

## Variation of absorbed photosynthetically active radiation (APAR) and yield of different *kharif* rice cultivars influenced by date of transplanting\*

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### ABSTRACT

A field experiment was conducted at BCKV, Kalyani, West Bengal (Latitude 22°58'60 N, Longitude 88°28'60 E) to evaluate the performance of different rice cultivars grown during *kharif* season of 2010 and 2011. The experiment was laid down in a split-plot design where three dates of transplanting (D<sub>1</sub>: 15<sup>th</sup> June; D<sub>2</sub>: 29<sup>th</sup> June and D<sub>3</sub>: 13<sup>th</sup> July) for both the years were allotted as main plot treatment and three rice cultivars (V<sub>1</sub>: *Satabdi*; V<sub>2</sub>: *Baishmukhi*; V<sub>3</sub>: Pre-Release) was considered as sub-plot treatment. Date of transplanting significantly influenced the grain yield. It was at the highest under D<sub>1</sub> which reduced gradually with delay in transplanting. Among different varieties, *Satabdi* produced the highest yield (4079 kg ha<sup>-1</sup>). Irrespective of variety, absorbed photosynthetically active radiation (APAR) value increased with the advancement of crop growing season and it was at the highest level during panicle initiation stage. In general, the highest APAR value (90.2 μMol m<sup>-2</sup>s<sup>-1</sup>) was recorded under *pre-released* variety during panicle initiation stage due to its leaf orientation which was declined by 14% and 19.5% respectively under *Baishmukhi* and *Satabdi* variety.

**Key Words:** Rice, dates of transplanting, APAR, yield.

The rice productivity in India (3.38 Mg ha<sup>-1</sup>) is abnormally low compared to the global productivity of 4.38 Mg ha<sup>-1</sup> (FAO, 2012). The productivity of rice in West Bengal is further lower to an extent of 42% compared to the national level. Despite different input parameters, aberrations in weather condition under climate change scenario may be one the vital cause of such lower productivity level. It has been observed that grain yield may decline by 10 % if minimum temperature increases by 1°C during the crop growing season (Peng *et al.*, 2004). In West Bengal nursery bed is generally prepared with the onset of rainfall (1<sup>st</sup> week of June) and transplanting operation started from last week of June and continued up to end of July. Thus, crops transplanted in different time frame, exposed to different weather condition during their critical growth stages. Only favorable weather condition is prime factor for obtaining optimum productivity. Thus, sowing or transplanting time is very important because it ensures whether the crop will grow under favorable weather (temperature, radiation, RH, rainfall) condition or not. It has been observed that yield and total biomass of rice decreased

as sowing was delayed (Xie *et al.*, 1996). The maximum grain yield was obtained when the crop is transplanted in between 1<sup>st</sup> to 16<sup>th</sup> July as compared to 31<sup>st</sup> July and 16<sup>th</sup> August (Gangwar and Sharma, 1997). But higher grain yield of rice was obtained by transplanting on 15<sup>th</sup> June as compared with 1<sup>st</sup> July (Munda *et al.*, 1994). Too early or too late transplanting may cause huge reduction in yield due to crop sterility and lower number of productive tillers, respectively (Nazir, 1994). Keeping the above situation in view, the present investigation was carried out with the following objectives; i) to assess the optimum date of transplanting for achieving maximum yield of rice and ii) to establish relationship between absorbed photosynthetically active radiation with dry matter accumulation.

### MATERIALS AND METHODS

#### *Study area*

An experiment was conducted during the *kharif* season of 2010 and 2011 in the 'C' Block farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani (Latitude 22°58' 60

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**Table 1:** Variation of APAR during tillering and PI stage of different rice cultivars of 2010 and 2011

Date of Transplanting	Year	Satabdi		Baishmukhi		Pre-released	
		Tillering	PI	Tillering	PI	Tillering	PI
D1	2010	65.7	74	66	63.3	36	78.9
	2011	34.5	50.5	32.6	78.3	51.5	93.1
D2	2010	63	88.4	62.2	91.6	41.4	92.2
	2011	48.6	57.1	47.1	61.9	54.1	93.8
D3	2010	49.5	75.7	59.8	81.3	53.4	92.5
	2011	57.5	89.8	57.7	88.7	62.0	90.8

N, Longitude 88°28'60 E and altitude 9.8 m), Nadia, West Bengal. The soil of the study area is mainly alluvial in nature (Entisol) and silty-clay in texture. The average annual rainfall is about 1650 mm and about 73% rainfall is received during June-September, *i.e.*, South-West Monsoon season.

The experiment was designed as split-plot where three different dates ( $D_1$ : 15<sup>th</sup> June,  $D_2$ : 29<sup>th</sup> June and  $D_3$ : 13<sup>th</sup> July) of each year were kept as main plot treatment and three rice varieties [ $V_1$ : *Satabdi*,  $V_2$ : *Baishmukhi* (local variety),  $V_3$ : Pre-released] were allotted in sub-plots. There were two replications for each date of transplanting. The size of the individual plot was 7.5 m x 3.6 m. Twenty one days old seedlings were transplanted with a spacing of 20 cm x 15 cm. The applied fertilizer dose N: P: K was 80:40:40 kg ha<sup>-1</sup>.

Different components of photosynthetically active radiation (PAR) were measured using a point quantum sensor (Make: Li-cor, USA. Model: Li- 185 B) and the absorbed PAR (APAR) was calculated by following Gallo and Daughtry (1986).

## RESULT AND DISCUSSION

### *Absorbed photosynthetically active radiation (APAR)*

The variation of APAR during tillering and panicle initiation (PI) stage of different cultivars is presented in Table 1. During 2010, highest PAR absorption was noted under  $D_2$  (*i.e.* transplanted in end of June) followed by  $D_3$  and  $D_1$ . The same was in the order of  $D_3 > D_2 > D_1$  during 2011. On an average during tillering stage the PAR absorption was to the tune of 54% which was increased by 26% during PI stage. During PI stage, on an average highest PAR (90.2  $\mu\text{Mol M}^{-2}\text{S}^{-1}$ ) was absorbed by *Baishmukhi* variety which was 14% and 19.5% less under Pre-released and *Satabdi* cultivar. But the Pre-released variety absorbed more or less same percentage of PAR for both the years.

### *Biomass- APAR relationship*

A linear relationship between total biomass and APAR was obtained in the present study (all data set for the year 2010 and 2011 were considered) (Fig. 1). The regression equations obtained from Fig. 1 showed that about 70, 50 and 63 per cent variation in biomass can be explained by APAR value respectively for  $V_1$ ,  $V_2$  and  $V_3$ . The regression equations were:

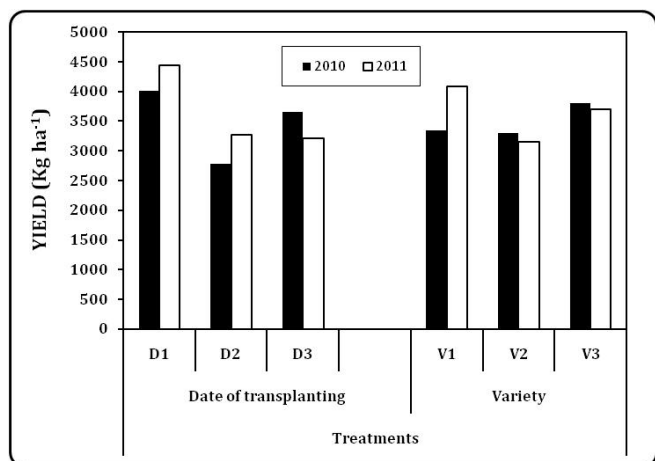
$$\text{Satabdi (V1)} : Y = 0.479 \text{ APAR} + 152.6; R^2 = 0.70^*, n = 18, p < 0.05$$

$$\text{Baishmukhi (V2)} : Y = 0.528 \text{ APAR} + 231.4; R^2 = 0.50^*, n = 18, p < 0.05$$

$$\text{Pre-released (V3)} : Y = 0.525 \text{ APAR} + 144.1; R^2 = 0.63^*, n = 18, p < 0.05$$

### *Yield*

Variation of grain yield under different treatment combination was presented in Fig. 2. During 2010, the highest grain yield was recorded under  $D_1$  (4010 kg ha<sup>-1</sup>) followed by  $D_3$  (3650 kg ha<sup>-1</sup>). But the yield was drastically reduced to 2779 kg ha<sup>-1</sup> under 29<sup>th</sup> June transplanted crop. Irrespective the date of transplanting, the highest grain yield was recorded under Pre-released variety (3799 kg ha<sup>-1</sup>). During 2010,  $D_2$  transplanted crop faced the highest temperature during the later part of the crop growth which might be resulting the lowest yield followed by  $D_3$  and  $D_2$ . It has been observed that irrespective of variety highest grain yield (4436 kg ha<sup>-1</sup>) was obtained when crop was transplanted during middle of June, 2011 which declined by 1161 kg ha<sup>-1</sup> when the crop was transplanted during fourth week of June. On an average, irrespective of DOT, highest grain yield (4079 kg ha<sup>-1</sup>) was attained under *Satabdi* ( $V_1$ ) cultivar which was declined by 9.49 % and 22.63% respectively under Pre-released ( $V_3$ ) and *Baishmukhi* ( $V_2$ )



**Fig. 1:** Average Biomass-APAR relationship of different rice cultivars

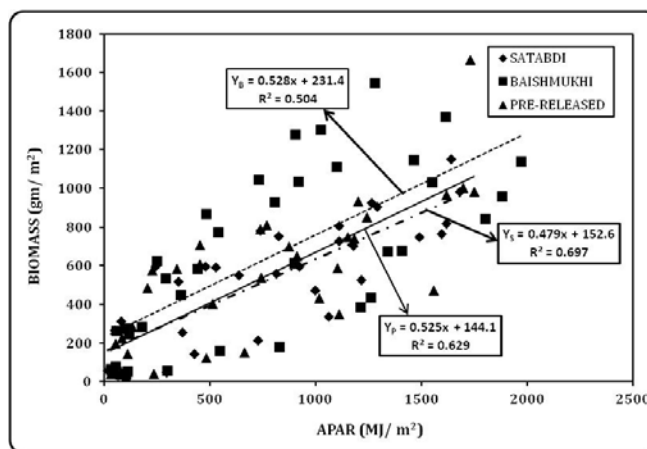
variety, respectively. In 2011, the maximum temperature was in the order of  $D_3 > D_2 > D_1$  during anthesis to maturity stage which may result in highest yield under  $D_1$  followed by  $D_2$  and  $D_3$ .

## CONCLUSION

The highest yield was obtained when the crop was transplanted on 15<sup>th</sup> June, which declined sharply under  $D_2$  and  $D_3$  in both the years. The absorption of PAR was highest under  $D_3$  and it was in close proximity under  $D_2$  for both the years. Thus it has been observed that temperature may influence strongly the crop growth, biomass and yield. High temperature during anthesis to maturity may increase the photorespiration resulting lower yield in delayed transplanted crops.

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Site visited on 06.12.12.



**Fig. 2:** Comparative study of impact of date of transplanting on grain yield of different rice cultivars

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