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ASSESSMENT ON THE DROUGHT TOLERANT CAPABILITIES OF NEWLY RELEASED TEA CLONES

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INTRODUCTION

Drought is a serious environmental hazard in global societies and its damage to cultivated crops has become a frequent phenomeon. Tea is no exception (Nawaratne, 1992: Yatawatte, 1992). In Sri Lanka, tea (*Camellia Sinensis L.)* is grown as a rain-fed plantation crop. Although monsoons bring in sufficient amount of rainfall to all tea growing regions, its poor distribution results in moisture stress on tea plants during the first quarter of the year. Tea lands in the Low-Country (600 amsl) are frequently affected by the dry weather conditions causing enormous losses to the tea industry.

Under prolonged dry weather conditions growth of the tea plant is adversely affected by water deficits due to lack of soil moisture and high saturation vapor pressure deficit of the environment (Wijeratne and Ekanayake, 1990). Mature tea bushes with well developed root systems can withstand drought better than young tea plantations. During first 3-4 years after field planting, bushes are highly prone to drought effects. Although irrigation during the dry periods is a reliable solution, it has limitations such as lack of water resources and high cost. There are practical problems such as lack of water resources, high costs etc. Therefore, the use of drought tolerant tea clones with a higher water use efficiency has become necessary in drought prone regions.

Transpiration and stomatal conductance of leaves are some indices generally used for screening clones for drought tolerance (Sandanam et. al.,1981; Wijeratne, 1986) However, accumulation of osmotically actives solutes in plant tissues leading to osmotic adjustments, plays a key role in plants adapting to dry weather conditions. Hence, it offers a reliable guide for screening cultivars for drought tolerance. Experimental results have also shown that the pressure volume curve which explains the relationship between the relative water content and water potential can be used to study the water relation characteristics of the tea plant (Wijeratne, 1994).

On the basis of field performance, most of the clones recommended by the Tea Research Institute of Sri Lanka have been ranked according to their ability to tolerate dry weather conditions. However, detailed studies have not been conducted on newly released TRI '3000' and TRI '4000' series clones. Hence, a glass house experiment was conducted at the Tea Research Institute, Low - Country Station, Ratnapura to assess the variation of water potential of selected clones comprising TRI 3000 and 4000 series.

MATERIALS AND METHODS

The experiment was conducted under glass house conditions at the Tea Research Institute, Low Country Station, Ratnapura. (6^0 40N, 80^0 25E and 60m amsl). A group of eighteen month old vegetatively propagated (vp) plants comprising eleven clones was selected from the Tea Research Institute nursery (St. Joachim Estate). They were as follows.

TRI '3000' SERIES CLONES:	TRI '4000' SERIES CLONES:
1. TRI 3058	6. TRI 4042
2. TRI 3025	7. TRI 4052
3. TRI 3041	8. TRI 4049
4. TRI 3057	9. TRI 4033
5. TRI 3052	10. TRI 4014

CONTROL : TRI 2025

These plants were transplanted in plastic pots (41) filled with top soil (utisol). One month after transplanting treatments were imposed. At the beginning of the experiment all the plants were thoroughly watered, and kept for 24 hours to drain out excess water. These potted plants were then exposed to moisture stress condition without watering until they were permanently wilted. Plants were arranged in three blocks according to their size. Each block consisted of 33 potted plants (3 plants x 11 clones).

Measurements of relative water content and leaf water potential (pre dawn) were taken between 6. 00 hrs - 8.00 hrs daily. For the determination of relative water content 3 mature leaves were excised from three different plants. Leaves were weight separately and floated on distilled water for 3 hours at room temperature under a light source of two 100W bulbs, mounted approximately 30 cm above the water surface (Sandanam et al., 1981). After floating, the surface water was removed by placing the turgid leaves between several layers of soft tissues ,and turgid weight was recorded. Leaf dry weight were determined by oven drying the leaves at 90 ^{0} C for 24 hours. The relative water content (RWC) was estimated as reported by weatherly (1950).

$$RWC = (FW - DW) /(TW - DW)$$

Where FW, TW and DW are the fresh weight, turgid weight and dry weight respectively.

Leaf water potential was measured on a similar set of leaves sampled from the same plants used for relative water content assessments. They were the opposite leaves to that removed for relative water content determination. The leaf water potential measurements were taken inside the glass house using the pressure bomb (Plant water status Console - Model - 3005, USA) (Scholander et al., 1965).

Soil samples were collected from each plant at the beginning and at the permanent wilting point (PWP) for the determination of soil moisture. A soil sample of 100g was placed in the oven at 102^{0}C for 24 hours and dry weight were recorded.

RESULTS AND DISCUSSIONS

Although the age of the plants were same, the total number of leaves per plant and the leaf area were markedly different among clones. Therefore, wilting of plants followed this variation of growth. The first signs of wilting were observed in clones having a larger leaf area. TRI 4049 and TRI 4014 permanently wilted 9 days after withholding watering; followed by TRI 4033. At the eleventh day of the drying cycle, TRI 2025, TRI 4042 and TRI 4052 wilted. The other clones except, TRI 3025, wilted twelve days after imposing moisture stress. TRI 3025 was the last to reach permanent wilting point 14 days after withholding irrigation. As wilting depended largely on the leaf area, comparison of tea clones based on their drought tolerant capabilities had to be done with utmost care, considering the soil moisture content at the PWP and changes of the osmotic potential of drying plants.

Pressure volume curves were drawn for each clone and the values of osmotic potential at turgor loss point (Zero turgor) were estimated as shown in Figure 1. Table 1 shows the variation of soil moisture content at the PWP and the osmotic potential zero turgor. The results indicate that the soil moisture content at the PWP and osmotic potential at the turgor loss point recorded for the well known drought tolerant clone TRI 2025 were comparable with those of TRI 3000 and 4000 series clones. Therefore, these newly released clones also can absorb water from drier soil by lowering their osmotic pressure to more negative values as observed in the well known drought tolerant clones such as TRI 2025.

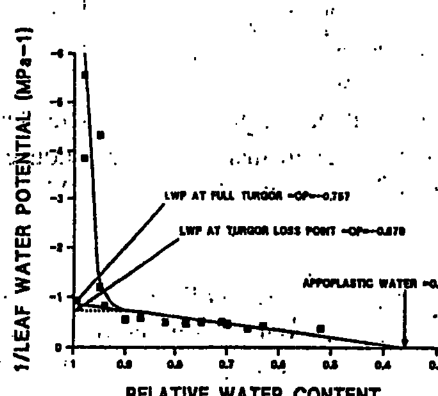

Figure 1. Pressure volume curve for TRI 3057

Table 1. Soil moisture content at PWP and osmotic potential at turgor loss point of tested tea clones.

Clones	Soil Moisture at BWP (%)	OP at turgor loss point (MPA)
TRI 2025	5.68	-0.971
TRI 3058	5.79	-1.114
TRI 3025	5.32	-0.860
TRI 3041	6.54	-1.098
TRI 3057	6. 06	-0.879
TRI 3052	5. 61	-0.991
TRI 4042	6.11	-1.240
TRI 4052	5.86	-1.039
TRI 4049	6.14	-1.275
TRI 4033	5.62	-1.033
TRI 4014	5.77	-1.562

With these findings, it is clear that the newly released TRI 3000 and 4000 series clones can withstand dry environments as efficiently as the drought tolerant TRI 2025 clone. Therefore, such clones appear to be suitable for drought prone regions provided that they possess other beneficial characteristics such as high yield, good quality of made tea, resistance to pest and diseases and better performance in the nursery etc. Moreover, the field observations have also shown that some of these newly released clones have survived over prolonged dry periods which confirm the findings of the study. Therefore, the osmotic potential at turgor loss point can be used as a reliable guide for screening tea clones for drought tolerance at an early stage of the breeding programme i.e. before they are tested in the field. However, such assessments need to be repeated few times in order to perform a proper statistical analysis and rank the clones precisely.

SUMMARY

Results of the glass house experiment revealed that, in comparison with a well known drought tolerant clone (TRI 2025) , most of newly released TRI 3000 and 4000 series clones are even

better adapted to dry weather conditions. The osmotic changes of drying plants can be used as a key factor for screening clones for drought tolerance.

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