RESPONSE OF RICE (*ORYZA SATIVA* L.) GENOTYPES FOR HEAT STRESS

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Abstract: Global warming results in high temperature induced floret sterility in rice. The anticipated high temperature will induce floret sterility and decrease in the stability of rice yield even in temperate regions. The temperature in summer season(April and May) rise up to 40°C during which the crop suffers from terminal heat stress and leads to more spikelet sterility resulting in chaffyness of grain in the study area. Among the fifty rice genotypes screened for heat tolerance for important traits like days to first heading, plant height at first heading, total number of productive tillers per plant ,pollen fertility, spikelet fertility and grain yield per plant, the genotype IR10C172 recorded highest significant mean values for almost all the trait. Besides this, the genotype IR10C172 portrayed its highest significant mean for spikelet fertility, which is a key trait for phenotyping heat tolerance. Due to its consistency nature of this IR 10C172 it could be used in breeding programmes as a donor for developing temperature tolerant rice cultivars.

Keywords: Rice, Heat Tolerance, Per *se* Performance, Donor

Introduction: Rice (Orya sativa L.) is life and world's most important food crop and a primary source of food for more than half of the world's population and accounts for more than 50 % of their daily calorie intake. The UN general assembly declared 2004 as the international year of rice (IYR), which reflects the importance of rice in global concerns regarding food security, poverty alleviation, preserving cultural heritage and sustainable development. In India, rice is now being cultivated in an area of 440 Mha with a production of 103.41 million tones of paddy and an average productivity of 2.35 t/ha milled rice(India stat,2012).To support a huge increasing in population of 1.3 billion by 2020 and 1.53 billion by 2030, rice production has to be increased by at least 70 per cent over next three decades (Balkunde et al., 2013).

Heat stress due to increased temperature is a growing agriculture problem limiting plant growth and productivity in many parts of the world (Sailaja *et al*., 2014). Rice has been cultivated under a wide range of climatic conditions and most , rice is currently grown in regions where current temperatures are already close to optimum for rice production. Therefore, any further increase in mean temperatures or of short episodes of high temperature during sensitive stages reduce grain yield. In rice, almost all the growth stages are affected by high temperature, but reproduction stage(booting and heading) is more sensitive than all other growth stages (Hall,1992; Shah et al.,2011) high temperature affects anther dehiscence, pollination and pollen germination, which in turn leads to spikelet sterility and yield loss(Yoshida,1981).Exposure at anthesis even for less than one hour at 33.7° C may result in spikelet sterility (Jagadish et al., 2007) which will greatly increase at temperature above 35°C(Matsui et al.,1997).Therefore due to impact of increased temperature, developing of new rice varieties tolerant to high temperature is an urgent need to feed the increasing population. Hence in this present study as part of developing high temperature tolerant rice varieties, fifty rice genotypes were screened for heat tolerance during summer season.

Materials and Methods: The experiment was carried out in plant breeding farm, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Chidambaram during summer season,2016 to screen fifty rice genotypes for heat tolerance. In each genotype, one seedling per hill was transplanted in the main field with the spacing of 20 cm between rows and 20 cm between plants in a randomized block design with three replications. All the needy agronomic practices were followed as per the recommendations. The flowering stage of the crop was coincided with the hottest month(April & May).Observations were recorded for days to first heading, plant height at first heading, total number of productive tillers per plant, pollen fertility, spikelet fertility and grain yield per plant. The mean data were statstically analyzed by adopting appropriate methods outlined by Panse and Sukhatme(1964).

Results and Discussion: Genetic variability in any crop is pre-requisite for superior genotypes over existing cultivars for developing and improving varieties or hybrids yield under high temperature stress. In this present study variation was observed for all the characters among the genotypes, indicating the existence of sufficient amount of variability. These results are in confirmation with the earlier findings of Sravan Raju et al.,(2013) and Shrivastava et al.,(2012).

Among the fifty genotypes screened for heat tolerance the genotype CSR 12 (60.42) was earliest followed by STBN17 (60.44) and IR10C172(62.86) days for days to first heading.(Table.1).The prolonged days were observed in the genotypes IR11C206 (84.95) followed by Mutrina Samba(84.64) and IRC208(82.69).The genotype IR10C172 recorded lowest plant height of 66.24 cm followed by STBN(66.46) and MTU1010(67.61) for the trait plant height at first heading. Total number of productive tillers per plant was significantly highest (28.87) for the genotype IR10C172 followed by VL DHAN86(23.00) and CSR12(22.37).The genotype Navara(97.63) recorded highest pollen fertility percentage followed by the genotypes IR11C221 (95.88) and STBN18(95.79) respectively.

The genotype IR10C172 (93.07) was observed to be highest for spikelet fertility followed by the genotypes STBN17(92.33) and MTU1121(92.03).Among the genotypes screened for high temperature, the genotype IR10C172 (30.66)gm recorded highest grain yield per plant followed by the genotypes MTU1121 (25.00)gm and improved White Ponni(24.10)gm respectively. The primary criterion for the evaluation of genotypes for selecting the suitable parent were mainly based on spikelet fertility (Nakagawa *et al*., 2003, Matsui *et al*., 1997). Jagadish *et al*. (2007) reported that less than 1 hour of exposure to temperatures above 33.7°C was sufficient to induce spikelet sterility. Accordingly, the genotype IR 10C172 recorded highly significant mean for spikelet fertility. This may be due to its tolerance nature of this genotype. The fertility of spikelets at high temperature can be used as a screening tool for high temperature tolerance during the reproductive phase (Satake and Yoshida 1978). The temperature range at the time of heading ranged from 33.2°C to 36°C. The genotype IR 10C172 also recorded high significant mean for most of the traits. Due to its consistency nature of this IR 10C172 it could be used in breeding programmes as a donor for developing temperature tolerant rice cultivars.

Table 1:Mean performance of fifty genotypes for heat tolerance

S. No	Genotypes	Days to First Heading	Plant Height at First Heading	Total Number of Productive Tillers per Plant	Pollen Fertility	Spikelet Fertility	Grain Yield per Plant
1	CSR 12	60.42**	73.23**	22.37**	66.04	88.37	18.32
2	ADT 47	70.50*	77.71**	16.13	77.15	89.32	17.95
3	CO 43	69.44**	75.50**	13.20	81.01	88.11	21.63
4	CO49	67.78**	75.52**	12.63	85.56	88.49	21.36
5	BL 20	73.27	76.01**	19.17**	91.51**	91.24	20.44
6	BL 18	69.89**	75.51**	12.50	92.60**	89.58	21.09
7	CARI 4	65.85**	122.53	18.63	90.60**	91.23	20.57
8	CARI 5	68.92**	75.25**	18.93	92.32**	89.22	17.94
9	CARI 3	71.54	75.59**	16.77	62.42	83.59	18.43
10	ASD 1	73.09	67.99**	16.13	83.64	88.34	19.76
11	STBN 10	71.36*	95.65	16.00	91.06**	85.36	15.27
12	STBN 1	69.09**	76.61**	20.57**	76.45	90.29	19.10
13	STBN 9	64.61**	74.97**	14.83	87.86*	91.83	18.56
14	STBN 13	82.68**	76.23**	18.80	54.62	90.60	19.64
15	STBN 17	60.44**	82.65	15.23	79.71	92.33*	18.62
16	STBN 18	74.02	66.46**	17.43	95.79**	90.51	18.16
17	MTU 7029	67.16**	73.19**	19.73**	77.84	90.09	18.38
18	VL Dhan 86	70.32**	73.27**	23.00**	79.84	89.01	18.72
19	MTU 1010	72.09	67.61**	13.97	88.55**	87.22	19.86
20	Ashwini	72.64	76.61**	16.33	74.09	90.02	17.38
21	Turga	70.84**	76.01**	20.87**	86.77	91.39	21.77
22	MTU 1121	73.00	72.66**	22.30**	84.98	92.03*	25.00**
23	Bhavani	73.77	78.83**	19.87**	75.06	90.16	19.33
24	Samba masuri	72.44	76.76**	17.53	93.32**	87.80	17.39
25	Geetanjali	73.86	75.40**	16.23	90.34**	91.31	19.27
26	Indra	70.79**	76.71**	14.93	87.69**	89.53	19.59
27	Annapurna	71.92	77.93**	18.53	89.00**	90.78	19.03
28	Giri	70.36**	78.95**	15.73	85.30	89.71	20.51
29	IR 20	74.27	72.21**	17.40	88.70**	90.88	21.28
30	ADT 37	70.53**	71.74**	12.73	80.03	85.27	22.44
31	ADT 36	72.49	74.83**	16.80	94.20**	86.54	20.37
32	IR 36	65.92**	74.17**	18.77	74.75	89.66	21.15
33	Improved White ponni	72.02	75.09**	21.90**	85.18	89.64	24.10*
34	Dhanya lakshmi	70.42**	82.50	16.90	91.75**	86.87	21.01
35	Kalyan sona	64.93**	92.78	15.33	95.16**	84.68	19.10
36	Savithiri	74.63	140.14	18.80	93.79**	90.96	22.57

37	CO 42	79.60	93.71	18.20	86.51	87.05	21.26
38	Kattu kurthalai	81.94	128.89	16.80	91.29**	86.28	21.07
39	Mutrina samba	84.64	136.04	16.07	90.49**	86.64	21.89
40	Kuruvai kalanjiyam	81.83	151.96	14.70	89.42**	85.89	19.61
41	Navara	79.60	86.28	17.80	97.63**	90.25	19.70
42	IR 11C123	82.11	74.14**	16.07	90.21**	89.97	17.43
43	IR 11C186	81.23	72.21**	13.80	84.92	89.06	19.15
44	IR 11C202	84.95	76.45**	13.27	61.77	88.85	19.29
45	IR 11C206	79.53	78.89**	19.37**	94.93**	88.43	21.40
46	IR 11C208	82.69	74.96**	12.70	88.86**	89.38	21.66
47	IR 11C221	81.97	77.05**	24.90**	95.88**	87.50	21.58
48	IR 10C172	62.86**	66.24**	28.87**	86.54**	93.07**	30.66**
49	IR 83142-B-36-B	81.04	70.61**	16.37	93.90**	86.74	20.48
50	IR 64197-3B-15-2	81.05	79.11**	16.33	94.84**	87.73	20.70
	Grand mean	73.24	82.42	17.44	85.43	88.97	20.21

*Significant at 5 per cent level

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