Annual Legumes with Greater Water Use Efficiency Can Overcome Seasonal Feed Imbalance

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The 21st International Grassland Congress / 8th International Rangeland Congress took place in Hohhot, China from June 29 through July 5, 2008.

Proceedings edited by Organizing Committee of 2008 IGC/IRC Conference

Published by Guangdong People's Publishing House

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Key words : fodder conservation ,summer moisture stress ,*Trifolium* ,*Ornithopus* ,*Biserrula*

Introduction Large areas of southern Australia experience severe moisture stress through the summer-autumn period (Fitzpatrick and Nix 1970) limiting pasture production and hence animal productivity . Under such seasonal conditions farmers can i) allow livestock to lose weight over the summer period or ii) provide livestock with supplementary feed such as silage or hay to maintain productivity .The later option is preferred to maintain animal productivity .Currently the most widely used legume on acid soils in farming systems in southern Australia is *Trifolium subterraneum* .Recently a number of new annual legume species have been developed for farming systems in this region (Nichols *et al* . 2006) and although not yet widely sown , have considerable agronomic potential .The aim of this study was to assess the water use efficiency (WUE) in kg DM/mm growing season rainfall (GSR) of eight recently developed annual legumes compared to *T .subterraneum* when sown at high densities for fodder conservation .

Materials and methods Sites 1 and 2 were located at Binalong (148°37′E ,34°40′S) and site 3 at Harden (148°21′E ,34°33′S) . The sites differed in regard to soil pH ,exchangeable aluminium levels ,total annual rainfall (TAR) and growing season rainfall (Table 1) .*Trifolium vesiculosum* (cv .Zulu) ,*T .michelanium* (cv .Bolta) ,*T .glanduliferum* (cv .Prima) ,*T .purpureum* (cv . Electra) ,*T .hitrum* (cv .Hykon) ,*Biserrula pelecinus* (cv .Mauro) ,*Ornithopus sativus* (cv .Margurita) ,*O .compressus* (cv . Avila) and *T .subterraneum* (cv .Goulburn) were sown into a prepared seed bed in 2m x 4m plots replicated 3 times ,on the 30th May 2004 .Sowing rates were 7kg/ha for *T .michelanium* ,*T .vesiculosum* ,*T .glanduliferum* and *B .pelecinus* and 10kg/ha for the remaining species . Phosphorus (20kg/ha) and sulphur (25kg/ha) were applied at sowing .Calibrated visual assessment of herbage production was made on the 23rd November 2004 .

Table 1 *Soil pH (CaCl2) ,exchangeable aluminium (% of cation exchange capacity ,total annual rainfall (TAR) and growing season rainfall (GSR) at three sites in southern NSW .*

	Site 1	Site 2	Site 3
pH (0-10cm)	5 .3	5 .2	5 .8
pH (10-20cm)	4 .0	4 .3	5 .2
Al (0-10cm)	1	1	0
Al (10-20cm)	38	21	0
TAR (mm)	540	547	631
GSR (mm)	370	375	443

Table 2 *WUE (kg DM/mm GSR) of 9 annual legume species at three sites .*

Species	Site 1	Site 2	Site 3
T .vesiculosum	27	42	65
T .purpureum	27	43	66
O .sativus	25	44	47
T .michelanium	21	27	35
T .hitrum	15	31	25
B .pelecinus	13	37	25
T .glanduliferum	16	26	32
O .compressus	25	13	31
T .subterraneum	16	35	24
LSD (5%)	5 .2	2 .7	12

Results *T .vesiculosum* ,*T .purpureum* and *O .sativus* had significantly higher WUE compared to *T .subterraneum* at all three sites .*T .michelanium* and *O .compressus* had superior WUE to *T .subterraneum* at site 1 .*T .michelanium* ,*O .compressus* ,*T . hirtum* ,and *T .glanduliferum* had inferior WUE compared to *T .subterraneum* at site 2 but were similar at site 3 .

Conclusions Three species (*T .vesiculosum* ,*T .purpureum* and *O .sativus*) were found to have consistently higher WUE and make better use of GSR compared to *T .subterraneum* even at sites where sub-surface soil acidity and high levels of aluminium would have been expected to impact on performance .Given the incidence of summer moisture stress and the need to supplementary feed livestock in this period to maintain production ,these species appear well suited to use as specialist fodder conservation species in southern Australian farming systems .

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