'A feedback loop of soil benefits'

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Dr Robert Banks. His PhD research has proven that once poorly regarded acidic sandy loam soils can not only can be productive, but can greatly increase soil organic carbon by almost 30 t/ha.

Dramatic upgrading of soil quality, including higher organic matter, better soil water storage, deeper rooting and far more extensive root development, all help explain why tropical grasses are performing so well on once poorly regarded soils.

These are some of the key findings in a PhD research study undertaken (and accepted by his university) by Dr Robert Banks, Gunnedah, principal soil scientist (Soil Futures Pty. Ltd). Acidic sodic-duplex soils can be transformed into productive and high-quality ones via well-managed tropical grass pastures. They commonly have acidic and sandy topsoil, often with an abrupt change to clay sub soil that disperses when wet, sometimes neutral to alkaline at depth and often referred to as "spewy soils".

A productive stand of Premier digit grass on once poorly regarded acidic sandy loam soil. Productivity and soil quality both rise dramatically from pasture improvement.

These soils commonly don't hold much water because of poor infiltration into sodic clay subsoils leaving only the sandy surface to hold meagre amounts following rain. Native grass productivity is limited by lack of soil water. A lot of this land years ago was developed for cropping and quickly degraded. It became pretty unproductive. Major findings from the study included that soil organic carbon (SOC) increased from 58 tonnes to the hectare on the native pasture to 84t/ha on the tropical grass (Premier digit predominately) in the 0-90 centimetre soil layer. Up to three times more SOC was in the top 20cm under tropical grass compared with native pastures.

Noteworthy was that tropical grass had far greater soil water penetration and storage in the B horizons compared to almost no water penetrating to depth in native pastures. Soil water content even at 70 to 90 cm under tropical grass was almost double that of native pasture.

The research assessed identical sodic duplex soils profiles comparing 14-year-old tropical grass with unimproved native grass. Comparisons were assessed for attributes via analysis of the profiles to 1.5 metre depth. Boggabri property "Towri", owned by George, Maree and Matthew Avendano was the research site on an east Pilliga sandstone soil. Dr Banks notes this site is typical of one of the poorer soil groups in NSW and common on quartz-rich sandstones across the northern slopes and plains.

Root abundance was far greater in the tropical pastures and they had foraged deeper into the normally impenetrable B clay horizon. Average root counts for tropical grass was 8.4 km roots per cubic metre of soil (to 1.5m depth) compared to 4.6 km for native grass.

Soil structure was much improved under tropical grass, with topsoil structure under native pasture remaining hard-setting and structurally degraded. Tropical grass topsoil structure was loose and friable and had developed a fine structure of aggregates of soil particles. Improved soil structure continued down the profile into subsoils which normally have only very large aggregates almost as big as an average sized person. Porosity of both topsoils was similar, but the top of the clayey B horizon was far more favourable under tropical grass for the passage of water down the profile, with more large pores. Subsoil, even at 75 cm, had a much lower bulk density. Water cannot easily move through soil with very fine pores in a dense soil, especially if coupled with dispersion characteristics. Dense B horizons normally lock up when wet, preventing infiltrating to the lower layers. Deeper roots from a well-managed tropical pasture produce more dry matter to facilitate a "feedback loop of soil benefits" Dr Banks notes. Roots assist in the movement of water and nutrients deeper into the profile, which also helps soil structure. Improved structure means more root access and so the process continues.

A typical comparison of unimproved acidic sandy loam soil. In the background paddock, an outstanding tropical grass plus winter legume pasture.

Soil chemistry analysis showed some leaching of nitrogen and phosphorus in the tropical grass pasture. The provision of nutrients to deeper layers allows soil fauna, fungi and roots to break up large soil structures into smaller aggregates.

This research supports that these pastures with winter legumes can substantially improve poorly structured soils as well as be more productive. North West LLS provided funding for soil chemistry testing and Meat and Livestock Australia provided research funding.

Next week. High promise with tropical grass trials down south, including into the tablelands.

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