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EFFECT OF SUMMER SEASON ON BIOCHEMICAL PARAMETERS AND YIELD OF RICE GENOTYPES

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ABSTRACT

The study was conducted to evaluate the effect of summer season on different genotypes of rice during year 2018-2019. Highest reducing sugar was observed in genotype SYE-1 (2.23%) and lowest reducing sugar in PKV- Ganesh (2.02%). Highest non-reducing sugar was noted in genotype SYE-1 (13.27%) indicated that, genotype SYE-1 found better for soft and sticky rice grain for summer cultivation and said to be thermo-tolerant one. KJT-184 (10.67%) was found susceptible for heat stress. The highest amylose content (AC) was noticed in PKV-Akshad (10.30%) and lowest AC in KJT-184 (7.80%) and PKV-Makrand (7.80). Intermediate alkali spreading value was observed in PKV-Ganesh (5.97), SYE-1 (5.31), KJT-184 (5.23), SKL-6 (5.19) and PKV-Akshad (4.65). High intermediate alkali spreading value was observed in RTN-5 (4.57%). For good cooking quality, all of the genotypes of rice were soft and relatively sticky for cooked rice based on amylose content. The reducing, non-reducing sugar, amylose content and alkali spreading value content were low to adequate in range due to high temperature.

(Key words: Rice, summer season, reducing and non-reducing sugar, alkali spreading value, amylose contents, yield plant^{-1})

INTRODUCTION

Rice (*Oryza sativa* L.) has a renowned relationship with the human since ages. It is the world's most important staple food crop, rice is among the worlds most important and second most produced crop worldwide. About 90% of the world's rice is grown in China, India, Pakistan, Japan, Korea, Southeast Asia and other adjacent areas. Rice is the most consumed cereal grain in the world, constituting the dietary staple food for more than half of the planets human population.

High temperature (heat) stress is considered to be one of the major environmental factors limiting crop growth and yield. This stress induces many biochemical, molecular, and physiological changes and responses that influence various cellular and whole plant processes that affect crop yield and quality. The impacts of environmental stress, particularly those of drought and heat, have been studied, independently. Increase in temperature during grain filling may result in abortion of fertilization, shrivelled and reduced in number of grains and chalkiness, white balley on grains and broken rice during milling is the main constraints among the summer rice growers.Chalkiness is reported to occur not only under the complex genetic network regulation but also under the effects of environmental factors, especially heat stress.

Considering the above facts present investigation was undertaken to study the effect of summer season on biochemical parameters and yield of rice genotypes.

MATERIALS AND METHODS

A field experiment was carried out at research farm ZARS, Sindewahi, during 2018-19 in RBD with three replications and seven genotypes (SYE-1, SKL-6, KJT-184, PKV-Akshad, PKV-Makrand, RTN-5 and PKV-Ganesh). Experimental gross plot was 4.50 m X 2.40 m and net plot was 3.90 m X 2.00 m. Total chlorophyll content was estimated by calorimetric method as suggested by Bruinsma (1982). Grain samples of all varieties were analyzed for alkali value as per method suggested by Little *et al.* (1958), amylose and sugar content was estimated as per method suggested by Juliano (1972), and yield plant^{-1} was also recorded.

RESULTS AND DISCUSSION

Leaf chlorophyll content

Chlorophyll is a green pigment present in chloroplast of all green plant cells and tissues. These are essential photosynthetic pigments capable of absorbing light energy for the synthesis of carbohydrates. Chlorophyll content of the plant tissue represents the photosynthetic capacity of plant.

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The data regarding total chlorophyll content in leaves were recorded at different growth stages as influenced by different genotypes and was tabulated in Table 1.

At 30 DAT, total chlorophyll content in leaves ranged between 0.071-0.167 mg g^{-1}. Significantly highest chlorophyll content was observed in genotype PKV-Ganesh (0.167 mg g^{-1}) followed by PKV-Makrand (0.147 mg g^{-1}). Genotypes SKL-6 (0.97 mg g^{-1}) and PKV-Akshad (0.084 mg g^{-1}) recorded moderately higher total chlorophyll content than rest of the genotypes. Genotypes SYE-1(0.080 mg g^{-1}), RTN-5(0.079 mg g^{-1}) and KJT-184 (0.071 mg g^{-1}) recorded significantly lowest total chlorophyll content among all other genotypes under study.

At 60 DAT, total chlorophyll content in leaves varied from 0.075-0.201 mg g^{-1}. The significantly highest chlorophyll noticed in genotype PKV-Ganesh (0.201 mg g^{-1}), whereas, PKV-Makrand (0.194 mg g^{-1}) recorded better total chlorophyll content. However, these two genotypes were found at par each other. Genotypes SKL-6 (0.104 mg g^{-1}), PKV-Akshad (0.089 mg g^{-1}), SYE-1(0.088 mg g^{-1}) and RTN-5(0.085 mg g^{-1}) recorded lower total chlorophyll content and were found at par with each other. Genotype KJT-184 (0.075 mg g^{-1}) exhibited significantly lowest total chlorophyll content among all other genotypes.

At 90 DAT, significantly highest total chlorophyll content in leaves was registered in PKV-Ganesh (0.156 mg g^{-1}) followed by PKV-Makrand (0.134 mg g^{-1}). Genotypes SKL-6 (0.093 mg g^{-1}), PKV-Akshad (0.083 mg g^{-1}) and SYE-1(0.079 mg g^{-1}) recorded moderately higher total chlorophyll content than rest of the genotypes. However, these three genotypes were found at par with each other. Genotypes RTN-5(0.067 mg g^{-1}) and KJT-184 (0.066 mg g^{-1}) exhibited significantly lowest total chlorophyll content among all other genotypes.

It might be denaturation of chlorophyll content due to high temperature and it ultimately effects on photosynthesis of plant. Similar results were found by (Kumar *et al*., 2012), who studied in his experiment two genotypes each of maize and rice for their response of varying degrees of temperature stress (35/30, 40/35, 45/40°c) with control condition. At elevated temperatures, the rice genotypes were inhibited high extends than maize genotypes. The stress injury measure and damage to membranes, loss of chlorophyll and reduction in leaf water status was significantly higher in rice plant, especially at 45/40 °C.

Xie *et al.* (2011) noted photosynthetic characteristic and dry matter accumulation of rice under high temperature at heading stage. The results showed that grain yield, chlorophyll content, net photosynthetic rate (NPn) sharply decined.

Liu *et al.* (2013) studied effects of elevated air temperature on physiological characteristics of flag leaves and grain yield in rice. Elevated air temperature laid to great loss in rice grain yield. Results revealed that, high temperature after rice heading stage significant reduced total chlorophyll content (SPAD value), soluble sugar and protein content, while increased MDA.

In this study PKV-Ganesh and PKV-Makrand recorded significantly higher total chlorophyll content which indicates tolerance towards heat stress. This might have reduced MDA and soluble sugar and which correlates with the finding of Kumar *et al.(*2012) .

Reducing and non-reducing sugar

The data regarding reducing and non-reducing sugar were recorded in different genotypes and it is given in Table 1.

Reducing sugar in rice seed ranged between 2.02-2.23 per cent in different genotypes. The significantly highest reducing sugar observed (2.23 %) in SYE-1 followed by PKV-Makrand (2.17%), however both the genotypes were at par with each other. Genotypes RTN-5 (2.13%), KJT-184 (2.11%) and SKL-6 (2.08%) recorded moderate range of reducing sugar in rice grain. However, these genotypes were said to be at par with each other. Significantly lowest reducing sugar was recorded by PKV-Akshad (2.03%) and PKV-Ganesh (2.02%), however, both were found at par with each other.

Non-reducing sugar in rice seed ranged between 10.67-13.27 per cent in different genotypes. The significantly highest non-reducing sugar observed in SYE-1 (13.27 %) followed by RTN-5 (13.26%), PKV-Makrand (13.05%) and SKL-6 (12.84%), however, all these four genotypes were found at par with each other. Genotype PKV-Ganesh (12.22%) recorded moderate non-reducing sugar. Genotypes PKV-Akshad (11.08%) and KJT-184 (10.67%) recorded significantly lowest non-reducing sugar. However, both these genotypes were found at par with each other.

Genotypes SYE-1 was found to be best thermo-tolerant genotypes as it might produces osmo-protectants.

Similar results were found by Kore *et al.*(2016), who studied grain quality of rice grown in Amgaon tehsil of Gondiya district in Maharashtra. The reducing and non-reducing sugar and amylose content were low to adequate in range due to high atmospheric temperature.

Amylose content (AC)

In evaluating rice grain quality, amylose content (AC) can play a significant role in determining the overall cooking, eating and pasting properties such as texture, flavor, stickiness, hardness grain elongation, gel consistency, and gelatinization temperature of rice varieties. Amylose content is important because firmness and stickiness are two properties of cooked rice that influences consumer preference for, and use of different classes of rice.

In present study, amylose content (AC) was estimated of seven genotypes under study and data were presented in Table 1. It was in the range of 7.80-10.30 per cent. The significantly highest amylose content (AC) observed in PKV-Akshad (10.30 %) followed by RTN-5

(9.70%) and PKV-Ganesh (9.40%), however, these three genotypes were observed at par with each other. Genotypes SYE-1 (8.90%), SKL-6 (8.30%), KJT-184 and PKV-Makrand each recorded 7.80% amylose content.

Amylose content of rice determines the hardness and stickiness of cooked rice. All the genotypes recorded less amylose content which indicates that these genotypes were quite soft and sticky after cooking. Genotypes PKV-Akshad, RTN-5 and PKV-Ganesh were softer and SYE-1, SKL-6, KJT-184 and PKV-Makrand were soft and sticky after cooking.

Similar results were found by Kore *et al.* (2016), who studied grain quality of rice grown in Amgaon tehsil of Gondiya district in Maharashtra. The reducing and non-reducing sugar and amylose content were low to adequate in range due to high atmospheric temperature.

Alkali spreading value (ASV)

The value of alkali spreading is being indirect method of measuring gelatinization temperature. Alkali spreading value ranged between 4.57- 5.97. The highest alkali spreading value of 5.97 observed in PKV-Ganesh which was significantly highest among all genotypes under study. Genotypes SYE-1 (5.31), KJT-184 (5.23), SKL-6 (5.19) and PKV-Makrand (4.79) recorded intermediate alkali spreading values. However, these four genotypes were found at par with each other. Genotypes PKV-Akshad (4.65) and RTN-5 (4.57) recorded significantly lowest alkali spreading values. This means high intermediate alkali spreading value.

PKV Ganesh showed low Alkali spreading value which means lower Gelatinization temperature (GT) indicating low peak temperature at which starch absorbs heat and requires less water and cooked faster which is desirable for cooking quality. RTN-5 has intermediate Alkali spreading value with moderating higher GT which requires more water, more cooking time also.

Matin *et al.* (2017) conducted experiment to know the chemical and cooking properties of nineteen BRRI released high yielding rice varieties (HYVs) including salinity, drought and submergence tolerant varieties. All the rice varieties were grown in normal conditions. Alkali spreading value ranged from 3.0 to 7.0. Maximum cooking time (20.5 min.) was required in the variety of BRRI dhan 40. Alkali spreading value was found significantly and negatively correlated with cooking time.

Similar results were found by Kore *et al.*(2016), who studied grain quality of rice grown in Amgaon tehsil of Gondiya district in Maharashtra. The reducing and non-reducing sugar and amylose content were low to adequate in range due to high atmospheric temperature. Findings of the experiment on alkali spreading value are in conformity with the findings of Kore *et al.* (2016) and Matin *et al.* (2017).

Yield plant^{-1}

Data regarding grain yield plant^{-1} showed in Table 1 that significantly higher grain yield plant^{-1} was produced by PKV-Ganesh (75.68 g) and significantly lowest grain yield noted in KJT-184 (63.30 g).

Significantly highest grain yield plant^{-1} was observed in genotype PKV-Ganesh (75.68 g) followed by PKV-Makrand (73.72 g) and SKL-6 (72.96 g), however, these three genotypes were found at par with each other. Genotypes PKV-Akshad (68.34 g), SYE-1 (67.56 g) and RTN-5 (66.40 g) recorded moderately higher grain yield plant^{-1}. However, these three genotypes were found at par with each other. KJT-184 (63.30 g) recorded significantly lowest grain yield plant^{-1} than all other genotypes.

Moosavi (2015) evaluated 30 breeding lines of rice. They showed that the correlation between grain yields plant^{-1} and number of panicles was the highest. Due to high levels of direct effects of harvest index and number of panicles and also significant correlation between these traits with grain yield plant^{-1}, these traits can be used as indicators for indirect selection of grain yield.

It was, thus concluded that physical and chemical quality parameters of rice grain varieties in SYE-1 were good and consumer can get better rice, with low to adequate reducing and non-reducing sugar and amylose content due to high temperature.

Table 1. Chlorophyll content, reducing and non-reducing sugar, amylose content and alkali spreading value of summer rice

Genotypes	Total chlorophyll content			Reducing sugar	Non-reducing sugar	Amylose content (%)	Alkali spreading value	Yield plant^{-1} (g)
	30 DAT	60 DAT	90DAT					
SYE-1	0.080	0.088	0.079	2.23	13.27	8.90	5.31	67.56
SKL-6	0.097	0.104	0.093	2.08	12.84	8.30	5.19	72.96
KJT-184	0.071	0.075	0.066	2.11	10.67	7.80	5.23	63.30
PKV-Akshad	0.084	0.089	0.083	2.03	11.08	10.30	4.65	68.34
PKV-Makrand	0.147	0.194	0.134	2.17	13.05	7.80	4.79	73.72
RTN-5	0.079	0.085	0.067	2.13	13.26	9.70	4.57	66.40
PKV-Ganesh	0.167	0.201	0.156	2.02	12.22	9.40	5.97	75.68
GM	0.10	0.120	0.100	2.11	12.34	8.89	5.10	69.70
SE (m) ±	0.005	0.007	0.006	0.024	0.344	0.381	0.181	0.942
CD at 5 %	0.015	0.021	0.018	0.073	1.030	1.142	0.543	2.824

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