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# Genetic Studies for Horticultural Traits in F3 Generations of Long Melon (*Cucumis Melo Var. Utilissimus* Duthie and Fuller)

**Anusha M. V[1*], Sood Meenakshi[2], Prakash B. G[3], Anjanappa M[4], Mushrif S. K[5] , Jayappa J[6]**

*[1]Department of Vegetable Science, College of Horticulture, India; [2]Department of Biotechnology and Crop Improvement, College of Horticulture, India; [3]Department of Vegetable Science, College of Horticulture, India; [4]Department of Plant Pathology College of Horticulture, India; [5]Department of Entomology, College of Horticulture, India; [6]Department of Vegetable Science, University of Horticulture Sciences, India*

## ABSTRACT

Sixty longmelon progenies/genotypes of three crosses viz., LM 3 × AS, LM 9 × AS, LM 15 × AS along with its parents and check variety was evaluated in F3 generation for quantitative and qualitative traits at College of Horticulture, Kolar, Karnataka. Analysis of variance revealed significant high amount of variability among the progenies for most of the characters studied. The ranges of mean values revealed sufficient variation for all the traits under study. The phenotypic coefficient of variation (PCV) value was found to be higher than the genotypic coefficient of variation value (GCV) and narrow differences was observed between PCV and GCV values for most of the characters under studied, indicates less environmental influence. High estimates of heritability coupled with high values of genetic advance over mean (GAM) were observed for characters viz., days to 50% germination, pericarp thickness, duration of harvesting, node at which first male flower anthesis, node at which first female flower anthesis, sex ratio, fruit length, average fruit weight, fruit yield and shelf life. This indicates the characters were governed by additive genes; further crop improvement can be done through simple selection for these characters.

**Keywords:** Genetic variability; Phenotypic coefficient of variation; Genotypic coefficient of variation; Heritability; Genetic advance; Long melon

## INTRODUCTION

Long melon (*Cucumis melo var. utilissimus* Duthie and Fuller), popularly known as "Kakri" or "Tar", is a minor and underutilized cucurbitaceous vegetable crop having diploid chromosome number of 24 [1]. It is grown under tropical and subtropical regions of India and popular in countries like Turkey, Saudi Arabia, Egypt, and Pakistan. It is also called as Serpent melon, Yard long cucumber, Armenian cucumber and snake cucumber. After fruit set ovaries grow faster, producing hissing sound in the night hence called serpent melon. It is used as summer cool nutritive fruit and good alternate of cucumber in salad [2]. It can be grown as river bed crop of North Indian states of Uttar Pradesh, Punjab and Haryana during November-December [3].

Long melon is sensitive to frost and hot, cannot tolerate frost during winter season. Dry weather favours vegetative growth and fruit development. Optimum temperature for better fruit development is 24°C to 30°C. It can be grown in well drained loam and sandy loam soils having pH of 5.5 to 6.8. Plants are monoecism annual with yellow corolla, petals are united, and five in number and stamens are attached to calyx tubes with inferior ovary [4].

Long melon is minor and underutilized crop with plenty of health benefits but lack of suitable varieties and hybrids with desirable traits is one of the reasons for its ignorance. This necessitates the need of crop improvement work in this crop.

## MATERIALS AND METHODS

The research was undertaken at College of Horticulture, Tamaka, Kolar (Karnataka) India, during the Kharif 2020. The experimental material consisted of 60 F3 progenies of three cross combination viz., LM 3 × AS, LM 9 × AS and LM 15 × AS and laid out in a completely randomized block design with two replications. All the progenies seeds were sown as plant to progeny rows along with its parents (LM 3, LM 9, LM 15 and AS) and check (10

**Correspondence to:** Anusha MV, Department of Vegetable Science, College of Horticulture, Bengaluru; Email: mvanusha2371@gmail.com

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plants were planted per replication per genotype/progeny). Seedlings were raised in portrays and transplanted at 20 days age to the raised beds at spacing of 1.5 m × 0.75 m

Observations were recorded on five randomly selected plants from each progeny in each replication for 20 characters number of days to first germination, number of days to 50 per cent germination, days to first male flower anthesis, days to first female flower anthesis, days taken to 50 per cent female flowering, node at which first male flower appeared, node at which first female flower appeared, vine length (cm), days to first harvest, days to last harvest, sex ratio, duration of harvesting, number of fruits per vine, average fruit weight (g), fruit length (cm), fruit diameter (cm), fruit yield per vine (kg), water content (%), pericarp thickness (cm), shelf life (days) data was subjected to statistical analysis. Qualitative traits fruit colour, fruit shape and fruit surface was recorded by visual observations.

Phenotypic variance (PV), genotypic variances (GV), Phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV) and heritability (h2) in broad sense were estimated according to the formula of [5]. The heritability percentage was categorized as suggested by [6]. PCV and GCV were classified as suggested by [7]. Genetic advance was estimated and categorized by the method formulated by [6].

## RESULT AND DISCUSSION

Analysis of variance revealed significant amount of variability among the progenies for most of the characters studied except for number of days to first germination and shelf life in LM 3 × AS and LM 15 × AS. Days taken to 50% female flowering and duration of harvesting in LM 9 × AS. However, the analysis of variance by itself is not enough to explain all the inherent genotypic variance in the genotypes. The maximum range of variability was reported for traits vine length (100.70-134.90) followed by average fruit weight (52.95-103.70) in the cross LM 9 × AS and days to first harvest (50.05-57.20) in the cross LM 3 × AS, those traits were suitable for further selection.

Values of phenotypic coefficient of variation (PCV) were found to be higher than the genotypic coefficient of variation values (GCV) for all the characters studied, indicates presence of environmental variation in expressing characters. Narrow difference between PCV and GCV values were observed for most of the characters studied indicating that the influence of environment was negligible simple selection would be effective for further improvement.

High GCV and PCV (>20%) were recorded in all three crosses for traits days to 50% germination and pericarp thickness. Similar results found by Afangideh and Uyoh, (2007) in cucumber. High GCV and PCV were exhibited in LM 3 × AS and LM 15 × AS for fruit yield per vine [8,9].

Heritability is a good index for transmission of characters from parents to their off spring. Estimation of heritability can help the breeders for effective selection of elite genotypes. Very often, heritability in broad sense only is not the true indicator of inheritance of traits, since only additive component of genetic variance is transferred efficiently from generation to generation. Therefore, heritability in broad sense may mislead in selection and judging the effectiveness of character. Considering heritability in broad sense along with genetic advance may reveal the prevalence of specific components (additive or non-additive) of genetic variance for the character more accurately. However, high heritability accompanied with high genetic advance indicates the prevalence of additive gene effects and hence, selection would be effective for such traits.

Genetic advance is improvement in the mean genotypic value of selected plant, over the parental population. It is a measure of genetic gain under selection. Success of genetic advance under selection depends upon genetic variability, heritability and selection intensity [10].

High heritability coupled with moderate to low values of GAM were observed for days to first male and female flower anthesis in all the three crosses, similar to Choudhary et al. (2011) in muskmelon. Low heritability with low GAM for node at which first female flower appeared in cross LM 3 × AS and LM 15 × AS. Same pattern has been reported in pumpkin [11,12].

High estimates of heritability coupled with high values of genetic advance over mean (GAM) were observed for characters viz., days to 50% germination in all the three crosses, duration of harvesting and pericarp thickness of fruit in LM 3 × AS, node at which first male and female flower anthesis, sex ratio, fruit length, average fruit weight and shelf life in LM 9 × AS and fruit length and fruit yield in LM 15 × AS. These results are in accordance with the findings in cucumber [13-16]. This indicates the importance of additive gene effects for these traits and there can be better response to selection.

Moderate estimates of heritability coupled with moderate values of genetic advance over mean (GAM) were observed for characters viz., number of fruits per vine in LM 3 × AS and LM 9 × AS, average fruit weight in LM 3 × AS and LM 15 × AS, days to first female flower, sex ratio, average fruit weight in LM 3 × AS, and node of male and female flowers, days to 50% female flowering and fruit diameter in LM 15 × AS [17,18].

In F3 generation, moderate heritability coupled with high GA indicates the importance of additive gene effects. Low to moderate heritability with high GAM was obtained for node of female flower in LM 3 × AS, fruit yield per vine in LM 3 × AS and LM 9 × AS, number of fruits per vine and pericarp thickness in LM 15 × AS [19].

High heritability with low genetic advance as per cent of means (GAM) shows the importance of non-additive gene action. High heritability coupled with moderate to low values of GAM were observed for water content of fruit with LM 9 × AS, days to first female flower, days to first harvest in LM 15 × AS [11,20].

The colour of fruits of all the parental lines LM 9, Arka Sheetal (AS), checks LM 3, LM 15, PBLM and all the progenies were light green in colour. Progeny of C1-1 fruits were dark green in colour, may cause due to mutation or seed admixture. First parent was obtuse in shape while another parent was acute in shape. Out of two hundred observed fruits in F3 generation 97 fruits were obtuse in shape and 103 fruits were acute in shape. The segregation pattern fits well in 1:1 ratio in F3 generation. Parent one (LM 9) recorded with sparse hair, parent 2 (AS) having profuse hairs. Among 200 observed plants in F3 generation, 108 fruits recorded profuse hair and 92 fruits recorded sparse hairs. F3 progenies segregated in 1:1 ratio (Tables 1 and 2).

**Table 1:** Estimation of variability, heritability, genetic advance and genetic advance as percent of mean for earliness and yield characters in three crosses of long melon

| Character | Crosses | F3 progeny range | F3 progeny mean | GV | GCV (%) | PV | PCV (%) | h2 (%) | GA | GAM (%) | C.V. (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Days to 1st germination | LM 3 X AS | 3.50-9.50 | 5.6 | 1.11 | 20 | 3.48 | 36 | 32 | 1.23 | 23.5 | 29.3 |
| | LM 9 X AS | 3.00-6.00 | 4.62 | 0.74 | 20 | 1.08 | 23 | 69 | 1.48 | 33.4 | 13.1 |
| | LM15 X AS | 2.50-7.00 | 4.55 | 0.23 | 11 | 2.4 | 36 | 9.74 | 0.31 | 7.12 | 33.7 |
| Days to 50% germination | LM 3 X AS | 4.00-12.50 | 7.5 | 4.13 | 30 | 5.84 | 35 | 70.7 | 3.52 | 51.1 | 19 |
| | LM 9 X AS | 4.50-8.50 | 7.37 | 2.07 | 21 | 2.64 | 24 | 78.4 | 2.62 | 38.7 | 11.2 |
| | LM15 X AS | 4.50-9.50 | 7.75 | 2.83 | 24 | 3.83 | 28 | 73.9 | 2.98 | 42 | 14.1 |
| Days to first male flower anthesis | LM 3 X AS | 32.45-41.45 | 36 | 1.48 | 4.2 | 2.54 | 7.1 | 34 | 1.78 | 4.99 | 5.79 |
| | LM 9 X AS | 27.76-39.71 | 34 | 5.81 | 7.1 | 9.43 | 9 | 61.6 | 3.89 | 11.4 | 5.58 |
| | LM15 X AS | 34.63-42.85 | 38 | 5.43 | 6.2 | 9.2 | 8.1 | 59 | 3.68 | 9.87 | 5.21 |
| Days to first female flower anthesis | LM 3 X AS | 43.15–55.1 | 47.9 | 9.93 | 6.7 | 18.3 | 9.2 | 54.2 | 4.78 | 10.2 | 6.21 |
| | LM 9 X AS | 38.31-48.85 | 43.3 | 4.13 | 4.7 | 11.8 | 8 | 35 | 2.48 | 5.77 | 6.44 |
| | LM15 X AS | 45.35–52.15 | 48.4 | 8.07 | 6.1 | 12.8 | 7.6 | 63.2 | 4.65 | 9.9 | 4.61 |
| Days taken to 50 % female flowering | LM 3 X AS | 44.50-55.50 | 48.8 | 7.15 | 5.6 | 16.3 | 8.5 | 43.8 | 3.65 | 7.65 | 6.36 |
| | LM 9 X AS | 40.00-49.50 | 44.3 | 2.9 | 3.9 | 11.4 | 7.7 | 25.5 | 1.77 | 4.02 | 6.61 |
| | LM15 X AS | 47.50-59.50 | 54.4 | 29.8 | 10 | 34.9 | 11 | 85.6 | 10.4 | 20 | 4.31 |
| Node at which first male flower appear | LM 3 X AS | 2.80-5.40 | 3.89 | 0.37 | 16 | 0.65 | 21 | 56.8 | 0.95 | 24.8 | 13.9 |
| | LM 9 X AS | 2.15-4.11 | 2.9 | 0.24 | 16 | 0.28 | 17 | 86.5 | 0.94 | 31.2 | 6.41 |
| | LM15 X AS | 2.95-5.00 | 3.84 | 0.23 | 13 | 0.46 | 18 | 49.8 | 0.7 | 18.5 | 12.8 |
| Node at which first female flower appear | LM 3 X AS | 5.00-7.55 | 6.23 | 0.41 | 10 | 0.66 | 13 | 62 | 1.04 | 16.9 | 8.14 |
| | LM 9 X AS | 3.76-7.10 | 5.16 | 0.74 | 16 | 0.91 | 18 | 81.4 | 1.6 | 30.1 | 7.75 |
| | LM15 X AS | 4.00-6.90 | 5.36 | 0.27 | 9.5 | 0.55 | 14 | 48.8 | 0.75 | 13.7 | 9.72 |
| Days to first harvest | LM 3 X AS | 50.05-57.20 | 54.1 | 7.35 | 5.1 | 15.2 | 7.4 | 48.4 | 3.99 | 7.33 | 5.28 |
| | LM 9 X AS | 44.65-55.65 | 51.5 | 4.22 | 4 | 10.5 | 6.4 | 40.1 | 2.68 | 5.27 | 4.93 |
| | LM15 X AS | 51.55-56.50 | 53.7 | 5.01 | 5.7 | 9.02 | 5.7 | 77.5 | 4.79 | 9.09 | 2.7 |
| Days to last harvest | LM 3 X AS | 69.85-77.95 | 74.3 | 0.76 | 1.2 | 9.2 | 4.1 | 8.3 | 0.52 | 0.7 | 3.92 |
| | LM 9 X AS | 71.55-76.30 | 74.4 | 0.49 | 0.9 | 3.11 | 2.4 | 15.7 | 0.57 | 0.77 | 2.19 |
| | LM15 X AS | 70.15-80.50 | 74 | 0.91 | 1.3 | 10.2 | 4.3 | 8.98 | 0.59 | 0.8 | 4.12 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of fruits per vine | LM 3 X AS | 7.80 -13.40 | 10.4 | 1.92 | 13 | 5.13 | 21 | 37.5 | 1.75 | 16 | 16.3 |
| | LM 9 X AS | 11.20-20.35 | 15.6 | 3.72 | 13 | 10.6 | 21 | 35.3 | 2.36 | 15.6 | 17.2 |
| | LM15 X AS | 8.30-11.40 | 9.83 | 1.81 | 13 | 4.11 | 19 | 43.9 | 1.83 | 17.4 | 14.4 |
| Average Fruit weight (g) | LM 3 X AS | 56.30-82.70 | 66 | 39.7 | 9.3 | 75.2 | 13 | 52.8 | 9.43 | 13.9 | 8.78 |
| | LM 9 X AS | 52.95103.70 | 82 | 197 | 17 | 223 | 19 | 88.3 | 27.2 | 33.7 | 6.34 |
| | LM15 X AS | 58.50-87.15 | 71 | 31.5 | 7.8 | 67.9 | 11 | 46.5 | 7.88 | 11 | 8.39 |
| Fruit length (cm) | LM 3 X AS | 18.40-29.50 | 22.8 | 6.5 | 11 | 10.1 | 14 | 64.5 | 4.22 | 18.2 | 8.17 |
| | LM 9 X AS | 19.40-29.10 | 24.5 | 8.82 | 12 | 11.5 | 14 | 76.8 | 5.36 | 21.9 | 6.66 |
| | LM15 X AS | 15.10-29.00 | 21.6 | 11.5 | 15 | 15.1 | 17 | 76.5 | 6.12 | 27.6 | 8.47 |
| Fruit diameter (cm) | LM 3 X AS | 2.01-2.91 | 2.47 | 0.08 | 11 | 0.13 | 14 | 64.9 | 0.47 | 18.7 | 8.29 |
| | LM 9 X AS | 2.10-3.66 | 2.87 | 0.13 | 13 | 0.22 | 17 | 58.7 | 0.57 | 20 | 10.6 |
| | LM15 X AS | 2.65-3.58 | 3.2 | 0.07 | 8.8 | 0.13 | 11 | 59.6 | 0.44 | 14 | 7.25 |
| Fruit yield/vine (Kg) | LM 3 X AS | 0.49-1.00 | 0.7 | 0.03 | 21 | 0.05 | 28 | 53.9 | 0.24 | 31.3 | 19.2 |
| | LM 9 X AS | 0.60-1.32 | 0.83 | 0.02 | 17 | 0.05 | 25 | 45.3 | 0.2 | 23.2 | 18.4 |
| | LM15 X AS | 0.48-0.7 | 0.59 | 0.04 | 28 | 0.05 | 31 | 82 | 0.36 | 52.8 | 13.2 |

**Table 2:** Estimation of variability, heritability, genetic advance and genetic advance as percent of mean for following characters in three crosses of longmelon

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sex ratio | LM 3 X AS | 24.21-33.03 | 28.2 | 8.29 | 11 | 21.8 | 18 | 38 | 3.65 | 13.7 | 13.8 |
| | LM 9 X AS | 15.72-31.64 | 21.6 | 11.3 | 16 | 15 | 18 | 75.6 | 6.02 | 28.1 | 8.92 |
| | LM15 X AS | 22.57-35.65 | 29.7 | 20.1 | 16 | 27.2 | 19 | 73.9 | 7.95 | 28.5 | 9.55 |
| Duration of harvest | LM 3 X AS | 17.75 – 26.95 | 23.2 | 17.8 | 19 | 26.4 | 24 | 67.3 | 7.12 | 32.8 | 13.5 |
| | LM 9 X AS | 12.65-27.65 | 20.2 | 2.37 | 6.6 | 16.2 | 17 | 14.7 | 1.22 | 5.2 | 15.9 |
| | LM15 X AS | 15.65-24.35 | 20.9 | 8.85 | 14 | 21.1 | 21 | 41.9 | 3.97 | 18.1 | 16 |
| Vine length (cm) | LM 3 X AS | 88.80-134.30 | 113 | 47.3 | 6.1 | 137 | 10 | 34.6 | 8.33 | 7.37 | 8.37 |
| | LM 9 X AS | 100.70-134.90 | 120 | 53.9 | 6.2 | 162 | 11 | 33.3 | 8.72 | 7.36 | 8.78 |
| | LM15 X AS | 92.55-127.45 | 110 | 38.4 | 5.6 | 113 | 9.6 | 34.2 | 7.46 | 6.73 | 7.77 |
| Water content (%) | LM 3 X AS | 77.48-79.53 | 78.6 | 0.34 | 0.7 | 0.6 | 1 | 56 | 0.9 | 1.14 | 0.65 |
| | LM 9 X AS | 76.36-79.45 | 78.4 | 0.61 | 1 | 0.67 | 1 | 91 | 1.53 | 1.96 | 0.31 |
| | LM15 X AS | 77.62-79.38 | 78.4 | 0.43 | 0.8 | 0.56 | 1 | 77.2 | 1.19 | 1.52 | 0.46 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Shelf life (days) | LM 3 X AS | 1.00-2.00 | 1.45 | 0.02 | 10 | 0.19 | 29 | 12 | 0.11 | 7.26 | 27.7 |
| | LM 9 X AS | 1.30-5.30 | 2.86 | 0.96 | 37 | 1.38 | 45 | 69.6 | 1.68 | 64.2 | 24.7 |
| | LM15 X AS | 1.00-2.30 | 1.34 | 0.09 | 19 | 0.32 | 36 | 27.1 | 0.31 | 20.1 | 30.8 |
| Pericarp thick-ness (cm) | LM 3 X AS | 0.11-0.33 | 0.2 | 0.01 | 44 | 0.01 | 48 | 85.2 | 0.2 | 83.5 | 18.3 |
| | LM 9 X AS | 0.15-0.62 | 0.25 | 0.01 | 41 | 0.01 | 43 | 92.3 | 0.22 | 82 | 11.9 |
| | LM15 X AS | 0.12-0.55 | 0.3 | 0.01 | 32 | 0.02 | 43 | 53.9 | 0.15 | 47.9 | 29.3 |

## CONCLUSION

The characters viz., days to 50% germination, node of first male and female flower, sex ratio, fruit length, average fruit weight and shelf life, fruit yield and duration of harvesting recorded high heritability (>60%) coupled with high GAM (>20%), indicates traits governed by additive gene action and further crop improvement can be done through direct selection.

The characters viz., Average fruit weight, days to first female flower, sex ratio, average fruit weight, node of male and female flowers, days to 50% female flowering and fruit diameter estimated moderate value of heritability coupled with moderate (30%-60%) values of genetic advance (10%-20%) over mean (GAM), indicates equal contribution of additive and non – additive gene action so selection as well as heterosis breeding would be effective for these traits.

Based on the performance of all the three crosses for qualitative and quantitative traits in F3 generations, from the present study, it may be concluded that, cross LM 9 × AS was superior to LM 3 × AS and LM 15 × AS. Hence this cross may be forwarded for further improvement in longmelon.

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