

Evaluation of Pointed Gourd (*Trichosanthes dioica* Roxb.) varieties by keeping using native pollinators boxes under Naturally Ventilated Polyhouse

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ABSTRACT

In the current study, efforts were made to select suitable pointed gourd for polyhouse in the eastern part of India by using native pollinators. Growth and yield traits of five pointed gourd varieties were studied under polyhouse conditions for three years from 2018-19 to 2020-21. Among the five varieties evaluated under polyhouse production, the three years of pooled data revealed Rajendra Parwal-2 (52.89) was the earliest followed by Swarna Rekha (54.71) and KashiAlankar (53.65). KashiAlankar (6.11) produced the first flower at the lowest node number followed by SwarnaRekha (7.41) and Rajendra Parwal-2 (7.59), KashiAlankar (64.88) was the earliest in days to first harvesting followed by Swarna Rekha (65.47) and Kashi Alankar (58.13). Fruit length, fruit diameter, and average fruit weight was recorded maximum in KashiAlankar followed by SwarnaRekha. The number of primary branches recorded maximum with KashiAlankar (7.52) followed by SwarnaRekha (7.39) whereas vine length was recorded maximum with Swarna Rekha (7.76 m) followed by Kashi Alankar (7.58 m). SwarnaRekha variety recorded significantly superior over the rest of the varieties in terms of a number of fruit per plant (279.85), Fruit weight per plant (7.43 Kg), and Fruit yield per 1000 sq.m (3.45 t). So, it is concluded that SwarnaRekha variety was found suitable for production under naturally ventilated polyhouse condition in the eastern part of India.

Keywords: Pointed gourd, Varieties, Pollinators, Polyhouse, Yield

INTRODUCTION

The perennial pointed gourd (*Trichosanthes dioica* Roxb.), $2n=2x=22$ is a highly nutritious cross pollinated cucurbit vegetable and is highly coveted in markets of our country, particularly during summer and rainy seasons. The pointed gourd is morphologically distinct from other cucurbitaceous species due to its perennial nature, well established dioecism, and vegetative means of propagation. [24]. The pointed gourd (*Trichosanthes dioica* Roxb.) is a perennial and

dioecious vegetable grown as a vine with a pencil thickness stem. It is widely cultivated in Bihar, West Bengal, Odisha, Assam, and Uttar Pradesh. The crop is cultivated over an area of 18,000 hectares in India with a production of 2,52,000 tonnes [19] In Bihar cultivable area is 7117.85 hectares with production is 76776.28MT (2017-18). The pointed gourd is referred to as the king of gourds because of its higher nutrient content. The fruits are rich in vitamin A, protein, and minerals. It is

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easily digestible, diuretic, and laxative, invigorates the heart and brain, and is useful in the disorder of the circulatory system [16] [2]. The important varieties grown in India are SwarnaRekha, Swarna Alaukik, SwarnaSuruchi, KashiAlankar, Rajendra Parwal-1, Faizabad Parwal-1, Arka Neelachal Kirti, etc. The selection of a high-yielding germplasm can therefore significantly increase the pointed gourd production.

Nowadays pointed gourd production is gaining importance due to the spread of awareness among consumers regarding its medicinal properties leading to elevated demand and higher yield and income which is attracting more farmers to cultivate. However, frost injury during the winter season is the limiting factor for successful cultivation during winter which adversely affects the overall morphological growth, and fruit set and ultimately interrupts the supply chain. Under the such prevailing condition, protected cultivation under polyhouse and insect-proof net house can be a viable option to provide a specified climate for crop growth. Presently pointed gourd is gaining popularity for greenhouse production due to its indeterminate vine growth, response to training and pruning, and development of new varieties which set fruits extended area of pointed gourd under greenhouse production. By planting pointed gourd seedlings during September-October in the polyhouse, their yield could be taken in one and one and a half months in advance than the open field condition and thus fetches the bonus price due to marketing of pointed gourd in the off-season. The environmental condition, particularly the increase in temperature inside polyhouse hastens the germination and early growth of pointed gourd fruits. Needless to emphasize, the growing of pointed gourd inside polyhouse eliminates the danger of biotic and abiotic stresses during the period of the rainy season. Protection against biotic and abiotic stresses becomes easier [28]. have proposed that the cultivar selection be based on certain parameters which include earliness, plant vigor, fruit yield, and quality, besides consumers' preference for fruits in the local market. Hence, cultivars selection for specific agro-ecosystem is a pre-requisite, especially for the prevailing non-automated greenhouse of plains such as naturally ventilated polyhouse or shade net houses of which the inside environment is greatly influenced by the ambient ones.

[10] reported that crop production under naturally ventilated structures is necessary to replace less productive, conventional crop production in the open field. The structure protects the crop against damage by environmental stress, high rainfall, strong wind, extreme solar radiation, weed growth, insects, and diseases. In addition, protected structures create an in-house micro-climate condition for crop physiological and agronomics requirements. The important parameters under the structure viz. temperature, humidity, light intensity, carbon dioxide concentration, oxygen level, ventilation rate, and crop water requirement give crops better growth, high yield, and quality. In crops like a pointed gourd, merely providing a specified climate for the crop is not sufficient because other factors like sex expression and pollination especially honeybee vector are also known to have a decisive role in successful production with enhanced productivity. Very few or even negligible reports are available on pointed gourd production under the protected condition in India. Hence the present study was undertaken to identify a suitable pointed gourd for early summer season production, based on different vegetative and reproductive growth, under naturally ventilated polyhouse conditions of the eastern part of India by keeping honeybee boxes inside to facilitate pollination.

MATERIAL AND METHODOLOGY

Five popular varieties of a pointed gourd (SwarnaRekha, SwarnaAlaukik, KashiAlankar Rajendra Parwal-1, and Rajendra Parwal-2) were evaluated under naturally ventilated polyhouse at the Hi-tech Horticulture unit of RPCAU, Pusa during three years (2018-19 to 2020-21). The experimental site is situated at 25.98° N latitude and 85.68° E longitude with an altitude of 52.0 m above MSL. The soil of the experimental field is deep and comes under the soil order *Entisols*. It is loamy sand in texture, whitish-brown in color, and alkaline in the reaction due to the presence of excess (23.62 %) free CaCO₃ in surface soil. At the time of field preparation surface soil samples (0-0.15m) were taken and processed for the analysis of the initial soil properties in the laboratory. The pH of the experimental field was 7.94 to 8.12, EC 0.46 to 0.53 dSm⁻¹, CEC (c mol (p+) kg⁻¹) 11.26 to 13.14 and organic carbon was 0.36%. The N statuses of the experimental field were low (184 to 206 kg ha⁻¹), low in available P (18.40 to 20.14

kg ha⁻¹), and medium in available K status (143.2 to 157.4 kg ha⁻¹). The size of the polyhouse was 500 sq.m covered with ultraviolet stabilized low-density polyethylene sheet having 200 micron thickness. The female and male plant populations in the experimental field were maintained in a ratio of 10:2 to ensure effective pollination. Normal Indian bees and stingless bees were kept inside polyhouse (the colony had an exit to both outsides as well as inside) to facilitate pollination. The crop was raised organically or without using plant protection chemicals that are detrimental to the bee population.

Two bees colonies were also kept on the boundary of the side ventilation of the polyhouse to facilitate pollination. The climate of the region is subtropical, warm, and humid. The average annual rainfall varies from 125 to 150 cm and temperature 5.70 to 45.80C during the year. The relative humidity varies from 50 to 90 percent and the sunshine hour varies from 10 to 12 hours.

The vine cuttings (50-60 cm long) were planted during the month of October 2017 and the same crop was taken in the second and third years. The experiment was laid out in randomized block design with four replication, the plot size of 2.0 sq m per variety, and row-to-plant distance was maintained at a spacing of 60 x 45 cm. Thirteen yields and their contributing characters were scored on the individual variety for the following recorded traits and procedures.

Observational procedure: The number of days taken from the date of sprouting to the date of the first female flower anthesis was observed in all the five selected plants from each treatment and their average was calculated. The node at which the first female flower appeared was counted from the base of the plant on each plant and the average was calculated. A number of days from the date of sprouting to the date when the first fruit was harvested were recorded and averaged. The branches arising from the base of the plant or from the main stem were considered primary branches or vines. The number was recorded while measuring the length of vines at the end of flowering and averaged from five plants. The distance between two nodes of the plant is called inter-nodal length. The length of five inter-nodes in one variety was measured randomly at the full foliage stage and the average was determined.

The trait was recorded by measuring the length of the main vine from the base of the plant up to the tip at the time of the last fruit harvest in meters on five plants with the help of a meter scale and the average was determined. The total number of nodes on the main vine of the plant was recorded for the five plants in each treatment and the average was calculated. Five fruits were randomly taken from each variety (the same five fruits selected for fruit length, fruit diameter, and fruit weight) at edible maturity of 8th harvesting and their mean was measured. The number of fruits per plant was obtained by adding the number of fruits of all pickings from all five plants in each treatment and the average was calculated for the number of fruits per plant. The total edible green fruit yield over all the pickings was recorded and yield per plant was obtained after dividing the total yield by a number of plants and expressed in kilograms. The average fruit yield per plant overall picking was calculated and multiplied with a number of female plants/1000 sq.m to get fruit yield per 1000 sq.m (t).

All the cultural practices including irrigation and hoeing were carried out, following the standard commercial procedures. Spraying for pests and diseases was applied whenever it appeared necessary throughout the growing season. The collected data were subjected to Analysis of Variance (ANOVA) using MS-Excel, OP-STAT software available from HAU, Hisar, and presented in tables [11].

RESULT AND DISCUSSIONS

There was a significant variation for different flowering and maturity characters, plant architectural characters and fruit, and yield characters among the pointed gourd varieties evaluated under polyhouse.

Flowering and maturity characters

There was a significant variation for different flowering and maturity characters among the pointed gourd varieties evaluated under polyhouse in the different years (Table 1). In the three years pooled data days to female flowering ranged from 52.89 to 62.99 days and Rajendra Parwal-2 (52.89) was the earliest followed by SwarnaRekha (54.71) and KashiAlankar (53.65), whereas the variety SwarnaAlaukik (62.99) took the highest number

Table1: Performance of pointed gourd varieties for flowering and maturity characters under naturally ventilated polyhouse.

Variety	Days to first female flowering				No. of nodes at first flowering				Days to first harvesting			
	2018-19	2019-20	2020-21	Pooled	2018-19	2019-20	2020-21	Pooled	2018-19	2019-20	2020-21	Pooled
Swarna Rekha	50.35	53.68	60.10	54.71	6.83	7.25	8.15	7.41	61.83	70.56	64.02	65.47
Swarna Alaukik	58.94	69.14	60.89	62.99	9.93	11.57	10.03	10.51	69.75	82.02	72.27	74.68
KashiAlankar	50.55	57.82	52.58	53.65	5.77	6.66	5.90	6.11	60.93	63.65	70.06	64.88
Rajendra Parwal-1	56.66	53.50	63.87	58.01	7.72	7.80	9.02	8.18	67.45	80.32	71.77	73.18
Rajendra Parwal-2	48.78	58.17	51.72	52.89	7.11	8.27	7.39	7.59	62.78	65.61	73.15	67.18
Grand Mean	53.06	58.46	57.83	56.45	7.47	8.31	8.10	7.96	64.55	72.43	70.25	69.08
Sem+	0.565	1.520	0.677	0.754	0.318	0.341	0.375	0.381	1.801	1.482	0.998	0.737
CD0.05	1.870	4.993	2.240	2.495	1.052	1.153	1.241	1.261	5.961	4.897	3.303	2.439
CV%	8.123	7.700	9.324	8.642	7.523	7.640	11.246	6.879	8.149	6.199	8.521	7.335

of days to first female flowering. Variation in the flowering of pointed gourd was also observed by [22] A number of nodes at first flowering ranged from 6.11 to 10.51 and KashiAlankar (6.11) produced the first flower at the lowest node number which was significantly superior over other varieties followed by SwarnaRekha (7.41) and Rajendra Parwal-2 (7.59), whereas the variety SwarnaAlaukik (10.51) produced its first flower at highest node number. This result is in agreement with the finding of [1]. Days to first harvesting varied from 64.88 to 74.68 days and KashiAlankar (64.88) was the earliest in days to first harvesting and at par with SwarnaRekha (65.47), whereas the variety SwarnaAlaukik (74.68) took the highest number of days to first harvesting. These findings are in proximity with the results of in the pointed gourd.

Plant architectural characters

The non-significant difference in a number of primary branches was recorded in the three years of pooled data presented in Table-2, although a number of primary branches ranged from 6.11 to 7.39 and KashiAlankar (7.52) produced more primary branches whereas the variety SwarnaAlaukik (6.11) produced less number of primary branches. SwarnaRekha (8.26 cm) and KashiAlankar (8.45 cm) recorded significantly shorter inter-nodal lengths whereas SwarnaAlaukik (11.78 cm) recorded significantly longer inter-nodal lengths. [23] also reported a wide range of variability in the inter-nodal length of the pointed gourd. Among all the five varieties SwarnaRekha (7.76 m) recorded significantly

longest vine length and was found to be at par with KashiAlankar (7.58m) and Rajendra Parwal-1 (7.10m) while SwarnaAlaukik (6.21m) recorded shorter vine length. This happens due to the stimulation of cellular expansion and cell division more by SwarnaRekha variety than other varieties under protected conditions. Similar results were reported by [21] [9] in sweet pepper.

Nodes per vine ranged from 55.84 to 83.88 and KashiAlankar (70.55) produced the highest node per vine and was found to be at par with Rajendra Parwal-1 (68.51) and KashiAlankar (65.31) whereas the variety SwarnaAlaukik (55.84) produced lower node per vine. Previous workers have also reported a significant variation in shoot growth including vine length and nodes per vine [27] [6]. In some instances, vine length has been found to be associated with nodes per vine and/ or internodal length as reported by [3] in the pointed gourd. This was due to the better assimilative power of the SwarnaRekha and KashiAlankar grown under insect-proof net house compared to other varieties and the results are in agreement with the work done by [26] in parental lines of pumpkin Pusa Hybrid-1. A similar result was also reported by [13]. The capacity of SwarnaRekha variety to perceive and adapt to changing light conditions is critical to the growth and development of photosynthetic organisms. Light quality and quantity can vary due to canopy of the plant [17].

Fruit and yield characters

There was a significant variation in fruit length,

Table2: Performance of pointed gourd varieties for plant architectural characters under naturally ventilated polyhouse.

Variety	No. of primary branches				Internodal length (cm)				Vine length (m)				Nodes per vine			
	2018-19	2019-20	2020-21	Pooled	2018-19	2019-20	2020-21	Pooled	2018-19	2019-20	2020-21	Pooled	2018-19	2019-20	2020-21	Pooled
Swarna Rekha	6.83	7.19	8.15	7.39	7.94	8.39	8.44	8.26	7.17	7.59	8.52	7.76	68.74	72.3	70.6	70.55
Swarna Alaukik	5.63	5.99	6.70	6.11	11.63	11.56	12.16	11.78	5.80	6.00	6.83	6.21	52.18	60.86	54.48	55.84
KashiAlankar	7.02	7.26	8.28	7.52	8.19	8.48	8.67	8.45	7.01	7.38	8.35	7.58	61.69	63.14	71.10	65.31
Rajendra Parwal-1	6.38	6.71	7.46	6.85	9.01	9.72	9.82	9.52	6.64	6.82	7.78	7.08	64.10	75.20	66.23	68.51
Rajendra Parwal-2	6.16	6.43	7.06	6.55	10.22	10.91	10.74	10.62	6.51	6.66	7.50	6.89	60.12	61.41	69.87	63.60
Grand Mean	6.40	7.01	7.24	6.88	10.4	10.41	10.77	10.53	6.63	7.25	7.44	7.10	63.37	68.58	70.46	67.43
Sem+	0.326	0.512	0.268	0.427	0.398	0.432	0.421	0.426	0.310	0.278	0.291	0.210	2.241	2.354	2.563	1.909
CD0.05	NS	NS	0.886	NS	1.317	1.425	1.393	1.410	1.026	0.920	0.962	0.695	7.395	7.791	8.463	6.318
CV%	9.245	8.249	6.503	11.254	9.341	8.514	7.124	13.998	8.641	9.241	7.084	18.29	7.234	11.0123	6.553	10.463

Table3: Performance of pointed gourd varieties for fruit length, fruit diameter and average fruit weight under naturally ventilated polyhouse.

Variety	Fruit length (cm)				Fruit diameter (cm)				Average fruit weight (g)			
	2018-19	2019-20	2020-21	Pooled	2018-19	2019-20	2020-21	Pooled	2018-19	2019-20	2020-21	Pooled
Swarna Rekha	8.24	8.70	9.79	8.91	3.54	3.68	4.06	3.76	44.01	46.18	52.13	47.44
Swarna Alaukik	6.33	7.38	6.66	6.79	2.79	3.32	2.95	3.02	29.60	34.07	30.89	31.52
KashiAlankar	8.42	8.83	9.87	9.04	3.66	3.78	4.32	3.92	35.58	41.35	44.39	40.44
Rajendra Parwal-1	9.07	10.39	9.46	9.64	3.33	3.90	3.51	3.58	39.45	46.06	41.54	42.35
Rajendra Parwal-2	7.47	7.77	8.55	7.93	3.53	3.67	4.02	3.74	34.16	35.91	40.36	36.81
Grand Mean	7.91	8.61	8.87	8.46				3.60				39.71
Sem+	0.301	0.291	0.271	0.213	0.112	0.129	0.123	0.061	1.631	1.462	1.491	1.513
CD0.05	0.996	0.962	0.897	0.702	0.370	0.428	0.407	0.201	5.398	4.845	4.935	5.008
CV%	7.249	5.947	9.124	17.91	7.956	6.207	10.245	9.229	7.246	6.381	8.714	13.412

fruit diameter, and average fruit weight characters among the pointed gourd varieties in the three years of pooled data (Table 3). A wide range of variation (6.79 to 9.64 cm) was recorded for fruit length and the longest fruit was observed in Rajendra Parwal-1 (9.64 cm) followed by KashiAlankar (9.04 cm) while the shortest fruit was observed in SwarnaAlaukik (6.79 cm). Fruit diameter ranged from 3.02 to 3.92 cm with maximum fruit diameter recorded in KashiAlankar (3.92 cm) followed by SwarnaRekha (3.76), Rajendra Parwal-2 (3.74 cm) in descending order, whereas minimum fruit diameter was found in SwarnaAlaukik (3.02 cm). Among all the five varieties tested, the variety SwarnaRekha (47.44 g) recorded a significantly higher average fruit weight and the variety Rajendra Parwal-2 (36.81g) recorded a significantly lower average fruit weight (Table-3). Similar findings were reported by [3]. The higher

average fruit weight recorded by SwarnaRekha variety under a naturally ventilated house may be due to better photosynthetic efficiency in comparison to other varieties and an increased quantity of chlorophyll [7] [9]

Pointed gourd fruit yield significantly varied among the varieties in the three years of pooled data (Table 4). Increasing trends were observed in characters like the number of fruits per plant, fruit weight per plant, and fruit yield per 1000 sq.m from the year 2016-17 to 2018-19 because plants were in their second and third years. Pointed gourd plants give better results in 2nd year, the 3rd year, and yield decline 4th year onwards [18] Swarna Rekha variety (279.85) recorded significantly more fruits per plant while SwarnaAlaukik (189.31) recorded a significantly less number of fruits per plant. SwarnaRekha

Table4: Performance of pointed gourd varieties for Fruit and yield characters under naturally ventilated polyhouse.

Variety	No. of fruits per plant				Fruit weight per plant (kg)				Fruit yield per 1000 sq.m (t)			
	2018-19	2019-20	2020-21	Pooled	2018-19	2019-20	2020-21	Pooled	2018-19	2019-20	2020-21	Pooled
Swarna Rekha	261.52	273.33	304.70	279.85	6.94	7.26	8.09	7.43	3.260	3.336	3.757	3.451
Swarna Alaukik	178.81	183.00	206.12	189.31	4.65	5.46	4.86	4.99	2.569	2.632	2.968	2.723
KashiAlankar	224.00	228.98	258.47	237.15	5.98	6.38	7.17	6.51	2.911	3.049	3.394	3.118
Rajendra Parwal-1	215.86	220.84	252.86	230.52	6.29	6.44	7.13	6.62	2.893	3.026	3.366	3.095
Rajendra Parwal-2	194.83	204.50	230.76	210.03	5.17	5.83	6.46	5.62	2.584	2.694	2.969	2.749
Grand Mean	215.00	233.16	239.55	229.37	5.81	6.41	6.60	6.23	2.843	3.083	3.156	3.027
Sem+	8.914	9.136	9.210	9.132	0.251	0.242	0.301	0.241	0.987	1.089	1.012	0.757
CD(0.05)	29.505	30.73	30.485	30.226	0.830	0.798	0.996	0.797	.326	.3601	.3349	.2505
CV%	7.541	6.895	7.456	9.706	11.021	6.401	9.451	8.680	9.241	6.291	8.214	7.561



Pictorial View of experiments

variety (7.43 Kg) recorded significantly higher fruit weight per plant while SwarnaAlaukik (4.99 Kg) recorded significantly lower fruit weight per plant. SwarnaRekha variety (3.45 t) recorded significantly higher fruit yield per 1000 sq.m while SwarnaAlaukik (2.72 t) recorded significantly lower fruit yield per 1000 sq.m (Table-4). Basically, cucurbits have a tendency to produce more male flowers than female flowers. The proportion of male flowers to female flowers varies from 10:1 to 25-30:1 among the cucurbits. The higher number of female and male flowers in insect-proof net houses might be due to optimum temperature, light intensity, relative humidity, and very low incidence of insects and diseases that might result in better growth and flowering [13]. Previous studies have also shown a wide variation in fruit yield among the tested greenhouse cucumber hybrids, and variation in yield was likely due to genotypic makeup of a particular hybrid

that is expressed in a particular environment [27] [6] According to [14] fruit yield is directly influenced by certain yield-attributing traits including a number of fruits and fruit weight; these may vary depending upon the genetic potential of the hybrids and climatic conditions in which they are grown. The highest fruit yield recorded in SwarnaRekha which was possibly ascribed to the highest fruit number and mean fruit weight. This finding is corroborated by the earlier studies on polyhouse cucumber [5] [6]

CONCLUSIONS

Based on three years of data for a targeted character for yield and its related traits of evaluated pointed gourd varieties, it is concluded that SwarnaRekha variety was found suitable for production under naturally ventilated polyhouse conditions by keeping honeybee boxes in the eastern part of India.

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