



# A STUDY ON PHYSIOLOGICAL ATTRIBUTES AND YIELD IN DEVELOPED RICE GENOTYPES

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## Abstract

An experiment was conducted to study physiological attributes and yield of developed rice varieties during *rabi* 2014-15. Results showed that maximum LAI, CGR, RGR, NAR, LAD and LAR were recorded in the variety RNR-15038. Highest dry matter production recorded for the variety RNR-15038, while lowest dry matter was recorded in genotype Rajendra. Maximum SPAD values were recorded in genotype RNR-15038 throughout the crop growth period and minimum was found for the genotype Rajendra. Highest grain yield was recorded in RNR-15038 and lowest grain yield was recorded in Rajendra. The developed rice genotypes differ significantly with respect to yield components like number of panicles per meter square, number of spikelets per panicle, 1000 grain weight filled grain percentage and harvest index.

**Key words :** Developed rice genotypes, growth parameters, SPAD values, yield, harvest index.

## Introduction

Rice (*Oryza sativa* L.) is one of the most important cereal crops of family Poaceae. It is the staple food crop of 60 per cent of the world's population. The edible uses of rice include rice flakes, puffed rice and canned rice. It is also used in starch and brewing industries. By products of rice milling *i.e.*, rice husk and bran are used as cattle and poultry feed. Rice is one of the diverse crop grown in different agro-climatic conditions and it is the second largest produced cereal in the world. More than 90 per cent of the world's rice area is in Asia, which is the home for more than half of world's poor and more than half of world's rice cultivators (Rao *et al.*, 2010).

India is the second largest producer and consumer of rice in the world. Its production in India crossed the mark of 100 million tones in 2011-12 accounting for 22.81% of global production in that year. The productivity of rice has increased from 1984 kg /ha in 2004-05 to 2372 kg / ha in 2011-12. Rice is grown in an area of 44.8 m ha with the production and productivity levels of 99.18m tones and 2214kg/ha, respectively in India. In Andhra Pradesh rice is grown in an area of 43.75 lakh ha with the production and productivity levels of 142.1 lakh tones and 3248 kg/ha (Anonymous, 2011). In crop improvement programs, continues efforts were on going in development of high yielding improved new varieties and management

practices aiming at rice productivity.

Among the rice genotypes cultivated in our country. The developed rice varieties are popular over the recent year. These rice varieties are essential and to have throughout knowledge on physiological parameters in view of this experiment was conducted to study the physiological parameters *viz.*, LAI, CGR, RGR, NAR, LAD, LAI and chlorophyll content and there influence on dry matter production and grain yield.

## Materials and Methods

An experiment was conducted during *rabi* season 2014-15 at Student Farm, College on Agriculture, Rajendranagar, Hyderabad, with eleven rice genotypes. The experiment was laid out by following randomized block design with three replications. 30days of old nursery was transplanted by following a spacing of 15 × 15 cm. Nitrogen, phosphorus and potassium were applied at the rate 100:60:40 N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O Kg ha<sup>-1</sup> in the form of urea, SSP and MOP. Scheduled irrigation and weed management practices were followed later harvesting were done. Destructive samplings was done at fort night interval by uprooting five hill per plot. Leaf area was measuring by using LI-3100 leaf area meter (LICOR-Lincoln, Nebraska, USA). Dry matter of the component parts was recorded by subjecting the sample at 70°C temperature in hot air oven till constant weight was

**Table 1 :** Total dry matter productive ( $\text{g m}^{-2}$ ) at different growth stages in rice genotypes during *rabi* season.

S. no.	Genotypes	Days after transplanting					
		15	30	45	60	75	90
1	Tellahamsa	84	311	555	1011	1371	1476
2	KNR-118	63	265	514	986	1304	1450
3	TN-1	63	262	505	906	1273	1429
4	JGL34449	74	322	585	1101	1485	1654
5	RNR 15048	56	264	571	1067	1474	1626
6	Swarna	80	231	490	970	1248	1359
7	MTU 1010	77	312	587	1079	1427	1593
8	RNR 15038	58	308	609	1129	1495	1707
9	HR 12	76	294	452	890	1153	1301
10	NLR 34449	72	243	481	831	1211	1345
11	Rajendra	65	267	527	937	1201	1296
	SE $\pm$	3.20	2.17	5.18	9.46	20.66	22.6
	C.D.	NS	18.14	15.30	54.62	61.40	84.05

**Table 2 :** SPAD (chlorophyll metre reading) at different growth stages in rice genotypes during *rabi* season.

S. no.	Genotypes	Days after transplanting					
		15	30	45	60	75	90
1	Tellahamsa	39.23	36.16	37.76	40.96	42.41	36.20
2	KNR-118	35.82	37.88	40.89	41.38	42.23	37.10
3	TN-1	33.92	38.85	39.85	41.32	43.42	39.53
4	JGL34449	36.81	38.79	40.72	42.34	43.14	38.69
5	RNR 15048	42.11	41.99	43.07	44.00	44.87	41.62
6	Swarna	36.77	37.71	38.93	41.87	42.83	36.87
7	MTU 1010	37.91	38.43	39.99	40.65	41.64	38.76
8	RNR 15038	38.59	39.69	40.30	42.83	44.01	41.41
9	HR 12	35.34	36.43	37.52	37.87	38.91	36.85
10	NLR 34449	37.15	37.72	38.86	39.64	40.39	35.78
11	Rajendra	36.88	37.46	38.44	39.15	36.16	35.23
	SE $\pm$	<b>0.41</b>	<b>0.23</b>	<b>0.36</b>	<b>0.16</b>	<b>0.12</b>	<b>0.20</b>
	C.D.	<b>0.38</b>	<b>0.70</b>	<b>0.40</b>	<b>0.48</b>	<b>0.38</b>	<b>0.60</b>

obtained. After complete drying, dry matter was expressed in  $\text{g m}^{-2}$ . Physiological parameters were calculated by using standard formulae and the SPAD-502 (Soil Plant Analytical Development) meter was used for measuring the relative chlorophyll content of leaves. Yield attributes like no of panicle  $\text{m}^{-1}$ , panicle length, total no of spikelets per panicle, test weight, filled grain percentage, yield and harvest index.

## Results and Discussion

The highest dry matter production of  $1707 \text{ g m}^{-2}$  was recorded in genotype RNR 15038 while minimum dry matter production of  $1296 \text{ g m}^{-2}$  was recorded for the

**Table 3 :** Crop growth rate (CGR) ( $\text{gm}^{-2} \text{ day}^{-1}$ ) at different growth stages in rice genotypes during *rabi* season.

S.no.	Genotypes	Days after transplanting				
		15-30	30-45	45-60	60-75	75-90
1	Tellahamsa	15.109	16.288	28.623	25.835	6.915
2	KNR-118	13.486	16.553	26.727	22.791	12.131
3	TN-1	13.242	16.218	31.458	22.957	7.950
4	JGL34449	16.553	18.492	34.083	25.599	11.310
5	RNR 15048	13.887	20.731	33.083	27.089	10.154
6	Swarna	10.043	17.261	31.994	18.754	7.375
7	MTU 1010	15.661	18.375	32.773	23.173	11.064
8	RNR 15038	16.657	19.064	34.659	24.404	12.855
9	HR 12	14.531	10.553	29.330	17.418	9.844
10	NLR 34449	11.432	15.814	25.926	22.732	8.907
11	Rajendra	13.470	17.376	26.772	17.419	6.372
	SE $\pm$	<b>0.14</b>	<b>0.36</b>	<b>1.05</b>	<b>1.38</b>	<b>0.96</b>
	C.D.	<b>0.41</b>	<b>1.06</b>	<b>3.11</b>	<b>4.09</b>	<b>2.83</b>

**Table 4 :** Relative growth rate ( $\text{g g}^{-1} \text{ day}^{-1}$ ) at different growth stages in rice genotypes during *rabi* season.

S.no.	Genotypes	Days after transplanting				
		15-30	30-45	45-60	60-75	75-90
1	Tellahamsa	0.0869	0.0385	0.0381	0.0218	0.0048
2	KNR-118	0.0958	0.0441	0.0432	0.0201	0.0059
3	TN-1	0.0988	0.0440	0.0389	0.0220	0.0090
4	JGL34449	0.0653	0.0434	0.0421	0.0219	0.0071
5	RNR 15048	0.1040	0.0526	0.0420	0.0210	0.0069
6	Swarna	0.0723	0.0501	0.0457	0.0179	0.0058
7	MTU 1010	0.0621	0.0419	0.0401	0.0192	0.0073
8	RNR 15038	0.1120	0.0420	0.0412	0.0186	0.0074
9	HR 12	0.0902	0.0388	0.0363	0.0169	0.0081
10	NLR 34449	0.0810	0.0450	0.0392	0.0220	0.0069
11	Rajendra	0.0992	0.0449	0.0382	0.0162	0.0050
	SE $\pm$	<b>0.0023</b>	<b>0.0074</b>	<b>0.0011</b>	<b>0.0013</b>	<b>0.0019</b>
	C.D.	<b>0.0354</b>	<b>0.0021</b>	<b>0.0034</b>	NS	NS

genotype Rajendra at 90 DAT (table 1). The highest dry matter production in genotype RNR 15038 (table 1) than in other genotype can be attributed to more LAI, LAD and better crop growth rates recorded with this genotype. Similar results were also reported by Chandrasekar *et al.* (2001) and Sinha *et al.* (2009). Maximum SPAD values were recorded for genotype RNR 15038 throughout the crop growth period and minimum was found in Rajendra (table 2). Horie (2003) also found significant difference among the genotypes regarding SPAD values.

The maximum crop growth rate (CGR) was observed at 45 to 60 DAT in all genotypes and at this stage highest

**Table 5 :** Net assimilation rate (NAR) ( $\text{g m}^{-2} \text{day}^{-1}$ ) at different growth stages in rice genotypes during *rabi* season.

S.no.	Genotypes	Days after transplanting				
		15-30	30-45	45-60	60-75	75-90
1	Tellahamsa	0.1589	0.0420	0.0660	0.0711	0.0384
2	KNR-118	0.1481	0.0548	0.070	0.0729	0.0492
3	TN-1	0.1565	0.0510	0.0534	0.0481	0.0416
4	JGL34449	0.1771	0.0629	0.0832	0.0684	0.0474
5	RNR 15048	0.1420	0.0550	0.0611	0.0570	0.0391
6	Swarna	0.1121	0.0373	0.065	0.0521	0.0410
7	MTU 1010	0.1848	0.0550	0.0632	0.0489	0.0338
8	RNR 15038	0.1859	0.0480	0.0542	0.0451	0.0387
9	HR 12	0.1620	0.0401	0.0889	0.0612	0.0588
10	NLR 34449	0.1212	0.0531	0.0592	0.0560	0.0359
11	Rajendra	0.1134	0.0484	0.0663	0.0490	0.0283
	SE±	<b>0.0032</b>	<b>0.0011</b>	<b>0.0042</b>	<b>0.0030</b>	<b>0.0049</b>
	C.D.	<b>0.0138</b>	NS	<b>0.0129</b>	<b>0.0110</b>	NS

**Table 6 :** Leaf area duration (LAD) ( $\text{dm}^2 \text{days}$ ) at different growth stages in rice genotypes during *rabi* season.

S.no.	Genotypes	Days after transplanting				
		15-30	30-45	45-60	60-75	75-90
1	Tellahamsa	74.85	146.64	162.99	132.55	70.45
2	KNR-118	41.78	126.25	186.89	178.89	115.91
3	TN-1	43.26	118.36	168.15	124.70	62.33
4	JGL34449	49.29	113.57	155.01	141.29	92.27
5	RNR 15048	52.02	145.75	202.57	180.90	91.88
6	Swarna	75.85	148.82	165.01	135.03	68.85
7	MTU 1010	42.29	134.10	194.36	176.33	125.03
8	RNR 15038	44.65	155.55	230.97	204.44	122.87
9	HR 12	45.33	115.67	161.34	157.10	132.71
10	NLR 34449	44.26	99.96	123.47	103.33	65.19
11	Rajendra	60.18	136.17	173.57	143.02	76.38
	SE±	<b>0.46</b>	<b>0.85</b>	<b>0.80</b>	<b>0.60</b>	<b>2.72</b>
	C.D.	<b>1.366</b>	<b>2.50</b>	<b>2.36</b>	<b>1.79</b>	<b>5.27</b>

CGR of  $34.569 \text{ g m}^{-2} \text{day}^{-1}$  recorded by RNR 15038 followed by RNR 15048 with  $34.08 \text{ g. m}^{-2} \text{Day}^{-1}$  and minimum CGR was recorded in the genotypes NLR 34449 ( $25.926 \text{ g m}^{-1} \text{day}^{-1}$ ) (table 3). Similar finding were also reported by Erfani and Nasiri (2000) and Chandrasekhar *et al.* (2001) for rice hybrids. Horie (2003) also reported that higher CGR had significant correlation with yield.

(RGR) among the rice genotypes throughout the crop growth period except at 60-70 and 75-90 DAT. Maximum relative growth rate (RGR) was recorded in all genotypes at 15-30 DAT (table 4). The highest RGR was recorded in RGR 15038 ( $0.1120 \text{ g g}^{-1} \text{day}^{-1}$ ) and minimum RGR

**Table 7 :** Leaf area index (LAI) at different growth stages in rice genotypes during *rabi* season.

S. no.	Genotypes	Days after transplanting					
		15	30	45	60	75	90
1	Tellahamsa	0.36	4.06	4.61	5.03	2.81	1.35
2	KNR-118	0.28	2.18	5.29	5.77	4.81	2.04
3	TN-1	0.35	2.20	4.80	5.15	2.22	1.45
4	JGL34449	0.27	2.64	4.39	4.78	3.58	1.88
5	RNR 15048	0.27	2.80	5.49	6.16	4.54	2.27
6	Swarna	0.34	4.13	4.67	5.10	2.89	1.36
7	MTU 1010	0.28	2.21	5.72	5.78	4.65	2.79
8	RNR 15038	0.31	2.26	6.56	7.12	4.99	2.28
9	HR 12	0.35	2.32	4.52	5.02	4.27	1.64
10	NLR 34449	0.30	2.30	3.61	3.71	2.39	1.45
11	Rajendra	0.40	3.61	4.89	5.37	3.06	1.43
	SE±	<b>0.01</b>	<b>0.03</b>	<b>0.10</b>	<b>0.13</b>	<b>0.03</b>	<b>0.02</b>
	C.D.	NS	NS	<b>0.30</b>	<b>0.42</b>	<b>0.31</b>	NS

was recorded by genotype MTU-1010 ( $0.0621 \text{ g g}^{-1} \text{day}^{-1}$ ) followed by JGL 11118 ( $0.0653 \text{ g g}^{-1} \text{day}^{-1}$ ) at 15-30 DAT. Relative growth rate (RGR) decreased with the age of crop. Similar decrease of RGR with the age of crop was reported by Chandrasekhar *et al.* (2001).

(NAR) among the rice genotypes throughout the growth period except at 30-45 and 75-90 DAT. Maximum net assimilation rate (NAR) was recorded in all genotypes during 15-30 DAT (table 5). Maximum NAR recorded by the genotype RNR 15038 ( $0.1859 \text{ g dm}^{-2} \text{day}^{-1}$ ) and minimum NAR was recorded by the genotype Swarna ( $0.1121 \text{ g dm}^{-2} \text{day}^{-1}$ ). The increase in the NAR can be attributed to the high SCMR values during this period. Shahidullah *et al.* (2009) were also reported by such significant variation in NAR among the developed rice genotypes.

Leaf area duration (LAD) increased gradually up to 45-60 DAT thereafter decreased. Among the genotypes maximum LAD was recorded in RNR 15038 ( $230.97 \text{ dm}^2$ ) at 45-60 DAT and minimum LAD was recorded by the genotype NLR 34449 (table 6). Higher LAD may be one of reason for higher photosynthetic rate and dry matter production in this genotype. Significant positive correlation between LAD and yield was recorded by Nighwan and Chandra (1980), Chandrasekhar *et al.* (2001) and Katsura *et al.* (2007). LAI increased from 15 DAT to 60 DAT behind which declined sharply and similar results were also found by Chandrashekar *et al.* (2001). Maximum leaf area index of 7.12 was reported in genotype RNR 15038 and minimum of 3.71 was reported with NLR 34449 at 60 DAT (table 7).

**Table 8 :** Yield and yield attributing characters in rice Genotypes during *rabi* season.

Genotypes	Panicle length (cm)	No. of panicles m <sup>-2</sup>	No. of spikelets panicle <sup>-1</sup>	No. of spikelets hill <sup>-1</sup>	1000 grain weight	Filled grain %	Grain yield in kg ha <sup>-1</sup>	Straw yield	Harvest index (%)
Tellahamsa	24.9	252	158	1209	16.1	78.63	5008	7720	0.393
KNR-118	24.4	272	161	1310	19.7	82.23	5644	6448	0.467
TN-1	26.4	264	146	1065	21.1	76.02	4785	8081	0.371
JGL-1118	25.2	285	213	1267	18.8	81.50	5303	6529	0.448
RNR-15048	28.4	321	218	1587	17.2	85.93	5788	6242	0.480
Swarna	23.1	245	124	1043	20.4	72.41	4130	8229	0.338
MTU-1010	24.0	296	208	1242	22.5	84.33	5402	7422	0.428
RNR-15038	26.3	319	221	1603	17.8	87.08	6142	6212	0.494
HR-12	28.2	249	112	1017	13.6	74.60	3733	7214	0.341
NLR-34449	22.5	272	178	1280	21.3	80.30	5230	6488	0.446
Rajendra	22.4	230	151	1053	20.9	69.70	3597	7843	0.314
SE±	<b>0.82</b>	<b>2.873</b>	<b>13.75</b>	<b>2.34</b>	<b>0.30</b>	<b>0.66</b>	<b>28.43</b>	<b>27.9</b>	<b>0.045</b>
C.D(0.05)	<b>3.24</b>	<b>6.03</b>	<b>NS</b>	<b>6.99</b>	<b>0.91</b>	<b>1.96</b>	<b>84.46</b>	<b>83.15</b>	<b>0.134</b>

Maximum panicle length of 28.4 cm was recorded in genotypes RNR 15038 and minimum panicle length of 22.4 cm of was recorded in genotype Rajendra LAI increased from 15 DAT to 60 DAT behind which declined sharply and similar results were also found by Chandrashekar *et al.* (2001). Maximum leaf area index of 7.12 was reported in genotype RNR 15038 and minimum of 3.71 was reported with NLR 34449 at 60 DAT (table 8). Similar results were also reported Sharma (2002) and Ashrafuzzaman *et al.* (2009). Number of panicle per m<sup>2</sup> (321) was recorded with genotype RNR 15048 followed by the genotypes RNR 15038 and MTU1010 and minimum number of panicles per m<sup>2</sup> (230) was recorded in Rajendra (4.22) positive correlation between number of panicles per square meter and grain yield was reported by Chandrasekhar *et al.* (2001). maximum number of spikelets per panicle (165) was found in the genotype and minimum number of spikelets per panicle (109) was found in the genotype. Chandrasekhar *et al.* (2001) and Tahir *et al.* (2002). Highest 1000 grains weight was recorded in ( 22.5 g) due to the bold grain while lowest 1000 grain weight was recorded For the genotype HR-12 (11.10 g) due to fine grain nature similar significant variation among the basmathi genotype was recorded by (Sidhu *et al.*, 1992) and Mandal *et al.* (2005). Rice genotypes exhibited significance differences in grain yield. Among the genotypes RNR 15038 recorded highest grain yield of 6142 kg.ha<sup>-1</sup> followed by RNR 15048 with (5788kg.ha<sup>-1</sup>). The lowest grain yield was recorded in Rajendra (3597 kg ha<sup>-1</sup>) followed by HR-12 (3733 kg.ha<sup>-1</sup>). The highest yield in RNR 15038 was attributed to highest total dry matter production and harvest index. The highest harvest

index of 0.49 was recorded in genotype RNR 15038 followed by RNR 15048 (0.48) and the lowest harvest index of 0.31 was recorded in Swarna. Highest harvest index in RNR15038 can be attributed to more grain filling per cent age and more grain weight per hill as compared to other genotypes.

## Conclusion

Based on the above results it is concluded that the variety RNR 15038 had the best morphology and physiological performance for grain yield, while Rajendra and HR 12 showed the lowest grain yield. From the study it is concluded that higher yields were associated with a number of effective tillers, higher no of grains per panicles, test weight, higher flage leaf area, higher LAI, CGR, NAR, RGR, LAD, LAR, SLW, Pn, Fv/Fm, RUE,yield and harvest index.

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