

Morphological finger printing of tomato hybrids

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ABSTRACT

The present experiment was carried to characterize morphological traits in tomato hybrids. The hybrids T 1210, NS 816 and NS 77 were unique by their seed colour and showed variation from all other cultivars. T 1210 is unique by its brown colour while, NS 816 and, NS 77 by its dark yellowish brown. Hybrids were grouped into two groups viz., Purple and green based on hypocotyl colour. Purple pigmentation was present in all the hybrids except eight cultivars. Among the hybrids studied only COTH 2 and T 1210 showed determinate type of growth habit while, Heem Sohna, US 1196, Super Samaurai, NS 816 and US-618 showed larger plant size. Most of the fruits were grouped into either greenish white or light green colour based on exterior colour of immature fruit. Presence of green shoulder on the fruit was observed in seven hybrids viz., COTH 2, T 1210, US 2175, US 1196, US 618, Anup, and NP 5024. There was a wide variation in fruit shape among hybrids and were grouped in to eight groups. The results of the present study clearly indicated that the hybrids of tomato examined can be distinguished and identified by seed, seedling morphological characters and could able to differentiate all the hybrids within a short period of time and can be successfully utilized.

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Key words : Tomato, Morphological traits, Hybrids

INTRODUCTION

In recent years public institutions and private companies introduced many hybrids/varieties one after the other for commercial cultivation. The enactment of Plant Varieties Protection and Farmers Right Act called as PPV and F R Bill, 2001, by the Government of India, that provide protection to new varieties and germplasm. To qualify for protection under this Act, the variety must be evaluated for its DUS (Distinctness, Uniformity and Stability) and VCU (Value for Cultivation and Use) tests. Hence, discrimination of tomato varieties, especially by examination of the plant / seed morphology is increasingly important in order to protect the breeders and farmers rights (Wang *et al.*, 2000) and to ensure genetic purity or genuineness of variety which is most important characteristic of a quality seed.

Therefore, to identify tomato cultivars relative taxonomical descriptors are published by International bodies like International Union for Protection of New Plant Varieties (UPOV, 1992) and these morphological descriptors have traditional significance and have been adopted as classical taxonomic approach for identification of crop varieties. Further, keys for identification could be developed on the basis of morphological traits which could serve as a data base for identification of cultivars.

Although tomato being widely studied crop, a systematic studies in varietal characterization is lacking especially for newly developed promising varieties and hybrids. Thus characterization of varieties and hybrids which are of wider acceptance by farming community need to be studied in order to regulate their purity.

MATERIALS AND METHODS

The experiment was conducted at the Horticulture Research Station, Gandhi Krishi Vigyana Kendra, University of Agricultural Sciences, Bangalore, on red sandy loam soil during the *Kharif* season of 2007-2008. In this experiment twenty two tomato hybrids have been selected from both public and private sectors (Table 1).

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Healthy, uniform 28 days old seedlings were transplanted on 31st August 2007. The distance between plants was 0.75m and the distance between rows was 1.0m. The crop was raised by providing recommended package of practices. (Anon., 2004). Five plants were selected at random from each hybrid and were observed for various stable and distinguishable characters according to UPOV guidelines (UPOV, 1992). Various morphological traits were recorded at different plant growth stages, besides

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Table 1: Hybrids of tomato used for evaluation

Sr. No.	Hybrid	Source
1.	Arka Shreshta	IIHR, Bangalore
2.	Arka Ananya	IIHR, Bangalore
3.	Arka Abhijit	IIHR, Bangalore
4.	CO TH- 2	TNAU, Coimbatore
5.	Surya	TOKITA Seeds Pvt. Ltd.
6.	TSI-48	TOKITA Seeds Pvt. Ltd.
7.	Super Samaurai	TOKITA Seeds Pvt. Ltd.
8.	Bhoomi-04	TOKITA Seeds Pvt. Ltd.
9.	T 1224	ZUARI Seeds
10.	T 1210	ZUARI Seeds
11.	US 2175	US Agri Seeds
12.	US 1196	US Agri Seeds
13.	US 618	US Agri Seeds
14.	Abhinav	Syngenta Seeds Pvt. Ltd.
15.	Heem Sohna	Syngenta Seeds Pvt. Ltd.
16.	TH -1389	Syngenta Seeds Pvt. Ltd.
17.	All Rounder	Syngenta Seeds Pvt. Ltd.
18.	Anup	Syngenta Seeds Pvt. Ltd.
19.	NS 77	Namdhari Seeds
20.	NS 816	Namdhari Seeds
21.	NS 585	Namdhari Seeds
22.	NP 5024	Nun hems seeds

taking photographs.

RESULTS AND DISCUSSION

The 1000 seed weight showed significant differences among the hybrids studied and the values ranged between 1.92 g (Arka Shreshta) to 3.14g (US 1196) (Table 2). Based on 1000 seed weight, hybrids were grouped into four categories *viz.*, very very light (<2.00 g), very light (2.01- 2.20 g), light (2.20-2.30g), medium (2.30-2.40g), heavy (2.41 – 3.00 g) and very Heavy (>3.00g). The variation in 1000 seed weight is due to their genetical makeup (Singh *et al.*, 1997).

Hairiness of seed has also been used by various researchers to characterize the cultivars (Atanassova *et al.*, 2004 in tomato). Among hybrids studied only six hybrids *viz.*, T 1224, T 1210, NS 585, NP 5024, All Rounder and TSI-48 did not show hairs on seeds and could be employed as a marker to identify these six hybrids. Slight seed hairiness was observed in four hybrids studied, while remaining hybrids showed dense seed hairiness (Table 2). Seed hairiness also depends on method and duration of seed extraction.

Based on hypocotyl colour hybrids were categorized into two groups *viz.*, purple and green (Table 2). Purple

pigmentation was absent only in T 1224, T 1210, Heem Sohna, NP 5024, Bhoomi-04, Surya, NS 585 and Abhinav and can be readily employed as an efficient marker to identify these hybrids.

In the present study six plant growth traits were studied *viz.*, plant growth habit, plant size, vine length, stem pubescence density, stem internodal length and foliage density (Table 2). COTH 2 and T 1210 were the only hybrids with determinate type of growth habit, which could be used exclusively to identify these hybrids. Heem Sohna, Super Samaurai, NS 816, US 1196 and US-618 showed larger plant size. Hence, plant size could be used for the identification of above mentioned hybrids from rest of the hybrids studied. Such difference in plant growth habit among the cultivars was noticed by Patel *et al.* (2001) in brinjal,

Hybrids were categorized into three groups based on stem pubescence density *i.e.* sparse, intermediate and dense. This character helped only in grouping of hybrids rather than clear cut differentiation as noticed by EL-Tahir (1993) in tomato.

Based on foliage density most of the studied hybrids were grouped either into intermediate or dense. Only five hybrids NS 77, Abhinav, TH 1389, NP 5024 and NS 816 showed their uniqueness of sparse foliage density and can be used as marker to identify these hybrids. Such variation in foliage density was also noticed in tomato by EL-Tahir (1993).

Grouping of hybrids based on exterior colour of immature fruit was employed. US-618, Anup and Heem Sohna were distinct by their dark green colour while, Surya, US 2175, US 1196 and NP 5024 by their green colour. This character can be employed to identify these hybrids before maturity. All other hybrids were grouped into either greenish white or light green colour (Table 3). Hybrids COTH 2, T 1210, US 2175, US 1196, US 618, Anup, NP 5024 can be identified by presence of green shoulder.

Wide variation was observed in fruit shape among the hybrids. Surya, US 618 and NS 585 showed flattened, highly rounded and pyriform fruit shape, respectively and was unique to these hybrids. Three hybrids (Arka Shreshta, Anup, NS 816) showed slightly flattened shape and two hybrids (Super Samaurai, Abhinav) showed slight heart shape fruit, three hybrids (T 1224, T 1210 and NP 5024) had ellipsoid shape and four hybrids (TSI-48, Bhoomi-04, and TH 1389, All Rounder) with long oblong shaped, while, seven hybrids (Arka Ananya, Arka Abhijit, COTH2, US2175, US 1196, Heem Sohna, NS 77) showed round shape (Table 3). This character is promising as it is stable and not influenced by biotic and abiotic stresses

Table 2 : Seed and seedling characteristics of different hybrids of tomato

Sr. No.	Hybrids	1000 seed weight (g)	Seed colour	Hairiness of seed	Hypocotyl colour	Plant growth type	Plant size
1.	Arka Shreshta	1.92	Light yellowish brown	Dense	Purple	Semi-determinate	Intermediate
2.	Arka Ananya	2.31	Brownish yellow	Dense	Purple	Semi-determinate	Intermediate
3.	Arka Abhijit	2.78	Light yellowish brown	Dense	Purple	Semi-determinate	Intermediate
4.	COTH 2	3.10	Brownish yellow	Dense	Purple	Determinate	Intermediate
5.	Surya	2.47	Light yellowish brown	Slight	Green	Semi-determinate	Intermediate
6.	TSI-48	2.28	Brownish yellow	Absent	Purple	Semi-determinate	Intermediate
7.	Super Samaurai	2.40	Light yellowish brown	Dense	Purple	Semi-determinate	Large
8.	Bhoomi-04	2.97	Light yellowish brown	Slight	Green	Semi-determinate	Intermediate
9.	T1224	2.38	Brownish yellow	Absent	Green	Semi-determinate	Intermediate
10.	T1210	2.07	Brown	Absent	Green	Determinate	Intermediate
11.	US 2175	2.47	Light yellowish brown	Slight	Purple	Semi-determinate	Intermediate
12.	US 1196	3.14	Yellowish brown	Dense	Purple	Semi-determinate	Large
13.	US 618	2.93	Light yellowish brown	Dense	Purple	Semi-determinate	Large
14.	Abhinav	2.37	Light yellowish brown	Dense	Green	Semi-determinate	Intermediate
15.	Heem Sohna	2.31	Light yellowish brown	Dense	Green	Semi-determinate	Large
16.	TH 1389	2.57	Very pale brown	Dense	Purple	Semi-determinate	Intermediate
17.	All Rounder	2.08	Very pale brown	Absent	Purple	Semi-determinate	Intermediate
18.	Anup	3.11	Yellowish brown	Dense	Purple	Semi-determinate	Intermediate
19.	NS 77	2.46	Dark yellowish brown	Dense	Purple	Semi-determinate	Intermediate
20.	NS 816	1.95	Dark yellowish brown	Slight	Purple	Semi-determinate	Large
21.	NS 585	1.98	Very pale brown	Absent	Green	Semi-determinate	Intermediate
22.	NP 5024	2.27	Yellowish brown	Absent	Green	Semi-determinate	Intermediate
	S.E. \pm	0.063					
	C.D. (P=0.05)	0.186					

and more useful in cultivar differentiation as shown by Garcia-Gusana *et al.* (2004) in tomato.

Fruit homogeneity is the most important character for marketing of fruits. Hybrids US 618, Super Samaurai, Bhoomi-04, US 2175, All Rounder and NS 77 showed high fruit homogeneity while, remaining hybrids showed low and intermediate homogeneity (Table 4). Such variations in fruit size between the cultivars were studied by Stomel and Giresach (1993) in capsicum.

Based on fruit shoulder shape hybrids were grouped into flat (5 hybrids) slightly depressed (9 hybrids) moderately depressed (6 hybrids) and strongly depressed (2 hybrids). This character can be used to identify Surya and Heema Sohna which showed strongly depressed fruit shoulder shape (Table 4).

Blossom end shape is promising and unaltered trait and more useful in cultivar identification. Hybrid Abhinav was distinct from others by their pointed fruit blossom end shape could be used as marker and Arka Ananya, Super Samaurai and Surya with indented fruit blossom end shape while, rest of hybrids showed flat shape (Table 5).

Based on fruit cross sectional shape, the hybrids were

grouped into round (11 hybrids), angular (6 hybrids) and irregular (hybrids). These results indicated that above three characters could be used in broad classification of hybrids and no one character could identify individual hybrid. However, it is further depends on fruit size. Number of locules varied among hybrids and even within the hybrid. Only NS 77 was distinct by its higher number of locules (>5) while, T 1224, Super Samaurai and Heem Sohna had lower number of locules (<2.23) (Table 5).

Among the fruit characteristics fruit shape, exterior colour of immature fruit, presence of green shoulder, number of locules, fruit blossom end shape can be utilized to characterize few hybrids. Fruit size, fruit size homogeneity, fruit weight, length, width, intensity of exterior colour of mature fruit, easiness of fruit to detach from the pedicel, fruit shoulder shape, easiness of fruit skin to peel were useful only in grouping of hybrids studied. Shape of pistil scar also promising character could be used to identify many hybrids. US 2175, Abhinav, US 618, NP 5024, Arka Shreshta, Surya, All Rounder US1196, NS 816, Anup, T1210, NS 77, Arka Abhijit were distinct by their star shape of pistil scar while Arka Ananya, COTH 2, Heem Sohna, and Super Samaurai by their irregular

Table 3 : Fruit characteristics of different hybrids of tomato

Sr. No.	Hybrids	Exterior colour of immature fruit	Presence of green shoulder on the fruit	Predominant fruit shape	Foliage density	Susceptibility to ToLCV (%)
1.	Arka Shreshta	Light green	Absent	Slightly flattened	Dense	0.00
2.	Arka Ananya	Light green	Absent	Round	Intermediate	0.00
3.	Arka Abhijit	Greenish-white	Absent	Round	Dense	15.00
4.	COTH 2	Greenish-white	Present	Round	Intermediate	25.00
5.	Surya	Greenish	Absent	Flattened	Intermediate	0.00
6.	TSI-48	Greenish- white	Absent	Long oblong	Intermediate	15.00
7.	Super Samaurai	Light green	Absent	Heart shape	Dense	0.00
8.	Bhoomi-04	Greenish-white	Absent	Long oblong	Dense	0.00
9.	T1224	Light green	Absent	Ellipsoid	Intermediate	0.00
10.	T1210	Light green	Present	Ellipsoid	Dense	45.00
11.	US 2175	Greenish	Present	Round	Intermediate	0.00
12.	US 1196	Greenish	Present	Round	Dense	0.00
13.	US 618	Dark green	Present	High rounded	Dense	0.00
14.	Abhinav	Light green	Absent	Heart shape	Sparse	5.00
15.	Heem Sohna	Dark green	Absent	Round	Dense	0.00
16.	TH 1389	Light green	Absent	Long oblong	Sparse	0.00
17.	All Rounder	Greenish-white	Absent	Long oblong	Dense	0.00
18.	Anup	Dark green	Present	Slightly flattened	Intermediate	0.00
19.	NS 77	Greenish- White	Absent	Round	Sparse	0.00
20.	NS 816	Greenish- white	Absent	Slightly flattened	Sparse	10.00
21.	NS 585	Greenish- white	Absent	Pyriform	Intermediate	0.00
22.	NP 5024	Greenish	Present	Ellipsoid	Sparse	15.00

Table 4 : Fruit characteristics of different hybrids of tomato

Sr. No.	Hybrids	Fruit size homogeneity	Fruit shoulder shape	Easiness of fruit to detach from pedicel	Pericarp colour	Pericarp colour intensity
1.	Arka Shreshta	Intermediate	Moderately depressed	Intermediate	Red	Light red
2.	Arka Ananya	Intermediate	Slightly depressed	Intermediate	Red	Dark red
3.	Arka Abhijit	Low	Slightly depressed	Difficult	Orange	Light orange
4.	COTH 2	Intermediate	Flat	Easy	Red	Intermediate red
5.	Surya	Low	Strongly depressed	Difficult	Orange	Light orange
6.	TSI-48	Intermediate	Flat	Easy	Red	Intermediate red
7.	Super Samaurai	High	Moderately depressed	Difficult	Red	Dark red
8.	Bhoomi-04	High	Flat	Intermediate	Green	Intermediate green
9.	T1224	Intermediate	Slightly depressed	Intermediate	Red	Dark red
10.	T1210	Intermediate	Slightly depressed	Intermediate	Orange	Intermediate orange
11.	US 2175	High	Slightly depressed	Difficult	Red	Dark red
12.	US 1196	Intermediate	Slightly depressed	Easy	Pink	Light pink
13.	US 618	High	Moderately depressed	Intermediate	Red	Intermediate red
14.	Abhinav	Low	Slightly depressed	Easy	Red	Dark red
15.	Heem Sohna	Intermediate	Strongly depressed	Difficult	Green	Intermediate green
16.	TH 1389	Low	Flat	Easy	Red	Dark red
17.	All Rounder	High	Moderately depressed	Easy	Red	Intermediate red
18.	Anup	Intermediate	Flat	Easy	Pink	Light pink
19.	NS 77	High	Moderately depressed	Easy	Orange	Light orange
20.	NS 816	Intermediate	Slightly depressed	Difficult	Red	Dark red
21.	NS 585	Intermediate	Moderately depressed	Intermediate	Red	Intermediate red
22.	NP 5024	Intermediate	Slightly depressed	Easy	Pink	Intermediate pink

Table 5 : Fruit characteristics of different hybrids of tomato

Sr. No.	Hybrids	Fruit cross sectional shape	Number of locules	Shape of fruit pistil	Fruit blossom end shape	Fruit firmness	Fruit hollowness
1.	Arka Shreshta	Irregular	4.23	Star	Flat	Firm	Slight
2.	Arka Ananya	Round	3.28	Irregular	Indented	Intermediate	Slight
3.	Arka Abhijit	Round	3.43	Star	Flat	Soft	Slight
4.	COTH 2	Round	3.63	Irregular	Flat	Soft	Intermediate
5.	Surya	Irregular	4.01	Star	Indented	Intermediate	Intermediate
6.	TSI-48	Angular	2.43	Dot	Flat	Firm	Severe
7.	Super Samaurai	Round	2.23	Irregular	Indented	Intermediate	Intermediate
8.	Bhoomi-04	Irregular	2.70	Dot	Flat	Firm	Severe
9.	T 1224	Round	2.21	Dot	Flat	Firm	Slight
10.	T 1210	Angular	3.33	Star	Flat	Firm	Slight
11.	US 2175	Round	2.97	Star	Flat	Intermediate	Slight
12.	US 1196	Irregular	3.43	Star	Flat	Firm	Intermediate
13.	US 618	Round	2.83	Star	Flat	Firm	Slight
14.	Abhinav	Round	2.23	Star	Pointed	Soft	Intermediate
15.	Heem Sohna	Round	2.23	Irregular	Flat	Firm	Intermediate
16.	TH 1389	Angular	3.30	Dot	Flat	Firm	Slight
17.	All Rounder	Round	2.37	Star	Flat	Firm	Intermediate
18.	Anup	Round	3.23	Star	Flat	Firm	Slight
19.	NS 77	Angular	5.23	Star	Flat	Soft	Intermediate
20.	NS 816	Irregular	4.03	Star	Flat	Intermediate	Slight
21.	NS 585	Angular	4.13	Dot	Flat	Intermediate	Intermediate
22.	NP 5024	Angular	2.92	Star	Flat	Firm	Slight
S.E. _±			0.141				
C.D. (P=0.05)			0.414				

shape and rest of the hybrid showed dot shape (Table 5).

Significant differences for susceptibility to ToLCV were observed among the hybrids. T 1210 (45%), COTH 2 (25%), Arka Abhijit (15%), TSI 48(15%), NP 5024 (15%), Abhinav (10%), and NS 816 (10%) hybrids showed susceptibility, where as remaining hybrids were highly free from ToLCV (Table 3). Such differences to biotic stress among cultivars were observed by Gill *et al.* (1997) and Patel *et al.* (2001) in okra and brinjal, respectively.

The morphological parameters recorded and discussed were prevailed at Bangalore condition, located at latitude of 12° 58' N and longitude of 77° 35' E with an altitude of 930 meters above mean sea level which may vary according to altitude and latitude and even with season.

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