



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(5): 1901-1910
© 2022 TPI
www.thepharmajournal.com
Received: 02-02-2022
Accepted: 04-03-2022

Deepak D Sharma
Department of Genetics and
Plant Breeding, B. A. College of
Agriculture, AAU, Anand,
Gujarat, India

Hareshkumar L Dhaduk
Medicinal and Aromatic Plants
Research Station, Anand
Agricultural University, Anand,
Gujarat, India

DJ Parmar
Department of Agricultural
Statistics, B. A. College of
Agriculture, AAU, Anand,
Gujarat, India

Parthik Patel
Department of Genetics and
Plant Breeding, B. A. College of
Agriculture, AAU, Anand,
Gujarat, India

Corresponding Author
Deepak D Sharma
Department of Genetics and
Plant Breeding, B. A. College of
Agriculture, AAU, Anand,
Gujarat, India

Genetic variability, association and biochemical profiling in pumpkin

Deepak D Sharma, Hareshkumar L Dhaduk, DJ Parmar and Parthik Patel

Abstract

The present investigation was carried out to estimate the extent of variability, correlation, path and genetic divergence for yield and quality related traits in pumpkin. The significant differences among genotypes were revealed by analysis of variance for all the 28 characters, indicating the presence of considerable genetic variability for the traits studied. The high genotypic coefficient of variation (GCV) and high heritability coupled with high genetic advance as per cent of mean was observed for 18 out of 28 characters indicating that sufficient variability existed in the experimental material. The correlation coefficient revealed a significant and positive association of 14 characters with fruit yield per vine (kg). Path analysis based on genotypic correlation showed positive and direct effects for 17 characters indicating the importance for these characters to impose selection pressure for improvement in pumpkin yield. Based on *per se* performance genotypes, GPPK 115, GPPK 18, GPPK 105, GPPK 95, GPPK 143 and AP 1 were identified as elite genotypes and could be used in the future breeding programme for improving yield in pumpkin.

Keywords: Pumpkin, GCV, PCV, heritability, genetic advance, correlation, path coefficient analysis

Introduction

Pumpkin (*Cucurbita moschata* Duch. Ex Poir.) is known as Kaddu (Hindi) locally. It belongs to the family Cucurbitaceae having chromosome number $2n=2x=40$. Primary centres of origin are possibly Northern and Southern America. Pumpkin is monoecious and cross-pollinated crop nature and does not suffer much from inbreeding depression in the process of purification through self-pollination (Allard, 1960) [1].

Pumpkin seeds are also a rich source of carbohydrates (22%), proteins (30%), oils (40-50%), minerals and vitamins (Singh *et al.*, 1998) [14]. It may have the potential to improve malnutrition among the people particularly regarding the requirement of vitamin 'A' (Satkar *et al.*, 2013) [11]. Phytochemicals isolated from pumpkin trigonelline and nicotinic acid are found to reduce blood cholesterol and glucose levels.

The area under cultivation of pumpkin is 72,000 ha in India, with a total production of 15,82,000 million tons (Anon., 2016-17) [2]. Any breeding programme starts by surveying the variation in the available germplasm. Germplasm resides the building blocks for the development of new varieties. Greater variability in population gives a greater chance of effective selection for the desirable types. Large heritable variability is essential for selection in a population. The phenotypic variability is the outcome of the effect of genotype and environment interaction. The nature and amount of genetic variability present in the crops have basic importance to breeders for the crop improvement programme.

Selection based on component characters are proved to be effective compared to direct selection for fruit yield (Fisher, 1918) [5]. Correlation studies estimate the degree of association between yield and its various components and also among the components but do not provide the magnitude of direct and indirect effects towards the yield. Here, path coefficient analysis was found to be useful in partitioning the correlation coefficient into direct and indirect effects used by breeders to achieve desirable goals (Wright, 1921) [18].

Considering the importance of pumpkin crop and to generate more information on above stated aspects, the present investigation was undertaken with objectives to estimate the extent of variability, heritability and genetic advance of different characters for yield and quality traits in pumpkin, correlation coefficient, path coefficient.

Material and Method

Total 34 genotypes of pumpkin were investigated at Main Vegetable Research Station, Anand Agricultural University (AAU), Anand during the *kharif* season of the year 2018 (Table 1). The experiment was conducted in a randomized complete block design (RBD) with three replications. Sowing was done on 17th July 2018 in the plot of 4.0 × 5.0 m size with spacing 2.0 × 1.0 m and all the agronomical practices were followed as per recommendations. Data were recorded using five randomly selected competitive plants from each experimental unit in all the three replications and the experimental material was evaluated for twenty-eight characters enlisted in Table 2. The mean, range and coefficient of variation (CV%) were estimated using SPAR 1. The genotypic and phenotypic coefficient of variation (Burton, 1952), heritability in the broad sense and genetic advance (Allard, 1960) ^[1], correlations coefficients (Singh and Choudhary, 1985) ^[13] were worked out.

Result and Discussion

Genetic variability

The perusal of the data of *per se* performance revealed that the genotypes GPPK 115, GPPK 143, GPPK 105, GPPK 95 and GPPK 18 were elite genotypes based on yield. Out of these the genotype GPPK 115 shows high *per se* performance for fruit yield per vine (6.85 kg), average fruit weight (6.61 kg), main vine length (5.61 m), number of fruits per vine (1.73), equatorial circumference of fruit (75.61 cm), flesh thickness (4.69 cm), and oil content (39.03%) with minimum free fatty acid content (0.60%). GPPK 105 for fruit yield per vine (6.65 kg), average fruit weight (6.39 kg), equatorial circumference of fruit (73.95 cm), polar circumference of fruit (71.85 cm), seed weight per fruit (77.29 g) and GPPK 18 for fruit yield per vine (5.42 kg), flesh thickness (4.21 cm), soluble sugar from pulp (31.71%) and Fe content (11.29).

Whereas, there is a huge variation was seen in quality parameters among the genotypes. However, AP 1 was found to be the most promising genotype for quality traits and showed high *per se* performance for ascorbic acid content from the pulp (5.97 mg/100g), β-carotene content from the pulp (3.15 mg/100g), β-carotene content from pulp flour (6.44 mg/100g), true protein from seed (14.20%) and also having considerable yield (5.12 kg). Thus, based on mean values of genotypes viz., GPPK 115, GPPK 18, GPPK 105, GPPK 95, GPPK 143 and AP 1 (Plate I) were identified as elite genotypes for future use (Table 4).

The analysis of variance revealed significant differences among genotypes for all the characters under study, which

indicated that experimental material had sufficient variability for different traits. The estimates of genotypic and phenotypic variances revealed that the characters like fruit yield per vine (kg), average fruit weight (kg), days to opening of first male flower, days to opening of first female flower, node number of first male flower, node number of first female flower, main vine length (m), number of fruits per vine, flesh thickness (cm), seed index (g), and all biochemical parameters showed the predominance of genotypic variance in total phenotypic variance (Table 2). Genotypic components were found to be a major contributor to the total variation (Table 3). The low values of the environmental variance show little effect on the phenotypic variation of various traits. These results suggest that the improvement of the above traits can be done through selection. On the other hand, equatorial circumference of fruit (cm), polar circumference of fruit (cm), number of seeds per fruit and seed weight per fruit (g) showed the greater influence of environmental factors for their expression and similar findings were also reported by Chaudhary *et al.* (2017) ^[4] and Kumar *et al.* (2017) ^[7].

Low GCV and PCV were recorded for characters like days to opening of first male flower (6.77%) (7.15%), days to opening of first female flower (8.00%) (8.53%), equatorial circumference of fruit (cm) (10.15%) (14.65%) and polar circumference of fruit (cm) (9.96%) (15.58%) indicating less variability for these traits in the genotype studied and cannot be exploited through selection. Rest of the characters showed high GCV and PCV values suggesting considerable scope for improvement of these traits by selection. These results were supported by Sultana *et al.* (2015) ^[16], Kumar *et al.* (2017) ^[7] and Srikanth *et al.* (2017) ^[15].

High heritability was observed for characters like fruit yield per vine (kg), average fruit weight (kg), days to opening of first male flower, days to opening of first female flower, node number of first male flower, node number of first female flower, main vine length (m), number of fruits per vine, flesh thickness (cm), number of seeds per fruit, seed weight per fruit (g), seed index (g), and all the biochemical traits. Moderate heritability was obtained for characters like equatorial circumference of fruit (cm) and polar circumference of fruit (cm).

The characters like days to opening of first male flower and days to opening of first female flower exhibited high heritability (89.49%, 87.91%) and with moderate genetic advance (13.19%, 15.45%) while equatorial circumference of fruit (cm) and polar circumference of fruit (cm) observed with moderate heritability (48.02%, 40.87%) and genetic advance (14.49%, 13.12%).

Table 1: List of the pumpkin genotypes selected for the study

Sr. no.	Genotype	Source	Sr. no.	Genotype	Source
1.	Saras	KAU, Kerala	18.	GPPK69	MVRS, AAU, (Gujarat)
2.	Ambili	KAU, Kerala	19.	GPPK 90	MVRS, AAU, (Gujarat)
3.	Anand Pumpkin 1	AAU, Anand	20.	GPPK 95	MVRS, AAU, (Gujarat)
4.	Pusa Vikas	IARI, Delhi	21.	GPPK 100	MVRS, AAU, (Gujarat)
5.	Pusa Vishwas	IARI, Delhi	22.	GPPK 105	MVRS, AAU, (Gujarat)
6.	Azad pumpkin 1	CSAUAT, Kanpur	23.	GPPK 107	MVRS, AAU, (Gujarat)
7.	Varanasi local	IIVR, Varanasi	24.	GPPK 109	MVRS, AAU, (Gujarat)
8.	Kasha Harit	IIVR, Varanasi	25.	GPPK 113	MVRS, AAU, (Gujarat)
9.	Arka Chandan	IIHR, Bangalore	26.	GPPK 115	MVRS, AAU, (Gujarat)
10.	GPPK 2	MVRS, AAU, (Gujarat)	27.	GPPK 126	MVRS, AAU, (Gujarat)
11.	GPPK 18	MVRS, AAU, (Gujarat)	28.	GPPK 133	MVRS, AAU, (Gujarat)
12.	GPPK 30	MVRS, AAU, (Gujarat)	29.	GPPK 139	MVRS, AAU, (Gujarat)
13.	GPPK 33	MVRS, AAU, (Gujarat)	30.	GPPK 141	MVRS, AAU, (Gujarat)
14.	GPPK 48	MVRS, AAU, (Gujarat)	31.	GPPK 143	MVRS, AAU, (Gujarat)

15.	GPPK 50	MVRS, AAU, (Gujarat)	32.	GPPK 148	MVRS, AAU, (Gujarat)
16.	GPPK 56	MVRS, AAU, (Gujarat)	33.	GPPK 150	MVRS, AAU, (Gujarat)
17.	GPPK 59	MVRS, AAU, (Gujarat)	34.	GPPK 201	MVRS, AAU, (Gujarat)

Table 2: Analysis of variance (mean sum of squares) for different characters in pumpkin

Sr. no.	Characters	Mean Sum of Square		
		Replications (df: 2)	Genotypes (df: 33)	Error (df: 66)
1.	Fruit yield per vine	0.179	7.069**	0.264
2.	Average fruit weight	0.061	1.635**	0.106
3.	Days to opening first male flower	42.320**	28.293**	1.065
4.	Days to opening first female flower	19.750**	57.272**	2.508
5.	Node number of first male flower	3.304**	5.935**	0.297
6.	Node number of first female flower	2.658	26.034**	1.022
7.	Main vine length	0.226*	3.540**	0.063
8.	Number of fruits per vine	0.033	0.656**	0.016
9.	Equatorial circumference of fruit	52.656	148.952**	39.489
10.	Polar circumference of fruit	27.469	168.869**	54.939
11.	Flesh thickness	0.023	1.735**	0.023
12.	Number of seeds per fruit	80.00	22866.790**	1598.621
13.	Seed weight per fruit	0.383	866.619**	44.754
14.	Seed index	0.053	30.473**	0.876
15.	Soluble sugar content from pulp	1.290**	150.204**	0.214
16.	Ascorbic acid content from pulp	0.317*	1.572**	0.093
17.	β -carotene content from pulp	0.002	0.273**	0.006
18.	True protein content from seeds	0.963**	17.345**	0.129
19.	Free amino acid content from seeds	0.006	2.919**	0.013
20.	Oil content	0.703	112.826**	1.623
21.	Free fatty acid content	0.006*	0.113**	0.002
22.	Soluble sugar content from pulp flour	7.434	117.459**	5.843
23.	β -carotene content from pulp flour	0.013	2.731**	0.004
24.	True protein content from pulp flour	2.685	5.677**	0.197
25.	Fe content	0.040	8.909**	0.009
26.	Zn content	0.035	17.213**	0.012
27.	Mn content	0.002	13.225**	0.004
28.	Cu content	0.002	2.027**	0.001

Note: * and ** indicate significant at 5% and 1% level, respectively

Table 3: The estimates of variance components and other genetic parameters for different characters in pumpkin

Sr. no.	Characters	σ^2_g	σ^2_p	GCV (%)	PCV (%)	H^2_b (%)	GA (% Mean)
1.	Fruit yield per vine	2.24	2.60	36.79	39.64	86.10	70.32
2.	Average fruit weight	1.87	2.16	37.27	40.13	86.28	71.33
3.	Days to opening first male flower	9.08	10.14	6.77	7.15	89.49	13.19
4.	Days to opening first female flower	18.25	20.76	8.00	8.53	87.91	15.45
5.	Node number of first male flower	1.88	2.18	20.61	22.18	86.37	39.46
6.	Node number of first female flower	8.34	9.36	13.80	14.62	89.08	26.83
7.	Main vine length	1.16	1.22	25.88	26.58	94.82	51.92
8.	Number of fruits per vine	0.15	0.17	46.37	48.77	89.90	90.80
9.	Equatorial circumference of fruit	36.48	75.97	10.15	14.65	48.02	14.49
10.	Polar circumference of fruit	37.98	92.92	9.96	15.58	40.87	13.12
11.	Flesh thickness	0.57	0.59	26.16	26.69	96.06	52.81
12.	Number of seeds per fruit	7422.65	9021.33	23.91	26.36	82.28	44.68
13.	Seed weight fruit	273.94	318.70	36.64	39.52	85.96	69.97
14.	Seed index	9.87	10.74	25.32	26.42	91.84	49.99
15.	Soluble sugar content from pulp	31.00	31.21	43.49	43.64	99.31	89.30
16.	Ascorbic acid content from pulp	0.49	0.59	16.70	18.22	84.02	31.54
17.	β -carotene content from pulp	0.09	0.10	15.73	16.25	93.61	31.36
18.	True protein content from seeds	5.74	5.87	25.95	26.24	97.81	52.87
19.	Free amino acid content from seeds	0.97	0.98	26.98	27.16	98.64	55.20
20.	Oil content from seeds	37.07	38.69	19.26	19.68	95.81	38.84
21.	Free fatty acid from seed oil content	0.037	0.039	22.69	23.23	95.39	45.65
22.	Soluble sugar from pulp flour	37.22	43.06	18.32	19.71	86.43	35.09
23.	β -carotene from pulp flour	0.909	0.913	22.45	22.50	99.76	46.11
24.	True protein from pulp flour	1.83	2.03	11.80	12.42	90.26	23.09
25.	Fe content	2.97	2.98	21.35	21.39	99.69	43.92
26.	Zn content	5.73	5.75	37.22	37.26	99.79	76.59
27.	Mn content	4.407	4.411	42.19	42.21	99.92	86.87
28.	Cu content	0.675	0.676	46.73	46.76	99.86	96.20

The results indicated the involvement of non-additive gene effect for expression of these traits and hence population improvement approach would be most effective for improvement of these characters. Remaining all the characters exhibited high heritability with a high genetic advance which could be effectively improved by selection. Similar findings were reported by Martins *et al.* (2016), Shrikanth *et al.* (2017) and Kumar *et al.* (2017).



Plate I: Elite pumpkin genotypes selected based on mean performance for different characters under study

Correlation studies

The values of genotypic correlation coefficients were higher than those of their respective phenotypic correlation coefficients in most of the cases, suggesting that there was a strong and inherent association between two characters (Table 5 and Table 6). However, the phenotypic correlation was slightly higher than their genotypic counterpart between seed weight per fruit (g) and number of seeds per fruit ($rg=0.804$ and $rp=0.806$), correlation of ascorbic acid content from pulp (mg/100g) with oil content (%) ($rg=0.197$ and $rp=0.199$) which implied that the non-genetic causes inflated the value of genotypic correlation because of the influence of environmental factors. The overall correlation analysis indicated that fruit yield per vine (kg) depicted significant and positive association with average fruit weight (kg) ($rg=1.003$ and $rp=0.896$), days to opening of first female flower ($rg=0.225$ and $rp=0.202$), node number of first female flower ($rg=0.399$ and $rp=0.334$), main vine length (m) ($rg=0.545$ and $rp=0.488$), number of fruits per vine ($rg=0.658$ and $rp=0.607$), equatorial circumference of fruit (cm) ($rg=0.625$ and $rp=0.531$), polar circumference of fruit (cm) ($rg=0.976$ and $rp=0.680$), flesh thickness (cm) ($rg=0.602$ and $rp=0.535$), number of seeds per fruit ($rg=0.637$ and $rp=0.544$), seed weight per fruit (g) ($rg=0.704$ and $rp=0.620$), seed index (g) ($rg=0.438$ and $rp=0.395$), ascorbic acid content from pulp (mg/100g) ($rg=0.335$ and $rp=0.248$) and oil content (%) ($rg=0.330$ and $rp=0.300$) at genotypic as well as phenotypic levels. Biochemical traits showed diverse association with yield attribute needs particular method for improvement. Free fatty acid content (%) ($rg=-0.195$) shows significantly negative association whose low concentration in oil is desirable and can be directly improved by selection for yield attribute. Other characters *viz.*, soluble sugar from pulp (%) ($rg=-0.288$ and $rp=-0.261$), β -carotene content from pulp (mg/100g) ($rg = -0.222$) and β -carotene content from pulp flour (%) ($rg=-0.424$ and $rp=-0.385$), Zn content ($rg = -0.231$

and $rp = -0.208$) and Cu content ($rg = -0.273$ and $rp = -0.247$) showed negative and significant association with fruit yield per vine (kg) at both the levels. Similar results were obtained by Kumar *et al.* (2005) [6], Shivananda *et al.* (2013) [12], Muralidhara *et al.* (2014) [10], Sultana *et al.* (2015) [16], Tamilselvi and Jansirani (2017) [17] and Kumar *et al.* (2018) [7].

Path coefficient analysis

The overall path coefficient analysis revealed that average fruit weight (kg), days to opening of first female flower, node number of first male flower, main vine length (m), number of fruits per vine, equatorial circumference of fruit (cm), polar circumference of fruit (cm), number of seeds per fruit, seed index (g), soluble sugar from pulp (%), ascorbic acid content from pulp (mg/100g), β -carotene content from pulp (mg/100g), true protein from seed (%), free amino acid content from seed (%), true protein content from pulp flour (%), Fe content and Mn content showed positive direct effect indicating their relative contribution to the fruit yield per plant (Table 7).

Among these, average fruit weight (kg), days to opening of first female flower, node number of first male flower, main vine length (m), number of fruits per vine, equatorial circumference of fruit (cm), polar circumference of fruit (cm), number of seeds per fruit, seed index (g), ascorbic acid content from pulp (mg/100g), Fe content and Mn content were significantly and positively correlated with fruit yield per vine (kg) in pumpkin genotypes under study. The direct effect of number of fruits per vine, equatorial circumference of fruit (cm) and polar circumference of fruit (cm) was moderate but its association with fruit yield per vine (kg) was highly positive because of positive and high indirect effect through number of seeds per fruit and seed index (g). The direct effect of number of seeds per fruit and seed index (g) was very high and positive but their association was moderately positive due to negative and high indirect effect through seed weight per fruit (g) per fruit. The direct effect of node number of first female flower was negative but the indirect effect through main vine length (m), number of seeds per fruit and β -carotene content from pulp flour (%) was high and positive. Similarly, seed weight per fruit (g) was very high and negative, but its indirect effect through number of seeds per fruit and seed index (g) was very high and positive results into positive association. Likewise, a negative direct effect was recorded by oil content (%) but its indirect effect through number of seeds per fruit and seed index (g) was very high in magnitude and positive in direction.

The residual effect determines how best the causal factors account for the variability of fruit yield. In the present study, the residual effect was found positive but very low (0.0584), which indicates that the characters included in the study are enough to explain the variability in pumpkin yield. These findings were supported by Shivananda *et al.* (2013) [12], Muralidhara *et al.* (2014) [10], Sultana *et al.* (2015) [16], Chaudhary *et al.* (2017) [4] and Kumar *et al.* (2018) [7].

Table 4: Mean performance of pumpkin genotypes for different characters

Sr. no.	Genotypes	Fruit yield per vine (kg)	Average Fruit weight (kg)	Days to opening first male flower	Days to opening first female flower	Node number of first male flower	Node number of first female flower	Main vine length (m)	Number of fruits per vine	Equatorial circumference of fruit (cm)	Polar circumference (cm)	Flesh thickness (cm)	Number of seeds per fruit	Seed weight per fruit (g)	Seed index (g)
1.	Saras	1.51	1.29	46.20	52.73	8.00	18.07	4.79	0.53	51.46	52.77	4.11	213.53	17.36	8.09
2.	Ambili	1.63	1.54	49.13	54.93	10.53	19.47	4.63	0.33	51.99	57.68	3.17	329.33	35.80	10.83
3.	Anand Pumpkin 1	5.12	2.60	45.67	50.33	6.87	20.40	2.63	0.93	65.73	58.13	3.03	372.47	47.28	12.74
4.	Pusa Vikas	3.57	3.37	43.80	52.13	7.13	18.47	3.58	0.33	44.29	53.92	2.59	239.20	20.60	8.59
5.	Pusa Vishwas	4.09	4.05	43.47	48.93	4.47	17.20	3.40	0.93	50.33	54.76	1.68	425.33	44.07	10.41
6.	Azad pumpkin 1	3.81	4.04	42.00	47.93	4.53	18.60	4.31	1.13	67.22	58.27	3.01	339.33	54.97	16.21
7.	Varanasi local	1.31	1.26	44.80	52.07	5.80	18.87	2.87	0.73	58.21	51.37	2.00	235.40	25.46	10.74
8.	Kashi Harit	0.93	0.94	43.87	50.93	4.00	16.87	2.00	0.33	55.41	42.63	2.11	242.27	26.81	11.04
9.	Arka Chandan	2.20	2.09	41.33	49.60	5.87	17.07	3.40	0.20	59.23	56.39	2.57	289.20	32.60	11.29
10.	GPPK 2	4.82	4.59	46.00	54.07	6.73	17.73	3.32	0.53	64.09	58.55	3.37	408.07	54.15	13.27
11.	GPPK 18	5.42	5.02	44.60	52.07	4.60	19.53	3.80	1.27	58.59	64.02	4.21	318.27	37.14	11.75
12.	GPPK 30	4.72	4.62	47.67	57.73	5.33	20.27	3.49	1.00	53.79	70.52	3.70	478.20	64.86	13.53
13.	GPPK 33	3.45	2.99	40.40	48.40	6.93	21.40	4.54	0.47	50.41	58.27	2.50	396.40	47.20	11.97
14.	GPPK 48	4.78	4.24	41.33	50.00	6.93	24.67	5.29	0.47	53.99	62.93	3.53	250.47	27.91	11.06
15.	GPPK 50	3.38	2.85	41.40	51.13	8.00	26.93	4.60	0.67	52.21	55.31	1.63	392.53	22.47	5.73
16.	GPPK 56	5.17	4.65	40.00	48.20	6.40	23.40	4.16	0.53	64.37	70.49	3.23	389.33	55.81	14.21
17.	GPPK 59	4.59	4.69	42.27	53.80	6.00	19.80	2.76	1.27	54.11	70.96	2.57	333.47	40.42	12.11
18.	GPPK69	3.35	2.71	44.07	51.13	5.27	18.47	4.08	0.40	68.77	61.74	2.49	304.40	44.87	14.73
19.	GPPK 90	2.59	2.43	41.53	49.87	5.00	19.60	2.51	0.27	58.22	56.37	1.35	353.93	32.73	9.17
20.	GPPK 95	6.60	6.13	40.07	47.13	6.60	19.73	6.80	1.47	58.91	73.85	2.87	396.93	76.16	19.19
21.	GPPK 100	3.34	3.15	51.33	64.20	6.67	26.13	3.31	0.53	60.35	54.42	2.69	168.33	36.09	21.33
22.	GPPK 105	6.65	6.39	44.73	55.13	6.27	18.93	4.96	1.60	73.95	71.85	3.73	487.93	77.29	15.78
23.	GPPK 107	4.74	4.30	46.13	58.80	6.07	18.93	2.73	1.33	54.11	66.67	3.46	473.67	53.26	11.23
24.	GPPK 109	3.32	3.23	46.00	53.53	6.13	20.07	4.51	1.20	63.65	66.21	2.53	476.73	78.87	16.54
25.	GPPK 113	5.02	4.71	44.13	58.60	8.33	22.73	4.53	1.87	63.24	66.08	2.59	436.93	60.87	13.90
26.	GPPK 115	6.85	6.61	49.20	61.40	5.93	21.93	5.61	1.73	75.61	67.99	4.69	467.00	63.11	13.55
27.	GPPK 126	1.78	1.33	41.67	51.53	8.13	24.53	3.37	0.13	54.62	52.12	2.09	283.13	17.66	6.19
28.	GPPK 133	3.48	3.44	46.07	59.47	6.60	19.53	5.63	0.80	60.83	65.54	2.62	384.87	45.82	11.94
29.	GPPK 139	4.64	4.33	50.60	62.27	7.07	20.93	4.63	0.67	53.29	60.41	2.33	334.67	40.99	12.22
30.	GPPK 141	5.10	5.06	40.40	49.80	9.00	26.60	5.20	1.53	64.25	69.41	3.87	336.60	34.98	10.44
31.	GPPK 143	5.45	4.92	43.20	53.60	8.27	25.13	4.30	0.67	65.44	68.31	3.03	492.47	64.69	13.12
32.	GPPK 148	5.12	4.71	49.13	58.20	7.13	25.87	5.26	0.67	62.91	64.09	2.58	411.33	48.39	11.81
33.	GPPK 150	5.07	4.75	45.87	51.87	8.00	23.27	5.58	1.07	63.28	70.88	3.43	496.27	63.05	12.72
34.	GPPK 201	4.61	4.60	45.47	54.13	7.53	20.20	4.87	0.80	66.32	70.85	2.84	294.00	42.27	14.39
	S.Em.±	0.30	0.19	0.60	0.19	0.31	0.58	0.15	0.07	3.63	4.28	0.09	23.08	3.86	0.54
	C.D. (5%)	1.44	0.53	1.68	2.58	0.89	1.65	0.41	0.21	10.24	12.08	0.25	65.18	10.91	1.53
	C. V. %	14.78	14.86	2.32	2.97	8.19	4.83	6.05	15.13	10.56	11.98	5.30	11.10	14.81	7.55
	Range	0.93-6.85	0.94-6.61	40.0-51.33	47.13-64.20	4.0-10.53	16.87-26.93	2.0-6.80	0.13-1.87	44.29-75.61	42.63-73.85	1.35-4.69	168.33-496.27	17.36-78.87	5.73-21.33
	General mean	4.07	3.66	44.52	53.41	6.65	20.92	4.16	0.84	59.51	61.88	2.89	360.35	45.18	12.41

Sr. no.	Genotypes	Soluble sugar content from pulp (%)	Ascorbic acid content from pulp (mg/100g)	B carotene content from pulp (mg/100g)	True protein content from seeds (%)	Free amino acid content from seed (%)	Oil content (%)	Free fatty acid content (%)	Soluble sugar content from pulp flour (%)	β-carotene content from pulp flour (mg/100g)	True protein content from pulp flour (%)	Seed mineral content (mg/100g)			
												Fe	Zn	Mn	Cu
1.	Saras	16.60	3.75	2.07	9.07	3.38	31.90	1.11	28.52	6.24	13.10	9.15	7.61	5.60	1.31
2.	Ambili	14.40	4.03	1.91	12.77	5.67	27.47	0.69	40.42	6.14	11.30	7.49	6.49	4.53	1.72
3.	Anand Pumpkin 1	13.00	5.97	3.15	14.20	4.47	29.93	0.90	38.45	6.44	11.42	9.43	7.45	4.53	1.15
4.	Pusa Vikas	16.73	3.33	1.86	13.87	4.15	21.17	1.13	39.99	4.43	12.37	11.08	8.91	4.23	2.11
5.	Pusa Vishwas	10.61	4.03	2.04	8.16	3.86	35.87	0.90	40.15	5.55	11.89	8.42	9.56	2.34	1.23
6.	Azad pumpkin 1	7.09	4.30	1.75	8.03	4.72	34.40	0.78	40.84	3.85	9.56	7.89	8.40	2.80	0.86
7.	Varanasi local	24.54	3.05	2.09	8.34	3.75	27.66	0.91	39.30	4.09	10.63	7.22	4.43	3.55	1.54
8.	Kashi Harit	16.39	2.92	2.77	9.37	4.18	30.00	0.71	20.24	6.05	12.66	9.22	7.85	5.62	2.45
9.	Arka Chandan	32.13	4.86	2.03	6.47	2.74	35.40	1.18	32.88	5.82	11.67	7.83	3.57	2.31	4.09
10.	GPPK 2	15.00	4.30	1.88	7.43	5.27	33.79	1.43	35.48	4.27	12.33	8.23	4.45	1.92	3.14
11.	GPPK 18	31.71	2.92	1.83	7.88	3.49	19.38	0.86	35.32	3.80	12.15	11.29	8.27	4.54	2.02
12.	GPPK 30	10.10	4.03	1.76	7.65	3.86	34.85	0.77	23.63	3.55	11.82	5.34	3.34	7.53	3.22
13.	GPPK 33	8.13	2.92	1.77	9.10	4.78	35.28	0.71	31.18	3.52	9.83	6.19	2.82	8.91	2.07
14.	GPPK 48	10.23	4.58	1.84	9.83	2.55	30.94	0.60	39.67	4.02	11.71	9.14	4.53	7.43	2.17
15.	GPPK 50	11.61	4.30	1.93	7.00	5.03	17.48	0.86	28.31	4.25	12.00	3.75	8.80	6.57	1.10
16.	GPPK 56	5.83	5.14	1.80	7.99	2.55	35.97	0.94	31.07	3.92	13.76	8.17	7.54	7.58	2.12
17.	GPPK 59	10.14	4.17	1.81	15.20	2.74	30.77	0.98	37.39	4.01	11.64	9.33	3.24	3.37	1.18
18.	GPPK69	12.81	5.14	1.78	10.52	2.77	32.83	0.73	31.87	3.85	10.74	5.49	6.57	3.89	2.44
19.	GPPK 90	14.63	4.30	1.86	6.89	2.45	38.30	0.70	30.86	4.16	9.77	7.35	4.43	4.54	2.76
20.	GPPK 95	13.81	4.44	1.80	8.18	2.79	41.10	0.73	23.42	3.81	11.87	11.32	5.55	5.23	1.84
21.	GPPK 100	16.89	4.30	1.83	8.83	2.25	35.87	0.62	29.16	4.09	12.44	8.51	5.54	9.27	1.43
22.	GPPK 105	7.00	4.58	1.86	7.67	4.47	35.73	0.69	27.35	4.25	10.14	8.38	4.30	4.53	0.47
23.	GPPK 107	2.06	4.58	1.74	8.32	5.04	31.52	0.92	39.30	3.46	11.33	6.25	8.85	3.36	1.01
24.	GPPK 109	14.32	4.44	1.75	10.10	2.69	27.36	1.14	39.04	3.69	8.39	7.45	9.82	3.22	2.05
25.	GPPK 113	13.26	5.00	2.21	7.86	2.57	36.24	0.70	25.76	5.64	13.40	9.06	10.26	2.25	2.11
26.	GPPK 115	6.07	3.47	1.86	8.09	2.80	39.03	0.60	33.51	4.03	11.96	9.46	4.14	4.08	1.85
27.	GPPK 126	11.42	4.30	1.70	7.32	4.55	14.20	0.99	33.78	3.38	12.55	9.27	11.14	5.10	2.53
28.	GPPK 133	6.27	3.47	1.70	9.14	4.24	29.92	0.85	39.04	3.37	9.76	7.26	5.41	4.35	1.24
29.	GPPK 139	4.37	5.14	1.70	8.73	3.64	27.79	0.68	28.84	3.43	14.31	5.34	3.44	3.34	0.55
30.	GPPK 141	11.66	4.72	1.67	7.43	4.49	38.37	0.74	39.89	3.46	9.51	9.80	8.71	2.56	1.28
31.	GPPK 143	17.69	4.86	1.70	7.70	4.18	33.05	1.00	39.36	3.34	11.75	8.55	7.30	7.13	0.75
32.	GPPK 148	3.43	4.30	1.70	15.97	2.74	33.24	0.94	26.66	3.58	9.54	7.41	3.24	9.17	0.64
33.	GPPK 150	3.80	3.47	1.72	9.80	2.76	35.89	0.71	21.51	3.55	12.41	6.45	4.56	7.59	1.22
34.	GPPK 201	21.46	3.75	1.69	8.97	2.42	31.94	0.60	39.83	3.39	9.76	7.73	8.23	6.21	2.16
	S.Em.±	0.27	0.18	0.04	0.21	0.07	0.74	0.02	1.40	0.04	0.26	0.06	0.06	0.03	0.02
	C.D. (5%)	0.75	0.50	0.13	0.58	0.19	2.08	0.07	3.94	0.11	0.72	0.16	0.18	0.10	0.05
	C. V. %	3.61	7.28	4.09	3.88	3.17	4.03	4.99	7.26	1.56	3.88	1.16	1.70	1.19	1.72
	Range	2.06-32.13	2.92-5.97	1.67-3.15	6.47-15.97	2.25-5.67	14.2-41.10	0.60-1.43	20.24-40.84	3.34-6.44	8.39-14.31	3.75-11.32	2.82-11.14	1.92-9.27	0.64-4.09
	General mean	12.80	4.20	1.90	9.23	3.65	31.61	0.85	33.30	4.25	11.46	8.07	6.43	4.98	1.76

Table 5: Genotypic correlation coefficients among different characters in pumpkin

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	1																											
2	1.003**	1																										
3	0.062	0.111	1																									
4	0.225*	0.281**	0.869**	1																								
5	0.145	0.088	0.110	0.166	1																							
6	0.399**	0.304**	-0.023	0.181	0.541**	1																						
7	0.545**	0.542**	0.014	0.061	0.445**	0.357**	1																					
8	0.658**	0.752**	0.064	0.231*	-0.042	0.062	0.363**	1																				
9	0.626**	0.664**	0.143	0.188	-0.099	0.150	0.317**	0.510**	1																			
10	0.976**	0.997**	-0.031	0.186	0.190	0.304**	0.667**	0.770**	0.468**	1																		
11	0.602**	0.631**	0.240*	0.206*	0.156	0.047	0.382**	0.467**	0.452**	0.598**	1																	
12	0.637**	0.634**	0.037	0.116	0.026	0.098	0.309**	0.565**	0.436**	0.788**	0.206*	1																
13	0.704**	0.752**	0.125	0.159	-0.114	-0.032	0.401**	0.648**	0.678**	0.880**	0.323**	0.804**	1															
14	0.438**	0.507**	0.256**	0.248*	-0.219*	-0.034	0.244*	0.391**	0.610**	0.515**	0.233*	0.163	0.689**	1														
15	-0.288**	-0.270**	-0.148	-0.249*	-0.120	-0.285**	-0.305**	-0.245*	-0.112	-0.386**	-0.071	-0.503**	-0.362**	-0.054	1													
16	0.335**	0.229*	-0.071	0.014	0.213*	0.244*	0.002	0.089	0.401**	0.328**	-0.042	0.203*	0.263**	0.217*	-0.210*	1												
17	-0.222*	-0.277**	0.001	-0.186	-0.184	-0.294**	-0.469**	-0.062	-0.034	-0.582**	-0.134	-0.200*	-0.183	-0.097	0.227*	0.136	1											
18	-0.005	-0.016	0.282**	0.101	0.164	-0.003	-0.047	-0.093	-0.182	0.013	-0.047	-0.130	-0.094	-0.019	-0.195*	0.024	0.219*	1										
19	-0.171	-0.183	-0.030	-0.103	0.224*	-0.141	-0.175	-0.093	-0.293**	-0.364**	0.027	0.141	-0.137	-0.386**	-0.144	-0.100	0.123	-0.058	1									
20	0.330**	0.407**	-0.013	0.011	-0.150	-0.074	0.255**	0.352**	0.510**	0.509**	0.241*	0.317**	0.553**	0.574**	-0.236**	0.197*	-0.038	-0.156	-0.361**	1								
21	-0.195*	-0.207*	-0.122	-0.193	-0.015	-0.278**	-0.315**	-0.257**	-0.218*	-0.252*	-0.059	0.014	-0.101	-0.270**	0.272**	0.068	0.043	0.084	0.227*	-0.282**	1							
22	-0.125	-0.081	-0.104	-0.136	0.090	-0.121	-0.139	-0.037	-0.013	-0.022	0.026	-0.131	-0.181	-0.145	0.168	0.072	-0.133	0.148	0.282**	-0.233*	0.254*	1						
23	-0.424**	-0.436**	0.053	-0.174	0.036	-0.408**	-0.320**	-0.157	-0.221*	-0.630**	-0.068	-0.283**	-0.290**	-0.195*	0.317**	0.103	0.791**	0.171	0.114	0.025	0.147	-0.079	1					
24	-0.011	-0.108	0.125	0.178	0.111	0.048	-0.144	-0.133	-0.389**	-0.227*	0.104	-0.189	-0.227*	-0.146	0.030	0.115	0.226*	-0.133	-0.070	-0.156	0.078	-0.392**	0.303**	1				
25	0.122	0.157	-0.209*	-0.206*	-0.029	-0.107	0.036	0.229*	0.069	0.034	0.328**	-0.278**	-0.048	0.126	0.342**	-0.114	0.224*	0.147	-0.160	0.041	0.126	0.177	0.233*	0.144	1			
26	-0.231*	-0.260**	-0.232*	-0.215*	0.138	0.062	-0.126	0.101	-0.096	-0.225*	-0.114	-0.071	-0.157	-0.205*	0.127	0.115	0.151	-0.148	0.198*	-0.419**	0.149	0.291**	0.169	0.071	0.252*	1		
27	0.158	0.056	0.108	0.084	0.174	0.558**	0.211*	-0.305**	-0.110	0.095	0.050	-0.044	-0.015	0.120	-0.191	-0.185	-0.142	0.166	-0.215*	0.026	-0.323**	-0.410**	-0.261**	0.043	-0.183	-0.281**	1	
28	-0.273**	-0.281**	-0.249*	-0.249*	-0.218*	-0.303**	-0.292**	-0.379**	-0.141	-0.240*	-0.073	-0.214*	-0.161	-0.074	0.496**	-0.102	0.077	-0.289**	-0.197*	0.024	0.241*	-0.121	0.169	0.097	0.064	-0.068	-0.113	1

*, ** Significant at 5% and 1% levels, respectively.

Sr. no.	Character name	Sr. no.	Character name	Sr. no.	Character name	Sr. no.	Character name	Sr. no.	Character name
1	Fruit yield per vine	7	Main vine length	13	Seed weight per fruit	19	Free amino acid content	25	Fe content
2	Average fruit weight	8	Number of fruit per vine	14	Seed index	20	Oil content	26	Zn content
3	Days to opening of first male flower	9	Equatorial circumference of fruit	15	Soluble sugar from pulp	21	Free fatty acid content	27	Mn content
4	Days to opening of first female flower	10	Polar circumference of fruit	16	Ascorbic acid content	22	Soluble sugar from pulp flour	28	Cu content
5	Node number of first male flower	11	Flesh thickness	17	β-carotene from pulp	23	β-carotene from pulp flour		
6	Node number of first female flower	12	Seed number per fruit	18	True protein from seed	24	True protein from pulp flour		

Table 6: Phenotypic correlation coefficients among different characters in pumpkin

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	1																											
2	0.896**	1																										
3	0.055	0.082	1																									
4	0.202*	0.231*	0.789**	1																								

*, ** Significant at 5% and 1% levels, respectively.

~ 1908 ~

Table 7: Genotypic path coefficient analysis showing direct (diagonal and bold) and indirect effects of different characters on fruit yield per vine in pumpkin

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Y _{xs} *
2	0.793	-0.067	0.120	0.046	-0.114	0.427	0.562	0.367	0.457	0.335	0.345	-1.754	-0.738	-0.117	0.103	-0.164	-0.005	-0.010	-0.104	0.000	0.012	0.369	-0.023	0.057	0.090	0.005	0.012	1.003
3	-0.087	-0.606	0.372	0.000	0.009	0.009	0.013	0.039	-0.008	0.127	0.109	-0.411	0.480	-0.064	-0.032	0.001	0.087	-0.002	0.003	0.000	0.015	-0.045	0.027	-0.076	0.080	0.010	0.011	0.062
4	-0.220	-0.528	0.428	0.001	-0.068	0.040	0.047	0.051	0.047	0.109	0.343	-0.523	0.463	-0.108	0.006	-0.109	0.031	-0.006	-0.003	0.000	0.019	0.147	0.038	-0.075	0.075	0.008	0.011	0.225
5	-0.069	-0.067	0.071	0.003	-0.203	0.289	-0.009	-0.027	0.048	0.083	0.077	0.375	-0.409	-0.052	0.096	-0.110	0.051	0.012	0.038	0.000	-0.013	-0.030	0.024	-0.011	-0.048	0.017	0.009	0.145
6	-0.238	0.014	0.077	0.002	-0.376	0.232	0.013	0.041	0.078	0.025	0.290	0.105	-0.064	-0.123	0.110	-0.174	-0.001	-0.008	0.019	0.000	0.017	0.345	0.010	-0.039	-0.022	0.053	0.013	0.399
7	-0.424	-0.008	0.026	0.001	-0.134	0.649	0.074	0.086	0.170	0.203	0.913	-1.317	0.456	-0.132	0.001	-0.279	-0.014	-0.009	-0.065	0.000	0.020	0.271	-0.031	0.013	0.044	0.020	0.012	0.545
8	-0.588	-0.039	0.099	0.000	-0.023	0.235	0.204	0.138	0.196	0.248	1.669	-2.133	0.731	-0.106	0.040	-0.036	-0.029	-0.005	-0.090	0.000	0.005	0.133	-0.029	0.084	-0.035	-0.029	0.016	0.658
9	-0.519	-0.087	0.080	0.000	-0.056	0.206	0.104	0.272	0.119	0.240	1.288	-2.232	1.140	-0.048	0.181	-0.018	-0.056	-0.016	-0.130	0.000	0.002	0.187	-0.083	0.025	0.033	-0.010	0.006	0.626
10	-0.780	0.019	0.080	0.001	-0.114	0.433	0.157	0.127	0.255	0.317	2.328	-2.897	0.962	-0.167	0.148	-0.345	0.004	-0.019	-0.130	0.000	0.003	0.533	-0.049	0.012	0.078	0.009	0.010	0.976
11	-0.494	-0.146	0.088	0.001	-0.018	0.248	0.095	0.123	0.153	0.530	0.609	-1.063	0.435	-0.031	-0.019	-0.078	-0.014	0.001	-0.061	0.000	-0.004	0.058	0.022	0.120	0.040	0.005	0.003	0.602
12	-0.496	-0.022	0.050	0.000	-0.037	0.200	0.115	0.118	0.201	0.109	2.955	-2.650	0.305	-0.218	0.091	-0.118	-0.040	0.008	-0.081	0.000	0.019	0.240	-0.041	-0.101	0.025	-0.004	0.009	0.637
13	-0.588	-0.076	0.068	0.000	0.012	0.259	0.132	0.184	0.224	0.171	2.379	-3.292	1.288	-0.157	0.118	-0.108	-0.029	-0.007	-0.141	0.000	0.026	0.246	-0.049	-0.018	0.054	-0.001	0.007	0.704
14	-0.397	-0.156	0.106	-0.001	0.013	0.158	0.080	0.166	0.131	0.124	0.482	-2.268	1.869	-0.023	0.098	-0.057	-0.006	-0.021	-0.146	0.000	0.021	0.165	-0.031	0.046	0.071	0.011	0.003	0.438
15	0.211	0.090	-0.107	0.000	0.107	-0.198	-0.050	-0.030	-0.098	-0.038	-1.486	1.192	-0.101	0.433	-0.095	0.134	-0.060	-0.008	0.060	0.000	-0.024	-0.268	0.006	0.125	-0.044	-0.018	-0.021	-0.288
16	-0.179	0.043	0.006	0.001	-0.092	0.001	0.018	0.109	0.084	-0.022	0.600	-0.866	0.407	-0.091	0.451	0.081	0.007	-0.005	-0.050	0.000	-0.010	-0.087	0.024	-0.042	-0.040	-0.018	0.004	0.335
17	0.215	-0.001	-0.079	-0.001	0.110	-0.304	-0.012	-0.008	-0.148	-0.070	-0.585	0.596	-0.179	0.098	0.061	0.595	0.067	0.007	0.009	0.000	0.019	-0.670	0.048	0.082	-0.053	-0.013	-0.003	-0.220
18	0.013	-0.171	0.043	0.001	0.001	-0.030	-0.019	-0.049	0.003	-0.025	-0.384	0.309	-0.036	-0.084	0.011	0.130	0.308	-0.003	0.040	0.000	-0.021	-0.145	-0.029	0.054	0.051	0.016	0.012	-0.005
19	0.143	0.018	-0.044	0.001	0.053	-0.114	-0.019	-0.080	-0.093	0.014	0.417	0.451	-0.721	-0.062	-0.045	0.073	-0.018	0.053	0.092	0.000	-0.040	-0.097	-0.015	-0.058	-0.069	-0.020	0.008	-0.171
20	-0.318	0.008	0.005	0.000	0.028	0.165	0.072	0.138	0.130	0.128	0.937	-1.817	1.073	-0.102	0.089	-0.022	-0.048	-0.019	-0.255	0.000	0.033	-0.021	-0.033	0.015	0.145	0.002	-0.001	0.330
21	0.162	0.074	-0.083	0.000	0.105	-0.204	-0.052	-0.059	-0.064	-0.031	0.041	0.329	-0.505	0.118	0.031	0.025	0.026	0.012	0.072	0.000	-0.036	-0.124	0.017	0.046	-0.052	-0.031	-0.010	-0.195
22	0.063	0.063	-0.058	0.000	0.046	-0.090	-0.008	-0.004	-0.006	0.014	-0.387	0.596	-0.271	0.073	0.032	-0.079	0.046	0.015	0.059	0.000	-0.143	0.067	-0.084	0.065	-0.101	-0.039	0.005	-0.125
23	0.341	-0.032	-0.074	0.000	0.153	-0.208	-0.032	-0.060	-0.161	-0.036	-0.836	0.955	-0.364	0.137	0.046	0.470	0.053	0.006	-0.006	0.000	0.011	-0.847	0.065	0.085	-0.059	-0.025	-0.007	-0.424
24	0.084	-0.076	0.076	0.000	-0.018	-0.093	-0.027	-0.106	-0.058	0.055	-0.558	0.747	-0.273	0.013	0.051	0.134	-0.041	-0.004	0.040	0.000	0.056	-0.257	0.215	0.053	-0.025	0.004	-0.004	-0.011
25	-0.123	0.127	-0.088	0.000	0.040	0.023	0.047	0.019	0.009	0.174	-0.821	0.158	0.235	0.148	-0.051	0.134	0.045	-0.009	-0.010	0.000	-0.025	-0.197	0.031	0.365	-0.087	-0.017	-0.003	0.122
26	0.203	0.141	-0.092	0.000	-0.023	-0.082	0.021	-0.026	-0.057	-0.060	-0.210	0.517	-0.383	0.055	0.052	0.090	-0.046	0.011	0.107	0.000	-0.041	-0.143	0.015	0.092	-0.347	-0.027	0.003	-0.231
27	-0.044	-0.066	0.036	0.001	-0.210	0.137	-0.062	-0.030	0.024	0.027	-0.130	0.049	0.224	-0.083	-0.083	-0.084	0.051	-0.012	-0.007	0.000	0.058	0.221	0.009	-0.067	0.097	0.095	0.005	0.158
28	0.220	0.151	-0.107	-0.001	0.114	-0.189	-0.077	-0.038	-0.061	-0.039	-0.632	0.530	-0.140	0.215	-0.046	0.045	-0.089	-0.011	-0.006	0.000	0.017	-0.143	0.021	0.023	0.024	-0.011	-0.042	-0.273

*genotypic correlation coefficient of fruit yield per vine

(Residual effect = 0.0584)

Sr. no.	Character name	Sr. no.	Character name	Sr. no.	Character name	Sr. no.	Character name	Sr. no.	Character name
1	Fruit yield per vine	7	Main vine length	13	Seed weight per fruit	19	Free amino acid content	25	Fe content
2	Average fruit weight	8	Number of fruit per vine	14	Seed index	20	Oil content	26	Zn content
3	Days to opening of first male flower	9	Equatorial circumference of fruit	15	Soluble sugar from pulp	21	Free fatty acid content	27	Mn content
4	Days to opening of first female flower	10	Polar circumference of fruit	16	Ascorbic acid content	22	Soluble sugar from pulp flour	28	Cu content
5	Node number of first male flower	11	Flesh thickness	17	β-carotene from pulp	23	β-carotene from pulp flour		
6	Node number of first female flower	12	Seed number per fruit	18	True protein from seed	24	True protein from pulp flour		

Conclusion

The analysis of variance showed a significant difference for most of the traits under study. The GCV and PCV were high for the characters viz., fruit yield per vine (kg), average fruit weight (kg), main vine length (m), number of fruits per vine, flesh thickness (cm) also having high genetic advance accompanied with high heritability. All these characters showed a high and positive association and positive direct effect on fruit yield indicating due weightage need to be given to these characters in the selection programme.

Based on *per se* performance genotypes, GPPK 115, GPPK 18, GPPK 105, GPPK 95, GPPK 143 and AP 1 were identified as elite genotypes and could be used in the future breeding programme for improving yield in pumpkin.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgement

We are thankful to the Main Vegetable Research Station, B. A. College of agriculture and Directorate of research, AAU, Anand for their support, providing research facilities and funding to conduct the experiment.

References

- Allard RW. Principles of Plant Breeding. John Willey and Sons, Inc., New York, 1960.
- Anonymous. National Horticulture Board, 2017. (Database)
- Burton GW. Quantitative inheritance in grass. In proceedings of 6th International Grassland Congress. 1952;1:277-283.
- Chaudhary DJ, Acharya RR, Gohil SB, Patel NA. Genetic divergence study in pumpkin (*Cucurbita moschata* Duch. ex Poir.). J Pharmacogn. Phytochem. 2017;6(4):744-747.
- Fisher RA. The correlation between relatives on the supposition of Mendelian inheritance. Philosophical Transactions of the Royal Society. 1918;52:399-433.
- Kumar J, Singh DK, Ram HH. Determining yield components in pumpkin through correlation and path analysis. Indian J Hort. 2005;62(4):344-349.
- Kumar V, Mishra DP, Yadav GC, Dwivedi DK. Genetic diversity assessment for morphological, yield and biochemical traits in genotypes of pumpkin. J Pharmacogn. Phytochem. 2017;6(3):14-18.
- Kumar R, Rajasree V, Praneetha S, Tripura U. Correlation and path coefficient analysis studies in pumpkin (*Cucurbita moschata* Duch. ex Poir.) for yield and quality traits. Int. J Curr. Microbiol. Appl. Sci. 2018;7(5):3067-3075.
- Martins LHP, Noda H, Lopes MTG, Mendonça MSP, Martins ALU. Genetic variability of pumpkin landraces in Brazilian Amazon. Agric. Sci. 2016;7(12):822-833.
- Muralidhara MS, Narasgowda NC, Narayanaswamy P. Genetic divergence in pumpkin (*Cucurbita moschata* Duch. ex Poir.). Indian J Hort. 2014;4(3-4):144-147.
- Satkar KP, Kulthe AA, Chalke PR. Preparation of bitter gourd ready-to-serve beverage and effect of storage temperature on its keeping quality. The Bioscan. 2013;8(1):115-117.
- Shivananda MM, Madalageri MB, Chikkur SS, Mohankumar A, Yathiraj K. Correlation and path coefficient studies in pumpkin (*Cucurbita moschata* Duch. ex Poir.). Int. J Agric. Sci. 2013;9(1):76-79.
- Singh RK, Chaudhary BD. Biometrical methods in quantitative genetics (3rd ed.). Kalyani Publication, New Delhi, 1985.
- Singh JK, Kumar JC, Sharma JR. Genetic variability and heritability of some economic traits in pumpkin in different seasons. Punjab Horticultural Journal. 1998;28(3-4):238-242.
- Srikanth M, Bharad SG, Thulasiram LB, Potdukhe NR. Studies on genetic variability, heritability and genetic advance in pumpkin (*Cucurbita moschata* Duch. ex Poir.). Int. J curr. Microbiol. Appl. Sci. 2017;6(6):1416-1422.
- Sultana S, Kawochar MA, Naznin S, Siddika A, Mahmud F. Variability, correlation and path analysis in pumpkin (*Cucurbita moschata*). Bangladesh J Agr. Res. 2015;40(3):479-489.
- Tamilselvi NA, Jansirani P. Evaluation of pumpkin (*Cucurbita moschata*) genotypes for earliness, yield and quality Int. J curr. Microbiol. Appl. Sci. 2017;6(3):1554-1559.
- Wright S. The methods of the path coefficients. The Annals of Mathematical Statistics. 1921;5:161-215.