

# Investigation of responses of plant mixture to different water stress regimes in a pot experiment

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## Introduction

- Drought has been a worldwide concern for many years with an increased concern for some regions impacted by global warming
- The tolerance of plants to drought stress can be facilitated by increasing water uptake or decreasing water loss but only one of these can be expressed in a monoculture
- Having more than one species adapted to drought present in a mixture should provide better 'insurance' than monocultures

## Objectives

- To determine if a mixture of plant species have higher net primary productivity than monoculture of a single species under conditions of water deficit?
- To determine which forage species has the best growth under conditions of water deficit?

## Materials and Methods

### Experiment locations

The study was conducted at SPARC-AAFC, in Swift Current, Saskatchewan.

### Experiment treatment

• 5 plant species from 3 functional groups were selected for testing

- 2 legume plants: alfalfa (ALF), purple prairie clover (PPC)
- 2 grasses plants: crested wheatgrass (CWG), blue grama (BG)

shrub: winterfat (WF)

• A randomized complete block design with 2 factors (species mixtures and water treatments) was used.

• 3 different watering treatments: a well-watered treatment (100% of field capacity) and two water-stressed treatments (85 and 70% of field capacity).

• The experiment had three replications, each with 42 pots.

• The soil water content was maintained at 100, 85 and 70% by watering daily.

## Acknowledgements

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**Table 1. Above-ground biomass in the greenhouse for mono- and poly-cultures (unit: g)**

Water treatment	100%	85%	70%	P	SEM
-----Above-ground Biomass-----					
ALF	1.39ab(A)	0.86a(B)	0.69a(B)	<0.001	0.01
PPC	0.12g(A)	0.11e(A)	0.07f(A)	0.26	0.02
CWG	0.55ef(A)	0.44d(AB)	0.34de(B)	0.06	0.05
BG	0.77cde(A)	0.50d(B)	0.37cde(B)	0.02	0.07
WF	0.85cd(A)	0.81ab(A)	0.53abc(A)	0.23	0.10
ALF*PPC	1.30b(A)	0.82a(B)	0.47bcd(B)	0.01	0.10
ALF*CWG	1.53ab(A)	0.92a(B)	0.59ab(C)	<0.001	0.07
ALF*BG	1.57a(A)	0.88a(B)	0.52abc(C)	<0.001	0.05
PPC*CWG	0.49f(A)	0.40d(A)	0.40cde(A)	0.42	0.05
PPC*BG	0.60def(A)	0.53cd(A)	0.25e(B)	0.04	0.08
CWG*BG	0.54ef(A)	0.46d(A)	0.36cde(A)	0.36	0.08
CWG*WF	0.72cdef(A)	0.56cd(A)	0.45bcd(A)	0.12	0.08
BG*WF	0.82cd(A)	0.68bc(AB)	0.50bcd(B)	<0.05	0.07
PPC*BG*WF	0.90c(A)	0.69bc(A)	0.45bcd(B)	<0.01	0.06
P	<0.001	<0.001	<0.001		
SEM	0.09	0.06	0.06		

Note: different lower-case letter indicates significant difference of species; Capital letter is the significant difference of water treatment.  $\alpha = 0.05$

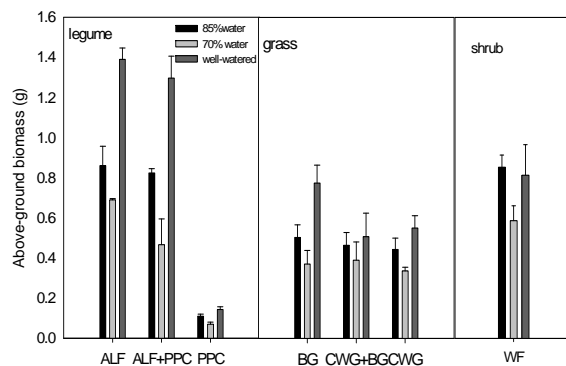


Figure 1. Above-ground biomass of different plant functional groups

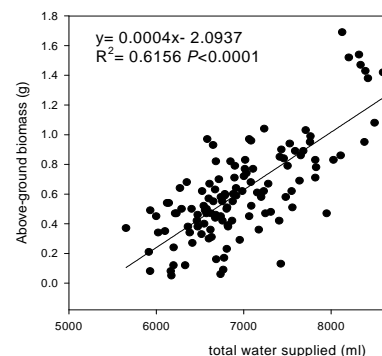


Figure 2. Temporal linear dependence of total water supply on above-ground biomass by 126 pots

## Results and discussion

- Fourteen treatment types above-ground biomass treatment than in the other two lower water treatments (Table1) than in the field capacity treatment (0.85g) although not statistically different. Our results are in agreement with the statement: water is an important limiting factor to plant productivity (Lal et al., 1998).
- Compared to other species combinations, the mixture of ALF and BG had the highest aboveground biomass in the field capacity treatment (1.57g), although not statistically different from the other two water-stressed treatments (Schellenberg 2002). ALF is also not statistically different from the other two water-stressed treatments.
- Not all mixtures improved plant above ground biomass (Fig.1). The ALF containing mixtures always had the highest biomass.
- Above-ground biomass ( $R^2=0.6156$ ,  $P<0.0001$ ) increased with increasing total water supplied.

## Conclusions

Increasing potential for drought will reduce above-ground biomass of mixtures were always higher than monoculture treatments. Biomass trends were ALF>WF>BG>CWG>PPC, as the plants may not be competitive. Compared with the other mixtures, the mixture of ALF × CWG had the highest biomass in the two water-stressed treatments.

## Key references

- Lambers H, Chapin FS, and Pons TL (1998) Plant physiology, 2nd ed. Academic Press, San Diego, CA.
- Schellenberg, MP, Banerjee, MR (2002). The potential of Optimum Forage Production: A Greenhouse Study. Canadian Journal of Plant Science 82: 357-363.

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