Quantifying Carbon Sequestration on Saltland Pastures in South West Australia

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Abstract

The large areas of saltland pastures in South West Australia offer opportunities for carbon (C) sequestration through re-vegetation. An investigation was carried out to quantify the amount of C sequestered in above- and below-ground biomass for wavy leaf saltbush (*Atriplex undulata*) at a saline site east of Wickepin with average EM38 readings of ~400 mS/m (in the vertical mode).

The preliminary results showed that the above ground and below ground biomass was higher under ungrazed than grazed management systems. The amount of above-ground biomass was 10.8 t/ha (4.01 t carbon /ha) for ungrazed saltbush plants and 3.6 t/ha (1.34 t C/ha) for grazed plants. Similarly, root biomass in the ungrazed system had higher biomass [2.7 t/ha (1.02 t C kg/ha)] compared with the grazed field [1.03 t/ha or 0.38 t C/ha]. Saltbush clearly has the potential to sequester a substantial amount of carbon and further research is underway to determine how amounts of carbon sequestered vary with species, soil type, site salinity and hydrology.

Key words

biomass, carbon sequestration, salinity, saltbush

Introduction

The recognition that CO_2 is increasing in the atmosphere (IPCC, 2003) has stimulated investigations that may lead to ways of reducing CO_2 emissions through C sequestration processes (Houghton, 1999). On a global basis, the increase in atmospheric CO_2 concentration is indisputable, but detailed understanding of sources and sinks of CO_2 is still uncertain (Torbet *et al*., 1997). Schimel *et al.* (1995) have estimated that in global C cycling models, there is a large missing sink of about 1.4 ?10^{15} gC y^{-1}. Terrestrial systems can function as sources or sinks for C, a major component of which is soil organic carbon (SOC) storage. This preliminary study examined the potential of C sequestration by wavy leaf saltbush, especially the non-grazed stems and roots.

Methods

The study was conducted on a saline field (EM38 reading of ~400 mS/m in the vertical mode) at Wickepin, 214 km southeast of Perth. The plot size was 10x10 m in both ungrazed and grazed fields and the plant spacing was 2 m, with four replicates in each field. Plots were selected in adjacent fields with similar soil salinity and hydrological regimes. The sampling was carried out to estimate above- and below-ground biomass under wavy leaf saltbush established 16 years previously.

In each plot, all the plants were measured for height (cm) and diameter (cm) and then chopped down and weighed for fresh weight (kg). Based on the fresh weight, plants were categorized as small, medium or large. The plants in each category were dried at 70?C for five days and then weighed for dry weight. In each field a 1x1x1m trench was dug using a backhoe and the roots were excavated. The roots were then recovered by washing. Coring was also used to excavate the roots; 20 cores were recovered using an auger (10 cm diameter) to a depth of 60 cm around the main plant stem with a distance of 20 cm between adjacent cores and from the stem. Soil from each core was soaked in water and left to disaggregate for a few hours and the samples were then manually stirred and sieved through a stack of, 2.0, 1.0 and 0.5 mm mesh size sieves with a steady flow of water. Roots were washed separately and weighed for fresh and dry weights. The very fine roots recovered on the 0.5 mm sieve were separated from soil and coarse particulate organic debris through repeated sedimentation and decantation before the soil slurry was discarded. These fine root samples were then washed, oven dried and weighed immediately.

Results and discussion

In all cases, the large saltbush plants in the stand accounted for over 58% of root biomass and over 80% of shoot biomass (Tables 1 & 2). The results showed that the standard error of the mean was small in both cases but slightly higher in the ungrazed field as compared with the grazed field. The ungrazed field had 3 times higher above-ground biomass due to greater plant density and lack of grazing (Table 1). Root biomass was 2.7 times higher in the ungrazed field than grazed field (Table 2). There was low variation in root biomass in both cases (Table 2) suggesting that the root sampling and recovery procedure was satisfactory.

Table 1: Shoot biomass and carbon estimates for ungrazed and grazed fields of wavy leaf saltbush. Carbon was assumed to represent 38% of biomass (Oslon *et al*., 1983).

Ungrazed field					**Grazed field**			
Plant size	No plants	Dry weight kg/plant	Biomass t/ha	Estimated C t/ha	No. of plants	Dry weight kg/plant	Biomass t/ha	Estimated C t/ha
Small	1	0.3	0.03	0.01	2	0.3	0.06	0.02
Medium	7	0.7	0.5	0.2	8	1.01	0.80	0.3
Large	23	4.5	10.3	3.8	16	1.7	2.8	1.02
Total			**10.8**	**4.01**			**3.6**	**1.34**
	S.E	1.3			S.E	0.42		

Table 2: Root biomass and carbon estimates for ungrazed and grazed fields of wavy leaf saltbush

Ungrazed field					**Grazed field**			
Plant size	No plants	Dry weight kg/plant	Biomass t/ha	Estimated C t/ha	No. of plants	Dry weight kg/plant	Biomass t/ha	Estimated C t/ha

Small	1	0.31	0.03	0.01	2	0.14	0.03	0.01
Medium	7	0.3	0.21	0.08	8	0.5	0.4	0.14
Large	23	1.09	2.5	0.93	16	0.4	0.6	0.23
Total			**2.74**	**1.02**			**1.03**	**0.38**
	S.E	0.3			S.E	0.1		

Conclusion

Estimates for above and below-ground biomass showed that there is a significant amount of carbon that can be sequestered under both the ungrazed and grazed fields planted with wavy leaf saltbush on saline land. If carbon sequestration and off setting greenhouse gas emissions is the prime motive behind planting saltbush on a saltland then ungrazed systems would be the better option of the two. Nevertheless, sequestered carbon could be a useful by-product in grazed systems.

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