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STUDIES ON NATURE OF GENE ACTION AND HERITABILITY IN MUSKMELON (*CUCUMIS MELO* L.)

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ABSTRACT

Estimation of nature of gene action and heritability in various 7 × 7 half diallel of muskmelon were studied for growth, yield and quality traits during *rabi*-2022 to summer-2024 at Horticulture research scheme (Vegetables), Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra) in Randomized Block Design with two replications. The mean squares due to gca and sca were significant for all the characters indicating variability among the parents and crosses. The sca variance greater than gca variance for most of the characters in *rabi* and summer seasons, except days required to first harvest of fruit in rabi season and fruit cavity and total sugar in summer season. The dominance variance (∂^2 D) was greater than additive variance (∂^2A) in both the seasons for most of the characters except length of vine, days required for first harvest of fruit and fruit cavity in both seasons. The highest heritability estimates recorded in length of vine (36%), while lowest was recorded in the characters days to first male flower (9%) in rabi season. However maximum and minimum heritability were recorded by length of vine (50%) and days to first male flower (10%) in summer season.

***Key words*:** Gene, Heritability, Muskmelon, Additive, Quality

Introduction

Muskmelon (*Cucumis melo* L.) is a popular and commercially cultivated cucurbitaceous vegetable crop of the tropics and sub tropics, grown globally for its nutritive and medicinal values. Muskmelon was first described by Linne during the year 1753 in species planetarum. It belongs to family cucurbitaceae represented by some 118 genera and 825 species (Parle and Singh 2011). Muskmelon (2n=24) is subdivided into 6-cultivar groups cantaloups, inodorus, flexusus, conomon, chita-dudaim and momordica (Munger and Robinson, 1991). Edible melons belong to either *Cucumis melo* var. *reticulatus* or *Cucumis melo* var. *cantaloupensis*. vines are either monoecious or andromonoecious annuals with long trailing vines with shallow lobed round leaves. Place of origin of this large and polymorphous species is not known with absolute certainty. A few consider Africa as the centre of origin, since 40 or more wild species of *Cucumis* occur in tropics and subtropics of Africa (Whitaker and David, 1962). Annual worldwide production of muskmelon was about 1495 M tons on a harvested area of 66 thousand ha. In India. In Maharashtra, it was cultivated on an area of 1.22 thousand ha with annual production of 21.10 M tons. (Anonymous, 2024)

The improvement programme of muskmelon is based mainly on exploiting natural sources of germplasm by means of selection and hybridization. For development of promising high yielding varieties, the identification of genetically superior plants is an important.

The knowledge of gene action could be helpful for predicting the effectiveness of selection in population. It gives an idea regarding type of gene action involved in inheritance of characters. It enables the breeder in deciding suitable breeding methodology to be adopted in crop improvement. In plant breeding, gene action is usually measured in terms of components of genetic variances or combining ability variances and effects. In heterosis breeding, a knowledge of combining ability, gene action and relative amount of additive and non- additive components of genetic variance present in cross combination helps to determine the its utilization and identification of best combiners. The success of selection mainly depends upon the extent of genetic variability present it. Hence, a higher genetic base should be utilized for faster and higher magnitude of success.

Muskmelon and its related species and genera co – exist in India and have rich genetic resources, which are characterized by a considerable amount of variability for horticultural traits and insect- pest and disease resistance (Roy *et al.,* 2011). Therefore, efforts should be made to collect, conserve and evaluate the genetic resources of melon in India. However, there is a need to develop superior muskmelon hybrids/varieties suited to different agro ecological conditions with specific end use. Therefore, it is necessary to observed variability into heritable and non- heritable components by calculating genetic parameters.

Materials and Methods

The present investigation entitled, "Studies on Heterosis and Combining Ability in Muskmelon (*Cucumis melo* L.)" was conducted at Horticulture Research Scheme (Vegetable), Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra) during the period from *Rabi* 2022 to Summer 2024. The seed of selected cultivars used as parents were sown during *Rabi*, 2022 to Summer 2023 to constitute a screening block and crossing block respectively. The crosses among parents was followed in half diallel fashion (without reciprocals) to obtain crossed seed. The experimental material comprised of 21 hybrids, 7 parents and 1 standard hybrid check were evaluated in randomized block design with two replication at Horticulture Research Scheme (Vegetable), Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The seed of each treatment were dibbled on Novembar 15, 2023 and March 1, 2024. Each genotype was entered as a separate treatment and represented by a separate bed. Each treatment consisted of a single row of ten plants accommodated in a bed of 10.0 × 2.0 m. The plants were spaced 2.0 m. between rows and 1.0 m. within row. The five plants were selected randomly for recording various observations on growth, flowering, fruiting, harvesting and fruit quality characters. Observations recorded for length of vine (cm), number of primary branches, number of secondary branches, days required for first male flower, days required for first female flower, days to 50% male flower, days to 50% female flower, number of male flowers per vine, number of female flowers per vine, node at which first female flower appeared, days required for first harvest of fruit, number of fruits per vine, weight of fruit per vine (kg), weight of fruit (g), length of fruit (cm), diameter of fruit (cm), rind thickness (cm), pulp thickness (cm), fruit cavity (cm^2), weight of pulp per fruit (g), weight of seed (dry) per fruit (g), TSS (%), reducing sugar (%), non-reducing sugar (%), total sugar (%), ascorbic acid (mg/100g).

Result and Discussion

The analysis of variance of means was carried out to test the significance of difference among the treatments. The data pertaining to the analysis of variance for means presented in Table 1

The treatment means were further subdivided into parents, crosses and parent versus crosses. The parent showed significance difference for all the characters except length of vine (cm), number of primary branches, number of secondary branches, days for first male flower, 50% female flowers, days to first harvest of fruit and diameter of fruit in *rabi* (cm) season. Whereas in Summer season days to first male flower, days to first female flower, 50% female flower, number of female flowers, days to first harvest of fruit and diameter of fruit (cm). The crosses were found significantly for all the characters except number of primary branches, number of secondary branches, days for first male flower, days for first female flower, 50% male flower, node at first female flower and days to first harvest of fruit in *rabi* season and days to first male flower, days to first female flower, 50% male flower, 50% female flower and days to first harvest of fruit in summer season respectively. The parent versus crosses showed significant differences for most of the

Table 1: Analysis of variance for 7 × 7 half diallel of muskmelon.

Source	DF	Length of vine (cm)		Number of primary branches		Number of secondary branches		Days to first male flower	
		Rabi	**Summer**	***Rabi***	**Summer**	***Rabi***	**Summer**	***Rabi***	**Summer**
Treatment	**27**	418.48*	2695.59**	0.33*	0.50**	2.01*	7.86**	7.23*	6.74**
Parents	**6**	320.32	4239.82**	0.15	0.58**	0.94	2.84**	0.94	0.92
Hybrids	**20**	398.55*	2190.99*	0.29	0.40**	1.37	7.90**	4.54	1.49
P × C	**1**	1406.04**	3522.02	2.38**	1.81**	21.47**	37.06**	112.29**	146.53**
Error	**27**	162.15	873.72	0.17	0.14	0.96	0.68	2.76	1.93

Table 1: Continue...

Source	DF	Days to first female flower		Days to 50% male flowers		Days to 50% female flowers		No. of male flower	
		Rabi	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer
Treatment	27	9.38*	8.21*	7.96*	6.80*	15.08**	8.77**	47.68**	57.18*
Parents	6	0.89*	1.49	9.60*	7.20*	4.43	19.74**	46.58*	44.30
Hybrids	20	6.39	4.43	3.66	4.07	12.92*	3.99	38.60*	59.75*
P × C	1	119.86**	124.29**	84.15*	59.05**	122.21**	38.39**	235.72**	82.88
Error	27	4.24	3.60	3.20	2.39	5.60	3.40	17.84	25.86

Table 1: Continue...

Source	DF	No. of female flower		Node to first female flowers		Days to first harvest of fruit		No. of fruit per vine	
		Rabi	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer
Treatment	27	58.44**	47.66**	0.32*	1.28**	26.07*	24.61*	0.94**	0.91**
Parents	6	23.55*	18.65	0.77**	1.90**	32.92	33.48	0.72**	1.02**
Hybrids	20	41.13**	40.09**	0.17	1.08**	23.14	14.73	0.72**	0.52**
P × C	1	614.10**	372.98**	0.64*	1.27**	43.41**	169.23**	6.84**	8.09**
Error	27	9.18	9.40	0.14	0.10	18.36	16.09	0.10	0.09

Table 1: Continue...

Source	DF	Weight of fruit per vine (kg)		weight of fruit (g)		Length of fruit (cm)		Diameter of fruit (cm)	
		Rabi	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer
Treatment	27	0.70**	1.48**	75145.31**	135372.80**	12.49**	21.46**	3.22**	3.59**
Parents	6	0.92**	2.25**	127152.50**	170294.20**	10.12**	30.23**	0.87	1.72
Hybrids	20	0.42**	0.88**	47427.27**	116208.90**	11.02**	19.83**	0.68	2.28**
P × C	1	4.91**	8.77**	317463.20**	309120.30**	55.85**	1.54	68.22**	40.89**
Error	27	0.09	0.13	8312.17	5589.59	0.64	1.52	0.45	0.80

Table 1: Continue...

Source	DF	Rind thickness (cm)		Pulp thickness (cm)		Fruit cavity (cm^2)		Weight of pulp per fruit (g)	
		Rabi	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer
Treatment	27	0.003**	0.004**	0.46**	0.56**	73.04**	42.33**	23182.47**	66381.27**
Parents	6	0.002**	0.002**	0.55**	0.51**	79.23**	42.16*	18166.30**	55815.41**
Hybrids	20	0.001**	0.004**	0.40**	0.41**	72.68**	42.82**	22800.40**	61701.08**
P × C	1	0.036**	0.015**	1.18**	3.75**	43.04	33.57	60920.77**	22380.20**
Error	27	0.001	0.000	0.06	0.13	13.23	12.16	735.56	5121.48

Table 1: Continue...

Source	DF	Weight of dry seed per fruit (g)		T.S.S. (%)		Reducing sugar (%)		Non reducing sugar (%)		Total Sugar (%)		Ascorbic acid (mg/100g)	
		Rabi	Smr	*Rabi*	Smr	*Rabi*	Smr	*Rabi*	Smr	*Rabi*	Smr	*Rabi*	Smr
Treatment	27	6.09 **	7.02 **	1.34 **	3.40 **	1.78 **	2.23 **	0.44 **	0.37 **	1.12 **	0.57 **	37.62 **	26.24 **
Parents	6	5.39 **	5.16 **	2.82 **	5.21 **	1.96 **	2.10 **	0.71 **	0.65 **	0.62 **	0.80 **	57.24 **	46.81 **
Hybrids	20	5.67 **	7.33 **	0.64 **	2.29 **	1.81 **	2.37 **	0.36 **	0.28 **	1.27 **	0.53 **	33.02 **	20.49 **
P × C	1	18.67 **	12.21 **	6.37 **	14.53 **	0.08	0.09	0.50 **	0.48 **	1.13 **	0.02	11.88 **	17.86 **
Error	27	1.25	1.27	0.10	0.04	0.036	0.05	0.10	0.001	0.04	0.09	1.22	0.86

smr = Summer

characters in both the season except length of vine, no. of male flower, length of fruit and total sugar in summer season and fruit cavity (cm) and reducing sugar (%) in both seasons.

The estimates of gca (σ^2gca), sca (σ^2sca) variances, gca and sca (σ^2gca/σ^2 sca) ratios, heritability [h^2 (ns)] and gene action, are presented in Table 2 The sca variance greater than gca variance for most of the characters in *rabi* and summer seasons, except days required to first harvest of fruit in *rabi* season, and fruit cavity and total sugar in summer season. Similarly, Dominance variance was greater than additive variance in both season for most of the characters except length of vine, days required to first harvest of fruit and fruit cavity in both season. The non additive type of gene action observed for most of characters except days required to first harvest of fruit in *rabi* season and length of vine, fruit cavity and total sugar in summer season. The similar predominance role of dominance gene action in the inheritance of major yield and yield contributing characters are reported by earlier workers. The pre dominance of non-additive gene action suggests opportunity of exploitation heterosis in muskmelon. Similar results were reported by Singh and Vashisht (2015), Shashikumar *et al.*, (2017), Saha *et al.*, (2018) and Panday *et al.*, (2010).

The highest heritability estimate recorded in the length of vine (36%), number of fruits per vine (55%), Weight of fruit (39%), Length of fruit (48%), Pulp thickness (57%), Fruit cavity (50%), Weight of pulp per fruit (43 %), Reducing sugar (53%), Non reducing sugar (34%) and Total sugar (42%) in *rabi* season. Whereas, In summer season length of vine (50%), number of primary

Table 2: Estimates of genetic variance component and heritability in various characters in 7 × 7 half diallel of muskmelon.

Genetic components	Length of vine (cm)		Number of primary branches		Number of secondary branches		Days to first male flower		Days to first female flower	
	Rabi	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer
σ^2 gca	40.28	355.34	0.02	0.05	0.06	0.58	0.20	0.02	0.37	0.08
σ^2 sca	61.20	257.47	0.05	0.09	0.49	3.13	2.68	3.05	2.35	2.77
σ^2 A	80.56	710.68	0.04	0.10	0.13	1.15	0.40	0.04	0.74	0.16
σ^2 D	61.20	257.47	0.05	0.10	0.49	3.12	2.68	3.05	2.35	2.77
h^2 (n.s) %	0.36	0.50	0.24	0.38	0.12	0.25	0.09	0.01	0.14	0.03
σ^2 gca/ σ^2 sca	0.66	1.38	0.43	0.52	0.13	0.18	0.08	0.01	0.15	0.09

Table 2: Continue...

Genetic components	Days to 50% male flowers		Days to 50% female flowers		Number of male flowers		Number of female flowers		Node at first female flower	
	Rabi	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer
σ^2 gca	0.27	0.31	0.35	0.74	1.20	5.00	4.37	4.91	0.02	0.10
σ^2 sca	2.37	2.05	5.19	1.54	8.49	7.25	20.41	11.96	0.08	0.48
σ^2 A	0.53	0.61	0.71	1.48	2.41	10.01	8.75	9.83	0.04	0.20
σ^2 D	2.37	2.05	5.19	1.54	8.49	7.25	20.41	11.96	0.08	0.48
h^2 (n.s) %	0.12	0.16	0.08	0.31	0.11	0.33	0.26	0.37	0.20	0.28
σ^2 gca/ σ^2 sca	0.11	0.15	0.07	0.48	0.14	0.69	0.21	0.41	0.23	0.22

Table 2: Continue...

Genetic components	Days to first harvest of fruit		Number of fruits per vine		Weight of fruit per vine (kg)		Weight of fruit (g)		Length of fruit *(cm)	
	Rabi	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer
σ^2 gca	1.59	1.39	0.06	0.08	0.05	0.15	8330.63	17244.94	1.67	3.08
σ^2 sca	0.87	1.89	0.38	0.33	0.26	0.50	21542.55	39087.90	3.31	4.87
σ^2 A	3.17	2.78	0.12	0.15	0.10	0.30	16661.25	34489.88	3.34	6.17
σ^2 D	0.87	1.89	0.38	0.33	0.26	0.49	21542.55	39087.90	3.31	4.87
h^2 (n.s) %	0.23	0.22	0.55	0.29	0.24	0.35	0.39	0.45	0.48	0.52
σ^2 gca/ σ^2 sca	1.82	0.74	0.16	0.23	0.19	0.30	0.38	0.44	0.50	0.63

Table 2: Continue...

Genetic components	Diameter of fruit (cm)		Rind thickness (cm)		Pulp thickness (cm)		Fruit cavity (cm^2)		Weight of pulp per fruit (g)	
	Rabi	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer
σ^2 gca	0.04	0.22	0.0001	0.001	0.07	0.04	9.81	5.93	2843.41	7365.98
σ^2 sca	1.66	1.22	0.001	0.001	0.08	0.15	13.20	4.13	7118.54	20440.18
σ^2 A	0.09	0.43	0.0003	0.001	0.14	0.08	19.63	11.87	5686.81	14731.98
σ^2 D	1.66	1.23	0.001	0.001	0.08	0.15	13.20	4.13	7118.54	20440.18
h^2 (n.s) %	0.05	0.21	0.15	0.43	0.57	0.28	0.50	0.54	0.43	0.39
σ^2 gca/ σ^2 sca	0.03	0.18	0.10	0.48	0.89	0.27	0.74	1.43	0.40	0.36

Table 2: Continue...

Genetic components	Weight of (dry) seed per fruit (g)		T.S.S. (%)		Reducing sugar (%)		Non reducing sugar (%)		Tota sugar (%)		Ascorbic acid (mg/100g)	
	Rabi	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer	*Rabi*	Summer
σ^2 gca	0.50	0.64	0.12	0.30	0.26	0.35	0.05	0.05	0.13	0.10	3.32	3.41
σ^2 sca	1.83	2.06	0.50	1.39	0.45	0.50	0.16	0.10	0.35	0.05	14.87	7.56
σ^2 A	0.99	1.28	0.23	0.60	0.52	0.70	0.09	0.11	0.27	0.20	6.63	6.81
σ^2 D	1.83	2.06	0.49	1.39	0.45	0.50	0.16	0.10	0.35	0.05	14.87	7.55
h^2 (n.s) %	0.29	0.32	0.30	0.30	0.53	0.57	0.34	0.51	0.42	0.67	0.30	0.46
σ^2 gca/ σ^2 sca	0.27	0.31	0.24	0.22	0.58	0.70	0.28	0.53	0.39	2.03	0.22	0.45

branches (38%), Days to 50% female flowering (31%), number of male flowers (33%), number of female flowers (37%), number of fruits per vine (55%), Weight of fruit per vine (35%), Weight of fruit (45%), length of fruit (52%), rind thickness (43%), fruit cavity (54%), weight of pulp per fruit (39%), weight of seed per fruit (32%), reducing sugar (57%), non reducing sugar (51%), total sugar (67%) and Ascorbic acid (46%). In moderate heritability group (10-30%) for the *rabi* season the characters *viz*., Number of primary branches (24%), number of secondary branches (12%), Days to first female flower (14%), Days to 50% male flowering (12%), number of male flowers (11%), number of female flowers (20%), days required to first harvest of fruit (23%), weight of fruit per vine (24%), rind thickness (15%), weight of seed per fruit (29%), TSS (30%) and ascorbic acid (30%) However, in summer season, moderate group of heritability estimate recorded in number of secondary branches (25%), days to 50% male flowering (16%), node at which first female flower (28%), days required to first harvest of fruit (22%), number of fruits per vine (29%) and TSS (30%). In the low heritability group (5-10%) for the *rabi* season the characters days to first male flower (9%), days to 50% female flowering (8%), diameter of fruit (5%) While, in summer season days required to first male flower (10%) only. The values of high heritability indicate the characters influenced by environmental effect, so these characters improved by selection. The estimated moderate and low heritability showed predominance of non-additive gene actin and useful for heterosis breeding. Similar result were obtained by Mehta *et al.,* (2009) and Saha *et al.,* (2018).

Conclusion

The result of present investigation revealed that dominance variance (∂^2D) was greater than additive variance (∂^2A) in both the seasons indicating predominance of dominant gene action over additive gene action. The values of high heritability indicate the characters influenced by environmental effect, so these characters improved by selection. The estimated moderate and low heritability showed predominance of non-additive gene actin and useful for heterosis breeding.

Referances

Anonymous (2024). Department of agriculture and farmers welfare.

Mehta, R., Singh D. and Bhalala M.K. (2009). Genetic variability, heritability and genetic advance in muskmelon (*Cucumis melo* L.). *Vegetable Science*. **36(2)**, 248-250.

Munger, H.M. and Robinson R.W. (1991). Nomenclature of *cucumis melo* L. Cucurbit Genetics Cooperative Report **14**, 43-44 (article 14).

Pandey, S., Jha A., Kumar S. and Rai M. (2010). Genetics and heterosis of quality and yield of pumpkin. *Indian journal of horticulture,* **67(3)**, 333-338.

Roy, A., Bal S.S., Fergany M., Kaur S., Singh H. and Malik A.A. (2012). Wild melon diversity in India. *Genetic Resources and Crop Evolution*. **59(5)**, 755-767.

Saha, K., Choudhary H., Mishra S. and Mahapatra S. (2018).

Gene action of nutritional and qualitative traits in muskmelon (*Cucumis melo* L.). *International Journal of Chemical Studies*. **6(3)**, 3094-9047.

Shashikumar, K.T. and Pitchaimuthu M. (2016). Heterosis and combining ability analysis of quantitative and qualitative traits in muskmelon (*Cucumis melo* L.). *International Journal of Agricultural Science*, **6**, 341-348.

Singh, V., and Vashisht V.K. (2018). Heterosis and combining ability for yield in muskmelon (*Cucumis melo* L.). *International Journal of Current Microbiolgy and Applied Sciences*, **7(8)**, 2996-3006.

Whitaker, T.W. and Devis G.N. (1962). The cucurbits, Botany, Cultivation and utilization. Leonard Hill (Books) Ltd., London, 250.