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Gene action for yield and quality traits in bottle gourd [*Lagenaria siceraria* (Molina) Standl.]

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Abstract
Gene action and their relative contribution in expression of characters is of great importance. Twenty one F_1 hybrids were obtained by partial diallel crosses between seven parents to determine the nature of gene action and their relative contribution in expression of characters. Significant values of dominance components $\hat{H}_1$ and $\hat{H}_2$ for all the traits (except fruit weight for $\hat{H}_2$), along with significant values of additive components $\hat{D}$ for number of fruits per plant, T.S.S. and ascorbic acid indicated the importance of both additive and dominance gene action in expression of these characters. However, additive ($\hat{D}$) component was lower in magnitude than dominance components of genetic variation for all the characters which revealed preponderance of dominance component of variance in the expression of fruit yield and its attributes. The average degree of dominance ($\hat{H}_1/\hat{D})^{\frac{1}{2}}$ involve in the gene action was found as over dominance for all the traits. This suggested that heterosis breeding might be advantageous for improvement of yield and its component traits in bottle gourd. Proportion of genes ($\hat{H}_2/4\hat{H}_1$) in the parents were less than 0.25 for all the traits which showed asymmetrical distribution of loci showing dominance in the inheritance of these characters. The ratio of $(4\hat{D}\hat{H}_1)^{1/2} + \hat{F}/(4\hat{D}\hat{H}_1)^{1/2} - \hat{F}$ indicated the excess of dominant genes among the parental strains for most of the characters. The ratio of $\hat{h}^2/\hat{H}_2$, provides information about groups of gene exhibiting that minor genes mainly governed the characters except days to first pistillate flower anthesis, node number to first staminate flower anthesis, days to first fruit harvest and fruit weight under study, which may be due to concealing effects of dominant gene with positive and negative effects.

Keywords: Bottle gourd, epistasis, gene effects, yield traits

Introduction
Bottle gourd [*Lagenaria siceraria* (Molina) Standl.] is one of the important and popular vegetable crops extensively cultivated during spring-summer, summer-rainy and early autumn seasons in all parts of the country (More and Shinde, 2003) [9]. It is also called as *White flowered gourd or Calabash gourd or Zucca melon* is grown for its immature fruits and used as culinary purposes. The fruit contains 96.3% moisture, 2.9% carbohydrate, 0.2% protein, 0.1% fat, 0.5% mineral matter and 11.0 mg of vitamin C per 100 g fresh weight (Thamburaj and Singh, 2005) [17].

Success of any crop improvement program is mainly dependent upon the information regarding nature and magnitude of gene effects controlling economic quantitative traits. Since yield is a complex character depending upon a number of other characters and their interactions, knowledge about the associations of these characters with yield will greatly help a breeder in his selection work with more precision and accuracy (Deb and Khaleque, 2009) [2].

For effective breeding programme, information concerning the magnitude and nature of genetic variation in a specific population is of prime importance. This analysis provides detailed accounts of additive and dominant components and the allied statistics. The genetic progress in a population depends largely upon the relative values of these components. The half diallel cross analysis through analytical method is based on a number of assumptions regarding applicability of this method was advocated by Hayman (1954a) [4] *viz.*, homozygous parents, diploid segregation, no reciprocal differences, no multiple allelism, absence of linkage and absence of epistasis and random mating. Therefore, the main objectives of the present investigation are to obtain clear and determined information about the relative importance of additive and non-additive gene actions involved in the inheritance of fourteen yield related characters of bottle gourd through estimates of gene actions.

Materials and Methods

The experiment was conducted with seven diverse parents *viz*. Pusa Naveen (P_1), NDBG-5005 (P_2), NDBG-104 (P_3), NDBG-5009 (P_4), NDBG-11 (P_5), NDBG-512 (P_6) and Narendra Rashmi (P_7) and 21 F_1 hybrids to determine the nature of gene action for fourteen quantitative and qualitative characters of bottle gourd. Seeds of 21 F_1s and 7 parental lines were sown in well-prepared plot with rows spaced at 3.0 meters apart with a plant to plant spacing of 0.5 meter during *Zaid* season, 2014-15 in Randomized Block Design (RBD) with three replications at Main Experiment Station (Vegetable Research Farm), Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, India (26.47° North latitude and 82.12° East longitudes at an altitude of 113 m above the mean sea level). All the recommended agronomic package of practices and protection measures were followed to raise good crop. The observations were recorded on five randomly selected plants from each genotype in each replication for the characters *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, days to first fruit harvest, vine length (m), number of primary branches per plant, fruit length (cm), fruit circumference (cm), average fruit weight (kg), number of fruits per plant, fruit yield per plant (kg), total soluble solids (^{0}Brix) and ascorbic acid (mg/100 g fresh fruit). Statistical analysis for genetic components were followed as per Jinks and Hayman (1953) [6], Hayman (1954a) [4] and Askel and Johnson (1963) [1].

Results and Discussion

The diallel cross analysis was carried out for all the fourteen characters (Table 1), using analytical approach in terms of components of variation *i.e.* $\hat{D}, \hat{H}_1, \hat{H}_2, \hat{F}, \hat{h}^2$ and $\hat{E}$ along with their respective standard errors. These genetic components were used in estimation of average degree of dominance ($\hat{H}_1/\hat{D})^{\frac{1}{2}}$, proportion of dominant and recessive gene (KD/KR) in parents *i.e.* $(4\hat{D}\hat{H}_1)^{1/2} + \hat{F}/(4\hat{D}\hat{H}_1)^{1/2}-\hat{F}$ and number of gene groups which control the character and exhibit dominance ($\hat{h}^2/\hat{H}_2$). The coefficient of correlation (r) between parental order of dominance (Wr-Vr) and parental measurements (Yr) was calculated to get an idea about the dominance genes with positive and negative effects. The non significant value of t^2 indicates validity of assumptions pertaining to diallel analysis. While, significant value of t^2 showed failure of hypothesis of diallel cross analysis.

The estimates of the components of variation and their related statistics for different characters of bottle gourd have been presented in table 1. Significant values of dominance components $\hat{H}_1$ and $\hat{H}_2$ for all the fourteen character (except fruit weight for $\hat{H}_2$), along with significant values of additive components $\hat{D}$ for fruit length, fruit circumference, number of fruits per plant, T.S.S. and ascorbic acid indicated the importance of both additive and dominance gene action in expression of these characters which is in consonance with the finding of Sharma *et al.* (1983) [12], Reyes *et al.* (1993) [11], Kathira *et al.* (2005) [7] and Singh *et al.* (2005) [14]. However, additive ($\hat{D}$) component was lower in magnitude than dominance components of genetic variation for all the fourteen characters which revealed preponderance of dominance component of variance in the expression of fruit yield and its attributes (Table 1). Sirohi *et al.* (1986) [15] recorded similar result in bottle gourd. The positive values of $\hat{F}$ for all the traits except days to first pistillate flower anthesis, node number to first staminate flower appearance and node number to first pistillate flower appearance under study showed that there is an excess of dominance gene in the inheritance of these traits among the parents.

The average degree of dominance ($\hat{H}_1/\hat{D}$) $^{1/2}$ involve in the gene action was found as over dominance for all the traits (Table 1). This suggested that heterosis breeding might be advantageous for improvement of yield and its component traits in bottle gourd. These findings are similar to that of Sirohi *et al.* (1986) [15], Maurya *et al.* (1993) [8], Dubey and Maurya (2003) [3], Singh *et al.* (2005) [14] and Sharma *et al.* (2010) [13].

Proportion of genes ($\hat{H}_2/4\hat{H}_1$) in the parents were less than 0.25 for all the traits (Table 1) which showed asymmetrical distribution of loci showing dominance in the inheritance of these characters. The ratio of $[(4\hat{D}\hat{H}_1)^{1/2} + \hat{F}/(4\hat{D}\hat{H}_1)^{1/2}-\hat{F}]$ indicated the excess of dominant genes among the parental strains for most of the characters (Table 1). The ratio of $\hat{h}^2/\hat{H}_2$, provides information about groups of gene exhibiting that minor genes mainly governed the characters except days to first pistillate flower anthesis, node number to first staminate flower anthesis, days to first fruit harvest and fruit weight under study, which may be due to concealing effects of dominant gene with positive and negative effect, which nullify the effects of each other. The positive correlation coefficient (r) between parental order of dominance (Wr + Vr) and parental measurement (Yr) for majority of traits indicated the direction of dominance towards negative side (Table 1). The above findings are in agreement with that of Singh *et al.* (2005) [14].

On the basis of gene action predominance of non-additive gene effects representing non-fixable dominance and epistatic components of genetic variance indicated that maintenance of heterozygosity would be highly fruitful for improving the characters. Hence, the suitable breeding strategy for attaining high yield would be the full or partial exploitation of heterosis through development of hybrid, synthetic or composite cultivars (Sit and Sirohi, 2008) [16]. The non-additive gene effects may also be exploited up to some extent for improving the characters by resorting to breeding methods such as bi-parental mating followed by recurrent selection and population improvement methods as suggested by Jensen (1970) [5] and Redden and Jensen (1974) [10].

Conclusion

The results showed that as a consequence of higher magnitude of interactions, the non-fixable gene effects were higher than the fixable. The importance of additive gene effects of fixable nature for fruit yield per plant and most of other yield components in the present study suggested that these traits are amenable to improvement through selection even in early generations. This indicated that considerable improvement in status of fruit yield and important yield attributes in bottle gourd can still be achieved by following conventional breeding procedures.

Table 1: Estimates of components of variation and their related statistics in 7 x 7 diallel crosses of bottle gourd

Components of variation and related statistics	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
$\hat{D}$ (Additive effect)	4.70 ± 2.80	3.31 ± 3.92	0.42 ± 1.01	1.49 ± 1.27	10.90 ± 7.67	1.11 ± 0.57	5.66 ± 3.73
$\hat{H}_1$ (Dominance effect)	28.52** ± 6.75	31.35 **± 9.43	7.31** ± 2.43	9.57 **± 3.05	99.73** ± 18.47	4.98 ** ± 1.38	36.52 ** ± 8.99
$\hat{H}_2$ (Dominance indicating asymmetry of +/- effect of genes)	26.01** ± 5.95	31.02 **± 8.31	7.00 **± 2.14	8.55** ± 2.69	85.09** ± 16.28	3.46 ** ± 1.22	32.78** ± 7.92
$\hat{F}$ (Mean Fr over arrays)	2.22 ± 6.73	-1.12 ± 9.40	-0.66 ± 2.42	-0.30 ± 3.04	18.34 ± 18.41	1.58 ± 1.38	2.16 ± 8.96
$\hat{h}^2$	1.28 ± 3.99	-0.75 ± 5.58	-0.25 ± 1.44	0.25 ± 1.80	0.58 ± 10.93	0.35 ± 0.82	42.80** ± 5.32
$\hat{E}$ (Environmental component)	1.90 ± 0.99	1.53 ± 1.38	0.53 ± 0.35	0.23 ± 0.44	2.74 ± 2.71	0.04 ± 0.20	0.40 ± 1.32
$(\hat{H}_1/\hat{D})^{\frac{1}{2}}$ (Mean degree of dominance)	2.46	3.07	4.13	2.53	3.02	2.11	2.53
$(\hat{H}_2/4\hat{H}_1)$ (Proportion of genes with +/- effects in parents)	0.22	0.24	0.23	0.22	0.21	0.17	0.22
$(4\hat{D}\hat{H}_1)^{1/2} + \hat{F} / (4\hat{D}\hat{H}_1)^{1/2} - \hat{F}$ (Proportion of dominant and recessive genes in parents)	1.21	0.89	0.68	0.92	1.77	2.01	1.16
$\hat{h}^2/\hat{H}_2$ (Number of gene groups)	0.05	-0.02	-0.03	0.03	-0.007	0.10	1.30
R (Correlation coefficient)	0.75	-0.46	0.30	0.60	0.51	0.35	0.31
t^2	5.39**	6.25**	17.37**	24.39**	2.93**	0.08	5.67**

** Significant at 0.01 probability level.

Table 1: Continued……

Components of variation and related statistics	Fruit length (cm)	Fruit circumference (cm)	Fruit weight (kg)	Number of fruits per plant	Fruit yield per plant (kg)	T. S. S. (^{0}Brix)	Ascorbic Acid (mg per 100g fresh fruit)
$\hat{D}$ (Additive effect)	18.60** ± 6.06	60.42** ± 6.19	0.01 ± 0.005	0.78** ± 0.17	0.44 ± 0.25	0.33** ± 0.07	0.82** ± 0.20
$\hat{H}_1$ (Dominance effect)	64.05 ** ± 14.59	69.70 ** ± 14.91	0.03** ± 0.01	2.19 ** ± 0.42	2.44 ** ± 0.61	1.23 ** ± 0.18	2.06 ** ± 0.49
$\hat{H}_2$ (Dominance indicating asymmetry of +/- effect of genes)	46.05** ± 12.85	46.29** ± 13.14	0.02 ± 0.01	1.43 ** ± 0.37	1.96** ± 0.54	1.10** ± 0.16	1.62** ± 0.43
$\hat{F}$ (Mean Fr over arrays)	12.62 ± 14.53	68.91** ± 14.86	0.01 ± 0.01	0.77 ± 0.42	0.57 ± 0.61	0.34 ± 0.18	0.46 ± 0.49
$\hat{h}^2$	12.86 ± 8.63	81.04** ± 8.82	0.00 ± 0.007	0.52* ± 0.25	0.38 ± 0.36	0.50** ± 0.10	0.64* ± 0.29
$\hat{E}$ (Environmental component)	1.20 ± 2.14	0.54 ± 2.19	0.001 ± 0.002	0.13** ± 0.06	0.09 ± 0.09	0.007 ± 0.027	0.05 ± 0.07
$(\hat{H}_1/\hat{D})^{\frac{1}{2}}$ (Mean degree of dominance)	1.85	1.07	1.48	1.67	2.35	1.92	1.58
$(\hat{H}_2/4\hat{H}_1)$ (Proportion of genes with +/- effects in parents)	0.18	0.16	0.19	0.16	0.20	0.22	0.19
$(4\hat{D}\hat{H}_1)^{1/2} + \hat{F} / (4\hat{D}\hat{H}_1)^{1/2} - \hat{F}$ (Proportion of dominant and recessive genes in parents)	1.44	3.26	2.55	1.83	1.77	1.72	1.43
$\hat{h}^2/\hat{H}_2$ (Number of gene groups)	0.27	1.75	-0.001	0.36	0.19	0.45	0.40
R (Correlation coefficient)	0.68	0.89	-0.34	0.76	0.38	0.86	0.45
t^2	3.11**	0.72	0.38	0.38	2.72	0.42	0.68

*, ** Significant at 0.05 and 0.01 probability level, respectively.

References

1. Askel R, Johnson LPV. Analysis of a diallel cross: A worked example. Adv. Frontiers Pl. Sci 1963;2:37-54.
2. Deb AC, Khaleque MA. Nature of gene action of some quantitative traits in chickpea (*Cicer arietinum* L.) World J Agric. Sci 2009;5(3):361-368.
3. Dubey SK, Maurya IB. Studies on heterosis and combining ability in bottle gourd [*Lagenaria siceraria* (Molina) Standl.]. Indian J Genet 2003;63:148-152.
4. Hayman BI. The theory and analysis of diallel crosses. Genetics 1954a;39:789-809.
5. Jensen NF. A diallel selective mating system for cereal breeding. Crop Sci 1970;10:629-35.
6. Jinks JL, Hayman BI. The analysis of diallel crosses. Maize Genetics Newsletter 1953;27:48-54.
7. Kathiria KB, Acharya RR, Patel AD, Nag M, Bhalala MK. Genetic analysis in bottle gourd. In: Abstract Book of National Seminar on Cucurbits, Sept. 22-23, G. B. Pant University of Agriculture and Technology, Pantnagar, 2005, pp10.
8. Maurya IB, Singh SP, Singh NK. Heterosis and combining ability in bottle gourd. Veg. Sci 1993;20:77-81.
9. More TA, Shinde KG. Bottle gourd. In: Thamburaj, S. and Singh, N. (eds.), Vegetable, tubercrops and spices. Directorate of Information and Publications of Agriculture, ICAR, New Delhi, India 2003.
10. Redden RJ, Jensen, NF. Mass selection and mating systems in cereals. Crop Sci 1974;14:345-50.
11. Reyes MEC, Altoveros EC, Rasco ETJr, Guevarra EB. Combining ability and heterosis for yield and yield components in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. Scientific Meeting of the Federation of Crop Science Societies of the Philippines. Aklan (Philippines) 1993.
12. Sharma BR, Singh S, Singh D. Genetical studies in bottle gourd. Veg. Sci 1983;10:102-111.
13. Sharma N, Sharma NK, Malik YS. Estimation of genetic variation in bottle gourd, In: Abstract book of National Seminar on Recent Trends in Hort. Crops Issues and Strategies for Res. Development, March 22-24, CCS HAU, Hissar. 2010, pp26.
14. Singh VB, Mishra CH, Singh SP, Srivastava RK. Genetical studies in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] for yield and its components. In: Abstract Book of National Seminar on Cucurbits, Sept. 22-23, G. B. Pant University of Agriculture and Technology, Pantnagar. 2005, pp163.
15. Sirohi PS, Sivakami N, Choudhary B. Genetic analysis in long-fruited bottle gourd. Indian J Agric. Res 1986;56(9):623-625.
16. Sit AK, Sirohi PS. Genetic architecture of yield and yield attributing characters of bottle gourd. Indian J Hort. 2008;65(2):243-244.
17. Thamburaj S, Singh N. Vegetables, Tuber crops and Spices, Directorate of Information and publications of Agriculture, ICAR, New Delhi, 2005, pp271-272.