Karnataka J. Agric. Sci., 22(2) :(395-398) 2009

Genetic studies on tospovirus resistance and yield components in tomato (*Solanum lycopersicum* Mill.) Wettsd*

K. H. YASHAVANTA KUMAR, SATISH S PATIL , P. R. DHARMATTI, A. S. BYADAGI, S. T. KAJJIDONI AND R. H. PATIL

Department of Horticulture
University of Agricultural Sciences, Dharwad - 580 005, Karnataka, India.
E-mail: yashhrt@gmail.com

(Received : October, 2008)

Abstract : Six geographically divergent lines were crossed with six testers in line x Tester fashion for estimation of combining ability effects for tospovirus resistance and economic characters including average fruit weight, number of fruits per plant and yield per plant. Estimates of gca, sca and their ratio indicated higher magnitude of non-additive gene action for majority of characters except TSS. The parents S-61(294.47) & (-5.76), S-05(350.85) & (-3.26) (Lines) and BFL (217.27) & (0.90) and Arka Alok (83.93) & (-7.01). (Testers) were found to be good general combiners for yield and tospovirus resistance. The crosses S-05 x BFL(859.61)&(-19.65), S-61 x Arka Alok(1037.96)&(-6.74), S-61 x BFL(812.33)&(-17.15) and S-05 x DMT-1(755.03)& (-13.82)were exhibited significant sca effect for yield and tospovirus resistance.

Key words : Combining ability, general combining ability, specific combining ability, non additive gene action, tospovirus

Introduction

In India, the major biotic constraints in the cultivation and production of tomato are the damage caused by insect and diseases. Tomato is susceptible to more than 200 diseases, important achievements in chemical, biological, cultural and genetic control methods have greatly reduced economic losses and sometimes have eliminated them. Viral diseases are a special case since they cannot be controlled by chemical treatments. Crop protection must then rely on genetic resistance or disease avoidance. Among the viral diseases, tomato spotted wilt virus is raising to an alarming proportions in India and becoming a limiting factor for tomato cultivation. In fact, early infection leads to loss upto 100 per cent as reported by Kumar and Irulappan (1991) thus tomato cultivation is almost precluded during summer season. Besides, disease intensity is increasing during the remaining period of the year. Also presence of wide host range for the vector as well as virus ensures abundant inoculum in nature resulting in fast spread of the disease. The balance of demand and supply could not be met throughout the year, especially during summer. Hence, Indian tomato industry is in a desperate need of tomato varieties tolerant to tomato spotted wilt virus to stabilize tomato production.

Material and methods

The material for experiment consisted of six diverse female parents (S-07, S-61, S-05, S-42, S-52 and S-20) were crossed with six male parents *viz.*, DMT-1, DMT-2, DMT-3, Arka Alok, Megha and BFL having desirable traits. The resulting 36 F_1 hybrids from Line x Tester mating design along with 12 parents and checks (Lakshmi and NS-585) were evaluated in a Randomized Block Design with three replications under natural conditions during summer 2008 at Vegetable block, Division of Horticulture UAS, Dharwad. Observations were recorded on three random plants from each entry and the average from these three plants was worked out for the purpose of statistical computation.The details of observations recorded in each experiment were as follows plant height(cm), number of branches, fruit clusters per plant , number of fruits per cluster, number of fruits per plant, average fruit weight (g), fruit yield per plant (g) , locules per fruit, total soluble solids (TSS),Tomato spotted wilt virus infection (%), TSWV symptom severity (%) Kumar and Irulappan, (1991), fruit set (%) and days to first fruit maturity. Combining ability effects were computed following Kempthorne (1957).

Results and discussion

Combining ability analysis helps in diagnosing the additive and non-additive gene action would inturn lead a breeder to select desirable and suitable parents and/or cross combinations that would be exploited for crop improvement.

When the analysis of variance for combining ability with respect to yield was looked into it revealed that line x testers contribution was higher than that of lines and testers contribution individually. SCA variance was greater than GCA indicating the predominance of non-additive gene action

The choice of parents in a breeding programme is generally based on the per se performance of parents and their $F_{1'S}$. However gca and sca effects are more informative than per se values as they also provide information about the type of gene action; that is additive or non additive. The studies on general combining ability of parents revealed that the line S-61 was a good general combiner for plant height, fruit cluster per plant, fruits per cluster, and S-05 for average fruit weight, locales per fruit, number fruits per plant and yield per plant. Similar

*Part of M.Sc.(Agri.) thesis, submitted by the senior author to the University of Agricultural Sciences, Dharwad-580 005, India.

Table 1. Analysis of variance in respect of 12 characters for combining ability

Sl. No.	Source	Mean sum or squares						Per cent contribution			Random effect		
		Replication	Crosses	Lines x Testers	Testers	Line x	Error	Lines	Tester	Line x	σGCA^2	σSCA^2	$\sigma GCA^2/\sigma SCA^2$
	Degrees of freedom	1	35	5	5	25	35	(%)	(%)	Tester (%)			
1	PH	35.870	171.301**	294.049**	47.498**	171.512**	18.365	24.52	3.96	71.52	-0.006	76.573	-0.0001
2	NB	0.039	4.051**	2.624**	2.515**	4.644**	0.352	9.25	8.87	81.88	-0.173	2.146	-0.008
3	FCPP	0.815	13.986**	20.942**	3.877**	14.616**	0.328	21.39	3.96	74.65	-0.018	7.144	-0.003
4	FPC	0.006	0.823**	1.028**	0.632	0.820**	0.024	17.84	10.98	71.18	0.0001	0.398	-0.0003
5	AFW	1.288	172.045**	173.815**	79.784**	190.143**	8.783	14.43	6.62	78.94	-0.528	90.680	-0.006
6	LPF	0.073	0.944**	2.457**	1.646**	0.500**	0.117	37.20	24.92	37.88	0.013	0.192	0.067
7	TSS	0.036	0.581**	2.239**	0.341**	0.297**	0.030	55.10	8.40	36.51	0.083	0.1336	0.061
8	TSWV SS (%)	17.014	467.014**	192.847**	346.181**	546.014**	35.585	5.90	10.59	83.51	-2.304	255.214	0.010
9	D 1st M	2.000	59.541**	67.856**	108.622**	48.062**	9.886	16.28	26.06	57.66	0.335	19.088	0.018
10	NFPP	0.502	96.787**	88.983**	46.921**	108.321**	2.110	13.13	6.93	79.94	-0.336	53.106	-0.006
11	YLD	4019.456	583353.32**	780761.103**	272507.481**	606040.937**	13343.404	19.12	6.67	74.21	-661.722	296348.767	-0.002
12	PFS	2.494	233.449*	297.292**	90.011**	249.368**	113.026	18.19	5.51	76.30	-0.464	68.171	-0.007

* - Significant at 5% level
** -Significant at 1% level
PH = Plant height
AFW =Average fruit weight
D 1stM = Days to 1st maturity
NB = Number of branches
LPF = Locules per fruit
NFPP = Number of fruits per plant
FCPP = Fruit cluster per plant
TSS = Total soluble solids
YLD = Fruit yield per plant
FPC = Fruits per cluster
TSWV SS (%) = Tomato spotted wilt virus symptom severity (%)
PFS = Per cent fruit set

Table 2. Estimation of general combining ability of 12 characters in line x tester study of tomato

Sl. No.	Character	Lines						Testers					
		S-07	S-61	S-05	S-42	S-52	S-20	DMT-1	DMT-2	DMT-3	Arka Alok	Megha (L-15)	BFL
1	PH	-1.25	5.49**	5.00**	-2.89*	1.15	-7.50**	-1.05	-2.21	-0.25	0.11	-0.30	3.69**
2	NB	-0.20	-0.17	-0.17	-0.45*	0.88**	0.11	0.11	-0.34	-0.06	0.13	-0.59**	0.75**
3	FCPP	-0.92**	1.83**	0.33	-0.78**	1.14**	-1.59**	-0.12	-0.25	-0.17	-0.14	-0.45**	1.13**
4	FPC	-0.02	0.48**	0.12**	-0.35**	0.01	-0.24**	0.01	-0.35**	-0.13**	0.32	0.15**	0.01
5	AFW	0.03	3.82**	5.40**	-2.90**	-3.01**	-3.34**	-1.66	1.75**	-2.41**	1.45	-2.81**	2.67**
6	LPF	-0.79	0.24**	-0.30**	-0.45	-0.12*	-0.17	0.37**	0.25**	0.59**	0.01**	0.28**	0.24**
7	TSS	-0.92**	-1.83**	-0.33**	-0.78**	1.14**	-1.59**	-0.12**	-0.25**	-0.17**	0.14**	-0.45**	1.13**
8	TSWV SS (%)	3.40	-5.76**	-3.26	2.99	-1.18	3.82*	0.07	6.32**	-5.35**	-7.01**	5.07**	0.90
9	D 1st M	-4.53**	-0.11	2.06*	1.56	1.06	-0.03	3.89**	-0.53	-2.94**	1.31	-3.86**	2.14*
10	NFPP	-2.22**	2.86**	3.67**	-0.83	-0.36	-3.11**	2.11**	-3.33**	-1.06*	0.67	0.06	1.56**
11	YLD	-148.33**	294.47**	350.85**	-129.48**	-115.86**	-251.64**	81.13*	-169.26**	-132.65**	83.93*	-80.42*	217.27**
12	PFS	3.24	0.23	-5.73	7.42*	-0.14	-5.03	0.71	-1.31	1.87	3.50	-0.36	-4.40

* - Significant at 5% level
** -Significant at 1% level
PH = Plant height
AFW =Average fruit weight
D 1st M = Days to 1st maturity
NB = Number of branches
LPF = Locules per fruit
NFPP = Number of fruits per plant
FCPP = Fruit cluster per plant
TSS = Total soluble solids
YLD = Fruit yield per plant
FPC = Fruits per cluster
TSWV SS (%) = Tomato spotted wilt virus symptom severity (%)
PFS = Per cent fruit set

Table 3. Estimation of specific combining ability of 12 characters in line x tester study of tomato

Hybrids	Characters											
	PH	NB	FCPP	FPC	AFW	LPF	TSS	TSWV SS (%)	D 1st M	NFPP	YLD	PFS
S-07 x DMT-1	-2.23	0.14	-1.97**	-0.01	5.33 *	-0.00	-0.02	12.01 **	5.11 *	-5.50 **	-230.04 **	-2.88
S-07 x DMT-2	1.77	0.76	1.34**	0.35 **	-6.21 **	-0.08	0.04	-1.74	-3.47	9.78 **	452.32 **	4.14
S-07 x DMT-3	-9.86 **	-1.19	0.09	0.13	-1.67	0.21	0.24	7.43	2.94	-5.33 **	-282.46 **	-10.29
S-07 x Arka Aloka	6.94 *	-0.38	2.06**	-0.32 **	9.84 **	-0.24	0.13	-10.90 *	-2.81	2.61 *	328.07 **	11.03
S-07 x Megha	3.26	-0.16	0.70	-0.15	-2.15	-0.26	-0.66**	-5.49	2.36	1.72	87.57	0.54
S-07 x BFL	0.13	0.84	-2.22**	-0.01	-5.13 *	0.37	0.28*	-1.32	-4.14	-3.28 **	-355.46 **	-2.53
S-61 x DMT-1	-14.30 **	-1.55**	-1.38**	-0.51 **	-6.59 **	-0.20	0.13	13.68 **	-1.31	-10.25 **	-762.87 **	-6.12
S-61 x DMT-2	0.37	-0.94*	2.09**	0.35 **	-3.50	-0.08	-0.06	-12.57 **	-8.39 **	-3.64 **	-341.08 **	1.33
S-61 x DMT-3	-6.93 *	-1.72**	-1.66**	-0.04	-3.09	-0.24	-0.66**	4.10	6.03 **	-3.08 **	-286.84 **	18.97*
S-61 x Arka Aloka	14.72 **	2.59**	2.98**	0.02	6.55 **	0.66**	0.03	-6.74	4.28	14.03 **	1037.96 **	2.33
S-61 x Megha	-7.14 *	-0.52	-4.38**	-0.48 **	-7.44 **	-0.05	0.19	18.68 **	-2.56	-4.86 **	-459.49 **	-13.39
S-61 x BFL	13.29 **	2.14**	2.36**	0.66 **	14.08 **	-0.08	0.38**	-17.15 **	1.94	7.81 **	812.33 **	-3.12
S-05 x DMT-1	6.35 *	0.12	2.12**	-0.15	5.33 *	-0.16	-0.05	-13.82 **	-1.97	9.78 **	755.03 **	-4.62
S-05 x DMT-2	-13.65 **	-0.27	-1.91**	0.21	-15.58 **	0.46	0.41**	32.43 **	2.94	-5.78 **	-618.78 **	6.90
S-05 x DMT-3	6.89 *	0.28	0.34	0.15	-2.92	-0.70**	-0.04	-8.40	-2.14	3.95 **	137.30	-2.15
S-05 x Arka Aloka	-11.30 **	-1.91**	-4.19**	-0.77 **	-2.03	0.45	0.40**	10.76 *	-0.89	-13.28 **	-924.75 **	-16.12*
S-05 x Megha	-0.40	-0.86*	-2.72**	-0.29 *	8.72 **	-0.01	-0.28*	-1.32	2.78	-5.67 **	-208.42 *	11.93
S-05 x BFL	12.12 **	2.64**	6.36**	0.85 **	6.49 **	-0.04	-0.45**	-19.65 **	-0.72	11.00 **	859.61 **	4.07
S-42 x DMT-1	4.74	1.73**	2.23**	0.32 **	-0.38	0.99**	-0.11	4.93	-4.97 *	0.11	4.00	19.029*
S-42 x DMT-2	9.07 **	0.84	-0.30	0.68 **	8.30 **	-0.74**	0.05	-16.32 **	2.44	0.89	218.12 *	-5.04
S-42 x DMT-3	0.27	0.56	-0.05	-0.70 **	0.37	0.45	-0.15	-17.15 **	-1.64	-1.05	-10.55	-3.23
S-42 x Arka Aloka	4.41	-1.47**	-0.41	0.02	-1.98	-0.48	-0.41**	-10.49 *	1.11	3.56 **	140.87	-16.11*
S-42 x Megha	-7.84 *	0.59	2.89**	0.19	-1.48	0.15	0.11	14.93 **	-3.22	3.34 **	178.46 *	7.31
S-42 x BFL	-10.67 **	-2.25**	-4.35**	-0.51 **	-4.83 *	-0.38	0.49**	24.10 **	6.28 **	-6.83 **	-530.90 **	-1.95
S-52 x DMT-1	6.86 *	-0.78	-0.02	1.13 **	-2.26	-0.84**	0.28*	-3.40	4.03	7.31 **	337.72 **	-0.07
S-52 x DMT-2	2.36	-0.16	-0.05	-0.84 **	28.08 **	0.11	-0.21	-19.65 **	-3.56	-0.42	448.55 **	-3.73
S-52 x DMT-3	2.83	0.56	0.87*	0.10	-5.01 *	0.12	0.64**	19.51 **	-3.14	5.47 **	216.66 *	-8.74
S-52 x Arka Aloka	-11.30 **	-0.13	-2.00**	0.15	-10.37 **	0.52*	-0.32*	13.68 **	-0.89	-7.25 **	-539.42 **	17.70*
S-52 x Megha	6.86 *	1.42**	2.14**	0.66 **	-0.36	-0.19	-0.01	-20.90 **	7.78 **	3.19 **	199.09 *	6.57
S-52 x BFL	-7.62 *	-0.91*	-0.94*	-1.20 **	-10.09 **	0.28	0.37**	10.76 *	-4.22	-8.31 **	-662.60 **	-11.73
S-20 x DMT-1	-1.42	0.34	-0.97*	-0.79 **	-1.43	0.21	-0.23	-13.40 **	-0.89	-1.44	-103.85	-5.32
S-20 x DMT-2	0.08	-0.22	-1.16**	-0.76 **	-11.09 **	0.33	-0.22	17.85 **	10.03 **	-0.83	-159.13	-3.59
S-20 x DMT-3	6.81 *	1.51**	0.42	0.35 **	12.32 **	0.17	-0.02	-5.49	-2.06	0.05	225.90 **	5.44
S-20 x Arka Aloka	-3.48	1.31**	1.56**	0.90 **	-2.01	-0.92**	0.17	3.68	-0.81	0.33	-42.74	1.17
S-20 x Megha	5.26	-0.47	1.36**	0.07	2.72	0.37	0.64**	-5.90	-7.14 **	2.28 *	202.78 *	-12.96
S-20 x BFL	-7.25 *	-2.47**	-1.22**	0.21	-0.51	-0.16	-0.33**	3.26	0.86	-0.39	-122.98	15.27*

* - Significant at 5% level
** -Significant at 1% level
PH = Plant Height
NB = Number of branches
FCPP = Fruit cluster per plant
FPC = Fruits per cluster
AFW =Average fruit weight
LPF = Locules per fruit
TSS = Total soluble solids
TSWV SS (%) = Tomato spotted wilt virus symptom severity (%)
D 1st M = Days to 1st maturity
NFPP = Number of fruits per plant
YLD = Fruit yield per plant
PFS = Per cent fruit set

results were obtained by Anbu *et al.* (1980) (39.60), Aswini (2005) (16.80) and Bhatt *et al.* (2001)(48.33) respectively for yield in positive direction.

Among the testers, BFL was found to be a good general combiner for plant height, number of branches fruit cluster per plants, average fruit weight and yield per plant. The line Megha (L-15) was a good general combiner for fruits per clusters, TSS and days to first maturity.

The cross S-61x Arka Alok showed significant sca effect for plant height, number of fruits per plant, fruit yield per plant and cross S-05 x BFL showed significant high sca effect for number of branches and fruit clusters per plant.

The overall gca status of parents considering all characters revealed that the line S-61(294.47)&(-5.76), S-05 (350.85) & (-3.26) and testers BFL (212.27) & (0.90) and Arka alok (83.93) & (-7.01) were high combiners for yield and tospovirus resistance. These parents can be utilized in crop improvement programmes for developing high yielding hybrids coupled with less Tomato spotted wilt virus symptom severity and higher TSS and less locules. Those parents which had high gca effects for different economic characters can be used for conventional breeding programme and crosses with high sac effects for exploitation of hybrid viger. Similar results were obtained by Chadda *et al*. (2002) (65.50), Dharmatti *et al*. (2001) (659.60), Gaikwad *et al.* (2002) (56.36) and Premalakshmi *et al.*, (2006) (36.63) for yield character.

Reference

Anbu, S., Muthukrishnan, C. R. and Irulappan, I., 1980, Line x Tester analysis in tomato (*Lycopersicon esculentum* Mill.) Part-I, Combining ability. South Indian Hort., 28: 128-135.

Ashwini, M. C., 2005, Heterosis and combining ability studies for heat tolerance in tomato. *M.Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad (India).

Bhatt, R. P., Biswas, V. R. and Kumar, N., 2001, Combining ability studies in tomato (*Lycopersicon esculentum* Mill.) under mid hill conditions of central Himalaya. Indian J. Genet. Pl. Breed., 61: 74-75.

Chadha, S., Vidyasagar and Kumar, J., 2002, Combining ability and gene action studies for some fruit characters in bacterial wilt resistant tomato lines. South Indian Hort., 50: 65-71.

Dharmatti, P. R., Madalageri, B. B., Patil, R. V., Mannikeri, I. M. and Patil., G., 2001, Combining ability studies in summer tomato. Karnataka J. Agric. Sci., 14: 417-422.

Gaikwad, S. P., Raijadhav, S. B., Dumbre, A. D. and Bhor, T. J., 2002, Combining ability analysis in tomato by use of line x tester technique. J. Maharashtra Agric. Univ., 27: 308-310.

Kempthorne, O., 1957, An Introduction to Genetic Statistics, New York, John Wiley and Sons, pp. 456-471.

Kumar, N. and Irulappan, I., 1991 Breeding tomatoes for resistance to spotted wilt virus (TSWV) I. Identification of sources of resistance. South Indian Hort., 39:188-192.

Premalakshmi, V., Thyagaraj, T. Veeraragavathatham, D. and Arumugam, T., 2006, Heterosis and Combining ability analysis in tomato [*Lycopersicon esculentum* (Mill.) Wettsd] for yield and yield contributing traits. Veg. Sci., 33: 120-122.