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ESTIMATION OF GENETIC VARIABILITY FOR QUANTITATIVE AND QUALITATIVE TRAITS IN CUCUMBER (*CUCUMIS SATIVUS* L.) UNDER SUBTROPICAL CONDITIONS OF GARHWAL HIMALAYA

K. N. Shah*, D. K. Rana and V. Singh

Department of Horticulture, H.N.B. Garhwal University, Srinagar - 246 174 (Uttarakhand), India.

Abstract

Thirteen strains of cucumber were collected from different parts of India for estimation of nature and magnitude of variability within strains for different qualitative and quantitative traits. The strains were planted in Randomized Block Design during 2014 in summer season. The analysis of variance revealed significant differences for almost all the characters. The high phenotypic coefficient of variability (PCV) and genotypic coefficient of variability (GCV) was observed for number of nodes bearing first male flower whereas, moderate PCV and GCV were observed for number of nodes bearing first female flower, leaf area, length of fruit, TSS and number of fruit per vine. High heritability was noticed for leaf area and length of fruit. High heritability couples with high genetic advance over mean was noticed for number of nodes bearing first male flower, leaf area, length of fruit, number of nodes bearing first male flower, number of fruit per vine and TSS, indicating the possible role of additive gene action. The selection based on phenotypic performance of these characters would be useful for achieving desired results.

Key words : Strains, GCV, PCV, variance, phenotypic and additive.

Introduction

Cucumber (*Cucumis sativus* L.) is one of the most important cucurbitaceous vegetables grown throughout the world in tropical and sub-tropical climatic conditions. It is an ideal summer vegetable crop chiefly grown for its edible tender fruits, preferred as a salad ingredient, pickles, and as a cooked vegetable (Shah *et al.,* 2016). For quick symptomatic cooling of the head, hand and feet, cucumber paste when applied on the body part is very effective in bringing a refrigerator effect. It may further be mentioned that cucumber juice is commonly used for treating diseases of teeth and gums. Its juice is still useful for rheumatic conditions and healthy growing hair (Khulakpam *et al.,* 2015). The role of genetic variability in a crop is of paramount importance in selecting the best genotypes for making rapid improvement in yield and related characters as well as to select most potential parents for making the hybridization programme successful (Naseeruddin *et al*., 2011 and Singh *et al*., 2014). Any crop improvement programme primarily depends on the amount of genetic variability available and the extent to which the economic traits are heritable. Most of the characters of economic importance and related characters are highly influenced by the environmental conditions; the heritable (genotypic) variation usually covered by non-heritable (environmental) variation and thereby creates difficulty in exercising the selection. The coefficient of variation of phenotypic and genotypic is helpful in detecting the amount of variation present in the available strains. Heritability is the ratio of genotypic variance to the phenotypic variance. It is a good index of the transmission of characters from parents to offspring (Falconer, 1981). Heritability indicates the accuracy with which a genotype can be identified by its phenotypic performance. Indeed, heritability in broad sense contains both additive and non-additive effects (Hanson *et al*., 1956). The knowledge of heritability and genetic advance helps the plant breeder in predicting the behavior of the succeeding generation and making desirable selections for the improvements.

Author for correspondence : E-mail: bharaniagrico@gmail.com

Materials and Methods

The materials for the present investigation consist of 13 genotypes *viz.*, GP-1, HP-1, HP-2, K-90, Mandal, New Manipur-1, New Manipur-2, PB- Naveen, RAJ-1, RAJ-2, Seven Star, SPP-63 and Swarna Purna collected from different region of India. The experiment was conducted during zaid season, 2014 at Horticultural Research Centre, Department of Horticulture, HNB Garhwal University, Srinagar (Garhwal), Uttarakhand, India. Srinagar (Garhwal) is located in Alaknanda valley (30º, 12' 0" to 30º 13' 4" latitude North and 78º 0' 45" to 78º 0' 50" East longitude and 540 m above MSL). This region exhibits a semi-arid, subtropical climate with dry summer and rigorous winter with occasional dense fog in the morning up to 10 am from January to mid-March and June to mid-August. The experiment was laid out in Randomized Block Design with three replications. The whole area of experimental site was divided into three blocks of equal size and each block possessed 13 plots. Each plot measured 4.50 × 2.0 m^2 area. The seedling were transplanting at four leaf stage *i.e.,* 25-30 days after sowing. Transplanting of seedlings was done in evening hours in each experimental plot at the spacing of 1.50 x 0.50 cm. After transplanting, a light irrigation was given for the proper establishment of the seedlings. Farmyard manure was applied at the rate of 25 tonnes/ ha and NPK fertilizer applied in the rate of 80:60:60 kg/ha, respectively. Full does of phosphorus, potassium and half does of nitrogen were applied at the time of transplanting, remaining half does of nitrogen was applied at 35days after transplanting. All the cultural activities and plant protection measures recommended for the successful crop. Five plants were randomly selected from each plot per replication for recording the data on the following observations *viz*., days to first seed germination, germination rate, length of vine (cm), number of primary branches/ plant, leaf area (cm^2), days taken to opening of first male flower, number of nodes bearing first male flower, days taken to opening of first female flower, number of nodes bearing first female flower, percent of fruit setting, days to first fruit harvest, number of fruits/ vine, length of fruit (cm), diameter of fruit (cm), average weight of fruit (g), total fruit yield/vine (kg), duration of harvesting (days), vitamin C (mg/100g) and TSS (°Brix). The obtained data were statistically analyzed with the help of computer for obtaining various biometrical parameters computed by the method given, Panse and Sukhatme (1961). Genetic variability for different parameters was estimated as suggested by Burton and De Vane (1953). Heritability and expected genetic

Table 1 : Analysis of variance (ANOVA) for 19 characters in cucumber (*Cucumis sativus* L.).

S. no.	Source	Mean Sum of Square		
		Replication	Treatment	Error
	Degree of freedom	**2**	**12**	**24**
1.	Days to first seed germination	0.1218	0.500**	0.101
2.	Germination rate	0.0325	0.059*	0.020
3.	Length of vine (cm)	11.1056	3739.14**	23.39
4.	Number of primary branches per vine	0.2879	2.749**	0.280
5.	Leaf area (cm^2)	15.5846	12510.25**	15.71
6.	Days taken to opening of first male flower	0.0361	26.45**	0.342
7.	Number of nodes bearing first male flower	0.0646	5.669**	0.072
8.	Days taken to opening of first female flower	0.8096	33.72**	0.311
9.	Number of nodes bearing first female flower	0.0647	8.25**	0.157
10.	Percent of fruit setting	4.5636	36.80**	2.773
11.	Days to first fruit harvest	0.4353	9.00**	1.342
12.	Number of fruits per vine	0.8309	30.72**	0.297
13.	Length of fruit (cm)	0.1663	95.83**	0.150
14.	Diameter of fruit (cm)	0.0468	1.44**	0.038
15.	Weight of fruit (g)	25.3030	2935.09**	9.163
16.	Total fruit yield per vine (kg)	0.0010	0.530**	0.014
17.	Duration of harvesting (days)	1.2677	8.34**	1.156
18.	Vitamin C (mg/100g)	0.1022	0.532**	0.0381
19.	Total Soluble Solids (° Brix)	0.0860	3.238**	0.0455

*Significant at 5% level, ** Significant at 1% level.

Table 2 : Estimation of genotypic and phenotypic variance, genotypic and phenotypic coefficient of variability, heritability, genetic advance and genetic advance over mean for 19 characters in cucumber.

S. no.	Characters	Range	Mean	Variance		Coefficient of variance (%)		Heritability h^2 (%)	Genetic advance (GA)	Genetic advance over mean GAM (%)
				GV	PV	GCV	PCV			
1.	Days to first seed germination	5.66-7.00	6.33	0.13	0.23	5.76	7.64	0.57	0.57	8.94
2.	Germination rate	3.57-4.06	3.75	0.01	0.03	3.06	4.86	0.40	0.15	3.97
3.	Length of vine (cm)	143.33-255.33	198.84	1238.58	1261.98	17.70	17.87	0.98	71.82	36.12
4.	Number of primary branches per vine	4.84-8.00	6.94	0.82	1.10	13.07	15.14	0.75	1.61	23.25
5.	Leaf area (cm^2)	120.04-343.78	220.16	4164.85	4180.56	29.31	29.37	1.00	132.69	60.27
6.	Days taken to opening of first male flower	31.81-40.73	35.32	8.70	9.05	8.35	8.52	0.96	5.96	16.88
7.	Number of nodes bearing first male flower	2.53-6.84	4.14	1.87	1.94	33.02	33.66	0.96	2.76	66.74
8.	Days taken to opening of first female flower	32.29-43.37	37.46	11.14	11.45	8.91	9.03	0.97	6.78	18.10
9.	Number of nodes bearing first female flower	3.58-8.87	5.64	2.70	2.86	29.15	29.98	0.94	3.29	58.36
10.	Percent of fruit setting	83.13-94.13	90.64	11.34	14.12	3.72	4.15	0.80	6.22	6.86
11.	Days to first fruit harvest	50.21-55.31	52.43	2.46	3.90	3.05	3.77	0.66	2.67	5.09
12.	Number of fruits per vine	11.28-20.97	14.59	10.14	10.44	21.83	22.15	0.97	6.47	44.33
13.	Length of fruit (cm)	11.94-33.75	19.87	31.89	32.04	28.42	28.48	1.00	11.61	58.40
14.	Diameter of fruit (cm)	2.70-5.08	3.79	0.47	0.51	18.09	18.82	0.92	1.36	35.80
15.	Weight of fruit (g)	111.76-225.76	160.43	975.31	984.47	19.47	19.56	0.99	64.03	39.92
16.	Total fruit yield per vine (kg)	1.73-3.01	2.28	0.17	0.19	18.16	18.92	0.92	0.82	35.93
17.	Duration of harvesting	60.30-65.45	63.43	30.50	32.89	18.17	18.87	0.93	10.95	36.04
18.	Vitamin C (mg/100g)	6.12-7.34	6.84	0.16	0.20	5.94	6.59	0.81	0.75	11.02
19.	Total Soluble Solids (° Brix)	2.79-5.85	4.70	1.06	1.11	21.94	22.40	0.96	2.08	44.25

advance was calculated according to Burton (1952) and Johnson *et al.* (1955) methods, respectively.

Results and Discussion

The analysis of variance for different quantitative and qualitative characters as shown in table 1 revealed that the mean sum of square due to treatment had highly significant differences at 1% level for almost all the characters except germination rate which was significant difference at 5% level indicating a wide range of variability among the 13 genotypes for all the characters studied.

In the present studies (table 2) the phenotypic coefficient of variation was higher than genotypic coefficient of variation for all the characters, but the differences were narrow indicating low environmental influence in the expression for almost all the traits, thus the selection based on phenotypic performance would be reliable. Similar results have also been reported earlier by Singh & Lal (2005), Kumar *et al.* (2008), Jat *et al.* (2014) and Singh *et al.* (2014). Those traits which showed less variation between PCV and GCV can be directly selected for further breeding programmes. The genotypic coefficient of variation and phenotypic coefficient of variation were moderate to low for almost all the characters under studied except number of nodes bearing first male flower which had high GCV and PCV. These findings are also reported by Arunkumar *et al.* (2011) and Jat *et al.* (2014). Days taken to first seed germination and number of primary branches per vine were reported high differences between PCV and GCV which indicated greater environmental influence, while these characters need more improvement for direct selection. Similar results were also noted by Arunkumar *et al.* (2011) and

Hanchinamani *et al.* (2011).

An estimate of heritability in the broad sense includes both additive and non-additive gene effects and in the narrow sense includes only additive effects. In the present research work, high heritability was observed for most of the characters studied. Similar results are also reported by Ram *et al.* (2006), Rabbani *et al.* (2012), Dubey *et al.* (2013) and Kumar *et al.* (2013). The characters like days to first seed germination, number of primary branches per vine, percent of fruit setting and days to first fruit harvest registered moderate heritability. Similar estimate of heritability for different traits have also reported by Rabbani *et al.* (2012), Arunkumar *et al.* (2011) and Jat *et al.* (2014).

While heritability estimates alter in interaction with the environment as well as genetic conditions, it should be studied along with the genetic gain for characters in concern for effective and a pin point selection. High heritability with high genetic advance over mean were recorded for length of vine, leaf area, number of nodes bearing first male flower, number of nodes bearing first female flower, number of fruits per vine, total fruit yield per vine, length of fruit, weight of fruit, diameter of fruit, duration of harvesting and TSS. It shows genotypic variance for these characters due to high additive gene effect (Panse, 1957). Hence, there is an ample scope for selection for these traits. The selection based on phenotypic performance of these characters would be useful for achieving desired results. The above results are also corroborated with the findings of Singh *et al.* (2002), Sanwal *et al*. (2007), Kumar *et al*. (2008), Samadia (2011) and Veena *et al.* (2012).

The days taken to opening of first male flower, days taken to opening of first female flower and vitamin C, had high heritability value coupled with a moderate genetic gain suggesting that the predominance role of both additive and non-additive gene action in the expression of these traits. Hence, these traits can be improved by mass selection. The results are in line with the findings of Arunkumar *et al.* (2011), Hanchinamani *et al.* (2011) and Jat *et al.* (2014).

Conclusion

On the basis of results obtained under the present investigation, it can be concluded that the experimental materials used in this research work has vast genetic variability with narrow differences between GCV and PCV, high to moderate heritability and genetic advance over mean for maximum characters so the selection would be more feasible for these traits. This genetic variability can be utilized for future breeding programme and also for development of new varieties in cucumber.

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