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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(1): 234-236

www.thepharmajournal.com
Received: 10-11-2021
Accepted: 12-12-2021

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Effect of drought on growth, proline & biochemical activities of various rice (*Oryza sativa* L.) genotypes under rainfed condition

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Abstract
The present investigation was conducted at student instructional farm, A.N.D. University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) during Kharif season of 2019-20. In a 2-year experiment,18 rice genotypes were grown under moisture stress conditions. Data were analyzed statistically for growth parameters; plant height and dry matter yield and biochemical parameters; proline, relative water content & chlorophyll were measured. It is evident with the result that genotypes with resistance were less affected with drought stress as compare to the susceptible ones.

Keywords: *Oryza sativa*, drought, rainfed, relative water content

Introduction
Drought is considered one of the main constraints that limit rice yield in rainfed and poorly irrigated areas. At least 23 million hectares of rainfed rice area in Asia are estimated to be drought prone, and drought is becoming an increasing problem even in traditionally irrigated areas (Pandey *et al*., 2005) [11]. Out of the total 20.7 million ha of rainfed rice area reported in India, approximately 16.2 million ha lie in eastern India (Singh and Singh, 2000) [14], of which 6.3 million ha of upland and 7.3 million ha of lowland area are highly drought prone (Pandey and Bhandari, 2009) [10]. The eastern Indo-Gangetic Plain is one of the major, drought-prone rice-producing regions in the world (Huke and Huke, 1997) [6]. In this plain, losses due to reproductive-stage drought stress are most severe in the key rice-producing states of eastern India: Chhattisgarh, Orissa, Jharkhand, Bihar, and eastern Uttar Pradesh. Rice (*Oryza sativa* L.) is one of the most important staple foods in the world, however most improved rice varieties are susceptible to drought stress (Dien *et al*., 2019) [3]. Rice is a semi-aquatic plant cultivated in land available of sufficient water. About 50% of rice cultivated area in the world are devoid of water supply and problem like prolonged drought have been reducing yield of rice crop. water deficit is one of the major abiotic stresses, which adversely affects crop growth and productivity. Lack of timely and sufficient rainfall as well as scarce condition of water availability in field can be defined as the drought condition that badly affects the growth and yield of field crops (Hanson *et al*., 1995) [5].
Drought stress is very important factor for plant growth and affects both elongation and expansion growth (Anjum *et al*., 2003; Kusaka *et al*., 2005; Shao *et al*., 2008) [1, 8, 13]. Water stress reduces the leaf area, cell size and intercellular volume (Kramer, 1969) [7]. The reduction in soil moisture may have led to lower water content in the leaves causing guard cells to loose turgor pressure and hence the size of stomatal pores are reduced (Tezera, *et al*., 2002) [16] and/ or causing stomatal closure. Reproductive stage is more affected by drought as compared to vegetative stage in rice crop. Avoidance or tolerance can reduce detrimental effect of drought in plants. Avoiding drought is the ability of plants to provide a high water potential with reduced water availability in the soil and in fact avoid dehydration. Tolerance to dehydration is the ability of plants to withstand minimum water injury and internal water deficits. Another way to face the drought is to escape. This is where the plant completes its life cycle long before the onset of drought.
Crop duration is adjusted so that critical stages like panicle emergence do not coincide with probable drought periods. Early or late maturation, varieties sensitive to photoperiods can quickly escape drought and regain strength.

The proper and appropriate phenotyping plays an increasingly important role in the selection of drought-resistant genotype. Singh *et al*. (2012) found that development of early maturing rice varieties to escape the drought, development of drought tolerance varieties that perform better under drought stress condition.

Material and Method
The present investigation was conducted at Student Instructional Farm (SIF), A.N.D. University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) during Kharif season of 2019-20. The experiment was conducted with 18 rice genotypes (tolerant & susceptible).

Plant height (cm)
Plant height was recorded from base of the plant to the top most leaf of the plant before & after moisture stress. In each plot, five plants were selected and mean height was calculated and expressed in cm.

Dry weight per plant (g)
Five plants were collected randomly form each treatment at various stage of crop growth. After drying them in sum, finally dried in over at 70±1 °C for 24 hrs and dry weight of plant was taken with the help of electronic balance

Estimation of Proline content (µg g^{-1} fresh wt.)
Proline was estimated spectrophotometically according to the method of Bates *et al*., (1973) [2]. Proline content in leaf tissue was calculated using the formula:

$$\text{Proline content}\left(\mu\frac{g}{g}\text{fr. wt.}\right) = \frac{36.23\ \times \text{Od } 520 \times \text{Volume of the aliquot made (ml)}}{\text{Volume of the aliquot (ml)} \times \text{Weight of the sample (ml)}}$$

Determination of chlorophyll content (SPAD value)
Chlorophyll content of leaf was directly measured from intact leaves microprocessor based plant efficiency analyzer model: X55/M-PEA.

Result and Discussion
Effect of moisture stress on plant height & dry weight
Plant height is often considered as a factor in plant response to drought stress. In the present study a much reduced plant height noted in suseptible plants as compared to that of tolerant plants. Under drought stress, reduced biomass production is a common feature in crop plants. Drought considerably reduced the dry matter production in rice mainly due to impaired photosynthesis which seemed to be affected by stomatal conductance and ROS production (Ma *et al*., 2006) [9]. In this study also suseptible plants when exposed to drought produced least biomass production at all observations (table.1).

Effect of moisture stress on relative water content & chlorophyll content: In the present investigation, drought stress alters various metabolic aspects in rice which included relative water content, chlorophyll content and proline content. Plant water relations in rice were hampered under drought stress. Chlorophyll is one of the major components that determine the yield as it is a photosynthetic pigment and determines the net photosynthetic rates. Under drought stress reduction in chlorophyll content is common. In the present study, it is evident that percent increase in chlorophyll content is more in the tolerant varieties under the moisture stress condition (table.1).

Effect of moisture stress on proline
Proline has been assigned the role of cyst solute, a storage compound or a protective agent for cytoplasmic enzymes and cellular structure (Pandey and Ganapathy, 1985) [12]. Hanson and Hits (1982) [4] suggested that proline accumulation is a consequence of stress induced damage to cells. In plants, the role of proline may not be restricted to that of compatible osmolytes, but proline synthesized during water deficit and salt stress may serve as an organic nitrogen reserve that can be utilized during recovery (Trotel *et al*., 1989). In the present study, it is evident that percent increase in proline content is more in the tolerant varieties (DRR-44) as compare to the susceptible ones (IR-64) under the moisture stress condition (table. 1).

Table 1: Effect of moisture stress on plant height, dry weight, relative water content, chlorophyll and proline

Variety	PH before	PH after	Dry wt.	RWC	Chl. Before	Chl. after	Proline Before	Proline After
DRR-42	75.00	81.50	33.53	83.31	9.49	12.96	227.45	382.37
DRR-44	73.33	79.17	32.03	84.41	7.21	11.66	246.40	370.24
Sahbhagi	79.67	85.55	28.07	79.96	7.39	10.91	228.20	265.12
Sarju 52	64.33	71.17	20.47	70.60	3.13	5.12	187.84	254.38
Sourabh	70.67	76.17	20.57	68.81	8.34	11.37	241.43	262.89
Sukha dhan-6	66.67	74.17	19.57	79.88	6.57	9.48	268.14	302.08
HUR 1304	64.67	72.17	25.63	82.31	8.23	12.86	217.95	234.21
Bio seed bheem	79.00	86.50	28.03	84.62	10.25	15.64	231.29	339.40
38 B	69.33	74.83	21.80	85.25	9.34	13.11	216.29	347.23
NDR-9501	77.67	85.17	23.63	67.82	8.87	11.44	220.49	265.97
IR 64	65.67	74.62	27.97	80.11	9.55	12.17	223.96	358.76
Swarna sub-1	85.70	90.45	33.64	72.59	8.98	12.77	284.72	388.26
IR 64 sub-1	79.67	87.32	31.28	74.93	9.76	12.34	276.05	396.73
IPR-763	70.67	76.17	36.17	79.88	7.96	10.37	271.57	318.12
Malbhog	61.67	69.17	31.23	74.62	7.48	10.60	224.99	385.95
Bina-11	82.76	87.17	30.10	75.25	9.86	12.96	296.35	390.53
GS-I	69.00	77.50	32.77	72.82	7.45	11.81	237.76	341.35
Sukha dhan-5	68.00	75.50	20.77	84.11	7.76	10.49	298.08	398.64
SEm±	1.34	1.65	7.46	3.25	1.21	1.45	4.84	6.5
C.D. at 5%	6.2	8.3	9.40	4.51	1.98	2.23	8.11	9.83

Acknowledgment

The authors are highly acknowledged to Dr. Ashok Kr. Singh (H.O.D., Department of Crop Physiology), Acharya Narendra Dev University of Agriculture & Technology, Narendra Nagar, Faizabad (U.P.) and Dr. Anil Kumar Singh, Junior breeder, SASRD, Medziphema, Nagaland Agriculture University, Nagaland, India for their keen supervision and constructive guidance during whole experimental study.

Conclusion

In general, drought reduces plant growth and development, leading to hampered flower production and grain filling and thus smaller and fewer grains. A reduction in grain filling occurs due to a reduction in the assimilate partitioning and reduced relative water content as well as chlorophyll in leaf thereby decreasing photosynthesis. The decrease in growth and biochemical parameter in susceptible genotype over genotypes with resistance due to moisture stress is quite evident with the result.

References

1. Anjum F, Yaseen M, Rasul E, Wahid A, Anjum S. Water stress in barley (*Hordeum vulgare* L.). I. Effect on morphological characters. Pakistan Journal of Agricultural Sciences. 2003;40:43-44.
2. Bates LS, Waldren RP, Teare ID. Rapid determination of free proline for water stress studies. Plant Soil. 1973;39:205-207.
3. Dien DC, Mochizuki T, Yamakawa T. Effect of various drought stresses and subsequent recovery on proline, total soluble sugar and starch metabolisms in Rice (*Oryza sativa* L.) varieties. Plant Production Science. 2019;22(4):530-545.
4. Hanson AD, Hits ED. Metabolic responses of mesophytes to plant water deficits. Annu Rev Plant Physiol. 1982;33:163-203.
5. Hanson AD, Peacock WJ, Evans LT, Arntzen CJ, Khus GS. Development of drought resistant cultivars using physiomorphological traits in rice. (eds. Fukai S. and Cooper M.). Field Crop Research. 1995;40:67-86
6. Huke RE, Huke EH. Rice Area by Type of Culture: South, Southeast, and East Asia. International Rice Research Institute, Los Banos, Philippines, 1997.
7. Kramer PJ. Plant and soil water relationship. TATA McGraw- Hill, Bombey New Delhi, 1969, pp. 360.
8. Kusaka M, Ohta M, Fujimura T. Contribution of inorganic components to osmotic adjustment and leaf folding for drought tolerance in pearl millet. Physiologia Plantarum. 2005;125:474–489.
9. Ma QQ, Wang W, Li YH, Li DQ, Zou Q. Alleviation of photo inhibition in drought stressed wheat (*Triticum aestivum*) by foliar applied glycine betaine. J Pl. Physiol. 2006;163:165-75.
10. Pandey S, Bhandari H. Drought: economic costs and research implications. In: Seeraj R, Bennet J and Hardy B.(eds.), Drought frontiers in rice: crop improvement for increased rainfed production. World Scientific publishing, Singapore, 2009, 3-17.
11. Pandey S, Bhandari H, Sharan R, Naik D, Taunk SK, Sastri ASRAS. Economic Costs of Drought and Rainfed Rice Farmers' Coping Mechanisms in Eastern India. Final Project Report. International Rice Research Institute, Los Banos, Philippines, 2005.
12. Pandey R, Ganapathy PS. The proline enigma NaCl Cicer arientinum. Plant Science. 1985;40:1.3-1.7.
13. Shao HB, Chu LY, Shao MA, Abdul Jaleel C, Hong-Mei M. Higher plant antioxidants and redox signaling under environmental stresses. Comptes Rendus Biologies. 2008;331:433-441.
14. Singh S, Singh TN. Morphological, chemical and environmental factor affecting leaf rolling in rice during water stress. Indian J Plant Physiol. 2000;5:136-141.
15. Singh CM, Kumar B, Mehandi S, Chandra K. Effect of drought stress in rice: a review on morphological and physiological characteristics. Bio Science Trends. 2012;5:261-265
16. Tezara W, Mitchel V, Driscul SP, Lawlor DW. Effects of water deficit and its interaction with CO2 supply on the biochemistry and physiology of photosynthesis in sunflower. Exp. Bot. 2002;53:1781-1791.