

EVALUATION OF INDIGENOUS TOMATO HYBRIDS UNDER PLASTIC TUNNEL

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ABSTRACT:- Seventeen locally developed indeterminate tomato hybrids were evaluated along with 'Sahel' as check under plastic tunnel for yield and yield components at National Agricultural Research Centre, Islamabad. Maximum yield of 71.58 tha^{-1} was recorded in NTT-12-08 while minimum yield (34.75 tha^{-1}) was observed in NTT-16-08. Sahel used as check bore maximum number of fruits plant^{-1} (30.26) and followed by NTT-04-08 and NTT-03-08 bearing 28.68 and 24.16 fruits plant^{-1} , respectively. The highest mean fruit weight of 170.63 g was recorded in NTT-05-08 while minimum fruit weight (80.90 g) was observed in Sahel (check). Maximum fruit length of 7.89 cm was recorded in Sahel which is oblong in shape while minimum (5.70 cm) in NTT-14-08. Similarly a significant difference was observed among hybrids for fruit diameter. Fruits having more diameter are round to roundish in shape. Fruit diameter ranged from 8.85 to 5.49 cm. Fruit firmness also varied significantly ranging from 3.54 to 1.67 kg m^{-3} in Sahel and NTT-07-08, respectively. Maximum pericarp thickness (0.90 cm) was recorded in NTT-10-08 while minimum pericarp thickness of 0.58 cm was observed in NTT-16-08. NTT-01-08 exhibits the highest number of locules (5.22). It was followed by NTT-02-08 having 4.55 locules while minimum (2.0) locules were observed in NTT-09-08.

Key Words: Tomato; Hybrids; Plastic Tunnel; Crop Yield; Yield Components; Pakistan.

INTRODUCTION

Tomato is one of the important summer vegetables, widely grown throughout the country during different times of the year. In Pakistan, total production of tomato is 476.8 thousand tonnes from 49.2 thousand hectares. Province wise contribution is 25% by Khyber Pakhtoonkhwa, 38% by Balochistan, 16% by Punjab and 21% by Sindh. Seventy two percent of the total tomato production is

contributed from spring crop and 28% from summer season crop (GoP, 2010). The commercially grown varieties e.g. Riogrande, etc. in the country are low yielder as compared to hybrids (Chaudhry et al., 1995; 2006). However, for off-season production, indeterminate tomato hybrids are used. The advantages of hybrid tomato cultivars are uniformity in shape and size, increased vigor, early maturity, high yield and resistance to specific pests and pathogens. Sudha-

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kar and Purushotham (2009) evaluated different F_1 hybrids of tomato for higher yield. The growth characters varied significantly among different tomato hybrids. The early maturing hybrid Lakshmi produced the highest number of fruits plant⁻¹ (20.13), yielding 1.532 kg plant⁻¹ and was significantly superior over all hybrids. Maklad et al. (1996) evaluated fruit yield and fruit characters of eight tomato hybrids under glasshouse conditions and the results showed significant differences among hybrids. Carli et al. (2011) analyzed eight tomato F_1 hybrids and their parental lines for nutritional properties and agronomic traits. They assessed eight traits contributing to the nutritional quality of tomato, average yield and calculated the nutritional index (IQUN) and an agronomic index (AI). On the basis of IQUN and AI they were able to select two hybrids (MR 48 and MR 47) that contain considerable amount of antioxidants and acceptable parameters for commercial production.

Under current scenario all hybrid seeds for vegetables including tomato for open field and off-season cultivation are being imported from different countries like Holland, Japan, USA and China etc. at a very high price. There is a need to develop and evaluate tomato hybrids. But in Pakistan, in spite of huge acreage under vegetable crops, this aspect was totally neglected. There is great potential of yield improvement in tomato through hybrid development. Therefore, heterosis breeding can be a potential alternative for substantial increase in tomato production in Pakistan. Keeping in view the importance of tomato hybrid and the future needs 17 indeterminate tomato

hybrids were developed by Vegetable Crops Research Programme, Horticultural Research Institute, National Agricultural Research Centre, (NARC) Islamabad, Pakistan for tunnel production and evaluated for yield and yield components. The efforts were made to minimize reliance on the import of hybrid seed.

MATERIALS AND METHOD

Seventeen indeterminate tomato hybrids were studied for primary evaluation of their yield and yield components along with Netherlands originated hybrid Sahel (commercially cultivated hybrid under plastic tunnel in Pakistan) as check under plastic tunnel (25m x 10m x 12.5m). The study was conducted in the experimental area of Vegetable Programme, NARC, Islamabad during 2008-09. Soil was sandy loam in texture. Seedlings were raised during October, 2008 and healthy seedlings were transplanted on November 12, 2008 under plastic tunnel. The experiment was laid out in randomized complete block design (RCBD) with three replications. Row to row and plant to plant distance was maintained at 75 and 50 cm respectively. Layout under plastic tunnel is given in Table 1.

The experiment was irrigated on need basis approximately with the interval of 6-7 days. Fertilizer NPK (75:50:50) was added in the form of urea, DAP and sulphate of potash. Data on number of fruits plant⁻¹, fruit weight plant⁻¹, individual fruit weight and fruit size were recorded from March to May, 2009. Fruit firmness was measured at harvest with the help of penetrometer. Pericarp thick-

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Table 1. Layout of experiment under plastic tunnel

R ₁	R ₂	R ₃
NTT-17-08	NTT-03-08	NTT-07-08
NTT-02-08	NTT-06-08	NTT-08-08
NTT-15-08	NTT-10-08	NTT-09-08
NTT-04-08	NTT-01-08	NTT-13-08
NTT-11-08	NTT-11-08	NTT-12-08
NTT-06-08	NTT-02-08	Sahel (check)
NTT-10-08	NTT-15-08	NTT-06-08
NTT-08-08	NTT-05-08	NTT-14-08
NTT-09-08	Sahel (check)	NTT-16-08
NTT-07-08	NTT-14-08	NTT-03-08
NTT-05-08	NTT-04-08	NTT-15-08
NTT-12-08	NTT-16-08	NTT-10-08
NTT-13-08	NTT-07-08	NTT-04-08
NTT-14-08	NTT-12-08	NTT-17-08
NTT-03-08	NTT-09-08	NTT-11-08
NTT-16-08	NTT-17-08	NTT-01-08
NTT-01-08	NTT-13-08	NTT-05-08
Sahel (check)	NTT-08-08	NTT-02-08

ness was measured with the help of vernier calliper after taking transverse section of fruit. Number of locules were also counted after taking

transverse section of fruit. The meteorological data during the study period for October, 2008 to May, 2009 is as given in Table 2.

The analysis of variance was compared at 0.05 % following Duncan's Multiple Range Test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Fruits per Plant

There was a significant difference among all hybrids for number of fruits per plant (Table 3). Maximum number of fruits plant⁻¹ (30.26) was exhibited by Sahel (check) (Table 4). It was followed by NTT-04-08 and NTT-03-08 bearing 28.68 and 24.16 fruits plant⁻¹, respectively, while minimum of 11.75 fruits plant⁻¹ were recorded in NTT-02-08 and NTT-16-08 (Table 4). Other hybrids ranged between these limits. Chaudhry et al. (2003) evaluated 12 indeterminate tomato hybrids alongwith moneymaker for yield and quality aspects. Hybrid Cherry gave significantly higher number of fruits plant⁻¹.

Table 2. Metereological data during October, 2008 and May 2009

Period of study	Max Temp (°C)	Min Temp (°C)	Relative humidity (%)	Rainfall (mm)
October, 2008	30.90	15.00	68	28.38
November, 2008	25.70	8.00	63	17.60
December, 2008	20.32	5.88	76	66.05
January, 2009	18.27	4.95	80	57.20
February, 2009	20.10	6.30	76	69.54
March, 2009	24.72	9.46	72	58.54
April, 2009	29.18	13.56	67	93.59
May, 2009	36.50	18.30	51	36.61

Source: Metrological Section, Water Resources Research Institute (WRII), NARC, Islamabad, Pakistan.

Table 3. Mean square values for analysis of variance for the traits studied

SOV	DF	Fruit per Plant	Fruit weight per plant	Individual fruit weight	Fruit length	Fruit dia	Firmness	No of locules	Pericarp thickness	Yield
Rep	02	28.804	0.30571	68.90	0.00850	0.19642	0.12692	0.10720	0.00016	159.523
Treatments	17	101.049**	0.45432 ^{ns}	2308.12**	0.91854**	1.83372**	0.73413**	2.08736**	0.01886**	303.800
Error	34	16.855	0.26824	455.27	0.06830	0.14394	0.17437	0.13322	0.00480	173.161
Total	53									

** Significant at $P < 0.01$ percent level of probability

Fruit Weight per Plant (kg)

Two local hybrids NTT-04-08 and NTT-12-08 were the highest yielder producing 2.77 kg plant⁻¹ and statistically at par with the Sahel (check) bearing 2.48 kg plant⁻¹ (Table 4). As Chaudhry et al. (2006) reported earlier that the hybrid Mamotaroyork produced maximum fruit weight of 3.29 kg per plant when evaluating five exotic tomato hybrids. Rest of hybrids gave less fruit yield per plant as compared to check. NTT-16-08 gave minimum fruit weight of 1.39 kg per plant.

Mean Fruit Weight (g)

Maximum individual fruit weight of 170.63 g was recorded in NTT-05-08 which is an important yield contributor (Table 4). NTT-01-08, NTT-02-08, NTT- 08-08 and NTT-04-08 proved better as compared to Sahel (check). Chaudhry et al. (1998) evaluated ten tomato hybrids under plastic tunnel. Maximum fruit weight of 167.11g was observed in Carmello. Chaudhry et al. (1995) evaluated six indeterminate tomato hybrids under plastic tunnel, Carmello gave the highest fruit weight of 163.33 g.

Fruit Size (cm)

All the local hybrids have roundish fruit shape hence they are shorter in fruit length as compared to check. Fruit length was maximum (7.89 cm) in Sahel which is oblong in shape and minimum of 5.70 cm in NTT-14-08 (Table 4). Other hybrids were between these limits. NTT-01-08 had maximum fruit diameter (8.85 cm) followed by NTT-10-08 with fruit diameter of 7.60 cm. Minimum fruit diameter (5.49 cm) was recorded in Sahel (check). A highly significant difference was exhibited by hybrids

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for this character. Chaudhry et al. (2006) reported significant differences in fruit size (length and width) in different tomato hybrids under study.

Fruit Firmness

This varies significantly among the hybrids. Sahel (check) have significantly higher (3.54) value of fruit firmness which is statistically at par with NTT-09-08 having 3.13 fruit firmness value (Table 5). Rest of hybrids showed less firmness as compared to check. NTT-07-08 showed

the lowest fruit firmness (1.67) as compared to other tested hybrids. Chaudhry et al. (1999) reported that NARC-1 exhibited maximum fruit firmness (6.2) at turning ripe stage. Present results correlate with the studies of Kanno and Kamimura (1985) and Hall (1987) who also observed significant differences in fruit firmness in different cultivars of tomato.

Pericarp Thickness

It plays an important role in shelf life of tomato fruit (Chaudhry et al., 2006). Maximum pericarp thick-

Table 4. Yield and yield contributing factors of locally developed F₁ hybrids of indeterminate tomato

Hybrid	No. of fruits per plant	Fruit weight per plant (kg)	Mean fruit weight (g)	Fruit size (cm)		Yield (tha ⁻¹)
				Length	Diameter	
NTT-01-08	12.24	2.02	164.93	6.74	8.85	50.51
NTT-02-08	11.75	1.81	154.50	6.89	7.39	45.33
NTT-03-08	24.16	1.76	80.07	7.03	6.33	44.12
NTT-04-08	28.68	2.77	98.30	6.75	5.94	69.33
NTT-05-08	12.58	2.16	170.63	7.20	7.12	54.75
NTT-06-08	18.18	2.34	127.73	6.02	6.87	59.20
NTT-07-08	22.53	2.36	103.17	6.11	6.07	59.00
NTT-08-08	14.31	2.19	154.03	6.27	7.58	54.75
NTT-09-08	17.16	1.93	112.33	6.77	6.33	48.25
NTT-10-08	15.64	2.03	131.67	6.97	7.60	50.87
NTT-11-08	13.27	1.51	124.57	5.94	6.14	37.83
NTT-12-08	20.54	2.77	135.17	6.39	6.51	71.58
NTT-13-08	16.73	1.71	103.13	6.44	6.62	42.83
NTT-14-08	12.25	2.12	165.90	5.70	6.87	53.08
NTT-15-08	13.60	1.81	132.83	6.14	6.15	44.33
NTT-16-08	11.75	1.39	117.20	5.84	6.40	34.75
NTT-17-08	13.74	1.77	129.63	6.52	6.73	44.25
Sahel (check)	30.26	2.48	80.90	7.89	5.49	62.00
LSD Value	6.81	0.86	67.69	0.43	0.63	21.83
CV	23.88	25.22	17.34	4.00	5.64	25.56

ness (0.90 cm) was recorded in NTT-10-08 followed by NTT-09-08, NTT-02-08 and NTT-15-08 having pericarp thickness of 0.82, 0.81 and 0.81 cm, respectively (Table 5). NTT-03-08, NTT-07-08, NTT-11-08 and NTT-14-08 showed minimum value for pericarp thickness and it was at par with the check having 0.62 cm thick pericarp. Chaudhry et al. (2003) also reported that tomato hybrid King Kong had very thick pericarp (0.84 cm).

Number of Locules

A significant difference was observed among tomato hybrids for

Table 5. Fruit characteristics of locally developed F_1 hybrids of indeterminate tomato

Hybrid	Firmness	Pericarp thickness (cm)	No. of locules
NTT-01-08	2.12	0.77	5.22
NTT-02-08	2.80	0.81	4.55
NTT-03-08	2.35	0.68	2.78
NTT-04-08	1.98	0.71	3.00
NTT-05-08	2.56	0.77	3.33
NTT-06-08	2.98	0.74	2.78
NTT-07-08	1.67	0.69	2.11
NTT-08-08	1.91	0.77	3.55
NTT-09-08	3.13	0.82	2.00
NTT-10-08	2.37	0.90	3.56
NTT-11-08	1.81	0.63	3.00
NTT-12-08	2.13	0.76	2.22
NTT-13-08	1.99	0.74	3.00
NTT-14-08	2.34	0.69	3.44
NTT-15-08	2.32	0.81	2.33
NTT-16-08	2.40	0.58	3.33
NTT-17-08	1.95	0.75	3.00
Sahel (check)	3.54	0.62	2.22
LSD value	0.69	0.12	0.60
CV	17.75	9.41	11.85

this character. Maximum of 5.22 locules were recorded in NTT-01-08, being followed by NTT-02-08 having 4.55 locules (Table 5). Minimum (2.00) number of locules was recorded in NTT-09-08. Chaudhry et al. (2006) reported that Mamotaro, Mamotaroyork, Chinese hybrid and Precious had the highest number of locules ranging from 7.11 to 5.55. Kartoffel (1993) obtained varied number of locules in different tomato cultivars.

Yield (tha^{-1})

Maximum fruit yield (71.58 tha^{-1}) was recorded in NTT-12-08 followed by NTT-04-08 and Sahel producing 69.33 and 62.0 tha^{-1} , respectively and were statistically at par with each other. Rest of hybrids gave lower yield as compared to check while NTT-16-08 proved the poorest yielder bearing 34.75 tha^{-1} (Table 4). Chaudhry et al. (2006) evaluated five exotic tomato hybrids along with a cultivar moneymaker to get early crop under plastic tunnel. The maximum yield of 13.16 kg m^{-2} was recorded in Mamotaroyork hybrid and it was recommended to be grown under plastic tunnel to get an early tomato crop. Chaudhry et al. (2003) evaluated 12 indeterminate tomato hybrids along with Moneymaker for yield and quality aspects. The highest fruit yield m^{-2} was recorded in Jiafen No. 15.

It is thus concluded that the two locally developed hybrids namely; NTT-12-08 (71.58 tha^{-1}) and NTT-04-08 (69.33 tha^{-1}) proved best regarding yield and yield contributing factors as compared to Sahel check (62.00 tha^{-1}) and other 15 evaluated local hybrids. However, the above three hybrids were statistically at par with each

other.

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