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Evaluation of some watermelon hybrids and cultivars under Lateritic Belt of West Bengal

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ABSTRACT

Watermelon is a promising vegetable crop grown in Red and Laterite Zone of West Bengal. Farmers mostly grow 'Sugar Baby' and often saved the seed that leads to poor quality, low productivity and less market return. Eleven F_1 hybrids along with three open pollinated watermelon cultivars were assessed for various growth, yield and quality attributes under in Horticulture Farm, Sriniketan during summer 2016. Significant variations were noted for all the studied traits among watermelon cultivars. Shaktiman was recorded longest vines and maximum branching. Sugar Baby was noted early to flowering. Hachimichhi produced maximum number of fruits per plant; while Shaktiman recorded highest yield per plant. Arka Manik and ISHQ were recorded maximum TSS content and Shaktiman recorded highest total sugar content. Watermelon cultivar Sugar Baby and three hybrids, Shaktiman, Indam Cannonball and Kajal, were suggested for cultivation during summer season.

***Keywords*:** Cultivar, flowering quality, watermelon and yield

Watermelon (*Citrullus lanatus* (Thunb.) Matsum. and Nakai) is an important summer season crop which is prized for sweet juicy flesh. It is a rich source of important phytochemicals that promote human health and reduce the extent of cancer insurgence, cardiovascular disorders, diabetes and macular diseases. (Naz *et al.*, 2014). Worldwide watermelon is grown over 3.5 million ha and produced 104 million tons (FAOSTAT, 2012). China is the leading country in watermelon production followed by Turkey (FAOSTAT, 2016). In India, area under watermelon is 100.88 thousand ha and production of 2479.71 thousand MT. Among the states of India, Uttar Pradesh stands first in area (13.07 thousand ha) and production (588.54 thousand MT) while, West Bengal ranked 4th in area (16.54 thousand ha) and production (230.10 thousand MT) (Anonymous, 2017). Peoples are buying more fruits and vegetables due to rise in purchasing power and shifting diet pattern. Due to technological advancement, market availability of watermelon is now almost round the year. Consumer preference has also shifted to small sized ice box type fruits with high pigmentation and sweetness. In West Bengal, watermelon is grown in river beds and river banks during summer months. In Red and Laterite Zone, most of the watermelon growers prefer to cultivate 'Sugar Baby' and they often save the open pollinated seeds for next year cultivation. However, low yield, small fruit size and often poor flesh colour severely affects its market acceptability. On the other hand, flooding of good quality fruits from other areas to the local market further discouraging the local farmers to grow watermelon and they are switching on to the other crops. The performance of genotypes is highly influenced by its growing environment and management practices. Evaluation of crop cultivars in a particular Agro-climatic region is highly necessary to judge their performance on that region that helps to select the best types and to promote these identified types among the growers. Mohanta and Mandal (2016) identified KSP-1127 and BS-504 as suitable cultivar/hybrid for Red and Laterite Zone of West Bengal. In this study some commercial cultivars (both OP and F_1S) were introduced to determine if these genotypes were good performer than the existing cultivars. In the present evaluation trial, eleven commercial hybrids along with three cultivars of watermelon were grown to select best performing type with respect to earliness, fruit quality and yield in this region.

MATERIALS AND METHODS

The experiment was carried out at Horticulture Farm of Institute of Agriculture, Sriniketan (West Bengal) during summer 2016. The experimental site was situated 230 42' N latitude and 870 40' 30'' E longitudes with an average altitude of 40 m above mean sea level. The experiment material was comprised of eleven F_1 (Aneesha, Hachimichi, Yuvraj, Indam Cannonball, Kajal, ISHQ, WN-786, Saras, Shaktiman, Abhisek and BSS 2000) and three open pollinated (Sugar Baby, Arka Manik and Arka Muthu) cultivars of watermelon. Experiment was conducted following randomized block design with three replications. FYM (10 t ha^{-1}) and NPK fertilizers (90:60:60 kg ha^{-1}) were applied to grow this crop. Full dose of FYM and phosphorus and one third dose of nitrogen and potash were applied as basal. Rest nitrogen and potash were applied in equal split doses at 30 and 45 days after sowing as top dressing. Seeds were soaked overnight and then treated with fungicide

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(Carbendazim 50% WP @ 3g/kg of seed) before sowing. The planting was done in channel and bed system. Spacing between bed to bed was given 2.5 m and plant to plant 0.5m. Data taken from five randomly selected plants from each treatment and replications. Observations were recorded on vine length, branch number, node to first male and female flower appearance, days to first male and female flower opening and number of fruits plant^{-1} in the field. After harvesting different fruits traits (fruit length, circumference and rind thickness and average fruit weight) were taken. Fruit yield plant^{1} was computed by adding weight of each fruits of a plant. Quality traits (TSS, titrable acidity, total sugar and reducing sugar) were determined in Departmental laboratory. Total Soluble Solids (TSS; ^{0}Brix) of the watermelon flesh were determined by hand refractometer (Pocket Refractometer PAL 1, Atago, Tokyo; *www.atago.net/*). Titrable acidity was estimated as per Sadasivam and Manickam (1996). Total and reducing sugar was estimated following anthrone method as described by Dubois *et al.* (1956). The mean values of various traits thus obtained were subjected to statistical analysis. The total variation for different cultivars was tested for significance by F test using analysis of variance technique. Critical differences were calculated for each trait to the test the significance of difference between means of different genotypes. For statistical analyses Panse and Sukhatme (1985) was followed.

RESULTS AND DISCUSSION

Growth parameters

Significant variation was noted among in different cultivars for plant height and branch numbers (Table 1). Longest vine was observed in Shaktiman which was found statistically *at par* with WN-786. Shortest vine length was noted in Arka Muthu which was noted statistically *at par* with Aneesha. Medium to short vines with compact growth habit is a desirable trait in watermelon. 'Hachimichi' was noted maximum branch number among the cultivars which was not significantly different from Shaktiman. Gichimu *et al.* (2010) reported that the landrace had the highest yield compared to commercial cultivars owing to its long vines and extensive branching. Long main vine and extensive branching was found to be highly correlated to yield.

Flowering traits

Monoecious is the major sex form in watermelon. Like other cucurbits, female flowers appears later after the appearance of several male flowers in lower nodes. Appearance of flowers (particularly female) at lower nodes and early days often interpreted as early type. Significant variation was noted among different cultivars for node to male and female flower appearance and days to first male and female flower opening (Table 1). Male flower appeared in lower node in Sugar Baby which was found statistically at par with Shaktiman, Hachimichi, Indam cannonball, ISHQ, Saras and Arka Muthu. The result revealed that Sugar Baby and Arka Manik required less number of days to male flower opening. Early appearance of female flowers gave early market opportunity. The cultivar Sugar Baby produced early female flower followed by Hachimichi, Aneesha and Indam cannonball. In a similar study Mohanta and Mandal (2016) reported variation for days to female flower opening in watermelon.

Yield attributes and yield

Maximum fruit length was obtained in cultivar Abhisek while, maximum fruit circumference was observed in Indam Cannonball which was noted statistically similar to Kajal, Abhisek and Sugar Baby. Fruit length and circumference were determined the size and shape of fruit. Ogwu *et al.* (2016) studied fruit diameter in four cultivars of watermelon. Mohanta and Mandal (2016) reported that watermelon cultivar KSP-1127 had maximum polar and equatorial diameter of fruit. Maximum rind thickness was noted in Shaktiman and Sugar baby which were observed statistically *at par* with Kajal and WN-786. High rind thickness associated with more storability and good transportability in watermelon. Mohanta and Mandal (2016) found maximum rind thickness in genotype KSP-1127. Maximum number of fruits per plant was found in cultivar Hachimichhi. Watermelon cultivars Kajal, Shaktiman and Sugar Baby also produced good number of fruits plant^{-1}. On an average 2.5 fruits plant^{-1} was recorded. Number of fruits plant^{-1} and fruit diameter was positively correlated with fruit yield (Samadia, 2007 and Sundaram *et al.*, 2011). Among the cultivars, Indam Cannonball produced the heaviest fruits. Watermelon cultivars Shaktiman, ISHQ, Yuvraj, Arka Muthu, Hachimichi, WN-786 and Saras produced fruits weighing below 2 kg. Variation in watermelon fruit weight was also reported by Ogwu *et al.* (2016). Gichimu *et al.* (2010) studied three commercial watermelon cultivars in Kenya and compared to a local landrace. They observed that 'Yellow Crimson' had significantly biggest and heaviest fruits averaging 3.01 kg. In Maharashtra, Jadhav *et al.* (2014) observed that 'Ayesha F1 Hybrid' was significantly superior with maximum weight of single fruit. Shaktiman (13.9 kg) gave highest yield per plant which out yield other cultivars. Indam Cannonball, Kajal and Sugar Baby produced average 10 kg fruit yield plant^{-1}. Minimum fruit yield was noted in cultivar Arka Muthu which was statistically at par with

Saras. These finding were supported by Jadhav *et al.* (2014), Gichimu *et al.* (2008 and 2010) and Mohanta and Mandal (2016). It was found that on an average the hybrids produced 7.5 kg fruit yield plant^{-1}; while open pollinated varieties gave an average yield of 5.4 kg plant^{-1}. Thus, in general, it may be assumed that selecting a hybrid offer better yield remuneration.

Quality parameters

Watermelon is a non-climateric crop. Thus, fully ripe fruits are harvested and marketed. The mature fruits of watermelon are prized for its sweetness and high pigmentation. The increase in total soluble solids was due to enzymatic (hydrolysis by á and â-amylases) conversion of starch into soluble sugar during ripening of watermelon fruit. TSS (Total Soluble Solids), total sugar and reducing sugar are quality parameters of watermelon have been presented on table 3. TSS is an important parameter to judge the sweetness of watermelon. Arka Manik was recorded highest TSS which was noted statistically *at par* with ISHQ. On the other hand, lowest TSS was observed in cultivar BSS 2000. Mohanta and Mondal studied the TSS of thirteen genotype in Red and Laterite Zone of West Bengal and noted highest TSS content in 'Sugar Baby' and 'KSP-1127'. On the other hand, Wehner *et al.* (2017) evaluated seven commercial cultivars and one breeding line at two locations in North Carolina and noticed highest lycopene content in 'Dixielee', followed by 'Sugar Baby' and 'Allsweet'. Highest acidity was observed in cultivar BSS 2000 and WN-786 and lowest acidity was observed in cultivar Sugar Baby. Singh (2016) was also studied physicochemical changes during development stages and post harvest storage of three watermelon cultivars and reported that acidity of watermelon fruit significantly decreased from white to red ripe stage in different cultivars. Accumulation of sugars was found to be concomitant with the fruit development and ripening which was coincided with the increased activity of sucrose phosphate synthase in pre-ripened stage and decreased activities of invertases (acid, neutral) in the course of ripening (Soumya and Ramana Rao, 2014). Highest and lowest total sugar was noted in Shaktiman and Saras, respectively. Singh (2016) noted significantly increased total sugars and reducing sugars among the cultivars at different stages of fruit development. Highest reducing sugar was found in cultivar ISHQ and lowest was observed in WN-786. Soumya and Ramana Rao (2014) studied biochemical composition of icebox cultivars for their nutritional quality and reported that accumulation of sugars was found to be concomitant with the fruit development and 'Beauty' was accumulated maximum of sugars.

The present study on performance of watermelon hybrids and cultivars measured the traits of growth, yield and quality. Significant variation was observed in all the traits of watermelon hybrids and cultivars. For suggesting among the cultivar, Sugar Baby performed better in earliness, fruit yield and quality. Three hybrids (Shaktiman, Indam Cannonball and Kajal), in addition to Sugar Baby, can also be recommended in this zone for large scale cultivation during summer season.

Table 1: Growth and flowering traits of watermelon hybrids and cultivars

Hybrids and cultivars	Vine length (cm)	Branch number	Node to first male flower appearance	Node to first female flower appearance	Days to first male flower opening	Days to first female flower opening
Aneesha	186^{fg}	4.2^{cd}	7^{abcd}	17.2^{cd}	46.8^{cd}	50.9^{bc}
Hachimichi	240.3^{cd}	6.4^{a}	6.6^{ab}	18.4^{def}	48.2^{cde}	50.6^{bc}
Yuvraj	216.7^{e}	3.1^{fg}	7.9^{def}	19.4^{efg}	50.1^{e}	57.3^{e}
Indam Cannonball	262^{b}	4.9^{b}	6.6^{ab}	17^{cd}	46.7^{cd}	51.4^{bcd}
Kajal	229.3^{de}	3.8^{de}	8.2^{f}	19.6^{efg}	50.6^{e}	62.5^{f}
ISHQ	246.7^{c}	4.8^{bc}	6.6^{ab}	14.6^{b}	49.7^{de}	55.0^{de}
WN-786	270^{ab}	3.5^{ef}	7.2^{bcde}	20.5^{g}	49.9^{e}	63.4^{f}
Saras	199.3^{f}	2.6^{gh}	6.9^{abc}	20.4^{g}	50.4^{e}	57.5^{e}
Shaktiman	283.7^{a}	6.0^{a}	6.3^{ab}	16.5^{bc}	48.1^{cde}	56.9^{e}
Abhisek	216^{e}	3.2^{ef}	8.5^{f}	20.2^{fg}	46.1^{c}	54^{cde}
BSS 2000	245.7^{c}	3.3^{ef}	8.0^{ef}	21.1^{g}	46^{c}	56.6^{e}
Sugar Baby	243.7^{cd}	5.1^{b}	6.1^{a}	12.1^{a}	33.3^{a}	40.0^{a}
Arka Manik	246.3^{c}	4.5^{bc}	7.6^{cdef}	19.5^{efg}	35.5^{ab}	48.3^{b}
Arka Muthu	184.3^{g}	2.4^{h}	7.0^{abcd}	18.3^{cde}	42.4^{b}	51.9^{bcd}
Mean	**233.6**	**4.0**	**7.2**	**18.2**	**46.0**	**54.0**
LSD (0.05)	**14.4**	**0.6**	**0.9**	**1.8**	**3.0**	**4.0**

Note: Similar alphabets in a column denote that they are statistically at par.

Table 2: Yield and yield attributing traits of watermelon hybrids and cultivars

Hybrids and cultivars	Fruit length (cm)	Fruit circumference (cm)	Rind thickness (cm)	Number of fruits plant^{-1}	Average fruit weight (kg)	Fruit yield plant^{-1} (kg)
Aneesha	22.3^{g}	41.7^{g}	0.9^{f}	2.2^{de}	1.9^{f}	5.4^{ef}
Hachimichi	26.3^{f}	36.3^{h}	1.0^{ef}	4.4^{a}	1.6^{fg}	7.5^{c}
Yuvraj	33.4^{bc}	53.3^{cd}	1.2^{bcd}	2.1^{e}	3.4^{bc}	7.3^{c}
Indam Cannonball	34.0^{b}	59.3^{a}	1.0^{ef}	2.4^{d}	4.5^{a}	10.9^{b}
Kajal	31^{cde}	58.0^{ab}	1.4^{ab}	3.4^{b}	2.9^{cd}	10.1^{b}
ISHQ	29.0^{e}	54.7^{bc}	1.1^{cdef}	2.1^{e}	3.6^{b}	7.6^{c}
WN- 786	29.7^{de}	55.0^{bc}	1.3^{abc}	2.4^{d}	1.8^{fg}	4.8^{fg}
Saras	23.7^{g}	45.0^{fg}	1.1^{cdef}	1.5^{f}	1.8^{fg}	3.1^{hi}
Shaktiman	28.7^{ef}	42.3^{g}	1.5^{a}	3.3^{b}	3.9^{b}	13.9^{a}
Abhisek	40.7^{a}	56.7^{abc}	0.9^{f}	3.0^{c}	2.1^{ef}	6.5^{cd}
BSS 2000	29.0^{e}	47.0^{ef}	1.0^{ef}	2.3^{de}	2.6^{d}	6.1^{de}
Sugar Baby	32^{bcd}	56.6^{abc}	1.5^{a}	3.2^{bc}	2.9^{cd}	9.9^{b}
Arka Manik	31.0^{cde}	50.3^{de}	1.1^{cdef}	1.6^{f}	2.5^{de}	3.9^{gh}
Arka Muthu	22.3^{g}	37.7^{h}	0.9^{f}	1.7^{f}	1.3^{g}	2.5^{i}
Mean	**29.5**	**49.6**	**1.1**	**2.5**	**2.6**	**7.1**
LSD(0.05)	**2.5**	**3.4**	**0.2**	**0.2**	**0.5**	**1.2**

Note: Similar alphabets in a column denote that they are statistically at par.

Table 3: Fruit quality trait of watermelon hybrids and cultivars

Hybrids and cultivars	TSS (˚Brix)	Titrable acidity (%)	Total Sugar (%)	Reducing sugar (%)
Aneesha	9.4^{d}	0.31^{e}	4.44^{gh}	2.92^{de}
Hachimichi	8.4^{e}	0.39^{cd}	5.72^{c}	3.65^{b}
Yuvraj	10.5^{c}	0.32^{e}	5.01^{ef}	2.73^{ef}
Sugar Baby	11.0^{b}	0.24^{f}	4.44^{gh}	2.74^{e}
Indam Cannonball	9.4^{d}	0.33^{e}	5.10^{e}	2.49^{g}
Kajal	10.5^{c}	0.32^{e}	4.23^{h}	3.33^{c}
ISHQ	11.2^{ab}	0.16^{g}	5.55^{cd}	4.44^{a}
WN-786	9.4^{d}	0.61^{a}	5.10^{e}	2.11^{h}
Saras	9.5^{d}	0.35^{de}	3.75^{i}	2.50^{fg}
Shaktiman	10.8^{bc}	0.33^{e}	8.7^{a}	3.33^{c}
Abhisek	8.4^{e}	0.35^{de}	5.24^{d}	2.86^{e}
Arka Manik	11.6^{a}	0.42^{c}	4.65^{fg}	3.75^{b}
Arka Muthu	9.6^{d}	0.53^{b}	6.56^{b}	2.67^{efg}
BSS 2000	7.7^{f}	0.61^{a}	4.35^{gh}	3.12^{cd}
Mean	**9.8**	**0.4**	**5.2**	**3.2**
LSD (0.05)	**0.4**	**0.04**	**0.4**	**0.2**

Note: Similar alphabets in a column denote that they are statistically at par.

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