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Studies on genetic variability, heritability and genetic advance in pointed gourd (*Trichosanthes dioica* Roxb.)

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Abstract
The present investigation was carried out at Vegetable Research Centre of Bihar Agricultural University, Sabour, Bhagalpur, India during *Kharif* seasons of 2014 in a Randomized Block Design with three replications to explore the variability among the genotypes. Fifteen parameters *viz*, days to first flowering, number of nodes at first harvest, inter nodal length at first harvest, vine length at first harvest, days to first harvest, fruit length, fruit diameter, number of seeds per fruit, seed weight per fruit, pulp weight per fruit, pulp: seed ratio, average fruit weight, number of fruits per plant, weight of fruit per plant and yield of fruit per hectare were taken under consideration to diagnose the variability. Analysis of variance revealed significant differences among genotypes for all the characters. In general, PCV was marginally higher than the corresponding GCV indicated the less influence of environment in the expression of the characters under study. High heritability coupled with high genetic advance as percentage of mean was observed for yield of fruit, number of fruits per plant, pulp weight per fruit, number of seeds per fruit, inter nodal length at first harvest and average fruit weight indicated that these characters were mainly controlled by additive gene effects and thus selection may be rewarding for the further improvement.

Keywords: Pointed gourd, genetic variability, heritability, genetic advance

Introduction
Trichosanthes dioica Roxb (2n=2x=22), locally known as parval and patal is a highly cross pollinated dioeceous vegetable crop originated in India. The fruit of pointed gourd is easily digestible, diuretic and laxative. It revitalizes the heart and brain and considered useful in disorders of the circulatory system (Malek, 2009) [6]. It is an important cucurbitaceous vegetable extensively cultivated during summer in eastern Bihar, Uttar Pradesh, West Bengal, Assam and lesser part in Odisha, Maharashtra and Gujarat (Nath and Subramanayam, 1972) [7]. It is a perennial crop but cultivated as annual on diara region, where flood is common feature during rainy season and recognized as Green Potato and Green Gold of Diara land. The productivity of the crop is very low at the national level. Out of several factors responsible for this low yield, the lack of high yielding varieties is the most important one due to which the farmers are bound to grow traditional one of low yielding potential.

Formulation of successful breeding programme for evolving superior cultivar requires the knowledge of nature and magnitude of genotypic and phenotypic variability present in any crop species. The genetic improvement of quantitative characters depends on the magnitude of genetic variability existing in the germplasms and the extent to which the desirable characters are heritable however, the nature and extent of variability attributed due to different causes, sensitive nature of the crop to environmental influences, heritability of the characters and genetic advance that can be realized in practical breeding in evolving varieties to various environmental conditions can be accessed through genetic variability analysis. Genetic variability is essential in order to realize response to selection pressure in successful breeding programme. The determination of genetic variability and partitioning it into heritable and non-heritable components using the genetic parameters viz., phenotypic and genotypic coefficients of variation (GCV and PCV), heritability and genetic advance is necessary to have an insight into genetic nature of yield and its components on which selection can be effectively carried out. Character like yield is complex in inheritance and is improved through its component traits. High yield can be achieved by selection of those yield contributing characters that have high heritability coupled with high genetic advance. Germplasm is an indispensible material to

vegetable breeders, which plays a key role for genetic improvement of any crop. Inbred line development is an important means of new germplasm development. In pointed gourd, fruit yield is a complex quantitative trait as it is governed by a large number of genes and considerably affected by the environment.

Hence, selection of lines based only on yield is not effective but the components of variability in yield and its components will also enable us to know the extent of environmental influence on yield. Efficient selection for yield in crops requires the estimation of genetic parameters for the strategic planning and allocation of limited resources. Improvement of complex characters such as yield may be accomplished through the component approach of breeding. Investigation of the interrelationships among growth, earliness and yield related attributes will improve the efficiency of a breeding programme with appropriate selection criteria. Meagre genetic information is available on improvement for yield in pointed gourd. Keeping the above facts in view the present investigation was undertaken to study the genetic variability, heritability and genetic advance in Pointed Gourd.

Materials and Methods

The experiment was carried out during *Kharif* season of 2014 at Vegetable Research Farm of Bihar Agricultural University, Sabour, Bhagalpur, situated between 25^0 50' N latitude and $87^0$19' longitude at an altitude of 52.73 meter above mean sea level. The centre enjoys the sub tropical climate often subjected to extremes cold winter and hot summer. Twenty six diverse genotypes of pointed gourd were collected from different parts of Bihar and Uttar Pradesh and the experiment was laid out in Randomised Block Design replicated thrice. The germplasms were planted at 2.0 m row to row and 1.0 m plant to plant spacing. The Pits of 30 x 30 x 30 cm size were dug and filled with soil, FYM and Ganga sand mixed in equal proportion. Manures and fertilizers were applied as per recommendation of Govt. of Bihar for Zone II & III. Nitrogen, Phosphorus and Potassium @ 90, 60 and 60 kg/ha, respectively were applied in the form of Urea, Single Super Phosphate (SSP) and Muriate of Potash (MOP). Besides, Neem cake @ 200g and Phorate 10G @ 2g per pit were also applied to save the vines inside the soil. Permanent iron logs of 7ft height were used to support the plants and the plants were allowed to creep on Iron trellis connected with iron wires at 2ft spacing along the height. All the recommended cultural and plant protection measures were adopted for a healthy and successful crop. The female and male plant population in the experimental field were maintained in the ratio of 10:1 to ensure effective pollination. The data were recorded on Days to first flowering, Number of nodes at first harvest, Inter Nodal length at first harvest, Vine length at first harvest, Days to first harvest, Fruit length (cm), Fruit diameter (cm), Number of Seeds Per fruit, Seed weight per fruit (g), Pulp weight per fruit (g), Pulp : Seed ratio, Average Fruit Weight (g), Number of fruits per plant, Weight of fruit per plant (g) and Yield of fruit (q/ha).

Results and Discussion

The analyses of variance for fifteen characters of twenty six genotypes of pointed gourd are presented in table 1. Highly significant differences were observed among the genotypes for all the characters indicating presence of large amount of variability in all the characters studied. Wide range of variation observed for all the characters. Components of variation estimated for all the traits indicated wide range of variability in Days to first flowering (137.33-173.00), Number of node at first harvest (29.11-38.33), Inter nodal length at first harvest (6.32-13.67), Vine length at first harvest(1.15-3.36), Days to first harvest (153.00-183.67), Fruit length (4.32-8.70cm), Fruit breadth (2.67-3.67cm), Number of seeds per fruit(12.99-25.66), Seed weight per fruit (2.25-3.37 g), Pulp weight Per fruit (22.60-43.09) g, Pulp : seed ratio (7.30-14.30), Average fruit weight(25.67-45.67g), Number of fruits per plant (44.11-148.33), Weight of fruit per plant (1.76-5.06g),Yield of fruit (85.83-250.00q/ha)which indicated that there is better scope for selection for the improvement of these characters. These findings are in proximity with the results of Singh *et al.,* (1985), Yawalkar (1985) [12], Shanmugavelu (1989), Singh and Prasad (1989) [10], Prasad and Singh (1990) [8], Dora *et al*., (2002) [2], khan *et al.,* (2009) [5] and Bharathi and Vishalnath (2010a) [1] in pointed gourd. The phenotypic variance (σ2p) and phenotypic coefficient of variation (PCV) were slightly higher than corresponding genotypic variance (σ2g) and genotypic coefficient of variation (GCV) for most of the characters indicated the presence of less environmental effect upon the concerned characters. The genetic parameters *viz*., genotypic and phenotypic coefficients of variation, heritability in broad sense and genetic advance along with mean and range of different characters are presented in table 2. High magnitude of GCV as well as PCV were recorded for traits *viz*., Yield of fruit (29.60 and 30.04), Number of fruits per plant (25.86 and 25.38), Vine length at first harvest (25.65 and 25.48), Weight of fruit per plant (23.21 and 24.38) and Number of seeds per fruit (22.21 and 23.80). Moderate GCV and PCV were recorded for Inter nodal length at first harvest(19.02 and 19.86), Fruit length (16.54 and 17.72), Pulp: seed ratio (15.08 and 15.99), Pulp weight Per fruit (14.86 and 16.02), Average fruit weight (13.24 and 14.82), Fruit breadth (10.32 and 11.58),Seed weight per fruit (7.02 and 9.45), Number of node at first harvest (5.88 and 8.59), Days to first flowering(3.68 and 7.89) and Days to first harvest (3.19 and 6.84), suggested existence of considerable variability in the population. Selection for these traits may also be given the importance for improvement programme. Jena *et al.* (2017) [3] have also reported the higher magnitude of PCV than the corresponding GCV for all the seventeen characters studied in pointed gourd. In the present investigation high magnitude of heritability was recorded for all the characters under the study. The highest heritability was recorded for yield of fruit (97.0%) and Number of fruits per plant (96.0%) followed by Vine length at first harvest (94.0%), Inter nodal length at first harvest (92.0%), Weight of fruit per plant (91.0%), Pulp : seed ratio (89.0%), Number of seeds per fruit (87.0%), Fruit length (87.0%), Pulp weight Per fruit (86.0%), Average fruit weight (80.0%), Fruit breadth (79.0%), Seed weight per fruit (55.0%), Number of node at first harvest (47.0%), Days to first harvest (22.0%) and Days to first flowering (22.0%). High heritability coupled with greater genetic advance was also observed for a number of fruit per plant and fruit yield per hectare (Verma *et al.,* 2017) [11]

Genetic advance as percentage of mean was observed high for all the characters under the study *viz*., Yield of fruit (60.08%), Number of fruits per plant (51.31%), Vine length at first harvest (49.11%), Weight of fruit per plant (45.53%), Number of seeds per fruit (42.69%), Inter nodal length at first harvest (37.52%), Fruit length (31.79%), Pulp : seed ratio (29.3%), Pulp weight Per fruit (28.4%), Average fruit weight (24.39%), Fruit breadth (18.94%), Seed weight per fruit (10.74%),

Number of node at first harvest (8.29%), Days to first harvest (3.07%) and Days to first flowering (3.54%)

Heritability estimate provide the information regarding the amount of transmissible genetic variation to total variation and determine genetic improvement and response to selection. Heritability estimate along genetic advance are normally more useful in predicting the gain under selection than that of heritability alone. However, it is not necessary that characters showing high heritability will also exhibit high genetic advance (Johnson *et al*., 1955) [4]. Heritability estimates along with genetic advance are more useful than the heritability value alone for selecting the best individual. High heritability coupled with high genetic advance as percentage of mean was observed for Yield of fruit, Number of fruits per plant, Pulp weight Per fruit, Number of seeds per fruit, Inter nodal length at first harvest and Average fruit weight indicated that these characters were mainly controlled by additive gene effects and thus selection may be rewarding for the further improvement of these traits. Moderate genetic advance as per cent of mean with high or moderate heritability indicates the action of both additive and non-additive genes as in case of Vine length at first harvest, Fruit length, Fruit breadth, Pulp weight Per fruit, Pulp : seed ratio and Weight of fruit per plant

Table 1: Analysis of variance for 15 quantitative traits in 26 genotypes of pointed gourd

S. No.	Character	Mean sum of squares		
		Replications (df = 2)	Treatments (df = 25)	Error (df = 50)
1.	Days to first flowering	3.4744	195.9138*	106.6477
2.	Number of node at first harvest	0.0904	15.7013**	4.3035
3.	Inter nodal length at first harvest	0.0315	8.9642**	0.2631
4.	Vine length at first harvest	0.0009	0.7732**	0.0174
5.	Days to first harvest	3.1154	176.1318*	96.0487
6.	Fruit length (cm)	0.0035	4.3432**	0.2047
7.	Fruit breadth (cm)	0.0021	0.3323**	0.0264
8.	Number of seeds per fruit	0.9704	55.9430**	2.6384
9.	Seed weight per fruit (g)	0.0153	0.1661**	0.0354
10.	Pulp weight Per fruit (g)	0.2635	85.4196**	4.3787
11.	Pulp : seed ratio	0.3580	10.0556**	0.4005
12.	Average fruit weight (g)	0.6337	81.5640**	6.3080
13.	Number of fruits per plant	19.5042	1711.7349**	21.6031
14.	Weight of fruit per plant (g)	0.0301	1.5486**	0.0513
15.	Yield of fruit (q/ha)	4.0212	5490.1719**	54.1040

Table 2: Estimates of variability, heritability and genetic advance as per cent of mean for 15 quantitative characters in 26 genotypes of Pointedgourd

No.	Character	Range		Mean	Variance		PCV (%)	GCV (%)	h^2b (%)	Genetic Advance	GA as percent of mean
		Minimum	Maximum		Phenotypic	Genotypic					
1	Days to first flowering	137.33	173.00	148.10	136.40	29.76	7.89	3.68	22	5.25	3.54
2	Number of node at first harvest	29.11	38.33	33.15	8.10	3.80	8.59	5.88	47	2.75	8.29
3	Inter nodal length at first harvest	6.32	13.67	8.95	3.16	2.90	19.86	19.02	92	3.36	37.52
4	Vine length at first harvest	1.15	3.36	2.04	0.27	0.25	25.48	24.65	94	1.00	49.11
5	Days to first harvest	153.00	183.67	161.88	122.74	26.69	6.84	3.19	22	4.96	3.07
6	Fruit length (cm)	4.32	8.70	7.10	1.58	1.38	17.72	16.54	87	2.26	31.79
7	Fruit breadth (cm)	2.67	3.67	3.10	0.13	0.10	11.58	10.32	79	0.59	18.94
8	Number of seeds per fruit	12.99	25.66	18.98	20.41	17.77	23.80	22.21	87	8.10	42.69
9	Seed weight per fruit (g)	2.25	3.37	2.97	0.08	0.04	9.45	7.02	55	0.32	10.74
10	Pulp weight Per fruit (g)	22.60	43.09	34.97	31.39	27.01	16.02	14.86	86	9.93	28.40
11	Pulp : seed ratio	7.30	14.30	11.90	3.62	3.22	15.99	15.08	89	3.49	29.30
12	Average fruit weight (g)	25.67	45.67	37.82	31.39	25.09	14.82	13.24	80	9.22	24.39
13	Number of fruits per plant	44.11	148.33	93.53	584.98	563.38	25.86	25.38	96	47.98	51.31
14	Weight of fruit per plant (g)	1.76	5.06	3.04	0.55	0.50	24.38	23.21	91	1.39	45.53
15	Yield of fruit (q/ha)	85.83	250.00	143.82	1866.13	1812.02	30.04	29.60	97	86.41	60.08

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