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Differentiation of tea (*Camellia sinensis* L.) Cultivars in relation to physiological parameters

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Abstract

Tea requires a moderately hot and humid climate. Tea grows in a variety of climate conditions and has very wide ecological amplitude. In the study, responses of some physiological, parameters related to drought stress were studied in few selected popular tea cultivars which included eleven clones and four biclonal seed stocks. All the cultivars were grown in pots and the experiment was laid in factorial 2CRD with two treatments viz. normal condition and moisture stress condition. Observations were made in 7 days interval for Relative Leaf Water Content (RLWC) and Water Saturation Deficit (WSD). The results of the study revealed that drought stress caused a gradual decline in RLWC but increase in WSD.

Keywords: RLWC, WSD, Tea (*Camellia sinensis* L.), drought, stress, clones

Introduction

Tea is the aromatic beverage widely consumed in the world. In India, tea is grown in 563.98 thousand ha with a production of 1208.78 million kg (Tea Board, 2014-2015). Humid climate and high relative humidity favours growth of tea. Tea grows well on high well drained soils having a good depth, acidic pH within a range of 4.5 to 5.5 and with an organic matter content of over 2 per cent.

Drought is a major yield limiting abiotic factor identified across the globe. Tea (*Camellia sinensis* (L.) O. Kuntze) is an economically important beverage crop. Drought stress seriously limits the growth and development of the tea plant, thus affecting crop yield and quality. Drought stress induces oxidative damage in tea plant and affects antioxidant systems, altering different physiological and biochemical processes (Upadhyaya and Panda 2004b)^[8] that cause significant crop loss. Antioxidant efficiency also varies in different clonal varieties of tea (Upadhyaya and Panda 2004a)^[7] and thus varies the responses to water stress in different clones of tea (Chakraborty *et al.* 2002)^[2]. Understanding the physiological and biochemical effects of post drought rehydration in tea is equally important and will give better insight into the mechanism of drought stress responses and tolerance as well as recovery potential of the plant.

Materials and methods

Experiment was investigated with eleven popular tea clones and four popular biclonal seed stocks in the tea industry of Assam. The clones were TV1, TV9, TV17, TV19, TV20, TV21, TV22, TV23, TV25, S₃A₃ and Teenali 17/1/54. The biclonal seed stocks were TS462, TS463, TS491 and TS520. The moisture content of soil was determined at three periods after imposition of drought between stress and control treatments in the pot experiment and various physiological related *viz.* Relative leaf water content and water saturation deficit were observed to get a detailed information.

Statistics

The mean data for each parameter were subjected to analysis of variance for factorial completely randomized design as described by Panse and Sukhatme (1985)^[6]. The treatment mean squares were tested for significance by F- test and the differences of treatment means were tested by estimating critical difference. Correlation is a broad class of statistical relationships involving dependence. Correlation may be linear or non-linear.

If the rate of change in the two variables is the same, then the correlation is linear, otherwise it is non-linear.

Results

Relative water content is an important parameter used to estimate the water potential under stress condition (Kumar *et al.*, 2004) [5]. The mean relative leaf water content were significantly ($P < 0.05$) different amongst cultivars and amongst different soil moisture contents. The interaction between cultivar and treatment was also significant ($P < 0.05$). Initially under high soil moisture content, relative leaf water content did not vary significantly among cultivars. With the depletion of soil moisture after a period of 7 and 14 days of stress imposition the relative leaf water content declined rapidly. The estimated result of relative leaf water content is

given in Fig 1. A wide variation for relative leaf water content was recorded in stressed plants compared to that in control plants. The relative leaf water content ranged from 11.81-30.49 per cent for stress; whereas under control conditions, relative leaf water content ranged from 97.92 per cent to 88.34 per cent. Few cultivars such as TV25, TV23 and TS520 maintained high relative leaf water content as high as 30.49 per cent in TV25 compared to others where relative leaf water content was as low as 11.81 per cent in TV21. The tissues that can maintain high relative leaf water content and leaf water potential are reported to have high tolerance to drought. The results fit the observations of Aminzadeh and Eshghi (2006) [1]; Ferrat and Lovatt (1999) [3] and Khan and Stoddard (2005) [4].

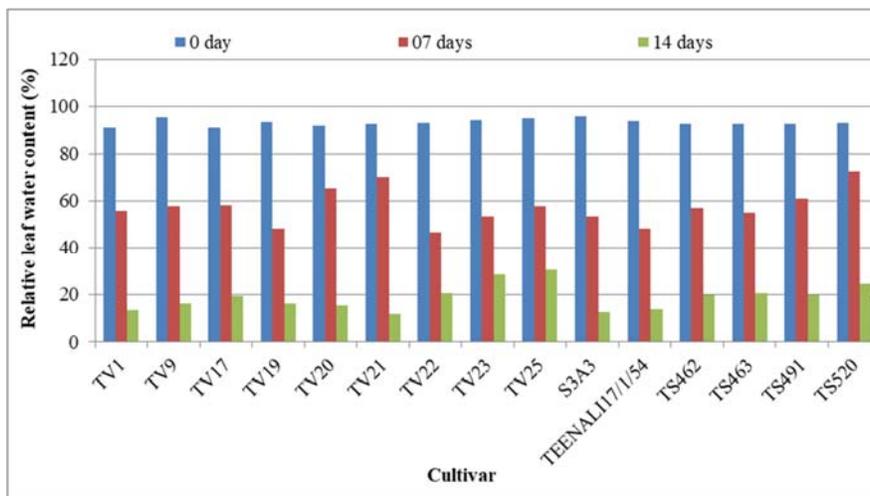


Fig 1: Relative leaf water content (%) of different cultivars on 0, 7th and 14th day after imposition of drought (T₁)

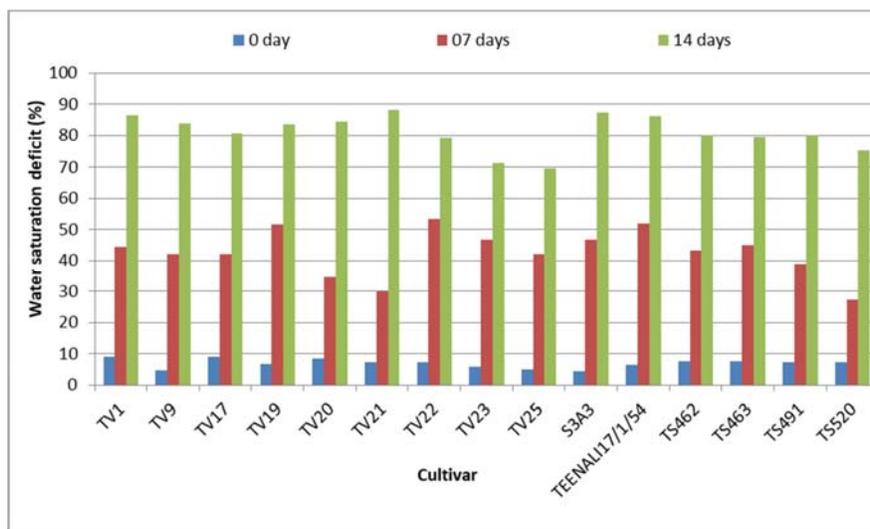


Fig 2: Water saturation deficit (%) of different cultivars on 0, 7th and 14th day after imposition of drought

Fig 2. revealed that water saturation deficit in tea plant under moisture stress conditions was significantly more than in the control plants. Although water saturation deficit did not vary initially among the cultivars, significant variation was observed among the tea cultivars following induction of stress. The cultivars TV21, S₃A₃, Teenali17/1/54 showed significant increase in per cent water saturation deficit when compared to cultivars TV25, TV23 and TS520.

Conclusion

In conclusion, drought stress caused a gradual decline in Relative leaf water content but increase in WSD. Cultivars TV21, S₃A₃ and Teenali17/1/54 showed a high degree of susceptibility to water deficit. Moreover from the experimentation, it was revealed that Cambod clones and biclonal seed stocks depicted good and average tolerance to drought compared to Assam type, Assam-China hybrid and Assam hybrid clones. Further studies are required in mature tea grown in estate conditions. Therefore, extensive studies

are needed in different tea growing zones using more cultivars including those released by TTRI (Tocklai Tea Research Institute), garden series clones, industrial clones, biclonal seed stocks and even a few *jats* which might have good tolerance to drought stress.

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