Pasture Cropping
Winona Farm, New South Wales, Australia

Since the mid-1990s, Australian farmer Colin Seis has been no-till drilling a cereal crop into perennial pasture on his farm during the pasture’s dormant period. This way he gains two crops from one parcel of land—a cereal crop for food or fibre and wool or lamb meat from his pastures.

The practice is called “pasture cropping” and it is used in various locations worldwide and by more than 2,000 farms in Australia alone. Here’s how it works.

The key to pasture cropping is the relationship between C3 (cool season) plants and C4 (warm season) plants—the difference being the number of carbon molecules and the way they affect the process of glucose production in a plant. C3 plants, such as wheat, rice, oats and barley, grow early in the season and then become less active or go dormant as temperatures rise and light intensity increases. In contrast, C4 plants, such as corn, sorghum, sugarcane and millet, remain dormant until temperatures become warm enough to “switch on” and begin growing.

Pasture cropping utilizes the niche created by C3 and C4 plants. When a C4 is dormant (during winter), a C3 plant seed is sown by no-till drilling into the C4 pasture. With the onset of spring, the C3 plants begin to grow. With proper management and the right amount of rain, the C3 crop can be harvested before the C4 plants begin the vigorous part of their growth cycle. The removal of the C3 crop will then stimulate C4 plant growth due to reduced competition. Also, because shallow and deep-rooted plants access water resources in the soil differently, overall productivity can increase.

A key is what’s happening in the soil. C3 cereal crops provide sugars to soil microbes, such as fungi, nematodes and protozoa, during the time when the C4 plants are dormant and improves soil fertility faster than a C4 pasture alone might. This also speeds up nutrient cycling, promotes an improved water cycle, increases nitrogen content and adds organic matter to the soil which can build humus. Additionally, the no-till drill lightly aerates the soil, allowing oxygen and water to infiltrate.

Another key is using grazing animals to prepare the C4 field before drilling. Grazing animals hit the perennial pasture hard so that the C4 plants come up slowly and give the C3 plants a chance to grow. By hitting the pasture hard with a large mob of sheep in a time-controlled manner, Colin can keep the C4 plants from growing too tall, too early and thus prevent them from shading the C3 plants. Animals can also control weeds, create litter on the soil...
sequestered to a depth of one-half meter on Winona. This has contributed to a dramatic increase in the water-holding capacity of the soil, which according to Dr. Jones has also increased by 200 percent in ten years and is now more than 360,000 liters per hectare for every rainfall event.

In 2010, the University of Sydney conducted a research project on both Colin's farm and the neighboring farm in order to evaluate the effects of pasture cropping versus conventional management on soil health and ecosystem function. The project compared paddocks of comparable size on each farm. Here are some of the results of the research:

- Colin's paddock was 83 percent native perennial grass species.
- The neighbor's paddock was 88 percent annual weed species.
- There was greater ecosystem function on Colin's farm.
- The sheep stocking rate was double on Colin's.
- Crop yields were the same.
- Soil microbial counts showed that Colin's land had significantly higher amounts of fungi and bacteria than the neighboring farm.

In the study's conclusion, Dr. Peter Ampt and Sarah Doornbos wrote:

> These results illustrate that the rotational grazing and pasture cropping practiced on the innovator site can increase perennial vegetative ground cover and litter inputs, compared to the continuous grazing system and conventional cropping practiced on the comparison site. Increased perenniality and ground cover lead to improved landscape function in the pasture through increased stability, water infiltration and nutrient cycling which in turn can lead to improved soil physical and chemical properties, more growth of plants and micro-organisms and an ultimately more sustainable landscape.

Advice from Colin: use grazing to create as much litter as possible; use no-till equipment to sow at the correct depth and row spacing; sow the correct crop for your soil type; conduct a soil test if possible; sow the crops up to two weeks earlier than usual because crops sown by pasture cropping are slower to develop; avoid fertilizer use as much as possible (it shouldn't be necessary).

Colin also cautions that crop yields are usually lower in the beginning than with conventional agriculture. This is more than offset by the ability to produce two or more products from the same land, as well as to increase the fertility that is being built up in the soil.

Here's a quick list of the benefits that pasture cropping has brought to Winona Farm:

- It's profitable. Colin and his son run around 4000 Merino sheep and pasture crop around 200 ha (500 acres) annually in oats, wheat and cereal rye.
- The farm has steadily improved its sheep-carrying capacity, wool quality and wool quantity.
- The farm is now almost entirely native grassland with over fifty different species of grasses, forbs and herbs.
- The farm saves around $60,000 annually in decreased inputs (fertilizer, etc.) in comparison to its former operation.
- Crop yields from pasture cropping remain about the same when compared to conventional cropping, with oat yields averaging 2.5 tons per hectare.
- Insect attacks and fungal diseases in crops or pasture are minimal.
- There has been a noticeable increase in bird and native animal numbers, as well as in species diversity.
- Soil microbial counts show that the Winona soil has significantly higher counts of fungi and bacteria now than before.
- According to a soil analysis, all trace minerals and nutrients have increased by an average of 150 percent.
- Perhaps most impressively, soil carbon has increased by 203 percent over a ten-year span compared to an adjacent farm (owned by Colin's brother). Dr. Christine Jones calculated that 171 tons of CO$_2$/hectare has been stored on Winona's farm, which is equivalent to taking 433 tons of CO$_2$ out of the atmosphere.


For a longer version of this essay, see: [www.awestthatworks.com/essays.html](http://www.awestthatworks.com/essays.html)

For Colin's farm, see: [www.winona.net.au](http://www.winona.net.au)

For Dr. Christine Jones’s work, visit: [www.amazingcarbon.com](http://www.amazingcarbon.com)