

Osmotic adjustment in three pasture and one grain legume in response to severe water deficits during flowering

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Osmotic adjustment is an adaptive mechanism to water deficits involving the lowering of osmotic potential. It occurs to varying degrees in different species and even in different cultivars (1), and has been demonstrated in a range of tropical pasture legumes (2). Little is known about the adaptation of temperate forage legumes to periods of severe internal water deficits especially during flowering. The present study examines osmotic adjustment in a subterranean clover, two annual medics and a lupin.

Methods

In a glasshouse at the University of Western Australia, swards of *Trifolium subterraneum* cv. Nungarin, *Medicago truncatula* cv. Cyprus, *Medicago polymorpha* cv. Serena and *Lupinus angustifolius* cv. Yandee were grown in 60 x 30 x 25 cm wooden boxes containing a 4:1 sand:loam mixture at a bulk density of 1.4 gm/cm³ and placed in trays for bottom watering. Swards were defoliated fortnightly (but not lupin) between 35 and 78 days from sowing (dfs) and two cycles of soil moisture deficit were imposed 94-108 and 116-126 dfs (1st and 2nd cycles, respectively). Predawn leaf water potentials were determined with a pressure chamber. Osmotic potentials of leaves were measured with a Wescor psychrometer and by the pressure-volume technique after rehydrating to full turgor. The values in Table 1 are the means observed by these two methods. The degree of osmotic adjustment is expressed as the difference in osmotic potential at full turgor between tissue that had been well watered and tissue that had undergone a water deficit before rehydration.

Results and discussion

Table 1. Lowest predawn leaf water potential, predawn water potential when plants were sampled for osmotic adjustment and the degree of osmotic adjustment in three pasture and one grain legume in response to soil moisture deficits during flowering and seed production. Figures in parentheses are the days to reach the reference potential.

Legume	Lowest predawn water potential (MPa)		Reference predawn water potential (MPa)		Degree of osmotic adjustment (MPa)	
	1st cycle	2nd cycle	1st cycle	2nd cycle	1st cycle	2nd cycle
Nungarin	-1.34	-1.95	-0.66(13)	-0.64(8)	0.30	0.27
Cyprus	-1.87	-1.94	-0.75(12)	-0.60(6)	0.40	0.29
Serena	-1.44	-1.57	-0.75(13)	-0.78(8)	0.53	0.39
Lupin	-1.80		-0.80(6)		0.05	
LSD(P=0.05)	0.32	ns	ns	ns	0.22	ns

ns = not significant

From a value of -0.2MPa in well watered plants, Table declines in predawn leaf water potential in both cycles of water deficit. When rewatered, lupin did not recover from a predawn leaf water potential of -1.8MPa. In the first cycle, the degree of osmotic adjustment at predawn leaf water potentials of -0.6 to -0.8MPa was least in the lupin when compared to the pasture legumes (0.05 as against values of about 0.3-0.5MPa). In the second drying cycle, the degree of osmotic adjustment was less than in the first cycle in all the pasture legumes, possibly because of the more rapid decline in water potential. The medics and the subterranean clover did not differ significantly in their ability to adjust osmotically.

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2. Ludlow, M.M. 1980. Tropical Grassland 14: 136-145.