Genetic Divergence and Character Association Studies in Pumpkin (*Cucurbita moschata* Duch ex. Poir)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

The studies of genetic divergence among 35 genotypes of pumpkin were carried out by using Mahalanobis D^2 statistics. 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 divergence among the traits during 2021(kharif season).

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The clustering pattern of the 35 genotypes was grouped into 6 different non-overlapping clusters. Cluster I (26), II (4) and III (2) had same genotypes number as well as cluster IV (1), V (1) and VI (1). The minimum intra-cluster distance was found for 0.00 (cluster VI) and maximum was recorded for 220.05 (cluster III). The inter cluster values between cluster I to IV (1100.17), V to VI (657.01), II to IV (1294.53), III to VI (1069.11) and IV to VI (1879.65) were very high.

1. INTRODUCTION

Pumpkin (*Cucurbita moschata* Duch. ex. Poir.) is a sexually propagated monoecious climbing vegetable belonging to the genus *Cucurbita*, order Cucurbitales, family Cucurbitaceae, [1], with chromosome number 2n= 40, [2].

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 [3]. Pumpkin plenty of more energy, carbs, vitamins, and minerals than other fruits and vegetables, and is particularly rich in carotenoid colours [4]. It is a day neutral plant.

The name "pumpkin" comes from the Greek word Pepon, which means "big melon" or "round and enormous fruit." "Pumpkin is composed of *Cucurbita moschata, Cucurbita pepo, Cucurbita maxima, Cucúrbita mixta, Cucurbita facifola* and *Telfairia occidentalis"* [5]. Carotene levels rise in mature fruits that have been stored. After three months of storage under shade discovered a 12.63 percent rise in beta-carotene content in fresh whole pumpkin [6]. Pumpkin is a good source of vitamins, especially high carotenoid colors and minerals, and is quite high in energy and carbs. It has the potential to improve people's nutritional health, particularly among vulnerable groups in terms of vitamin A. Night-blindness is a severe problem in many South Asian countries. The problem can simply be rectified by encouraging the general public to consume more pumpkin.

It is grown on 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. It has unisexual, single, or fasciculate flowers that range in color from yellow to deep orange. Genetic advance, 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. Genetic divergence is the process in which two or more populations of an ancestral species accumulate independent genetic changes (mutations) through time. Continued can lead to speciation. In spite of that pumpkin is very important vegetable crop, and research work done towards its improvements is very scanty.

2. MATERIALS 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 was 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. Sometimes, continuous cloudy weather with heavy rains for a longer period drastically affects the local agricultural system. 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 thirty five genotypes including 1 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.

3. RESULTS AND DISCUSSION

The studies of genetic divergence among 35 genotypes of pumpkin were carried out by using Mahalanobis D^2 statistics.

"The clustering pattern of the 35 genotypes was grouped into 6 different non-overlapping clusters Table-1. Cluster I (26), II (4) and III (2) had same genotypes number as well as cluster IV (1), V (1) and VI (1). The estimates of intra and inter cluster distance represented by D^2 values are given in Table 2. The minimum intra-cluster distance was found for 0.00 (cluster VI) and maximum was recorded for 220.05 (cluster III). The maximum inter-cluster distance was observed between clusters IV to cluster VI (1879.65), which suggested that members of these two clusters are genetically very diverse to each other. The inter cluster values between cluster I to IV (1100.17), V to VI (657.01), II to IV (1294.53), III to VI (1069.11) and IV to VI (1879.65) were very high" [7].

"The minimum inter-cluster D^2 value was recorded in case of cluster V to cluster VI (657.01). The higher inter-cluster distance indicated greater genetic divergence between the genotypes of those clusters, while lower inter-cluster values between the clusters suggested that the genotypes of the clusters were not much genetically diverse from each other. The intra-cluster means for eleven characters in pumpkin are given in Table-2. A perusal of Table-3 showed that cluster means for different traits indicated considerable differences between the clusters". [7] All the clusters from cluster I to cluster VI had in general medium mean performance for most of the characters, exhibiting extreme cluster means for none of the character under the study.

Cluster I showed minimum mean values for total fruit weight (3.08). Cluster II showed maximum mean value for node number at first pistillate flower anthesis (7.54) and fruit polar length (22.3). Cluster III showed maximum mean value for fruit polar circumference (49.41) and flesh thickness (2.85) while Cluster III showed minimum mean values for node number at first staminate flower anthesis(2.36) and days to first fruit harvest(62.00).

Table 1. Clustering pattern of 35 genotypes on the basis of Mahalanobis D^2 (statistics)

Cluster number	No. of genotypes	Genotypes in clusters
I	26	NDPK-27,NDPK-39,NDPK-37,NDPK-46,NDPK-36, 2018/PUMAR-1,2018/PUMAR-5, NDPK-44, 2018/PUMAR-3 2019/PUMAR-2,NDPK-32, NDPK-34, 2019/PUMAR-1, NDPK-35, 2018/PUMAR-7, NDPK-30, NDPK-38, 2019/PUMAR-5, NDPK-26, 2019/PUMAR-4, NDPK-42, NDPK-43, NDPK-45, Narendra Agrim(C), ,2018/PUMAR-4, 2019/PUMAR-6
II	4	NDPK-25, NDPK-28, 2018/PUMAR-2, 2018/PUMAR-6
III	2	NDPK-37, NDPK-40
IV	1	NDPK-31
V	1	NDPK-29
VI	1	NDPK-33

Table 2. Average of intra- and inter- D^2 values for seven clusters

	I	II	III	IV	V	VI
I	111.83	428.79	453.25	1100.17	259.64	998.26
II		146.81	582.83	1294.53	306.09	238.97
III			220.05	302.43	879.10	1069.11
IV				0.00	1765.82	1879.65
V					0.00	657.01
VI	0.00					

Table 3. Intra-cluster group means for eleven characters in pumpkin

Cluster	Node numberat first staminate flower anthesis	Node number at first pistillate flower anthesis	Days to first staminate flower anthesis	Days to first staminate flower anthesis	Fruit polar length (cm)	Fruit equatorial circumference (cm)	Flesh thickness (cm)	Days tofirst fruit harvest	Average fruit weight (kg)	Number of fruit Per plant	Total Fruit yield (kg)
I	2.47	7.32	46.50	48.17	21.15	44.68	2.43	64.33	1.05	3.14	3.08
II	2.58	7.54	46.44	49.58	22.31	43.98	2.63	63.42	1.29	5.02	6.44
III	2.36	6.95	43.50	48.33	21.33	49.41	2.85	62.00	2.36	1.95	4.62
IV	2.72	7.50	37.00	48.67	20.57	44.00	2.20	65.67	3.47	1.33	4.43
V	2.40	7.53	48.00	46.00	20.23	41.78	2.42	67.33	0.55	6.33	3.48
VI	2.44	6.63	50.00	51.00	19.11	43.95	2.25	65.33	1.33	6.35	8.88

Cluster IV showed maximum mean value for node number at first staminate flower anthesis (2.72) and average fruit weight (3.47) while showed minimum mean value for days to first staminate flower anthesis(37.00) and flesh thickness(2.20). Cluster V showed minimum mean value for days to first staminate flower anthesis(46.00), fruit equatorial circumference (41.78) and average fruit weight (0.55) while showed maximum mean value for days to first fruit harvest(67.33). Cluster VI showed maximum mean value for days to first staminate flower anthesis(50.00), days to first pistillate flower anthesis(51.00), number of fruit per plant(6.35) and total fruit weight(8.88) while showed minimum mean value for node number at first pistillate flower anthesis(6.63) and fruit polar length (19.11) . The importance of genetic divergence in vegetable breeding programme has been emphasized by several scientists [8,9,10,11,12,7].

4. CONCLUSION

The inter cluster values between cluster I to IV (1100.17), V to VI (657.01), II to IV (1294.53), III to VI (1069.11) and IV to VI (1879.65) were very high. Thus the crossing between the genotypes belonging to cluster pairs separated by very high inter-cluster distance as discussed above may be through desirable transgressive segregates. The minimum inter- cluster D^2 value was recorded in case of cluster V to cluster VI (657.01). The crosses between genotypes belonging to clusters separated by low inter-cluster distances are unlikely to produce promising recombinant in the segregating generations.

A perusal of Table-1 revealed that Cluster I showed minimum mean values for total fruit weight. Cluster II showed maximum mean value for node number at first pistillate flower anthesis and fruit polar length. Cluster III showed maximum mean value for fruit polar circumference and flesh thickness while Cluster III showed minimum mean values for node number at first staminate flower anthesis and days to first fruit harvest.

Cluster IV showed maximum mean value for node number at first staminate flower anthesis and average fruit weight while showed minimum mean value for days to first staminate flower anthesis and flesh thickness. Cluster V showed minimum mean value for days to first staminate flower anthesis, fruit equatorial circumference and average fruit weight while showed maximum mean value for days to first fruit harvest. Cluster VI showed maximum mean value for days to first staminate flower anthesis, days to first pistillate flower anthesis, number of fruit per plant and total fruit weight while showed minimum mean value for node number at first pistillate flower anthesis and fruit polar length.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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