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Nutrient Characters Analysis in Rice Genotypes under Different Environmental Conditions

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ABSTRACT
Abiotic stress is a major limiting factor for plant growth and food production in many regions of the world and its effects will become more severe as desertification claims more of the world's arable land. Among environmental stresses, drought has the huge effect on agriculture worldwide. Drought is the most important environmental factor limiting plant development and crop productivity worldwide. In this study, thirteen rice genotypes which were grown in three different environmental conditions i.e. water stress (drought), rain fed and irrigated, which were fixed homozygous lines characterized for abiotic stress and agro-morphological characters. The objective of the study was to evaluate the effect of water stress on nutritive value of rice grains with main emphasis on protein and lysine content of rice grain. The quality of rice grains were significantly affected under water stress environments. The protein and lysine contents increased in the entire genotypes under water stress conditions. The protein showed negative correlations with lysine under normal and under water stress conditions, so it is imperative for breeder and biotechnologist to balance these characters through genetic manipulation.
Key words: - Nutrition, drought, protein, lysine irrigated and rainfed.

INTRODUCTION

Food security in the world is challenged by increasing food demand and threatened by declining water availability [1]. The main stay of India's economy based on agriculture. Rice is staple food of one third population of the world. It provides 20% of the total dietary energy supply and is regarded as good source of riboflavin, niacin and dietary fiber [2 & 3]. Rice breeders are continuously trying to improve the rice yield under water stress conditions but paying less attention on its quality. This pernicious but preventable human health crises calls for a new agenda for agriculture, an agenda that no longer focuses the agriculture the agriculture community only on staple food production as primary goal, but one that also recognizes the urgent need for agriculture to adjure attention in producing enough food of high quality to satisfy a balanced diet for all people thereby increasing healthy and productive lives [4]. Biofortification or plant breeding for the specific purpose of enhancing the nutritional properties of crop verities reflects the new application of an ancient technique. This approach involves the development of staple food crops that are selectively bred to enhance specific nutritional quality as well as the level of biologically available protein, amino acid and micro-nutrient [5].

Among cereals, the rice protein is considered as highly notorious, however the protein content of rice is relatively low (about 9 %). The protein content is known to be influenced by many factors including the genotype, fertilizers, frequency of irrigation water and rainfall but is mainly influenced by the environment [6] amino acid analysis showed lysine to the first limiting essential amino acid in cereals proteins [7]. It is an essential amino acid and lysine content of plant is also affected by various physiological processes for instance growth, development and response to environment changes and stress. Keeping in view the above facts, this project was designed to determine the effect of water stress on nutritive value of rice grain. Another objective was to study correlation of protein and lysine parameters.

MATERIALS AND METHODS

The thirteen fixed homozygous lines characterized for abiotic stress and agro-morphological character including some crosses. F_7 seeds of all lines were sown in three different condition i.e.

water stress, rainfed, (maintained by immediate percolation of water from field) and irrigated. The data were subjected to statistical analysis using analysis of variance [8]. Protein and lysine content analyzed under irrigated, rainfed and water stress conditions to methods described by [9] for rice grains.

RESULTS & DISCUSSION

Analysis of variance was performed for all thirteen genotypes. Mean square of protein and lysine content in rice genotypes over three environmental conditions varied significantly (Table 2 and 3). According to the results, difference among genotypes is highly significant for all indicating traits indicating high variability among genotypes.

The results of protein and lysine analysis delineated that the level of protein was found to increase in the seed obtained from the plant grown under drought condition by range of 6.31% to 41.91% to the that of compare seed obtained from irrigated and rainfed grown plants. The percent increase varied from 4.95% in 237-5-D to 41.91% in cross of SWX IR-55 indicating good quality protein.

Table 1: Diverse Rice genotypes used in this study

Sr. No.	Name of Genotypes
1	DGI 75
2	Ramjiyawan
3	SW X IR – 55
4	SL-k04-39-1
5	SL-k04-61-8
6	133-3
7	426-1
8	133-4
9	237-5-D
10	16
11	83
12	Swarna X IR-4225-3
13	Poornima X Azucina

* The fixed homozygous lines characterized for abiotic stress and agro-morphological characters and generation of the all genotypes was F_7.

Table: 2 Percent Protein increases due to drought in rice grain.

Sr. no	Genotype	Drought	Irrigated	Rainfed	Mean (Rainfed + Irrigated)	% Protein increase in drought
1	DGI 75	11.57	7.46	7.59	7.52	34.95
2	Ramjiyawan	11.44	6.89	8.08	7.48	34.58
3	SW X IR - 55	12.33	6.02	8.30	7.16	41.91
4	SL-k04-39-1	10.85	7.32	7.04	7.18	33.79
5	SL-k04-61-8	9.63	6.61	7.72	7.16	25.64
6	133-3	8.74	7.99	7.81	7.90	9.62
7	426-1	8.38	6.96	8.73	7.85	6.31
8	133-4	9.23	7.72	8.16	7.94	13.95
9	237-5-D	8.69	6.81	7.87	7.34	15.59
10	16	8.24	7.85	7.82	7.83	4.95
11	83	10.33	8.20	7.87	8.04	22.23
12	Swarna X IR-4225-3	9.55	7.04	7.76	7.40	22.54
13	Poornima X Azucina	8.41	7.07	7.48	7.27	13.50

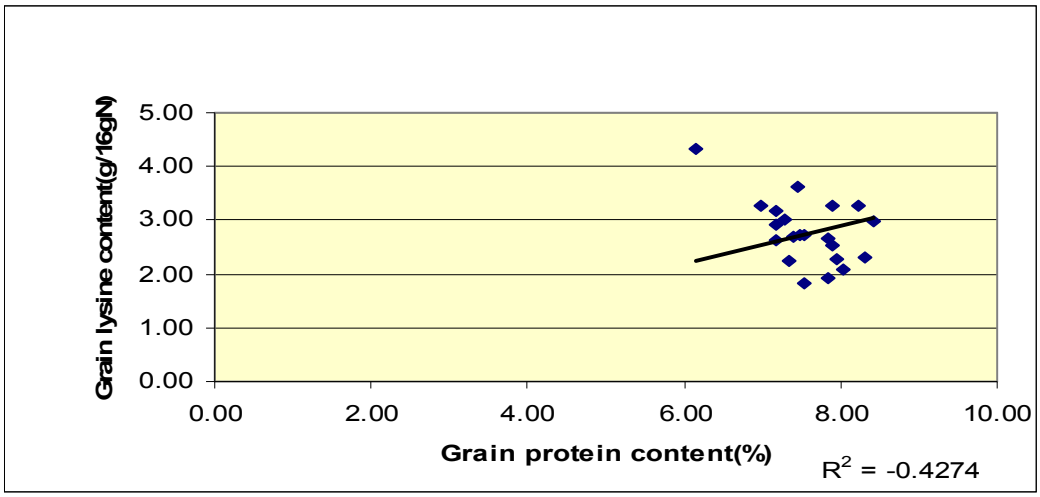
The grain lysine content also significantly affected by drought condition and showed percent increase. The percent increase range from 1.31% to 74.20% in cross between Poornima X Azucena and SW X IR4225-3 respectively. The reason of increasing protein percent in drought could be due to the accumulation of protein content in drought more than in other two. The leaves are the main

source of protein, Rubisco account for 50% of total protein content of leaves and, together with photo system protein. The remobilization from leaves, stem and reproductive structure making lesser contribution for seed import, the photo assimilation was reduced in drought condition as compare to other two, indicating the reduction in rate of translocation of photo assimilate due to drought stress [10].

Table: 3 Percent lysine increase due to drought in rice grain

Sr. no	Genotype	Drought	Irrigated	Rainfed	Mean (Irrigated + rainfed)	% Lysine increase in drought
1	DGI 75	4.44	3.19	2.26	2.72	38.69
2	Ramjiyawan	3.23	3.50	1.96	2.73	15.49
3	SW X IR – 55	3.26	3.49	2.37	2.93	10.09
4	SL-k04-39-1	3.54	2.88	2.39	2.64	25.41
5	SL-k04-61-8	4.34	4.30	2.02	3.16	27.12
6	133-3	3.43	2.48	2.56	2.52	26.55
7	426-1	5.17	3.15	2.15	2.65	48.70
8	133-4	3.73	2.41	2.14	2.27	39.08
9	237-5-D	5.85	2.55	1.92	2.23	61.82
10	1126	5.28	2.30	1.58	1.94	63.28
11	83	3.94	2.04	2.11	2.07	47.47
12	Swarna X IR-4225-3	7.07	1.35	2.29	1.82	74.20
13	Poornima X Azucina	3.05	4.21	1.81	3.01	1.31

Fig. 1 Correlation between protein and lysine



Several reports that showed the effect of water drought of grains in rice and have shown the drought at the seed development stage of the plants leads to shrunken and underdeveloped seed, which is due to insufficient loading in seed [11], and amino acid could be due to the hydrolysis of protein and also may occur in response to change in osmotic adjustment content [12].

Correlation coefficients were calculated to establish relationship between grain protein and lysine [13]. The results of correlation among the protein and lysine content in grains under normal as well as drought condition are presented in by the graph. The protein content has negative correlation with lysine content (Fig.1), which indicated that lysine which accumulates into glutamine fraction of the protein and prolamine fraction contributes more to the increase in protein concentration of rice grain [14], so it is imperative for breeders to pay attention to balance these characters through genetic exploitation.

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