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PERFORMANCES OF HEAT TOLERANT TOMATO (*Solanum lycopersicum*) HYBRIDS DURING RAINY SEASON

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Abstract

An investigation was undertaken with a view to observing the performance of newly developed summer tomato hybrids during May 2008 to September 2008 at experimental field of Horticulture Research Centre, BARI, Gazipur. Number of fruits per plant, individual fruit weight, fruit size, etc. was significantly higher when the plants were treated with hormone. Fruit yield per plant was quite high in the hormone treated plant (1.57 kg) compared to untreated plants (0.90 kg). In general, all the hybrids performed better when treated with hormone in respect of yield compared to their corresponding untreated plants. The hybrid WP7 × C-51 had the highest individual fruit weight (56.0 g) Among the hybrids, HT019 × WP10 had the highest fruit yield per plant (1.87 kg) closely followed by C-11 × WP10 (1.81 kg) when the plants were treated with hormone. The untreated plants of the hybrid lines C-41 × WP8, HT019 × WP10 and C-41 × WP10 produced more than 1.0 kg of fruits per plant. This indicates that there is bright scope of tomato production during summer through with and without hormone application, though application of hormone had positive effect on tomato yield.

Keywords: Heat tolerant tomato hybrids, rainy season.

Introduction

Tomato *(Solanum lycopersicum)* is a winter season crop. It likes cool and dry weather for better growth and development (Rashid, 1999). Tomato production during summer season is restricted due to presence of high temperature, high humidity, and rainfall. Adverse climatic condition during summer causes severe flower dropping in tomato (Picken, 1984). In Bangladesh, tomato is mostly grown in winter. Poor fruit set in summer is the major problem in tomato, which is frequently caused by adverse weather condition during flowering. Plant growth regulators have been reported to enhance fruit set under both normal and adverse weather conditions. Application of hormones in tomato production during hot summer was found very effective (Kuo, 1993). Recently, Bangladesh Agricultural Research Institute (BARI) has developed two summer tomato hybrids, which are grown during summer-rainy season under polytunnel with appreciable yield (Ahmad *et al.,* 2008). The organization has also developed many new hybrids (Anon., 2009) with a view to boosting up the production and quality of tomato during summer in Bangladesh. The present study was undertaken to evaluate the newly developed materials of F_1 generation grown with or without hormone application during summer.

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Materials and Method

The experiment was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur during the summer season of 2008. The seeds of newly developed 11 F_1 tomato hybrids and BARI Hybrid Tomato-3 as check were sown in the seed bed on 5 May 2008. Seedlings were transplanted in the main field on 1 June 2008. The experiment was laid out in RCB design with three replications. All the hybrids were grown with and without hormone application. The unit plot size was 4.80 m × 2.3 m accommodating 4 rows. Each row consisted of 12 plants. Spacing was maintained at 60 cm × 40 cm between row to row and plant to plant, respectively. The crop was fertilized with cowdung 10 ton, urea 550 kg, TSP 450 kg and MP 250 kg per ha, respectively. Half of the quantity of cowdung, entire TSP, and half of the MP were applied during land preparation. The remaining half of the cowdung was applied during pit preparation. The rest of MP and entire urea were applied at three equal installments at 15, 30, and 45 days after transplanting. The crop was protected from rain providing polythene tunnel. The growth regulator Tomatotone (consisting of para-chlorophenoxyacetic acid) at the rate of 2% was sprayed on plants having 4-5 flower clusters at full bloom stage. Plant received three sprays at 5-6 days interval, and only blooming flower clusters were sprayed. Two rows in each plot were kept unsprayed. Irrigation, pruning, mulching weeding, and other intercultural operations were done as and when necessary. Data were recorded for yield and yield contributing characters and statistically analyzed using MSTAT software.

Results and Discussion

Effect of hormone

Hormone application had significant influence on summer tomato production (Table 1). The plant height of untreated plants was higher (136.6cm) compared to the hormone treated plants (129.0cm). Since the untreated plants produced lesser number of fruits per plant (29.0) indicating the untreated plants utilized most of the metabolites for their vegetative growth. Hormone treated plants produced significantly higher number of fruits per plant (40.4) with heavier individual fruit (40.64g) compared to the untreated plants. However, the plants that were not treated with growth regulator showed severe shedding of flowers, presumably because of high temperature. High day (above 32°C and night (above 21°C) temperatures usually accelerate the abscission of floral organ after anthesis (Iwahori, 1967; Picken, 1984). At higher temperatures, the level of endogenous auxin (IAA-like substance) becomes low which arrests the growth of the floral organs and causes abscission (Leopold and Kriedemann, 1975). Treating plants with exogenous auxin reduces flower drop and increase fruit set. Therefore, the treated plants produced 1.57 kg of fruits per plant, while it was only 0.90 kg of

fruits per plant when the plants were not treated with tomatotone. Fruit length, fruit breadth, total soluble solids of the treated plants were statistically identical with fruits of untreated plants. However, although hormone application is cost related, but it may be compensated by the higher production of tomato oompared to the untreated control. Table 1 indicated that at least 1.5 times higher yield can be achieved through hormone application.

Effect of hybrids

Yield and yield attributes of hybrids are presented in Table 2. Most of the characters were significantly affected due to hybrids. The hybrid lines HT019 × C-41, HT019 × C-51 took minimum days to first flower (42.5), while it was maximum for the hybrid HT019 × C-71 (49.0 days). The tallest plant was recorded from the hybrid WP7 × C-51 (146.6cm), while it was the lowest for C-41 × WP10 (121.7 cm). The highest number of fruits per plant (49.38) was recorded in the hybrid HT019 × C-41 which was closely followed by HT019 × WP10 (43.95). A wide variation in individual fruit weight (27.13 to 55.88 g) was recorded among the hybrids of which the hybrid WP10 × C-51 produced the heaviest fruit. Considerable variation in fruit yield per plant was recorded among the lines. The hybrid HT019 × WP10 produced the highest fruit yield per plant (1.66 kg) closely followed by the lines C-41 × WP10 (1.45 kg) and C-41 × WP8 (1.44 kg). Varietal difference in respect of fruit setting in summer tomato could be attributed due to variation of endogenous auxins before or after anthesis or response of varieties to application of hormone (Kuo *et al.,* 1989) in conjunction with physiological state of the tissues. Similar yield variation with regard to number of fruits per plant, individual fruit weight and yield, among different summer tomato lines was reported by Patwary (2009). Significant variation was observed among the hybrids in respect of fruit breadth, while fruit length was at par among the hybrids. The hybrid WP7 × C-51 had the highest fruit breadth (5.24cm). Total soluble solid among the hybrids varied from 3.94% to 5.01%. Difference in pericarp thickness indicates that the hybrids might have differential keeping quality after harvest since tomato fruit with high pericarp thickness is associated with higher shelf life (Thakur and Kohli, 2005).

Interaction effect between growth hormone and hybrids

Significant interaction between growth hormone and hybrid lines was observed for the traits of number of fruits per plant, individual fruit weight, fruit yield per plant, total soluble solid (TSS), and pericarp thickness (Table 3). Result revealed that when the hybrids were treated with growth hormone produced higher number of fruits per plant and corresponding yield per plant was also higher compared to the untreated plants. Individual fruit weight of all hybrids was higher when the plants were treated with hormones. Therefore, exogenous

Table 1. Main effect of growth regulator on yield and yield attributes of summer tomato hybrids.

Treatment	Days to 50% flower	Plant height at last harvest	No. of fruits/ plant	Individual fruit wt (g)	Fruit yield/ plant (kg)	Fruit length (cm)	Fruit breadth (cm)	TSS (%)	Pericarp thickness (mm)	Yield (t/ha)
Untreated	44.5	136.63	29.0	33.12	0.90	4.16	4.33	4.69	5.58	
Hormone treated	45.12	129.0	40.4	40.64	1.57	4.37	4.40	4.66	5.24	30.6
F-test	ns	*	**	**	**	ns	ns	ns	*	53.38
CV(%)	2.90	7.9	10.6	9.65	10.3	6.0	9.29	7.2	8.68	

Table 2. Main effect of tomato hybrids on yield and yield attributes planted during summer season un Bangladesh.

Hybrids	Days to 50% flower	Plant height at last harvest	No. of fruits/ plant	Individual fruit wt (g)	Fruit yield/ plant (kg)	Fruit length (cm)	Fruit breadth (cm)	TSS (%)	Pericarp thickness (mm)	Yield (t/ha)
HT019 × C-11	44.25	122.4bc	41.l3bc	27.70e	1.l3bcd	4.35	3.85b	4.4lab	5.l9ab	38.42
HT019 × C-41	42.50c	126.9bc	49.38a	27.13e	1.35abc	3.88	3.71b	4.77ab	5.22ab	45.9
HT019 × C-51	42.50c	131.0abc	36.67bcd	34.05cde	1.30bc	3.81	4.l4ab	4.68ab	4.99ab	44.2
HT019 × C-71	49.00a	147.0a	34.l3cde	29.38de	1.05cd	4.5	4.10ab	4.8lab	5.97a	35.7
HT019 × WP7	46.00bc	138.7abc	23.83f	31.98cde	0.75e	4.63	4.l4ab	4.63ab	5.83ab	25.5
WP7 × C-51	45.5bc	146.6a	14.65g	55.88a	0.86de	4.45	5.24a	4.74ab	5.37ab	29.24
C-41 × WP8	46.75ab	139.5ab	35.83bcd	39.85bc	1.44ab	4.65	4.22ab	3.94b	5.87ab	48.96
HT019 × WP10	42.75c	126.9bc	43.95ab	37.80bcd	1.66a	4.09	4.54ab	4.63ab	5.39ab	56.44
C-11 × WP10	44.5bc	129.3bc	31.88de	44.50b	1.40abc	4.45	4.78ab	4.70ab	4.74b	47.6
C-41 × WP10	44.75bc	121.7c	39.72bcd	36.92b-e	1.45ab	3.96	4.44ab	4.87ab	5.11ab	49.3
C-51 × WPI0	44.5bc	128.6bc	27.42ef	45.70b	1.3lbc	4.18	4.87b	4.93ab	5.34ab	44.54
BARI F_1 tomato-3	44.75bc	135.4abc	37.83bcd	31.70cde	1.l8bc	4.24	4.42ab	5.01a	5.9lab	40.12
F-test	**	*	**	**	**	ns	*	**	*	
CV(%)	2.90	7.9	10.6	9.65	10.3	6.0	9.29	7.2	8.68	

** = Significant at 1% level, *= Significant at 5% level. Means followed by common letter (s) in a column do not differ significantly by DMRT.

Table 3. Interaction effect of growth regulator and tomato hybrids on yield and yield attributes during summer season.

Hybrids Hormone	Days to 50% flower	Plant height at last harvest	No. of fruits/ plant	Individual fruit wt (g)	Fruit yield/ plant (kg)	Fruit length (cm)	Fruit breadth (cm)	TSS (%)	Pericarp thickness (mm)	Yield (t/ha)
Without hormone										
HT019 × C-11	42.0	129.0	34.7c-g	26.75c	0.93c-f	4.35	3.84	4.4ab	5.24ab	31.62
HT019 × C-41	42.0	130.8	33.7d-h	28.1c	0.94c-f	3.62	3.87	4.47ab	4.64ab	31.96
HT019 × C-51	42.0	125.5	27.2f-I	29.0c	0.79e-g	3.64	4.24	4.77ab	5.30ab	26.86
HT019 × C-71	48.0	142.3	26.9f-I	26.15c	0.68fg	4.75	3.94	4.86ab	5.6lab	23.12
HT019 × WP7	45.0	136.6	21.6i	32.6bc	0.70fg	4.26	4.29	4.60ab	6.18ab	23.8
WP7 × C-51	45.0	148.2	6.9j	55.5a	0.37g	4.40	5.06	4.82ab	6.34a	12.58
C-41 × WP8	47.0	144.1	32.5d-I	34.2bc	l.12c-f	4.73	3.99	4.74ab	6.04ab	38.08
HT0I9 × WP10	43.0	131.0	42.2b-d	34.5bc	1.44a-c	3.80	4.49	4.22ab	5.53ab	48.96
C-l1 × WP10	43.5	133.5	29.0e-I	34.4bc	0.99c-f	4.36	4.6	5.13ab	5.05ab	33.66
C-41 × WP10	43.5	135.0	33.4d-I	35.1bc	1.14c-f	3.93	4.51	4.76ab	5.06ab	38.76
C-51 × WP10	43.0	133.8	23.5g-I	35.5bc	0.83d-g	3.96	4.57	4.71ab	5.68ab	28.22
BARI F_1 tomato-3	44.5	149.8	36.4b-f	25.65c	0.92c-f	4.17	4.67	4.80ab	6.34a	31.28

Table 3. Cont'd.

Hybrids × Hormone	Days to 50% flower	Plant height at last harvest	No. of fruits/ plant	Individual fruit wt (g)	Fruit yield/ plant (kg)	Fruit length (cm)	Fruit breadth (cm)	TSS (%)	Pericarp thickness (mm)	Yield (t/ha)
With hormone										
HT019 × C-11	46.5	115.7	47.5b	28.65c	1.32b-e	4.35	3.86	4.42ab	5.l3ab	44.4
HT019 × C-41	43.0	123.0	65.la	26.15c	1.76ab	4.15	3.56	5.07ab	5.8lab	59.84
HT019 × C-51	43.0	136.5	46.2bc	39.lbc	1.80ab	3.99	4.04	4.60ab	4.69ab	61.2
HT019 × C-71	50.0	151.8	41.4b-d	32.6bc	1.42ac	4.25	4.27	4.77ab	6.33a	48.28
HT019 × WP7	47.0	140.8	26.lf-I	31.35bc	0.80fg	5.01	3.99	4.66ab	5.50ab	27.2
WP7 × C-51	46.0	145.0	22.4h-I	56.25a	1.34a-d	4.51	5.43	4.65ab	4.40b	45.56
C-41 × WP8	46.5	135.0	39.2b-e	45.5ab	1.74ab	4.57	4.46	3.14b	5.7lab	59.16
HT019 × WP10	42.5	122.8	45.7bc	4l.lbc	1.87a	4.38	4.6	5.05ab	5.26ab	63.58
C-11 × WP10	45.5	125.0	34.8c-g	54.6a	1.8lab	4.55	4.96	4.28ab	4.44ab	61.54
C-41 × WP10	46.0	108.5	46.lbc	38.75bc	1.76ab	3.99	4.38	4.98ab	5.l6ab	59.84
C-51 × WP10	44.0	123.5	31.4d-I	55.9a	1.79ab	4.41	5.17	5.iSab	5.0lab	60.85
BARI F_1 tomato-3	45.0	121.0	39.3b-e	37.7bc	1.45abc	4.32	4.17	5.22a	5.48ab	49.3
F-test	ns	ns	**	**	**	ns	ns	**	**	**
CV(%)	2.90	7.9	10.6	9.65	10.3	6.0	9.29	7.2	8.68	10.2

** = Significant at 1% level, *= Significant at 5% level. Means followed by common letter(s) in a column do not differ significantly by DMRT

application of growth hormone not only influences the fruit setting but also trigger the growth of the fruits. The hybrid HT019 × C-41 produced the highest number of fruits per plant (65.05) when treated with hormone, while it was only 33.7 when remained untreated. Similar trend was also observed for other hybrids. The hybrid WP7 × C-51 produced only 6.9 fruits per plant when untreated. The highest individual fruit weight was recorded from the hybrid WP7 × C-51 (56.25 g) that was closely followed by C-5l × WP10 (55.9 g) and C-1l × WP10 (54.6 g) when treated with hormone. The highest fruit yield per plant was recorded from hormone treated hybrid HT0 19 × WP10 (1.87kg) whereas, it was the lowest from untreated hybrid WP7 × C-51 (0.37 kg/plant). However, this hybrid is more responsive to hormone since it produced the heaviest individual fruit (56.25 g) along with reasonable higher fruit yield per plant (1.34 kg). Yield potentiality of the hybrids C-41 × WP8, HT019 × WP10 and C-41 × WP10 during summer clearly indicated that these hybrids could be grown during summer without hormone application since they produced more than one kilogram of fruits per plant. The highest TSS of 5.22% was recorded from BARI F_1 tomato-3 when treated with hormone. Pericarp thickness ranged from 6.34 to 4.40 mm. Results reported here suggest that it is possible to produce tomato throughout the year in Bangladesh with the help of heat tolerant hybrids through chemical application for fruit set etc. The economic aspects of such crops have been calculated, and it has been observed that summer and rainy season crops under poly-tunnel are much more profitable than the main season crop (Kuo, 1993; Ahmad *et al,* 2008).

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