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Effect of Micro-Weather Health Indices on Growth and Yield of Rice (*Oryza sativa* L.) under Semi-arid Conditions of Andhra Pradesh

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ABSTRACT

A field experiment pertaining to "Effect of micro-climate on growth and yield of rice (*Oryza sativa* L.) under semi-arid conditions of A.P." was conducted in *Kharif,* 2014. The experimental site was at the ARI farm of SRTC Rajendranagar. The soil was low in available N (154 kg ha^{-1}) medium in P_2O_5 (41 kg ha^{-1}) and K_2O (209 kg ha^{-1}). The layout was factorial randomized block design. The treatments were a combination of four rice genotypes *viz.,* Tellahamsa, WGL (20471), Jagityala Sannalu (JGL 1798) and Anjana (JGL 1118) and four dates of sowing at 15 days interval from 15th June 1st August. Among the dates of sowing the July 15th sown crop yielded highest . Similarly, the genotypes Tellahamsa performed well over the other three varieties not only in plant grown characters but also in yield attributes and yield owing to favourable trends in micro weather health indices regimes within its canopies. Particularly Absorbed Photosynthatically Active Radiation (APAR) and Radiation Use Efficiency (RUE) values were optimum in 15th July sown crop and Tellahamsa genotype.

Key words: *Growth, Micro-weather health indices, Yield.*

Rice of Asian origin (*Oryza sativa* L.) is one of the most important major cereal crops and the staple food for more than half of the human population. In less than 40 years, the world's population is predicted to reach 9 billion, (raising the " 9 billion- people issue"). Rice crop is constantly exposed to a variety of biotic and abiotic stresses that reduce their fitness and performance. In such scenarios micrometeorological technics have greater role in modifying the weather inside the crop. Genotypes of varying physiological features and altering dates of sowing have proved to show variations in microclimate there by enhanced yields in optimally grown crops (Ghosh *et.al.,* 2014). The weather health indicer at micro level viz., APAR, RUE etc., are the best indicer to relate rice goy yields and weather and to use weather as now monetary input (Murthy, 2015 and Murthy 2016).

MATERIAL AND METHODS

A field experiment was conducted in during *kharif* 2014 at the ARI farm of SRTC Rajendranagar on medium black soil with available N (154 kg ha^{-1}), available P_2O_5 (41 kg ha^{-1}) and available K_2O (209 kg ha^{-1}). The experiment was laid out in factorial randomized block design and the treatments were replicated thrice. There are 12 treatment combinations replicated thrice in the study and the treatments consisted of four rice genotypes *viz.,* Tellahamsa, WGL(20471), Jagityala Sannalu (JGL 1798) and Anjana (JGL 1118) and four dates of sowing at 15 days interval from 15th June to 1st August. The meteorological and micrometeorological observations, analysis and studies were conducted as per the procedures laid out by Zaman *et.al.* (1982) and Murthy (2002) and Murthy (2016).

Absorbed photosynthetically active radiation (APAR)

The quantum of Absorbed Photosynthetically Active Radiation (APAR) and Radiation Use Efficiency (RUE) by 4 genotypes of rice under varying dates of sowing in *kharif* indicated that the crop sown on 15th July absorbed high amount of photosynthetically active radiation. The APAR was least in the 15th June sown crop. Irrespective of the sowing dates , maximum absorption of photosynthetically active radiation was recorded by the genotype Tellahamsa followed by WGL (20471), Jagityala Sannalu (JGL 1798) and

Table 1. Dry matter accumulation, grain, straw yield and harvest index of rice as influenced by different treatments.

Treatments	Dry Matter accumulation (kg ha^{-1})	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
Dates of swoing				
D_1) 15th June	11864	5042	6091	45.3
D_2) 1st July	12451	5254	6374	45.2
D_3) 15th July	13302	5770	6624	46.5
D_4) 1st August	10832	4796	5904	44.6
S.E.±	584	207	221	1.2
C D at 5%	1192	422	451	NS
Rice genotypes				
V_1) Tellahamsa	13083	5777	6861	45.7
V_2) WGL-20471	12765	5547	6387	46.5
V_3) Jagityala Sannalu (JGL-1798)	12367	5164	6245	45.3
V_4) Anjana (JGL-1118)	11941	4932	5958	45.2
S.E.±	584	207	221	1.2
C D at 5%	1192	422	451	NS
Interaction				
S.E.±	1167	413	441	2.3
C D at 5%	N S	NS	NS	NS
General Mean	12539	5355	6363	45.7

Table 2. Absorbed photosynthetically active radiation (APAR), radiation use efficiency (RUE) soil and canopy air temperature as influenced by different treatments.

Treatments	APAR (MJm-2)	RUE (g MJm-2)	Soil temperature (°C)	Canopy air temperature (°C)
Dates of swoing				
D_1) 15th June	159.32	2.74	22.61	31.12
D_2) 1st July	161.88	2.81	22.49	30.87
D_3) 15th July	166.27	3.55	21.77	26.54
D_4) 1st August	156.57	2.39	20.32	32.08
S.E.±	2.99	0.22	1.15	2.58
C D at 5%	6.11	0.44	NS	NS
Rice genotypes				
V_1) Tellahamsa	167.55	3.23	21.52	27.41
V_2) WGL-20471	164.13	3.05	21.99	29.44
V_3) Jagityala Sannalu (JGL-1798)	161.32	2.96	22.47	30.15
V_4) Anjana (JGL-1118)	156.97	2.89	23.17	31.03
S.E.±	2.99	0.22	1.15	2.58
C D at 5%	6.11	0.44	NS	NS
Interaction				
S.E.±	5.98	0.43	2.30	5.17
C D at 5%	NS	NS	NS	NS
General Mean	162.49	3.03	22.29	29.51

Anjana (JGL 1118). The genotype Anjana was less efficient in APAR. The mean absorbed photosynthetically active radiation was 159.32 MJm^{-2} by early sown crop on 15 th June. The value raised to 161.88 MJm^{-2} by shifting the sowing date to 1 st July. It reached to peak value of 166.27 MJ per meter square when sown on 15th July. It dropped sharply to 156.57 in 1 st August sown crop.

Radiation Use Efficiency (RUE)

The variations due to changes in dates of sowing indicated that the crop had higher radiation use efficiency in the 15th July sown crop. It was least in 15th June and 1st August sown crops. The genotypic differences were narrow. The genotype Tellahamsa had maximum radiation use efficiency of 3.23 g MJm^{-2}. The corresponding value was 3.05 for WGL (20471) Jagityala Sannalu 2.80 and for Anjana it was 2.96.

Soil temperature (oC)

The mean soil temperature recorded during the crop growth period of rice genotypes varied considerably with the dates of sowing. It was maximum in the 15th June sown crop (22.61). Moderate in 1st July crop (23.49) . Optimum (21.72) in 15th July sown crop. Least (20.32) in 1st August sown crop. Temperatures at any given point of day or night followed similar trends with no regard to the genotype or season. The morning temperature was least at 6.00 A.M. in 15th June sown crop. It raised consistently and attained the peak value at 2.15 P.M. This was followed by a steep reduction past the noon until 6 A.M.on the following day. The genotypes showed a distinct variation in soil temperature. The temperature of the soil supporting the genotype Tellahamsa was invariably optimum than all the other three genotypes all through the day or night at any given hour. It was 20^0c at 6 A.M. in 15th July sown crop and in the other genotypes it was either less or more than the optimum. The soil recorded least temperature by growing the crop on 1st August.

Canopy air temperature (o C)

The canopy air temperature recorded from dawn to dusk at hourly intervals indicate that the canopies of 15 th July sown crops recorded optimum (26.54) and in the other dates of sowing it was above 30.00. Among the genotypes Tellahamsa recorded optimum of 21.52 and for the other varieties it was less than optimum.

Canopy temperature and humidity

Canopy temperature showed similar trends as that of canopy air temperature. The humidity within the canopy of rice genotypes sown on 15th July was most optimum ranging from 45 to 60 % through out the day. The values for other dates ranged from 55 to 75 % which were uncongenial. Among the genotypes Tellahamsa recorded optimum humidity values ranging from 46 to 56 % and for the other genotypes, these values were not at all close to the optimum. These trends were in accordance with the observations of Yoshida et.al., (1976) Murthy (2016).

Weather health indices and yield

The data in table 1 releats that the rice crop grown on 15th july yielded highest grains (5770 kg ha^{-1}) and among genotypes tested tellahumsa gave highest yield (5777 kg ha^{-1}). The micro level weather health indices viz., APAR (166.27 M Jm^{-2}) RUE (3.552 gM Jm^{-2}) soil temperature (20.32°C) and canopy air temperatere (32.08°C) are the best among different dates of sowing. Similarly, for genotypes tellahanser the APAR (167.55 M Jm^{-2}) RUE (3.23 g MJM^{-2}) soil temperature (21.52°C) and canopy air temperature (27.41 °C) were found be best weather health indices at micro level, which resulted in best yield in the investingation (Table 2).

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