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Variability and Inherritance of Some Quantitative Trians in Tomato

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Abstract: ***The study was conducted to estimate heterosis of 10 tomato cross combinations involving 10 parents in the green house of Vegetable research division of PSARI during the spring season of 2010-2011. Analysis of variance indicated highly significant differences for all the characters suggesting the presence of genetic variability among the studied materials. Three combinations (7B-1 xVentura, 7B-1 xIyulski, 7B-1 xÀpelsin) showed significance for early flowering, while two 7B-1 xÀpelsin (4.5%) and 7B-1 xRavid (3.3%) for individual fruit weight.***

Keywords: heterosis, fruit characters, genetic variability

1. Introduction

Heterosis in tomato was first observed by Hedrick and Booth /1908/ for higher yield and more number of fruits. Since then, heterosis for yield, its components and quality traits were extensively studied. Chaudhary /1965/ emphasized the extensive utilization of heterosis to step up tomato production.

We are recently studying to develop hybrid tomato varieties using male sterile technique and to adopt the hybrid seed production technique in Mongolia for the first time.

The extent of heterosis for yield components and characters of tomato in cross combinations involving tolerant accessions and processing /breeding/ varieties is reported in this paper.

2. Objectives

The objective is to develop hybrid tomato varieties using male sterile technique and to adopt the hybrid seed production technique for the first time in Mongolia. Following tasks are identified:

1) Development of hybrid seed materials by crossing tomato varieties which selected as a result of previous variety tests. /2010/
2) Identification of best combinations through yield and crop quality and reveal combination ability of tomato lines /2011/

3. Materials and methods

The male sterile tomato line 7B-1 used as female parent and another 10 tomato varieties selected as male parent for hybrid seed development.

The tomato seed planted in glasshouse on 30 March and after 50 days old seedlings were transplanted into the plastic greenhouse in 21 of May 2010.

4. Results and Discussions

Experiment-1: Crossing plot
The 10 best tomato varieties which are selected from yield trial conducted in 2007-2009 are used as male parent and male sterile line 7B-1 is used as female parent.

For crossing 4-6 plants from 7B-1 male sterile line and 10 plants from each male parent and 5-10 flowers from each plants used for crossing. Totally 80-120 plants used for 10 combinations and total 190 flowers are pollinated. The crossing carried out from 28 June to 9 July 2010.

Table 1: Results of crossing tomato varieties /2010/

	Combination	Number of pollinated flowers	Number of fruits	Successful seed fertilization %
1	7B-1 xKarlson	24	20	83.3
2	7B-1 xVentura	16	13	81.3
3	7b-1 xEfimya	14	10	71.4
4	7B-1 xÀpelsin	16	14	87.5
5	7B-1 xJeltygigant	12	5	41.7
6	7B-1 xIyulski	24	14	58.3
7	7B-1 xPertsevidnii	18	14	77.8
8	7B-1 xRavid	24	18	75.0
9	7B-1 xNaama	24	20	83.3
10	7B-1 xDe baroakrasni	18	16	88.9

After the crossing the successful seed fertilization rate ranges between 41.7-88.9% and the variety De baraokrasni showed the highest performance 88.9%.

As an overall result we were able to harvest 144 fruits and 8513 hybrid seeds of 10 from combinations. Approximately, each fruit holds about 34-110 seeds /table2/.

Table 2: The amount of tomato hybrid /F1/ seeds from combination

д/д	Combination	The number of harvested fruits	Number of harvested seed	Number of seeds per fruit	Weight of 1000 seed, g
1	7B-1 xKarlson	20	687	43	4.07
2	7B-1 xVentura	13	310	34	3.95
3	7b-1 xEfimya	10	990	110	3.43
4	7B-1 xÀpelsin	14	1077	82	3.68
5	7B-1 xJeltygigant	5	137	46	3.53
6	7B-1 xIyulski	14	791	60	3.70
7	7B-1 xPertsevidnii	14	492	35	3.29
8	7B-1 xRavid	18	1051	81	3.75
9	7B-1 xNaama	20	1800	60	3.84
10	7B-1 xDe baroakrasni	16	1178	78	3.71
	Total	144	8513		

Experiment 2:
In 2011 the study was undertaken to estimate the heterosis in tomato and combining abilities of tomato varieties and find out high heterosis lines.

Materials and Methods
The 10 male parent varieties and 10 lines which were crossed in 2010 planted in randomized block each on 3.2 m^2 plots. Seedlings were transplanted on 10 May with apart 70õ40 cm or 10 plants per plot. Plant growth and development, yield performance and structure, morphology, biochemistry components were studied during growing period. The collected data were statistically analyzed. For estimation of heterosis in each character, the mean values have been compared with better parent /BP/.

5. Results and Discussions

Inheritance capacity of hybrids
Inheritance capacity is important in yield performance increase breeding program, at the same time yield factors are essential. In comparable studies of 10 hybrid lines with their parents, the differed by leaf shape, color, flower shape and diameter, fertilization capability, fruit color and shape, inside color and morphology resulted in leaf shape modification similarly to potato's and light green color, but all fertilized. Red fruit color dominated than yellow and long shape round one's.
Quantity of inheritance traits like yield, fruit numbers, size, plant heights are differed depending on parent characters.

Combining ability of tomato and heterosis
Proportion of matured fruits is essential in green house tomato production. The proportion varied.4 to 14.1 kg/m^2 among studied materials.7B-1 x Jeltygigantand 7B-1 x Iyulski were indicated 0.5-3.3% higher yield than their parents. On the contrary, 7B-1 x Åfimiya, 7B-1 x Naama showed less yield than their parents.

Table 3: Yield performance of tomato varieties and combination lines

No.	Varieties and hybrids	Average yield, kg/ m^2	Fresh yield			
			Matured on plants		Green fruits	
			Total yield kg/ m^2	Perce tags in total yield	Yield kg/m^2	Perce tags in total yield
1	Karlson	9.2	8.8	95.7	0.25	2.7
2	7B-1 x Karlson	7.7	7.4	96.1	0.17	2.2
3	Ventura	7.0	6.8	97.1	0.10	1.4
4	7B-1 x Ventura	10.5	10.1	96.2	0.28	2.6
5	Efimya	11.9	11.5	96.6	0.17	1.4
6	7B-1 x Efimya	11.3	10.4	92.0	0.67	5.9
7	Àpelsin	10.3	9.7	94.2	0.30	2.9
8	7B-1 x Àpelsin	10.7	10.2	95.3	0.37	3.4
9	Jeltygigant	10.7	10.0	93.5	0.16	1.5
10	7B-1 x Jeltygigant	13.5	12.9	95.5	0.30	2.2
11	Iyulski	7.0	6.6	94.3	0.23	3.3
12	7B-1 x Iyulski	14.7	14.1	95.9	0.49	3.3
13	Pertsevidni	7.7	7.2	93.5	0.41	5.3
14	7B-1 x Pertsevidnii	7.9	7.5	94.9	0.24	3.0
15	Ravid	5.6	5.2	92.8	0.10	1.8
16	7B-1 x Ravid	10.9	10.3	94.4	0.37	3.4
17	Naama	7.2	6.8	94.4	0.12	1.7
18	7B-1 x Naama	8.5	8.0	94.1	0.31	3.6
19	De baraokrasni	6.9	6.4	92.7	0.39	5.7
20	7B-1 x De baraokrasni	10.1	9.7	96.0	0.30	2, 9

Statistical analysis of tomato hybrid lines proved that their inheritance rate is an adequate (H^2=0.90). This fact confirmed, can be developed out hybrid lines with high yield performances and inheritance modification. Plant fruit

number increase and distribution of balanced growth are the main factors high yield performance of tomatoes. There is a tendency to be developed out large fruiting (101.3-140.5g) hybrids for combining lines 7B-1 x Àpelsin, 7B-1 x Iyulski, 7B-1 x Jeltygigant and 7B-1x Ravid, but by seed number in fruits dominated female parent genotypes. That is meaning hybrid lines (F_1) became small number seeds in fruits than male parents. This character could be useful for tomato fresh consumption market needs.

Table 4: Percent heterosis of tomato hybrids over better parent

Crosses	Plant height at last harvest, cm	Per one plant				Weight of 1000 seeds, g
		Internode measure, cm	Number of fruits per cluster	Individual fruit weight, g	Number of seeds in a fruit	
7B-1 x Karlson	- 0.2*	- 1**	3.0**	- 0.4*	- 21**	- 0.16*
7B-1 x Ventura	158.5**	2.7**	- 2.5**	25.5**	- 9**	0.97**
7B-1 x Efimya	57.8**	1.5**	3.8**	- 19.6**	23**	- 0.18*
7B-1 x Àpelsin	114.9**	0.1*	4.5**	58**	- 21**	0.78**
7B-1 x Jeltygigant	62.7**	- 0.9**	0.8**	- 101.1**	- 58**	0.02
7B-1 x Iyulski	236.5**	2.7**	0.4*	2.7**	- 43**	1.35**
7B-1 x Pertsevidnii	- 49.7**	- 1.2**	2.6**	27.1**	- 14**	0.34*
7B-1 x Ravid	111.8**	2.7**	3.3**	- 52**	- 42**	0.86**
7B-1 x Naama	117**	2.4**	2.9**	- 67.5**	- 49**	0.95**
7B-1 x De baroakrasni	- 14.1**	- 1.1*	1.8**	2.1**	2**	0.1*

*Significant at 5% level of probability
** Significant at 1% level of probability

Plant height measurement of varieties and hybrid lines 6 to 8 leaf stage or on 45 days showed that plant height increased by 7 to 10 cm in hybrids than varieties (determinant type) Ventura, July, Ravid and Naama.

Further growth and development of hybrids intensified and at fruit maturing stage were 111.8 to 236.5 cm higher than male parents. Plant height of 7B-1mutant line reaches 264 cm in light intensity condition. This fact confirms that the mutant 7B-1 line's height dominated in combining hybrids. The finding suggested that by breeding 7B-1xIyulski can be grown hybrid line grow up to 324.6 cm height with good yield potential in green house growing. Numbers of seeds in hybrid fruits were low, however the large size allowed to increase the number of seeds with good quality and heterosis traits. High growing hybrid lines permit to increase the tomato raceme number, resulting in adequate harvesting.

6. Conclusion

As this experiment proved, tomato breeding program, can be started using male sterile line and produce heterosis (F_1) seeds. Early maturing 7B-1 x Iyulski tomato hybrid line provided higher yield-15.3 kg/m^2 and sugar acid ratio; its male parent selected as an appropriate variety in terms of performance, disease and pest tolerance in Mongolia. All hybrids have been grown 57.8 to 236.5 cm higher than their parents, providing more crossing heterosis in plant height. 7B-1 x Ravid has higher biochemical component than its male parent or can be find out higher heterosis.

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