Native grassland soils : How do they compare with cropping and remnant woodland soils?

B. R. Wilson[A] and J. Lemon[B]

NSW Department of Infrastructure, Planning and Natural Resources,
[A] PO Box U245, University of New England, Armidale, NSW 2351
[B] PO Box 462, Gunnedah NSW 2380

Much has been reported regarding the soils of native pastures in Australia, particularly with respect to their nutrient status, acidity etc. Recommendations are therefore widely available regarding the management and 'improvement' of these soils through fertiliser amendment, liming, legume addition and so forth. However, few studies have considered the extent to which contemporary native grassland soils differ from those under relatively undisturbed grassy woodland systems from which they were mostly derived. Here we compare the properties of both native pasture and cropping soils with adjacent remnant woodland at 4 representative sites near Bingara on the North-West Slopes of NSW.

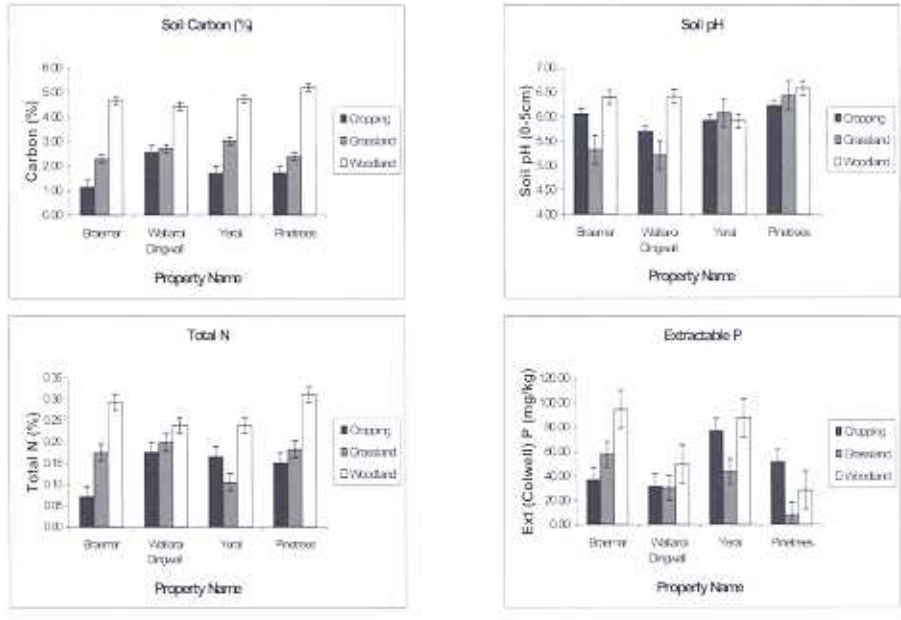
Methods

A series of 'site clusters' was established on properties near Bingara. Each 'site cluster' was located on a separate property and each cluster consisted of 3 adjacent treatments: i) heavily grazed, unimproved native pasture, ii) a cropping paddock that had been cultivated for at least 30 years, and iii) remnant woodland. Each of the individual treatments was in an adjacent paddock and the various treatments in each cluster were located on a common soil type, etc. Within each treatment, 9 soil cores were collected from a 20 by 20 m plot in a regular grid pattern. Each soil core was sub-divided into depth increments of 0-5, 5-10 cm and then 10 cm increments to 100 cm (or solid rock whichever was reached first). Each soil sample was analysed for pH($CaCl_2$), organic carbon (%C), total nitrogen (N) and extractable phosphorus (P). Results were pooled and averaged across each treatment.

Results

Figure 1 shows the mean values of soil properties for the various treatments at the 0-5 cm depth. Soil C content was consistently and significantly higher in the woodland soils than the native grassland soils.

Figure 1. Soil carbon, pH, nitrogen (N) and extractable phosphorus (P) in remnant woodland, native grassland and cropping soils (Error bars = 1 standard error of the mean).



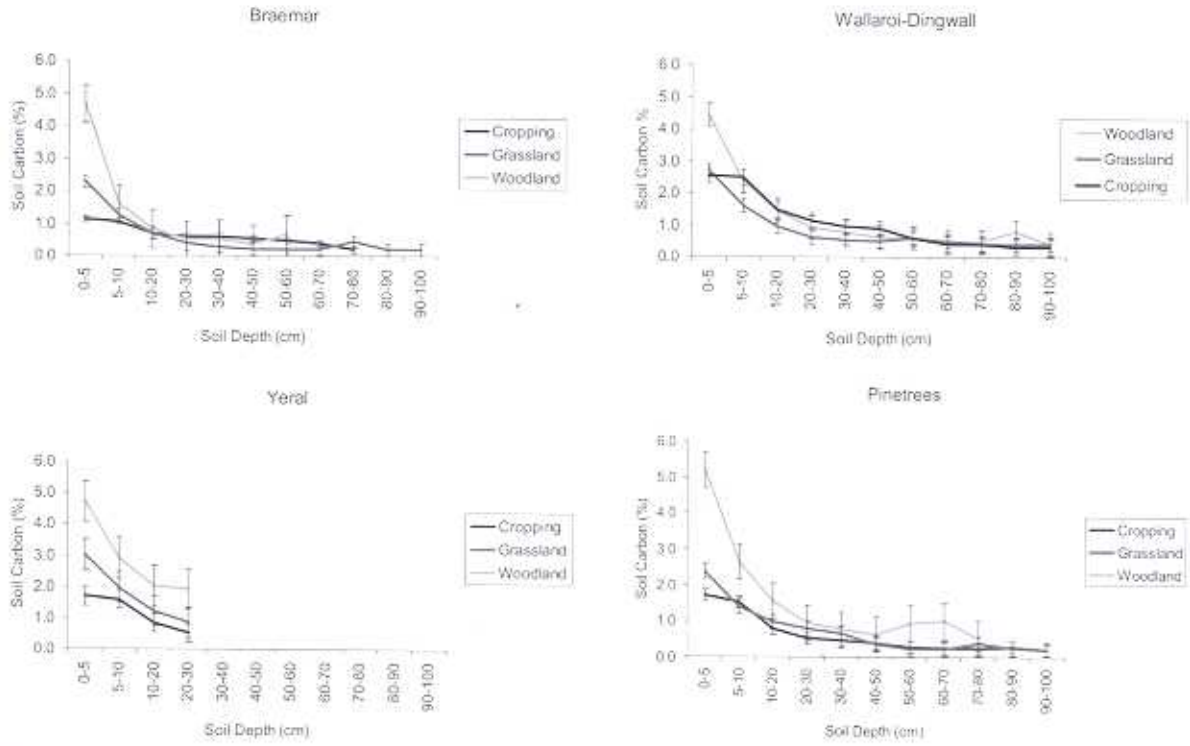


Figure 2. Carbon content (%) down the profile of remnant woodland, native grassland and cropping soils on 4 properties near Bingara, NSW. (Error bars = 1 standard error of the mean)

However, at most locations, the soil C content was lowest under cropping. Soil pH was highly variable, but where significant differences existed between treatments (e.g. 'Braemar', 'Wallaroi-Dingwall'), soil pH was lower in grassland compared with both woodland and cropping soils. N and P were again highest under woodland at every location. The soil content of both these elements was significantly lower under grassland compared with remnant woodland and was generally lowest under cropping except where soils had recently been fertilised. At 'Yeral' where N+P amendments had been applied to cropping paddocks, both N and P content of the soil was enhanced while at 'Pinetrees', where only P had been applied, soil P alone showed a significant increase in the cropping soils. In neither case did the added nutrients create a soil that was significantly more fertile than the woodland equivalent.

The C content down the soil profile for the various treatments shows that the difference among management systems diminished rapidly with soil depth (Fig. 2). For most sites, a significant difference in C content among management types existed in only the 0-5 and 5-10 cm soil layers. Below these depths, no significant difference could be detected. This pattern existed for most of the soil properties assessed.

Discussion

The heavily grazed, unimproved native grassland soils generally had lower pH, C and nutrient contents compared with remnant woodlands. The grassland soils would therefore seem to be of significantly poorer quality than their woodland equivalents. However, these native grasslands were probably derived from woodlands similar to the remnants studied here and it might be speculated that the soils of the grassland sites were once in considerably better condition than is currently found. These soils have probably lost considerable quantities of organic C and nutrients and have been acidified as a result of clearing and grazing. When modifying or 'improving' these grassland soils it should therefore be appreciated that they are currently far below both their potential and probably their past soil condition.

In virtually every case, cropping soils were lower in all of the soil properties measured compared with other management types. The only exception to this was where soils had been recently fertilised but, even there, the nutrient content did not significantly exceed that found in the woodland systems. By comparison with the woodland soils however, C content of these fertilised sites was largely unaffected. Although significant differences existed in the soils between

management types, these differences were largely restricted to near the soil surface. Deeper in the soils, the profiles were similar for most soil properties assessed.

Acknowledgements

The authors would like to thank the various landholders in the Bingara region and for their assistance with the completion of this project and for allowing access to their properties for soil sampling.