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Short Communication

Assessment of genetic potential for economically important characters in an intervarietal cross of tomato: P-4-5-2 × UC 82-B

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Processing industry requires fruits that are firm, having thick pericarp, optimum acidity and high total soluble solids (TSS). To combine all these traits into a single genotype, it is imperative to first study gene effects governing the inheritance of such traits. The material for the present investigation comprised of two parents, F_1, B_1, B_2 and F_2 generations derived from the cross P4-5-2 × UC-82-B. The line P4-5-2 is a locally developed high yielding genotype while UC-82-B is a processing variety introduced from USA. Each of three replications comprised of 17 rows representing one row each of P_1, P_2 and F_1; four rows of each back cross (B_1 and B_2) and six rows of F_2. Data on single plant basis were recorded on TSS% (using hand refractometer), pH (using pH indicator papers), number of locules, pericarp thickness (cm), fruit shape index (ratio of polar/ equatorial diameter), fruit weight (g) and yield plant^{-1} (kg). Data were analyzed following the procedure of Mather and Jinks [1]. The model with most number of significant parameters and least χ^2 value was considered the most fit.

The mean values for different generations along with their respective standard errors are reported in Table 1. Non- significant estimates of χ^2 (Table 2) for pH, number of locules and pericarp thickness revealed that the additive - dominance model was adequate to account for the total genetic variation exhibited by these traits. For pH, although additive - dominance model was adequate, but neither additive nor dominance effects were significant. Such a situation could arise either due to lack of genetic variability between the parents involved in the cross or due to dispersal of positive and negative alleles between the parents. Their cancellation effect might have resulted in non-significant estimates of gene effects. For rest of the traits, estimates of χ^2 were significant indicating the presence of digenic or higher order gene interactions. Consequently, the model was extended to six parameters to include digenic interactions. Sequential fitting of the six parameters (m [d] [h] [i] [j] and [l]) resulted in non- significant estimates of χ^2 for all those characters where additive-dominance model was found to be inadequate (Table 2). This suggested that higher order gene interactions were absent for these traits. Four parameter model, m. [d] [h] and [j], was the best fit for pericarp thickness and yield plant^{-1} whereas five parameter model, m [d] [h] [i] and [j], was best fit for fruit shape index and m [d] [h] [j] and [l] was the best fit for fruit weight.

Based upon the results obtained from the best fit model for respective characters, the additive component of gene effects was significant for TSS, fruit shape index, fruit weight and yield plant^{-1}; the dominance for number of locules, pericarp thickness, fruit shape index (undesirable direction in all cases) and fruit weight; additive × additive for fruit shape index; additive × dominance for TSS, pericarp thickness, fruit shape index, fruit weight and yield plant^{-1} (negative and undesirable direction in all cases) and dominance × dominance for fruit weight. Opposing signs of [h] and [l] for fruit weight indicated duplicate type of epistasis which inhibits their utilization through heterosis breeding.

Rick and Butler [2] observed that small fruit size was partially dominant over large fruit size. Banerjee and Kalloo [3] reported that fruit weight seemed to be governed by additivity. The predominance of additive gene effects for total yield was reported by Cheema *et al.* [4] and Kalloo *et al.* [5] and for TSS by Lower and Thompson [6].

Estimates of genetic effects based upon the best fit model have clearly brought out the overwhelming importance of fixable ([d] and [i]) gene effects for the improvement of characters under study. Even though

Table 1. Generation means of different characters in the cross P 4-5-2 × UC82 B

Generation/ Character	Total soluble solids (%)	pH	Number of locules	Pericarp thickness (cm)	Fruit shape index	Fruit weight (g)	Yield plant^{-1} (kg)
P 4-5-2	4.12 ± 0.09	4.37 ± 0.13	1.25 ±0.14	0.72 ± 0.04	1.00 ± 0.03	63.26 ± 2.67	1.45 ± 0.09
UC 82-B	4.41 ± 0.08	4.54 ± 0.07	1.33 ± 0.15	0.65 ± 0.03	1.12 ± 0.02	52.36 ± 4.86	2.01 ± 0.21
F_1	4.38 ± 0.10	4.55 ± 0.07	1.66 ± 0.11	0.61 ± 0.02	0.92 ± 0.02	51.86 ± 2.66	2.01 ± 0.18
F_2	4.35 ± 0.06	4.57 ± 0.04	1.66 ± 0.07	0.63 ± 0.01	1.08 ± 0.02	61.58 ± 1.85	1.86 ± 0.08
B_1	4.48 ± 0.07	4.58 ± 0.05	1.59 ± 0.07	0.60 ± 0.02	1.09 ± 0.02	62.49 ± 2.06	1.80 ± 0.14
B_2	4.25 ± 0.07	4.51 ± 0.05	1.76 ± 0.11	0.65 ± 0.02	1.00 ± 0.02	67.14 ± 2.15	1.58 ± 0.08

Table 2. Estimates of gene effects based upon the best fit model in the cross P 4-5-2 × U 82-B

Character	m	[d]	[h]	[i]	[j]	[l]	χ^2	Epistasis
Total soluble solids	4.28 ± 0.05	0.14 ± 0.06	0.14 ± 0.11	-	−0.75** ± 0.24	-	0.20	-
pH	4.52 ± 0.05	0.004 ± 0.05	0.05 ± 0.10	-	-	-	2.75	-
Number of locules	0.41 ± 0.08	0.07 ± 0.08	0.40* ± 0.15	-	-	-	4.50	-
Pericarp thickness	0.67 ± 0.02	0.02 ± 0.02	−0.07* ± 0.03	-	−0.16* ± 0.08	-	1.10	-
Fruit shape index	1.24 ± 0.04	0.06** ± 0.01	−0.31** ± 0.06	0.17** ± 0.05	−0.29** 0 0.07	-	0.39	-
Fruit weight	57.81 ± 2.99	5.44* ± 2.77	28.90** ± 9.89	-	−19.97* ± 8.14	−34.85 ± 8.99	1.84	D
Yield plant^{-1}	1.68 ± 0.10	0.25* ± 0.11	0.21 ± 0.20	-	−1.16** ± 0.38	-	2.68	-

* : Significant at 5% level ** : Significant at 1% level epistasis D : Duplicate

the role of non-fixable gene effects ([h], [j] and [l]) in the inheritance of characters under study was also evident, the same can not be exploited for various reasons. The presence of additive × dominance type of gene effects for TSS, pericarp thickness, fruit shape index, fruit weight and yield plant^{-1} can not be exploited due to self pollinated nature of the crop. Dominance type of gene effects exhibited for number of locules, pericarp thickness and fruit shape index cannot be exploited through heterosis breeding due to dominance being in the undesirable direction. Presence of dominance and dominance × dominance interaction for fruit weight cannot be exploited through heterosis breeding due to duplicate type of epistasis (opposing signs of [h] and [l]). So pure line breeding which can exploit fixable gene effects [d] and [i] exhibited by the cross is recommended for the genetic improvement of characters studied.

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