

Identification of suitable early rabi onion varieties under West Bengal condition

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ABSTRACT

Promising kharif onion cultivars or breeding lines developed at different Agricultural Universities and National Research Centre for Onion and Garlic, Pune have been evaluated under different temperature regimes by three plantings in field condition under tropical-humid conditions to assemble the basic information on the possibility of growing onion under early rabi condition in the Gangetic plain of West Bengal. Average day/night temperature of 20° to 21°C coupled with rainless condition has been found suitable for growing early onion in the humid condition in the Gangetic alluvial region of West Bengal. Growing early-rabi onion with planting of seedlings in the first week of October employing the varieties like, Baswant 780, Agrifound Dark Red, Arka Pragati and Phule Safed and harvesting the bulbs during last week of February appeared to be the best.

Key words: Onion, early-rabi and temperature

Onion is basically a cool season crop. For good vegetative growth 12.8 ° to 23°C temperature before bulbing and for bulb development 20° to 25°C are required. Photoperiod and temperature both influence bulb development and flowering. Almost all cultivars grown in India are short day cultivars. The kharif and early rabi onion varieties require relatively low temperature and 10-11 hours day length for proper bulb development and the rabi onion varieties require relatively high temperature and 12-13 hours day length for proper bulb development. The most short day onion, “the kharif and early rabi group” have expanded the span of onion cultivation in the plains of India.

As the temperature and humidity conditions of West Bengal during August to January are not alike with that of Maharashtra, kharif or early rabi onion varieties developed in Maharashtra/Gujarat/Bangalore condition can not be expected to perform equally under West Bengal condition. Keeping in view of the onion growing situation in West Bengal and the objectives in view, promising kharif onion cultivars or breeding lines developed at different centers have been evaluated under different temperature regimes by three plantings in field condition under tropical-humid conditions of the Gangetic plain of West Bengal.

MATERIALS AND METHODS

Fourteen varieties including “Sukhsagar”, the old local cultivar of West Bengal constitute the materials for the present study. The 13 other varieties viz., Phule Safed, Pusa Red, N-53, Arka Kalyan, Taloja Red, PKV White, Gujrat White, Arka Pragati, Agrifound Rose, Agrifound Dark Red, Fursangi Local, Phule Samrat and Baswant-780 were collected

from NRC for Onion and Garlic, Pune, Maharashtra. These were evaluated for bulb production through three plantings September to last week of January (avg. day/night temp. 28.34°/17.33°C; avg. 22.83°C), October to last week of February (avg. day/night temp. 27.41°/15.07°C; avg. 21.24°C) and November to last week of March (average day/night temp. 27.34°/14.32°C; average 20.83°C) in RBD with three replications in 2.0m x 2.0 m plot with 15 x 7.5 cm spacing and to identify most suitable planting date for early rabi onion.

The 45 days old seedlings were transplanted on the first week of September, Oct. and Nov.). Top fall over the ground which is the normal maturity index of onion in low rainfall areas did not occur fully in this experiment. Hence, maturity of the bulbs was judged by the growing span, drying of the leaves from the top along with “top fall”. Ten plants per replication (plot) were selected for recording data on six quantitative characters viz., Length of top (cm), No. of leaves/plant, polar diameter of bulb (cm), equatorial diameter of bulb (cm), weight of bulb (g) and yield per sq.m (kg). the bulbs were harvested in 1st week of Jan., 1st week of Feb. and last week of March respectively in 3 plantings. The data were analyzed statistically.

RESULTS AND DISCUSSION

September planting

Comparatively high average temperature (28.34°/17.33°C; average 22.83°C), high average relative humidity (88.3%) and high rainfall during first 60 days (average 130.55 mm during September and October) were the main environmental features of this season. The bulbs were developed and matured under short photoperiod condition. Analysis of

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Short communication

variance for the evaluation of the 14 varieties has been presented in Table 1. The varieties showed significant difference among themselves for all the characters excepting polar and equatorial diameter of bulb. All the 14 varieties showed significant variation for the leaf and bulb characters (Table 2) excepting polar and equatorial diameter of the bulb which clearly suggested the possibility of selecting the suitable variety among those evaluated under the present study.

Length of the top

Length of the top was comparatively low in most of the varieties which might have been due to comparatively high temperature and high rainfall condition at the early stage of growth. Length of the top in this planting was highest (47.43 cm) in Agrifound Dark Red followed by Pusa Red (44.47 cm) and Baswant-780 (42.70 cm). Leaf development under early rabi season was found to be one of the contributing plant characters influencing bulb yield. Agrifound Dark Red was the highest bulb yielder in this season followed by Baswant-780.

Number of leaf

Leaf number in the varieties grown in early rabi season varied widely from 13.26 in Agrifound Light Red to 7.26 in Baswant-780. Leaf number apparently did not influence much on the bulb production. It was recorded that (Table 2) that the high bulb yielder, Agrifound Dark Red and Baswant-780 produced comparatively less number of leaves contrast to most of the low yielding varieties under this planting.

Polar diameter of bulb

This bulb character did not vary significantly among the varieties under this season which ranged between 3.46 cm in Agrifound Rose and 4.85 cm in N-53.

Equatorial diameter of bulb

This bulb character also did not differ significantly among the varieties in this season. Highest equatorial diameter of 5.36 cm was recorded in Baswant-780 followed by 5.23 cm in Agrifound Dark Red. Lowest equatorial diameter of bulb was recorded in the variety Taloja Red (3.15 cm).

Weight of the bulb

Significantly high bulb weight was recorded in the varieties, Agrifound Dark Red (71.25g) and Baswant 780 (70.67g). In all the other 12 varieties bulb weight varied between 33.0g in Sukhsagar and 56.27g in Agrifound Rose.

Bulb yield/sqare meter

All the varieties responded significantly differently for bulb production. Agrifound Dark Red (5.83kg) and Baswant 780 (5.18kg) clearly emerged

as two most promising varieties under this growing season. N-53, Agrifound Rose, Fursangi Local, Pusa Red and Agrifound Light Red also performed better in this season registering bulb yield between 4.01 to 4.85 kg per square meter.

October planting

In comparison to September planting, low average temperature (27.41^o/15.07^oC; average 21.24^oC), low average relative humidity (81.1%) and low rainfall in first 60 days (average 57.76 mm during October and November) were the main environmental features of this season. The bulbs were developed and matured under comparatively high photoperiod condition. The varieties showed significant difference among themselves for all the characters excepting polar and equatorial diameter of bulb. All the 14 varieties showed significant variation for the leaf and bulb characters excepting polar and equatorial diameter of the bulb (Table 3). It indicated that the varieties responded differently to the October planting which clearly suggested the possibility of selecting the suitable variety among those evaluated under the present study.

Length of the top

Length of the top was comparatively higher compared to September planting in all the varieties which might have been due to comparatively low temperature and low rainfall condition at the early stage of growth. Length of the top in this planting was highest (55.63cm) in Phule Safed followed by Arka Pragati (53.40cm) and Pusa Red (52.80cm). Leaf development under this season also was found to be one of the influencing plant characters influencing bulb yield. Baswant 780 produced almost same bulb yield as that of Phule Safed, despite much lesser leaf production (45.03) in Baswant 780 with respect to that was produced in Phule Safed (Table 5). Still it emerged as one of the promising plant characters contributing to bulb yield.

Number of leaf

Leaf number in the varieties grown in this planting varied significantly among themselves. It was to be noted that leaf number varied widely among the 14 varieties in the September planting also. The highest leaf number of 11.33 was produced in Phule Samrat and lowest of 7.67 was recorded in Gujarat White (Table 3). In this planting also leaf number apparently did not influence much on the bulb production.

Polar diameter of bulb (cm)

This bulb character did not vary significantly among the varieties under both September and October planting. In October planting, it ranged between 3.42 cm in Taloja Red and 5.12cm in Sukhsagar.

Equatorial diameter of bulb

The equatorial diameter increased in almost all the varieties in this planting which might have been due to exposure of more favourable temperature during growth and development of the bulbs. Highest equatorial diameter of 5.35 cm was recorded in Baswant-780 followed by 5.32 cm in Agrifound Dark Red. These varieties recorded significantly high bulb yield under both September and October plantings. Lowest Equatorial diameter of bulb was recorded in the variety Taloja Red (3.35 cm).

Weight of the bulb

Significantly high bulb weight was recorded in the varieties, Agrifound Dark Red (76.12g) followed by in Phule Safed (75.33g) and PKV White (75.28 g). Bulb weight of Baswant 780 reduced marginally (67.52g) in this planting.

Bulb yield/square meter

It clearly emerged enhanced bulb yield in all the varieties under October planting which might be due to their exposure to comparatively more favourable temperature and photoperiodic condition. Baswant 780 and PKV White clearly emerged the most promising varieties under this growing season both producing 6.68 kg bulb/sqm area. Other promising varieties under October planting were Phule Safed (6.67 kg), Agrifound Dark Red (6.23 kg), N-53 (6.19 kg) and Arka Pragati (6.01 kg),

November planting

Average temperature regime was almost same as October planting (27.34°/14.32°C; average 20.83°C however, low average relative humidity (74.9%) and almost no rainfall in first 60 days (average 1.36 mm during November and December) was the main environmental features of this season. The bulbs were developed and matured under comparatively high photoperiod condition. The varieties showed significant difference among themselves for all the characters. It is to be recorded that these varieties did not differ among themselves for polar and equatorial diameter of the bulb under both September and October planting (Table 1). All the 14 varieties showed significant variation for all the leaf and bulb characters (Table 4) which indicated that the varieties responded differently to the November planting.

Length of the top

Length of the top was highest in November planting in most of the varieties which might have happened due to comparatively much low temperature and no rainfall condition through out the stage of growth. Length of the top in this planting was highest (52.53 cm) in N- 53 followed by Pusa Red (49.50 cm). Leaf development under this season also was found to be one of the influencing plant characters

influencing bulb yield. However, the influence was not as pronounced as registered in the early rabi planting in September which agreed well to the October planting also. Baswant 780 with 45.13 cm leaf length produced high bulb yield of 6.39 kg/sqm where as Agrifound Rose with somewhat higher leaf length of 46.07 cm produced much lesser bulb yield of 5.67 kg/sqm. Still it emerged as one of the promising plant characters contributing to bulb yield.

Number of leaf

Leaf number in the varieties grown November planting did vary significantly among themselves unlike that happened in October planting. It was apparent that length of the leaf that was produced in the genotypes was the determining growth parameter for onion. However, highest leaf number of 9.67 was produced in PKV White and lowest of 6.33 was recorded in Fursungi local (Table 7). In this planting also leaf number apparently did not influence much on the bulb production.

Polar diameter of bulb

This bulb character also varied significantly among the varieties under November planting which ranged between 3.44cm in Agrifound Rose and 5.32cm in Sukhsagar.

Equatorial diameter of bulb

It was markedly apparent that equatorial diameter decreased in almost all the varieties in this planting which might have been due to exposure of comparatively low temperature during growth and development of the bulbs. In general, onion requires cool weather during the early development of bulb crop and again prior to and during early growth of the seed stalk. Later, a moderately high temperature and a dry atmosphere are favourable for the maturing of bulb crop. Highest equatorial diameter of 4.80cm was recorded in Arka Pragati followed by 4.77cm in Baswant 780.

Weight of the bulb

It clearly indicated high dry matter accumulation under November planting because of comparatively higher bulb weight in the bulbs of comparatively low diameter. Significantly high bulb weight was recorded in the varieties, Baswant 780 (77.50 g), Arka Kalyan (75 g), Arka Pragati (75 g) and Agrifound Dark Red (71.06g).

Bulb yield/square meter

It clearly emerged marginally enhanced bulb yield in all the varieties under November planting which might be due to high dry matter production in this planting. Baswant 780, Arka Pragati and Agrifound Dark Red clearly emerged the most promising varieties under this growing season. Sukhsagar, the local variety of West Bengal emerged

as a rabi onion variety which gave much enhanced bulb yield of 5.36 kg/sqm area in this planting (Table 4).

In the case of growing the widely cultivated “Rabi onion” in India (December-January to May-June), the temperature prior to bulb initiation is low, and with the onset of bulb formation days become longer and temperature rise reaching maximum around 40°C in May-June completing the bulb maturity. In general, moderately low temperature tends to prolong the vegetative phase and thereby increase the size and yield of the bulb (Nanda and Kochhar, 1985). Farooqui *et al* (2005) also documented the temperature of 12.8° to 21.0°C before bulb formation and 15.5° to 25.0°C for bulb development was ideal for onion. Average bulb weight of the 14 varieties of onion in the present investigation increased from 51.2 g in September planting (30.69°C/21.88°C: average 26.28°C for during first 60 days and 26.2°C/13.08°C: average 19.64°C during last 60 days) to 63.01g in October planting (29.06°C/17.71°C: average 23.38°C for during first 60 days and 25.67°C/11.61°C: average 18.64°C during last 60 days) and 63.94g in November planting (26.20°C/13.08°C: average 19.64°C for during first 60 days and 26.85°C/13.60°C: average 20.20°C during last 60 days). These bulb production feature in three plantings (Table 2, 3, 4) also suggested the requirement of moderate temperature before bulbing, in particular, for good bulb production of onion. Average day/night temperature of 20° to 21°C coupled with rainless condition has been found suitable for growing early onion in the humid condition in the Gangetic alluvial region of West Bengal.

In kharif and early-rabi onion, bulb initiation and production occurs under comparatively shorter day length and moderate temperature. The present investigation amply justified the possibility of growing early-rabi onion during September with particularly two varieties, Baswant 780 and Agrifound Dark Red. However, keeping the avoidance of high precipitation during the first 60 days of the plants which causes high seedling mortality and consequently slow down growth, planting of seedlings of the selected varieties like, Baswant 780 and Agrifound Dark Red, Arka Pragati and Phule Safed in first week of October and harvesting the bulbs during last week of February has been found the best for growing early-rabi onion in this humid Gangetic alluvial zone of West Bengal. It should be kept in mind that temperature conditions are never precisely alike year after year so same variety of onion cannot be anticipated to perform consistently even under similar cultural practices (Thamburaj and Singh, 2003). This proposition of variable response of onion varieties to different temperature conditions has found ample support from the present findings.

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Table 1: Analysis of variances for bulb character in different plantings

Character	Mean sum of squares					
	Months			Treatment		
	September	October	November	September	October	November
Length of top (cm)	1.154	2.726	0.923	86.885 **	203.941**	121.948 **
No. of leaf	0.724	0.990	0.066	7.760 **	5.114 **	4.310 **
Polar diameter of bulb (cm)	0.509	0.095	0.013	1.238	0.734	0.747 *
Equatorial diameter of bulb (cm)	0.119	0.356	1.44	1.266	1.192	0.568 **
Weight of bulb (g)	0.712	0.125	33.402	309.438 **	2328.25 **	394.423 **
Yield per sq.m (kg)	0.005	0.585	0.272	3.768 **	4.421**	3.875 **

*= Significant at 0.05 probability level, **= Significant at 0.01 probability level & NS= Non significant

Table 2. Evaluation of the onion varieties in September planting

Variety	Length of top (cm)	No. of leaf	Polar diameter of bulb (cm)	Equatorial diameter of bulb (cm)	Weight of bulb (g)	Bulb yield per sq.m (kg)
Sukhsagar	32.17	8.26	4.12	3.49	33.00	2.36
Phule Safed	35.14	8.26	4.26	5.01	45.00	3.67
Arka Kalyan	34.28	11.00	3.62	3.77	47.25	3.81
Taloja Red	33.53	9.67	3.39	3.15	45.26	2.90
PKV White	30.53	8.36	4.32	3.78	45.28	2.68
Gujrat White	28.83	7.27	3.62	3.68	45.50	2.46
Arka Pragati	33.40	9.13	4.27	4.45	50.67	4.01
Agrifound Rose	37.47	9.43	3.46	4.08	56.27	4.58
Fursangi Local	37.23	9.77	4.06	4.28	55.16	4.79
Phule Samrat	39.70	13.26	3.80	4.01	52.24	4.85
Baswant-780	42.70	7.26	4.83	5.36	70.67	5.18
N-53	34.27	8.26	4.85	4.45	53.33	4.97
Agrifound Dark Red	47.43	7.67	4.79	5.23	71.25	5.83
Pusa Red	44.47	9.18	4.52	4.15	46.25	4.38
SEm (±)	0.61	0.33	0.27	0.18	0.51	0.21
LSD (0.05)	1.47	0.78	NS	NS	1.22	0.51

Table 3. Evaluation of the onion varieties in October planting

Variety	Length of top (cm)	No. of leaf	Polar diameter of bulb (cm)	Equatorial diameter of bulb (cm)	Weight of bulb (g)	Yield per sq.m (kg)
Sukhsagar	28.37	7.16	5.12	3.79	53.16	5.36
Phule Safed	55.63	8.00	4.26	5.01	75.33	6.67
Pusa Red	52.80	10.33	4.03	4.81	67.50	5.79
N-53	47.10	8.33	3.83	4.56	68.00	6.19
Arka Kalyan	44.07	11.00	3.62	3.82	56.25	5.01
Taloja Red	43.73	9.33	3.42	3.35	55.02	4.90
PKV White	40.03	10.33	4.82	4.15	75.28	6.68
Gujrat White	26.83	7.67	3.62	3.72	45.50	2.41
Arka Pragati	53.40	8.33	4.30	4.66	70.50	6.01
Agrifound Rose	44.57	10.33	3.48	4.17	61.67	4.71
Agrifound Dark Red	45.30	9.00	3.90	5.32	76.12	6.23
Fursangi Local	47.97	9.67	4.24	4.38	65.32	5.79
Phule Samrat	43.47	11.33	4.44	3.73	45.08	4.00
Baswant-780	45.03	8.67	4.13	5.35	67.52	6.68
SEm (±)	0.75	0.51	0.54	0.50	0.75	0.48
LSD (0.05)	1.82	1.23	NS	NS	1.82	1.16

Table 4. Evaluation of the onion varieties in November planting

Variety	Length of top (cm)	No. of leaf	Polar diameter of bulb (cm)	Equatorial diameter of bulb (cm)	Weight of bulb (g)	Yield per sq.m (kg)
Sukhsagar	34.27	8.16	5.32	3.58	62.00	5.36
Fursangi local	28.80	6.33	4.03	3.83	50.00	4.45
Pusa Red	49.50	8.67	3.63	4.03	50.00	3.56
Gujrat White	39.93	6.46	3.50	3.20	37.50	3.34
Arka Kalyan	41.53	6.24	3.97	4.53	75.00	6.67
PKV White	44.27	9.67	4.37	4.53	60.00	5.34
Arka Pragati	39.60	7.33	4.30	4.80	75.00	6.67
Phule Samrat	38.30	8.56	4.63	4.17	57.83	5.15
Agrifound Rose	46.07	8.67	3.44	4.23	65.23	5.67
Baswant-780	45.13	8.67	4.03	4.77	77.50	6.39
Taloja Red	44.83	7.67	3.77	4.10	68.40	5.79
N-53	52.53	9.62	4.10	4.07	68.75	6.12
Agrifound Dark Red	48.17	7.67	3.70	4.20	71.06	6.67
Phule Safed	36.90	9.67	3.80	4.20	77.00	6.88
SEm (±)	0.39	0.26	0.31	0.25	3.60	0.21
LSD (0.05)	0.94	0.64	0.72	0.60	8.71	0.50

*= Significant at 0.05 probability level and **= Significant at 0.01 probability level NS = Non significant

