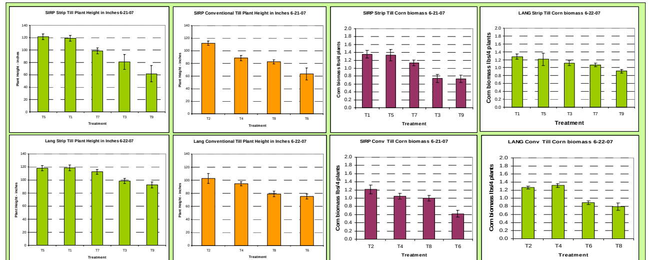
Surface soil water was consistently greater for strip-tillage in all irrigation treatments.

Stomatal conductance (transpiration) was greater in strip-tillage in the dry land and V10 treatment.

This was reversed for Fully irrigated plots and the V14 did not show tillage effect.

Irrigated treatments had lower emmitance (lower temperature) than the dry land corn.

REMOTE SENSING STUDIES



Treatments

ST-H	ST-L	CT	IRRIGATION
T5	T1	T2	Full from planting
T7		T4	Full from V10
T3		T8	Full from V14
T9		T6	No irrigation

ST-H & ST-L: Strip-tillage with high and low residue
CT: Conventional tillage

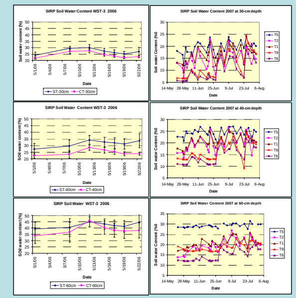
BIOMASS

CORN GRAIN YIELD

Corn Grain Yield Bushels/Acre at 15% Moisture

	Irrrigation	Soil	Conservation Tillage	Conventional Tillage	Soil Type Average	Two Soil Average
2006						
	Trigger for bare soil	Oranageburg	239	237	238	
		Tifton	181	194	188	213
	Trigger for residue	Oranageburg	216	226	221	
		Tifton	183	175	179	200
	Irrigator Pro	Oranageburg	221	221	221	
		Tifton	163	189	176	199
	Non-Irrigated	Oranageburg	53	51	52	
		Tifton	45	68	57	54
	Tillage Average		163	170	166	166
2007			High/low residue			
	To keep soil at field capacity from planting	Oranageburg	198/174	178	185	
		Tifton	214/211	205	208	197
	To keep soil at field capacity from V10	Oranageburg	161	147	154	
		Tifton	160	176	168	161
	To keep soil at field capacity from V14	Oranageburg	137	157	147	
		Tifton	167	158	162	155
	Non-Irrigated	Oranageburg	53	42	48	
		Tifton	82	96	89	68
	Tillage Average		154	145	150	

SOIL WATER CONTENT



Examples of cases in 2006 (w/error bars) & 2007 where strip-tillage plots showed greater soil water content (30, 40, 60-cm depths).
In 2007: T5-Strip-tillage, high residue w/full irrigation (mean 3 plots)
T1-Strip-tillage, low residue w/full irrigation (mean 3 plots)
T2-Conventional-tillage, w/full irrigation (mean 3 plots)
T9-Strip-tillage, w/no irrigation (mean 3 plots)
T6-Conventional-tillage, w/no irrigation (mean 3 plots)
In 2006: WST-3, treatments 4&5, had least amount of water supply.
ST= Strip-tillage; CT= Conventional tillage

Concluding remarks

Two years of research definitely shows a) need for irrigation of corn, and b) the advantages of strip-tillage, a form of conservation tillage, in increasing infiltration in the two soils. Because of the complex corn physiology governing and controlling transpiration rate which directly influences grain production, we have not yet seen a statistically valid tillage-grain yield relations, but quantifiable yield advantages have been observed for strip-tillage at both or either location. Plant height and biomass measurements on the other hand point to improved performance under conservation tillage than conventional. We hope to continue the research for several more years.

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