Identification of Drought Tolerance Accessions of Tea (*Camellia Sinensis*) in Uva Region of Sri Lanka

M.J.A.Rasith
Uva Wellassa University, Badulla, Sri Lanka
M.M.N. Damayanthi
Tea Research Institute of Sri Lanka, Talawakelle
and
L.M.H.R.Alwis
Uva Wellassa University, Badulla, Sri Lanka

Introduction

Drought is one of the major and ever present threats that adversely affect on the plant growth and yield all over the world (Stephens and Carr, 1989). Plant water stress, caused by drought has major impact on plant growth and development. Growth of tea is also adversely affected by the plant water deficits created by lack of soil moisture (Smith, *et al.*, 1994). Drought causes the losses to the tea industry. Planting of drought tolerant cultivars is the most efficient solution to maintain the productivity. Hence this study attempted to identify drought tolerant ability of TRI 5000 series accessions that can be grown in Uva region.

Methodology

Experiment was conducted at the Field No – 02 at Tea Research Institute (Uva Region Centre), Passara. Four control cultivars (TRI 2025, TRI 4042, TRI 3019 and DN) and nine accessions (N243, N199, N210, N88, N89, N21, N5, N17 and N208) of tea (*Camellia sinensis* L.) were used for the experiment. Drought tolerant ability of test accessions was compared with control cultivars by using some physiological parameters such as relative water content (RWC), photosynthesis rate, transpiration rate and stomatal conductance and also using a biochemical parameter, total soluble sugar (TSS). Soil moisture content was measured along with physiological and biochemical parameter. Drought susceptibility index was calculated by using photosynthesis rate under stressed and non-stressed conditions, and cluster analysis of accessions with known cultivars was done.

Results and Discussion

In all the control cultivars and accessions, RWC decreased with the drought. Figure 1shows that RWC of N243 was significantly lower than cultivars TRI 4042, DN and TRI 2025. RWC of N208 and N17 were significantly lower than cultivars DN and TRI 4042 while RWC of N210, N21, N5, N88, N199 and N89 were not significantly different from all control cultivars. After raining, RWC of N212 increased in higher rate (>9). RWC of leaves of all cultivar declines with water stress, but drought tolerant clones retain higher RWC indicating that they are more drought tolerant. Results revealed that N210, N21, N5, N88, N199 and N 89 are drought tolerant clones that were used as controls.

A major effect of drought is reduction in photosynthesis (Whid and Rasul, 2005). Figure 2 shows that photosynthesis rate decreased with the drought in all accessions and in control cultivars. According to the Figure 2, Photosynthesis of N199 and N89 were not significantly different from any of the other control cultivars, but N88, N17, N5 and N21 were significantly lower than cultivar TRI 2025, whilst N208 and N210 were significantly lower than cultivars TRI 2025, TRI 3019 and DN. N243 was significantly lower than all known cultivars. A major effect of drought is reduction in photosynthesis. Thus, results

revealed that N199and N89 are as drought tolerant cultivars among the control cultivars used in the study.

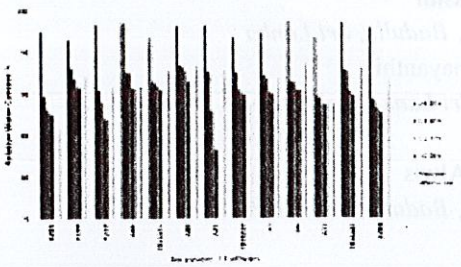

Figure 1: RWC of the control Cultivars and TRI 5000 series Accessions

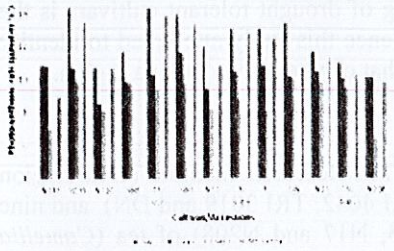

Figure 2: Photosynthesis Rate of control Cultivars and TRI 5000 series Accessions

Water stress resulted in stomatal closure and reduction in transpiration rates. Dry and hot winds decrease the relative humidity of the atmosphere and increase the transpiration rate on the surface of the leaves (Lemmesa, 1996). Figure 3 shows that control cultivars and accessions transpiration rate decreased with the drought. N89, N17 and N21 were not significantly different from all control cultivars. N243, N208 and N5 were significantly different from TRI 4042. N199 was significantly lower than TRI 4042 and TRI 3019. N88 was significantly lower than TRI 4042, TRI 3019 and DN. N210 was significantly lower than all known cultivars. Thus, results revealed that N243, N208, N5, N199, N88 and N210 having lower transpiration rate are as drought tolerant cultivar.

Virtually, all the plants at acute water deficit exhibit closure of their stomata to prevent the transpirational water loss (Mansfield and Atkinson, 1990). Figure 4 shows that in all control cultivars and accessions, stomatal conductance decreased with the drought. Stomatal conductance of N89, N5 and N199 were not significantly different from any of control cultivars, while N17, N21 and N208 were significantly lower than TRI 4042 but N243 was significantly lower than TRI 4042, DN and TRI 3019. N88 and N210 were significantly lower than all control cultivars. Thus, the results revealed that N89, N5 and N199 are as drought tolerant clones as known cultivars.

Figure 5 shows that in all accessions and known cultivars, TSS content increased with the soil moisture stress. At the commencement of drought TSS content of all the accessions and control cultivars was very low. TSS increased during the drought period. TSS of N243, N210, N21 and N17 were significantly lower than the control cultivars and showed the

lowest increasing rate than the control cultivars. TSS of other accessions were not significantly different from the control cultivars. Thus, the results revealed that N199, N88, N89, N5 and N208 are as drought tolerant accessions.

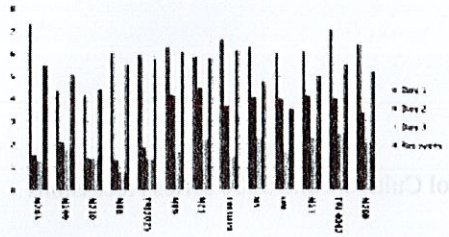

Figure 3. Transpiration Rate of control Cultivars and 5000 series Accessions

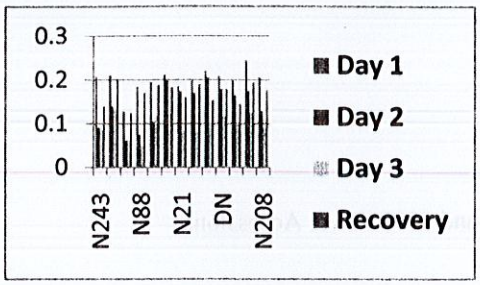

Figure 4. Stomatal Conductance of control Cultivars and 5000 series Accessions

Drought susceptibility index showed that accessions N243, N21, N5 and N208 were more susceptible to the drought than the other TRI 5000 series accessions. Thus, the results revealed that N199, N88, N89, N17 and N210 are as drought tolerant clones.

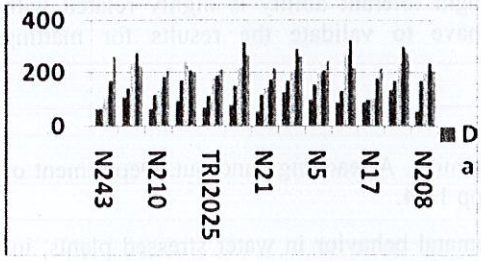

Figure 5: TSS of control Cultivars and 5000 series Accessions

Cluster Analysis

In the cluster analysis, studied all 5000 series accessions and control cultivars were categorized into five groups using the physiological parameters and biochemical parameter. Accessions N199 and N89 are clustered into one group. Moreover, control cultivars TRI 2025, DN and TRI 3019 are also clustered in this group. Accessions N5 and N17 were separated into another group. Control cultivar TRI4042 is also in this group. Accessions N243, N210 and N208 are categorized into one group. Accessions N88 and N21 are categorized separately in the other two groups.

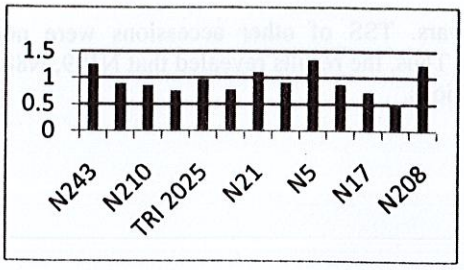

Figure 6: Drought Susceptibility Index of control Cultivars and 5000 series Accessions

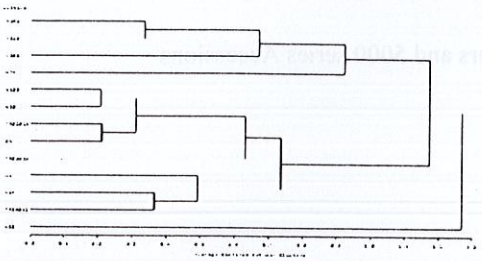

Figure 7: Cluster Analysis of control Cultivars and 5000 Series Accessions

Conclusion

In higher moisture levels most of the accessions are not significantly different from the control cultivars. In the moisture stress period most of the accessions are significantly different from the control cultivars. Accessions N89 and N199 can be categorized into one group and drought tolerant ability in these two accessions is highly related with control cultivars TRI2025, DN and TRI3019. Accessions N5 and N17 can be categorized into another group and these two accessions drought tolerant ability is highly related with known cultivar TRI4042. Further studies have to validate the results for matting recommendations.

References

Lemmesa F., 1996. Tea production and management. A teaching hand out. Department of Plant Sciences, Jimma College of Agriculture, pp 1-14.

Mansfield, T.J. and Atkinson, C.J., 1990. Stomatal behavior in water stressed plants, in: R.G. Alscher Cumming J.R. (Eds.), Stress Responses in Plants: Adaptation and Acclimation Mechanisms, Wiley-Liss, New York, , pp. 241–264.

Smith, B.G., Paul, J., Burgess and Carr, M.K.V., 1994. Response of different tea (*Camellia sinensis*) clones against drought stress. J. Mater. Environ. Sci. *Ext & Dev* 30:1-16.

Stephens, W. and Carr, M.K.V., 1989.Water stress index for tea (*Camellia sinensis*) 25:545-558.

Wahid, A. and E. Rasul, 2005. Photosynthesis in leaf, stem, flower and fruit,in: Pessarakli M. (Ed.), Handbook of Photosynthesis, 2nd ed., CRC Press, Florida, pp. 479–497.