BANGLADESH JOURNAL OF PROGRESSIVE SCIENCE & TECHNOLOGY **BJPST**

BJPST: 13(2): 054-057 [July, 2015] **ISSN: 2305-1809** (Online version)

Available online at ***http:/www.bjpst.net***

DEVELOPMENT OF SUMMER HYBRID TOMATO VARIETY FOR HEAT TOLERANCE

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ABSTRACT

A field experiment was conducted to develop summer hybrid tomato variety for heat tolerance. Among the 10 cross combination maximum number of crossed fruits per plant was harvested from C41 x FP5 (31.0) while it was the lowest for FP5 x C71 (19.0). The average seed yield per plant was ranged from 2.78 g to 7.05 g of which the maximum amount of F_1 seeds harvested from the cross of C51 x C71 (7.05 g) followed by C11 x FP5 (6.58 g). Results clearly indicated that the summer tomato hybrid lines had the genetic potentiality to produce fruit during summer season. The highest number of fruits per plant was recorded from the hybrid C41 x C11 (27.07) that were followed by C51 x C71 (22.27). Individual fruit weight was ranged from 20.40 g to 46.27 g of which C11 x C71 produced the heaviest individual fruit. Among the hybrids, C41 x C11, C51 x C71 and C11 x C71 produced more than 1.0 kg of fruit per plant. A remarkable increase in number of fruit per plant, individual fruit weight and fruit yield per plant was observed for most of the cross combinations. The cross combination C41 x FP5 exhibited the highest heterosis over better parent (162.9%) for number of fruits per plant followed by C51 x C71 (80.56 %). The highest heterosis for individual fruit weight was recorded from C11 x C71 (66.01) followed by FP5 x C71 (65.71 %). Among the hybrid lines, C41 x FP5 showed the highest heterosis for fruit yield per plant (216.7 %) followed by C51 x C71 (158.3%).

Key words: *Summer hybrid tomato, heat tolerance, heterosis*

INTRODUCTION

Tomato is an important and nutritious vegetable crop grown round the world. Cool and dry weather condition is suitable while high humidity and high temperature are detrimental for tomato production (Kuo *et al.,* 1992). Tomato is mostly grown during winter in Bangladesh due to presence of congenial atmospheric conditions (Rashid, 1999). Production of tomato during summer in Bangladesh is very limited due to high temperature and other adverse climatic conditions. Production and supply of tomato during summer in Bangladesh is very limited and price of tomato is also very high. Some heat tolerant tomato varieties are in under cultivation in Bangladesh but their fruit bearing potentiality during summer is low due to severe flower and fruit dropping tendency. Development of heat tolerant tomato varieties can be made through hybridization between heat tolerant tomato lines. It was reported that hybrids showed higher yield performance than that of their involving parents (Ahmad *et al*, 2008; Patwary 2009). Eighteen parental lines of tomato were evaluated during summer for heat tolerance of which eight lines were found promising under Gazipur conditions (Anon, 2011). The heat tolerant lines can be taken in hybrid breeding program with a view to develop new tomato hybrids suitable for Sylhet region of Bangladesh during summer. Therefore, the present research project was conducted to develop heat tolerant tomato hybrid suitable for summer season in Sylhet region of Bangladesh.

MATERIALS AND METHODS

The experiment was conducted at the experimental field of Horticulture Department of Sylhet Agricultural University, Sylhet. The seeds of the five tomato parental lines were sown in the seed bed on 11 October, 2012 and the seedlings were transplanted in the main field on 11 November of the same year. The parental lines were C41, C51, C11, FP5 and C71. These five lines were crossed in half diallel fashion to produce hybrid seeds of 10 cross combinations. The cross combinations were C41 x C51, C41 x C11, C41 x FP5, C41 x C71, C51 x C11, C51 x FP5, C51 x C71, C11 x FP5, C11 x C71 and FP5 x C71. Unit plot size was 2.5m x 1.0m accommodating 10 plants having 60cm x 50 cm plant spacing. Five healthy plants of each cross combination were selected as maternal plant for crossing operation. Crossing operation was done as per AVRDC (1992). The seeds of the ten newly developed F_1 tomato lines along with their five involving parents were further sown in the seed bed on May 15, 2013. Seedlings were transplanted in the main field on June 10, 2013. The experiment was laid out in RCB design with three replications. The unit plot size was 2.0 m x 2.3 m

accommodating 20 plants in each plot having 60 cm x 40 cm plant spacing. All the crops were fertilized with well decomposed cowdung 10 ton, urea 550kg, TSP 450kg and MP 250kg 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 in three equal installments at 15, 30 and 45 days after transplanting. The crop was protected from rain providing polythene tunnel. Irrigation, pruning, mulching weeding and other intercultural operations were done as and when necessary. Full ripen fruits of each cross combination were collected separately for seed extraction. Data were recorded for some seed yield and yield contributing characters. The compiled data were subjected to simple statistical analysis for interpretation of results. Estimation of heterosis was made by the following formula:

$$H\ (\%) = \frac{(F1-BP)}{BP} \times 100$$

(Where F1= Mean of hybrid and BP= Mean of better parent)

RESULTS AND DISCUSSION

Hybrid seed production potentiality of tomato inbred lines

Seed yield and yield attributes are given in Table 1. Maximum number of crossed fruits per plant was harvested from C41 x FP5 (31.0) while it was the lowest for FP5 x C71 (19.0). The combination C11 x FP5 produced the highest number of seeds per fruit (109.0) closely followed by C51 x FP5 (102.8). The lowest number of seeds per fruit was counted from the cross combination of C41 x C11 (35.5). The average seed yield per plant was ranged from 2.78 g to 7.05 g of which the maximum amount of F_1 seeds harvested from the cross of C51 x C71 (7.05 g) followed by C11 x FP5 (6.58 g). The seed yield per kg of fruit of different cross combinations was varied from 3.7g to 6.47 g with an average of 5.26 g.

Performance of hybrids

Yield and yield parameters of summer tomato hybrids were displayed in Table 2. Results clearly indicated that the summer tomato hybrid lines had the genetic potentiality to bear fruit during summer season. The highest number of fruits per plant was recorded from the hybrid C41 x C11 (27.07) that was followed by C51 x C71 (22.27). Individual fruit weight was ranged from 20.40 g to 46.27 g of which C11 x C71 produced the heaviest individual fruit. Among the hybrids, C41 x C11, C51 x C71 and C11 x C71 produced more than 1.0 kg of fruit per plant. Therefore these hybrid lines may be tested against released hybrid tomato variety under Sylhet conditions.

Table 1: Hybrid seed yield and yield attributes of 10 cross combinations of tomato

Cross Combination	No. of fruits/ Plant	Individual fruit wt (g)	Fruit yield/ Plant (kg)	No. of seeds/ Fruit	Seed yield/ plant (g)	1000-seed wt (g)	Wt. of seed/ kg fruit	Seed yield/ha (kg)
C41 x C51	24.0	27.60	0.745	36.60	2.78	3.2	3.7	79.5
C41 x C11	26.5	19.60	0.578	35.50	3.28	3.48	5.65	121.4
C41 x FP5	31.0	21.00	0.735	58.50	4.13	3.4	5.58	120.0
C41 x C71	21.3	27.50	0.685	63.00	4.47	3.3	6.47	139.0
C51 x C11	25.5	41.00	1.23	73.80	6.22	3.3	5.05	108.0
C51 x FP5	22.5	45.00	1.12	102.80	6.39	2.88	5.7	122.5
C51 x C71	23.5	46.00	1.26	70.50	7.05	2.42	5.59	120.1
C11 x FP5	20.5	45.80	1.03	109.00	6.58	2.95	6.38	137.1
C11 x C71	22.00	50.00	1.2	97.00	5.23	2.46	4.35	93.5
FP5 x C71	19.00	43.60	0.915	67.50	3.8	2.96	4.13	88.8
Mean	23.58	36.71	0.9498	71.42	4.993	3.035	5.26	112.99
Max	31.00	50.0	1.26	109.0	7.05	3.48	6.47	139.0
Min	19.00	19.6	0.578	35.5	2.78	2.42	3.7	79.5
Std	3.44	11.49	0.25	25.42	1.51	0.37	0.93	20.08
CV%	14.61	31.29	26.51	35.59	30.25	12.25	17.76	17.77

Table 2: Yield and yield attributes of 10 tomato hybrids during summer

Hybrid/ Parents	Days to flower	Days to harvest	No. Of fruits/ plant	Individual fruit weight	Fruit yield/plant (g)	Fruit Length (cm)	Fruit breadth (cm)	TSS
C41 x C51	46.00c	85.33b-e	18.07de	44.03abc	0.84bc	4.167de	4.367bc	5.100ª
C41 x C11	47.67a-c	86.00a-d	27.07b	40.77c-e	1.11a	4.233cde	4.56ab	4.967ab
C41 x FP5	49.67ab	86.67a-d	35.50a	28.67g	0.94b	3.76fg	3.40fg	3.23d
C41 x C71	51.00a	88.67a	17.17ef	38.33ef	0.67d	4.53c	3.60ef	5.03a
C51 x C11	46.67bc	88.00a-c	16.27fg	36.30f	0.61d	4.30c-e	4.30cd	5.03a
C51 x FP5	46.33bc	85.00c-e	19.20d	42.07b-d	0.79c	4.20c-e	4.66a	4.90ab
C51 x C71	48.67a-c	84.67de	22.27c	40.67de	0.92b	4.33c-e	4.66a	5.06a
C11 x FP5	49.67ab	84.00de	16.20fg	35.30f	0.59d	4.13de	3.20gh	5.00ab
C11 x C71	51.00a	88.33ab	19.00d	46.27a	0.89bc	4.33cde	3.20gh	5.03a
FP5 x C71	50.67a	84.00de	15.17g	44.37ab	0.68d	3.50gh	3.10h	5.06a
C41	45.67c	82.33e	12.37hi	20.40h	0.27f	5.06b	3.66e	5.03a
C51	46.67bc	88.00a-c	10.40j	35.50f	0.36ef	3.23h	4.48abc	4.93ab
C11	46.33bc	87.00a-d	16.20fg	28.07g	0.46e	4.03ef	4.33bcd	4.60bc
FP5	45.67c	85.33b-e	13.37h	22.10h	0.31f	4.40cd	4.10d	4.26c
C71	48.67a-c	85.33b-e	12.03i	26.20g	0.34f	5.50a	3.46ef	4.96ab
F-Test	**	**	**	**	**	**	**	**
CV%	2.8	4.47	3.72	3.94	6.40	3.21	2.57	3.37

Table 3: Percent heterosis over better parent for number of fruits/plant, individual fruit weight and fruit yield per plant

Hybrids	Number of fruits /plant	Individual fruit Weight	Fruit yield per plant
C41 x C51	44.44	24.085	133.33
C41 x C11	66.63	43.014	136.96
C41 x FP5	162.96	21.076	216.67
C41 x C71	38.89	42.932	97.06
C51 x C11	1.84	3.9437	32.61
C51 x FP5	41.93	18.789	122.22
C51 x C71	80.56	15.549	158.33
C11 x FP5	1.84	25.355	28.26
C11 x C71	16.56	66.099	93.48
FP5 x C71	23.02	65.714	100.00

Performance of parental lines

Performances of parental lines of tomato during summer are presented in Table 2.0. Results indicated that the lines had the potentiality to produce flower and fruit, but the number of fruits per plant, individual fruit weight or fruit yield per plant were very low compared to their corresponding hybrids. However, among the lines, C11 produced the maximum number of fruits per plant (16.2) and fruit yield per plant (0.46 kg). In respect to individual fruit weight, the line C51 produced the heaviest individual fruit (35.5 g).

Estimation of heterosis

Better parent heterosis was estimated for the characters of number of fruits per plant, individual fruit weight and fruit yield per plant. A remarkable increase in number of fruit per plant, individual fruit weight and fruit yield per plant was observed for most of the cross combinations. The cross combination C41 x FP5 exhibited the highest heterosis over better parent (162.96%) for number of fruits per plant followed by C51 x C71 (80.56 %). The highest heterosis for individual fruit weight was recorded from C11 x C71 (66.01) followed by FP5 x C71 (65.71 %). Among the hybrid lines, C41 x FP5 showed the highest heterosis for fruit yield per plant (216.67 %) followed by C51 x C71 (158.33%).

From the above discussion it can be concluded that the hybrids C41 x C11, C41 x FP5, C51 x C71 and C11 x C71 performed very well during summer season in

Sylhet region of Bangladesh in respect of fruit yield and yield attributes. Therefore, further evaluation of these lines along with popular summer tomato varieties may be done for recommendation.

ACKNOWLEDGEMENTS

The authors are grateful to Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka to support the research project.

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