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Short Communication

Studies on association of fruit colour with other traits in chilli (*Capsicum annuum* L.)

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Chilli (*Capsicum annuum* L) is an indispensable condiment in the Asian continent because of the coloring matter obtained from the fruits which is used as a natural colourant in food-stuffs in place of synthetic dyes, which are harmful. There are 20 carotenoids contributing to the colour of matured fruits, and capsanthin contributes as much as 36 per cent of total carotenoid content in the fruits. Therefore, there is need to develop varieties with higher content of capsanthin in the fruits.

The material for the study comprised 36 genotypes which were evaluated in *Kharif* 2000 in a randomized block design with two replications. Observations on five random plants in each replication of each genotype were recorded for 20 characters, of which, capsanthin content in the matured fruits was taken as the dependent character (Table 1). Genotypic and phenotypic correlation coefficients between capsanthin content and other characters, and path coefficients for the capsanthin content were estimated. The details of correlations and path coefficients at the phenotypic and genotypic levels are presented in the Tables 1 and 2 respectively. At both phenotypic and genotypic levels, the character ascorbic acid (red) had positive correlations with capsanthin content, which was mainly due to its positive direct effect, its indirect effects being nil or of negligible magnitude. Positive association of this character on capsanthin content was reported earlier also [1&2].

Interestingly, the direct effects and the indirect effects of the characters X_1 to X_9, X_{14}, X_{15}, X_{18}, X_{19} and X_{20} through all other characters except X_{10} to X_{13} and X_{16} were equal to zero; same was the case with regard to the characters xio to X_{13} and X_{16} also, but for the fact that their direct effects were not equal to zero leading to the apparent inference that these characters were not at all associated with capsanthin content.

Positive correlations of the characters plant spread, number of fruits per plant, fruit length, fruit yield and ascorbic acid (green) on capsanthin content were mainly because of their high magnitudes of positive indirect effects through ascorbic acid (red). Positive direct effect of fruit yield on capsanthin content was reported in an earlier study [3]. Fruit rot was negatively correlated with capsanthin content and this was mainly because of its negative indirect effect through ascorbic acid (red).

The characters seed weight, plant height, pericarp weight and muruda scores were not correlated with capsanthin content. However, seed weight had reasonable magnitudes of positive direct effect and two positive indirect effects. So also, indirect effect of plant height through one character was positive and of considerable magnitude, while, pericarp weight had substantial magnitude of positive direct effect, two positive indirect effects and one negative indirect effect. The indirect effect of muruda score with one character at genotypic level was positive and of considerable magnitude; however, to achieve improvement in colour one cannot select on the positive side for a disease.

Similarly, fruit weight though did not show correlation with capsanthin, it had high magnitude of negative direct effect and high to moderate magnitudes of positive indirect effects through seed weight and pericarp weight at genotypic level. With regard to days to maturiry, neither its correlation with capsanthin content, nor its inderect effects were of considerable magnitude. Number of primary branches, stalk length, stalk weight, fruit girth and number of seeds per fruit showed negative as well positive indirect effects through one to two characters which ultimately resulted in a small magnitude of correlation with capsanthin content that was not significant. Positive correlation of stalk weight with capsanthin, which was mainly due to its indirect effects was reported in an earlier study [2].

A comprehensive consideration of the results of the present study, pertaining to correlations, direct effects and indirect effects including the direction of these parameters, led to the inference that, in achieving improvement for capsanthin content, selection has to be towards higher side for height, plant spread, number of fruits, fruit length, ascorbic acid (green) and ascorbic

Table 1. Phenotypic path coefficient analysis of capsanthin in chilli

Character	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{18}	X_{19}	X_{20}	r value
X_1	0	0	0	0	0	0	0	0	0	0.002	0.014	−0.02	0.00	0	0	−0.175	0	0	0	−0.172
X_2	0	0	0	0	0	0	0	0	0	0.004	−0.009	0.005	0.00	0	0	0.359	0	0	0	0.4149*
X_3	0	0	0	0	0	0	0	0	0	−0.01	−0.002	0.012	−0.001	0	0	0.248	0	0	0	0.2936
X_4	0	0	0	0	0	0	0	0	0	−0.024	−0.003	0.026	0.001	0	0	0.248	0	0	0	0.2604
X_5	0	0	0	0	0	0	0	0	0	−0.029	0.008	0.02	0.001	0	0	0.405	0	0	0	0.4196*
X_6	0	0	0	0	0	0	0	0	0	0.053	−0.016	−0.04	−0.002	0	0	0.351	0	0	0	0.3897
X_7	0	0	0	0	0	0	0	0	0	0.017	−0.006	−0.01	−0.002	0	0	0.184	0	0	0	0.2263
X_8	0	0	0	0	0	0	0	0	0	0.049	−0.013	−0.04	−0.001	0	0	−0.258	0	0	0	−0.284
X_9	0	0	0	0	0	0	0	0	0	0.073	−0.035	−0.04	−0.004	0	0	−0.066	0	0	0	−0.0751
X_{10}	0	0	0	0	0	0	0	0	0	0.111	−0.042	−0.07	−0.005	0	0	0.051	0	0	0	0.037
X_{11}	0	0	0	0	0	0	0	0	0	0.09	−0.052	−0.03	−0.004	0	0	0.118	0	0	0	0.1051
X_{12}	0	0	0	0	0	0	0	0	0	0.10	−0.025	−0.07	−0.004	0	0	−0.024	0	0	0	−0.029
X_{13}	0	0	0	0	0	0	0	0	0	0.073	−0.029	−0.04	−0.007	0	0	0.175	0	0	0	0.1827
X_{14}	0	0	0	0	0	0	0	0	0	0.005	−0.006	0.001	0.00	0	0	0.482	0	0	0	0.498*
X_{15}	0	0	0	0	0	0	0	0	0	0.001	−0.001	0.00	−0.001	0	0	0.704	0	0	0	0.7308**
X_{16}	0	0	0	0	0	0	0	0	0	0.006	−0.006	0.002	−0.001	0	0	1.00	0	0	0	1.0000*
X_{18}	0	0	0	0	0	0	0	0	0	−0.01	0.001	0.008	0.00	0	0	0.11	0	0	0	0.1146
X_{19}	0	0	0	0	0	0	0	0	0	−0.004	0.001	0.003	−0.001	0	0	0.11	0	0	0	0.14
X_{20}	0	0	0	0	0	0	0	0	0	−0.006	0.011	−0.01	0.002	0	0	−0.602	0	0	0	−0.639**

Residual effect = 0.000

Table 2. Genotypic path coefficient analysis of capsanthin in chilli

Character	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{18}	X_{19}	X_{20}	r value
X_1	0	0	0	0	0	0	0	0	0	−0.014	−0.12	0.135	−0.001	0	0	−0.171	0	0	0	−0.17
X_2	0	0	0	0	0	0	0	0	0	0.091	0.009	−0.094	−0.005	0	0	0.497	0	0	0	0.4968*
X_3	0	0	0	0	0	0	0	0	0	0.103	0.000	−0.109	0.006	0	0	0.352	0	0	0	0.3518
X_4	0	0	0	0	0	0	0	0	0	0.21	0.027	−0.228	−0.01	0	0	0.276	0	0	0	0.275
X_5	0	0	0	0	0	0	0	0	0	0.258	−0.075	−0.172	−0.011	0	0	0.435	0	0	0	0.434*
X_6	0	0	0	0	0	0	0	0	0	−0.432	0.107	0.305	0.019	0	0	0.439	0	0	0	0.434*
X_7	0	0	0	0	0	0	0	0	0	−0.166	0.005	0.137	0.024	0	0	0.327	0	0	0	0.3267
X_8	0	0	0	0	0	0	0	0	0	−0.453	0.117	0.331	0.005	0	0	−0.32	0	0	0	−0.319
X_9	0	0	0	0	0	0	0	0	0	−0.651	0.277	0.34	0.034	0	0	−0.087	0	0	0	−0.087
X_{10}	0	0	0	0	0	0	0	0	0	−0.836	0.262	0.543	0.031	0	0	0.021	0	0	0	0.0206
X_{11}	0	0	0	0	0	0	0	0	0	−0.687	0.319	0.346	0.021	0	0	0.09	0	0	0	0.0897
X_{12}	0	0	0	0	0	0	0	0	0	−0.795	0.193	0.572	0.029	0	0	−0.036	0	0	0	−0.036
X_{13}	0	0	0	0	0	0	0	0	0	−0.545	0.142	0.356	0.047	0	0	0.197	0	0	0	0.1975
X_{14}	0	0	0	0	0	0	0	0	0	−0.007	0.03	−0.019	−0.004	0	0	0.516	0	0	0	0.5158*
X_{15}	0	0	0	0	0	0	0	0	0	−0.019	0.005	0.008	0.006	0	0	0.76	0	0	0	0.7598**
X_{16}	0	0	0	0	0	0	0	0	0	−0.017	0.029	−0.021	0.009	0	0	1.00	0	0	0	1.0000**
X_{18}	0	0	0	0	0	0	0	0	0	−0.018	0.057	−0.037	−0.001	0	0	0.121	0	0	0	0.1205
X_{19}	0	0	0	0	0	0	0	0	0	0.04	−0.108	0.075	−0.007	0	0	0.416	0	0	0	0.4158
X_{20}	0	0	0	0	0	0	0	0	0	0.042	−0.113	0.089	−0.018	0	0	−0.682	0	0	0	−0.6819**

Residual effect = 0.000

X_1	Days to maturity	X_6	Fruit length (cm)	X_{11}	Seed weight (g)	X_{16}	Ascorbic acid (red)
X_2	Plant spread (cm)	X_7	Stalk length (cm)	X_{12}	Pericarp weight (g)	X_{17}	Capsanthin
X_3	Plant height (cm)	X_8	Fruit girth (cm)	X_{13}	Stalk weight (g)	X_{18}	Oleoresin
X_4	No. of primary branches	X_9	Number of seeds	X_{14}	Fruit yield (g)	X_{19}	Muruda disease
X_5	Number of fruits per plant	X_{10}	Fruit weight (g)	X_{15}	Ascorbic acid (green)	X_{20}	Fruit rot

acid (red) and fruit yield, towards intermediate level for weight per fruit and towards negative side for fruit rot. Of these again, ascorbic acid (red) was found to be very important. If a large population is being handled, in the first instance, selection has to be made based on visual scoring for such of those characters for which it is possible, and then further selection has to be made in the second instance by evaluating based on the actual observations recorded in the first stage selections for all the characters mentioned above. As several characters were involved in the study, no residual effect was noticed, strengthening the reliability of the results.

References

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