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

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ABSTRACT: The present experiment was carried out to find out the variability among the thirty five diverse genotypes including one check for quantitative traits and qualitative traits. The research was conducted at Main Experiment Station of Department of Vegetable Science, Acharya Narendra Deva University of Agriculture & Technology, (Narendra Nagar), Kumarganj, Ayodhya, U.P. The experiment was conducted in Randomized Block Design with three replications. The wide range of variability among the traits during 2021 (kharif season). Genotypes involved in this study were genetically diverse and have good breeding value, which confirmed the predictions of analysis of variance. Out of 35 genotypes among four genotypes were produced significantly higher yield than best check Narendra Agrim.

Keywords: Pumpkin, heritability, variability, PCV, GCV and genetic advance.

INTRODUCTION

Pumpkin (*Cucurbita moschata* Duch. ex. Poir.) is a sexually propagated monoecious climbing vegetable belonging to the genus *Cucurbita*, order Cucurbitales, family Cucurbitaceae, (Mohsin *et al*., 2017), with chromosome number 2n= 40 (Martins *et al.*, 2015). Kashiphal, Sitaphal, and Kaddu are all names for pumpkin (Rana, 2014). The principal sites of origin and domestication for cultivated Cucurbita species may be found in various parts of Central and South America (Jeffrey, 1990), and Cucurbita's primary domestication dates back 8,000 to 10,000 years (Sanjur *et al*., 2002). Pumpkin fulfill the more energy, carbs, vitamins, and minerals than other fruits and vegetables, and is particularly rich in carotenoid colors (Bose and Som 1998).

Flowers have more nutrients than fruits. Carotene is also abundant in the young leaves and blossoms (Rajan and Markose 2001). Carotene levels rise in mature fruits that have been stored. After three months of storage under shade 12.63 percent rise in beta-carotene content in fresh whole pumpkin was discovered from the studies (Chavasit *et al*., 2002). It has the potential to improve people's nutritional health, particularly among vulnerable groups in terms of vitamin A. It is grown in 99 thousand hectares in India, with yearly production and productivity of 2117 thousand Mt and 22.5 thousand Mt/ha (NHB, 2018-19). Uttar Pradesh produces 360.16 ton of pumpkin.

Variability parameter like genotypic and phenotypic coefficient of variations, heritability and degree of association between the various characters and direct effect of yield contributing traits on total yield, is of paramount significance in formulating an appropriate breeding strategy aimed at exploiting the inherent variability of the original population. Though pumpkin is a very important vegetable crop the research work done towards its improvements is very scanty.

MATERIAL AND METHODS

The present investigation was carried out during summer 2021 at the Main Experiment Station of Department of Vegetable Science, Acharya Narendra Deva University of Agriculture & Technology, (Narendra Nagar), Kumarganj, Ayodhya, U.P. Geographically, Kumarganj falls under humid sub-tropical climate and is located in between 24.470 and 26.560N latitude and 82.120 and 83.980E longitude at an altitude of 113 m above the mean sea level. The soil type of experimental site is clay-loam. Kumarganj falls under semi-arid region receiving an annual mean rainfall of about 1200 mm. Major rainfall in this area occurs from July to September. Occasional showers are also very common in winter season, but this period is usually cool and dry. The hot period of summer season

generally starts somewhere in middle of April and continues till the middle of June when the presence of monsoon in the sky become clearly visible. The experiment was conducted in Randomized Block Design with three replications to assess the performance of 35 genotypes including one check (Narendra Agrim). Each entry was sown in one rows with 3 m, length spaced 3 m with plant to plant spacing of 0.5 m in each replication.

RESULTS AND DISCUSSION

Breeders place a high value on genotypic coefficient of variation estimates as genetic variance alone does not enable them to determine which traits exhibit the most variability. The phenotypic and genotypic coefficients of variation can thus be used to make precise relative comparisons. For all the characters under study, the phenotypic coefficients of variability were generally larger than the genotypic coefficients of variability, indicating that the environment had a significant impact on expression of the traits. 11 characters of pumpkin germplasm's estimated genotypic and phenotypic coefficients of variation were showed in a Table 3.

The phenotypic coefficient of variation ranged from 3.847 per cent (Days to first pistallate flower anthesis) to 49.674 per cent (average fruit weight) for the various characters studied. Highest phenotypic coefficient of variation was recorded for the character average fruit weight 49.674 per cent followed by total fruit yield (kg) 44.835 per cent, while, moderate to high values of PCV were observed for characters, number of fruit per plant (38.748%), flesh thickness (13.592%), node number at first staminate flower anthesis(7.592%), node number at first pistillate flower anthesis (7.267%), fruit equatorial circumference (6.351%), days to first staminate flower anthesis (5.703%) and days to first fruit harvest (4.006%). However, low phenotypic coefficient of variation was observed in characters *viz.,* node number at first staminate flower anthesis (7.592%), node number at first pistillate flower anthesis (7.267%), fruit equatorial circumference (6.351%), days to first staminate flower anthesis (5.703%) and days to first fruit harvest (4.006%)**.** The genotypic coefficient of variation (GCV) ranged from 2.491 per cent (days to first pistillate flower anthesis) to 49.534 per cent (Average fruit weight (kg), whereas, genotypic coefficient of variation was lower for the characters, node number at first pistillate flower anthesis (6.441%), fruit equatorial circumference (5.533%), node number at first staminate flower anthesis (5.155%), days to first staminate flower anthesis (5.013%) and days to first fruit harvest (2.598%). The observed environmental coefficient of variation was in the range between days to first staminate flower anthesis (4.711) per cent to flesh thickness (9.938) per cent. The high estimates of PCV and GCV for these characters were also reported earlier (Karthick *et al.,* 2019).

Highest environmental coefficient of variation was recorded for the character flesh thickness (9.938) per cent. There was moderate to low environmental coefficient of variation reported for all the characters under studied. While, moderate to high values of ECV were observed for characters number of node number for first staminate flower anthesis (9.653) per cent ,number of fruit per plant (7.604%), average fruit weight (6.449%), total fruit yield(6.298)%, node number at first female for anthesis (5.830%), fruit equatorial circumference(5.401)%, days to first fruit harvest (5.280%), fruit polar circumference (5.140%), days to first pistillate flower anthesis (5.077%) and days to first staminate flower anthesis (4.711%).

The broad sense heritability was observed for 99.400 per cent in case of average fruit weight (kg), while lowest for days to first pistillate flower anthesis 41.900 per cent. Result presented in the Table 3, revealed that the high heritability estimates in broad sense for fruit yield per plant (99.300%), and number of fruit per plant (98.700)%, fruit polar length (cm) (85.300)%, flesh thickness (82.200)%, node number at first female flower anthesis (78.500)%, days to first staminate flower anthesis (77.300)%, fruit equatorial circumference (75.900)%, node number at first staminate flower anthesis (46.100%), days to first harvest (42.100)%, days to first pistallate flower anthesis (41.900%). Estimate of high heritability (>50%) were recorded for all the 11 characters except to node number at first staminate flower anthesis (46.100%), days to first fruit harvest (42.2100%) and days to first pistallate flower anthesis (41.900%).

The highest value of genetic advance in per cent of mean was shown by average fruit weight (101.753), while days to first pistillate flower anthesis had lowest value (3.323) for this parameter. The characters showing very high estimate of genetic advanced were average fruit weight (101.753), total fruit yield (91.754), number of fruit per plant (78.796), flesh thickness (23.010), fruit polar length (13.584), node number at first female flower anthesis (11.758), fruit equatorial circumference (9.929), days to first staminate flower anthesis (9.076), node number at first male flower anthesis (7.212), and days to first fruit harvest (3.472). The traits like number of average fruit weight (kg), total fruit yield (kg), number of fruit per plant and flesh thickness (cm) showed comparatively higher values of phenotypic coefficients of variations, genetic coefficient of variation, heritability (in broad sence), genetic advance and expected genetic advanced as % of mean through additive gene effect and they can be improved by selection. High heritability along with high genetic advance has also been reported for most of the fruit yield and yield attributing traits by (Mohenty and Mishra 1999; Pandey *et al*., 2002; Veena *et al.,* 2012; Shah *et al.*, 2018; Sundharaiya *et al*., 2019).

Table 1: Analysis of variance (mean squares) for eleven characters in pumpkin.

Sr. No.	Characters	Mean sum of square		
		Replication	Treatments	Error
		d.f. 2	d.f. 34	d.f. 68
1.	Node number at first staminate flower anthesis	0.171	0.106*	0.057
2.	Node number at first pistillate flower anthesis	1.400	0.849**	0.182
3.	Days to first staminate flower anthesis	4989.849	79.699ns	101.164
4.	Days to first pistillate flower anthesis	5.600	10.388*	6.031
5.	Fruit polar length (cm)	0.017	8.055**	1.186
6.	Fruit equatorial cercumferance (cm)	1.846	24.230**	5.841
7.	Flesh thickness(cm)	5.282	0.337**	0.06
8.	Days to First harvest	36.695	19.870*	11.509
9.	Average fruit wt.(kg)	0.510	1.091**	0.006
10.	No. of fruits/plant	2.540	5.255**	0.068
11.	Total Fruit yield /Plant(Kg)	3.117	8.572**	0.056

Table 2: Mean performance of thirty five pumpkin genotypes for eleven quantitative traits.

Sr. No.	Treatments/Genotypes	Node number at first staminate flower anthesis	Node number at first pistillate flower anthesis	Days to first staminate flower anthesis	Days to first pistillate flower anthesis	Fruit polar length (cm)	Fruit equatorial cercumferance (cm)	Flesh thickness(cm)	Days to First harvest	Average fruit wt.(kg)	No. of fruits/plant	Total Fruit yield/Plant (Kg)
		1	2	3	4	5	6	7	8	9	10	11
1.	2019/PUMAR-1	2.10	6.57	35.67	49.00	19.17	39.03	2.49	60.33	0.55	4.25	2.55
2.	2019/PUMAR-2	2.10	6.47	60.00	48.00	20.33	48.67	2.58	66.00	1.04	3.27	3.33
3.	2019/PUMAR-4	2.40	6.80	50.83	42.00	21.43	48.20	2.52	65.33	1.46	1.70	2.43
4.	2019/PUMAR-5	2.10	6.47	51.00	46.00	22.35	51.35	2.50	64.33	1.41	2.42	3.32
5.	2019/PUMAR-6	2.46	6.60	41.67	46.67	20.90	48.88	2.47	63.00	1.76	2.57	4.49
6.	2018/PUMAR-1	2.63	7.57	49.07	50.00	20.00	42.67	2.48	59.00	0.74	3.50	2.57
7.	2018/PUMAR-2	2.77	7.50	46.00	49.00	19.83	45.18	3.60	59.67	1.42	4.57	6.40
8.	2018/PUMAR-3	2.27	8.57	39.17	46.00	20.32	43.25	2.48	60.67	0.85	3.57	2.97
9.	2018/PUMAR-4	2.50	7.53	44.00	49.00	20.83	47.89	2.32	64.00	0.66	5.45	3.59
10.	2018/PUMAR-5	2.30	7.63	49.67	48.00	20.95	47.60	2.20	57.33	0.76	3.32	2.53
11.	2018/PUMAR-6	2.47	7.67	52.78	50.33	22.17	42.67	2.23	67.00	1.55	5.53	8.57
12.	2018/PUMAR-7	2.50	8.43	47.00	49.67	19.00	45.42	2.50	65.00	0.87	4.42	3.80
13.	NDPK-25	2.53	7.50	42.00	49.33	21.70	45.33	2.20	64.67	1.00	5.35	5.32
14.	NDPK-26	2.33	6.60	41.00	48.00	21.53	43.15	2.20	65.67	1.51	2.32	3.50
15.	NDPK-27	2.43	7.37	42.00	48.00	22.33	42.77	2.27	63.67	1.03	2.39	2.43
16.	NDPK-28	2.55	7.50	45.00	49.67	25.53	42.75	2.50	62.33	1.19	4.61	5.49
17.	NDPK-29	2.40	7.53	48.00	46.00	20.23	41.78	2.42	67.33	0.55	6.33	3.48
18.	NDPK-30	2.63	7.50	46.00	48.33	22.80	41.55	2.40	66.00	1.44	2.58	3.60
19.	NDPK-31	2.72	7.50	37.00	48.67	20.57	44.00	2.20	65.67	3.47	1.33	4.43
20.	NDPK-32	2.75	7.47	45.00	46.67	21.00	44.63	2.45	66.00	0.57	4.43	2.47
21.	NDPK-33	2.44	6.63	50.00	51.00	19.11	43.95	2.25	65.33	1.33	6.35	8.88
22.	NDPK-34	2.67	6.50	48.00	48.00	20.00	45.02	2.42	67.67	0.47	3.25	1.54
23.	NDPK-35	2.40	7.50	54.92	47.67	17.33	42.67	2.42	66.00	0.67	2.23	1.50
24.	NDPK-36	2.47	7.43	36.67	49.33	22.00	40.28	2.42	64.67	0.70	3.27	2.28
25.	NDPK-37	2.20	6.73	43.00	48.00	22.67	49.92	2.23	63.00	2.43	1.47	3.38
26.	NDPK-38	2.53	6.57	51.17	48.33	21.03	46.30	2.28	66.67	1.48	2.30	3.35
27.	NDPK-39	2.59	7.57	49.92	51.33	22.00	44.00	2.23	67.67	1.13	2.33	2.57
28.	NDPK-40	2.52	7.17	44.00	48.67	20.00	48.90	3.47	61.00	2.29	2.43	5.85
29.	NDPK-41	2.47	7.57	49.00	48.67	22.00	42.93	2.37	65.33	1.04	2.30	2.38
30.	NDPK-42	2.62	7.60	46.67	48.67	26.00	42.83	3.33	66.00	1.36	2.60	3.53
31.	NDPK-43	2.20	7.58	45.67	48.33	21.32	44.53	2.45	63.00	0.97	4.41	4.27
32.	NDPK-44	2.67	7.60	49.00	46.00	21.58	42.17	2.20	64.67	1.02	3.34	3.35
33.	NDPK-45	2.67	7.40	43.00	48.00	20.40	44.00	2.40	66.00	1.30	3.45	4.69
34.	NDPK-46	2.65	7.60	46.00	52.00	21.42	44.44	2.23	66.33	0.94	2.38	2.53
35.	Narendra Agrim(C)	2.72	7.94	47.00	50.67	21.77	47.53	2.60	62.33	1.54	3.53	4.57
	SEd	0.19	0.35	8.21	2.01	0.89	1.97	0.20	2.77	0.06	0.21	0.19
	CV %	9.65	5.83	10.77	5.08	5.14	5.40	9.94	5.28	6.45	7.60	6.30
	CD1%	0.52	0.92	8.33	5.31	2.36	5.23	0.53	7.34	0.17	0.56	0.51
	CD5%	0.39	0.70	16.42	4.01	1.78	3.95	0.40	5.54	0.13	0.43	0.39
	MEAN	2.48	7.32	46.20	48.37	21.19	44.75	2.47	64.25	1.21	3.42	3.77
	MAX	2.77	8.57	60.00	52.00	26.00	51.35	3.60	67.67	3.47	6.35	8.88
	MIN	2.10	6.47	35.67	42.00	17.33	39.03	2.20	57.33	0.47	1.33	1.50

Table 3: Estimates of range, variability, heritability and expected genetic advance in per cent of mean for the eleven characters in pumpkin germplasm.

Sr. No.	Characters	Range		Variability			Heritability (in broad sense) %	Genetic advanced	Expected g. a. as % of mean
		Min.	Max.	PCV%	GCV%	ECV%			
1.	Node number at first staminate flower anthesis	2.10	2.77	7.592	5.155	9.653	46.100	0.179	7.212
2.	Node number at first pistallate flower anthesis	6.47	8.57	7.267	6.441	5.830	78.500	0.861	11.758
3.	Days to first staminate flower anthesis	35.67	60	5.703	5.013	4.711	77.300	4.067	9.076
4.	Days to first pistallate flower anthesis	42	52	3.847	2.491	5.077	41.900	1.608	3.323
5.	Fruit polar length (cm)	17.33	26	7.733	7.141	5.140	85.300	2.878	13.584
6.	Fruit equatorial circumference (cm)	39.03	51.35	6.351	5.533	5.401	75.900	4.443	9.929
7.	Flesh thickness (cm)	2.20	3.60	13.592	12.322	9.938	82.200	0.567	23.010
8.	Days to first fruit harvest	57.33	67.67	4.006	2.598	5.280	42.100	2.231	3.472
9.	Average fruit weight (kg)	0.47	3.47	49.674	49.534	6.449	99.400	1.235	101.753
10.	Number of fruit per plant	1.33	6.35	38.748	38.498	7.604	98.700	2.691	78.796
11.	Total Fruit yield Per Plant (Kg)	1.50	8.88	44.835	44.688	6.298	99.300	3.459	91.754

CONCLUSIONS

Four genotypes *viz*., NDPK-40, 2018/PUMAR-2, 2018/PUMAR-6 and NDPK-33 were found significantly superior for fruit yield per plant than check variety Narendra Agrim. High magnitude of phenotypic as well as genotypic coefficients of variation were observed for the character average fruit weight 49.674 per cent followed by total fruit yield (kg) 44.835. Heritability and genetic advance revealed that high heritability coupled with high genetic advance was recorded for all the characters except days to first fruit harvest, days to first staminate flower anthesis, days to first pistillate flower anthesis and fruit equatorial circumference. Thus, these traits exhibiting high heritability in broad sense and high expected genetic advance as per cent of mean may be considered to be largely governed by additive gene action and therefore, could be effectively improved through selection.

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