

Original Research Article

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Inheritance Pattern of F₂ Population of Melon (*Cucumis Melo. L*) for Various Fruit Traits and Ovary Characters

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ABSTRACT

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In our present investigation we reported the study on inheritance pattern of F₂ population of melon (*Cucumis melo. L*) for various fruit traits and ovary characters. A chi square test was done to study the segregation pattern of 151 F₂ lines of melon for various fruit and ovary traits like ovary pubescence, ovary shape, fruit shape in longitudinal section, fruit shape at peduncle end, fruit grooves, sutures on fruits, fruit surface netting, firmness of flesh and fruit taste. Monogenic complete dominance was observed for ovary shape, firmness of flesh and fruit taste. Incomplete dominance was observed for fruit shape in longitudinal section. Digenic control was observed for ovary pubescence, fruit shape at peduncle end, fruit grooves, sutures on fruits and fruit surface netting.

Introduction

Melon (*Cucumis melo* L., 2n=2x=24) of Cucurbitaceae family has great importance because of its commercial value and is grown mostly for its fruits. The center of origin of melon was believed to be East Africa, but the recent literature suggests the Asiatic origin (Schaefer *et al.*, 2009 and Sebastian *et al.*, 2010). *C. melo* is more diverse and polymorphic than other species in the genus (Pitrat *et al.*, 2000) and such polymorphism is highest with respect to the fruit related traits such as shape, size, colour, texture, taste and

composition. Melons play a significant role in supplying fresh fruits and vegetables used for salad, cooking, and dessert and it can also be candied. They contain high amount of water, rich in antioxidants, primary metabolites (protein, lipid and carbohydrate), several vitamins (Vitamin A, Vitamin B1, Vitamin B2, Vitamin B6, etc.) and minerals like potassium, calcium, iron, magnesium and phosphorous. The fruits have approximately 45 kcal energy per 100 g (Salunkhe and Kadam, 1998). Melon plants also contain various bioactive principles including elaterin, stigmasterol, spinosterol and the antitumour

principle cucurbitacin. Duke and Ayensu (1985). Genetic variability in the genome is a pre requisite for crop improvement. The utilization of available genetic material in further breeding programme depends on the knowledge on extent of variability. The early segregating generations like F₂s provide wide variability for different traits and the inheritance pattern of characters could also be understood. F₂s also serve as mapping population to map genes and quantitative trait loci (QTL). In this context the present investigation was undertaken to study inheritance pattern using F₂ population.

Materials and Methods

The study consists of parents, Kashi Madhu and COHB38, F₁ and 151 F₂ lines. The experiment was conducted in summer 2016 at College of Horticulture, Bengaluru. The F₂s were un-replicated and parents and F₁ were replicated four times. The experiment was conducted in green house condition with spacing of 2m x 0.45m. Observations were recorded on all F₂s of Kashi Madhu X COHB38, F₁ and parents. Morphological characterization of melon F₂s was done as per PPV & FRA DUS guidelines. A chi square analysis was done to study the inheritance pattern of ovary and fruit traits for the data collected in this study. Characters of parents and F₁ given in the table 1 for particular ovary characters and fruit traits.

Results and Discussion

According to data given in table 2, Inheritance of ovary pubescence in melon F₂s observed three classes, 40 lines with presence of pubescence (dense), sparse pubescence in 101 lines and pubescence was absent in 10 lines. The chi square calculated ($\chi^2 = 0.019$; P = 0.990) discrepant with Mendelian 3: 1 ratio and fits into 9:6:1 ration indicated digenic control. Shape of the ovary in melons was observed as elongated (104) and round (47).

The segregation pattern ($\chi^2 = 0.082$; P = 0.740) was in accordance with hypothetical 3:1 ratio clearly indicated that the ovary shape is controlled by single dominant gene. Fruit shapes in melon were found to be oblate (42 lines), ovate (36 lines) and intermediates (73 lines) in F₂ population of melon. The calculated chi square value ($\chi^2 = 0.725$; P = 0.912) was deviated from 3:1 ratio and fitted into 1:2:1 indicated the nature of incomplete dominant gene action in the segregation pattern of fruit shape. Evaluation of fruit shape at peduncle end observed three classes such as truncate (21 lines), pointed (78 lines) and round (52 lines) in the present study. Test of goodness of fit revealed that the calculated chi square value was 0.002 with a probability of 0.990 and the ratio is deviated from hypothetical 3:1 ratio and showed a significant fit with expected 9:6:1 ratio, indicated that more than one gene control the inheritance. Inheritance pattern of fruit grooves in melon F₂s observed two classes, grooves were present in 139 lines and absent in 12 lines. The chi square calculated ($\chi^2 = 0.389$; P = 0.532) was discrepant with mendelian 3: 1 ratio and fitted into 15:1 ratio indicating the digenic control for this trait. Presence or absence of sutures was observed on fruits of individual F₂ plants. Out of 151 Plants, 135 plants were having sutures on fruits whereas sutureless fruits were found in 16 plants. It was tested against the expected Mendelian ratio of 3:1 using test for goodness of fit. The calculated chi square value (0.012) with probability of 0.920 was in agreement with 13:3 revealed the digenic control on fruit suture. Among 151 Plants, fruit surface netting was present in 83 plants and absent in 68 plants. The chi square calculated ($\chi^2 = 0.748$; P = 0.387) was discrepant with mendelian 3:1 ratio and fitted into 9:7 ratio indicating the digenic control for this trait. Flesh firmness of fruit segregated into two classes such as crisp (39 lines) and soft (112 lines). The calculated chi square value ($\chi^2 = 0.814$; P = 0.366) was fitted

significantly in accordance with mendelian 3:1 indicated that the inheritance of flesh firmness is controlled by monogenic dominance. Fruit taste was observed in two classes, sweet (24 lines) and less sweet (127 lines) in the present study. Test of goodness of fit was done to know the segregation pattern in F₂ population. It revealed that the calculated chi square value was 0.012 with a probability of 0.912 and showed a significant fit with expected 3:1 ratio that indicated the monogenic dominance for this trait.

The ovary pubescence was polymorphic in F₂s i.e. absent and present (sparse and dense). The Presence of ovary pubescence was noticed earlier by, Kirkbride (1993), Stepansky *et al.*, (1999) and Sudhakara (2014) in melons. The variation in ovary characters is due to the genetic nature of plants under the influence of environmental factors. Based on visual observations, ovary shape was categorised into elongated and round ovary. Elongated ovary (85 F₂, COHB38 and F₁), medium elongated ovary (19 F₂), medium round ovary (2 F₂) and round shaped ovary (45 F₂s and Kashi Madhu). This is in confirmation with the studies conducted by Stepansky *et al.*, (1999) in melons. Ovary shape is controlled by single dominant gene where, elongated ovary is dominant over round but Perin *et al.*, (2002) reported six QTLs for ovary shape. A wide variation was found in F₂s for shape of fruit at peduncle and blossom end. Similar observations were made by Stepansky *et al.*, (1999); Pitrat (2013) and Sudhakara (2014) in muskmelon in their studies. In the present study, some F₂s were found to have grooves on fruit surface and there was no grooves on other F₂s. These observations were in collaboration with Stepansky *et al.*, (1999), Pitrat (2013) and Sudhakara (2014) in muskmelon. Inheritance pattern of fruit grooves in melon F₂s found to be controlled by more than one gene. This is in association with Takada *et al.*, (1975) where he reported that ridge in fruit is recessive to ridge less.

Fruit suture was found on 135 F₂s including Kashi Madhu and F₁. Rest of the F₂s and COHB38 were suture less. These observations were in accordance with Stepansky *et al.*, (1999), Pitrat (2013) and Sudhakara (2014) in muskmelon. Inheritance of fruit suture found to be controlled by more than one gene. These were in collaboration with Perin *et al.*, (1999) and Hagiwara and Kamimura (1936) where they reported sutureless is recessive to sutured nature. Fruit surface netting is one of the important traits for shelf life analysis in melons. Netted melons have less storage life, that may be a result of the presence of fissured epidermal tissue (netted), which is an elaborated system of lenticels as they are more prone to loose moisture and also the netted rind fruit melons produce higher amounts of ethylene at the stage of ripening (Pratt, 1971). In the present study, presence or absence of netting was studied including density of netting on fruits.

Variability in melon fruit surface netting was also observed in studies by Bokashi *et al.*, (1992), Stepansky *et al.*, (1999), Hossein *et al.*, (2012), Pitrat (2013), Sudhakara (2014) and Mamatha (2016) in muskmelon. Flesh firmness and fruit flavour contribute for the overall quality of the fruit. The flesh firmness in 151 F₂s varied from firm to soft flesh. Similar results were recorded earlier by Khokhar *et al.*, (1988) in muskmelon cultivars, Pitrat (2013) in wild and cultivated melons Sudhakara (2014) and Mamatha (2016) in muskmelon. The segregation of fruit flesh firmness in our study revealed that the inheritance of flesh firmness is controlled by monogenic dominant gene which is in collaboration with Chadha *et al.*, (1972) and Ganeshan (1988), where they reported juicy flesh is dominant over crisp and mealy flesh is dominant over crisp texture. Fruit taste was sensory evaluated for its sweetness. Fruits of 24 F₂ including Kashi Madhu were sweet in taste, 127 including COHB38 and F₁ were less sweet and sour taste found in 27 F₂.

Table.1 A summary of ovary and fruit characters of parents and the hybrid

Sl. No.	Characters	Kashi Madhu	COHB38	Kashi Madhu × COHB38
1	Ovary pubescence	Dense	Absent	Sparse
2	Ovary shape	Round	Elongated	Elongated
3	Fruit shape at longitudinal section	Oblate	Ovate	Elongated globe
4	Fruit shape in peduncle end	Truncate	pointed	Truncate
5	Fruit grooves	Present	Absent	Absent
6	Fruit sutures	Present	Absent	Present
7	Fruit surface netting	Present	Absent	Absent
8	Flesh firmness	Crisp	Soft	Soft
9	Fruit taste	Sweet	Less sweet	Less sweet

Table.2 Chi square analysis of 151 melon F₂ lines of Kashi Madhu × COHB38 for ovary characters and fruit traits

Sl. No.	Characters	Categories	O	E	Ratio	χ^2	P	Gene action
1	Ovary pubescence	Dense	40	56.66	9:6:1	0.019	0.990	Digenic
		Sparse	101	84.94				
		Absent	10	9.44				
2	Ovary shape	Elongated	104	113.25	3:1	0.082	0.744	Monogenic complete dominance
		Round	47	37.75				
3	Fruit shape in longitudinal section	Oblate	42	37.75	1:2:1	0.725	0.912	Monogenic, Incomplete dominance
		Intermediate	73	75.50				
		Ovate	36	37.75				
4	Fruit shape at peduncle end	Truncate	21	9.44	9:6:1	0.002	0.990	Digenic
		Pointed	78	84.94				
		Round	52	56.66				
5	Fruit grooves	Present	139	141.56	15:1	0.389	0.532	Digenic
		Absent	12	9.44				
6	Sutures	Suture	135	122.68	13:3	0.012	0.920	Digenic
		Sutureless	16	28.32				
7	Fruit surface netting	Present	83	84.94	9:7	0.748	0.387	Digenic
		Absent	68	66.03				
8	Flesh firmness	Soft	112	113.25	3:1	0.814	0.366	Monogenic complete dominance
		Crisp	39	37.75				
9	Fruit taste	Less sweet	127	113.25	3:1	0.012	0.912	Monogenic complete dominance
		Sweet	24	37.75				

O - Observed value

E – Expected value

*P- Probability at 0.05%

High value of total sugars is desirable because of consumer preferences but the sugar content varies depending upon the different fruit parts in melon (Chrost and Schmitz, 1996; Yativ *et al.*, 2010) and also variation in sucrose levels accounts for the genetic differences in total sugar content and for the natural variability within a particular cultivar due to environmental differences (Stepansky *et al.*, 1999). Inheritance of fruit taste was found to be monogenic dominant, less sweet fruits were dominant over sweet typed. This in in association with Kubicki (1962) where it was recorded sour is dominant over sweet fruit.

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