Int.J.Curr.Microbiol.App.Sci (2020) *9*(9): 2309-2315

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 9 Number 9 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.909.288

Genetic Studies in Coloured Sweet Pepper

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Keywords

Coloured Sweet pepper, Variability, Heritability, Correlation

Article Info

Accepted:
17 August 2020
Available Online:
10 September 2020

A B S T R A C T

In the present investigation, fifteen diverse genotypes of coloured capsicum were evaluated in experimental field of Division of Vegetable Science, SKUAST-Kashmir, Shalimar during *kharif* 2018. Analysis of variance revealed highly significant differences among genotypes for all the traits. Highest genotypic coefficients of variation were depicted by total carotenoids (38.90), fruit yield plant^{-1} (27.93), fruit yield plot^{-1} (26.99) and fruit weight (20.33). The heritability in broad sense was high above 60 per cent for all traits except quality traits. Genetic advance was found to be low in almost all traits. The genotypic correlation coefficients were higher in magnitude than phenotypic correlation coefficients but similar in direction. Fruit yield plot^{-1} was found to be positively and significantly correlated with plant height, plant spread, number of secondary branches, number of fruits plant^{-1}, average fruit weight, fruit length, fruit diameter, flesh thickness, pedicel length, average seed weight fruit^{-1}, number of seeds fruit^{-1}, fruit yield plant^{-1}, seed yield plant^{-1} and seed yield plot^{-1}.

Introduction

The consumption of sweet pepper is on the increase all over the world. It has become a multibillion dollar industry, as well as a part time hobby for home gardeners. Coloured Sweet peppers are gaining popularity day by day due to changing food habits of people, increasing health concerns, and knowledge about benefits of consuming coloured vegetables. The farmers are shifting towards the cultivation of coloured capsicums. However the yield potential and total production of coloured capsicum is low due to the unavailability of high yielding cultivars adaptable to Kashmir valley.

The success of any breeding programme depends on the presence of sufficient variability to pursue effective selection. It is important to assess the relative magnitude of components of variability in order to use such information, together with other selection parameters for improvement of the plant type through adoption of effective breeding method (Johnson *et al.*, 1955; Hanson *et al.*, 1956; William, 1964; Briggs and Knowels, 1967). Burton (1952) suggested that the extent of variability indicates the amenability of a given character for its improvement while the knowledge on the heritability along with genetic advance aid in drawing valuable conclusions for effective selection based on

phenotypic performance as suggested by Johnson *et al.,* (1955).Correlation studies provide information that selection for one character would result in selection and progress of all traits that are positively and significantly correlated with the selected character.

Correlation coefficient would indicate how much progress might be expected from selecting for two variables simultaneously or in selecting for one variable and expecting to bring about a change in second variable. If significant correlation values are found between yield and other economic traits, considerable improvement could be made through selection.

Materials and Methods

The present investigation was carried out to generate information regarding variability, heritability and correlation in coloured Sweet pepper genotypes for subsequent use in future breeding programmes. Fifteen diverse genotypes of coloured Capsicum maintained in Division of Vegetable Science were evaluated in Experimental Field, Division of Vegetable Science, SKUAST-K Shalimar. The experiment was laid in RCBD during *kharif* 2018 with three replications. The observations were recorded on various maturity, yield and yield attributing traits and quality traits. Analysis was done as per standard statistical procedures.

Results and Discussion

Analysis of variance revealed highly significant differences among genotypes for all the traits under study indicating the presence of sufficient amount of variability in the genotypes. This provides an ample opportunity for selecting suitable genotypes with high mean for all the traits of interest. These results are in accordance with those of Tembhurne and Rao (2013), Abu *et al.,* (2013), and Spaldon *et al.,* (2017).

Wide range of variability was observed for most of the traits under study as depicted by range values which is a pre requisite for making improvement through selection. The estimates of phenotypic, genotypic and environmental variances revealed that the magnitude of environmental variances were much smaller than the magnitudes of correspondence genotypic variances indicating that the variations observed were mostly due to genotypes, that is, genetic in nature. Genotypic coefficients of variation were found to be higher than corresponding environmental coefficients of variation. Highest genotypic coefficients of variation were shown by total carotenoids (38.90), fruit yield plant^{-1} (27.93), fruit yield plot^{-1} (26.99) and fruit weight (20.33) indicating that selection for these traits would be effective.

The heritability in broad sense was high above 60 per cent for all traits except quality traits i.e., SSC, vitamin C, total chlorophyll and total carotenoids suggesting that the selection based on phenotype would be more effective and there is every possibility to transmit these traits into off springs. Genetic advance was found to be low in almost all traits except seed yield plot^{-1} (45.40), number of seeds fruit^{-1} (33.10), vitamin C (24.50), total chlorophyll (15.13) and seed yield plant^{-1} (14.53).

High heritability and genetic advance together are helpful in predicting gain under selection. However, when heritability is high and genetic advance is not proportionately high, this situation indicates that non-additive genes with dominance and epistatic effects are controlling the concerned traits. High heritability along with high genetic advance responds to selection better than high heritability and low genetic advance (Table 1–4).

Table.1a Mean square of individual environments for maturity, yield attributing and quality traits in Coloured Capsicum (*Capsicum annuum* L. var. *grossum* Sendt.)

Source of variation	d.f	Mean sum of squares										
		Days to first flowering	Days to first fruit set	Days to first fruit harvest	Plant height (cm)	Plant spread (cm)	Number of secondary branches	Number of fruits plant^{-1}	Number of fruits plant^{-1}	Fruit Length (cm)	Fruit diameter (cm)	Flesh thickness (mm)
Genotypes	14	11.850**	10.660**	16.363**	94.940**	29.521**	2.110**	22.600**	1652.544**	0.878**	0.852**	2.071**
Error	28	0.554	0.774	0.484	0.442	0.860	0.100	1.300	4.912	0.001	0.001	0.128

Table.1b Mean square of individual environments for maturity, yield attributing and quality traits in Coloured Capsicum (*Capsicum annuum* L. var. *grossum* Sendt.)

Source of variation	d.f	Mean sum of squares									
		Pedicel length (cm)	Average seed weight (g)	Number of seeds fruit^{-1}	Average fruit yield plant^{-1} (kg)	Average fruit yield plot^{-1} (kg)	Seed yield plant^{-1}(g)	Seed yield plot^{-1}(g)	Soluble solid content SSC (°B)	Vitamin C (mg/100g)	Total chlorophyll (mg/100g)	Total carotenoid (mg/100g)
Genotypes	14	0.747**	1.264**	5502.519**	0.298**	30.190**	317.508**	31788.956**	1.538**	1873.355**	754.963**	0.483**
Error	28	0.045	0.001	6.542	0.001	0.162	3.211	317.208	0.010	1.203	0.988	0.004

Table.2 Variability parameters for maturity, yield attributing and quality traits in Coloured Capsicum (*Capsicum annuum* L. var. *grossum* Sendt.)

S.No	Traits	Mean	Range	Phenotypic coefficient of variance (PCV)%	Genotypic coefficient of variance (GCV) %	Phenotypic variance (σ^2p)	Genotypic variance (σ^2g)	Heritability in broad sense (%)	Genetic advance (%)
1.	**Days to first flowering**	31.30	28.00-34.82	7.38	6.23	5.34	3.81	71.35	3.40
2.	**Days to first fruit set**	36.68	33.64-39.06	5.47	4.80	4.03	3.10	76.92	3.17
3.	**Days to first harvest**	52.48	49.86-55.53	4.36	3.39	5.25	3.17	60.38	2.85
4.	**Plant height (cm)**	46.15	38.99-52.60	12.39	10.27	32.73	22.49	68.71	8.09
5.	**Plant spread (cm)**	41.55	38.89-45.27	7.15	6.28	8.83	6.82	77.24	4.73
6.	**No. of sec. branches plant^{-1}**	7.34	6.64-8.08	11.49	9.43	0.71	0.48	67.60	1.17
7.	**Number of fruits plant^{-1}**	11.00	8.75-13.77	23.57	19.81	6.73	4.75	70.58	3.77
8.	**Average Fruit weight (g)**	90.93	77.16-106.05	25.61	20.33	542.30	341.77	63.02	2.81
9.	**Fruit length (cm)**	6.96	6.49-7.47	7.92	6.26	0.30	0.19	63.33	0.71
10.	**Fruit diameter (cm)**	6.88	6.49-7.28	6.00	5.24	0.17	0.13	76.49	0.65
11.	**Flesh thickness (mm)**	5.29	4.66-5.86	14.68	11.80	0.60	0.39	65.00	1.04
12.	**Pedicel length (cm)**	3.07	2.44-3.54	15.30	13.43	0.22	0.17	77.29	0.80
13.	**Average seed weight fruit^{-1} (g)**	4.17	3.87-4.62	12.72	10.98	0.28	0.21	75.00	0.82
14.	**Number of seeds fruit^{-1}**	250.85	230.86-262.91	9.43	7.76	559.76	379.86	67.86	33.10
15.	**Average fruit yield plant^{-1} (kg)**	0.98	0.72-1.27	31.14	26.99	0.09	0.07	77.78	0.48
16.	**Average fruit yield plot^{-1} (kg)**	9.85	7.27-12.80	31.25	27.93	9.48	7.57	79.85	5.10
17.	**Seed yield plant^{-1} (g)**	44.80	32.73-54.43	22.54	18.76	102.03	70.64	69.23	14.53
18.	**Seed yield plot^{-1} (g)**	448.09	327.36-544.33	22.54	18.72	1020.00	704.00	69.00	45.40
19.	**SSC (°Brix)**	3.80	3.08-4.48	17.81	13.15	0.46	0.25	54.35	0.80
20.	**Vitamin-C (mg/100g)**	151.72	125.90- 168.80	15.06	10.86	522.33	271.65	52.00	24.50
21.	**Total chlorophyll (mg/100g)**	73.56	59.69-81.14	17.83	13.34	172.17	96.41	56.00	15.13
22.	**Total carotenoids (mg/100g)**	0.68	0.36-1.01	55.45	38.90	0.14	0.07	50.00	0.4

Table.4 Estimates of genotypic (above diagonal) correlation coefficients among different traits in coloured capsicum (*Capsicum annuum* var. *grossum* Sendt.)

	DFF	DFS	DFH	PH	PS	NSB	NFP	AFW	FL	FD	FT	PL	ASW	NSF	FYP	FYPP	SYP	SYPP
DFF	**1.000**	0.906**	0.928**	-0.924**	-0.198	-0.280*	-0.855**	-0.070	-0.383**	0.040	0.403**	-0.056**	-0.677**	-0.075	-0.616**	-0.617**	-0.116	-0.116
DFS		**1.000**	0.948**	-0.609**	-0.176	-0.209	-0.977**	-0.053	-0.202*	0.091	0.097	-0.021	-0.215*	-0.140	-0.629**	-0.630**	-0.027	-0.027
DFH			**1.000**	-0.830**	-0.170	-0.208	-0.993**	-0.091	-0.246*	0.030	0.070	-0.041	-0.640**	-0.097	-0.644**	-0.644**	-0.234*	-0.234*
PH				**1.000**	0.656**	0.617**	0.423**	0.230*	0.536**	0.038	-0.607**	0.112	0.001	0.080	0.882**	0.880**	0.893**	0.894**
PS					**1.000**	-0.183	0.235*	0.061	0.065	0.182	-0.174	0.115	0.088	0.044	0.620**	0.061	0.537**	0.537**
NSB						**1.000**	0.374**	-0.198	-0.490**	-0.178	-0.199	0.195	-0.363**	0.046	0.551	0.056	0.205	0.205
NFP							**1.000**	-0.406**	-0.313*	-0.534*	-0.207*	0.013	-0.036	0.054	0.806**	0.809**	0.846**	0.846**
AFW								**1.000**	0.668**	0.284*	0.418**	0.900**	0.243*	0.813*	0.130	0.271*	0.267*	0.266**
FL									**1.000**	0.728**	0.133	0.540**	0.591**	0.163	0.209	0.207*	0.043	0.044
FD										**1.000**	0.151	0.551**	0.176	0.166	0.588**	0.584**	0.360**	0.359**
FT											**1.000**	-0.181	-0.123	-0.163	0.708**	0.078	0.007	0.007
PL												**1.000**	0.076	0.183	0.301*	0.030	0.598**	0.599**
ASW													**1.000**	0.245*	0.408**	0.408**	0.508**	0.508**
NSF														**1.000**	0.262*	0.026	0.350**	0.351**
FYP															**1.000**	1.000**	0.892**	0.892**
FYPP																**1.000**	0.894**	0.895**
SYP																	**1.000**	1.000**
SYPP																		**1.000**

*, ** significant at 5% and 1* respectively

DFF: Days to first flowering
DFS: Days to first fruit set
DFH: Days to first harvest
PH: Plant height (cm)
PS: Plant spread (cm)
NSB: No. of secondary branches plant^{-1}
NFP: Number of fruits plant^{-1}
AFW: Average fruit weight (g)
FL: Fruit length (cm)
FD: Fruit diameter (cm)
FT: Flesh thickness (mm)
PL: Pedicel length (cm)
ASW: Av. seed weight fruit^{-1}
NSF: No. of seeds fruit^{-1}
FYP: Fruit yield plant^{-1} (kg)
FYPP: Fruit yield plot^{-1} (kg)
SYP: Seed yield plant^{-1}
SYPP: Seed yield plot^{-1} (g)

Similar results on variability, variances and heritability and genetic advance have also been reported by Mishra *et al.,* (2001), Sharma and Sharma (2006), Kumar *et al.,* (2010), Prema *et al.,* (2010), Ramya *et al.,* (2016), Najeema *et al.,* (2018), etc.

In the present study, the genotypic correlation coefficients were higher in magnitude than corresponding phenotypic correlation coefficients but similar in direction. The maturity traits viz. days to flowering, days to first fruit set and days to first harvest were positively and significantly correlated with each other but negatively and significantly correlated with plant height, number of fruits plant^{-1}, fruit length, pedicel length, average seed weight fruit^{-1}, fruit yield plant^{-1} and fruit yield plot^{-1}. The most economic trait viz. fruit yield plot^{-1} was found to be positively and significantly correlated with plant height, plant spread, number of secondary branches, number of fruits plant^{-1}, average fruit weight, fruit length, fruit diameter, flesh thickness, pedicel length, average seed weight fruit^{-1}, number of seeds fruit^{-1}, fruit yield plant^{-1}, seed yield plant^{-1} and seed yield plot^{-1} thereby indicating that the selection for these traits would automatically bring about improvement in yield. Several research workers viz. Aliyu *et al.,* (2000), Feipeng and Huang (2004), Bindal *et al.,* (2005), Lahbib *et al.,* (2012), etc have reported significant correlations between different traits in sweet pepper. Correlation studies between yield and its components are of great value in planning and evaluating breeding populations. The knowledge of degree of correlation of yield or any other character of interest with its component traits is important in the construction of selection indices to enable effective direct selection.

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How to cite this article:

Amreena Sultan, Baseerat Afroza, Rizwan Rashid, Afroza Akhter and Azralateef. 2020. Genetic Studies in Coloured Sweet Pepper. *Int.J.Curr.Microbiol.App.Sci.* 9(09): 2309-2315. doi: https://doi.org/10.20546/ijcmas.2020.909.288