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Studies on heritability (Narrow Sense) and genetic advance analysis for growth, fruit yield and its component traits in cucumber (*Cucumis sativus* L.)

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ABSTRACT

The present investigation was conducted during *Zaid* seasons 2022-23 (Y1) and 2023-24 (Y2) to estimate heritability in narrow sense and genetic advance in percent of mean by using Line x Tester mating design at the Main Experiment Station (MES) of the Department of Vegetable Science, Acharya Narendra Deva University of agriculture & Technology, Kumarganj, Ayodhya (U.P.) India. All selected diverse parents of cucumber were crossed in a Line x Tester mating design from generating experimental material. All the ten parents and three testers their 30 F_1 hybrids ware grown in randomized block design with three replications. Observation were recorded for the 18 characters. High heritability coupled with high genetic advance were observed for days to first staminate flower anthesis, days to first pistillate flower anthesis, vine length (m), number of primary branches per plant, number of fruit per plant, fruit yield per plant (kg), ascorbic acid (mg/100g), non-reducing sugar (%) and total sugar (%)in the year over season pooled. High heritability (narrow sense) along with high genetic advance in per cent of mean were observed for most of important economic traits showing ample scope of crop improvement by selection. Moderate heritability coupled with high genetic advance were observed for node number to first staminate flower appearance, node number to first pistillate flower appearance, fruit breadth (cm) and TSS (Brix) shows moderate heritability coupled with high genetic advance.

Keywords: genetic advance, heritability, hybrids and selection

INTRODUCTION

Vegetables are important nutritive component of the daily diet because their nutritive value as a vital source of micronutrients has been well recognized. Thus, vegetables are getting increasingly higher importance in India as well as in the world due to their relevancein achieving nutritional security from emerging nutritional problems inhuman beings. India is the world's second largest producer of vegetables next only to China. In warmer regions of the world, the family Cucurbitaceae, which has 117 genera and 825 species, includes cucumber (*Cucumis sativus* L.) (Gopalakrishnan 2007). It has been grown for more than 3000years in India (de Candolle 1982), where Chakravarthy (1982) estimated 36 genera and 100 species. It is one of the oldest vegetable crops. A thermophillic and frost-sensitive crop, cucumber thrives in temperatures above 20°C.It is rich in carbohydrates, vitamin B and C, Ca and P (Yawalkar, 1985). As per studies done by Alcazar and Gulick (1983), it recorded that one hundred gram of edible cucumber fruits is reported to provide water - 96g, carbohydrate - 2.2g, fat - 0.1g, protein - 0.6g, Calcium - 12mg, Iron - 0.3mg, Magnesium - 15mg and phosphorus – 24 mg , Vitamin A - 45IU, Niacin - 0.3mg , Vitamin B1 and Vitamin B2 - 0.03mg and 0.02mg respectively, and Vitamin C - 12mg. It is also used in Ayurvedic medicines based on the astringent and antipyretic properties of the fruit and oil extracted from seeds of cucumber reported to be associated with brain development (Robinson and Decker-Walters, 1999). Cucumber is also very well established in the cosmetic industry, owing to its hydrating, soothing and healing properties.

In India, it is cultivated from plains to higher altitudes. In northern India, two crops are cultivated annually that is in spring-summer and kharif season, whereas in hilly areas it is cultivated in autumn summer. In India, the total production of cucumber is 1665 2 thousand MT from an area of 118,000 hectares with a productivity of 14.11 MT/ha (Anonymous 2021).

Heritability estimates provide information about transmissibility of character from parents to offspring. This facilitates evaluation of hereditary and environmental effects in phenotypic variation and helps in deciding selection intensity. Heritability in narrow sense which denotes the proportion of additive genetic variance to the total variability, measures the genetic relationship between parents and progeny. It denotes the amount of variability which is heritable, whereas, genetic advance predicts the quantum of genetic gain expected by imposing a particular intensity of selection

MATERIALS AND METHODS

The present investigation conducted during Zaid seasons 2022-23 (Y1) and 2023-24 (Y2) to study the heritability in narrow sense and genetic advance in percent of mean by using Line x Tester mating design at the Main Experiment Station (MES) of Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Ayodhya (U.P.) India. The experimental site is geographically, falls under humid, sub-tropical climate and is located in between 24.470 and 26.560 N latitude and 82.120 and 83.980 E longitude at an altitude of 113 m above the mean sea stratum in the Gangetic alluvial plains of Eastern Uttar Pradesh. The soil of experimental site was sandy loam with average fertility level with pH in the range of 7.5-8.5. The selected parental lines i.e.; Swarna Sheetal , Pusa Uday , Arka Veera , Phule Shubhangi , Khira 75, AAUC-2 , uday, NDCC-9, NDCC-10, Solan Srij anand testers Punjab Naveen , Pusa Barkha , Pant Kheera-1 were crossed in Line x Tester cross combinations to get 30 F1's that were evaluated in randomized block design in three replications having each experimental unit of single row with spacing of 2.5 mx 0.5 m for the study of heritability in narrow sense and genetic advance in percent of mean. The mean of five plants was calculated and used for statistical analysis. Observations were recorded for eighteen characters as follows days to first staminate flower anthesis , days to first pistillate flower anthesis, node number to first staminate flower appearance, node number to first pistillate flower appearance, days to first fruit harvest , vine length (m) , number of primary branches per plant, fruit breadth (cm), fruit length (cm), average fruit weight (kg),number of fruits per plant , fruit yield per plant (kg), total soluble solids (^{0}brix), ascorbic acid (mg/100g fresh fruit), reducing sugars (%),non-reducing sugar (%),total sugars (%),dry matter content in fruit (g/100g).All the recommended agronomic package of practices and plant protection measures were followed to raise good crops.

RESULT AND DISCUSSION

The estimates of heritability in narrow-sense and genetic advance in per cent of mean had given in table-1. The estimates of heritability in narrow-sense (h^2ns) have been classified by Kempthorne and Curnow (1961) into three categories viz., high (> 30%), medium (10-30%) and low (<10%). In first year (Y1), the high estimate of heritability in narrow sense was recorded for days to first staminate flower anthesis (69.89%), days to first pistillate flower anthesis (64.11%), days to first fruit harvest (63.47%), vine length (m) (32.15%), number of primary branches per pant (38.03%), average fruit per plant (g) (37.04%), number of fruit per plant (72.59%), fruit yield per plant (kg) (47.49%), ascorbic acid (mg/100g) (48.75%), non reducing sugar (%) (51.94%) and total sugar (%) (55.03%). Moderate estimate of heritability in narrow sense was observed for node number to first staminate flower appearance (16.76%), node number to first pistillate flower appearance (16.99%), fruit breadth (13.71%), TSS (brix) (13.40%), reducing sugar (%) (27.36%) and dry matter (%) (28.55%). Low estimate of heritability in narrow-sense was observed for fruit length (cm) (9.23%).

In second year (Y2), the high estimate of heritability in narrow sense was recorded for days to first staminate flower anthesis (66.13%), days to first pistillate flower anthesis (64.11%), days to first fruit harvest (44.77%), vine length (m) (34.54%), number of primary branches per pant (46.51%), average fruit per plant (g) (34.29%), number of fruit per plant (68.64%), fruit yield per plant (kg) (46.14%), ascorbic acid (mg/100g) (36.80%), non reducing sugar (%) (52.81%) and total sugar (%) (54.49%). Moderate estimate of heritability in narrow sensewas observed for node number to first staminate flower appearance (17.14%), node numberto first pistillate flower appearance (16.83%), fruit breadth (14.21%), fruit length (cm) (15.41%), TSS (brix) (13.58 %), reducing sugar (%) (28.83%) and dry matter (%) (29.87%). Low estimate of heritability in narrow-sense was observed for none of characters in Y_2.

In case of pooled, the high estimate of heritability in narrow sense was recorded for days to first staminate flower anthesis (70.31%), days to first pistillate flower anthesis (65.56%), days to first fruit harvest (59.81%), vine length (m) (33.27%), number of primary branches per pant (44.02%), average fruit per plant (g) (36.60%), number of fruit per plant (71.43%), fruit yield per plant (kg) (48.22%), ascorbic acid (mg/100g) (43.06%), non reducing sugar (%) (52.41%) and total sugar (%) (53.78%). Moderate estimate of heritability in narrow sense wasobserved for node number to first staminate flower appearance (17.38%), node number to first pistillate flower appearance (17.32%), fruit breadth (14.69%), fruit length (cm) (15.21%), TSS (brix) (13.42%), reducing sugar (%) (28.11%) and dry matter (%) (29.44%). Low estimate of heritability in narrow-sense was observed for none of characters in Y_2.

For easy explanation, genetic advance was classified into three groups such as (i) high (> 20%) (ii) moderate (> 10% to 20%) and (iii) low (< 10%). In first season (Y_1) high genetic advance in per cent of mean were estimated for days to first pistillate flower anthesis (20.27%), node number to first staminate flower appearence (22.80%), node number to first pistillate flower appearance (22.77%), vine length (m) (26.48%), number of primary branches per plant (37.90%), fruit breadth (cm) (25.79%), average fruit weight (g) (28.13%), number of fruit per plant (39.22%), fruit yield per plant (kg) (37.49%), TSS (Brix) (22.35%), ascorbic acid (mg/100g) (26.99%), reducing sugar (%) (95.81%), non-reducing sugar (%) (79.97%) and total sugar (%) (45.96%). The moderate genetic advance was estimated for days to first staminate flower anthesis (18.90%), fruit length (cm) (14.30%) and dry matter (%) (15.17%). The low genetic advance was recoded for days to first fruit harvest (8.84%).

In second year (Y_2) high genetic advance in per cent of mean were estimated for days to first staminate flower anthesis (22.92%), days to first pistillate flower anthesis (21.68%), node number to first staminate flower appearance (24.92%), node number to first pistillate flower appearence (24.37%), vine length (m) (23.72%), number of primary branches per plant (36.98%), fruit breadth (cm) (24.87%), average fruit weight (g) (30.96%), number of fruit per plant (40.73%), fruit yield per plant (kg) (35.76%), TSS (Brix) (28.75%), ascorbic acid (mg/100g) (33.66%), reducing sugar (%) (97.10%), non-reducing sugar (%) (81.17%) and total sugar (%) (49.93%). The moderate genetic advance was estimated for days to first fruit harvest (10.87%), fruit length (cm) (18.28%) and dry matter (%) (18.89%). The low genetic advance was recorded for none of the characters in Y_2.

While in pooled high genetic advance in per cent of mean were estimated for days to first staminate flower anthesis (22.90%), days to first pistillate flower anthesis (20.49%), node number to first staminate flower appearence (25.74%), node number to first pistillate flower appearence (25.14%), vine length (m) (25.60%), number of primary branches per plant (37.52%), fruit breadth (cm) (26.70%), number of fruit per plant (41.54%), fruit yield per plant (kg) (37.36%), TSS (Brix) (28.16%), ascorbic acid (mg/100g) (31.72%), reducing sugar(%) (97.26%), non-reducing sugar (%) (81.15%) and total sugar (%) (49.93%). The moderate genetic advance was estimated for days to first fruit harvest (13.23%), average fruit weight (g) (19.17%), fruit length (cm) (18.52%) and dry matter (%) (19.64%). The low genetic advance was recoded for none of the characters in the over pooled as shown in table 1.

High heritability coupled with high genetic advance were observed for days to first staminate flower anthesis, days to first pistillate flower anthesis, vine length (m), number of primary branches per plant, number of fruit per plant, fruit yield per plant (kg), ascorbic acid (mg/100g), non-reducing sugar (%) and total sugar (%)in the year over season pooled. These results are in close conformity with the findings of **Bartaula *et al*. (2019), Setyaningastuti (2019), Pradhan *et al*. (2018) and Deepa *et al*. (2018).**

Moderate heritability coupled with high genetic advance were observed for node number to first staminate flower appearance, node number to first pistillate flower appearance, fruit breadth (cm) and TSS (Brix) shows moderate heritability coupled with high genetic advance.**Veena *et al*. (2012) , Singh *et al*. (2022), Tripathi *et al*. (2021) and Yadav *et al*. (2021)**

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Table- 1: Estimates of heritability in narrow sense (h^2ns) and genetic advance in per cent of mean for eighteen characters in cucumber over two years (Y1= 2023, Y2=2024) and pooled.

S. No.	Parameters / Characters	Heritability(h^2ns%)			Genetic advance in percent of mean		
		Y1	Y2	Pooled	Y1	Y2	Pooled
1.	**Day to First Staminate Flower Anthesis**	69.892	66.138	70.319	18.90	22.92	22.90
2.	**Days to first pistillate flower anthesis**	64.113	65.304	65.563	20.27	21.68	20.49
3.	**Node Number to first staminate flower apperance**	16.766	17.145	17.386	22.80	24.92	25.74
4.	**Node Number to first pistillate flower apperance**	16.993	16.839	17.323	22.77	24.37	25.14
5.	**Days to first fruit harvest**	63.476	44.778	59.814	8.84	10.87	13.23
6.	**Vine length (m)**	32.158	34.548	33.276	26.48	23.72	25.60
7.	**Number of branches per plant**	38.031	46.517	44.022	37.90	36.98	37.52
8.	**Fruit breadth (cm)**	13.711	14.212	14.691	25.79	24.87	26.70
9.	**Fruit length (cm)**	9.238	15.416	15.216	14.30	18.28	18.52
10.	**Average Fruit weight (g)**	37.044	34.291	36.6	28.13	30.96	19.17
11.	**Number of Fruit per plant**	72.591	68.641	71.43	39.22	40.73	41.54
12.	**Fruit Yield per plant kg**	47.497	46.146	48.225	37.49	35.76	37.36
13.	**TSS (Brix)**	13.407	13.585	13.424	22.35	28.75	28.16
14.	**Ascorbic acid (mg/100)**	48.753	36.804	43.061	26.99	33.66	31.72
15.	**Reducing sugar (%)**	27.36	28.831	28.117	95.81	97.10	97.26
16.	**Non Reducing Sugar (%)**	51.943	52.816	52.415	79.97	81.17	81.15
17.	**Total Sugars (%)**	53.038	54.499	53.788	45.96	48.93	48.93
18.	**Dry matter (%)**	28.554	29.876	29.443	15.17	18.89	19.64