healthy soils case study

DRYLAND ROTATIONS

Crop Rotations in a Dryland Cotton Farming System

A Warra, Darling Downs, case study

AT A GLANCE

- Rotation crops such as wheat sown after cotton are known to improve soil structure and other physical properties.
- Legume rotation crops can improve the soil's nitrogen status.
- Rotation crops help in providing more plant residues to increase organic matter.

Sustainability in any farming system is dependent upon a number of interacting factors, including climate, plant nutrition, management, weed and disease incidence, economic factors and, of course, soil quality.

In agricultural systems, soil quality is thought of in terms of productive land that can maintain or increases farm profitability, as well as conserving soil resources so that future farming generations can make a living.

Why Act?

Land preparation methods in cotton production range from intensive tillage (deep ripping, discing, chiselling and bed reconstruction every year) to minimum tillage or permanent beds.

Cropping systems under which cotton is grown can be broadly classified into three groups:

1 cotton monoculture, where cotton is sown in the same field every year indefinitely

2 long-fallow cotton, where cotton alternates with a bare fallow

3 cotton-rotation crop sequences, where cotton alternates with either summer or winter rotation crops.

With continuous cotton, soil structural degradation, particularly that due to shearing and compaction during land preparation and harvesting under wet conditions, fertility decline and increasing disease intensity can occur.

Jeff Bidstrup and Darling Downs Cotton Regional Extension Officer, Kate Charleston, check a dryland cotton crop grown in 2006–07. Jeff says:

"Dryland rotations are simply linked to growing a crop when water is available but also have many soil health benefits"

Dryland Systems Farming Trial, Warra

Season	Rainfall (mm)	ROTATIONS				
		1. Cotton/ cotton	2. Cotton/ summer cereal	3. Cotton d/c winter cereal	4. Cotton/d/c winter legume or cereal	5. Cotton/ winter cereal
Summer 1992–93		Cotton	Cotton	Cotton	Cotton	Cotton
Winter 1993	143			Barley 0.22 t/ha	Barley 0.22 t/ha	
Summer 1993–94	502		Sorghum 2.1 t/ha			
Winter 1994	64				Chickpea 0.66 t/ha	Wheat 1.43 t/ha
Summer 1994–95	483	Cotton 3.73 b/ha	Cotton 3.05 b/ha	Cotton 4.05 b/ha		
Winter 1995	116			Durum Wheat 0.42 t/ha		
Summer 1995–96	580		Sorghum 5.77 t/ha		Cotton 4.45 b/ha	Cotton 4.50 b/ha
Winter 1996	288				Wheat 2.7 t/ha	Wheat 2.7 t/ha
Summer 1996–97	395	Cotton 3.35 b/ha	Cotton 3.21 b/ha	Cotton 3.80 b/ha		
Winter 1997	296			Wheat 3.05 t/ha	Chickpea 2.57 t/ha	
Summer 1997–98	353		Sorghum 3.05 t/ha			Cotton 2.77 b/ha
Winter 1998	469					Wheat 3.79 t/ha
Summer 1998–99	617	Cotton 3.80 b/ha	Cotton 2.92 b/ha	Cotton 4.41 b/ha	Cotton 3.04 b/ha	
Winter 1999	136			Wheat 1.99 t/ha	Chickpea 1.03 t/ha	
Summer 1999–00	335		Sorghum 5.78 t/ha			Cotton 2.9 b/ha
Winter 2000	46				Wheat 1.73 t/ha	
Summer 2000–01	337	Cotton 3.7 b/ha	Cotton 2.5 b/ha	Cotton 3.5 b/ha		
Winter 2001	64			Wheat (not planted–dry)		Wheat 1.58 t/ha
Summer 2001–02	438		Sorghum 1.76 t/ha		Cotton 3.27 b/ha	
Winter 2002	114				Chickpea 0.46 t/ha	
Summer 2002–03	247	Cotton 1.74 b/ha	Cotton 1.32 b/ha	Cotton 1.6 b/ha		Cotton 2.54 b/ha
Winter 2003	155			Wheat 3.37 t/ha	Wheat 2.98 t/ha	
Summer 2003–04	490		Sorghum 4.1 t/ha			
Winter 2004	48					
Summer 2004–05	147	Cotton 2.71 b/ha	Cotton 2.38 b/ha	Cotton 2.75 b/ha	Cotton 2.79 b/ha	Cotton 2.72 b/ha

Summer: October–March; Winter: April–September

What is science saying?

Results from many cotton-rotation system experiments conducted in New South Wales and Queensland show that cotton yield/per hectare was lowest or equal lowest with continuous cotton, particularly if intensive tillage was the management practice.

In 1992 Jeff and Marilyn Bidstrup became involved in a dryland on-farm experiment at Warra in South East Queensland in rotation crop management with the Cotton Catchments Communities CRC. The objective of this study was to quantify the changes in physical and chemical properties of a grey cracking clay due to sowing cereal and legum crops in rotation with dryland cotton. The preceeding chart contains results obtained between 1996 and 2004 from this on-farm trial.

The major contributing factor to changes in soil chemical properties from the rotations was the coarse soil organic matter. This is the more labile or mobile fraction of soil organic matter. An increase in organic matter has many benefits from improved structure, which corresponds to improved plant available water content through to improving the soils nutrient cycles and providing an energy source for the soil biology. Significant improvement in soil chemical properties can be expected to occur if crops which produce large amounts (that is, greater than 15 tonnes per hectare) of dry matter such as forage sorghum were to be sown at regular intervals. Soil structure was also improved by growing a rotation crop to maximise cracking by drying of the soil profile.

Their Solution

In essence both the amount and timing of rainfall drives the profitability on this property, as opportunity cropping rather than a fixed rotation is the most profitable option. As a result, cotton double cropped cotton into a winter cereal has become the most profitable, along with its beneficial inputs into improving the soil's health. With the information gained from the trial Jeff and his family are now exploring the benefits of manure application in their farming system.

Acknowledgements

Dr Nilantha Hulugalle, Senior Research Scientist at the NSW Department of Primary Industries, for his contribution to farming systems research.

Jeff and Marilyn Bidstrup for the use of their farm and coordination of the trial.

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