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Phenotyping and Characterization of Pointed Gourd (*Trichosanthes dioica* Roxb.) Genotypes

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Abstract

In contrast to the field crops, quality is as important as yield in vegetable crops. Keeping this in view, the present investigation was carried out during 2021-22 with the objective of assessing the diversity and novelty of pointed gourd genotypes at Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal, India. Qualitative data based on vegetative and reproductive characters was collected for 18 parameters of 34 distinct genotypes as per the DUS (distinctiveness, uniformity and stability) guidelines developed for the crop. The results revealed a high level of variability and large diversity among the genotypes for majority of the qualitative traits.

Key words: *DUS characterization, morphology, qualitative characters*

Introduction

Vegetables are important components of Indian agriculture and food security because of their short growing season, higher yield, nutrient content, commercial viability, and potential to generate on-and off-farm employment (Kumar, 2020). Pointed gourd (2n=2x=22) is a dioecious, perennial, nutritious, remunerative vegetable belonging to the family Cucurbitaceae. The total cultivated area under the crop in India is about 20,000 ha with the production of 3,25,000 MT per annum (Anon., 2019). In West Bengal, it is grown in almost all the districts and fetches high economical returns. It is known as the 'King of Gourds' as it is a rich source of different nutrients and vitamins. Its roots have purgative property whereas green fruits and succulent shoots exhibit laxative property (Rahman et al. 2008). Khatua et al. (2016) described the leaves to be useful in treatment of oedema, baldness, fever and heart.

The characterization of germplasm provides information on the characteristics possessed by each genotype, ensuring maximal use of the germplasm collection by end users (Reddy et al., 2016). Morphological features are the oldest and most commonly used genetic markers (Bretting and Widrlechner, 1995). Morphological characterization is the initial stage in the description, classification, and arrangement of germplasm collections besides identification of unique ones for future use (Torkpo et al., 2006; Arslanoglu et al., 2011). Information on characterization of pointed gourd genotypes and germplasm is scanty and hence, the current study was conducted with an aim to characterize, appraise, and compare the precise morphological aspects of pointed gourd genotypes to determine their variability and uniqueness. The main aim of the research work was to get acquainted with the desirable morphological descriptor states to be used as potential breeding traits for designing farmer-driven pointed gourd varieties by the breeders.

Material and methods

Description of study area

The experimental study was done at 'C' Block farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal, India under the AICRP on Vegetable Crops in the summer season of 2021-22. The farm is situated at an elevation of 9.75 m above the mean sea level. Topographic situation of the experimental site comes under Gangetic alluvial plains of West Bengal.

Experimental material and design

Thirty four genotypes of pointed gourd collected from different parts of western Uttar Pradesh, Jharkhand, West Bengal and other parts of India (Table 1) were planted in randomized block design (RBD) with three replications each. Raised beds of 15-20 cm height, 6.0 m length and 1.0 m width accommodating twelve plants per plot were prepared. Stem cuttings of each genotype were planted during the 1st week of November, 2021 in 5 cm deep pits previously filled with well rotten cow dung manure. The spacing followed was 0.90 m and 0.60 m between rows and plants, respectively.

Table 1. Brief description of the pointed gourd genotypes

Sl. No.	Notation	Sources of Material
1	BAUPG-I	Department of Horticulture, BAU, Ranchi, Jharkhand
2	BAUPG-II	Department of Horticulture, BAU, Ranchi, Jharkhand
3	BAUPG-III	Department of Horticulture, BAU, Ranchi, Jharkhand
4	BAUPG-IV	Department of Horticulture, BAU, Ranchi, Jharkhand
5	BCPG-1	Department of Horticulture, BCKV, West Bengal
6	BCPG-3	Department of Horticulture, BCKV, West Bengal
7	BCPG-4	Department of Horticulture, BCKV, West Bengal
8	BCPG-5	Department of Horticulture, BCKV, West Bengal
9	BCPG-6	Department of Horticulture, BCKV, West Bengal
10	BCPG-16	Department of Horticulture, BCKV, West Bengal
11	BCPG-17	Department of Horticulture, BCKV, West Bengal
12	BCPG-22	Department of Horticulture, BCKV, West Bengal
13	BCPG-23	Department of Horticulture, BCKV, West Bengal
14	BCPG-24	Department of Horticulture, BCKV, West Bengal
15	BCPG-25	Department of Horticulture, BCKV, West Bengal
16	BCPG-26	Department of Horticulture, BCKV, West Bengal
17	BCPG-27	Department of Horticulture, BCKV, West Bengal
18	BCPG-29	Department of Horticulture, BCKV, West Bengal
19	BCPG-30	Department of Horticulture, BCKV, West Bengal
20	BCPG-31	Department of Horticulture, BCKV, West Bengal
21	BCPG-34	Department of Horticulture, BCKV, West Bengal
22	BCPG-35	Department of Horticulture, BCKV, West Bengal
23	BCPG-36	Department of Horticulture, BCKV, West Bengal
24	BCPG-37	Department of Horticulture, BCKV, West Bengal
25	BCPG-38	Department of Horticulture, BCKV, West Bengal
26	SwarnaAlaukik	ICAR Research Complex for Eastern Region Ranchi, Jharkhand
27	SwarnaRekha	ICAR Research Complex for Eastern Region Ranchi, Jharkhand
28	KashiAlankar	ICAR- Indian Institute of Vegetable Research, Varanasi, Uttar Pradesh
29	KashiSuphal	ICAR- Indian Institute of Vegetable Research, Varanasi, Uttar Pradesh
30	Tripura Local	College of Agriculture, Tripura
31	NP-260	Dept. of Horticulture, Acharya Narendra Deva University of Agriculture and Technology, Uttar Pradesh
32	NP-520	Dept. of Horticulture, Acharya Narendra Deva University of Agriculture and Technology, Uttar Pradesh
33	Rajendra Parwal-1	Rajendra Agriculture University, Samastipur, Bihar
34	Rajendra Parwal-2	Rajendra Agriculture University, Samastipur, Bihar
35	Male	Department of Horticulture, BCKV, West Bengal

Qualitative observations recorded

Qualitative data was collected based on vegetative and reproductive characteristics that corresponded to the distinctiveness, uniformity, stability (DUS) test guidelines of pointed gourd developed by Protection of Plant Varieties and Farmers Rights Authority (PPV&FRA), Government of India (Table 2). For the assessment of uniformity of characteristics on the plot as a whole (visual assessment by a single observation of a group of plants or parts of plant), 30 plants are considered for observations and other observations were made an all plants in the test. Royal Horticulture Society (RHS) (sixth revised edition) colour chart was used for the assessment of characters such as leaf colour, fruit colour *etc*. Data for nine characteristics were collected by visual assessment by observation of individual plant or parts of plants (VG) whereas data for eight characteristics were collected via visual assessment by a single observation of a group of plants or parts of plants (VS). One character was measured by a number of individual plant or parts of plants (MS).Correlation between different characters were studied by using IndoStat software.

Table 2. Qualitative descriptors used in morphological characterization of pointed gourd genotypes

S. No.	Character code	Character measured	Descriptor states and codes	Notes	Stage of observation	Type of Assessment
1	SS	Shape of stem	Round (R)	3	10	VS
			Angular (A)	5		
2	SP	Stem pubescence nature	Sparse (S)	3	20	VG
			Dense (D)	7		
3	LS	Leaf shape	Auriculate (A)	3	10	VS
			Cordate (C)	5		
4	LP	Leaf pubescence nature	Absent (A)	1	20	VS
			Present (P)	9		
5	LL	Leaf lobes	Absent (A)	1	20	VS
			Present (P)	9		
6	DLL	Depth of leaf lobing	Shallow (S)	3	20	VS
			Medium (M)	5		
			Deep (D)	7		
7	LM	Leaf margin	Entire (E)	3	10	VS
			Undulated (U)	5		
			Lobed (L)	7		
8	LC	Leaf colour	Light green (LG)	1	30	VG
			Green (G)	2		
			Dark green (DG)	3		
9	LT	Leaf tip	Blunt (B)			VS
			Pointed (P)			
10	FS	Fruit shape	Club	1	30	VS
			Cylindrical	2		
			Oval	3		
			Spindle	4		
			Elongated spindle	5		
			Ovate	6		
			Spheroid	7		
			Spindle tapering	8		
11	FSC	Fruit skin primary colour	Light green (138C)	1	30	VG
			Green (138A)	2		
			Dark green (N137A)	3		

S. No.	Character code	Character measured	Descriptor states and codes	Notes	Stage of observation	Type of Assessment
12	FST	Fruit surface striped pattern	Uniform Mottled Striped	1 2 3	30	VG
13	FG	Fruit glossiness	Non-glossy Glossy	1 9	30	VG
14	FPH	Fruit pericarp hardness	Soft Hard	3 5	30	VG
15	FFC	Fruit flesh colour	White Creamy white		30	VG
16	FBES	Blossom end fruit shape	Depressed Flatten Round Pointed	1 3 5 7	30	VS
17	S	Seediness	Absent Present	1 9	40	MS
18	FPA	Fruit peduncle attachment	Soft (S) Hard(H)	3 5	30	VG

VG: Visual assessment by a single observation of a group of plants or parts of plants; VS: Visual assessment by observations of individual plant or parts of plants, MS: Measurement of a number of individual plant or parts of plants.

Results and discussion

a. Characterization of pointed gourd genotypes

Stem and leaf characters

A wide range of variations were recorded for stem and leaf characters (Table 3a) of the germplasm under study. Majority of the genotypes (70.58%) had sparse pubescence on stem, while 29.4% genotypes had dense pubescence. In case of stem shape, all the 34 genotypes were found to have angular stem (Fig. 1a). Similar findings related to stem pubescence and stem shape were reported by Sharma (2015). Leaf margin shape was categorized as cordate and auriculate. While 50% of the genotypes had cordate shaped leaves, remaining 50% had auriculate leaves. Majority of the genotypes (88.23%) recorded undulated leaf margin and the remaining recorded entire (2.94%) and lobed (8.82%) margins. Leaf colours of different genotypes were divided into three groups; light green (20.58%), deep green (29.41%) and green (50%).

Fig.1. Stem shape (a) and leaf blade-depth of lobing (b)

Table 3a. Qualitative morphological characteristics of pointed gourd genotypes (Stem and leaf)

Sl. No.	Genotypes	SS	SP	LS	LP	LL	DLL	LM	LC	LT
1	BCPG-1	A	S	A	P	P	S	UN	DG	P
2	BCPG-3	A	S	A	P	P	S	UN	G	P
3	BCPG-4	A	D	A	P	P	D	UN	DG	B
4	BCPG-5	A	S	C	P	P	S	UN	G	P
5	BCPG-6	A	S	C	P	P	S	UN	G	B
6	BCPG-16	A	S	A	P	P	S	UN	LG	P
7	BCPG-17	A	S	C	P	P	D	UN	DG	P
8	BCPG-22	A	S	C	P	P	S	UN	LG	B
9	BCPG-23	A	D	C	P	P	S	UN	G	P
10	BCPG-24	A	S	C	P	P	S	UN	G	P
11	BCPG-25	A	S	A	P	P	S	UN	DG	P
12	BCPG-26	A	S	A	P	P	S	UN	G	P
13	BCPG-27	A	S	A	P	P	S	UN	G	P
14	BCPG-29	A	S	C	P	P	S	UN	DG	P
15	BCPG-30	A	S	A	P	P	S	UN	G	P
16	BCPG-31	A	S	C	P	P	S	UN	G	B
17	BCPG-34	A	S	A	P	P	D	UN	G	P
18	BCPG-35	A	S	A	P	P	M	UN	G	P
19	BCPG-36	A	S	C	P	P	S	UN	G	P
20	BCPG-37	A	D	C	P	P	D	UN	LG	B
21	BCPG-38	A	S	C	P	P	S	UN	G	B
22	Swarna Alaukik	A	D	C	P	P	S	L	DG	B
23	Swarna Rekha	A	D	C	P	P	S	E	LG	P
24	Kashi Alankar	A	D	C	P	P	M	UN	G	P
25	Kashi Suphal	A	D	A	P	P	S	UN	DG	P
26	Tripura Local	A	S	A	P	P	S	UN	DG	P
27	NP-260	A	D	A	P	P	S	L	G	P
28	NP-520	A	S	C	P	P	S	L	DG	B
29	Rajendra Parwal-1	A	S	A	P	P	S	UN	G	P
30	Rajendra Parwal-2	A	D	A	P	P	S	UN	LG	P
31	BAUPG-I	A	S	C	P	P	M	UN	G	P
32	BAUPG-II	A	S	A	P	P	S	UN	LG	P
33	BAUPG-III	A	S	A	P	P	S	UN	G	P
34	BAUPG-IV	A	D	C	P	P	D	UN	LG	P
Descriptor		A	S	A	P	P	S	UN	G	P
Number of cultivars		34	24	17	34	34	26	30	17	26
Percent of cultivars		100	70.58	50	100	100	76.47	88.23	50	76.47
Descriptor			D	C			M	E	LG	B
No. of cultivars			10	17			3	1	7	8
Percent of cultivars			29.41	50			8.82	2.94	20.58	23.52
Descriptor							D	L	DG	
No. of cultivars							5	3	10	
Percent of cultivars							14.70	8.82	29.41	

SS: stem shape; SP: stem pubescence nature; LS: leaf shape; LP: leaf pubescence nature; LL: leaf lobes; DLL: depth of leaf lobing; LM: leaf margin; LC: leaf colour; LT: leaf tip. Descriptor Codes for different characters are as detailed in Table 2.

Pointed apex leaves were produced by 76.47% of the genotypes. Leaf lobes were present in all the genotypes. The depth of leaf lobbing (Fig. 1b) was found to be shallow (76.47%), medium (8.82%) and deep (14.70%). Deeply lobed leaf trait meant less surface area per leaf. This finding related to leaf margin, leaf colour and leaf end nature had a similarity with Ara et al. (2012).

Fig.2. Fruit shape (a) and fruit surface colour pattern(b)

Fruit characters

Fruit characters of different genotypes under study showed large range of deviation and were categorized as per DUS guidelines (Table 2, 3b). Fruit shapes of different genotypes were categorized into seven groups namely club, cylindrical, oval, spindle, spindle tapering, elongated spindle and spheroid. Maximum frequency of genotypes was observed in case of spindle tapering (47.05), followed by club shaped (26.47%), cylindrical (11.76%), ovate (5.88%), spindle (5.88%) and elongated spindle (2.94%) (Fig. 2a). Previously, Hazra et. al. (1998) had characterized sixty eight female clones of pointed gourd, which were categorized under four groups based on fruit shape. For surface colour of fruits at marketable stage, the results revealed that 55.88% of genotypes exhibited dark green fruit surface followed by 35.29%(green) and 8.82% (light green) (Fig. 2b). A similar range of variations in fruit surface colour has also been reported by Kumar and Singh (2012). Pattern of fruit stripes is also an important morphological parameter in distinguishing two or more genotypes. For this character, all the studied genotypes were divided into three groups namely uniform, mottled and stripped. Striped pattern was found in higher frequency of genotypes (76.47%) than mottled (17.64%) and uniform (5.89%). Unique genetic identity of the individual genotypes is responsible for such type of variations. Similar findings were also recorded by Ara et. al. (2012), Ghosh (2000) and Sharma (2015).

Fruit glossiness is one of the important indices which determine the market value of pointed gourd. The present study revealed that twenty seven genotypes (79.47%) had glossy and seven (20.58%) had non-glossy fruit surface (Fig. 3). The result was supported by findings of Ghosh (2000). As per pericarp hardness of the fruit at marketable stage, all the genotypes were grouped into two categories; soft and hard. Soft pericarp found higher frequency (52.95%) over hard pericarp (47.05%) and it had conformity with the findings of Ghosh (2000).

Fig.3. Fruit glossiness

Table 3b. Qualitative morphological characteristics of pointed gourd genotypes (Fruit)

Sl.No.	Genotypes	FS	FSC	FST	FG	FPH	FFC	FBES	FS	FPA
1	BCPG-1	O	DG	S	G	S	W	F	P	S
2	BCPG-3	C	G	M	G	H	W	R	P	H
3	BCPG-4	CS	DG	S	NG	H	CW	F	P	H
4	BCPG-5	CS	DG	S	NG	H	CW	F	P	H
5	BCPG-6	CS	G	S	G	H	W	F	P	H
6	BCPG-16	ST	G	S	G	S	W	P	P	S
7	BCPG-17	O	DG	M	G	S	W	P	P	S
8	BCPG-22	ST	DG	S	G	S	CW	F	P	H
9	BCPG-23	C	DG	S	NG	S	CW	F	P	H
10	BCPG-24	ST	G	S	G	S	CW	F	P	S
11	BCPG-25	ST	DG	S	G	H	W	P	P	S
12	BCPG-26	ST	DG	S	G	H	W	P	P	S
13	BCPG-27	CS	G	S	G	H	W	P	P	S
14	BCPG-29	CS	DG	S	G	H	CW	F	P	S
15	BCPG-30	CS	DG	S	G	H	CW	P	P	S
16	BCPG-31	ST	DG	S	G	H	CW	R	P	S
17	BCPG-34	ST	DG	S	G	H	CW	R	P	S
18	BCPG-35	S	DG	S	NG	S	CW	R	P	S
19	BCPG-36	ST	DG	S	NG	H	W	P	P	S
20	BCPG-37	CS	G	S	G	S	W	P	P	S
21	BCPG-38	ST	DG	M	G	S	W	R	P	H
22	Swarna Alaukik	ST	G	U	G	S	CW	R	P	H
23	Swarna Rekha	ST	G	M	G	S	CW	R	P	H
24	Kashi Alankar	ST	DG	S	NG	H	CW	F	P	H
25	Kashi Suphal	ST	G	S	G	H	W	P	P	S
26	Tripura Local	ST	G	S	G	H	W	P	P	S
27	NP-260	CS	DG	S	G	H	W	P	P	S
28	NP-520	ST	LG	M	G	S	CW	F	P	S
29	Rajendra Parwal-1	CS	DG	S	G	S	CW	F	P	S
30	Rajendra Parwal-2	ST	G	S	G	S	CW	P	P	S
31	BAUPG-I	S	G	S	G	S	CW	P	P	S
32	BAUPG-II	C	LG	U	G	S	CW	R	P	S
33	BAUPG-III	ES	DG	S	NG	S	CW	P	P	S
34	BAUPG-IV	C	LG	M	G	S	CW	F	P	S
Descriptor		O	DG	S	G	S	CW	F	P	S
No. of cultivars		2	19	26	27	18	21	12	34	24
Percent of cultivars		5.88	55.88	76.47	79.41	52.94	61.76	35.29	100	70.58
Descriptor		C	LG	M	NG	H	W	R		H
No. of cultivars		4	3	6	7	16	13	8		10
Percent of cultivars		11.76	8.82	17.64	20.58	47.05	38.23	23.52		29.41

	FS	FSC	FST	FG	FPH	FFC	FBES	FS	FPA
Descriptor	CS	G	U				P		
No. of cultivars	9	12	2				14		
Percent of cultivars	26.47	35.29	5.88				41.17		
Descriptor	ST								
No. of cultivars	16								
Percent of cultivars	47.05								
Descriptor	S								
No. of cultivars	2								
Percent of cultivars	5.88								
Descriptor	ES								
No. of cultivars	1								
Percent of cultivars	2.94								

FS: Fruit shape; FSC: Fruit skin primary colour; FST: Fruit surface striped pattern; FG: Fruit glossiness; FPH: Fruit pericarp hardness; FFC: Fruit flesh colour; FBES: Blossom end fruit shape; S: Seediness; FPA: Fruit peduncle attachment. Descriptor Codes for different characters are as detailed in Table 2.

Flesh colour of the fruit varied from white to creamy white and most of the genotypes were categorized under creamy white flesh colour category (61.76%). In the present study, fruit shape varied from flattened (12 genotypes) to round (8 genotypes) and pointed (14 genotypes). Fruit peduncle attachment is also an important qualitative character. Twenty four genotypes showed soft fruit attachment with peduncle and only ten genotypes showed hard attachment. Seeded fruits were produced by all the genotypes under study and none of the genotypes was found to bear seedless fruits.

Conclusion

Vegetable product innovation is necessary to maintain the interest of today's consumers. Unlike field crops, quality generally dominates yield with vegetable crops. Market acceptability is required for farmers to survive as well as increase of shelf-life is also very important. Now pointed gourd is becoming popular crop among cucurbits crops for its medicinal value. Thus, quality typically trumps productivity. Vegetable breeding programmes aim to create a new variety with exceptional combinations of desirable horticultural traits. Along with fruit yield, there are fruit attributes that influence pointed gourd's productivity and marketability. The economic value of pointed gourd depends on both fruit output and quality, which is a combination of horticultural features. The pointed gourd genotype was linked to fruit greenness, length, weight, seediness and glossiness. So, it is traded based on its quality and size.

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