

# Study of paddy genotypes for physiological variation under upland cultivation

C.M. KAMBLE, K.M. SONAWANE AND V.S. PAWAR

Agricultural Research Station, Mahatma Phule Krishi Vidyapeeth, Niphad, NASHIK (M.S.) INDIA  
Email : khemarajs@rediffmail.com, arsniphad@yahoo.co.in

A field trial conducted at MPKV, Rahuri Post Graduate Institute farm during *Kharif* under upland condition in Randomized Block Design with three replications and twelve treatments. Paddy genotypes namely PBNR 89 II-6, PBNR 89, II-53, PBNR 90 III-64, PBNR 90 III-4, PBNR 90 II-11, PBNR 90 III-10, PBNR 89 I-3, PBNR 93-9, PBNR 93-4 and varieties Sugandha. (check), Parag (check), Basumati-370 (check) were tested. Significant differences were observed among the genotypes for stem dry matter, leaf dry matter, total dry matter, absolute growth rate, relative growth rate, net assimilation rate, chlorophyll content, harvest index etc. None of genotypes was found to surplus the grain yield than genotypic check Parag and Basumati-370 under upland condition.

**Key words :** LAI, LAD, AGR, RGR, NAR, Harvest index, Chlorophyll content

**How to cite this paper :** Kamble, C.M., Sonawane, K.M. and Pawar, V.S. (2014). Study of paddy genotypes for physiological variation under upland cultivation. *Asian J. Bio. Sci.*, 9 (1) : 26-29.

## INTRODUCTION

Paddy (*Oryza sativa* L.) environment in India is extremely diverse, about 33 per cent are rainfed low lands, 45 per cent irrigated, 15 per cent rainfed upland and 7 per cent in flood prone area. The area under upland paddy is 0.78 million hectares (Anonymous, 2012) and productivity was low 670 as against 1776 kg/ha of an average production. The soils of command areas are medium to deep black, calcareous and clay with high pH (Vertisols). Therefore, rainfed low land paddy varieties are not suitable for cultivation in upland condition. It is also closely interlinked with various physiological processes which influencing photosynthetic efficiency, partitioning of dry matter becomes economically useful to other plant parts. No clear cut morphological differences could separate tropical paddy varieties to upland and lowland types. Any paddy varieties grown in upland or flooded cultures differ distinctly in grain and other characters.

In view of above, the present investigation was planned to identify physiological desirable genotypes for the region which could give better yield of upland paddy with the object of production of dry matter and partitioning (source to sink relationship) on physiological basis for varietal differences in yield of upland paddy varieties.

## RESEARCH METHODOLOGY

A field experiment was conducted at Post Graduate Institute farm, Mahatma Phule Krishi Vidyapeeth, Rahuri during *Kharif* and was laid out in Randomized Block Design with three replications and twelve upland genotypes and varieties (treatments) having plot size of 4.50 m × 2.70 m and 30 cm × 10 cm of plant to plant distance.

The dibbling method was used for sowing. Plant samples were collected after 30 days of sowing and then at 30 days interval for studying of dry matter accumulation, its distribution among plant parts of different genotypes *i.e.* in stem dry matter/ plant (g), leaf dry matter per plant (g), panicle dry matter per plant (g) and total dry matter per plant (g) as well as growth function such as absolute growth rate (AGR), relative growth rate (RGR) and net assimilation rate (NAR). AGR, RGR, NAR were calculated from total dry matter accumulation by using following formula :

$$\text{Absolute growth rate (AGR)} = \frac{(w_2 - w_1)}{(t_2 - t_1)}$$

$$\text{Relative growth rate (RGR)} = \frac{\log_e w_2 - \log_e w_1}{t_2 - t_1}$$

$$\text{Net assimilation rate (NAR)} = \frac{(w_2 - w_1)}{(t_2 - t_1)} \uparrow \frac{\log_e L_2 - \log_e L_1}{(L_2 - L_1)}$$

$w_1$  and  $w_2$  = weights of total dry matter per plant in g day<sup>-1</sup>

$t_1$  and  $t_2$  = times in days

$L_1$  and  $L_2$  = Leaf area in dm<sup>2</sup>.

Total chlorophyll content in the leaves was estimated at 30, 60 and 90 days after sowing (DAS) by spectrophotometer. Grain yield in quintal per hectare was recorded after threshing and cleaning.

## RESEARCH FINDINGS AND ANALYSIS

Dry matter accommodation and its distribution among the plant part of different genotype at different stages of growth are presented in Table 1-3.

### Stem dry matter :

The data presented in Table 1 revealed that maximum

**Table 1 : Influence of physiological character (leaf character) on yield of upland paddy**

Sr. No.	Name of cultivar	Mean stem dry matter per plant				Mean Leaf dry matter per plant (g)				Mean Panicle dry matter per plant (g)				Mean Total dry matter (g)			
		Days after sowing			At harvest	Days after sowing			At harvest	Days after sowing		At harvest	Days after sowing			At harvest	
		30	60	90		30	60	90		90	105		30	60	90		
V <sub>1</sub>	PBNR 89 II-6	0.19	3.96	7.78	8.94	0.45	3.82	7.50	5.70	0.65	4.69	8.60	0.64	7.79	15.86	21.19	
V <sub>2</sub>	PBNR 89 II-53	0.36	4.24	6.95	8.46	0.40	3.17	6.53	3.34	0.80	4.26	8.13	0.77	7.40	14.29	20.35	
V <sub>3</sub>	PBNR 90 III-64	0.23	2.40	12.44	13.67	0.35	3.87	7.13	3.00	0.72	3.37	7.96	0.61	6.24	20.30	24.57	
V <sub>4</sub>	PBNR 90 III-4	0.21	4.92	7.95	9.23	0.29	2.38	4.55	1.85	0.42	2.73	9.15	0.47	7.48	12.94	20.19	
V <sub>5</sub>	PBNR 90 III-11	0.27	5.13	6.44	8.95	0.37	2.34	3.05	2.09	0.55	5.09	9.88	0.61	7.43	10.40	20.86	
V <sub>6</sub>	PBNR 90 III -10	0.08	0.40	1.68	4.48	0.45	3.13	1.98	1.11	0.76	6.25	10.14	0.54	3.70	4.62	15.65	
V <sub>7</sub>	PBNR 89 I-3	0.015	2.54	6.23	9.19	0.25	3.75	4.68	2.74	0.80	7.13	9.25	0.37	6.29	11.72	21.13	
V <sub>8</sub>	PBNR 93-9	0.19	1.83	6.71	8.24	0.43	4.26	5.23	4.13	0.64	4.36	6.36	0.59	6.05	16.26	18.65	
V <sub>9</sub>	PBNR 93-4	0.24	2.16	4.55	5.54	0.54	5.19	6.17	5.95	0.41	5.15	6.81	0.76	7.34	17.18	18.25	
V <sub>10</sub>	Sugandha (c)	0.28	3.27	8.20	9.18	0.50	4.14	6.10	5.80	0.55	6.75	7.16	0.78	7.40	21.12	18.80	
V <sub>11</sub>	Parag (c)	0.15	1.63	4.52	5.44	0.34	3.95	6.09	2.48	0.44	4.80	6.72	0.48	5.56	9.01	14.60	
V <sub>12</sub>	Basumati-370 (c)	0.18	0.91	6.74	9.60	0.28	2.24	3.96	3.57	0.74	5.78	6.44	0.45	3.13	13.18	19.57	
	Mean	0.20	2.78	6.68	8.41	0.39	3.52	5.25	3.48	0.62	5.03	8.04	0.59	6.31	13.96	19.65	
	SE ±	0.008	0.017	0.57	0.07	0.09	0.031	0.032	0.09	0.010	0.08	0.010	0.07	0.030	0.088	0.96	
	C.D. (P=0.05)	0.024	0.051	1.69	0.021	0.026	0.090	0.095	0.025	0.029	0.023	0.029	0.020	0.087	0.259	2.82	

**Table 2: Influence of physiological character (leaf character) on yield of upland paddy**

Sr. No.	Name of cultivar	Mean relative growth rate (gg <sup>-1</sup> day <sup>-1</sup> )			Mean absolute growth rate (g day <sup>-1</sup> Plant <sup>-1</sup> )			Mean net assimilation rate (mgdm <sup>2</sup> day <sup>-1</sup> )			Mean total chlorophyll content mgg <sup>-1</sup> of Fresh weight		
		Days after sowing			Days after sowing			Days after sowing			Days after sowing		
		30-60	60-90	90-Harvest	30-60	60-90	90-Harvest	30-60	60-90	90-Harvest	30-60	60-90	90-Harvest
V <sub>1</sub>	PBNR 89 II-6	0.036	0.23	0.005	0.23	0.26	0.036	22.56	39.81	24.60	0.30	0.72	1.25
V <sub>2</sub>	PBNR 89 II-53	0.032	0.19	0.005	0.19	0.22	0.032	13.89	15.32	16.14	0.28	0.66	1.35
V <sub>3</sub>	PBNR 90 III-64	0.033	0.14	0.002	0.14	0.45	0.033	15.54	39.23	30.52	0.51	1.09	1.32
V <sub>4</sub>	PBNR 90 III-4	0.039	0.24	0.006	0.24	0.18	0.040	42.15	32.86	55.48	0.41	0.73	1.25
V <sub>5</sub>	PBNR 90 III-11	0.036	0.35	0.007	0.35	0.07	0.036	17.45	74.29	49.23	0.51	1.35	1.42
V <sub>6</sub>	PBNR 90 III -10	0.027	0.35	0.017	0.36	0.03	0.027	60.78	10.47	13.09	0.55	0.94	1.14
V <sub>7</sub>	PBNR 89 I-3	0.042	0.31	0.009	0.31	0.17	0.042	17.42	40.17	23.3	0.32	0.65	1.43
V <sub>8</sub>	PBNR 93-9	0.032	0.08	0.002	0.08	0.33	0.033	18.61	42.27	27.70	0.57	1.08	1.29
V <sub>9</sub>	PBNR 93-4	0.032	0.033	0.010	0.03	0.32	0.032	15.41	60.32	18.27	0.37	0.95	1.43
V <sub>10</sub>	Sugandha (c)	0.030	0.043	0.007	0.04	0.44	0.031	18.91	17.17	30.21	0.54	0.82	1.02
V <sub>11</sub>	Parag (c)	0.035	0.183	0.006	0.18	0.11	0.035	14.12	43.20	14.33	0.33	0.55	1.45
V <sub>12</sub>	Basumati-370 (c)	0.028	0.187	0.005	0.18	0.35	0.028	10.12	47.38	18.90	0.29	0.51	1.01
	Mean	0.034	0.19	0.007	0.198	0.249	0.034	16.49	39.75	24.74	0.42	0.84	1.28
	SE ±	0.003	0.05	0.001	0.005	0.004	0.005	7.75	0.53	0.48	0.005	0.006	0.010
	C.D. (P=0.05)	0.010	0.015	0.004	0.015	0.012	0.015	23.56	1.60	1.46	0.016	0.017	0.029

**Table 3 : Mean grain yield, biomass and harvest index of different cultivar**

Sr. No.	Name of cultivar	Grain yield (Q/ha)	Biomass yield (Q/ha)	Harvest index
V <sub>1</sub>	PBNR 89 II-6	21.93	98.74	22.20
V <sub>2</sub>	PBNR 89 II-53	12.38	78.08	15.85
V <sub>3</sub>	PBNR 90 III-64	14.94	97.61	15.33
V <sub>4</sub>	PBNR 90 III-4	19.67	94.44	20.82
V <sub>5</sub>	PBNR 90 III-11	18.73	88.79	21.09
V <sub>6</sub>	PBNR 90 III -10	7.74	84.18	9.19
V <sub>7</sub>	PBNR 89 I-3	15.30	89.58	17.07
V <sub>8</sub>	PBNR 93-9	21.12	92.17	22.91
V <sub>9</sub>	PBNR 93-4	8.74	67.12	13.02
V <sub>10</sub>	Sugandha (c)	12.84	72.18	17.78
V <sub>11</sub>	Parag (c)	29.13	76.31	31.62
V <sub>12</sub>	Basumati-370 (c)	25.12	67.18	24.18
	Mean	17.30	83.36	19.25
	SE ±	0.371	0.44	0.332
	C.D. (P=0.05)	1.11	1.34	0.97

dry matter per plant was in PBNR -90 –III-64 (13.67 gram per plant) at harvest followed by variety Basumati 370 (9.60 g/plant). However, dry matter was noticed in variety Parag was 5.44 g/plant.

#### Leaf dry matter :

Maximum leaf dry matter was found in genotypes PBNR-93–IV (5.95 g/plant) followed variety Sugandha (5.80g/plant) as against least was noticed in genotypes PBNR -90 –III-10 (1.11 g/plant) at harvest.

#### Panicle dry matter :

Highest panicle dry matter was recorded in genotypes PBNR-90 –III-10 (10.14 g/plant) followed by PBNR-90 –III-11 (9.88 g/plant) and against least was found in PBNR-93–9 (6.36 g/plant) at harvest.

#### Total dry matter :

Per cent partitioning of total dry matter at harvest by different plant part were in range of dry leaves 7.05 (PBNR-90–III-10) to 32.5 per cent (PBNR-93–9) by dry stem 28.48 per cent (PBNR -90–III-10) to 55.50 per cent (PBNR -90–III-64) as against panicle contribution was maximum in PBNR 90–III-10 (64.46%) followed by PBNR -90 –III-11 (47.23%).

#### Absolute growth rate (AGR) :

Absolute growth rate at harvest was in range of 0.027 g day<sup>-1</sup>plant<sup>-1</sup> in PBNR -90–III-10 to 0.042 g day<sup>-1</sup>plant<sup>-1</sup> in PBNR-89–I-3.

#### Relative growth rate (RGR) :

The maximum relative growth rate was in PBNR-90–III-

10 (0.017 g g<sup>-1</sup> day<sup>-1</sup>) followed by PBNR-93–4 (0.010 g g<sup>-1</sup> day<sup>-1</sup>) as against minimum relative growth rate was in PBNR -90–III-64 and PBNR -93–9 (0.002 g g<sup>-1</sup> day<sup>-1</sup>) at harvest.

#### Net assimilation rate (NAR) :

The net assimilation rate was in range of 13.09 to 55.48 g dm day<sup>-1</sup>. The maximum net assimilation rate was in genotype PBNR-90–III-4 (55.48 gdm day<sup>-1</sup>) followed by PBNR-90–III-11, least net assimilation rate was in PBNR-90–III-10 (13 g dm day<sup>-1</sup>).

#### Chlorophyll content :

Total chlorophyll content in leaves (Table 2) revealed that the maximum chlorophyll content was in variety Parag (1.45 mg g<sup>-1</sup> leaves) and least in variety Basumati- 370 (1.01 mg g<sup>-1</sup> leaves).

#### Grain yield, biomass and harvest index :

The maximum grain yield per hectare was obtained from variety Parag (29.13 q/ha) followed by variety Basumati – 370 (Table 3). In case of genotype 21.93 q/ha from grain yield was recorded PBNR-89–II-6 followed by PBNR-93–9 (21.12 q/ha). The maximum biomass yield was obtained from genotypes PBNR-89–II-6 (98.74 q/ha) followed by PBNR-90–III-64 (97.61 q/ha). However, maximum harvest index ratio was in variety Parag (31.62) followed by Basumati- 370 (24.18). Minimum was recorded in genotype PBNR-90–III-10 (9.19).

On basis of above factor it is concluded that the growth function viz., AGR, RGR, NAR are the characters which are responsible for translocation and assimilation of source to sink relationship. The yield contributing characters viz., stem dry matter, leaf dry matter, panicle dry matter, total dry matter,

harvest index are responsible for yield in paddy. The variety Parag recorded highest grain yield (29.13 q/ha) due to higher harvest index and highest chlorophyll content (1.45 mg g<sup>-1</sup> leaves).

## LITERATURE CITED

- Anandkumar, C.R. and Rangaswamy, S.R.S. (1986).** Casual influence of background traits on grain yield and plant height in rice. *Oryza*, **23**: 23-26.
- Baruah, K.K. and Singh, O.S. (1982).** Physiological growth analysis in field grown upland rice. *J. Res. Assam Agric. Univ.*, **3**(1): 4-11.
- Bhowmik, A. and Chaudhary, M.A. (1984).** Chlorophyll content in rice crosses. *Bangladesh J. agric. Res.*, **9**(2) : 119-123.
- Chauhan, V.S. and Tondan, J.P. (1984).** Yield characters for cold tolerant paddy. *International Rice Res. Newsletter*, **9**(2) : 11.
- Daskalov, A. Zaprganov, Z.I. and Chilikov, (1986).** Correlation between flag leaf area and grain no. in rice. *Rasteniev. Dni. Nauki.*, **23**(6): 20-22.
- Dekendra, R., Urs, Y.S.V., Kumar, M.V. and Sastry, K.S.K. (1983).** Leaf area duration and its relationship to productivity in early cultivar of paddy. *Proc. Indian Nat. Sci. Acad.*, **49**(6) : 692-696.
- Dunand, R. and Dilly, R. (1982).** Chlorophyll, Sugar and starch in rice. In 74<sup>th</sup> Annual Progress Report. Rice Expt. Stn. Crowley, Louisiana. 173-209.
- Hiremath, S.M. and Parvatikar, S.R. (1985).** Growth and yield analysis in Sorghum identification of genotypes with low leaf area and high dry matter production. *Sorgh. Newsletter*, **28** : 108-109.
- Lallo and Lal, K.B. (1981).** Physiological analysis in paddy varieties under rainfed condition. *Indian J. agric. Chem.* **14**(1/2) : 167-172.
- Murty, K.S. and Pattanaik, R.K. (1986).** Net assimilation rate of traditional upland paddy varieties at vegetative growth stage. *Oryza*, **23**:45-49.
- Murty, P.S.S. and Murty, M.S. (1981).** Influence of LAI and flowering on the productive efficiency of long duration rice cultures. *Oryza*, **18**: 35-38.
- Prasad, M. (1981).** Biological yield and harvest index of rice. *Oryza*, **18** : 31-34.
- Radford, P.J. (1967).** Growth analysis formulae their use and abuse. *Crop Sci.*, **70** : 171-175.
- Salam, Abdul and Subramaniam, S. (1992).** A note on relationship between ososynthetic efficiency & plant characters in Paddy in different season. *Madras Agric. J.*, **79**(9) : 535-537.

  
 ★★★★★ OF EXCELLENCE ★★★★★