Root depths of sown and native pastures on the North-West Slopes of New South Wales

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Few agronomic studies in Australia have reported root depth and distribution data for grazed pastures (e.g. Greenwood and Hutchinson 1998). However, such data are essential for understanding changes in soil water and nutrient dynamics and in estimating the amount of water lost from the soil water balance by transpiration (Lodge *et al.* 2001) and defining the root zone for calculating plant available water (PAW).

METHODS

Studies were undertaken at three sites in northern NSW as part of the Sustainable Grazing Systems (SGS) Program (Mason and Andrew 1998). Two of the sites were on native pasture and the third on a pasture sown to *Phalaris aquatica* cv. Sirosa and Seaton Park subterranean clover in 1992. The native pastures were unfertilised and intermittently grazed with cattle and sheep at stocking rates of 2-5 dry sheep equivalents (dse) per ha. The sown pasture had received 500 kg/ha of single superphosphate (8.8% P, 11.0% S) since sowing and was grazed intermittently by sheep and cattle at a stocking rate of around 6-8 dse per ha. The phalaris pasture was on a mixed brown chromosol/brown sodosol soil and one of the native pastures (Site 1) was on a hard setting red chromosol and the other (Site 2) on a mixture of a red chromosol and a cracking brown vertosol. Site 1 was dominated by *Bothriochloa macra* (redgrass) and *Austrodanthonia* spp. (wallaby grass) and Site 2 was dominated by red grass and *Aristida ramosa* (wiregrass) on the red soil and *Dichanthium sericeum* on the brown soil, with wallaby grass occurring on both soil types.

As part of the installation of neutron moisture meter tubes, soil cores (50 mm diameter) were sampled to a maximum depth of 210 cm at each site in spring 1997. For the sown pasture 12 cores were sampled and for each of the native pasture sites 15 cores were taken, with eight cores at Site 2 being from the red soil and seven from the brown. Extracted cores were divided into 5 cm segments. Roots were recovered from each segment from one core at each site or for each soil type by washing over a 0.2 mm sieve to ensure fine roots were retained. Root weight was determined after drying for 48 hours at 80°C. For all cores segments from depths below 10 cm were then combined (i.e. 10-30, 30-50 cm etc), washed and sieved. Mean depth of root (cm) was calculated and for the single cores root weights were plotted. Subsequently root weight and root length and diameter (Greenwood and Hutchinson 1998) was estimated for all cores and these data will be reported in a separate paper.

RESULTS AND DISCUSSION

Site	Root depth (cm)	
	Mean	Range
Native pasture		
Site 1	117 ± 36.0	30-170
Site 2	90 ± 23.9	50-130
Site 2 – red	107 ± 18.0	70-130
Site 2 – brown	75 ± 17.7	50-110
Sown pasture	90 ± 31.9	30-150

Table 1. Mean root depth (cm ± standard deviation) and the range of root depths for native and sown pastures in spring 1997.

Mean root depth for the native pastures was 117 cm at Site 1 and 90 cm at Site 2, compared with 90 cm at the sown pasture site (Table 1). At Site 2 mean root depth was deeper for the red chromosol (107 cm, Table 1), compared with only 75 cm for the brown soil.

Root distribution data (Figure 1) supported these results with >45% of total root weight being in the 0-30 cm zone and >87% of roots being at a depth of <100 cm. The top 5 cm of soil contained 13-33% of total root weight and no major differences were apparent in the different pastures despite marked differences in species composition. At the time of sampling the sown pasture contained a mixture of phalaris, subterranean clover and annual ryegrass while the native pastures were dominated by native perennial grasses.

The implications of these data are that for both sown and native pastures on the North-West Slopes of NSW, most of the plant roots in these perennial grass-based pastures are in the top 1 m of soil. Therefore this is the main area of the soil profile for water extraction by perennial grasses.

Water below the root zone may be held at excessive tension for perennial grass plants to extract (~ -1500 kPa),

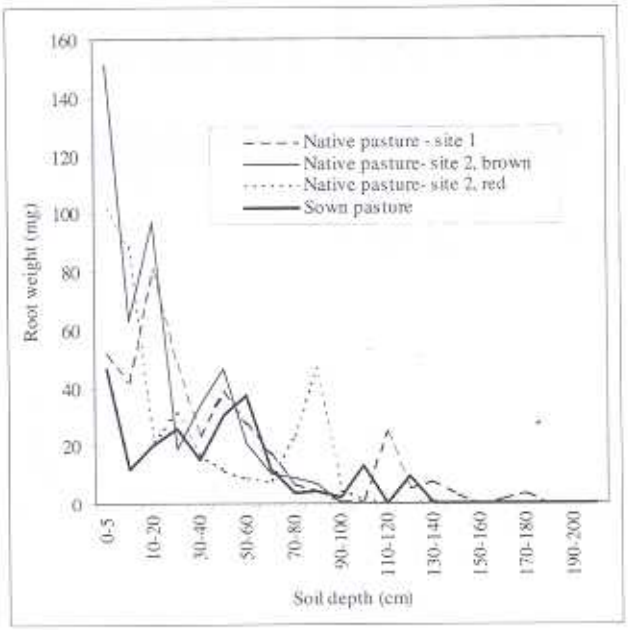

Figure 1. Distribution of root weights (mg) for soil depths of 0-210 cm for native and sown pastures.

but may be accessed by other herbaceous perennials, shrubs or trees.

Whether or not management (grazing method or fertiliser application) can substantially affect rooting depth in these pastures is being studied within the SGS program.

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