Components of genetic variation for yield and its attributing traits in bottle gourd (*Lagenaria siceraria* (Mol.) Standl.)

Abstract

An investigation was carried out to assess the gene action in bottle gourd for twenty-three characters at Main Experiment Station, Department of Vegetable Science, A.N.D.U.A.&T., Kumarganj, Ayodhya (U.P). during *Zaid* 2022 using 12 genotypes, nine lines *i.e*., Narendra Rashmi, NDBG-17, Pusa Naveen, NDBG-21, Punjab Komal, NDBG-28, NDBG-65-2, NDBG-105, NDBG-Sel-2 and three testers *i.e*., Narendra Prabha, Narendra Kamna, Narendra Pooja and their 27 hybrids obtained through line × tester mating pattern. The variances due to sca **(**σ^2s) were higher than variance due to gca (σ^2g) for all the characters. The value of dominance genetic variances (σ^2D) were larger than additive genetic variance (σ^2A), indicating the presence of dominance and over dominance effects and preponderance of non-additive gene action .The heritability in narrow sense was low for most of the traits except fruit length, days to first staminate flower anthesis and primary branches per plant where high estimate of heritability in narrow sense with low genetic advance were recorded, indicating the presence of non-additive gene action accompanied by environmental influence.

Keywords: environmental influence, genetic advance, soil-borne diseases, hybrid development

Introduction

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] (2n = 2x = 22), is a diploid, self-compatible, monoecious annual belonging to the genus *Lagenaria* of the *Cucurbitaceae* family (Beevy and Kuriachan 1996). Fresh fruit usually has light green smooth skin and white flesh and is frequently used in many regions of Asia and Africa as either a stir-fry or soup vegetable ingredient (Morimoto and Mvere, 2004; Grubben and Denton, 2004). The bottle gourd is predominantly grown for its fruit which, when dry, forms a woody rind that is used mostly for the manufacture of containers, musical instrument and fishing floats. (Heiser,1979).

Phylogenetically, bottle gourd is close to many economically important cucurbit species including cucumber and melon that belong to the genus of *Cucumis*, as well as watermelon that belongs to the genus *Citrullus*. It is known almost exclusively in cultivation but is probably native to Africa (Heiser, 1979). Two morphologically distinct subspecies of bottle gourd were recognized as: *L. siceraria ssp. siceraria* (the African and American/New World gourds) and *L. siceraria ssp. asiatica* (the Asian gourds) (Kobiakova 1930;Heiser,1973).Another recent utilization of bottle gourd is as rootstock for watermelon against soil-borne diseases and low soil temperature (Lee, 1994; Yetisir and Sari,2003).

The genetic variation in homozygous genotypes is entirely additive and additive-epistatic, but in segregating populations, both additive and non-additive genes are present. The nature and magnitude of gene action controlling quantitative traits is very useful for successful development of crop varieties through proper choice of parents for hybridization programme (Baker, 1978; Falconer,1989; Griffings, 1956).

The *per se* performance of parents alone cannot judge parents for their breeding value, it is important to understand the behavior and the nature of the genes involved to develop effective heterotic combinations. Therefore, gene action, heritability in the narrow sense, and genetic advance are important to estimate the breeding value in selecting good combiner parents, and parental combinations for hybrid development. Keeping in view of the above stated facts, the present investigation was carried out to assess the gene action involved in inheritance of various traits.

MATERIALS AND METHODS

The present experiment was conducted in a Completely Randomized Block Design (CRBD) with three replications to appraise the performance of 27 F_1hybrids and their 12 parents (9 lines and 3 testers). The crop was sown in rows spaced at 3 meters apart with a plant to plant spacing of 0.50 meter at the MES, Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya. All the recommended agronomic package of practices and protection measures were followed to raise good crop. Data were recorded on five randomly selected plant in each and every treatment for all the characters studied viz. 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, length of pedicel of staminate flower, length of pedicel of pistillate flower, days to first harvest, primary branches per plant, vine length(m), number of node per vine, internodal length(cm), harvest duration, peduncle length, fruit length, average fruit circumference, average fruit weight(g), number of fruits per plant, fruit yield/ plant(kg) ,total soluble solids%, reducing sugars%, non-reducing sugar%, total sugars% ,dry matter.

RESULTS AND DISCUSSION

The estimates of components of variation are given in table 1. Combining ability analysis exhibited higher magnitude of variances due to sca (**σ^2** s) than variance due to gca (**σ^2**g) indicating preponderance of non-additive gene action for all the characters. The value of sca variances were found significant and positive for all twenty three characters. Likewise, the significant gca effects were observed in the characters days to first staminate flower anthesis (3.02), days to first pistillate flower anthesis (3.06), node number to first pistillate flower appearance (0.82), length of pedicel of both staminate and pistillate flower appearance (0.66 ,0.33), days to first harvest (2.48), primary branches per plant (9.20), vine length (0.28), number of node per vine (6.95), fruit length (12.80), average fruit circumference (0.76), fruit yield per plant (0.25) and dry matter(0.06). Result were in conformity with the findings of Dubey and Maurya (2007), Sharma *et al.*(2007), Kumar *et al.*(2014), Ray *et al.*(2015), Adarsh *et al.*(2015), Janaranjani *et al.*(2016), Doloi *et al.* (2017), Rani and Reddy (2017), Maurya *et al*.(2020),Mahawar *et al. (*2021), Ahmad *et al*. (2022) in bottle gourd.

The average degree of dominance was more than unity (1) for all the characters except for characters i.e., days to first staminate flower anthesis (0.95) and fruit length (0.92) were less than unity (1) was observed which indicates existence of over dominance and preponderance of non-additive gene effect suggesting there by scope of development of F_1s as well as the recombinants within the segregating populations. The predictability ratio represents the proportion of phenotypic variation that can be attributed to genetic effect of tester line. The predictability ratio was less than 1 for all the characters, indicating that phenotypic variation observed in offspring is influenced by genetic factors and environmental interaction along with tester contribution.

The value of dominance genetic variances (σ^2D) was larger than additive genetic variance (σ^2A) for all the twenty-three characters studied. Additive genetic variance in lower magnitude than dominance variance for all the characters indicates the preponderance of dominance gene action.

CONCLUSION

The line× tester analysis is a simple and efficient method to study the components of variance and assess gene action involved. The higher magnitude of sca(**σ^2** s) variances than variance due to gca (**σ^2**g) indicates the preponderance of non-additive gene action. The average degree of dominance values greater than 1 imply over dominance effects and values closer to 1 and 1 imply complete dominance. If the predictability ratio is high and close to 1, it suggests that additive gene action plays a significant role in expression of such traits. On other hand, if the predictability ratio is low and close to 0, it suggests dominance gene action is pronounced. The value of dominance genetic variances (σ^2D) greater than additive genetic variance (σ^2A) indicated the dominance gene action.

S.No	Characters	Gca variance $\sigma^2 g$ **σ†2 g)**	Sca variance $\sigma^2 s$	Average degree of dominance
1.	Days to first staminate flower anthesis	3.02 **	3.72**	0.95
2.	Days to first pistillate flower anthesis	3.06 **	6.45**	1.24
3.	Node number to first staminate flower appearance	0.27	2.82**	2.71
4.	Node number to first pistillate flower appearance	0.82 *	3.30**	1.70
5.	Length of pedicel of staminate flower	0.66 *	1.99**	1.47
6.	Length of pedicel of pistillate flower	0.33*	1.20**	1.62
7.	Days to first harvest	2.48*	5.63**	1.29
8.	Primary branches per plant	9.20**	14.72**	1.08

9.	Vine length	0.29*	1.06**	1.66
10.	Number of nodes per vine	6.95*	30.81**	1.80
11.	Internodal length	0.38	1.49**	1.70
12.	Harvest Duration	1.37	21.46**	3.38
13.	Peduncle length	0.24	5.29**	4.03
14.	Fruit length	12.98**	15.06**	0.92
15.	Average fruit circumference	0.76*	1.94**	1.36
16.	Average fruit weight	0.01	0.03**	1.75
17.	Number of fruits per plant	0.13	1.71**	3.15
18.	Fruit yield/ plant	0.25**	0.70**	1.42
19.	Total soluble solids	0.00	0.01**	3.66
20.	Reducing sugars	0.00	0.04**	2.47
21.	Non-reducing sugar	0.00	0.01 **	2.07
22.	Total sugars	0.00	0.01 **	2.87
23.	Dry matter	0.05**	0.11**	1.19

Table 1 Components of variation

Table1Contd…

S.No	**Characters**	**Predictability ratio**	**σ^2A**	**σ^2D**
1.	Days to first staminate flower anthesis	0.62	12.09	14.88
2.	Days to first pistillate flower anthesis	0.49	12.27	25.82
3.	Node number to first staminate flower appearance	0.17	1.12	11.26
4.	Node number to first pistillate flower appearance	0.34	3.32	13.21
5.	Length of pedicel of staminate flower	0.42	2.67	7.95

6.	Length of pedicel of pistillate flower	0.36	1.33	4.79
7.	Days to first harvest	0.47	9.91	22.51
8.	Primary branches per plant	0.56	36.78	58.87
9.	Vine length	0.35	1.13	4.25
10.	Number of nodes per vine	0.31	27.79	123.22
11.	Internodal length	0.34	1.51	5.98
12.	Harvest Duration	0.11	5.48	85.85
13.	Peduncle length	0.08	0.95	21.16
14.	Fruit length	0.63	51.91	60.22
15.	Average fruit circumference	0.44	3.04	7.74
16.	Average fruit weight	0.32	0.03	0.12
17.	Number of fruits per plant	0.13	0.50	6.86
18.	Fruit yield/ plant	0.42	1.01	2.79
19.	Total soluble solids	0.10	0.00	0.00
20.	Reducing sugars	0.19	0.02	0.16
21.	Non-reducing sugar	0.26	0.01	0.06
22.	Total sugars	0.15	0.00	0.03
23.	Dry matter	0.51	0.22	0.43

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