www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2021; 10(2): 499-501

www.thepharmajournal.com
Received: 13-12-2020
Accepted: 25-01-2021

S Ashok
Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

CN Chandrasekhar
Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

A Senthil
Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

P Jeyaprakash
Department of Plant Breeding & Genetics, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

K Srinivasan
Department of Agronomy Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

NK Prabhakaran
Department of Agronomy Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Corresponding Author:
S Ashok
Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Physiological performance of traditional rice landraces affected by water stress during vegetative stage under pot culture condition

S Ashok, CN Chandrasekhar, A Senthil, P Jeyaprakash, K Srinivasan and NK Prabhakaran

Abstract
An experiment was conducted to establish the physiological performance of traditional rice landraces under water stress given at the vegetative stage under pot culture condition. Drought is one of the serious threats on rice productivity. Traditional rice landraces shows substantial adaptability to drought so eight popular rice land races, namely Rascadam, Kothamalli Samba, Kaattu Samba, Kallundai, Kuliyadichan, Milagu Samba, Cochin Samba and Muttrina sannam from Tamilnadu, India and two popular check varieties, namely IR64 (susceptible check), N22 (tolerant check) were used to study the physiological performance for drought tolerance. These genotypes were subjected to drought under pot culture condition at glass house in the Department of Crop Physiology, TNAU, Coimbatore. The crops were imposed with drought during vegetative stage by withholding irrigation till the soil moisture reaches below 20 per cent. The experiment was laid out in factorial experiment under completely randomized design (FCRD) with three replications. Chlorophyll Stability Index (CSI), Relative water content (RWC), and Proline content of leaves were measured.

Keywords: Traditional rice, physiological parameters, CSI, Proline

Introduction

Rice one amongst the foremost noticeable food crops on the globe, is giving a starch source to over half of the worldwide population (Feng *et al*, 2013). In developing nations, it gives 27% of dietary vitality and 20% of dietary protein (Singh and Singh 2007), which is that the staple food for quite 2.7 billion population. Over 90% of the world's rice is developed and devoured in Asia, where rice is grown in 135 million ha with a yearly production of 516 million tons (Roy and Mishra, 2002). It is cultivated under a scope of ecologies, from flooded to rainfed and upland to swamp to profound water systems. Declining water accessibility undermines the maintainability of flooded rice (Oryza sativa L.) cultivation in many nations (Peng *et al*., 2009). Among different pressure, dry season forces genuine reason for rice production and influences in excess of 23 million hectares in Asia (Kumbhar *et al*, 2015). The event of dry spell can be evaluated by following factors, for example, climate conditions, soil dampness, and yield condition over a specific developing season. In rice, the impact of dry season shifts with the variety, degree, and length of stress and its fortuitous event with various development stages. Rice's defenselessness to water pressure is increasingly articulated at the conceptive stage and causes the decrease in grain yield when stress harmonizes with the irreversible regenerative process (Cruz and O'Toole, 1986) [4]. The reaction of plants to dry season stress includes changes in the physiology, metabolism and decrease the plant growth (Sairam and Srivastava, 2001) [9]. Traditional landraces grown in the rainfed areas have vast genetic potential to adapt in drought-prone environments (Vikram *et al*, 2016). Several researches focused on indigenous rice landraces that are traditionally cultivated and maintained by farmers, contain high level of genetic diversity and harbour lot of favourable genes for tolerance to abiotic or biotic stress (Vikram *et al*, 2016). Traditional rice landraces are lesser in productivity; however, they are set forth to be highly tolerant to a number of biotic and abiotic stress, which offer great promise to combat the current challenges of adverse effects of climate change, ensuring food security and livelihood of poor farming communities (Sarkar and Bhattacharjee, 2011). There is limited phenotypic knowledge and profiling reports of indigenous rice landraces were available so phenotyping for drought tolerance is an important pre-requisite aspect for using them in breeding programmes.

The aim of this work was to study the effects of drought stress on vegetative stage of popular traditional rice landraces to judge the performance of these rice varieties under drought stress.
The study may be helpful for better understanding of drought tolerance and use of these popular landraces in future breeding programs.

Material and Methods
The pot culture experiment was conducted in the Glass house of the Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore during Summer, 2019. The location is in North Eastern Agro-Climatic Zone of Tamil Nadu at 11.01°N latitude and 76.39°E longitude and at an altitude of 426.7 m above MSL.
In this study, separate set of plants with three replications were maintained in pots. All the treatments, the control and treatment groups, were watered regularly up to 45 to 60 DAS according to their duration and then the irrigation was withheld to create drought at vegetative stage. Soil moisture content was monitored using moisture meter (Delta-T Soil moisture kit - Model: SM150, Delta-T Devices, Cambridge) periodically and re-watering was done when the soil moisture reached below 20 per cent and leaves were completely rolled and started drying at tips and margins.
Chlorophyll stability index (CSI) was determined by adopting the method of Murthy and Majumdar (1962) [7] and was expressed in percentage. The relative water content (RWC) was estimated according to Barrs and Weatherly (1962) [2] and expressed as per cent. Proline accumulation in the leaf was estimated by the method of Bates *et al.* (1973) [3]. The proline content was expressed in mg g^{-1} fresh weight.

Results and Discussion
The data on Relative water content (RWC) revealed that a significant difference among the rice genotypes under drought stress condition (Table 04). Also, there was a significant decrease in RWC in stressed plants compared to control plants irrespective of genotypes. Among the genotypes, G1, G4, G5, G6 showed higher RWC followed by G2, G3 under stress conditions. The reduction in RWC was found to affect the photosynthetic machinery, cell membrane stability and proline synthesis.
RWC is influenced by the duration and severity of drought (Yang and Miao, 2010) [11]. Drought resistant cultivars maintained greater relative water content compared to susceptible ones. This character might be an adaptive feature that certain plant species have developed under water stress conditions (Ahmadi and Siosemarideh, 2005) [1].
Among the different genotypes, the drought created some negative effect on CSI (%) and some genotypes had tolerant mechanism which was recorded higher RWC compared to other genotypes.
The genotypes G1, G4, G5, G6 showed higher chlorophyll stability index (CSI) when compared to their respective control and other rice genotypes (Table 03). Higher CSI indicates the level of polyunsaturated lipids which stabilizes chloroplast membrane and increases adaptive response to tolerance under water stress condition. Drought stress induced reduction in CSI was also reported in wheat (Sairam *et al*., 1997) [10] maize genotypes (Meenakumari *et al*., 2004) [6].
The higher proline content was recorded in drought stressed rice genotypes when compared to control plants. G1, G5, G6, G9 genotypes recorded the highest proline content followed by G4 at vegetative stage stress.
The lowest values of Proline content under drought at vegetative stage stress were observed in G7, G8 genotypes. In interaction effects among genotypes and treatments, G5, G6, G9 accumulated higher proline content followed by G1, G4, G6, G9 at drought stressed plants (Table 02).
Ramanjulu and Bertels (2002) [8] reported that proline synthesis under water stress helps the cell maintain their hydrated state and therefore provide resistance against drought and cellular hydration. Maggaio *et al.* (2002) [5] suggested that proline might act either as a signalling or regulatory molecule which is capable of activating multiple responses which are component of the adaptation process.

Table 1: Detail of studied genotypes with their origin and special character.

	Variety	Origin
G1	Rascadam	Tamil Nadu, India
G2	Kothamalli Sambha	Tamil Nadu, India
G3	Kaattu Sambha	Tamil Nadu, India
G4	Kallundai	Tamil Nadu, India
G5	Kuliyadichan	Tamil Nadu, India
G6	Milagu Sambha	Tamil Nadu, India
G7	Cochin Sambha	Tamil Nadu, India
G8	Muttrina sannam	Tamil Nadu, India
G9	N22	Eastern India
G10	IR64	IRRI, Philippines

Table 2: Impact of Drought stress on Proline content (mgg^{-1}) in rice genotypes under pot culture condition

Genotypes	Vegetative stage		
	Control	Drought	Mean
Rascadam	1.90	3.01	2.45
Kothamalli sambha	1.65	2.59	2.12
Kaattu sambha	1.54	2.41	1.97
Kallundai	1.81	3.01	2.41
Kuliyadichan	1.90	3.28	2.59
Milagu sambha	1.85	3.08	2.46
Cochin sambha	0.74	1.52	1.13
Muttrina sannam	0.63	1.43	1.03
N22	1.88	3.07	2.47
IR64	1.86	2.38	2.12
Mean	1.57	2.57	2.07
	G	T	G x T
SEd	0.08	0.04	0.11
CD (0.05)	0.16	0.07	0.23

Table 3: Impact of Drought stress on chlorophyll stability index (%) in rice genotypes under pot culture condition

Genotypes	Vegetative stage		
	Control	Drought	Mean
Rascadam	92.14	88.24	90.19
Kothamalli sambha	87.54	79.84	83.69
Kaattu sambha	85.23	77.81	81.52
Kallundai	90.46	86.96	88.71
Kuliyadichan	89.41	85.11	87.26
Milagu sambha	88.69	83.89	86.29
Cochin sambha	75.16	65.25	70.21
Muttrina sannam	78.45	69.74	74.10
N22	89.41	82.61	86.01
IR64	85.64	65.50	75.57
Mean	86.21	78.50	82.35
	G	T	G x T
SEd	2.20	0.98	3.11
CD (0.05)	4.45	1.99	6.29

Table 4: Impact of Drought stress on relative water content (%) in rice genotypes under pot culture condition

Genotypes	Vegetative stage		
	Control	**Drought**	**Mean**
Rascadam	91.45	86.25	88.85
Kothamalli sambha	87.41	76.31	81.86
Kaattu sambha	86.24	74.74	80.49
Kallundai	91.23	85.23	88.23
Kuliyadichan	89.14	82.44	85.79
Milagu sambha	88.54	81.74	85.14
Cochin sambha	84.15	69.75	76.95
Muttrina sannam	83.26	69.76	76.51
N22	81.75	72.65	77.20
IR64	86.97	62.67	74.82
Mean	87.01	76.15	81.58
	G	T	G x T
SEd	2.96	1.33	4.19
CD (0.05)	5.99	2.68	8.47

Conclusion

Considering the above results of this experiment, it is concluded that rice landraces, being adapted to harsh environments, have inherent ability to withstand drought situation. And Rascadam (G1), Kuliyadichan (G5), Milagusamba (G6) performed better interms of physiological parameters like CSI, RWC and Proline which ultimately contributed for better tolerance compared to other landraces and check varieties taken for this study. Hence, the traits which are conferring better tolerance in these landraces may be studied further to unravel the actual mechanisms responsible for drought tolerance and to exploit these traits for crop improvement programme.

References

1. Ahmadi A, Siosemarideh A. Investigation on the physiological basis of grain yield and drought resistance in wheat: leaf photosynthetic rate, stomatal conductance and non-stomatal limitations. Int. J. Agri. Biol 2005;7:6-10.
2. Barrs HD, Weatherly PE. A re-examination of relative turgidity for estimating water deficits in leaves. Aust. J. Biol. Sci 1962;15:413-428.
3. Bates LS, Waldren RD, Teare ID. Rapid determination of free proline in water stress studies. Plant soil 1973;39:205-208.
4. Cruz RT, O'Toole JC, Dingkuhn M, Yambao EB, Thangaraj M, De Datta SK, *et al*. Shoot and root responses to water deficits in rainfed lowland rice. Aust. J. PlanPhysiol 1986;3:567-5
5. Maggaio A, Miyazaki S, Veronese P, Fujita T, Ibeas JI, Damsz B, *et al*. Does proline accumulation play an active role in stress induced growth reduction? Plant J 2002;31:699-712.
6. Meenakumari SD, Vimala Y, Pawan A. Physiological parameters governing drought tolerance in maize. Ind. J. Plant Physiol 2004;9:203-207.
7. Murthy KS, Majumdar SK. Modification of the technique for determination of chlorophyll stability index in relation to studies of drought resistance in rice. Current Sci 1962;31:470-471 .
8. Ramanjulu S, Bertels D. Drought and desiccation-induced modulation of gene expression in plants. Plant Cell Environ 2002;25:141-151.
9. Sairam RK, Srivastava GC. Water stress tolerance of wheat (*Triticum aestivum* L.): variations in hydrogen peroxide accumulation and antioxidant activity in tolerant and susceptible genotypes. J. Agron. Crop Sci 2001;186:63-70.
10. Sairam RK, Desmukh PS, Shukla DS. Tolerance of drought and temperature stress in relation to increased antioxidant enzyme activity in wheat. J. Agron. Crop Sci 1997;178:171-177.
11. Yang F, Miao LF. Adaptive responses to progressive drought stress in two poplar species originating from different altitudes. Silva Fennica 2010;44:23-37.