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Physiological and Morphological Responses of Four *Centrosema* Species to a Preconditioning Period of Different Soil Water Deficits: An Ongoing Research in Venezuela

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Introduction

•In savanna ecosystems, rainfall seasonality is the main cause of variation in forage yield and quality.

•Since extended dry periods are common in these regions, identification of plant traits promoting long term persistence under drought is a critical issue for forage plant adaptation.

•Under natural conditions, the progressive exposure (acclimation) to drying soil during the low-rainfall period is expected to allow inherent mechanisms for drought survival to be fully expressed.

Objective

To identify differences in growth and biomass partitioning among four *Centrosema* species: *C. molle* (CIAT 151601[1]) *C. brasilianum* (BGLFV2 121[2]) (*C.brasi*), *C. macrocarpum* (CIAT 5713) (*C.macro*) and *C. rotundifolium* (CIAT 5721) (*C.rotun*), after being subjected to a similar acclimation period with contrasting soil water contents.

[1]Cv. Barinas. [2]Venezuelan Seed Bank of Forage Legumes

Materials and Methods

•Plants were grown in PVC pots (10 cm d, 50 cm depth) under glasshouse conditions. Soil fertilization and *Rhizobium* inoculation prevented any possible nutrient deficiency. Average daily air temperature fluctuation was: 17-32ºC, and maximum PAR=1200 $\mu molm^{-2}s^{-1}$ (14 hrs).

•All species were watered to field capacity for 40 days. Afterwards, three irrigation treatments were imposed, so soil moisture was kept at the following matrix potentials:-0.05, -0.3 and –1.5 MPa. Plants were cut after 30 days of preconditioning and let to regrow for about 45 days under the same treatments before final harvest.

•Plant measurements were: a)biomass production and partitioning (S:R ratio), leaf area (LA), and c) specific leaf weight (SLW).

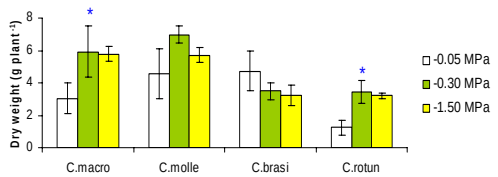
Results

•Variation in all measured plant traits was high within treatments, probably because the plant material is relatively wild or still incompletely selected for uniformity.

•Total plant biomass at the end of the regrowth period (Fig. 1) was only modified in *C.macro* and *C.rotun*, where final yield under low soil moisture regimes was even higher than control (-0.05 MPa). *C.brasi* was the only species in which total biomass tended to decrease with water deficits (Fig.1).

• Leaf, stem and consequently, shoot biomass, followed the same trend as in Fig. 1. However, during the preconditioning period, above–ground biomass in *C.macro* and *C.rotun* was similar among treatments. In these species, the observed increase in total biomass (Fig. 1) was the result of an increase in both, shoot and root biomass. In *C. molle,* total and shoot biomass varied little among treatments during and after the preconditioning period. In *C.brasi,* the decrease in total biomass was the net result of a marked decrease in shoot biomass, as root dry weight remained similar among treatments.

Figure 1. Total plant biomass in *Centrosemas* after a preconditioning period of soil water deficit



(*shows significant differences (p<0.05) among treatments)

Root biomass was also increased in *C. molle* at low water potentials, though this did not result in a significant increment of total plant biomass. Under low soil water potentials, it was observed a high number of fine roots, which may have induced a nearly complete reduction of soil moisture with depth, as shown in Figure 2.

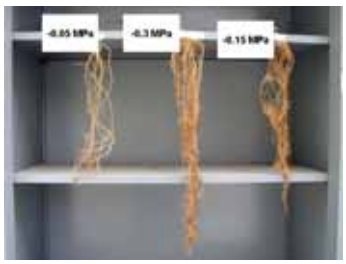


Figure 2. Root system of *C. macrocarpum* at different soil water potentials

•LA decreased at low water potentials during the preconditioning period. Subsequently, low moisture had negative (*C.brasi*) and positive (*C.rotun*) effects in LA. Similar positive effects were also observed in *C. molle* and *C.macro* at –0.3 MPa, though not significant.

•During preconditioning, SLW was relatively similar among treatments, but at final harvest it was increased by low water contents in all species except *C.rotun*.

•The S:R remained similar among treatments in *C.macro*, but was markedly decreased at low soil water contents in *C. molle* and *C.brasi*. An increase in S:R was observed in *C.rotun* at –0.3 MPa.

Conclusions

•All species appear to be well adapted to drier savanna environments.

•Acclimation seems to induce more plasticity in some morphological traits that contribute to drought tolerance.

In *C.brasi*, the increase in SLW and the early decrease in biomass and LA appear to be useful traits to survive but not to produce during drought. The sustained increased in root growth and the root:shoot ratio at low water contents, may allow *C. molle*, *C.macro* and *C.rotun* to have more access to deep water and hence to have at least a longer period for biomass production during drought.

•Research is on the way to gain a better understanding of the physiological basis for differences in drought tolerance between species.

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