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# Studies on Genetic variability for quantitative and qualitative traits in Muskmelon (*Cucumis melo* L.)

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**Abstract**

Muskmelon (*Cucumis melo* L.) is one of the members of Cucurbitaceae family with diploid chromosome number 2n=2X=24. It is thought to have originated in tropical Africa. The experiment comprises of 33 genotypes of muskmelon collected from various location. During the months of February to May 2022, the plants were raised in three replications with spacing of 3 m x 60 cm using a Randomized Block Design (RBD) at Puthur village, Thalaivasal taluk, Salem district. The result shows, estimates of high PCV and GCV (>20%) were recorded in fruit yield per plant (60.16 & 60.09) followed by seed yield per fruit (41.70 & 41.62), average fruit weight per plant (41.56 & 41.49), seed yield index (39.50 & 39.42) respectively. Highest heritability (>60%) along with high genetic advance as per mean (>20%) were noticed in fruit yield per plant (99.79 & 98.55) followed by average fruit weight per plant (99.66 & 85.32), seed yield index (99.59 & 81.03) and seed yield per fruit (99.58 & 85.55) respectively. It indicates the presences of additive gene action for these characters. Therefore, selection may be effective for these characters.

**Key words :** Genetic variability, Quantitative & qualitative traits, Muskmelon, Seed yield index.

Muskmelon (*Cucumis melo* L.) is one of the most popular dessert vegetable crops grown worldwide. It is also referred to as wholesome food or kharbooz. It belongs to the Cucurbitaceae family, has the chromosomal number 2n=2X=24, and is thought to have originated in tropical Africa. Muskmelon is heavily cross-pollinated due to the presence of andromonoecious sex form. The fruit is known as pepo in botanical terms. Muskmelon

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is one of the most prized summer fruits, because of its musky smell, sweet taste and refreshing impact, it is regarded as the most favoured vegetable. It is a good source of vitamins, minerals, and dietary fibre. According to Premnath and Swamy[16], muskmelons are 94% water, 5% carbohydrates, 1% protein, 3420 IU of vitamin A, and 33 mg of vitamin C. muskmelon is one of the main cucurbitaceous crops grown in riverbeds, it accounts for 80% of the total area used for muskmelon cultivation[8]. In our nation, 59 thousand hectares of muskmelons are grown, yielding 1.3 million tonnes per year (Depart. Agri. Co & Farmers Welfare, 2019-2020). Genetic diversity is the most crucial factor in crop improvement programmes and a must for any successful breeding programme. According to Vavilov[22], there is a greater opportunity to choose the appropriate genotypes from a wide range of variability. The heritability of a trait reflects the extent to which it can be passed on from one generation to the next. Pandey *et al.,*[11] suggested that heritability combined with high genetic advance as percent of mean would be more accurate to predicting the best genotypes for yield and its attributing characters. The goal of the current study is to determine the degree of morphological variation found among 33 genotypes of muskmelon germplasms and to calculate the genotypic and phenotypic components of variation in growth, earliness, yield, and quality related parameters.

Thirty three different genotypes of muskmelon were used in the current experiment. During the months of February to May 2022, the plants were produced in three replications with spacing of 3 m x 60 cm using a Randomized Block Design (RBD) at Puthur village, Thalaivasal taluk, Salem district. A successful crop was raised by adhering to advised cultural customs. Five plants from each entry in each replication were chosen at random to record observations on days to first female flower opening, first female flowering node, number of vines per plant, vine length (cm), sex ratio, days to first fruit harvest, average fruit weight per plant (g), fruit length (cm), fruit girth (cm), number of fruits per plant, rind thickness (cm), flesh thickness (cm), seed cavity length (cm), seed cavity width (cm), total soluble solids (%), titerable acidity (%), ascorbic acid content (mg/100g), seed yield per fruit (g), 100 seed weight (g), seed yield index and fruit yield per plant (kg). Using the ANOVA technique, the total variation among the 33 genotypes for each character was pertained into sources related to genotype, replication, and error (Panse and Sukhatme[12]). Burton[1] method was used to calculate the genetic variability parameters known as the genotypic and phenotypic coefficients of variation. The formula provided by Lush [6] was used to assess heritability in a broad sense, while the formula provided by Johnson *et al.,*[5] was used to calculate genetic advance as percent mean.

For all of the investigated characters, Table-1 displays genotype differences that are very significant. It demonstrates that the genotypes under study had adequate levels of diversity. To improve any crop, this kind of extreme variance was necessary. Based on the maximum and minimum range of mean values, Table-1 showed that genotypes had the necessary level of variation. Days to the first fruit harvest (79.30 - 96.60) had the widest range of variability, followed by ascorbic acid content (9.07 - 25.85), days to first female flower opening (43.60 - 56.60) and sex ratio (10.20 - 21.79).

For all of the characteristics, phenotypic variances showed higher maximum values than genotypic variances (Table-2). The highest phenotypic variance (PV) was observed in ascorbic acid content (24.36) followed by days to first fruit harvest (22.95), days to first female flower opening (15.70) and sex ratio (8.25). The lowest phenotypic variance was found in titerable acidity (0.00317), rind thickness (0.0171) and average fruit weight per plant (0.208). The maximum genotypic variance (GV) was recorded in ascorbic acid content (24.21) followed by days to first fruit harvest (19.06), days to first female flower opening (14.49) and sex ratio (8.07). The lowest genotypic variance was registered in titerable acidity (0.00315), rind thickness (0.0170) and average fruit weight per plant (0.207). For all the traits, there is a smaller gap between phenotypic and genotypic variance, indicating that their environmental influences were less pronounced. This implies that simple phenotypic selection could enhance the good breeding value of all of these characters. Similar findings were reported by Reddy *et al.,*[18] in muskmelon for first female flowering node, fruit diameter, number of fruits per vine, fruit cavity length, fruit cavity width, rind thickness, pulp thickness and seed yield; and Prajapati *et al.,*[15] in muskmelon for number of vines per plant, fruit length, TSS and yield per plant; Mishra *et al.,*[7] in muskmelon for days to first female flowering; Naroui Rad *et al.,*[9] in muskmelon for days to maturity, fruit length and fruit width; Ibrahim[3] in sweet melon for fruit weight and total yield per plant.

For all of the investigated traits, the phenotypic coefficient of variation (PCV) was greater than the genotypic coefficient of variation (GCV) (Table-2). The estimates of high PCV and GCV (>20%) were recorded in fruit yield per plant (60.16 & 60.09) followed by seed yield per fruit (41.70 & 41.62), average fruit weight per plant (41.56 & 41.49), seed yield index (39.50 & 39.42), total soluble solids (33.35 & 33.25), ascorbic acid content (30.62 & 30.52), vine length (28.18 & 28.05), titerable acidity (26.64 & 26.53), first female flowering node (26.46 & 26.36), rind thickness (24.80 & 24.73), 100 seed weight (24.26 & 24.16), flesh thickness (22.10 & 21.99), number of fruits per plant (21.43 & 21.31) and fruit length (20.21 & 20.09) respectively. In light of this, these traits would be chosen according to their genotypic performance. Most traits show the highest values of GCV, indicating substantial genetic variability in the genotypes and little environmental influence. These characters have a lot of scope for enhancement through direct selection. These results were coincide with similar results obtained by Prajapati *et al.,*[15] in muskmelon for total soluble solids, fruit weight and fruit yield per plant; Pandey *et al.*,[11] in snapmelon for number of fruits per plant; Pasha *et al.,*[13] in snap melon for node at first female lower appearance, 100 seed weight and flesh thickness; Indraja *et al.,*[4] in muskmelon for flesh thickness and titrable acidity. Naroui Rad *et al.*,[9] in muskmelon for fruit length. Singh *et al.* (2016) in melon for fruit length, fruit diameter, flesh thickness and ascorbic acid content.

The estimates of moderate PCV and GCV (10% - 20%) were observed in seed cavity length (18.06 & 17.92) followed by number of vines per plant (17.98 & 17.82), fruit girth (17.17 & 17.03), seed cavity width

(16.65 & 16.49) and sex ratio (15.77 & 15.60) respectively. It indicates the presence of moderately high variability. Through selection in subsequent generations, these traits would be used for improvement. These results were in conformity with Reddy *et al.*,[18] in muskmelon for number of primary branches per vine and fruit cavity width; Prajapati *et al.,*[15] in muskmelon for fruit girth; Gaikwad *et al.,*[2] in muskmelon for sex ratio.

Table-1. Analysis of variance, mean and rage for growth, yield and quality parameters of muskmelon

| S. no. | Characters | Mean sum of square | | | Mean ± SEm | Range | |
|---|---|---|---|---|---|---|---|
| | | Treatment | Replication | Error | | Minimum | maximum |
| 1 | DFFFO | 44.67** | 88.678 | 1.210 | 49.17±0.64 | 43.60 | 56.60 |
| 2 | FFFN | 13.09** | 2.1986 | 0.0318 | 7.92±0.10 | 4.30 | 11.60 |
| 3 | NVPP | 1.398** | 0.54167 | 0.00832 | 3.82±0.05 | 2.50 | 5.50 |
| 4 | VL | 1.55** | 0.25699 | 0.00468 | 2.56±0.04 | 1.35 | 4.22 |
| 5 | SR | 24.38** | 12.1375 | 0.1801 | 18.21±0.25 | 10.20 | 21.79 |
| 6 | DFFH | 61.07** | 285.512 | 3.897 | 88.15±1.14 | 79.30 | 96.60 |
| 7 | AFW | 0.62** | 0.04138 | 0.00068 | 1.10±0.02 | 0.51 | 2.53 |
| 8 | FL | 12.61** | 3.7130 | 0.0519 | 10.18±0.13 | 8.10 | 17.70 |
| 9 | FG | 13.37** | 5.4385 | 0.0732 | 12.36±0.16 | 9.00 | 19.10 |
| 10 | NFPP | 0.816** | 0.21341 | 0.00309 | 2.44±0.03 | 1.40 | 3.60 |
| 11 | RT | 0.05** | 0.010074 | 0.000149 | 0.53±0.007 | 0.30 | 0.80 |
| 12 | FT | 0.79** | 0.18891 | 0.00255 | 2.33±0.03 | 1.30 | 3.50 |
| 13 | SCL | 4.89** | 1.8444 | 0.0260 | 7.10±0.09 | 5.10 | 11.60 |
| 14 | SCW | 4.98** | 2.2319 | 0.0319 | 7.79±0.10 | 4.70 | 11.20 |
| 15 | TSS | 16.84** | 1.8585 | 0.0328 | 7.12±0.11 | 4.21 | 12.50 |
| 16 | TA | 0.01** | 0.0016090 | 0.0000255 | 0.21±0.003 | 0.11 | 0.28 |
| 17 | AAC | 72.77** | 9.434 | 0.153 | 16.12±0.23 | 9.07 | 25.85 |
| 18 | SYPF | 16.42** | 1.1115 | 0.0229 | 5.62±0.09 | 2.65 | 12.69 |
| 19 | 100 SW | 1.19** | 0.22998 | 0.00305 | 2.60±0.032 | 2.01 | 4.51 |
| 20 | SYI | 14.46** | 1.0912 | 0.0196 | 5.57±0.08 | 2.46 | 11.81 |
| 21 | FYPP | 8.59** | 0.2655 | 0.0059 | 2.82±0.04 | 1.12 | 7.41 |

*Significant at 5% level, **significant at 1% level.

DFFO - days to first female flower opening, FFFN - first female flowering node, NVPP - number of vines per plant, VL - vine length (cm), SR- sex ratio, DFFH - days to first fruit harvest, AWF - average fruit weight (g), FL - fruit length (cm), FG - fruit girth (cm), NFPP - number of fruits per plant, RT - rind thickness (cm), FT - flesh thickness (cm), SCL - seed cavity length (cm), SCW - seed cavity width (cm), TSS - total soluble solids (%), TA - titrable acidity (%), AAC – ascorbic acid content (mg/100g), SYPF - seed yield per fruit (g), 100 SW - 100 seed weight (g), SYI - seed yield index and FYPP - fruit yield per plant (kg).

Table-2. Estimates of variance, coefficient of variation, heritability and genetic advance as percentage of mean for growth, yield and quality parameters of muskmelon

| S. no | Characters | PV | GV | PCV | GCV | Heritability | Genetic Advance as percentage of mean |
|---|---|---|---|---|---|---|---|
| 1 | DFFFO | 15.70 | 14.49 | 8.06 | 7.74 | 92.29 | 15.32 |
| 2 | FFFN | 4.39 | 4.35 | 26.46 | 26.36 | 99.27 | 54.10 |
| 3 | NVPP | 0.47 | 0.46 | 17.98 | 17.82 | 98.24 | 36.39 |
| 4 | VL | 0.521 | 0.516 | 28.18 | 28.05 | 99.10 | 57.52 |
| 5 | SR | 8.25 | 8.07 | 15.77 | 15.60 | 97.82 | 31.78 |
| 6 | DFFH | 22.95 | 19.06 | 5.44 | 4.95 | 83.02 | 9.30 |
| 7 | AFW | 0.208 | 0.207 | 41.56 | 41.49 | 99.66 | 85.32 |
| 8 | FL | 4.24 | 4.19 | 20.21 | 20.09 | 98.78 | 41.13 |
| 9 | FG | 4.50 | 4.43 | 17.17 | 17.03 | 98.37 | 34.80 |
| 10 | NFPP | 0.274 | 0.271 | 21.43 | 21.31 | 98.87 | 43.65 |
| 11 | RT | 0.0171 | 0.0170 | 24.80 | 24.73 | 99.42 | 50.79 |
| 12 | FT | 0.27 | 0.26 | 22.10 | 21.99 | 99.02 | 45.08 |
| 13 | SCL | 1.65 | 1.62 | 18.06 | 17.92 | 98.42 | 36.63 |
| 14 | SCW | 1.68 | 1.65 | 16.65 | 16.49 | 98.10 | 33.65 |
| 15 | TSS | 5.64 | 5.60 | 33.35 | 33.25 | 99.42 | 68.30 |
| 16 | TA | 0.00317 | 0.00315 | 26.64 | 26.53 | 99.20 | 54.43 |
| 17 | AAC | 24.36 | 24.21 | 30.62 | 30.52 | 99.37 | 62.67 |
| 18 | SYPF | 5.49 | 5.46 | 41.70 | 41.62 | 99.58 | 85.55 |
| 19 | 100 SW | 0.398 | 0.395 | 24.26 | 24.16 | 99.25 | 49.59 |
| 20 | SYI | 4.83 | 4.81 | 39.50 | 39.42 | 99.59 | 81.03 |
| 21 | FYPP | 2.87 | 2.86 | 60.16 | 60.09 | 99.79 | 98.55 |

PV - Phenotypic variance, GV- Genotypic variance, PCV- Phenotypic coefficient of variation, GCV-Genotypic coefficient of variation.

DFFO - days to first female flower opening, FFFN - first female flowering node, NVPP - number of vines per plant, VL - vine length (cm), SR- sex ratio, DFFH - days to first fruit harvest, AWF - average fruit weight per plant (g), FL - fruit length (cm), FG - fruit girth (cm), NFPP - number of fruits per plant, RT - rind thickness (cm), FT - flesh thickness (cm), SCL - seed cavity length (cm), SCW - seed cavity width (cm), TSS - total soluble solids (%), TA - titerable acidity (%), AAC-Ascorbic acid (mg/100g), SYPF - seed yield per fruit (g), 100 SW - 100 seed weight (g), SYI - seed yield index and FYPP - fruit yield per plant (kg).

Whereas the low PCV and GCV (<10%) were noticed in days to first female flower opening (8.06 & 7.74) and days to first fruit harvest (5.44 & 4.95) respectively. It demonstrates that these traits have a limited genetic background. These traits are not helpful for crop selection or future improvement since they have minimal variability. These results are similar with the findings of earlier workers viz., Sulochana *et al.,*[20] in snapmelon for days to first female flower opening and days to first fruit harvest. Rad *et al.,*[17] in melon for days to first fruit harvest. Pandey *et al.,*[11] in snapmelon for days to first female flower anthesis. Indraja *et al.,*[4] in muskmelon for days to first female flower opening and days to first fruit harvest. Mishra *et al.,*[7] in muskmelon for days to first female flowering.

The findings demonstrate that every character under this study displayed highest heritability (>60%) (Table-2). Fruit yield per plant (99.79) had the highest heritability, followed by average fruit weight per plant (99.66), seed yield index (99.59) and seed yield per fruit (99.58). It indicates that all the studied traits are less influenced by the environment. The results shows (Table-3) the high genetic advance as per mean (>20%) were exhibited by all the characters except days to first female flower opening and days to first fruit harvest. The maximum GAM was recorded in fruit yield per plant (98.55) followed by seed yield per fruit (85.55), average fruit weight per plant (85.32) and seed yield index (81.03). Whereas the moderate GAM (10-20%) and low GAM (<10%) were noticed in days to first female flower opening (15.32) and days to first fruit harvest (9.30) respectively.

The estimates of heritability alone fail to indicate the response to selection. Hence, the estimates of heritability appear to be much meaningful when accompanied with estimates of genetic advance as percentage of mean[5]. High heritability (>60%) coupled with high genetic advance as per mean (>20%) were noticed in first female flowering node, number of vines per plant, vine length, sex ratio, average fruit weight per plant, fruit length, fruit girth, number of fruits per plant, rind thickness, flesh thickness, seed cavity length, seed cavity width, total soluble solids, titerable acidity, ascorbic acid content, seed yield per fruit, 100 seed weight, seed yield index and fruit yield per plant. It indicates that these characters were strong influenced by the additive gene action. Hence, it would be more effective to make a simple phenotypic selection based on these traits. Similar results find by Tomar *et al.,*[21] in muskmelon for titerable acidity and ascorbic acid content; Sulochana *et al.,*[20] in snapmelon for average fruit weight per plant, fruit length, fruit girth, number of fruits per plant, total soluble solids, titerable acidity and ascorbic acid content; Reddy *et al*.,[18] in muskmelon for fruit length, fruit weight, seed cavity length, seed cavity width, rind thickness, total soluble solids and seed yield per fruit. Pasha *et al.,*[13] in snap melon for 100 seed weight, flesh thickness and yield per plant; Indraja *et al.,*[4] in muskmelon for first pistillate flower appeared and ratio of male and female flowers. Gaikwad *et al.,*[2] in muskmelon for sex ratio. Smita *et al.,*[19] in melon for ascorbic acid content and yield per plant. High heritability (>60%) coupled with moderate genetic advance as per mean (10-20%) were recorded in days to first female flower. It is also reveals the presences of additive gene action for this trait. Therefore, selection for this trait made based on phenotypic performance would be more effective. These results were conformity with earlier findings Mishra *et al.,*[7] in muskmelon for days to first female flowering. High heritability (>60%) coupled with low genetic advance as per mean (<10%) were reported in days to first fruit harvest, it indicates the expression of this character was based on the presences of non-additive gene action. Hence, the selection may be ineffective, which could be further exploited through heterosis breeding. The results were conformity with Ibrahim[3] in sweet melon for number of fruits per plant.

Since the majority of the characters in the current study exhibited high heritability long with high genetic advance as per mean, it was determined that numerous additive genes were present for governing these characters. The amount of heritable variation was higher in those genotypes, particularly in terms of fruit yield per plant, average fruit weight per plant, seed yield index and seed yield per fruit. Therefore, these traits have greater scope for further improvement through selection.

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