DETERMINATION OF DROUGHT STRESS TOLERANCE AMONG SOYBEAN VARIETIES USING MORPHOLOGICAL AND PHYSIOLOGICAL MARKERS

by

PASEKA TRITIETH MABULWANA

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DEDICATION

This is a special dedication to my late sister, Tinyiko Tercia Mabulwana-Mnisi for being a wonderful sister during her short and precious life on earth. *Ndza ku tsundzuka, ndza ku rhandza hinkwawo masiku ya ku hanya ka mina. Etlela hi ku rhula phyembye ra ka hina, madyondza ya Khalanga na n'wa Mulambya!*

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ABSTRACT

The aim of the study was to identify drought tolerant South African soybean cultivars for cultivation where water is a limited resource. Soybean [*Glycine max*. (L.) Merr] is one of the most important legumes in the world. A lot of attention has been focused on soybean cultivation in South Africa recently. Soybean production is mainly affected by several biotic and abiotic factors which reduce the yield and quality of the crop.

Six South African soybean cultivars (LS 677, LS 678, Mopanie, Sonop, Knap and Pan 1564) and two American cultivars (R01 416 and R01 581) were carefully studied for morphological and physiological markers which contribute to drought tolerance. The study was conducted at the University of Limpopo (Turfloop campus). Soybean plants were grown in a glasshouse in a randomised block design given same amounts of nutrients and differing amounts of water (limited and overwatering).

Data was collected at R3 growth stage by measuring several morphological (stem length, leaf surface area, flowers and seeds counts) and physiological (percentage chlorophyll, moisture content, total phenolics, total flavonoids, ureide content and antioxidant activity) parameters. An anatomical study was also carried out on the transverse sections of leaves, roots, leaf stalk and nodules.

The different cultivars reacted differently to the three water treatments. LS 678 produced the tallest plants whereas those of Pan 1564 were the shortest. Water stress affected plants by reducing the number of flowers produced, the leaf surface area as well as the relative leaf water content. The moisture content of the growth medium was reduced faster as the plants matured and it was also lowered by the limited water availability. Percentage chlorophyll is another trait which was affected by water limitation. Cultivars with high phenolic and flavonoids content were associated with high antioxidant activity and slightly yielded higher than the others.

The anatomical transverse sections of the roots and petioles have shown some secondary growth. The anatomy of the nodules of Mopani has shown some interesting differences in response to the three treatments. Limited water decreased

the size of the vascular tissue and sclerenchyma as a result altering the functionality of the nodule. The anatomy of Sonop's petiole had a thickened sclerenchymatous bundle sheath covering the phloem tissue. The sclerenchyma tissue is thought to guard against loss of water. The cross section of the leaf had a double layer of palisade mesophyll (upper surface) and only a single layer of spongy mesophyll (lower surface). In addition, the mesophyll and the epidermal cells of Mopani appeared much thicker.

In terms of yield, there was no cultivar which yielded the highest but Mopani yielded the lowest. Since Mopani was low yielding, the main focus of the discussion was on the features (morphological, physiological and anatomical) of Mopani which can be associated with drought susceptibility. Some of these features include reduced stem length, large leaf surface area, low relative leaf water content, low growth medium moisture content and low antioxidant activity.