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Studies on Genetic Variability, Heritability and Genetic Advance in Pumpkin (*Cucurbita moschata* Duch ex Poir.)

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A B S T R A C T

The present study was planned to assess genetic variability, heritability and genetic advance among the twenty three genotypes of pumpkin. Analysis of variance showed that there was a high significant variation for all of the studied traits between genotypes. In the present investigation PCV was higher than the GCV for all the characters indicating the substantial modifying effect of environment in the expression of all traits studied. The highest GCV as well as PCV was observed for vine length at 90 DAS, fruit cavity, number of seeds per fruit, rind thickness and number of fruits per vine. The highest estimates of heritability (in broad sense) recorded for fruit cavity (84.80 %) followed by inter nodal length (76.90 %), and fruit yield per ha (73.60 %). Highest genetic advance (as per cent of mean) was observed for the characters fruit cavity. However, it ranged from (72.32 to 3.44%) for all the characters. Therefore, selection of superior genotypes in view point of desirable morphologic traits, with high genetic distance could be selected for hybridization programme and recognition of best genotypes for different traits to produce new elite hybrids in pumpkin.

Keywords

Genetic variability, Heritability, Genetic advance, Pumpkin.

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Introduction

Pumpkin (*Cucurbita moschata* Duch ex. Poir) being an important Cucurbitaceous vegetable crop cultivated under tropical, sub-tropical and temperate regions all over the world. India is the center of origin of many cucurbitaceous vegetables, where the cucurbits are capable of thriving and performing well even under the hot summer. Much emphasis on alleviating vitamin A deficiency through vegetables like pumpkin, a cheaper source of carotene rich vegetable is laid by WHO (Anonymous, 2008). The study of variability is an important pre requisite in any breeding programme for improvement of the crop as well as exploitation of heterosis. Parameters of genotypic and phenotypic coefficient of variation (GCV & PCV) are useful in detecting the amount of variability present in the available genotypes. Heritability and genetic advance help in determining the influence of environment in expression of the characters and the extent to which improvement is possible after selection. The present investigation was, therefore, under taken to ascertain magnitude and extent of genetic variability, heritability

and genetic advance in pumpkin have been worked out and reported.

Materials and Methods

Experiment was conducted at Main Garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra) during summer season in randomized block design with 23 local (AKP-1 to AKP-22 and one check Arka Chandan) genotypes of pumpkin (*Cucurbita moschata* Duch. ex Poir) replicated thrice. All recommended cultural and management practices were followed to raise the healthy crop. Five competitive plants were selected randomly in each row for recording the observations on 21 parameters viz., vine length (m) 90 DAS, number of primary branches 90 DAS, node at first male flower appears, node at first female flower appears, days to first male flower appears, days to first female flower appears, sex ratio (%), inter nodal length (cm), days to first harvest, fruit set (%), number of fruits per vine, fruit yield per vine (kg), average fruit weight (kg), fruit length (cm), fruit diameter (cm), fruit yield per hectare (tonnes), rind thickness (cm), flesh thickness (cm), fruit cavity (cc), number of seeds per fruit, test weight (100 seed weight (g)). The recorded data were analysed as suggested by Panse and Sukhatme (1954) for analysis of variance. The genotypic and phenotypic coefficient of variance was calculated as per the formula suggested by Burton (1952) and Johnson *et al.,* (1995) for heritability and genetic advance.

Results and Discussion

The mean sum of square was highly significant at one percent for all traits, indicating the presence of wide variability in the genotypes (Table 1). The findings are in consonance with Sudhakarpandey *et al.*, (2002) in pumpkin.

Genetic variability

Genetic variability is the basic need for a plant breeder to initiate any breeding programme. Among the horticultural traits (Table 2), the vine length at 90 DAS ranged from 2.6 to 3.56 (m), number of primary branches at 90 DAS ranging from 2.26 to 3.5, node at first male flower and node at first female flower ranged from 2.20 to 3.20 and 8.61 to 15.53. Similarly days to first male flower and days to first female flower also registered considerable variability between 44.56 to 54.56 and 52.27 to 64.83. Sex ratio (male to female flower) was recorded in between 9.84 to 13.72, inter nodal length (cm) was recorded between 3.76 to5.56, Variability in days to first harvest ranged from 88.90 to 107, fruit set (%) also recorded wide variability between 31.60 to 66.50. Average number of fruits per vine showed a wide range in between 1.22 to 3.71, fruit yield per vine ranged from 4.31 to 13.08 (kg), average fruit weight ranged from 2.33 to 4.75 (kg), wide variability recorded in fruit length between 19.48 to 32.22 (cm), fruit diameter was recorded between 13.72 to 24.58 (cm), fruit yield per ha was recorded between 21.58 to 65.40(tonnes), rind thickness was recorded between 2.93 to 5.25 (cm), flesh thickness ranged from 2.93 to 5.33 (cm), variability in fruit cavity was recorded between 687.76 to 2950.00(cc), number of seeds per fruit ranging from 106.1 to 278.53, test weight ranging from 10.57 to 15.27 100 seed weight (gm). Hence wide range of variability for these traits was observed in the present investigation. This result is encouraging because the presence of high variability, among the traits has been an indication of better chance for improvement. Significant variability for various characters in pumpkin have been reported by various workers viz., Gopalkrishnan *et al.,* (1980), Doijode and sulladmath (1986).

Table.1 Analysis of variance for yield and yield attributing characters in pumpkin

Source	DF	Vine length at 90 DAS (m)	Number of primary branches per vine 90 DAS	Node at first male flower appears	Node at first female flower appears	Days to first male flower appears	Days to first female flower appears	Sex ratio (male: female flower)	Inter nodal length (cm)	Days to first harvest	Fruit set (%)
Replication	2	0.261	0.209	0.044	3.119	0.717	10.493	0.147	0.005	2.5036	301.306
Treatment	22	0.197**	0.364**	0.253**	9.915**	29.043**	34.011**	2.566**	0.843**	70.486**	306.330**
Error	44	0.086	0.149	0.069	3.126	12.720	13.350	1.125	0.076	36.713	130.312

Source	DF	Number of fruits per vine	Fruit yield per vine (kg)	Average fruit weight (kg)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield per hectare (tonnes)	Rind thickness (cm)	Flesh thickness (cm)	Fruit cavity (cc)	Number of seeds per fruit	Test weight (100 seed wt) (g)
Replication	2	0.675	0.244	0.053	2.781	15.232	7.950	0.026	0.130	22571.62	1910.25	0.377
Treatment	22	1.378**	8.840**	0.946**	42.799**	30.465**	224.049**	0.022**	0.919**	674419.50**	7165.580**	5.220**
Error	44	0.595	0.967	0.151	8.276	6.933	23.92	0.0090	0.184	38159.76	2661.63	2.286

Significant at 5% level - * Significant at 1% level - **

Table.2 Range, and mean performance of different parameters in pumpkin

Characters		Range		Mean	SE(m)	CV	CD (5%)
		Minimum	Maximum				
1	Vine length (m) 90 DAS	2.60	3.56	3.07	0.16	9.53	0.48
2	No of primary branches @ 90 DAS	2.26	3.64	3.07	0.22	12.60	0.63
3	Node at first male flower appears	2.20	3.20	2.52	0.15	10.43	0.43
4	Node at first female flower appears	8.61	15.53	13.12	1.02	13.78	2.91
5	Days to first male flower	44.56	54.58	50.30	2.05	7.09	5.86
6	Days to first female flower	52.70	64.83	58.52	2.11	6.24	6.01
7	Sex ratio	9.84	13.72	11.52	0.61	9.21	1.74
8	Inter nodal length (cm)	3.76	5.56	4.50	0.16	6.16	0.45
9	Days to first harvest	88.93	110.00	98.06	3.49	6.18	9.97
10	Fruit set %	31.60	66.50	47.36	6.59	24.10	18.78
11	Number of fruits per vine	1.20	3.71	2.37	0.44	32.49	1.27
12	Fruit yield per vine (kg)	4.31	13.08	9.72	0.56	10.12	1.61
13	Average fruit weight (kg)	2.33	4.75	3.24	0.22	12.00	0.64
14	Fruit length (cm)	19.48	32.21	25.80	1.66	11.15	4.73
15	Fruit diameter (cm)	13.72	24.58	20.29	1.52	12.97	4.33
16	Fruit yield per ha (tonnes)	21.50	65.40	48.66	2.82	10.05	8.04
17	Rind thickness (cm)	0.16	0.46	0.33	0.05	28.50	0.15
18	Flesh thickness (cm)	2.97	5.25	3.80	0.24	11.29	0.70
19	Fruit cavity(cc)	687.76	2950	1207.63	112.78	16.18	321.44
20	Number of seeds per fruit	106.10	278.50	175.25	29.78	29.44	84.89
21	Test weight (100 seed wt) (g)	10.75	15.27	13.28	0.87	11.38	2.48

Table.3 Estimates of variability, heritability, expected genetic advances per cent of mean

Sr. No.	Character	Range	Mean	PCV (%)	GCV (%)	Heritability (h^2) %	Expected genetic advance as % over mean
1	Vine length (cm) 90 DAS	2.60-3.56	3.07	11.40	6.26	30.10	7.07
2	No of primary branches @ 90 DAS	2.26-3.50	3.07	15.32	8.72	32.40	10.23
3	Node at first male flower appears	2.20-3.2	2.52	14.30	9.79	46.80	13.80
4	Node at first female flower appears	8.61-15.53	13.12	17.69	11.46	42.00	15.29
5	Days to first male flower	44.56-54.56	50.30	8.47	4.63	30.00	5.22
6	Days to first female flower	52.70-64.83	58.52	7.68	4.48	34.00	5.38
7	Sex ratio	9.84-13.72	11.52	10.99	6.01	29.90	6.77
8	Inter nodal length (cm)	3.76-53.56	4.50	12.80	11.22	76.90	20.27
9	Days to first harvest	88.93-110.00	98.06	7.06	3.42	23.50	3.41
10	Fruit set %	31.61-66.55	47.36	29.02	16.17	31.00	18.56
11	Number of fruits per vine	1.22-3.71	2.37	38.96	21.51	30.50	24.46
12	Fruit yield per vine (kg)	4.31-13.08	9.72	19.48	16.65	73.10	29.33
13	Average fruit weight (kg)	2.33-4.75	3.24	19.90	15.87	63.60	26.08
14	Fruit length (cm)	19.48-32.22	25.80	17.23	13.14	58.20	20.66
15	Fruit diameter (cm)	13.72-24.58	20.29	18.94	13.79	53.10	20.70
16	Fruit yield per ha (tonnes)	21.58-65.40	48.66	19.56	16.78	73.60	29.66
17	Rind thickness (cm)	0.16-0.46	0.33	34.94	20.22	33.50	24.10
18	Flesh thickness (cm)	2.93-5.25	3.80	17.21	12.99	57.00	20.21
19	Fruit cavity(cc)	687.76-2950.00	1207.63	41.42	38.13	84.80	72.32
20	Number of seeds per fruit	106.10-278.53	175.25	36.81	22.10	36.10	27.35
21	Test weight (100 seed wt) (g)	10.75-15.27	13.28	13.59	7.44	30.00	8.39

Genotypic and phenotypic coefficient of variation

In the present investigation the phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the characters (Table 3), indicating the substantial modifying effect of environment in the expression of all traits studied. Hence, selection based on phenotypic performance will be more reliable. These results corroborate the view of Dhatt and Singh (2008) in pumpkin.

The highest genotypic coefficient of variation was observed for fruit cavity, number of seeds per fruit, and number of fruits per vine. High GCV is an indication of greater range of variability among the population and the scope of improvement of these characters through simple selection. Similar findings pertaining to different traits including the characters like number of fruits per vine, fruit set (%), and number of seeds per fruit in pumpkin Mukunda Lakshmi *et al.,* (2002).

Whereas the highest phenotypic coefficient of variation was observed for fruit cavity, number of fruits per vine, average fruit weight and number of seeds per fruit. High PCV is an indication of the existence of wide scope of selection for the improvement of the traits from a considerable amount of variability present. The above findings stood parallel with number of fruits per vine fruit weight, and number of seeds per fruit in pumpkin Mohanty (2000).

Result presented in table 3, revealed that the heritability estimates in broad sense were of lower magnitude except the characters fruit cavity (84%), and inter nodal length (76%). The range was in between 23.5 per cent to 84.8%.The moderate heritability character fruit length (58%), flesh thickness (57%), fruit diameter (53%). Low heritability characters include number of seeds per fruit (36%), days to first female flower (34%) rind thickness (33%). High heritability indicated the effectiveness of selection based on phenotypic performance but does not necessarily mean a high genetic advance for the particular trait.

Expected genetic advance

The results indicated that the expected genetic advance over mean observed was in the range of 3.41 per cent to 72.32 per cent for different characters. The highest per cent of expected genetic advance to the extent of 72.32% was noted for the characters fruit cavity followed by fruit yield per ha (29.66%). The moderate values were recorded in the character yield per vine (29.33%), number of seeds per fruit (27.35%). These observed high to moderate estimates of EGA are indicative of the fact that improvement could be quickly achieved in these characters through selection. Similar findings with high EGA were pertaining to different traits reported for the character fruit cavity, fruit yield per vine in musk melon Kalloo *et al.,* (1983), number of seeds per fruit in pumpkin Doijode and Sulladmath (1986). Generally high heritability accompanied with high genetic advance in a characters suggest that the inheritance of such character was governed mainly by additive gene effects and therefore improvement in these traits would be more effective by selection in the present material.

The mean sum of squares for all the characters studied was found to be significant, indicating the variation for the characters under study.

Genotypic coefficient of variation in general were greater in magnitude than the corresponding phenotypic ones, High values of GCV and heritability estimates supplemented with greater genetic gains are

also indicative of additive gene effects regulating the inheritance of such traits therefore these characters reflect greater selective value and offer ample scope for selection and phenotypic coefficient of variation was lessened under the influence of environment.

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