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Effect of potassium on the tolerance to PEG induced water stress of two white clover varieties (*Trifolium repens* L.)

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Extended abstract of a paper published in *Plant and Soil* 120, 153–158 (1989)

The paper describes the results of an experiment in which two varieties of white clover, Crau and Huia, were grown hydroponically at two levels of potassium supply ($K_1=0.005$ mM and $K_2=5$ mM), unstressed and with water stress induced by polyethylene glycol (PEG) at two levels: 10% PEG and 20% PEG w/v. Treatments were applied to 2 month old seedlings and the duration of the experiment was 5 days.

The following measurements were made at day 1, day 3 and day 5:

Pre-dawn leaf water potential (Figure 1),

Stomatal resistance (Figure 2),

Nitrogen fixation capacity (Figure 3) by acetylene reduction activity (ARA),

Nodule number, fresh weight and water content (Table 1).

Pre-dawn water potential and ARA of unstressed plants remained constant but those of stressed plants declined, more markedly to day 3 than later. The ill effects of stress were less marked with Crau than with Huia and the effect of potassium in countering stress was evident. Stomatal resistance remained virtually constant in unstressed plants but increased during the course of the experiment in stressed plants with a marked difference between varieties, Crau again showing better performance than Huia. ARA was positively correlated with leaf water potential ($0.86 < r < 0.92$) and negatively with stomatal conductance ($-0.85 < r < -0.89$).

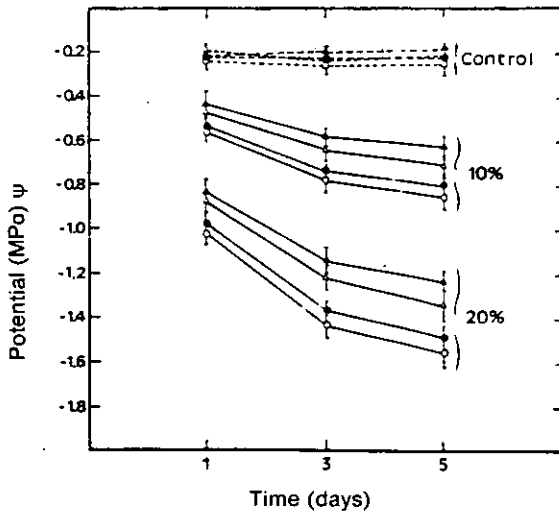


Figure 1 Dawn water potentials (bars) of the 2 varieties of white clover (Crau and Huia) during the osmotic stress induced by PEG (0, 10 and 20%) under 2 levels of K: $K_1 = 0.005$ and $K_2 = 5$ mM. Δ Crau K_2 ; \triangle Crau K_1 ; \bullet Huia K_2 ; \circ Huia K_1 .

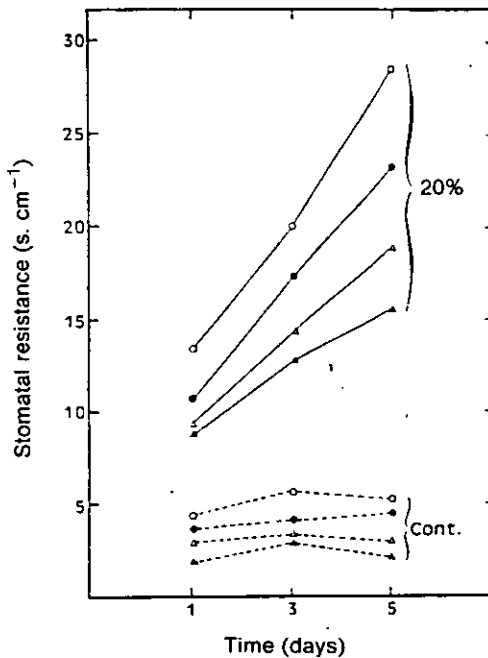


Figure 2 Stomatal resistance of the 2 varieties during the osmotic stress induced by PEG (0 and 20%) under 2 levels of K: $K_1 = 0.005$ and $K_2 = 5$ mM. Δ Crau K_2 ; \triangle Crau K_1 ; \circ Huia K_2 ; \circ Huia K_1 .

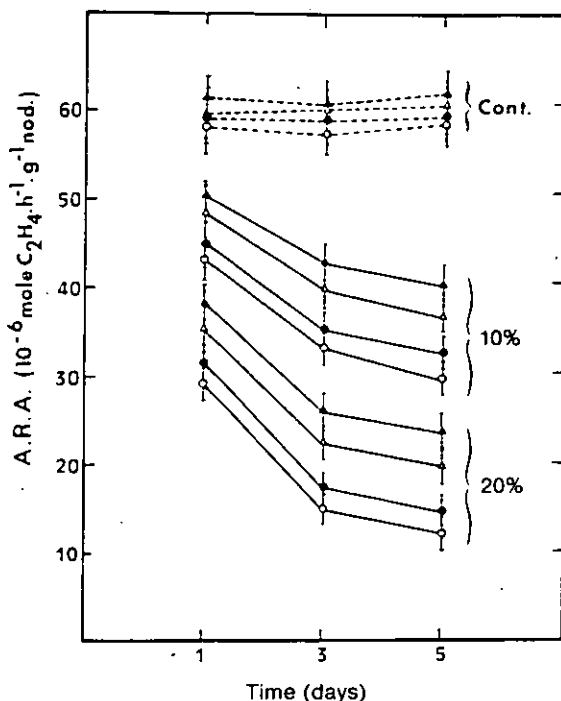


Figure 3 Nitrogen fixation N_2 (acetylene reduction activity) of the 2 varieties during the osmotic stress induced by PEG (0, 10 and 20%) under 2 levels of K: $K_1 = 0.005$ and $K_2 = 5$ mM. ▲ Crau K_2 ; △ Crau K_1 ; ● Huia K_2 ; ○ Huia K_1 .

Table 1 shows difference between varieties in favour of Crau which also had the better leaf and root development. Nodule mass was reduced by water stress. The effect of K was to increase nodule mass and to lessen the damaging effect of increasing water stress, the effect of water stress in lowering nodule water content being reduced by adding K.

The beneficial effects of potassium on leaf water status, stomatal activity and osmotic processes in plants are well-known, and these results show clearly that it is an essential factor determining resistance to water stress in white clover.

Osmotic stress caused a rapid decrease in N fixation while a shortage of K aggravated this effect. The work confirms earlier findings that white clover varieties differ in their resistance to water stress and also shows that varietal resistance to water stress is reinforced by high potassium supply.

Table 1 Nodule mass (g-plant^{-1}), nodule number (per plant) and nodule water content (% of the controls)

Variety	K level	Control			10% PEG			20% PEG		
		Nodule		Water content (%)	Nodule		Water content	Nodule		Water content
		number	f. wt (mg)		number	f. wt (mg)		number	f. wt (mg)	
<i>1st day</i>										
Crau	K ₁	33	22	100	32	19	90	33	17	84
	K ₂	45	25	100	41	18	90	42	17	86
Huia	K ₁	30	17	100	27	8	79	29	12	74
	K ₂	43	19	100	38	15	80	37	14	75
<i>3rd day</i>										
Crau	K ₁	39	18	100	35	17	82	35	23	76
	K ₂	51	21	100	45	29	84	45	32	78
Huia	K ₁	32	17	100	30	10	68	29	16	61
	K ₂	43	18	100	40	14	69	39	25	63
<i>5th day</i>										
Crau	K ₁	33	20	100	40	28	79	37	28	73
	K ₂	52	35	100	49	39	80	45	30	71
Huia	K ₁	34	16	100	33	15	65	33	20	58
	K ₂	45	22	100	41	22	68	40	29	60