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Assessment of genetic variability for fruit yield and quality traits in cucumber (*Cucumis sativus* L.) in eastern coastal plains of Odisha

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Abstract
The experiment was conducted in Randomized Block Design with three replications to assess the performance of 32 genotypes of cucumber to determine PCV, GCV, heritability and genetic advance as percentage of mean for various horticultural traits. The analysis of variance revealed significant differences among the genotypes for all the characters. The estimates of phenotypic coefficients of variation (PCV) were higher than genotypic coefficients of variation (GCV) for all the characters and there was narrow difference between GCV and PCV for total soluble solids, shelf life, node at which first female flower appears, number of days to first female flower production, days to first harvest, fruit length, fruit diameter, severity of downy mildew percentage and fruit yield per vine, implying that greater role was played by genotype rather than environment for expression of these characters. Moderate GCV and PCV were observed for node at which first female flower appears, shelf life, number of fruits per plant, fruit diameter and number of days to first female flower production. High GCV and PCV were observed for fruit yield per vine, average fruit weight, vine length, severity of downy mildew percentage and total soluble solids. It was observed that high heritability along with high to moderate genetic advance was observed for most of the characteristics. High genetic advance as percent of mean was observed fruit yield per vine, average fruit weight, total soluble solids, vine length, severity of downy mildew percentage and node at which first female flower appears, shelf life, number of fruits per plant, fruit length and fruit diameter.

Keywords: Cucumber, variability, heritability and genetic advance as percentage of mean

Introduction
Cucumber (*Cucumis sativus* L.) is an important member of the family Cucurbitaceae, with a chromosome number 2n = 14, which comprises of 117 genera and 825 species in warmer parts of the world. *Cucumis sativus* var. *hardwickii* is progenitor of cultivated cucumber (Gopalakrishnan, 2007) [6]. It is considered to have been originated from India and China is believed to be the secondary center of diversity. Generally, the tender fruits are used as salad ingredient, as a desert and pickles, cooked as vegetables and eaten raw with salt and pepper. It is grown primarily for fresh market (slicing) as well as for processing (pickling). It provides cooling effect prevents constipation and is also used as an antipyretic and astringent. The seeds are rich in protein and edible oil which are helpful for development of brain and body smoothness (Bhagat *et al.*, 2018) [1]. Cucumber juice is important medicinal food in treatment of the hyperacidity, gastric and duodenum ulcer and also useful in jaundice. In addition to this, cucumber has soothing and softening properties of fruits that are important for the cosmetic and soap industries (Wang *et al.*, 2007) [16]. On the basis of flowering habit, cucumber has three types- 'gynoecious' which produces only female flowers, 'predominantly gynoecious' which also bears some male flowers and 'monoecious' which produces both male and female flowers. Gynoecious and predominantly gynoecious produce fruits parthenocarpically *i.e.*, fruit development takes place without pollination whereas, pollination is required by monoecious types for seed development which is accomplished by honey bees (Mehdi *et al.*, 2012) [13]. Inspite of the extensive cultivation and consumption cucumbers have not much been taken up for systematic research work in order to understand the genetic architecture and endeavor in crop improvement programs in India. In India cucumber occupies 1,16,000 ha with a production of 16,08,000 MT. In Odisha, cucumbers are grown in an area of 3.29 million hectares with an annual production of 54.63 million tonnes (Indiastat, 2021-22) [7].

Inspite of the extensive cultivation and consumption cucumbers have not much been taken up for systematic research work in order to understand the genetic architecture and endeavor in crop improvement programs in India. Variability is the pre- requisite for starting any crop improvement programme. The development of promising genotypes is primarily based on the magnitude of genetic variability existing for the desired character. Improvement in the productivity in order to keep pace with increasing demand of country is the new at present. Crop improvement depends on the magnitude of genetic variability and extent to which desirable character are heritable. Thus, the study of genetic variability is having much importance for breeders in making the final selection of genotype for yield improvement. In view of this, present investigation was undertaken in cucumber to gather information on yield and yield components and selection of suitable cucumber types for Odisha conditions.

Materials and Methods

The experiment was conducted at the experimental field of Department of Vegetable Science, OUAT, Bhubaneswar, Odisha. The experimental materials comprised of 32 genotypes of Cucumber viz., Special Machar sasa, Tejas, Nandini, Khirasagar, Varshamangalam, Sachin, Barsamongal, Barsha, Bharatmata, Pant khira – 1, Rain special, Duranta, Barsha mangalsasha, Gautam-910, Saptarishi, Green long S-82, 12 pata sasa, Shubra, Rajamata, Barsha Rani, Swarn Sheetal, Sagar, Banki local, Kalpataru Sasa improve, Gangothri, Green long, Adimata, Kheera haralamba, Basumathi, Barshalaxmi, Mahaprasad and Priya collected from different parts of India. The experimental was laid out in Randomized Block Design and each treatment was replicated three times with a spacing of 120 cm between pit to pit and 150 cm between row to row. All essential cultural practices were observed to maintain uniform crop in each treatment per replication. All suggested package of practices were followed to raise the crop. The observation was recorded on five randomly selected plants per treatment from each replication for 12 quantitative and qualitative traits, viz., node at which first female flower appears, number of days to first female flower production, days to first harvest, fruit length (cm), fruit diameter (cm), average fruit weight (g), number of fruits per plant, vine length (m), TSS (^{0}B), shelf life (days), severity of downy mildew (%) and fruit yield per vine (kg).

The data were subjected to analysis of variance as per procedure described by Gomez and Gomez (1983) [5]. The genotypic and phenotypic coefficients of variation were calculated as per formulae given by Burton (1952) [3]. Heritability was calculated according to Lush (1949) [12] and De Vance (1953) [2] and expressed in percentage according to Weber and Moorty (1952) [17], genetic advance as percent of mean was estimated as per the method given by Johanson *et al.* (1955) [8].

Results and Discussion

Table 1: Analysis of variance (mean sum of squares) for 12 characters of 32 genotypes of cucumber

Sl.no	Characters	Mean sum of squares		
		Replications	Genotypes	Error
1.	Node at which first female flower appears	0.108	3.134**	0.16
2.	Number of days to 1st female flower production	1.022	60.902**	6.501
3.	Days to first harvest	11.127	65.452**	10.979
4.	Fruit length (cm)	1.326	13.156**	1.42
5.	Fruit diameter (cm)	0.0890	0.89**	0.12
6.	Average fruit weight (g)	42.265	4095.526**	272.611
7.	Number of fruits per plant	0.017	6.188**	0.741
8.	Vine length (m)	0.0010	0.753**	0.058
9.	Total soluble solids (^{0}B)	0.046	1.683**	0.023
10.	Shelf life (Days)	0.019	3.108**	0.088
11.	Severity of downy mildew (%)	1.256	38.985**	2.491
12.	Fruit yield per vine (Kg)	0.0080	0.777**	0.031

*Significant at 5%, ** significant at 1% level, respectively

Genetic variability is the basic need for a plant breeder to initiate any breeding programme. Genetic improvement can be brought about by manipulating the genetic makeup of the plant for desirable characters or to remove the undesirable genes which retard, or inhibit, certain pathways. Analysis of variance (Table 1) indicated significant differences among the genotypes for all the characters under study. These differences indicated the presence of variability in the available germplasm and offers opportunity for improvement in yield and quality traits of cucumber.

The results with regard to mean, range, genetic variability parameters like genotypic coefficient of variation and phenotypic coefficient of variation, heritability, genetic advance and genetic advance as per cent mean for all thirteen characters are mentioned in Table-2. The details of these variability parameters are presented below.

Node at which first female flower appears varied from 2.88 to 6.68 with a mean value 5.00, the value of GCV (19.90%) and PCV (21.45%) were high. In case of number of days to first female flower production the value ranged from 28.12 days to 45.54 days with mean valve 37.89 days, value of PCV (13.10%) and GCV (11.24%) were found to be moderate. Days to first fruit harvest varied from 35.74 to 56.88 days with a mean value 47.30 days, values of GCV (9.01%) and PCV (11.41%) were low. The fruit length ranged from 12.07 to 21.31 cm with mean value 15.02 cm and GCV (13.17%) and PCV (15.37%) were moderate. Fruit diameter value ranged from 3.13 cm to 5.34 cm with mean value 4.09 cm and GCV (12.37%) and PCV (14.99%) was found to be moderates. Fruit weight varied from 97.01 to 210.42 g with mean value of 150.13 and PCV (26.19%) and GCV (23.77%) were high. Number of fruits per plant ranged from 6.45 to 11.89 with a mean value 8.73 and GCV (15.43%) and PCV (18.32%) were moderate for this character.

The vine length ranged from 1.33 to 3.09 m with a mean value of 2.13 m and GCV (22.54%) and PCV (25.19%) was

found to be high. Total soluble solids ranged from 2.29 to 4.82 ^{0}B with a mean valve 3.59 ^{0}B. GCV and PCV for this character were 20.70% and 21.13% respectively. Shelf life value ranged from 3.41 days to 7.92 days with mean value 5.93 days and GCV (16.90%) and PCV (17.63%) were noted to be moderate. Severity of downy mildew (%) which range from 9.24 to 21.93% with a mean value 16.08%, recorded GCV (21.69%) and PCV (23.80%) respectively. Fruit yield per vine ranges from 0.70 to 2.27 kg with average value of 1.31 kg and GCV (38.14%) and PCV (40.42%) was high for this character (Table 1). These results are in line with findings of Karthick *et al.,* (2019) [9], Rawat *et al*., (2017) [14], Deepa *et al*, (2018) [4], who also reported same trend of variability for above traits.

The high heritability in broad sense was recorded for total soluble solids (96.01%), shelf life (91.97%), fruit yield per vine (89.03%), node at which first female flower appears (86.09%), severity of downy mildew percentage% (83.00%), average fruit weight (82.37%), vine length (80.06%), number of days to first female flower production (73.61%), fruit length (73.36%), number of fruits per plant (71.00%), fruit diameter (68.12%) and days to first harvest (62.31%). Kumar *et al.,* (2008) [10] and Yadav *et al.,* (2012) [18] were also reported wider range of heritability.

A perusal of genetic advance as per cent of mean (Table 2) revealed that it ranged from 14.65 to 74.13. The result showed that all attributes exhibited high genetic advance as percent of mean which was observed for fruit yield per vine (74.13%), average fruit weight (44.45%), total soluble solids (41.79%), vine length (41.55%), severity of downy mildew percentage (40.71%) and node at which first female flower appears (38.04%), shelf life (33.40%), number of fruits per plant (26.79%), fruit length (23.23%), fruit diameter (21.04%) and the moderate level of genetic advance as percent of mean was seen in case of number of days to first female flower production (19.86%) and days to first harvest (14.65%). The findings are in accordance with Karthick *et al*., (2019) [9], Kumari *et al*., (2020) [11] and Sahoo *et al*., (2020) [15]

Table 2: Estimation of genetic variability parameters for twelve characters in cucumber

Characters	Mean	Range	Var (g)	Var (p)	PCV (%)	GCV (%)	Heritability (%)	GA% mean
Node at which first female flower appears	5.00	2.88 to 6.68	0.99	1.15	21.45	19.90	86.09	38.04
Number of days to first female flower production	37.89	28.12 to 45.54	18.13	24.63	13.10	11.24	73.61	19.86
Days to first harvest	47.30	35.74 to 56.88	18.15	29.13	11.41	9.01	62.31	14.65
Fruit length (cm)	15.02	12.07 to 21.31	3.91	5.33	15.37	13.17	73.36	23.23
Fruit diameter (cm)	4.09	3.13 to 5.34	0.25	0.37	14.99	12.37	68.12	21.04
Average fruit weight (g)	150.13	97.01 to 210.42	1274.30	1546.91	26.19	23.77	82.37	44.45
Number of fruits per plant	8.73	6.45 to 11.89	1.81	2.55	18.32	15.43	71.00	26.79
Vine length (m)	2.14	1.33 to 3.09	0.23	0.29	25.19	22.54	80.06	41.55
Total soluble solids (^{0}B)	3.59	2.29 to 4.82	0.55	0.57	21.13	20.70	96.01	41.79
Shelf life (days)	5.93	3.41 to 7.92	1.00	1.09	17.63	16.90	91.97	33.40
Severity of downy mildew (%)	16.08	9.24 to 21.93	12.16	14.65	23.80	21.69	83.00	40.71
Fruit yield per vine (kgs)	1.31	0.70 to 2.27	0.24	0.27	40.42	38.14	89.03	74.13

The characters like fruit yield per vine, average fruit weight, vine length, severity of downy mildew percentage had high genotypic coefficient of variation (GCV), heritability and genetic advance% mean. It indicates that the above mentioned traits are under the influence of additive gene action and selection may effectively be based on these characters as their phenotypic expression would give good indication of their genotypic potential.

Conclusion

The high level of variability, heritability and genetic advance over mean (GAM) observed among the genotypes used in this work showed the suitability of using these genotypes for initiating cucumber improvement programme. The values of PCV were of higher magnitude than GCV for all the characters indicating influence of environment over the genotype. High values of genetic advance over mean coupled with high estimates of heritability was observed for all the characters like fruit yield per vine, average fruit weight, Total soluble solids, vine length, severity of downy mildew percentage and node at which first female flower appears, shelf life, number of fruits per plant, fruit length, fruit diameter. This indicates predominance of additive component for these traits and hence direct selection would be more effective in improving these traits.

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