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Studies on heritability(ns) and genetic advance for fruit yield and its component traits in pumpkin (*Cucurbita moschata* Duch. ex.Poir.)

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ABSTRACT

The estimates of high heritability coupled with high genetic advance as per cent of mean were observed for fruit yield per plant (Kg) average fruit weight (kg), node number to first male flower appearance, non-reducing sugars, dry matter content, node number to first female flower appearance,number of fruits per plant ,reducing sugar and number of primary branches per plant in Y1, fruit yield per plant (Kg),node number to first male flower appearance, average fruit weight (kg),dry matter content, non-reducing sugars ,node number to first female flower appearance, number of fruits per plant ,number of primary branches per plant and reducing sugar in Y2 while, fruit yield per plant (Kg),node number to first male flower appearance, average fruit weight (kg), non-reducing sugars,dry matter content ,node number to first female flower appearance, number of fruits per plant , number of primary branches per plant and reducing sugar in pooled. Moderate heritability coupled with high genetic advance which indicating the additive gene action for these traits and the phenotypic selection could be relied upon.

Keywords: *Heritability, Genetic advance, Narrow sense*

Introduction

Pumpkin (*Cucurbita moschata* Duch. ex. Poir) is a significant vegetable crop in the Cucurbitaceae family. The pumpkin word derived from Greek word “pepon” meaning "large melon" or something enormous and round. Because of its great yield to farmers and its beneficial nutritional and medicinal uses, it is grown in all over the world. The origin place of pumpkin is Central Mexico.

The cultivated Cucurbita species are ranked among the top ten vegetable crops in the world based on their commercial significance. India is the world's second-largest producer of pumpkins after China other major producers include the United States, Egypt, Mexico,Ukraine, Cuba, Italy, Iran, and Turkey (Ferriol and Pico, 2008).

Pumpkin is a sexually propagated, herbaceous annual vegetable having chromosome number 2n=2x=40. Pumpkin is a crop with three anthers that is monoecious, heavily cross-pollinated, and entomophilous. The stem of the plant is hairy, angular, five-ridged, trailing and branching. Trailing vine hits nodes in the roots. Leaves are not pinnatifid, they are lobed deeply or shallowly. The big size, yellow-coloured flowers have gamopetalous, campanulate corollas. Pumpkin fruits range in shape from oblate to globular, rectangular and are frequently yellowish to orange in colour.

Pumpkins' orange colour is a result of its high carotene content. The primary nutritional components are lutein and both α and β-carotene, which allow the body to synthesize vitamin-A. In addition to the soft shell, leaves, seeds, and flowers, the majority of the pumpkin's parts are edible.

Pumpkin is comparatively high in energy, carbohydrates and also a good source of vitamins, minerals and especially high carotenoid pigments. It may undoubtedly help improve people's nutritional status, particularly for those who are more susceptible in termsof their need for vitamin-A. Night blindness is a very important problem in South Asian countries that can be treated with pumpkin.

India is home to five different cultivate species of pumpkin: *Cucurbita argyrosperma* (formerly known as *C. mixta*), *C. pepo*, *C. maxima, C. moschata*, and *C. ficifolia*. Foreign explorers and diplomats from South America, where *Cucurbita moschata* is more extensively grown than the other four domesticated species, brought pumpkins and squashes to India. *Cucurbita moschata* is the most extensively cultivated vegetable in the tropics of both

hemispheres because it can withstand high temperatures than other domesticated species. Squash, including pumpkins are believed to have originated in North America.

Pumpkin showed more variability in their fruit size, colour, shape, fruit yield and also other agronomic attributes (Singh, 2005 and Singh et al., 2005). Similar to other gourds, pumpkins are summertime crops that can be grown all year round in the country's center and southern regions. In contrast, it is typically grown during the summer and rainy season, which is sowed from January to July, in the northern regions of the nation, where winters are colder. Farmers in northern India seed their crops in mounds or on Introduction 4 hills near their homes in July and August, following the start of the monsoon. The developing plants are supported by thatches, hutments, and other vacant areas. The genotypes that are typically planted close to a household are land races that have historically been preserved by the locals and are known locally as Bhadhavaha Kohara, or pumpkins for the rainy season.

Bhadhavaha Kohara thrives in the wet season, can withstand relatively cold temperatures and continues to bear fruit throughout the winter. Therefore, it is also advised to refer to these genotypes as winter type pumpkins. The genotypes belonging to the rainy season or winter season type generate a sufficient number of male and female flowers between late August andearly September. They also bear a large number of fruits in September and October, as well asduring the short days of November and December. They may continue to produce, if slowly, throughout the upcoming months of January and February if they are not harmed by frost.

Materials and Methods

The experiment was conducted at main Experimental Station, Department of Vegetable Science, Acharya Narendra Deva University of Agriculture &Technology Kumarganj ,Ayodhya. Geographically, experimental site falls under humid sub-tropical climate and is located in between 24.47º and 26.56º N latitude, 82.12º and 83.58 ºE longitudes at an altitude of 113 m above the mean sea level. The soil type of experimental site was sandy- loam with average fertility level and Ph in the range of 7.5-8.5.

The experimental materials for the present study comprised of eight promising and diverse inbreds and varieties of pumpkin selected on the basis of genetic variability from the germplasm stock maintained in the Department of Vegetable Science, A.N.D.U.A.T., Kumarganj, Ayodhya (U.P.) India. The selected parental lines *i.e*. Narendra Agrim (P_1), Narendra Amrit (P_2), Narendra Upkar(P_3), NDPK-73-1(P_4), NDPK-76-1(P_5), NDPK-12-

1(P_6), NDPK-13-1(P_7) and NDPK-17-12-1(P_8) were raised and crossed in the all-possible combinations, excluding reciprocals during *Zaid*, to develop 28 F_1 hybrid seeds for the study of the mean performance of parental line and their resultant F1.

All thirty-six genotypes (eight parental lines and twenty-eight F_1) were evaluated in Randomized Complete Block Design (RBD) with three replications. The row to row spacing was kept 3.0 m and plant to plant spacing 0.50 m in both the season (Y1, Y2) and pooled. To raise a good crop, all agronomic techniques were followed. The data were recorded on fourteen quantitative and seven qualitative traits viz., node number to first male flowerappearance, node number to first female flower appearance, days to first male flower anthesis, days to first female flower anthesis, days to first fruit harvest, vine length (m), internodal length (cm), number of primary branches per plant, equatorial circumference of fruit (cm), polar circumference of fruit (cm), flesh thickness (cm), average fruit weight (kg), number of fruits per plant, fruit yield per plant (kg) and quality/biochemical traits namely ascorbic acid (mg/100g), total soluble solids (%), β-carotene (mg/100g), dry matter content (%), reducing sugars (%), non-reducing sugar (%) and total sugars (%). In addition to these ancillary traits viz. fruit colour and fruit shape were also recorded. The following is a summary of the findings in relation to several aspects:

Heritability(ns)and genetic advance in pumpkin during 2022-23(Y1),2023- 24(Y2) and pooled.

Characters	Year	Heritability (Narrow sense)	GA% mean
Days to first male flower anthesis	Y1	34.10	8.79
	Y2	41.87	5.38
	Pooled	43.50	8.08
Days to first female flower anthesis	Y1	21.57	3.52
	Y2	38.74	5.14
	Pooled	36.56	5.88
Node number to first male flower appearance	Y1	79.67	39.35
	Y2	70.70	40.53
	Pooled	76.94	40.19

Node number to first female flower appearance	Y1	59.03	26.25
	Y2	65.04	28.76
	Pooled	63.51	28.32
Days to first fruit harvest	Y1	31.82	6.24
	Y2	62.80	6.33
	Pooled	59.16	7.05
Vine length	Y1	21.97	13.69
	Y2	28.16	17.50
	Pooled	25.62	14.89
Number of primary branches per plant	Y1	66.20	21.15
	Y2	70.47	21.86
	Pooled	70.67	23.04
Number of node per vine	Y1	32.90	10.07
	Y2	46.59	13.78
	Pooled	44.75	12.83
Internodal length(cm)	Y1	52.81	10.20
	Y2	62.41	11.84
	Pooled	63.99	12.06
Polar circumference of fruit (cm)	Y1	65.29	7.40
	Y2	88.49	10.86
	Pooled	86.73	10.19
Equatorial circumference of fruit(cm)	Y1	62.18	5.90
	Y2	63.33	8.37
	Pooled	67.51	8.29
Average fruit weight(kg)	Y1	58.96	39.71
	Y2	53.85	36.81
	Pooled	56.97	38.03
Number of fruit per plant	Y1	14.08	24.55
	Y2	20.70	25.83

	Pooled	17.21	25.65
Total soluble solids (%)	Y1	59.95	10.83
	Y2	83.75	13.13
	Pooled	80.56	11.46
Ascorbic acid(mg/100g)	Y1	58.99	12.73
	Y2	55.98	13.33
	Pooled	60.51	13.64
Reducing sugars (%)	Y1	56.61	22.82
	Y2	57.03	21.48
	Pooled	57.46	22.52
Non-Reducing sugars (%)	Y1	42.80	36.38
	Y2	51.31	29.23
	Pooled	47.45	32.51
Total sugars (%)	Y1	50.91	17.79
	Y2	39.54	18.46
	Pooled	46.06	18.07
Beta-Carotene	Y1	64.86	15.33
	Y2	65.68	15.02
	Pooled	65.81	15.63
Dry matter Content (%)	Y1	86.01	30.62
	Y2	85.92	29.34
	Pooled	86.67	30.19
Fruit yield per plant(kg)	Y1	45.32	51.06
	Y2	40.46	51.71
	Pooled	43.30	51.42

Result and Discussion

Choosing the right parents and using the right breeding techniques are fundamental steps in increasing yield and transferring traits. The parents chosen for the crossing program were assessed according to their heritability and genetic advance since choosing parents with good performances would be beneficial in creating superior hybrids. Below is a discussion of various quality attribute results for Y1,Y2 and pooled seasons data, along with the most significant trait" The estimates of heritability in narrow-

sense(h^2ns) have been classified by **Kempthorne and Curnow (1961)** into three categories *viz*., high (> 30%), medium (10-30%) and low (<10%). **In first year (Y1),** the high estimate of heritability in narrow sense was recorded for dry matter content (86.01%) followed by node number to first male flower appearance (79.67%), number of primary branches per plant (66.20%), polar circumference of fruit(cm) (65.29%), β-carotene(mg/100g)(64.86%), equatorial circumference of fruit(cm) (62.18%),total soluble solids (59.95%),node number to first female flower appearance (59.03%),ascorbic acid content(mg/100g)(58.99%), average fruit weight(kg) (58.96%), reducing sugars (56.61%), inter nodal length(cm) (52.81%), total sugars (50.91%), fruit yield per plant (Kg) (45.32%), Non- reducing sugar(42.80%), days to first male flower anthesis (34.10%), Number of node per vine (32.90%) and days to first fruit harvest(31.82%).Moderate estimate of heritability in narrow sense was observed for vine length(m) (21.97%) followed by days to first female flower anthesis(21.57%) and number of fruits per plant (14.08%) and low estimate of heritability in narrow sense was none.**In second year (Y2),** the high estimate of heritability in narrow sense was recorded for polar circumference of fruit (cm)(88.49%), dry matter content (85.92%), total soluble solids(83.75%), node number to first male flower appearance (70.70%), Number of primary branches per plant (70.47%), β-carotene(mg/100g) (65.68%), Node number to first female flower appearance (65.04%), equatorial circumference of fruit(cm) (63.33%), days to first fruit harvest (62.80%), Inter nodal length(cm)(62.41%),ascorbic acid content(mg/100g) (55.98%), average fruit weight(kg)(53.85%),non-reducing sugar (53.31%),reducing sugars (57.03%),number of node per vine (46.59%),days to first male flower anthesis (41.87%), fruit yield per plant (Kg) (40.41%),total sugars(39.54%) and days to first female flower anthesis (38.74%) . Moderate estimateof heritability in narrow sense was observed for vine length(m) (28.16%) followed by number of fruits per plant (20.70%) and low estimate of heritability in narrow sense was none. **In case of pooled,** the high estimate of heritability in narrow sense was recorded for polar circumference of fruit(cm)(86.73%),dry matter content (86.67%), total soluble solids(80.56%),node number to first male flower appearance(76.94%), equatorial circumference of fruit(cm)(67.56%),β-carotene(mg/100g) (65.81%), inter nodal length(cm) (63.99%),node number to first female flower appearance (63.51%), ascorbic acid content(mg/100g) (60.61%),days to first fruit harvest (59.16%), reducing sugars (57.46%),average fruit weight (kg)(56.57%),non-reducing sugar(47.45%), total sugars(46.06%), number of node per vine (44.75%), days to first male flower anthesis (43.50%), fruit yield per plant (Kg) (43.30%) and days to first female flower anthesis (35.59%).

Moderate estimate of heritability in narrow sense was observed for vine length(m) (25.62%) followed by number of fruits per plant (17.21%) and low estimate of heritability in narrow sensewas none.

For easy explanation, genetic advance was classified into three groups such as (i) high (> 20%) (ii) moderate (> 10% to 20%) and (iii) low (< 10%).

In first year (Y1), the high genetic advance in per cent of mean were estimated for fruit yield per plant (Kg) (51.06%),average fruit weight(kg) (39.71%), node number to first male flower appearance (39.35%), non-reducing sugars (36.38%), dry matter content (30.62%), node number to first female flower appearance (26.25%), number of fruits per plant (24.55%), reducing sugar (22.82%) and Number of primary branchesper plant (21.15%). The moderate genetic advance in per cent of mean were estimated for total sugars (17.79%),β-carotene(mg/100g) (15.33%), vine length (13.69%), ascorbic acid content(mg/100g) (12.73%), total soluble solids(10.83%),inter nodal length(cm) (10.20%) and Number of node per vine (10.07%).The low genetic advance in per cent of mean were estimated for days to first male flower anthesis (8.79%), polar circumference of fruit(cm) (7.40%),days to first fruit harvest (6.24%),equatorial circumference of fruit(cm) (5.90%) and days to first female flower anthesis (3.52%).**In second year (Y2),** the high genetic advance in per cent of mean were estimated for fruit yield per plant (Kg) (51.71), node number to first male flower appearance (40.53%),average fruit weight(kg) (36.81%), dry matter content (29.34%), non-reducing sugars (29.23%), node number to first female flower appearance (40.53%), number of fruits per plant (25.83%), number of primary branches per plant (21.86%) and reducing sugar(22.82%). The moderate genetic advance in per cent of mean were estimated for total sugars (18.46%), vine length (17.50%), β-carotene(mg/100g) (15.02%), number of node per vine (13.78%), ascorbic acid content(mg/100g) (13.33%), inter nodal length(cm)(11.84%),total soluble solids(13.13%) and polar circumference of fruit(cm) (7.40%). The low genetic advance in percent of mean were estimated for equatorial circumference of fruit(cm) (8.37%),days to first fruit harvest (6.33%), days to first male flower anthesis (5.38%) and days to first female flower anthesis (5.14%).**In case of pooled,** the high genetic advance in per cent of mean were estimated for fruit yield per plant (Kg) (51.42),node number to first male flower appearance (40.19%), average fruit weight(kg) (38.03%), non-reducing sugars(32.51%),dry matter content (30.19%),node number to first female flower appearance (28.32%), number of fruits per plant (25.65%),number of primary branches per plant (23.04%)and reducing sugar(22.82%). The moderate genetic advance in per cent of mean were estimated for Total sugars (18.07%), β-

carotene(mg/100g) (15.63%), vine length (14.89%), ascorbic acid content(mg/100g) (13.64%), Number of node per vine (12.83%), inter nodal length(cm) (12.06%),polar circumference of fruit(cm) (7.40%) and total soluble solids (13.13%). The low genetic advance in per cent of mean were estimated for equatorial circumference of fruit(cm) (8.29%), days to first male flower anthesis (8.08%), days to first fruit harvest (7.05%) and days to first female flower anthesis (5.88%).

CONCLUSION

The estimates of high heritability coupled with high genetic advance as per cent of mean were observed for fruit yield per plant (Kg) average fruit weight (kg), node number to first male flower appearance, non-reducing sugars, dry matter content ,node number to firstfemale flower appearance ,number of fruits per plant ,reducing sugar and number of primary branches per plant in Y1, fruit yield per plant (Kg),node number to first male flower appearance, average fruit weight (kg),dry matter content, non-reducing sugars ,node number to first female flower appearance, number of fruits per plant ,number of primary branches per plant and reducing sugar in Y2 while, fruit yield per plant (Kg),node number to first male flower appearance ,average fruit weight (kg), non-reducing sugars ,dry matter content ,node number to first female flower appearance, number of fruits per plant , number of primary branches per plant and reducing sugar in pooled. Moderate heritability coupled with high genetic advance which indicating the additive gene action for these traits and the phenotypic selection could be relied upon.

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