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Genetic studies of F₄ progenies in pumpkin (*Cucurbita moschata* Duch Ex. Poir)

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Abstract

A field experiment was conducted at All India Co-ordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) during the *Summer* season in the year 2019. The present investigation was undertaken with 5 progenies with their 20 plants of each progeny for a cross RHR PK-09-4-6 x RHR PK-10-1-1 (C:2x3) of pumpkin in F₄ generation for evaluating their genetic components such as variability, heritability, genetic advance, genetic advance as per cent of mean and correlation for growth, yield and yield attributes. Wide range of variability was observed for most of the characters. High values of GCV and PCV observed for number of primary branches per vine, number of fruits per vine, yield per vine, fruit weight and total yield tonnes per hectare. While, moderate value were observed for the node number at which the first female flower appeared, days until the first female flower appeared, fruit diameter and fruit length. For the remaining features, such like final vine length, days until the first fruit harvest, fruit diameter noted low value of genotypic and phenotypic co-efficients of variations. high calculates of heritability were associated with high calculates of per cent mean of genetic advance were observed for characters like vine length, number of primary branches per vine, number of fruit per vine, fruit length, fruit diameter, fruit yield per vine, fruit yield per plot, fruit yield per hectare, flesh thickness, number of ridges per fruit, seed cavity length, seed cavity width, number of seed, 100-seed weight and TSS. The significant and high positive correlation both at phenotypic and genotypic level were observed between fruit yield per plot and the yield contributing characters such as final vine length, number of primary branches per vine, number of fruit per vine, weight of fruit and fruit flesh thickness.

Keywords: Pumpkin, variability, heritability, genetic advance, F₄ generation

Introduction

Pumpkin (*Cucurbita moschata* Duch Ex. Poir) is a popular cucurbitaceous vegetable that can be grown in a variety of climates around the world. Fresh vegetables, processed foods and stock feed are all made from the fruits. When stewed, boiled, or baked, pumpkin pulp is delicious. Ripe fruits are used to make halwa, jams, and other sweets. Fruits are less nutritious than flowers. After the seed coats have been removed, the seeds are used in confectionery. It's a diuretic that's used to treat tapeworm infection.

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 extent to which improvement is possible after selection. The present investigation was under taken to ascertain magnitude and extent of genetic variability, heritability and genetic advance in pumpkin have been worked out and reported.

Materials and method

The present investigation was carried out at All India Co-ordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) during the *summer* 2019. The seeds of cross RHR PK-09-4-6 x RHR PK-10-1-1 (C:2x3) along with their parents were obtained from Department of Horticulture, MPKV, Rahuri. F₃ progenies from the cross were selected on the basis of shape of fruit and flesh colour. Five progenies (20 plants/progeny) were sown along with parents in randomized block design with three replications. Seeds of these generations were sown at a spacing of 5m x 1m. Observations were recorded on various growth and yield parameters such as final vine length (cm), number of primary branches per vine, days to 1st female flower

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appearance, sex ratio, node at which first female flower appeared, days to first harvest, no. of fruit per vine, weight of fruit (Kg), length of fruit (cm), diameter of fruit (cm), yield per vine (kg), yield per plot (Kg), yield per hectare (t/ha), fruit flesh thickness (cm), number of ridges per fruit, seed cavity length (cm), seed cavity width (cm), number of seeds per fruit, 100 seed weight (g) and TSS (⁰Brix). Estimation of variations and genetic advance was done following [6] coefficient of variations following [3] and heritability following [7] The correlation coefficient was estimated as suggested by [12].

Results And Discussion

The RHR PK-09-4-6 x RHR PK-10-1-1 (C:2x3) cross demonstrated a wider range of variability in almost all of the pumpkin traits. The vine length was varied from 461.33 to 620.67 cm, with 3.15 to 4.28 per vine number of primary branches, 48.05 to 57.65 days until the first female flower appearing, 16.23 to 19.46 sex ratio, 12.13 to 15.47 node number at which first female flower appeared, 93.30 to 104.47 the days to first harvest, 1.77 to 2.78 per vine number of fruit, 4.57 to 5.53 kg fruit weight, 13.82 to 29.72 cm fruit length, 16.42 to 22.30 cm fruit diameter, 8.12 to 15.96 kg per vine fruit yield, 40.62 to 79.78 kg per plot fruit yield, 16.25 to 31.91 tonnes per hectare fruit yield, 2.62 to 4.75 flesh thickness, 10.42 to 19.35 number of ridges per fruit, 11.36 to 22.46 cm seed cavity length, 12.27 to 20.10 cm seed cavity width, 124.20 to 277.49 number of seeds, 4.98 to 13.73 g weight of 100-seed and 6.60 to 9.34 ⁰Brix TSS. Significant variability for various characters in pumpkin have been reported by various workers viz., [2, 11].

The coefficient of genotypic and phenotypic variability is helpful to measure the extent of variability present in particular trait. They also provide a measure to compare the variability present among various quantitative traits. The estimates of genotypic and phenotypic coefficients of variation for twenty characters are presented in Table 1. The estimates of phenotypic as well as genotypic coefficient of variation in the cross RHR PK-09-4-6 x RHR PK-10-1-1(C-2x3) were observed higher for the per vine number of primary branches, number of fruits and yield per vine, fruit weight and total yield tonnes per hectare. While, moderate phenotypic as well as genotypic coefficients of variation were observed for node number at which the first female flower appeared, days until the first female flower appeared, fruit diameter and fruit length. For the remaining features, such like vine length, days until the first fruit harvest, fruit diameter noted low value of genotypic and phenotypic co-efficients of variations. Characters with higher estimations of GCV and PCV could be fully exploited in a future selection programme due to the wider range of the variation within segregating populations, i.e., potential for the enhancement by selection. Characters with lower GCV and PCV estimations might be used the least

in future selection programmes because of the relatively small amount of the variation observed within segregating populations, indicating that there is no room for further research through choosing [1, 2, 5].

Estimates of heritability (in broad sense) and genetic advance (in per cent of mean) for different characters is presented in Table 1. Heritability in broad sense of a character is important to the breeder since it indicates the possibility and extent to which improvement is possible through selection. It also indicates direction of selection pressure to be applied for a trait during selection because it measures relationship between parents and their progeny, hence widely used in determining the degree to which a character may be transmitted from parents to offspring. However, high heritability alone is not enough to make efficient selection in advanced generation unless accompanied by substantial amount of genetic advance [11]. High estimate of heritability along with high genetic advance in per cent of mean provides good scope for further improvement in advance generations.

High calculates of heritability were associated with high calculates of per cent mean of genetic advance were observed for characters like vine length, number of primary branches per vine, number of fruit per vine, fruit length, fruit diameter, fruit yield per vine, fruit yield per plot, fruit yield per hectare, flesh thickness, number of ridges per fruit, seed cavity length, seed cavity width, number of seed, 100-seed weight and TSS. Whereas, high calculates of heritability were observed in combination with moderate calculates of genetic advance as a percent of the mean for days until the first female flower appearance and node number at which the first female flower appeared which revealed that these traits are governed by additive gene action and phenotypic selection would be effective for improvement of these traits [1, 8, 9].

The significant and high positive correlation in F₄ generations both at phenotypic and the genotypic level (Table 2) were observed between fruit yield per plot and yield contributing characters such as final vine length, number of primary branches per vine, number of fruits per vine, number of fruit per vine, weight of fruit and fruit flesh thickness. While, the characters like days required for first female flower appearance, sex ratio, node at which first female flower appeared and days to first harvest of fruit were significantly and negatively correlated with fruit yield per plot. Most of these characters were also found to be positively associated among them. These findings in F₄ generations indicate that the ideal vine should have more vine length, more number of primary branches per vine, more number of fruits per vine, more weight of fruit, maximum flesh thickness, less days required for first female flower appearance, lower node position at which first female flower appeared and less days required for first harvest of fruit. The selection of a better yielder should also emphasis for improvement in these components [5, 10].

Table 1: Mean, range, GCV, PCV, ECV, heritability, genetic advance and per cent mean of genetic advance of F₄ population of cross RHR PK-09-4-6 x RHR PK-10-1-1 (C: 2x3)

Sr. No.	Character	Mean	Range	GCV (%)	PCV (%)	ECV (%)	h ² (bs) (%)	GA	GAM (%)
1.	Final vine length (cm)	516.33	461.33-620.67	10.36	10.36	0.33	99.97	110.19	21.34
2.	Number of primary branches per vine	3.62	3.15-4.28	10.55	11.23	6.63	88.36	0.74	20.44
3.	Days to 1 st female flower appearance	52.78	48.05-57.65	6.60	6.68	1.77	97.66	7.09	13.43
4.	Sex ratio	17.67	16.23-19.46	6.23	6.34	1.98	96.74	2.23	12.63
5.	Node at which first female flower appeared	13.57	12.13-15.47	8.13	8.82	5.91	85.04	2.10	15.45
6.	Days to first harvest	98.65	93.30-104.47	3.82	3.86	0.96	97.93	7.69	7.79
7.	Number of fruits per vine	2.31	1.77-2.78	15.66	15.75	2.97	98.82	0.74	32.07

8.	Weight of fruit (kg)	5.24	4.57-5.53	4.66	6.01	6.57	60.16	0.39	7.45
9.	Length of fruit (cm)	22.71	13.82-29.72	25.81	25.92	4.19	99.13	12.02	52.94
10.	Diameter of fruit (cm)	19.27	16.42-22.30	13.32	15.23	12.79	76.48	4.66	24.00
11.	Yield per vine (kg)	12.29	8.12-15.96	20.11	20.73	8.74	94.08	4.94	40.18
12.	Yield per plot (kg)	61.46	40.62-79.78	20.11	20.73	8.74	94.08	24.70	40.18
13.	Yield per hectare (t)	24.58	16.25-31.91	20.11	20.73	8.74	94.08	9.88	40.18
14.	Fruit flesh thickness (cm)	3.63	2.62-4.75	21.29	21.94	9.21	94.13	1.54	42.54
15.	Number of ridges per fruit	14.83	10.42-19.35	22.13	22.65	8.32	95.50	6.61	44.56
16.	Seed cavity length (cm)	16.07	11.36-22.46	31.10	31.17	3.59	99.56	10.28	63.93
17.	Seed cavity width (cm)	16.70	12.27-20.10	16.35	16.69	5.81	95.95	5.51	33.00
18.	Number of seeds per fruit	185.85	124.20-277.49	28.24	28.24	0.82	99.97	108.09	58.16
19.	100 seed weight (g)	9.45	4.98-13.73	31.09	32.40	15.76	92.11	5.81	61.48
20.	TSS (^o Brix)	8.39	6.60-9.34	12.09	12.12	1.48	99.50	2.08	24.85

Table 2: Genotypic and Phenotypic Correlation coefficient for yield and yield contributing characters in F₄ generation of Cross RHR PK-09-4-6 x RHR PK-10-1-1 (C:2x3)

Sr. No.	Characters		Final vine length (cm)	Number of primary branches per vine	Days to 1 st female flower appearance	Sex ratio	Node at which first female flower appeared	Days to first harvest	Number of fruit per vine	Weight of fruit (Kg)	Length of fruit (cm)	Diameter of fruit (cm)	Fruit flesh thickness (cm)	Yield per plot (kg)
1	Final vine length (cm)	G	1.000	0.993**	-0.848*	-0.756*	-0.937**	-0.929**	0.908**	0.804**	0.463	0.055	0.960**	0.953**
		P	1.000	0.933**	-0.838*	-0.743	-0.867**	-0.920**	0.904**	0.618	0.461	0.046	0.932**	0.925**
2	Number of primary branches per vine	G	-	1.000	-0.923**	-	-1.116**	-1.004**	0.979**	0.936**	0.614	0.248	1.002**	0.987**
		P	-	1.000	-0.860**	0.877**	-0.938**	-0.928**	0.923**	0.632	0.583	0.211	0.947*	0.911**
3	Days to 1 st female flower appearance	G	-	-	1.000	0.832**	0.970**	0.962**	-0.937**	-0.755*	-0.285	-0.624	-0.896**	-0.953**
		P	-	-	1.000	0.816**	0.915**	0.944**	-0.909**	-0.597	-0.283	-0.526	-0.875**	-0.892**
4	Sex ratio	G	-	-	-	1.000	1.032**	0.935**	-0.966**	-0.882**	-0.245	-0.648	-0.934**	-0.953**
		P	-	-	-	1.000	0.947**	0.920**	-0.941**	-0.682	-0.234	-0.589	-0.915**	-0.907**
5	Node at which first female flower appeared	G	-	-	-	-	1.000	1.069	-1.091	-0.989	-0.351	-0.594	-1.038**	-1.116**
		P	-	-	-	-	1.000	0.983	-0.988	-0.742	-0.321	-0.465	-0.969**	-0.969**
6	Days to first harvest	G	-	-	-	-	-	1.000	-1.008**	-0.931**	-0.302	-0.502	-1.000**	-1.037**
		P	-	-	-	-	-	1.000	-0.992**	-0.724	-0.294	-0.413	-0.976**	-0.987**
7	Number of fruit per vine	G	-	-	-	-	-	-	1.000	0.977**	0.290	0.468	1.029**	1.014**
		P	-	-	-	-	-	-	1.000	0.710	0.287	0.397	0.990**	0.983**
8	Weight of fruit (Kg)	G	-	-	-	-	-	-	-	1.000	-0.098	0.264	0.927**	1.087**
		P	-	-	-	-	-	-	-	1.000	-0.095	0.289	0.654	0.800*
9	Length of fruit (cm)	G	-	-	-	-	-	-	-	-	1.000	-0.148	0.385	0.254
		P	-	-	-	-	-	-	-	-	1.000	-0.156	0.378	0.236
10	Diameter of fruit (cm)	G	-	-	-	-	-	-	-	-	-	1.000	0.383	0.304
		P	-	-	-	-	-	-	-	-	-	1.000	0.293	0.335
11	Fruit flesh thickness (cm)	G	-	-	-	-	-	-	-	-	-	-	1.000	1.039**
		P	-	-	-	-	-	-	-	-	-	-	1.000	0.968**
12	Yield per plot (kg)	G	-	-	-	-	-	-	-	-	-	-	-	1.000
		P	-	-	-	-	-	-	-	-	-	-	-	1.000

S: Symbol, G: Genotypic, P: Phenotypic *, **: Significance at 5% and 1%, respectively

Conclusion

The value of phenotypic and genotypic coefficient of variation was observed for characters viz. number of primary branches per vine, number of fruits per vine, yield per vine, fruit weight and total yield tonnes per hectare in pumpkin and remaining character shows moderate and low PCV and GCV in the cross RHR PK-09-4-6 x RHR PK-10-1-1 (C:2x3). The characters showing wide range of variation provide ample scope for selecting the desirable plant types. High estimates of heritability for all characters indicating that they were least affected by environment and selection based on phenotypic performance would be reliable. The significant and positive correlation both at phenotypic and genotypic level were observed between fruit yield per vine and yield contributing characters. Thus, association of characters should be considered for improvement.

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