

Can Kikuyu improve soil organic carbon levels on Kangaroo Island?

Over the past year, it has been hard to pick up a newspaper without a headline referring to soil carbon as our climate saviour: the proverbial win-win situation.

Within the agricultural community, the potential to get paid for doing something that can also help increase productivity, profitability and sustainability has obviously stirred a lot of interest. Despite all the headlines, hype and anecdotal accounts, there is a surprising lack of scientific research into soil carbon sequestration, particularly in pastoral systems.

Why might we expect carbon levels to increase under perennial pastures?

Perennial grasses, compared to annuals, generally maintain a deeper and more extensive root system with associated mycorrhizal fungi. Increased below-ground carbon flow, coupled with an increase in duration of carbon inputs and decreased surface erosion, may lead to an increase in soil carbon when compared to annual pastures. Additionally, decomposition of soil carbon may be reduced under perennial grasses because summer rains are effectively and rapidly utilized by perennial grasses, thereby reducing the duration that a soil remains wet enough to support microorganisms that decompose carbon.

Measuring and tracking changes in the amount of organic carbon stored in soils are difficult due to both large variations across even small distances and slow changes through time. Fence-line comparisons are particularly troublesome because there is no way of knowing if soil carbon levels were exactly the same back in the year that the perennial grasses were sown.

Fortunately, subtropical perennial grasses produce carbon with an isotope composition that is distinct from most temperate grasses. This difference creates a fingerprint

that allows us to track the amount of carbon entering the soil from these perennial grasses and to measure the proportion of SOC that originated from the perennial grasses.

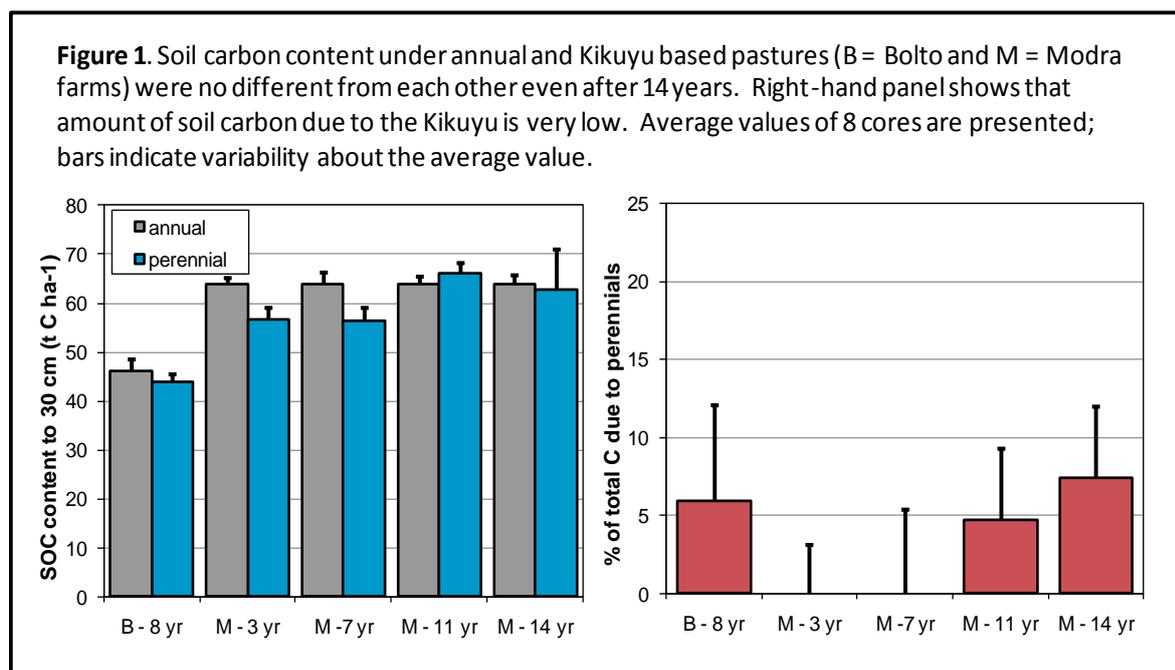
Initial results.

In July 2010, we collected a series of soil samples from five paddocks sown to kikuyu at various times over the past 14 years and from accompanying annual grass-based paddocks on the Bolto farm (8 y.o. stand) near D'Estrees Bay and Modra farm (3, 7, 11 and 14 y.o. stands) on the Dudley Peninsula. The soils were typical of grazed pasturelands on Kangaroo Island with a gravelly iron-stone layer at 20-30 cm sitting over clay.

The surface soil had a sandy texture on the Bolto farm, while loamy textures dominated the paddocks at the Modra farm. Kikuyu was sown at 2 kg per hectare on all of the Modra paddocks, while the sowing rate was 250 g per ha on the Bolto farm in a mix with fescue, *Phalaris sirosa*, clover, paradana and cocksfoot. On average, about 10 kg of phosphate per hectare per year has been applied to the pastures on both farms. There was little difference in total carbon content between the annual and kikuyu-based pastures in the upper 30 cm of the soil (Figure 1).

The differences in carbon between the two farms is likely primarily a factor of the different soil textures with the finer textured soil (Modra farm), being able to hold more carbon. The isotope results also indicate that the kikuyu is having little effect on soil carbon levels (Figure 1). Here, I have plotted the isotope results as the percent of total carbon in the kikuyu-based pasture that is attributable to the kikuyu vegetation. There have only been minor shifts in the carbon isotope composition indicating that there has been little accumulation of carbon

originating from the introduced perennial grasses in these pastures.



Discussion

Both methods of assessing changes in soil carbon levels were in agreement. There has been little change in carbon levels even after 14 years under kikuyu at these sites.

The soils we sampled on KI under both the kikuyu and annual-based pastures were all very healthy with high organic matter content and lots of biological activity. Dean Modra indicated that he runs about twice as many sheep on the kikuyu paddocks as the annual paddock, so I would suspect that there is more carbon entering the soil with the kikuyu but it does not appear that these increased inputs have translated to increased levels of soil carbon.

My initial impression of these results is that these soils are close to their inherent maximum carbon levels. It is much easier to improve carbon levels in a really impoverished soil, but very hard to improve a soil that is already high in carbon and nutrients. For comparison, we have sampled several kikuyu pastures in the southern part of Western Australia. The annual paddocks at these sites had carbon contents as low as 15 tonnes of C per ha.

The introduction of kikuyu at some of these sites has seen the carbon levels nearly double after 12-15 years.

Perennial based pasture systems can offer numerous benefits, including increased access to fresh summer feed, lowered water table with a decrease in associated salinity issues, and minimisation of surface erosion. While it is premature to apply these results broadly across KI, these results suggest that the decision to switch to a perennial pasture should not be made based solely upon anticipated changes in soil carbon levels.

Funding/Sponsors

Recently CSIRO, with funding from the Department of Agriculture, Fisheries and Forestry (DAFF), and the Grains Research and Development Corporation (GRDC) has begun a study of soil organic carbon change under perennial pastures.

For further information contact

Dr. Jonathon Sanderman, CSIRO Land and Water, Adelaide on 8273 8135 or email jonathon.sanderman@csiro.au