

## Comparative study of potato (*Solanum tuberosum* L.) cultivars in terai agro-climatic region of West Bengal

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Received:04.01.2011, Revised: 27.07.2011, Accepted : 29.08.2011

### ABSTRACT

The field experiment was carried out at the institutional farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal during the Rabi season of 2006-07 and 2007-08 to study the performance of different potato cultivars. Experiment was laid out in a Randomized Block Design with ten treatments (cultivars): Kufri Pukhraj ( $V_1$ ), TPS 92 PT 27 ( $V_2$ ), Kufri Ashoka ( $V_3$ ), HPS II/13 ( $V_4$ ), Kufri Jyoti ( $V_5$ ), Kufri Chipsona 2 ( $V_6$ ), Kufri Chandramukhi ( $V_7$ ), Kufri Jyoti (Hill Source Cultivar) ( $V_8$ ), Local Cultivar ( $V_9$ ) and Kufri Jyoti (Farmer's Cultivar) ( $V_{10}$ ). The treatments were replicated thrice. Results obtained from the experiment showed that the increase in final yield of Kufri Jyoti (hill source cultivar) corresponded to the higher Leaf Area Index; higher chlorophyll content in leaves, higher crop growth rate, higher net assimilation rate and higher relative growth rate, followed by Kufri Pukhraj ( $V_1$ ) and TPS 92 PT 27 ( $V_2$ ). Kufri Jyoti (hill source cultivar) recorded highest values of most of the all yield attributes like number of tubers plant<sup>-1</sup> (5.66 plant<sup>-1</sup>) tuber weight plant<sup>-1</sup> (208.26 g plant<sup>-1</sup>) which ultimately produce higher final tuber yield (29.02 t ha<sup>-1</sup>). This was followed by Kufri Pukhraj and 92 PT 27. Thus, it may be concluded from the above results that the cultivar Kufri Jyoti (hill source cultivar) is highly suitable under late planted condition of Terai agro-climatic situation.

**Key words:** Chlorophyll content (SPAD values), CGR, LAI, NAR, net photosynthesis rate, RGR, yield

Potato (*Solanum tuberosum* L.) popularly known as 'The king of vegetables', has emerged as fourth most important food crop in India after rice, wheat and maize. In the year 2002-2003, the production was 25 million tonnes while it was 5 million tonnes during 1970. India ranks 4<sup>th</sup> in area and it is the 3<sup>rd</sup> largest country in world in production of potato after China and Russian Federation. Photosynthesis is probably the most important metabolic event on earth and is certainly the most important process to understand in order to maximize potato productivity (Dean, 1994). It is not absolute rate of photosynthesis that is important, but rather the relationship between photosynthesis and respiration, termed as net photosynthetic rate. Selection of cultivars with high net photosynthetic rate will result in higher yield if all other factors are equal (Dwelle, 1985). Gaur and Pandey (2000) reported that the problems of potato in the subtropical region are in several ways different from those experienced in temperate countries and are essentially linked with higher temperatures. Warmer conditions during the period of active growth and tuberization reduce the tuber yields and also create problems of storage and maintenance of health standards.

### MATERIALS AND METHODS

The field experiments were carried out at farm of Uttar Banga Krishi Viswavidyalaya at Pundibari, Cooch Behar, West Bengal during the Rabi, 2006-'07 and Rabi season of 2007-'08. The farm is situated at 26°19'86"N latitude and 89°23'53" E longitude at an elevation of 43 meters above mean sea level. The climate of terai zone is subtropical in nature with distinctive characteristics of high rainfall,

high humidity and prolonged winter. The average rainfall of this zone varies between 2100 to 3300 mm. The maximum rainfall, i.e., about 80% of the total, is received from south-west monsoon during the rainy months of June to September. The temperature range of this area varies from minimum of 7.1-8°C to maximum of 24.8-32.2°C. The area as a whole is humid and warm except having a short winter spell during December to February. This varied climatic situation makes the agro-ecological condition more complex and dynamic. Composite soil samples from all the experimental plots in both the years were collected and analyzed before starting the experiment. The experimental soil's pH was 5.5, organic carbon was 0.639%, cation exchange capacity was 14.54 me/100 g, available nitrogen was 107.59 Kg ha<sup>-1</sup>, available phosphorus was 15.36 kg ha<sup>-1</sup> and available potassium was 71.68 kg ha<sup>-1</sup>.

The present study was conducted during late winter season to evaluate different potato cultivars in terai agroclimatic situation of West Bengal during the rabi, 2006-'07 and 2007-'08 to study the performance of different potato cultivars. Experiment was laid out in a Randomized Block Design with ten treatments (cultivars):  $V_1$  = Kufri Pukhraj,  $V_2$  = 92PT27,  $V_3$  = Kufri Ashoka,  $V_4$  = HPS II/13,  $V_5$  = Kufri Jyoti,  $V_6$  = Kufri Chipsona 2,  $V_7$  = Kufri Chandramukhi,  $V_8$  = K. Jyoti (Hill Source Seed),  $V_9$  = Local seed and  $V_{10}$  = K. Jyoti (Farmer's seed). The treatments were replicated thrice.

Net assimilation rate was calculated by using the following formula-

$$\text{NAR} = \frac{(W_2 - W_1) (\text{Log } e L_2 - \text{Log } e L_1)}{(T_2 - T_1) (L_2 - L_1)} \text{ g m}^{-2} \text{ day}^{-1}$$

It was expressed as g of dry matter produced per mm<sup>2</sup> of leaf area in a day. Where, W<sub>1</sub> & W<sub>2</sub> were the dry weight of the plant and L<sub>1</sub> and L<sub>2</sub> were leaf area at two successive time intervals T<sub>1</sub> and T<sub>2</sub> respectively. This is the dry matter accumulation unit<sup>-1</sup> time and unit<sup>-1</sup> land area.

## RESULTS AND DISCUSSION

### Leaf Area Index (LAI)

It was revealed from the pooled data that the maximum leaf area index was recorded in Kufri Jyoti hill source cultivar (6.20), which was statistically at par with Kufri Pukhraj, Kufri Chipsona 2 at 60 days after planting. The increase of LAI at 60 days after planting indicated full shooting of expanded leaves which increased the capacity factor for Carbon assimilation, Watson (1958). LAI is the manifestation of the capacity factor of growth of the crop. Higher LAI at 40 and 60 days after planting was obtained which might be due to the higher number of leaves and branches unit<sup>-1</sup> area. Production of more leaves and faster rate of leaf emergence and leaf expansion have given rise to higher LAI at various stages of growth. Thus the cultivar Kufri Jyoti hill source cultivar recorded the highest LAI. The results corroborated with the findings of Singh 1987.

### Crop Growth Rate

It was found from the pooled data that the maximum crop growth rate between 41 to 60 days after planting was recorded in Kufri Jyoti hill source cultivar (10.95 g m<sup>-2</sup>day<sup>-1</sup>) which was statistically at par with 92 PT-27, Kufri Jyoti, Kufri Ashoka, Kufri Jyoti farmer's cultivar, Local cultivar, Kufri Chipsona 2, Kufri Pukhraj. The higher crop growth rate among the cultivars might be due to higher leaf area indices and higher dry matter accumulation. The result corroborated the findings of Fernando (1958), Gunasena and Haris (1971) and Patel *et al.* (2000).

### Relative Growth Rate (RGR)

It was revealed from the result (pooled) that Kufri Jyoti hill source cultivar recorded the maximum relative growth rate of 0.174 g g<sup>-1</sup>day<sup>-1</sup> between 20 to 40 days after planting which was significantly different from other cultivars. Similar result was found by Hruska and Chloupek (1973) and Midmore and Prange (1992).

### Net Assimilation Rate (NAR)

It was observed from the pooled data that Kufri Jyoti recorded the maximum net assimilation rate of 5.41 g mm<sup>-2</sup> day<sup>-1</sup> between 20 to 40 days after planting which was significantly different from other cultivars. However, there were no statistically significant differences among the cultivars 92 PT-27, Kufri Pukhraj, Kufri Chandramukhi, HPS II/13, Kufri Jyoti hill source cultivar, Kufri Jyoti farmer's cultivar between 20 to 40 days after planting. Between 41 to 60 days after planting the maximum net assimilation

rate was recorded in Kufri Jyoti hill source cultivar (3.01 g mm<sup>-2</sup> day<sup>-1</sup>), which was statistically at par with 92 PT-27, Kufri Jyoti, Kufri Ashoka, Kufri Jyoti farmer's cultivar, Local cultivar, Kufri Chipsona 2. The lowest net assimilation rate was recorded in Kufri Chandramukhi (1.40 g mm<sup>-2</sup> day<sup>-1</sup>) which was significantly different from other cultivars. There was a decrease in net assimilation rate as the crop advanced to maturity. The net assimilation rate was high between 20-40 days after planting and was reduced between 41-60 days after planting. Pravin *et al.* (2001) reported the existence of distinct varietal differences in net assimilation rate.

### Net Photosynthesis Rate (NPR)

It was revealed from the results (pooled) that Kufri Jyoti recorded the maximum Net Photosynthesis Rate of 24.87 micro mol m<sup>-2</sup> s<sup>-1</sup> at 20 days after planting which was statistically at par with Kufri Chipsona 2, Kufri Chandramukhi, Kufri Jyoti farmer's cultivar, Local cultivar, Kufri Pukhraj, Kufri Ashoka. Selection of cultivars with high net photosynthetic rate will result in higher yield if all other factors are equal (Dwelle, 1985).

### Chlorophyll Content (SPAD values) in Leaves

Kufri Jyoti hill source cultivar recorded the maximum chlorophyll content of 68.95 SPAD value at 20 days after planting which was significantly different from others. There were no statistically significant differences between the cultivars 92 PT-27, Kufri Jyoti, Kufri Pukhraj; HPS II/13, Kufri Ashoka, Kufri Chipsona 2 and Kufri Chipsona 2, Kufri Jyoti farmer's cultivar, Kufri Chandramukhi, Local cultivar at 20 days after planting. The maximum chlorophyll content was recorded in Kufri Jyoti hill source cultivar (59.05 SPAD value) at 60 days after planting which which were significantly different from other cultivars. However, Kufri Pukhraj, Kufri Jyoti, 92 PT-27; HPS II/13, Kufri Ashoka, Kufri Chipsona 2; Kufri Chipsona 2, Local cultivar, Kufri Chandramukhi, Kufri Jyoti farmer's cultivar were statistically at par at 60 days after planting, the lowest chlorophyll content was recorded in Kufri Jyoti farmer's cultivar (39.55 SPAD value). Similar result was found by Wanchuk *et al.* (2005); Vos and Bom (1993). Results of the experiment showed that among the cultivars Kufri Jyoti (hill source cultivar) recorded the higher values of all the growth attributes like Leaf Area Index, Crop Growth Rate and Net Assimilation Rate in all the sampling dates in both the years of experimentation, which was followed by Kufri Pukhraj and 92 PT 27. The increases of LAI at 60 days after planting indicated full shooting of expanded leaves which increased the capacity factor for carbon assimilation. The expansion rate of leaves was the dominant factor that determines the nature of leaf area irrespective of leaf numbers. Kufri Jyoti (hill source cultivar) recorded highest

values of most of the all yield attributes like number of tubers plant<sup>-1</sup>(5.66), tuber weight plant<sup>-1</sup>(208.26 g) which ultimately produce higher final tuber yield and fetched more net income and Return-Cost ratio. This was followed by Kufri Pukhraj and TPS 92 PT 27.

**Table 1: Comparative study on growth attributes of potato cultivars**

Cultivars	Leaf Area Index			Crop Growth Rate (g m <sup>-2</sup> day <sup>-1</sup> )			Relative Growth Rate (g g <sup>-1</sup> day <sup>-1</sup> )			Net Assimilation Rate (g m <sup>-2</sup> day <sup>-1</sup> )		
	2007	2008	Pooled	2007	2008	Pooled	2007	2008	Pooled	2007	2008	Pooled
	60 DAP	60 DAP	60 DAP	41-60 DAP	41-60 DAP	41-60 DAP	20-40 DAP	20-40 DAP	20-40 DAP	20-40 DAP	20-40 DAP	20-40 DAP
V <sub>1</sub>	5.50	5.60	5.55	7.21	6.22	6.71	0.146	0.146	0.146	3.67	4.36	4.02
V <sub>2</sub>	4.70	5.70	5.20	9.08	10.15	9.62	0.148	0.147	0.148	3.59	4.79	4.19
V <sub>3</sub>	5.80	4.80	5.30	5.86	9.29	7.57	0.147	0.145	0.146	1.54	3.23	2.39
V <sub>4</sub>	5.20	4.70	4.95	2.81	5.08	3.95	0.145	0.149	0.147	2.60	4.16	3.38
V <sub>5</sub>	5.30	4.80	5.05	7.67	8.16	7.92	0.137	0.142	0.140	4.64	6.19	5.41
V <sub>6</sub>	4.85	4.35	4.60	4.67	8.92	6.79	0.130	0.125	0.127	1.72	2.77	2.25
V <sub>7</sub>	4.55	4.75	4.65	2.08	6.42	4.25	0.152	0.142	0.147	3.72	3.60	3.66
V <sub>8</sub>	6.70	5.70	6.20	10.39	11.52	10.95	0.178	0.171	0.174	3.60	3.06	3.33
V <sub>9</sub>	5.15	4.75	4.95	5.40	8.50	6.95	0.153	0.144	0.148	1.87	3.02	2.44
V <sub>10</sub>	4.65	4.15	4.40	6.51	7.48	7.00	0.139	0.141	0.140	2.81	3.73	3.27
SEm(±)	0.158	0.218	0.334	1.381	1.432	1.402	0.002	0.002	0.003	0.363	0.369	0.365
LSD(0.05)	0.500	0.687	0.956	4.545	4.413	4.486	0.008	0.008	0.009	1.098	1.168	1.169

**Table 2: Comparative study on photosynthesis and yield attributes of potato cultivars**

Cultivars	SPAD* Values			Net Photosynthesis Rate (micro mol m <sup>-2</sup> s <sup>-1</sup> )			Number of tubers plant <sup>-1</sup>			Weight of tubers (g plant <sup>-1</sup> )		
	2006-07	2007-08	Pooled	2006-07	2007-08	Pooled	2006-07	2007-08	Pooled	2006-07	2007-08	Pooled
	20	20	20	60 DAP	60 DAP	60 DAP	Harvest	Harvest	Harvest	Harvest	Harvest	Harvest
V <sub>1</sub>	61.90	63.40	62.65	35.44	37.01	36.22	3.33	4.66	4.00	171.09	191.09	181.09
V <sub>2</sub>	60.20	61.70	60.95	32.12	36.77	34.44	5.33	6.33	5.83	163.26	179.93	171.60
V <sub>3</sub>	53.45	54.95	54.20	25.73	28.37	27.05	2.66	3.66	3.16	140.48	162.48	151.48
V <sub>4</sub>	55.50	57.00	56.25	36.76	38.10	37.43	5.86	6.53	6.20	143.23	179.90	161.57
V <sub>5</sub>	61.75	63.25	62.50	19.56	28.77	24.16	4.66	6.33	5.50	147.10	167.10	157.10
V <sub>6</sub>	51.25	52.75	52.00	34.22	34.65	34.44	3.00	5.00	4.00	121.06	144.39	132.72
V <sub>7</sub>	49.75	51.25	50.50	39.52	40.51	40.01	3.33	4.66	4.00	124.70	164.70	144.70
V <sub>8</sub>	68.20	69.70	68.95	26.26	28.81	27.53	5.00	6.33	5.66	203.26	213.26	208.26
V <sub>9</sub>	50.15	51.65	50.90	36.05	27.74	31.90	2.66	5.00	3.83	137.36	187.36	162.36
V <sub>10</sub>	48.75	50.25	49.50	26.72	24.57	25.64	3.66	5.33	4.50	129.63	166.30	147.97
SEm(±)	0.90	0.90	0.90	1.031	0.994	2.136	0.77	0.44	0.26	7.85	3.51	7.03
LSD(0.05)	2.81	2.85	4.52	3.041	2.934	6.301	2.27	1.32	0.83	23.17	10.36	22.15

Note: V<sub>1</sub>=Kufri Pukhraj; V<sub>2</sub>= 92 PT 27; V<sub>3</sub>= Kufri Ashoka; V<sub>4</sub>=HPS II/13; V<sub>5</sub>= Kufri Jyoti; V<sub>6</sub>=Kufri Chipsona-2; V<sub>7</sub>=Kufri Chandramukhi; V<sub>8</sub>= Kufri Jyoti hill source; V<sub>9</sub>= Local Cultivar; V<sub>10</sub>= Kufri Jyoti Farmer's cultivar. \*SPAD =Soil Plant Analytical Development

The cultivars like Kufri Jyoti (hill source cultivar), Kufri Pukhraj and TPS 92 PT 27 recorded the maximum net photosynthesis rate; transpiration rate and stomatal conductance rate at 60 days after planting. Crop Growth Rate was recorded highest between 40 to 60 days after planting. Net Assimilation Rate was found to be the highest between 20 to 40 days after planting and declined

thereafter. Kufri Jyoti hill source cultivar recorded the higher chlorophyll content in leaves followed by Kufri Pukhraj and TPS 92 PT 27. It can be concluded from the above results that the hill source cultivar Kufri Jyoti may be recommended to obtain the highest yield under late planted condition of Terai agroclimatic region of West Bengal.

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