Lift ground cover and reduce drainage with pasture cropping

Pasture cropping — integrating direct drilled crops such as oats into summer-growing native pastures — increases annual pasture production, improves soil water use and nitrogen use compared with conventional systems.

by **Sarah Bruce,**
CSIRO SUSTAINABLE ECOSYSTEMS AND

Col Seis,
GULGONG, NEW SOUTH WALES

Photos: CSIRO Sustainable Ecosystems

Pasture cropping involves sowing winter cereal crops directly into summer-active perennial pastures, enabling stock to be grazed right up to the time of sowing. A key feature of pasture cropping is the separation of growing periods between the crop and pasture with cool season crops growing from May–November and warm season pasture growing from September–May.

Nearly one thousand Australian farmers are trialling the pasture cropping approach to lift profits and combat dryland salinity, waterlogging and soil acidification.

Pasture cropping integrates direct drilled crops into summer-growing pastures to increase production.

The system also increases ground cover, because mixtures of different types of plants better fill the available niches, thereby using resources more effectively.

For example, a mix of shallow- and deep-rooted plants can access different soil water resources, reducing competition and increasing productivity.

During September 2003, researchers from CSIRO and the Australian National University established a paddock trial in response to requests from local farmers to investigate the impacts of pasture cropping on biomass production, total soil cover and soil water and nitrogen contents.

Measurements were taken from three sites on Col Seis' property at Gulgong, New South Wales, at two-monthly intervals from September 2003 until January 2005.

The measurements compared the impact of pasture cropping (direct-drilled oats into summer pastures) with conventional cropping (direct-drilled oats) and pasture (predominantly summer growing).

The results confirmed the value of pasture cropping as a strategy to reduce soil water in systems prone to waterlogging and deep drainage (see Figure 1) and indicated benefits for reduced soil acidification and increased soil organic matter.

At a glance

- The impact of pasture cropping on biomass production, ground cover, nitrogen availability and total soil water was measured over 16 months and compared with the impact of conventional cropping and pasture management.
- Pasture cropping produced more biomass and provided year-round ground cover, intercepting more light for photosynthesis and providing less opportunity for weed germination or soil erosion.
- Pasture cropping also regulated nitrogen availability in the soil, providing less opportunity for nitrogen leaching and denitrification.
- The mix of shallow- and deep-rooted plants in the pasture cropping system provided better access to soil water, reducing total soil water and hence the threat of waterlogging.

The mix of shallow- and deep-rooted plants in pasture–crop system improved access to soil water, resulting in lower total soil water content. Increased use of soil water reduces the risk of waterlogging or dryland salinity.

What is pasture cropping?

Pasture cropping is a farming practice conceived and developed in NSW during the past 10 years by Gulgong farmers Col Seis and Darryl Cluff.

The cropping method involves sowing winter cereal crops directly into summer-active perennial pastures, enabling stock to be grazed up to the time of sowing.

When dual–purpose crops are used, grazing can occur until stem elongation.

After harvest, the paddock is again ready to graze as the summer pastures respond to the removal of the covering crop.

A key feature of pasture cropping is the separation of growing periods between the crop and pasture.

Cool season crops grow from May–November and warm season pastures grow from September–May.

Increased biomass production

The results of the experiments showed biomass in the pasture cropping system was, on average, similar to biomass in the crops only system during the oats growing season (June–November), and no different to biomass in the pasture system during the pasture only growing season (September–March)

Oat seed yield was more variable under pasture cropping but there was compensating pasture growth, resulting in no net increase in biomass variability.

Since the pasture cropping system incorporates plants that grow at all times of the year, it intercepts more light for photosynthesis, leading to a higher useful biomass production per hectare (grain plus forage) than either the cropping or pasture systems alone.

Improved ground cover

The combination of retained stubble with crowns and shoots of perennial grasses resulted in more ground cover in the pasture cropping system compared with the crop only system.

The reduced cover in the pasture cropping system was probably caused by spraying and seeding the pasture crop during the winter months.

The results also indicated pasture cropping systems were more likely to maintain substantial ground cover than annual cropping systems, even in droughts, due to the presence of perennial species.

Improved ground cover can increase soil organic carbon, as well as reduce wind- and water-induced soil erosion.

It also reduces weed outbreaks due to competition from actively growing plants at all times of the year and fewer sites available for germination.

Reduced nitrogen availability

Nitrogen availability was less variable and on average lower in the pasture cropping system than the crop or pasture systems, which could have been a response to year-round plant growth.

Peaks in nitrogen availability are caused by an interaction between dead root and litter inputs, previous soil temperature and moisture conditions and plant uptake.

For example, a large peak in nitrogen availability during November 2003 in the crop system was associated with crop maturity when nitrogen use was ceasing, root decay was increasing and from limited nitrogen use over the previous season due to drought conditions.

In contrast, during November 2004 the plants had not matured and were still using nitrogen at the time of sampling, which could explain the difference in nitrogen availability between the two sampling times.

The low availability of nitrogen in the pasture cropping system could reduce the risk of soil acidification through reduced opportunities for nitrate leaching, and could reduce loss of nitrogen through denitrification in soils prone to waterlogging.

Reduced soil water content

The pasture cropping system used more soil water compared with the crop or pasture systems (see Figure 1).

Soil water was highest year-round in the crop system, despite plant growth during winter. This could be a result of the shorter root systems of oats not accessing water deeper in the profile.

The pasture cropping system had the lowest soil water content, which is likely to be due to year-round plant growth and the mix of shallow- and deep-rooted plants.

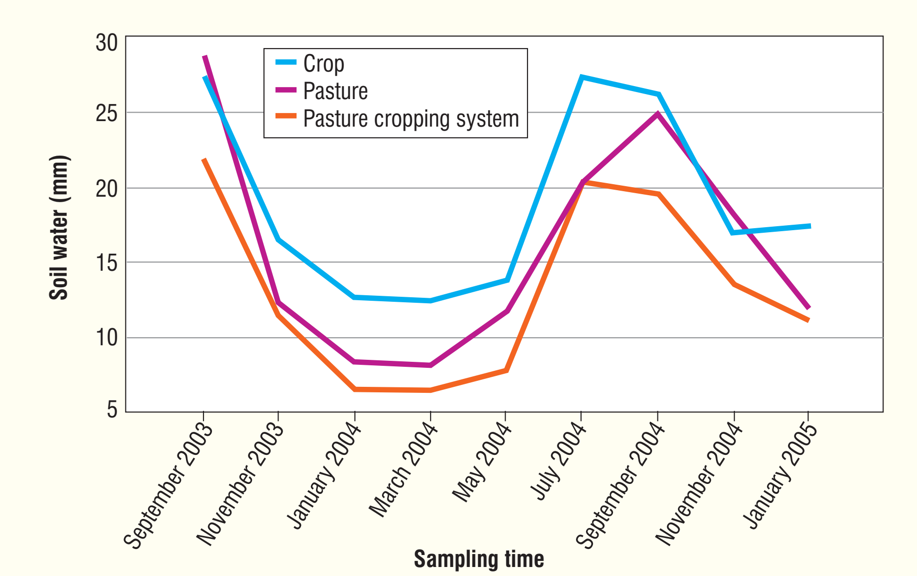
In the strongly duplex soils on the Seis property, the higher use of soil water reduced the risk of waterlogging.

In other soil types, the frequency and size of drainage events is likely to be reduced, potentially reducing the risk of dryland salinity.

Mixing it up

The separation of growing periods and the mix of shallow- and deep-rooted plants in the pasture cropping system had several benefits compared with conventional cropping practices or native pasture management.

FIGURE 1 Soil water content under different cropping regimes



Source: Sarah Bruce, CSIRO Sustainable Ecosystems.

The pasture cropping system outperformed both the crop and pasture system in each of their non-growing seasons, and produced similar biomass in their growing seasons. Nitrogen availability in the pasture cropping system was also more regular than for the other two systems.

Compared with conventional cropping practices, pasture cropping led to higher total ground cover year-round and increased the total biomass outside the cropping season.

Such year-round consistency in ground cover and growth is likely to result in reduced wind and water erosion, fewer weed outbreaks and increased soil organic carbon.

The pasture cropping system resulted in less total ground cover than native pasture systems, but increased total biomass, suggesting the benefits might not be so significant in terms of erosion control.

Nevertheless, the pasture cropping system resulted in reduced nitrogen availability and soil water compared with the native pasture and conventional cropping systems, indicating pasture cropping could reduce the likelihood of waterlogging, dryland salinity and soil acidification.

In an era when dryland salinity, soil acidification and loss of soil carbon are having increasing impacts on the productivity and sustainability of farming enterprises, pasture cropping could provide one option for addressing these issues.

For more information contact Sarah Bruce on sarah.bruce@csiro.au or phone (02) 6242 1747.

Acknowledgements: Sonia Graham, Mark Howden, CSIRO; Julian Ash, Australian National University.

CSIRO