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RESEARCH ARTICLE

Mean performance and genetic variability of parthenocarpic gynoecious cucumber inbreds under protected conditions of Eastern India

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ABSTRACT

Kharif 2018, department of horticulture BAU, Sabour, Bihar, Eastern India, carried out an experiment to determine the average performance and genetic diversity of eight inbred genotypes of parthenocarpic gynoecious cucumber cultivated in a polyhouse. In a randomised block design, the experiment consisted of three replications. We evaluated 13 growth and yield-related factors on six competing plants, including total soluble solids (TSS) and the downy mildew percent disease index (PDI). When it came to first female flowering, node to first female flowering, and first fruit harvest, BRPCU-1 was the earliest of eight cucumber inbreds. Contrary to this, the inbreds BRPCU-3, 5 and 7 produced a large number of fruits/ plant and a large amount of fruit on a given number of plants. However, yield and fruits/plant showed evidence of additive gene effects in the majority of cases.

Keywords: Heterosis; Hybrid; Genetic variability; Inbred; Parthenocarpy

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INTRODUCTION

Greenhouse farming allows small growers to increase yields by a factor of ten or more, it is the most efficient method for commercially growing high-value vegetable crops.Moreover, it provides help to break the seasonal barrier by creating a microclimatic condition, favouring crop production, and overcoming biotic and abiotic stresses (Murthy et al., 2009). Cucumber (*Cucumis sativus* L. 2n=2x=14) is a fruit vegetable with great economic importance that belongs to the family Cucurbitaceae and considered an indigenous Indian origin plant. This is commercially grown all over the world in open fields or under protected conditions. In order for cucumber genotypes to be commercially grown in polyhouses, they must have an intrinsic parthenocarpic gynoecious fruit formation mechanism. The dark green colour, texture, burpless quality, and flavour of parthenocarpic/seedless cucumbers are highly respected and popular throughout the world. Cucumbers in the field are generally spiky or rough to the touch, whereas cucumbers in the greenhouse are smoother (Amrita et al., 2021). Because parthenocarpic cucumber genotypes are gynoecious and do not require pollinators for fruit set, their yield potential is larger than that of typical seeded cucumber kinds. Furthermore, economic gains are high because seedless fruit is more expensive than seeded fruit (Thapliyal, 2017).

Because numerous factors interact to produce a crop production, direct selection for increased yield could be deceiving (Gatti et al., 2005). As a result, understanding genetic variability is essential for the success of any crop development effort and the strategies used to exploit it. With all of these considerations in mind, an attempt was undertaken to investigate the average performance and determine the type and extent of genetic variability among eight cucumber inbreds.

MATERIALS AND METHODS

The experimentation was led during *Kharif*, 2018, on eight inbreds of cucumber, namely BRPCU-1, BRPCU-2, BRPCU-3, BRGCU-4, BRPCU-5, BRPCU-6, BRPCU-7, and BRPCU-8, maintained at Bihar Agricultural University, Sabour. The nursery was grown in pro-trays, and transplantation was done in a three-replication Randomized Block Design. For the crop produced in a naturally ventilated polyhouse, a double row system with spacing of 40 cm 60 cm (P-P R-R) was used. All of the cultural practises that were proposed were implemented (Anonymous, 2021). The coefficient of variation and broad sense heritability were calculated by the formula of Burton and De Vane (1953). The predicted genetic advance was calculated by Lush (1949) and Johnson et al. (1955) formulas, using the value of constant 'K' as supplied by Allard (1960).

RESULT AND DISCUSSION

Table 1 shows the mean sum squares and genetic characteristics of all eight cucumber inbreds. All of the examined traits revealed highly significant (p0.01) variation in the ANOVA, indicating the presence of genetic variability among genotypes. Table 2 shows the mean values of eight genotypes for 13 morphological features. In terms of anthesis days to 1st female flower, the inbred BRPCU-1 (24.06) was the earliest of the eight cucumber genotypes, followed by BRGCU-4 (24.78) and BRPCU-2 (25.22).

Table 1. Analysis of variance for different traits in cucumber

S. No.	Sources	df	Replication	Treatment	Error
			2	8	16
1.	Days to first female flower anthesis		0.47	2.05**	0.36
2.	Node number to first female flower		0.05	1.24**	0.13
3.	Days to first fruit harvest		1.07	4.31**	0.97
4.	Fruit length (cm)		0.12	5.39**	0.24
5.	Fruit diameter (cm)		0.00	0.14**	0.00
6.	Flesh thickness (cm)		0.00	0.09**	0.00
7.	Fruit weight (g)		15.11	177.35**	11.18
8.	Fruits/plant		2.07	95.35**	1.32
9.	Yield/plant (g)		34291.35	1115827.96**	21481.61
10.	Vine length (cm)		2.08	2128.48**	92.27
11.	Crop duration		0.36	115.47**	7.80
12.	Percent disease index for downy mildew (PDI)		6.54	344.26**	20.54
13.	Total soluble solid (TSS)		0.01	0.09**	0.01

Table 2. Mean values of genotypes for 13 morphological traits

CHARACTER GENOTYPES	DFFFA	NFFF	DFFH	FrL	FrD	FlT	FrW
BRPCU-1	24.06	4.06	34.07	16.91	3.19	1.01	106.79
BRPCU-2	25.22	5.00	35.83	15.28	3.27	0.99	106.99
BRPCU-3	26.78	4.28	35.33	14.78	3.56	1.14	105.66
BRGCU-4	24.78	3.94	38.07	14.05	3.68	1.47	122.94
BRPCU-5	26.41	5.28	36.70	18.02	3.12	0.93	112.15
BRPCU-6	26.00	5.39	37.17	15.66	3.04	0.90	94.42
BRPCU-7	25.61	5.67	36.20	16.94	3.09	0.93	103.18
BRPCU-8	25.39	5.39	34.50	17.49	3.23	1.07	109.11
RS (CHECK)	25.78	5.17	35.13	16.95	3.22	0.99	111.97
Mean	25.56	4.91	37.05	16.23	3.27	1.05	108.14
C V (%)	2.36	7.21	2.66	3.04	2.05	5.27	3.09
SEm (±)	0.35	0.20	0.57	0.29	0.04	0.03	1.93
CD (0.05)	1.01	0.59	1.66	0.83	0.11	0.10	5.79

CHARACTER GENOTYPES	FrP	YP	VL	CD	PDI	TSS
BRPCU-1	19.56	2162.92	325.44	85.89	16.00	3.12
BRPCU-2	20.22	2243.17	350.72	87.06	27.93	3.27
BRPCU-3	23.06	2524.30	362.17	89.39	44.33	3.30
BRGCU-4	4.28	545.26	275.45	69.34	44.30	3.20
BRPCU-5	20.89	2430.88	336.89	85.89	49.47	3.45
BRPCU-6	20.39	1993.92	341.22	90.06	47.27	3.47
BRPCU-7	21.39	2287.97	355.11	83.39	43.00	3.63
BRPCU-8	20.45	2312.39	361.61	84.17	34.60	3.32
RS (CHECK)	21.44	2491.96	338.16	88.00	38.53	3.12
Mean	19.07	2110.31	338.53	84.80	38.38	3.32
C V (%)	6.02	6.95	2.84	3.29	11.81	2.83
SEm (±)	0.66	84.62	5.55	1.61	2.62	0.06
CD (0.05)	1.99	253.69	16.63	4.83	7.84	0.16

Days to first fruit harvest is an important and economically crucial attribute for a grower to capture the market early; the genotype BRPCU-1 had the shortest days to first fruit harvest (34.07), followed by BRPCU-8 (34.50). Fruit length was highest in genotype BRPCU-5 (18.02 cm), followed by genotype BRPCU-8 (17.49 cm), while fruit diameter was highest in BRGCU-4 (3.68 cm), followed by BRPCU-3 (3.56 cm). BRGCU-4, which was inbred, likewise had the greatest mean for meat thickness (1.47 cm), followed by BRPCU-3 (1.14 cm). The genotype BRGCU-4 had the highest average fruit weight (122.94 g), while the inbred line BRPCU-6 had the lowest average fruit weight (94.42 g). BRPCU-3 (23.06) had the maximum quantity of fruits/plant, followed by standard check (21.44) and BRPCU-7 (21.44). (21.39). BRPCU-3 had the highest fruit production (2524.30 g), followed by standard check (2491.96 g) and BRPCU-5 (2430.88 g). BRPCU-3 (322.17 cm) had the most vine length increase, followed by BRPCU-8 (321.61 cm) and BRPCU-2 (321.61 cm) (320.72 cm). BRPCU-6 had the longest cucumber harvesting duration (90.06), followed by BRPCU-3 (89.39), standard check (88.00), and BRPCU-2 (87.06). In BRPCU-1, the lowest PDI percent for downy mildew was found (16.00 percent). BRPCU-7 (3.63 °Brix) had the highest TSS, followed by BRPCU-6 (3.47 °Brix) and BRPCU-5 (3.45 oBrix). Nagamani et al., 2019; Kumar et al., 2019; Hochmuth et al., 2004 observed considerable differences for respective features while evaluating their materials in previous studies on evaluation of parthenocarpic cucumber hybrids under shade net situation.

Table 3. Estimates of parameters of variability for different traits in cucumber

Traits	PCV (%)	GCV (%)	h^2_{bs}	GA as % of mean
Days to first female flower anthesis	3.76	2.93	61.01	4.71
Node number to first female flower	14.36	12.42	74.00	22.12
Days to first fruit harvest	3.90	2.85	53.44	4.28
Fruit length (cm)	8.62	8.07	87.73	11.03
Fruit diameter (cm)	6.76	6.44	81.25	12.65
Flesh thickness (cm)	17.26	16.44	90.69	32.25
Average fruit weight (g)	7.55	6.88	83.21	12.93
Fruits/plant	29.96	29.35	95.97	59.23
Yield/plant (g)	29.45	28.62	94.44	57.29
Vine length (cm)	8.20	7.70	88.03	14.87
Crop duration	7.79	7.06	82.15	13.19
Percent disease index for downy mildew (PDI)	29.53	27.06	84.01	51.10
Total soluble solids (TSS)	5.77	4.92	72.73	8.78

PCV: Phenotypic Coefficient of Variation

The heritable (genetic variance) and non-heritable (environmental variance) components of the phenotypic variance of the characteristics were separated (Table 3). PCV and GCV estimates anticipate the amount of variability in the genetic stock and aid in the decision-making process for future breeding methods. Simultaneously, moderate PCV was seen in the thickness of the flesh and the number of nodes to the first female bloom. The remaining quantitative attributes had low PCV, with days to first female flower anthesis being the least. This suggests that selection would be beneficial for yield, fruits/plant, and PDI among cucumber genotypes.

The GCV is a useful tool for estimating genetic variability in many quantitative traits. Fruits/plant had the highest GCV, followed by yield/plant and percent disease index for downy mildew (PDI), with days to first fruit harvest having the lowest GCV. The high GCV indicates exploitable genetic variability, and inbred selection for the traits might be effective. Singh et al., 2018; Behera et al., 2007; Bisht et al., 2011 for fruits/plant; Chaudhary et al., 2015 for fruits/ plant and yield/vine verified the high PCV and GCV for fruits/plant and yield per vine. Bhardwaj, 2017 and Ranjan et al., 2015, on the other hand, estimated low PCV and GCV. Although PCV was larger than GCV, this indicated that genotypic contribution was greater than environmental input in the expression of these traits, implying that phenotypic based selection would be possible.

Heritability estimates provide a metric that can be used to improve the selection efficiency of specific features (Bhardwaj, 2017). The lower the influence of environment in observable variation, the higher the value of heritability (Eid, 2009). The highest h2 bs was assessed in ten cucumber genotypes, whereas moderate was found in three quantitative traits. On the other hand, have moderate heritability. In general, the trait with the most significant variability has a higher level of genetic advancement (Bhardwaj, 2017). Additive gene effects are shown in traits with high heritability and higher genetic advancement (Panse and Sukhatme, 1957).

Non-additive gene effects, are connected to qualities with high heritability but limited genetic advance, according to the study. There was modest heritability with poor genetic progress in terms of the number of days till female flower anthesis and fruit harvest.

Genetic advance estimates for traits such as average fruit weight, total soluble solids (TSS) and fruit length were low, suggesting that non-additive gene action is important for these traits. Simple selection would be inefficient if the high heritability was due to environmental influences rather than genotypic effects. For fruit length, Basavarajeshwari et al. (2014) also observed significant heritability and low genetic advance.

CONCLUSION

Among eight cucumber inbreds, genotype BRPCU-1 had the earliest female flowering date and the earliest fruit harvest date, as well as disease tolerance to downy mildew. BRPCU-3, BRPCU-5, and BRPCU-7, on the other hand, produced the largest yield. Traits like as fruits/plant, flesh thickness, yield/plant and per cent disease index for downy mildew are regulated by additive gene activity These qualities could be increased by phenotypic selection. Gene action is non-additive when it comes to other variables studied in the study, which had a moderate heritability and a moderate to low genetic advance. These traits could be improved by heterosis breeding.

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