

Short Communication

## Growth, yield and quality of onion cultivars under laterite belt of Eastern India

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Onion (*Allium cepa*, Family: Alliaceae, 2n=16) is grown for consumption as vegetable and spices. India is the second largest producer of onion with an area of 12.70 lakh ha and production of 215.64 lakh ton. West Bengal is an onion deficit state, where the coverage is 29.0 thousand ha with production of 465.45 thousand ton (Department of Agriculture, Cooperation & farmers Welfare 2017). Yield of onion is dependent on the use of high yielding varieties and adaptability of that variety to a region (Mahanthesh et al. 2008; Gupta and Singh 2016). Red and Laterite Zone of West Bengal which covers western districts of the State (extension of Chota Nagpur Plateau), is a non-traditional area of onion cultivation. Here, farmers have grown onion limited to kitchen garden. However, commercial cultivation of onion has been started by some farmers encouraging by seeing the market return. Thus, potential lies for increasing area, production and productivity of onion in this region (Dhar et al. 2016). Here, farmers are relying upon the cultivar Sukhsagar, which is an heirloom onion cultivar that exclusively cultivated in entire West Bengal. In India, many new onion varieties were developed by various public institutions and private seed companies in recent past, Therefore, standardization of cultivars for *rabi* season in West Bengal has immense utility. Haldar et al. (2009) identified some early *rabi* season onion varieties suitable for growing under New Alluvial Zone (Gangetic plains) of West Bengal. Mohanta and Mandal (2014) identified suitable *kharif* onion varieties for Red and Laterite Zone of West Bengal. However, no such study was done to judge the performance of *rabi* onion cultivars

under Red and Laterite Zone of West Bengal. Thus, it was felt necessary to see the performance of improved onion cultivars under the agro-climatic condition of Red and Laterite Zone for their additional yield and quality advantages over Sukhsagar.

The experiment was conducted at the Horticulture Farm (23° 42' N latitude, 87° 40' 30" E longitude and 40 m above mean sea level) of Institute of Agriculture, Sriniketan that represent the sub-humid, subtropical lateritic belt of West Bengal, located in the eastern part of India. Performance of twenty-one onion cultivars was assessed for bulb yield and various growth, yield and quality attributes *rabi* 2014-15. The onion cultivars were Pusa Madhavi, Pusa Riddhi, Pusa Red, Pusa White Flat, Pusa White Round, Arka Kalyan, Arka Niketan, Arka Kirthiman, N-53, NHRDF Red, NHRDF Red 2, NHRDF Red 3, Bhima Shakti, Bhima Kiran, Agrifound Dark Red, Agrifound Light Red, Sukhsagar, Superior Light Red, Onion-1700, Kadam (F<sub>1</sub>) and Improved Gavran. Cultivars were obtained from IARI (New Delhi), DOGR (Pune), NHRDF (Nasik), IIHR (Bangalore) and few from private companies. The soil of the experimental site was loamy in texture with pH 5.9 and 0.44% organic carbon. The available phosphorus content was 31.4 kg/ha and available potassium content was 290.8 kg/ha. Seeds were sown in nursery beds on 3<sup>rd</sup> November 2014 and seedlings were transplanted in the main field on 18<sup>th</sup> December 2014. The planting was done in 3.0m x 1.5m plots with spacing of 15cm x 10 cm. FYM @ 10 t /ha and N:P:K @ 125:100:100 kg /ha was applied to the crop. Harvesting was done after neck fall in a period of 10<sup>th</sup> April 2015 to 5<sup>th</sup> May 2015 according to cultivars. Ten plants were selected and tagged randomly from each plot to record the observations on different growth (plant height, number of leaves and neck diameter) and yield attributes (average bulb weight, polar and equatorial diameter). Bulb yield /ha was obtained by converting the bulb yield /plot after harvest. TSS, pyruvic acid and

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number of rings /bulbs was determined in the Chemistry Laboratory of Vivekananda Mahavidyalaya, Burdwan within a month of harvest.

The range of plant height was noted 81.3 cm to 64.1 cm with mean of 73.1cm. The maximum plant height was noticed in variety NHRDF Red 2 which was statistically at par with N- 53, Bhima Shakti, Agrifound Dark Red, Arka Niketan, Pusa Madhavi, Kadam (F1) and Improved Gavran. The variation in plant height in onion was reported by Haldar *et al.* (2009), Mohanta and Mandal (2014) and Tripathy *et al.* (2016). The leaf number is an important yield component as leaves through photosynthesis make food and transfer it down to stores it in the bulbs. The range of number of leaves per plant was 10.5 to 4.7. The mean leaf number was noted 6.3. The maximum number of leaves per plant was recorded in variety NHRDF Red. Similar result was reported by Haldar *et al.* (2009) and Tripathy *et al.* (2016). Neck diameter is an important parameter that determines the storage potential of onion. Thin necked cultivars of onion have more storability than thick neck cultivars. The range of neck diameter was observed 20.9 mm to 12.3 mm. The maximum neck diameter was recorded in NHRDF Red and Bhima Kiran; whereas the minimum neck diameter was recorded in Arka Kirthiman which was noted statistical similar to Superior Light Red, NHRDF Red 3, Sukhsagar, Arka Niketan, Kadam (F1), Improved Gavran and Agrifound Light Red. Variation in neck diameter in onion reported by Singh *et al.* (2011) and Tripathy *et al.* (2016).

Bulb weight is the most important yield attributing character of onion. Average bulb weight was ranged from 84.1 to 53.0g with a mean value of 69.0g. The maximum bulb weight was recorded in variety N- 53, which was found statistically at par with Bhima Shakti, Onion- 1700, Agrifound Dark Red, Sukhsagar, Kadam (F1), Superior Light Red, Bhima Kiran, Arka Niketan and NHRDF Red. Bulb weight variation among different cultivars of onion has been reported by Haldar *et al.* (2009), Singh *et al.* (2011) and Mohanta and Mandal (2014). The polar and equatorial diameter of onion bulb is an important character that determines the shape and size of bulb. The polar diameter of bulb was varied from 41.3 to 52.2 mm, while the equatorial diameter of bulb was varied from 45.5 to 58.2 mm. The average bulb polar and equatorial diameter was noted 45.8 mm and 51.6 mm respectively. The maximum polar diameter recorded in N- 53 which was found at par with Bhima Shakti, Agrifound Dark Red and Sukhsagar; whereas the maximum equatorial diameter was recorded in variety N- 53, which was found at par with Onion-1700, Kadam (F1), Sukhsagar and Agrifound Dark Red. Similar result was reported by Haldar *et al.* (2009) and Singh *et al.* (2011). Yield is the ultimate goal of any crop husbandry. Wide variation was observed among the onion cultivars for bulb yield. The total bulb yield varied from 33.01 to 11.51 t/ha. Average bulb yield was noted 22.2 t/ha. Maximum total yield recorded in N-53, which was found statistically at par with Bhima Shakti, Onion- 1700, Agrifound Dark Red, Kadam (F1) and Sukhsagar. Variation in bulb yield was reported by

Table 1. Performance of onion cultivars on growth and yield parameter

Cultivars	Plant height (cm)	Leaf number	Neck diameter (mm)	Average bulb weight (g)	Polar diameter (mm)	Equatorial diameter (mm)	Yield (t/ha)	Pyruvic acid ( $\mu\text{mol/gm}$ )	TSS (°Brix)	Number of scales
Pusa Madhavi	75.0 <sup>abcd</sup>	6.4 <sup>bcdef</sup>	18.0 <sup>b</sup>	61.2 <sup>efgh</sup>	45.7 <sup>cdef</sup>	48.4 <sup>hij</sup>	13.7 <sup>fg</sup>	9.9 <sup>cdefgh</sup>	11.0 <sup>ij</sup>	9.8 <sup>bcdef</sup>
Pusa Riddhi	72.6 <sup>bde</sup>	6.1 <sup>cdefg</sup>	15.9 <sup>bcde</sup>	58.3 <sup>efgh</sup>	43.0 <sup>efg</sup>	46.1 <sup>j</sup>	12.8 <sup>fg</sup>	8.9 <sup>fgh</sup>	11.7 <sup>fghij</sup>	9.2 <sup>defg</sup>
Pusa Red	71.5 <sup>bcdef</sup>	6.3 <sup>bcdefg</sup>	16.9 <sup>bc</sup>	56.1 <sup>fgh</sup>	42.1 <sup>g</sup>	46.5 <sup>i</sup>	14.0 <sup>fg</sup>	11.7 <sup>bcde</sup>	12.6 <sup>cdefg</sup>	9.3 <sup>cdefg</sup>
Pusa White Flat	66.9 <sup>ef</sup>	5.4 <sup>fgh</sup>	15.6 <sup>bcdef</sup>	53 <sup>h</sup>	43.6 <sup>defg</sup>	45.5 <sup>i</sup>	11.5 <sup>g</sup>	9.4 <sup>defgh</sup>	12.6 <sup>defg</sup>	10.6 <sup>ab</sup>
Pusa White Round	64.1 <sup>f</sup>	4.7 <sup>h</sup>	15.2 <sup>bcdef</sup>	54.1 <sup>gh</sup>	41.3 <sup>g</sup>	46.0 <sup>j</sup>	12.9 <sup>fg</sup>	9.2 <sup>defgh</sup>	12.3 <sup>defgh</sup>	10.4 <sup>abcd</sup>
Arka Kalyan	70.7 <sup>bcdef</sup>	7.1 <sup>bcd</sup>	16.8 <sup>abcd</sup>	64.7 <sup>cdefg</sup>	44.3 <sup>defg</sup>	51.0 <sup>fgh</sup>	17.2 <sup>ef</sup>	10.9 <sup>cdefg</sup>	12.0 <sup>efghi</sup>	10.0 <sup>bcd</sup>
Arka Niketan	76.4 <sup>abc</sup>	7.3 <sup>bc</sup>	13.8 <sup>efg</sup>	74.7 <sup>abc</sup>	46.4 <sup>cdef</sup>	51.8 <sup>efg</sup>	23.5 <sup>cd</sup>	7.6 <sup>h</sup>	12.5 <sup>defg</sup>	9.3 <sup>cdefg</sup>
Arka Kirthiman	72.5 <sup>bde</sup>	5.2 <sup>gh</sup>	12.3 <sup>g</sup>	56.3 <sup>fgh</sup>	44.3 <sup>defg</sup>	47.3 <sup>ij</sup>	15.7 <sup>efg</sup>	11.0 <sup>cdefg</sup>	13.0 <sup>cde</sup>	9.3 <sup>cddefg</sup>
N- 53	80.7 <sup>a</sup>	5.7 <sup>efgh</sup>	17.3 <sup>bc</sup>	84.1 <sup>a</sup>	52.2 <sup>a</sup>	58.2 <sup>a</sup>	33.0 <sup>a</sup>	11.8 <sup>bode</sup>	11.4 <sup>ghij</sup>	10.8 <sup>ab</sup>
NHRDF Red	72.8 <sup>bcde</sup>	10.5 <sup>a</sup>	20.9 <sup>a</sup>	66.7 <sup>cdef</sup>	43.8 <sup>defg</sup>	54.0 <sup>bcdef</sup>	23.5 <sup>cd</sup>	11.3 <sup>cdef</sup>	10.7 <sup>ij</sup>	10.3 <sup>abcd</sup>
NHRDF Red 2	81.3 <sup>a</sup>	6.8 <sup>bcde</sup>	17.6 <sup>b</sup>	62.9 <sup>defgh</sup>	45.5 <sup>defg</sup>	50.1 <sup>ghi</sup>	19.0 <sup>de</sup>	9.1 <sup>efgh</sup>	11.2 <sup>hij</sup>	10.5 <sup>abc</sup>
NHRDF Red 3	72.6 <sup>bde</sup>	5.5 <sup>fgh</sup>	13.0 <sup>fg</sup>	73.2 <sup>abcd</sup>	43.1 <sup>defg</sup>	54.6 <sup>bcde</sup>	25.4 <sup>bc</sup>	9.7 <sup>cdefgh</sup>	12.8 <sup>def</sup>	8.6 <sup>fg</sup>
Bhima Shakti	78.4 <sup>ab</sup>	6.7 <sup>bcde</sup>	16.8 <sup>bcde</sup>	82.3 <sup>a</sup>	51.7 <sup>a</sup>	53.8 <sup>bcdef</sup>	32.0 <sup>a</sup>	12.4 <sup>bc</sup>	12.8 <sup>def</sup>	9.9 <sup>bcde</sup>
Bhima Kiran	73.8 <sup>abcde</sup>	6.4 <sup>bcdef</sup>	18.3 <sup>a</sup>	75.6 <sup>abc</sup>	47.2 <sup>bde</sup>	52.6 <sup>cdefg</sup>	23.5 <sup>cd</sup>	14.1 <sup>ab</sup>	14.6 <sup>ab</sup>	11.3 <sup>a</sup>
Agrifound Dark Red	77.8 <sup>ab</sup>	5.7 <sup>efgh</sup>	17.2 <sup>bc</sup>	81.1 <sup>a</sup>	50.7 <sup>ab</sup>	55.2 <sup>abcd</sup>	30.6 <sup>a</sup>	8.5 <sup>gh</sup>	12.9 <sup>def</sup>	9.7 <sup>bcdef</sup>
Agrifound Light Red	69.0 <sup>cdef</sup>	6.0 <sup>defg</sup>	14.6 <sup>cdefg</sup>	69.4 <sup>bcde</sup>	45.7 <sup>cdef</sup>	51.9 <sup>defg</sup>	23.6 <sup>c</sup>	9.5 <sup>d<sup>efgh</sup></sup>	12.5 <sup>defg</sup>	10.0 <sup>bcde</sup>
Sukhsagar	67.8 <sup>def</sup>	5.3 <sup>fgh</sup>	13.2 <sup>efg</sup>	80.6 <sup>ab</sup>	49.8 <sup>abc</sup>	55.6 <sup>bcde</sup>	30.0 <sup>a</sup>	10.7 <sup>cdefg</sup>	13.4 <sup>bcd</sup>	8.1 <sup>g</sup>
Superior Light Red	72.4 <sup>bde</sup>	6.1 <sup>cdefg</sup>	12.8 <sup>fg</sup>	75.8 <sup>abc</sup>	42.3 <sup>fg</sup>	54.6 <sup>bcde</sup>	29.2 <sup>ab</sup>	11.0 <sup>cdefg</sup>	11.4 <sup>ghij</sup>	9.3 <sup>cdefg</sup>
Onion- 1700	71.1 <sup>bcdef</sup>	7.1 <sup>bcd</sup>	15.2 <sup>bcdef</sup>	82.1 <sup>a</sup>	47.3 <sup>bcd</sup>	56.5 <sup>ab</sup>	31.6 <sup>a</sup>	15.3 <sup>a</sup>	14.2 <sup>abc</sup>	10.2 <sup>abcd</sup>
Kadam (F1)	74.7 <sup>abcd</sup>	7.2 <sup>bc</sup>	14.0 <sup>defg</sup>	78.1 <sup>ab</sup>	47.3 <sup>bcd</sup>	55.8 <sup>abc</sup>	30.0 <sup>a</sup>	11.9 <sup>bcd</sup>	12.7 <sup>def</sup>	9.9 <sup>bcde</sup>
Improved Gavran	73.9 <sup>abcde</sup>	5.5 <sup>fgh</sup>	14.6 <sup>cdefg</sup>	57.6 <sup>fgh</sup>	44.3 <sup>defg</sup>	47.9 <sup>hij</sup>	13.5 <sup>fg</sup>	11.0 <sup>cdefg</sup>	15.0 <sup>a</sup>	8.7 <sup>efg</sup>
C.D. (P=0.05)	7.7	1.1	2.8	11.3	4.2	3.3	4.5	2.7	1.2	1.2

Singh et al. (2011), Mohanta and Mandal (2014) and Tripathy et al. (2016).

Taste and pungency are important elements in determining the quality of onion crops. Onion bulb pungency is an indicator of the hotness of the onion. Highly pungent onions are preferred in India. The pungent flavours of onion is produced by hydrolysis of the flavor precursor compounds like S-alk(en)yl-L-cysteine sulfoxides (ACSOs) when the tissues are damaged by cutting or macerating. Assessment of pungency is made by measuring pyruvate, which is formed as a stable primary compound from the enzymatic decomposition of the flavor precursors. Pyruvic acid content was significantly varied among the onion cultivars under this study (Table 1). The range of pyruvic acid content was noted 7.6 to 15.3  $\mu\text{mol/gm}$  with mean value of 10.7  $\mu\text{mol/gm}$ . The highest pyruvic acid content in bulb was observed in Onion-1700 that was noted at par with Bhima Shakti and Bhima Kiran. Arka Niketan recorded significantly lower pyruvic acid content, which was found at par with Agrifound Dark Red, Pusa Riddhi, NHRDF Red 2, Pusa White Round, Pusa White Flat, Agrifound Light Red, NHRDF Red 3 and Pusa Madhavi. Sweetness in onion is a balance between sugars and pungency. Dehydration industries need onion varieties with high TSS. In the present study the range of TSS was noted 10.7 to 15.0 °Brix with an average value of 12.5 °Brix. Maximum TSS was observed in Improved Gavran, which was found at par with Onion-1700 and Bhima Kiran. Phenotypic correlation between pyruvic acid and soluble solids were moderate and positive, because the compounds responsible for onion pungency also contribute to total dissolved solids (Lin et al. 1995). Variation in TSS among the onion cultivars was reported by Kushal et al. (2015). Maximum number of scales was observed on cultivar Bhima Kiran which was at par with N-53, Pusa White Flat, NHRDF Red 2, Pusa White Round, NHRDF Red and Onion-1700. Kushal et al. (2015) also reported variation in number of scales among onion cultivars. Short day *Alliums* in the tropics must acquire adequate leaf growth in order to reach large bulb sizes. Formation of certain number of scales is important before maturity. Thicker scales and fewer scales are considered to have higher water content, lower dry matter content and be softer (Lee et al. 2015).

The present study revealed that the performance of N-53, Bhima Shakti, Onion- 1700, Agrifound Dark Red and Kadam (F1) was similar to the popular heirloom cultivar Sukhsagar. Sukhsagar has well adaptability in entire West Bengal and thus performed well. Onion - 1700 and Kadam (F1) were from private seed companies. Farmers may not have easy access to the

seed material. Again, as these varieties are F1 hybrid, farmers would not be able to multiply the seeds of their own. N- 53 is a *kharif* season cultivar and may store poorly. This cultivar, if grown, should be marketed quickly within a couple of months. *Kharif* varieties if grown in *rabi* season would confer equally good bulb yield as that of *kharif* (Kushal et al. 2015). Bhima Shakti with its production level of 32.02 t/ha may be tried in region along with Sukhsagar. Thus, N-53 and Bhima Shakti in addition to Sukhsagar has been suggested to the onion growers of Red and Laterite Zone of West Bengal during *rabi* season for higher productivity.

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