Biological Forum – An International Journal **15(8): 18-21(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Performance of Pumpkin (*Cucurbita moschata* Duchex. Poir) Genotypes for Earliness and Yield Parameters

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(Received: 07 May 2023; Revised: 29 May 2023; Accepted: 05 July 2023; Published: 15 August 2023)
(Published by Research Trend)

ABSTRACT: An experimental material comprised of 28 germplasm of pumpkin *viz*., Harp-4, CM-350-SPS, BS-13-1, CO-1-SPS, Harp-10, CO-2-SPS, NDPK-1, NDPK-2, NDPK-3, NDPK-4, NDPK-5, NDPK-6, NDPK-7, NDPK-8, NDPK-9, NDPK-10, NDPK-11, NDPK-12, NDPK-13, NDPK-14, NDPK-15, NDPK-16, NDPK-17, NDPK-18 including three standard checks *viz*., Arka Chandan, Azad Kaddu and Pusa Vikash. The investigation was carried out in a Randomized Block Design with three replications at the Main Experiment Station of the Department of Vegetable Science at Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during the summer season. Given experimental results obtained further the present investigation, pumpkin genotypes NDPK-13, Narendra Upkar, NDPK-12, and NDPK-7 produced significantly higher yields than checks (Arka Chandan, Azad Kaddu, and Pusa Vikash). Two genotypes namely NDPK-8 and BS-13-1 were found significant for medium fruit yield per plant. For the maximum number of fruit per plant and minimum node number for the first staminate flower anthesis was observed in the case of NDPK-13 which is promoted to earliness and high yielding. NDPK-12 for the maximum number of primary branches and NDPK-5 for node number at first pistillate flower anthesis at minimum node number when enhancing earliness and fruit yield. Based on overall performance and high fruit yield, genotype NDPK- 13 could be recommended for large-scale cultivation under the agro-climatic condition of north Indian plains.

Keywords: Pumpkin, Genotype, Earliness, Fruit yield.

INTRODUCTION

Pumpkin belongs to the family Cucurbitaceae having chromosome number 2n=2x=40. There are 27 species under the genus Cucurbita, five of which are in cultivation. These are *C. moschata*, *C. maxima*, *C. ficifolia*, *C. pepo*, and *C. mixta*, commonly known as pumpkin (Jahan *et al.*, 2012). *Cucurbita* moschata is probably the most widely grown species of Cucurbita and this species is cross-compatible with *C. maxima*, *C. pepo*, and *C. mixta* (Tindall, 1987). Pumpkin fruits are extensively used as vegetables both in the immature and mature stages and the matured fruits can be stored for 2-4 months (Yawalkar, 1991**).** Pumpkin is relatively high in energy values, and carbohydrates, a good source of vitamins, and especially high in carotenoid pigments and minerals (Bose and Som 1998). It may contribute to improving the nutritional status of people, particularly the vulnerable groups in respect of vitamin-A requirements (Satkar *et al.*, 2013). I n India, it is mainly grown in Assam, West Bengal, Tamil Nadu, Karnataka, Madhya Pradesh, Uttar Pradesh, Orissa, Kerala, and Bihar. The total area of pumpkins in India is 108 '000 hectares whereas, the total production is 2245 ('000 MT) with a productivity of 21.71 t/ha (Anonymous, 2020-21**).** Pumpkin is monoecious and highly cross-pollinated in nature. Like other cucurbits, inbreeding depression is negligible in *Cucurbita* even after prolonged selfing (Whitaker, 1974**).** Pumpkin is cultivated for its green and mature fruits which are used as a cooked vegetable, processed food, and stock feed. The flesh is delicious when stewed, boiled, or baked. The fully ripened fruit becomes sweetish, which can be

used for preparing delicious *Halwa*, *Jam*, and other sweets. It is also used to prepare candies and fermented beverages. Mature fruits make a better mix with tomato for preparing sauce. Tender shoot tops and leaves are also cooked as a vegetable. Its flowers are more nutritive than fruits. The decorated seeds are used in confectionery (Rajan and Markose 2001). Pumpkin is a summer season vegetable under the north Indian climatic condition, it is mainly cultivated both in spring-summer (February-June) and rainy (July-November).

The grower needs an early maturity and high-yielding pumpkin variety. Therefore, this study aimed to evaluate growth, earliness, and yield under the agro-climatic condition of the north Indian plain. Pumpkin has received little attention in crop improvement, as compared to other Cucurbitaceous vegetables. Since ancient times, a wide number of germplasms are available conscious evaluation and exploitation of germplasm have not been attended to until recently. This is very helpful for a plant breeder in developing a commercial variety with market preference by determining the component characters on which selection can be exercised based on the improvement in yield and quality. Preliminary identification of early maturing genotypes can be done based on characters like node number to first staminate flower anthesis, node number to first pistillate flower anthesis, days to first staminate flower anthesis, days to first pistillate flower anthesis, days to first fruit harvest as well as focus on a direct contributing number of primary branches, vine length, a character like fruit polar circumference, fruit equatorial circumference, flesh thickness, number of fruit per plant, average fruit weight and fruit yield per plant. Collection and evaluation of germplasm is a pre-requisite in any improvement program to select high-yielding genotypes with desirable attributes *viz*., growth, earliness, high yield, and quality. Therefore, a trial for characterization and evaluation of presently available pumpkin germplasm was carried out to identify the potential cultivar for growth, earliness, and high fruit yield.

MATERIALS AND METHODS

An experimental material comprised of 28 germplasm including three standard checks *viz.*, Arka Chandan, Azad Kaddu, and Pusa Vikash. The investigation was carried out in a Randomized Block Design with three replications at the Main Experiment Station of the Department of Vegetable Science at Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during the summer season with 28 genotypes *viz.*, 'Harp-4', 'CM-350-SPS', 'BS-13-1', 'CO-1-SPS', 'Harp-10', 'CO-2-SPS', 'NDPK-1', 'NDPK-2', 'NDPK-3', 'NDPK-4', 'NDPK-5', 'NDPK-6', 'NDPK-7', 'NDPK-8', 'NDPK-9', 'NDPK-10', 'NDPK-11', 'NDPK-12', 'NDPK-13', 'NDPK-14', 'NDPK-15', 'NDPK-16', 'NDPK-17', 'NDPK-18', 'Narendra Upakar', 'Arka Chandan (C)', Azad Kaddu (C)' and 'Pusa Vikash (C)' collected from diverse sources. The seeds were sown in summer, having a plot size of 3×3 m accommodating 6 plants per plot with a row-to-row spacing of 3 m and plant-to-plant spacing of 0.50 m. Observations were recorded on five plants of each genotype in each replication for node number to first staminate flower anthesis, node number to first pistillate flower anthesis, days to first staminate flower anthesis, days to first pistillate flower anthesis, days to first fruit harvest, number of primary branches, fruit polar circumference (cm), fruit equatorial circumference (cm), vine length (m), flesh thickness (cm), number of fruits per plant, average fruit weight (kg) and fruit yield per plant (kg.).

The data on thirteen quantitative characters are recorded on five competitive and randomly selected plants of each genotype and in each replication. All the statistical analysis was carried out using OPSTAT statistical software. The analysis of variance among genotypes was estimated by using statistics analysis (Panse and Sukhatme 1984).

RESULT AND DISCUSSION

The analysis of variance for all 13 traits was highly significant (Table 1), indicating, therefore, significant differences among the genotypes concerning the traits under study. The mean performances of 28 genotypes in respect of thirteen characters have been presented in Table 2 and the same is described character-wise in the ensuing paragraphs for the mean performance of genotypes respectively. The node number at the first staminate flower anthesis ranged from 3.50 (NDPK-13) to 9.20 node (NDPK-15). The general mean of the character was 6.02 nodes. Three genotypes *viz.*, NDPK-13 (3.10), NDPK-9 (3.20), and BS-13-1 (3.50) were found significantly lower node number at first staminate flower anthesis than the best check variety Arka Chandan (4.30). Another three genotypes *viz.*, NDPK-17 (4.40), NDPK-18 (4.56), and Narendra Upkar (4.86) had significantly lower node numbers at first staminate flower anthesis than the general mean (6.02).

The node number to the first pistillate flower anthesis varied from 8.50 (NDPK-5) to 21.30 node (NDPK-12). The general mean of the character was 14.06 nodes. Five genotypes *viz.*, NDPK-5(8.50), NDPK-18 (8.66), NDPK-9 (9.03), NDPK-11 (9.26), and NDPK-10 (10.46) were found to statistically lower node number at first pistillate flower anthesis than the best check variety Arka Chandan (10.63), while, four genotypes *viz.*, Narendra Upkar (11.06), CO-2 SPS (11.47), NDPK-8 (11.70) and NDPK-1 (10.8) had significant lower node number to first pistillate flower anthesis than the general mean (14.06).

Days to first staminate flower anthesis ranged from 39.20 (BS-13-1) to 50.36 (NDPK-14) days, out of 28 genotypes, while the general mean of the character was 43.66 days. The genotype BS-13-1 (39.20) was found significant the same as the best check variety Arka Chandan (39.20) days. Among all genotypes, only one genotype NDPK-13 (39.43) was found significantly lower days to first staminate flower anthesis than the general mean (43.66) days.

Days to first pistillate flower anthesis ranged from 40.23 (NDPK-18) to 51.36 days (NDPK-4). The general mean of the character was 46.77 days. The

genotypes NDPK-18 (40.23) showed significantly earlier days for the first pistillate flower anthesis.

The days to the first fruit harvest showed a range of 57.90 (NDPK-18) to 76.10 days (BS-13-1) with a general mean of 65.52 days. Among the twenty-eight types only two genotypes *viz.*, NDPK-18 (57.90) and BS-13-1 (57.96) were significantly earlier for the days to first fruit harvest.

The number of primary branches ranged from 2.76 m (NDPK-10) to 9.43 m (NDPK-12) with the general mean of the character being 4.90 primary branches. The significantly higher number of primary branches per plant was exhibited by genotype NDPK-12 (9.43) followed by NDPK-14 (8.76), while, four genotypes showed significance for the more number of primary branches *viz.*, Narendra Upkar (5.73), NDPK-11 (6.14), NDPK-3 (7.53) and NDPK-6 (8.70).

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

Sr. No.	Characters	Mean sum of square		
		Replications	Treatments	Error
		d. f. 2	d. f. 27	d. f. 54
1.	Node number at first staminate flower anthesis	1.80	8.59**	0.53
2.	Node number at first pistillate flower anthesis	84.75	41.15**	1.31
3.	Days to first staminate flower anthesis	266.42	29.32**	5.46
4.	Days to first pistillate flower anthesis	555.22	28.03**	6.24
5.	Days to first fruit harvest	1130.29	40.36**	11.92
6.	Number of primary branches per plant	0.70	9.70**	0.23
7.	Fruit polar circumference (cm)	177.06	21.70**	4.06
8.	Fruit equatorial circumference (cm)	880.95	43.30**	15.11
9.	Vine length (m)	2.92	10.15**	0.18
10.	Flesh thickness (cm)	1.07	0.92**	0.05
11.	Number of fruit per plant	5.93	2.95**	0.23
12.	Average fruit weight (kg)	0.07	0.35**	0.01
13.	Fruit yield per plant (kg)	1.71	5.40**	0.12

Table 2: Mean performance of twenty-eight pumpkin genotypes for thirteen quantitative traits.

Sr. No.	Treatments/ Genotypes	Node no. at first staminate flower anthesis	Node no. at first pistillate flower anthesis	Days to first staminate flower anthesis	Days to first pistillate flower anthesis	Days to first fruit harvest	No. of primary branches	Fruit polar circumference (cm)	Fruit equatorial circumference (cm)	Vine length (cm)	Flesh thickness (cm)	No. of fruit plant^{-1}	Average fruit weight (kg)	Fruit Yield per plant
		1	2	3	4	5	6	7	8	9	10	11	12	13
1.	Harp-4	4.86	14.50	40.40	43.26	63.10	4.03	26.60	56.86	04.20	3.20	3.49	2.110*	5.160
2.	CM- 350 SPS	5.16	16.80	43.20	43.96	64.70	3.46	27.20	57.43	05.30	2.76	3.10	1.906*	4.770
3.	BS-13-1	3.50*	13.33	39.20*	43.56	57.96*	3.33	29.70	62.17	03.53	4.06*	6.22*	1.576	7.266*
4.	CO-1-SPS	5.50	15.50	45.38	43.40	65.40	4.70	31.20	61.50	06.67*	3.16	4.10	1.420	5.253
5.	NDPK-1	8.56	10.80*	43.60	48.13	65.30	5.00	27.26	58.90	04.27	2.13	5.07	1.626	5.916
6.	Narendra Upkar	4.76*	11.06*	47.23	50.46	70.10	5.73*	25.26	66.70*	03.50	2.90	4.56	1.966*	7.773*
7.	Harp-10	5.56	16.53	44.63	47.53	67.73	3.01	35.93*	59.06	07.63*	3.23	4.78	1.326	4.306
8.	NDPK-2	7.76	19.16	40.93	48.70	61.70	4.56	27.26	56.70	04.06	2.60	5.96*	1.413	6.093
9.	CO-2-SPS	7.56	11.47*	46.07	50.56	68.16	4.66	32.23	64.13	05.32	2.96	6.16*	0.976	4.876
10.	NDPK-3	8.20	16.03	47.13	49.76	69.56	7.53*	28.66	52.63	04.63	3.23	4.62	0.733	2.733
11.	NDPK-4	6.03	20.80	50.36	51.36	67.63	5.16	30.16	51.56	10.16*	2.20	5.36	1.303	5.983
12.	NDPK-5	6.23	8.50*	42.53	44.46	61.83	4.50	28.66	55.43	04.47	3.26	6.31*	1.370	6.730*
13.	NDPK-6	7.03	14.36	42.50	48.56	65.03	8.70*	31.90	66.03*	05.36	4.30*	4.32	1.326	4.580
14.	NDPK-7	8.66	16.40	48.06	50.53	76.13	4.46	28.13	61.56	04.53	3.00	5.66	1.623	7.560*
15.	NDPK-8	6.60	11.70*	42.16	44.26	65.73	3.36	29.76	52.46	08.20*	3.30	6.19*	1.406	6.753*
16.	NDPK-9	3.20*	9.03*	41.17	45.36	63.33	3.66	29.80	57.76	03.56	2.76	5.35	0.810	3.856
17.	NDPK-10	8.60	10.46*	45.37	53.10	67.63	2.76	31.06	60.20	04.13	2.16	3.84	1.446	4.746
18.	NDPK-11	5.70	9.26*	43.60	46.93	66.50	6.14*	30.66	59.80	02.62	3.10	2.67	1.933*	4.976
19.	NDPK-12	6.06	21.30	47.16	45.80	65.53	9.43*	28.06	64.40	07.26*	4.23*	5.24	1.633	7.680*
20.	NDPK-13	3.10*	13.06	39.43*	45.06	62.46	5.23	31.03	63.46	04.16	3.17	6.33*	1.740*	8.136*
21.	NDPK-14	6.43	16.86	44.93	48.51	68.90	8.76*	34.53*	58.76	03.80	2.57	4.48	1.326	4.733
22.	NDPK-15	9.20	15.16	49.33	49.23	65.86	4.43	29.10	59.93	04.06	3.40	5.65	1.453	6.153
23.	NDPK-16	5.46	14.37	44.56	45.46	63.30	5.56	29.33	61.33	09.20*	2.10	5.14	1.210	4.883
24.	NDPK-17	4.40*	20.53	40.23	46.73	68.03	4.80	35.93*	59.46	06.06*	3.10	4.84	1.130	4.943
25.	NDPK-18	4.56*	8.66*	41.40	40.23*	57.90*	4.83	27.36	57.50	04.56	2.87	3.87	1.160	4.230
26.	Arka Chandan (c)	4.30*	10.63*	39.20*	44.70	65.50	3.76	26.36	60.56	05.63	2.80	4.26	1.900*	5.213
27.	Azad Kaddu (c)	6.06	12.40	42.23	46.93	66.23	2.80	29.46	61.03	03.73	3.26	4.24	1.800*	5.720
28.	PusaVikash (c)	5.50	15.06	40.60	43.10	63.53	2.93	27.63	62.36	04.20	3.07	5.24	1.810*	7.306*
	G M	6.02	14.06	43.66	46.77	65.52	4.90	29.65	59.63	05.17	3.03	4.89	1.480	5.655
	S.Em±	0.42	0.66	1.349	1.44	1.99	0.28	1.16	02.24	00.24	0.13	0.28	0.07	0.20
	C.D. (at 5%)	1.19	1.87	3.82	4.09	5.65	0.79	3.30	06.36	00.69	0.37	0.79	0.20	0.57
	C.V. %	11.12	8.14	5.35	5.34	5.27	9.92	6.80	06.51	08.25	7.58	9.92	8.54	6.20

The range of fruit polar circumference (cm) was recorded between 25.26 (Narendra Upkar) to 35.93 cm (Harp-10, NDPK-17). The general mean of the fruit's polar circumference was 29.65 cm. The genotype Harp-10 (35.93) was found significantly equal to the genotype NDPK- 17 (35.93) cm, while, genotype NDPK-14 (34.53) had significantly higher fruit polar circumference. The genotypes ranged for fruit equatorial circumference (cm) from 51.56 (NDPK-4) to 66.70 cm (Narendra Upkar) with the general mean of the character being 59.63 cm. Among the twenty-eight genotypes, Narendra Upkar (66.70) followed by NDPK-6 (66.03) cm was found a significantly higher length of fruit equatorial circumference, whereas, the

genotypes *viz.*, NDPK-13 (62.36), NDPK-CO-2 SPS (64.13) and NDPK-12 (64.40) had the higher number for fruit equatorial circumference than the check variety Pusa Vikash (62.36) cm.

The vine length (m) ranged from 2.62 (NDPK-11) to 10.12 m (NDPK-4). Seven genotypes out of the twenty-eight genotypes *viz.*, NDPK-17 (6.06), CO-1 SPS (6.67), NDPK-12 (7.26), Harp-10 (7.63), NDPK-(8.20), NDPK-16 (9.20) and NDPK-4 (10.16) m were found a significantly higher number of vine length, while, the genotypes *viz.*, NDPK-11 (2.62), Narendra Upkar (3.50), BS-13-1(3.53), NDPK-9 (3.56), NDPK-14 (3.80), NDPK-2 (4.04), NDPK-15 (4.04), NDPK-10 (4.13), NDPK-13 (4.16), NDPK-1 (4.27), NDPK-5 (4.47), NDPK-7 (4.53), NDPK-18 (4.56) and NDPK-3 (4.63) m had a lower number of vine length as compared to the general mean (5.17) m.

The flesh thickness of fruit for all the twenty-eight genotypes ranged from 2.10 cm (NDPK-16) to 4.30 cm (NDPK-6). Three genotypes BS-13-1 (4.06), NDPK-12 (4.23), and NDPK-6 (4.30) were recorded with higher flesh thickness among all genotypes. The general mean of the character was recorded at 3.03 cm.

The number of fruits per plant is a major component in deciding fruit yield per plant which ranged from 2.67 (NDPK-11) to 6.33 numbers of fruits (NDPK-13) with a general mean of 4.89 fruits. Six genotypes *viz.*, NDPK-2 (5.96), CO-2-SPS (6.16), NDPK-8 (6.19), BS-13-1 (6.22), NDPK-5 (6.31) and NDPK-13 were found a significantly higher number of fruits per plant, whereas, the genotypes *viz.*, NDPK-11 (2.67), CM-350 SPS (310), Harp-4 (3.49), NDPK-10 (3.54). NDPK-18 (3.87), NDPK6- (4.32), Narendra Upkar (3.56), NDPK-14 (4.48), NDPK-3 (4.62), and NDPK-17 (4.84) had less number of fruit per plant than general mean 4.89 fruits, respectively.

The average fruit weight ranged from 0.733 kg (NDPK-3) to 2.110 kg (Harp-10). Out of 28 genotypes, four genotypes *viz.*, CM-350 SPS (1.906), NDPK-11 (1.933), Narendra Upkar (1.966), and Harp-4 (2.110) kg had a higher average fruit weight than the best check Arka Chandan (1.900) kg. The average mean of the character was 1.480 kg. Only one genotype NDPK-13 (1.740) was found significantly higher average fruit weight (kg).

The highest fruit yield per plant was recorded in NDPK-13 (8.136) kg and the lowest yield per plant was observed in NDPK-3 (2.733) kg with a general mean value of 5.655 kg per plant. Five genotypes *viz.*, NDPK-7 (7.560), NDPK-12 (7.680), Narendra Upkar (7.773), and NDPK-13 (8.136) were found significantly superior for fruit yield per plant than check variety Pusa Vikash (7.306 kg). However, another three genotypes namely NDPK-5 (6.730), NDPK-8 (6.756), and BS-13-1 (7.266) kg produced statistically high yielder genotype for fruit yield per plant whereas, the genotype *viz.*, NDPK-3 (2.733), NDPK-9 (3.856), NDPK-18 (4.230), Harp-4 (5.160), NDPK-6 (4.580), NDPK-14 (4.730), NDPK-10 (4.746), CM-350 SPS (4.770), CO-2- SPS (4.876), NDPK-16 (4.886), NDPK-17 (4.9433), Harp-4 (5.160) and CO-1-SPS (5.253) had less number of fruit yield per plant than the general mean (5.655) kg.

CONCLUSIONS

Given experimental results obtained during the present investigation, pumpkin genotypes NDPK-13, Narendra Upkar, NDPK-12, and NDPK-7 produced significantly higher yields than checks (Arka Chandan, Azad Kaddu, and Pusa Vikash). Two genotypes namely NDPK-8 and BS-13-1 were found significant for medium fruit yield per plant. For a maximum number of fruit per plant and minimum node number for the first staminate flower anthesis was observed in the case of NDPK-13 which is promoted to earliness and high yielding. NDPK-12 for the maximum number of primary branches and NDPK-5 for node number at first pistillate flower anthesis at minimum node number which enhances earliness and fruit yield.

Acknowledgement. I am very grateful to the Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (Uttar Pradesh), India for providing the facilities and carrying out the research. Additionally, I would like to extend my sincere gratitude to Dr. V. B. Singh, Associate Professor, Department of Vegetable Science, ANDUAT, Ayodhya, who kindly provided meticulous guidance, supervision, prodigious discussion, and exceptional cooperation throughout the entirety of an investigation and setup of this research work.

Conflict of Interest. None.

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How to cite this article: Aniket Kumar Verma, Pranjal Singh, Avanish Kumar Singh, Jaswant Prajapati, Vaishali Gangwar, Himanshu Singh, V. B. Singh and A. C. Mishra (2023). Performance of Pumpkin (*Cucurbita moschata* Duchex. Poir) Genotypes for Earliness and Yield Parameters. *Biological Forum – An International Journal, 15*(8): 18-21.