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Responses of Different Tropical Forage Legumes under Stress Factors of Acid Soil and Drought

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Abstract

Tropical savannahs represent about 43% of the world's arable land and are among the few frontiers still available for agricultural expansion. The development of improved agropastoral systems forms part of the overall effort to increase the sustainability of farms in these regions. Forage legume species and genotypes exhibit a wide phenotypic variability in resistance towards aluminum toxic acid soil and progressive soil drying, as major constraints limiting productivity in tropical savannah ecosystems.

Objective of this study was to characterise the adaptive response of rooting systems of three genotypes of each of *Canavalia brasiliensis*, *Arachis pintoi* and *Stylosanthes guianensis* to forms of abiotic stress in a greenhouse trial using a soil cylinder screening method. Plants were grown on a highly aluminum saturated, acid Oxisol with and without fertiliser application and liming (high aluminum saturation without fertiliser versus low aluminum saturation with fertiliser) under two levels of soil moisture (irrigated and progressive soil drying). Main parameters analysed were total root length (TRL), deep rooting ability (DRA), mean root diameter (MRD), specific root length (SRL), shoot dry weight (SDW) and leaf area (LA).

Results indicate that under all conditions plants which are able to faster establish DRA will have a greater TRL and SDW. Acid soil inhibited development (TRL, SDW) stronger than drought stress, while combined stress did not have any further negative effect on SDW, although plants reacted with adaptive root growth. *C. brasiliensis* and *A. pintoi* were found adaptive to toxic aluminum, as indicated by no significant inhibition of DRA or decrease of SRL and MRD compared with the control. Nevertheless, both species were strongly inhibited by nutrient deficiency under acid soil and had strongly reduced SDW. *S. guianensis* was found sensitive to aluminum for the same parameters and had a reduction of SDW of 96% as compared with the control. Although, some adaptive responses could be observed (increased DRA) under drought conditions all plants had significantly reduced SDW. *C. brasiliensis* was found superior to *A. pintoi* and *S. guianensis* under all stress treatments, with accession *Canavalia* 905 performing overall best by combining an extensive root system, large leaves and vigorous seedlings.

Keywords: Aluminum toxicity, drought stress, forage legumes