Original Research Article

Geneticdivergenceandcharacterassociationstudiesinpumpkin(*Cucurbitamoschata*Duch ex.Poir)

Abstract

The studies of genetic divergence among 35 genotypes of pumpkin were carried out by usingMahalanobisD^{2}statistics.TheresearchwasconductedatmainexperimentStationofDepartmentofVegetableScience,AcharyaNarendraDevaUniversityofAgriculture&Technology, (Narendra Nagar), Kumarganj, Ayodhya, U.P.The experiment was conducted inRandomized Block Design with three replications. The wide range of divergence among thetraits during 2021(kharif season). The clustering pattern of the 35 genotypes was grouped into6 different non-overlapping clusters. Cluster I (26), II (4) and III (2) had same genotypesnumber as well as cluster IV (1), V (1) and VI (1). The minimum intra-cluster distance wasfound for 0.00 (cluster VI) and maximum was recorded for 220.05 (cluster III). The intercluster values between cluster I to IV (1100.17), V to VI (657.01), II to IV (1294.53), III to VI(1069.11)andIVto VI(1879.65)wereveryhigh.

Keywords: Pumpkin, Inter-cluster, Intra-cluster,GenotypesandGeneticdivergence

Introduction

Pumpkin (*Cucurbitamoschata*Duch. ex. Poir.) is a sexually propagated monoeciousclimbingvegetablebelongingtothegenus*Cucurbita*,orderCucurbitales,familyCucurbitaceae,(Mohsin*etal*.,2017),withchromosomenumber2n=40(Martins*etal.*,2015).

Kashiphal, Sitaphal, and Kaddu are all names for pumpkin (Rana, 2014). The principal sites oforigin and domestication for cultivated Cucurbita species may be found in various parts ofCentral and South America (Jeffrey, 1990). Pumpkin plenty ofmore energy, carbs, vitamins,and minerals than other fruits and vegetables, and is particularly rich in carotenoid colours(Bose and Som, 1998).Itis a dayneutral plant.

Comment [C1]: ?

The name "pumpkin" comes from the Greek word Pepon, which means "big melon" or"round and enormous fruit." Pumpkin is composed of *Cucurbitamoschata*, *Cucurbitapepo*,*Cucurbita maxima*, *Cucúrbitamixta*, *Cucurbitafacifola*and *Telfairiaoccidentalis*(Caili*et al.*,2006). Carotene levelsrise inmature fruits thathave been stored. After three months ofstorage under shade discovered a 12.63 percent rise in beta-carotene content in fresh wholepumpkin(Chavasi*etal*.2002).Pumpkinisagoodsourceofvitamins,especiallyhighcarotenoid colors and minerals, and is quite high in energy and carbs. It has the potential toimprovepeople'snutritionalhealth,particularlyamongvulnerablegroupsintermsofvitamin A. Night-blindness is a severe problem in many South Asian countries. The problem cansimplyberectified byencouragingthegeneral public to consumemorepumpkin.

Comment [C2]: This seems to have been included in the introduction by mistake.

It is grown on 99 thousand hectares in India, with yearly production and productivity of 2117thousand Mt and 22.5 thousand Mt/ha (NHB, 2018-19). Uttar Pradesh produces 360.16 ton ofpumpkin. It has unisexual, single, or fasciculate flowers that range in colorfrom yellow todeeporange.

Genetic advance, and degree of association between the various characters and directeffect of yield contributing traits on total yield, is of paramount significance in formulating anappropriatebreedingstrategyaimedatexploitingtheinherentvariabilityoftheoriginalpopulation. Geneticdivergenceistheprocessinwhichtwoormorepopulationsofanancestralspeciesaccumulatei ndependentgeneticchanges(mutations)throughtime.Continued can lead to speciation. In spite of that pumpkin is very important vegetable crop,andresearchwork donetowards its improvementsis veryscanty.

MaterialandMethods

The present investigation was carried out during summer 2021 at the Main Experiment Stationof Department of Vegetable Science, Acharya Narendra Deva University of Agriculture &Technology, Narendra Nagar (Kumarganj), Ayodhya, U.P. Geographically, Kumarganj fallsunderhumidsub-tropicalclimateandislocatedinbetween24.470and26.560Nlatitudeand 82.120 and 83.980E longitude at an altitude of 113 m above the mean sea level. The soil typeof experimental site was clay-loam. Kumarganj falls under semi-arid region receiving anannual meanrainfall of about 1200 mm. Major rainfall in this area occurs from July toSeptember.Sometimes,continuouscloudyweatherwithheavyrainsforalongerperioddrastically affects the local agricultural system. Occasional showers are also very common inwinter season, but this period is usually cool and dry. The hot period of summer seasongenerally starts somewhere in middle of April and continues till the middle of June when thepresence of monsoon in the sky become clearly visible. The experiment was conducted inRandomized Block Design with three replications to assess the performance of thirty fivegenotypes including 1 check(Narendra Agrim). Each entry was sown in one rows with 3 m,lengthspaced 3 m with plant toplant spacingof 0.5 m in eachreplication.

ResultsandDiscussion

Thestudiesofgeneticdivergenceamong35genotypesofpumpkinwerecarriedoutbyusing **MahalanobisD^2**statistics.

The clustering pattern of the 35genotypes was grouped into 6 different non-overlappingclusters (Table-1). Cluster I (26), II (4) and III (2) had same genotypes number as well ascluster IV (1), V (1) and VI (1). The estimates of intra and inter cluster distance represented byD^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-clusterdistance was observed between clusters IV to cluster VI (1879.65), which suggested thatmembers of these two clusters are genetically very diverse to each other. The inter clustervalues between cluster I to IV (1100.17), V to VI (657.01), II to IV (1294.53), III to VI(1069.11)andIVto VI(1879.65)wereveryhigh.

The minimum inter-cluster D^2 value was recorded in case of cluster V to cluster VI

(657.01).Thehigherinter-
clusterdistanceindicatedgreatergeneticdivergencebetweenthegenotypes

of those clusters, while lower inter-cluster values between the clusters suggested that thegenotypes of the clusters were not much genetically diverse from each other. The intra-clustermeans for eleven characters in pumpkin are given in Table-2. A perusal of Table-3showed that cluster means for different traits indicated considerable differences between theclusters. All the clusters from cluster I to cluster VI had in general medium mean performancefor most of the characters, exhibiting extreme cluster means for none ofthe character underthestudy.

Cluster I showed minimum mean values for total fruit weight (3.08). Cluster II showedmaximum mean value for node number at first pistillate flower anthesis (7.54) and fruit polarlength (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 atfirststaminatefloweranthesis(2.36)and days tofirst fruit harvest(62.00)

Cluster IV showed maximummean 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 firststaminate flower anthesis(37.00) and flesh thickness(2.20). Cluster V showed minimum meanvalue 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 fruitharvest(67.33). Cluster VI showed maximum mean value for days to first staminatefloweranthesis(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 firstpistillate flower anthesis(6.63) and fruit polar length (19.11) . The importance of geneticdivergence in vegetable breeding programme has been emphasized by several scientists **(Moll*etal*, 1962;Arunachalam, 1981, Hawkesh, 1981 and Kumar*et.al*)**.

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 crossingbetween the genotypes belonging to cluster pairs separated by very high inter-cluster distanceas 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 betweengenotypesbelongingtoclustersseparatedbylowinter-

clusterdistancesareunlikelytoproducepromisingrecombinant in the segregatinggenerations.

A perusal of (Table-1) revealed that Cluster I showed minimum mean values for totalfruit weight. Cluster II showed maximum mean value for node number at first pistillate floweranthesisandfruitpolarlength.ClusterIIIshowedmaximummeanvalueforfruitpolarcircumference and flesh thickness while Cluster III showed minimum mean values for nodenumberat first staminateflower anthesisand daysto firstfruit harvest.

Cluster IV showed maximummean value for node number at first staminate floweranthesisandaveragefruitweightwhileshowedminimummeanvaluefordaystofirststaminate flower anthesisand flesh thickness. Cluster V showed minimum mean value fordays to first staminate flower anthesis, fruit equatorial circumferenceand average fruit weightwhileshowedmaximummeanvaluefordaystofirstfruitharvest.ClusterVIshowedmaximum mean value for days to first staminateflower anthesis, days to first pistillate floweranthesis, number of fruit per plantand total fruit weight while showed minimum mean valuefornodenumber at firstpistillateflower anthesisand fruitpolarlength.

Table1:Clusteringpatternof 35genotypesonthebasisof MahalanobisD^2 statistics

Cluster number	No. ofgenotypes	Genotypesinclusters
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,NarendraAgrim(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

Table2:Averageofintra-andinter-D^2 valuesforseven 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**

Table3:Intra-clustergroupmeansforelevencharactersin pumpkin

Cluster	Nodenumberat first staminatefloweranthesis	Nodenumberat first pistillatefloweranthesis	Daystofirststaminatefloweranthesis	Days to firststaminatefloweranthesis	Fruit polar length(cm	Fruitequatorialcircumference (cm)	Fleshthickness(cm)	Days tofirstfruitharvest	Average fruitweight(kg)	Number of fruitPer 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

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