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**SJ Ban**
Ph.D. Scholar, Post Graduate Institute, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India

**DB Kshirsagar**
Associate Professor, Post Graduate Institute, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India

**BV Kagane**
Senior Research Assistant, AICRP on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India

**Corresponding Author:**
**SJ Ban**
Ph.D. Scholar, Post Graduate Institute, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India

# Genetic variability and correlation analysis in $F_6$ generation of pumpkin (*Cucurbita moschata* Duch Ex. Poir)

**SJ Ban, DB Kshirsagar and BV Kagane**

**Abstract**
The study on genetic variability in $F_6$ generation of pumpkin (*Cucurbita moschata* Duch Ex. Poir) for yield and quality was conducted at AICRP on Vegetable Crops, Department of Horticulture, MPKV, Rahuri during the year 2020-2021. The aim of the present study is to develop high yielding and good quality fruits of pumpkin. The five selected pumpkin progenies derived from cross-1 (RHR PK-18-3-1-2-12 × RHR PK-09-4-6 3-3) along with parents used for this study. The present study was laid out in Randomized Block design (RBD) with three replications. The results revealed that moderate GCV, PCV and high heritability along with high genetic advance as percentage of mean recorded for the characters *viz.* final vine length, number of primary branches per vine, length of fruit, diameter of fruit, yield per vine, yield per hectare, fruit flesh thickness, number of ridges per fruit, seed cavity length, seed cavity width, number of seeds per fruit, 100 seed weight, TSS and β-carotene. Regarding correlation studies, fruit yield was significantly and positively correlated with vine length, number of primary branches per vine, number of fruits per vine, weight of fruit and flesh thickness. Significant and negative correlation both at phenotypic and the genotypic levels were observed between fruit yield per vine and days to first male flower appearance, days to first female flower appearance and days to first harvest.

**Keywords:** Pumpkin, GCV, PCV, heritability, genetic advance and correlation

## 1. Introduction

Pumpkin is an important cucurbitaceous vegetable crop in India, Assam, West Bengal, Tamil Nadu, Karnataka, Madhya Pradesh, Uttar Pradesh, Orissa, Kerla and Bihar are the main pumpkin producing states. Pumpkin has total area of 10.6 thousand hectares with production of 22.18 metric tonnes (Anon 2022) [2]. Pumpkin use as both the immature and mature fruit stages. The mature fruits are eaten as vegetables and the seeds are eaten as fried nuts. Pumpkin is classified as a high value vegetable due to its high productivity, nutritive value, good storability, long period of availability, superior transport qualities and widespread cultivation in both tropical and subtropical regions of our country.

Pumpkin has recently gained industrial importance due to the development of pulp powder as a nutritional supplement to Vitamin 'A' requirements. Pumpkin is a less expensive source of Vitamin A than carrot, which has specific climatic requirements for production and high productivity per unit area. The pumpkin grown in India is primarily consumed as a fresh vegetable. Pumpkin pulp powder is exported in small quantities. There is a lot of room to increase pumpkin production and exports in order to boost foreign exchange.

Pumpkin has a broad range of diversity, making it appealing for hybridization. Early maturity, fruit yield and fruit quality are the decisive elements whether variety will succeed or fail. Knowledge of the nature of gene influence for yield and their contributing qualities is always beneficial in the selection of effective and efficient breeding procedures. Keeping this in mind, the current study is being conducted to investigate the correlation and variability for crucial qualitative and quantitative features, as well as to estimate heritability and genetic advancement for yield contributing characters in $F_6$ generation.

## 2. Materials and Methods

The present study was conducted at AICRP on vegetables Department of Horticulture, MPKV, Rahuri. Maharashtra, India during *kharif* 2020. The five progenies derived from cross RHR PK-18-3-1-2-12 × RHR PK-9-4-6-3-3 ($C_1$: 1 × 2) with their parents were used as genetic material for this study. The seeds were sown in spacing of 5m × 1m in Randomized Block

Design (RBD) with three replications for $F_6$ generation.

The observations were recorded during research *viz.* vine length, number of primary branches per vine, days to first male flowering, days to first female flowering, node at which first female flower appeared, sex ratio, days to first harvest, number of fruits per vine, weight of fruit, length of fruit, diameter of fruit, yield per vine, yield per hectare, flesh thickness, number of ridges, seed cavity length, seed cavity width, number of seeds per fruit, 100 seeds weight, TSS and β-carotene. The data were recorded statistically analyzed for genotypic and phenotypic coefficient of variation by Burton and DeVane (1953) [3], heritability suggested by Lush (1949) [9], genetic advance as percent of mean suggested by Johnson *et al.* (1955) [19] and correlation suggested by Snedecor and Cochran (1967) [16].

## 3. Results and Discussion

### 3.1 Genotypic and Phenotypic Co-efficient of Variation

Variability, heritability and genetic advance as percent of mean were present in the Table 1.

Phenotypic coefficient of variation (PCV) was higher than the respective genotypic coefficient of variation (GCV) for all the characters. The moderate genotypic and phenotypic coefficient of variation were observed for characters *viz.* final vine length, number of primary branches per vine, length of fruit, diameter of fruit, yield per vine, yield per hectare, fruit flesh thickness, number of ridges per fruit, seed cavity length, seed cavity width, number of seeds per fruit, 100 seed weight, TSS and β-carotene. This indicates the presence of medium amount of variability and improvement of these traits is possible up to some extent in further generation and to attain homozygosity. This agrees with the finding of Kumar *et al.* (2017) [8], Muttur *et al.* (2017) [11], Sampath *et al.* (2017) [14], Shrikanth *et al.* (2017) [15], Kanal *et al.* (2019) [7], Ingole *et al.* (2021) [6] in pumpkin, Alekar *et al.* (2019) [1], Chaudhari (2019) [4], Pradhan *et al.* (2021) [13] in bitter gourd, Mali *et al.* (2015) [15], Gaikwad (2016) [5] in muskmelon and Naik *et al.* (2016) [12], Vijaykumar *et al.* (2020) [18] in ridge gourd.

Low genotypic and phenotypic coefficient of variation were observed for characters *viz.* days to first male flowering, days to first female flowering, node at which first female flower appeared, sex ratio, days to first harvest, number of fruits per vine and weight of fruit in RHR PK-18-3-1-2-12 × RHR PK-9-4-6-3-3 ($C_1$: 1 × 2) $F_6$ generation. This indicates selection resulted in attaining homozygosity and further selection will not alter these traits. These characters will not be considered for selection. This agrees with the finding of Kumar *et al.* (2017), Muttur *et al.* (2017) [11], Sampath *et al.* (2017) [14], Shrikanth *et al.* (2017) [15], Kanal *et al.* (2019) [7], Ingole *et al.* (2021) [6] in pumpkin, Alekar *et al.* (2019) [1], Chaudhari (2019) [4], Pradhan *et al.* (2021) [13] in bitter gourd, Mali *et al.* (2015) [15], Gaikwad (2016) [5] in muskmelon and Naik *et al.* (2016) [12], Vijaykumar *et al.* (2020) [18] in ridge gourd.

**Table 1:** Mean, range, GCV, PCV, ECV, heritability and genetic advance as percent of mean of $F_6$ population in C1 (RHR PK-18-3-1-2-12 × RHR PK-09-4-6 3-3)

| Sr. no. | Character | Mean | Range | GCV (%) | PCV (%) | ECV (%) | $H^2$ (b.s.) (%) | GAM (%) |
|---|---|---|---|---|---|---|---|---|
| 1 | Vine length | 5.71 | 4.62-7.15 | 17.42 | 18.81 | 7.09 | 85.79 | 33.25 |
| 2 | Primary branches per vine | 3.53 | 3.07-4.10 | 12.53 | 13.07 | 3.71 | 91.94 | 24.76 |
| 3 | Days to 1st male | 44.33 | 40.27-51.05 | 8.26 | 8.37 | 1.32 | 97.52 | 16.81 |
| 4 | Days to 1st female | 51.95 | 45.10-59.07 | 9.13 | 9.20 | 1.12 | 98.53 | 18.68 |
| 5 | Node first female | 13.35 | 12.00-14.79 | 8.09 | 8.62 | 2.95 | 88.25 | 15.66 |
| 6 | Sex ratio | 17.64 | 16.83-18.53 | 3.66 | 3.87 | 1.24 | 89.72 | 7.15 |
| 7 | Days to first harvest | 96.89 | 90.33-105.03 | 5.13 | 5.18 | 0.74 | 97.95 | 10.46 |
| 8 | Number of fruits | 2.83 | 2.61-3.32 | 9.22 | 10.05 | 4.01 | 84.09 | 17.42 |
| 9 | Weight of fruit | 3.37 | 2.87-3.64 | 6.80 | 8.23 | 4.62 | 68.45 | 11.61 |
| 10 | Length of fruit | 19.53 | 16.90-22.94 | 10.51 | 11.27 | 4.05 | 87.08 | 20.21 |
| 11 | Diameter of fruit | 20.58 | 17.94-24.50 | 10.61 | 10.97 | 2.79 | 93.55 | 21.13 |
| 12 | Yield per vine | 9.31 | 7.35-11.62 | 15.91 | 16.95 | 5.87 | 88.03 | 30.74 |
| 13 | Yield per hectare | 18.62 | 14.70-23.24 | 15.91 | 16.95 | 5.89 | 88.03 | 30.74 |
| 14 | Flesh thickness | 3.21 | 2.48-3.88 | 18.17 | 18.72 | 4.52 | 94.15 | 36.31 |
| 15 | Number of ridges | 12.50 | 10.66-14.63 | 10.87 | 11.62 | 4.11 | 87.52 | 20.95 |
| 16 | Seed cavity length | 13.10 | 11.02-15.50 | 12.16 | 13.92 | 6.78 | 76.29 | 21.88 |
| 17 | Seed cavity width | 14.17 | 12.04-16.71 | 12.87 | 13.92 | 5.32 | 85.38 | 24.49 |
| 18 | Number of seeds | 158.51 | 124.71-190.36 | 17.39 | 18.15 | 5.21 | 91.77 | 34.31 |
| 19 | 100 seed weight | 10.69 | 8.83-12.42 | 11.15 | 11.22 | 1.22 | 98.81 | 22.84 |
| 20 | TSS | 5.24 | 4.13-5.98 | 16.33 | 16.87 | 4.22 | 93.73 | 32.58 |
| 21 | β-carotene | 5.61 | 4.70-6.24 | 10.48 | 10.99 | 3.32 | 90.87 | 20.58 |

**GCV:** Genotypic coefficient of variation, **PCV:** Phenotypic coefficient of variation, **ECV:** Environmental coefficient of variation, **$H^2$ (b.s.):** Heritability in broad sense and **GAM:** Genetic advance as per cent of mean

**Table 2:** Genotypic and phenotypic correlation co-efficient for yield and yield contributing characters in $F_6$ generation of C1 (RHR PK-18-3-1-2-12 × RHR PK-09-4-6 3-3)

| Characters | | VL | NPB | DFMF | DFFF | NFFF | SR | DFH | NFV | WF | LF | DF | FFT | YV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. VL | G | 1 | 0.9986** | -0.7956* | -0.909** | -0.9673** | -0.701 | -0.9015** | 0.9046** | 0.688 | 0.7634 * | 0.6376 | 0.9845** | 0.8746** |
| | P | 1 | 0.9241** | -0.7445** | -0.8102** | -0.9007** | -0.649** | -0.8189** | 0.7172** | 0.4277 | 0.5992** | 0.6007** | 0.8791** | 0.7396** |
| 2. NPB | G | | 1 | -0.7529 | -0.8386* | -0.9099** | -0.7077 | -0.8956** | 0.8901** | 0.6488 | 0.7436 | 0.6446 | 0.9811** | 0.8631* |
| | P | | 1 | -0.7195** | -0.7877** | -0.8575** | -0.6727** | -0.8698** | 0.7322** | 0.4982 * | 0.6924** | 0.6099** | 0.9098** | 0.7761** |
| 3. DFMF | G | | | 1 | 0.9736** | 0.6608 | 0.8181* | 0.8121* | -0.6464 | -0.9847** | -0.3007 | -0.2843 | -0.8391* | -0.8802** |
| | P | | | 1 | 0.9458** | 0.6544** | 0.7736** | 0.7958** | -0.5623** | -0.7379** | -0.2604 | -0.2753 | -0.7948** | -0.8230** |
| 4. DFFF | G | | | | 1 | 0.7816 | 0.8413* | 0.8585 * | -0.7342 | -0.8093* | -0.4825 | -0.4641 | -0.8823** | -0.8997** |
| | P | | | | 1 | 0.6992 ** | 0.7706** | 0.8498** | -0.6939** | -0.7055** | -0.4624* | -0.4451* | -0.844 ** | -0.8262** |
| 5. NFFF | G | | | | | 1 | 0.5393 | 0.8732* | -0.8132 * | -0.5614 | -0.6481 | -0.5438 | -0.8399 * | -0.7018 |
| | P | | | | | 1 | 0.5421* | 0.8124** | -0.6398** | -0.2700 | -0.5556** | -0.5216* | -0.7633** | -0.6448** |
| 6. SR | G | | | | | | 1 | 0.7979* | -0.3597 | -0.6412 | -0.2125 | -0.1077 | -0.7569 * | -0.5734 |
| | P | | | | | | 1 | 0.7291** | -0.2644 | -0.4199 | -0.1803 | -0.1001 | -0.7125** | -0.5047 |
| 7. DFH | G | | | | | | | 1 | -0.7278 | -0.5984 | -0.548 | -0.49 | -0.8094 * | -0.7806* |
| | P | | | | | | | 1 | -0.6609** | -0.5054* | -0.5316* | -0.4843 | -0.766** | -0.7267** |
| 8. NFV | G | | | | | | | | 1 | 0.5525 | 0.9193** | 0.9337** | 0.816 * | 0.971** |
| | P | | | | | | | | 1 | 0.5272 * | 0.836 ** | 0.839 ** | 0.7054** | 0.7875** |
| 9. WF | G | | | | | | | | | 1 | 0.1368 | 0.1835 | 0.7967 * | 0.9197** |
| | P | | | | | | | | | 1 | 0.1498 | 0.1271 | 0.6278** | 0.7076** |
| 10. LF | G | | | | | | | | | | 1 | 1.0014** | 0.6352 | 0.6937 |
| | P | | | | | | | | | | 1 | 0.9347** | 0.5582** | 0.5730** |
| 11. DF | G | | | | | | | | | | | 1 | 0.5404 | 0.6930 |
| | P | | | | | | | | | | | 1 | 0.4798 * | 0.6205** |
| 12. FFT | G | | | | | | | | | | | | 1 | 0.8890** |
| | P | | | | | | | | | | | | 1 | 0.8104** |
| 13. YV | G | | | | | | | | | | | | | 1 |
| | P | | | | | | | | | | | | | 1 |

* Significance at 5% and ** Significance at 1% levels

**VL:** Vine length, **NPB:** No of primary branches per vine, **DFMF:** Days to 1st male flower appearance, **DFFF:** Days to 1st female flower appearance, **NFFF:** Node at which 1st female flower appeared, **SR:** Sex ratio, **DFH:** Days to 1st harvest, **NFV:** Number of fruits per vine, **WF:** Weight of fruit, **LF:** Length of fruit, **DF:** Diameter of fruit, **FFT:** Fruit flesh thickness, **YV:** Yield per vine, **G:** Genotypic correlation coefficient and **P:** Phenotypic correlation coefficient.

### 3.2 Heritability and Genetic Advance as Percent of Mean

High heritability with high genetic advance as per cent of mean were observed for the characters *viz.* final vine length, number of primary branches per vine, length of fruit, diameter of fruit, yield per vine, yield per hectare, fruit flesh thickness, number of ridges per fruit, seed cavity length, seed cavity width, number of seeds per fruit, 100 seed weight, TSS and beta carotene. This confirms the presence of additive gene action and the traits were less influenced by environment and selecting the genotypes based on such characters could be worthwhile, which agrees with the findings of Kumar *et al.* (2017) [8], Muttur *et al.* (2017) [11], Sampath *et al.* (2017) [14], Shrikanth *et al.* (2017) [15], Kanal *et al.* (2019) [7], Ingole *et al.* (2021) [6] in pumpkin, Alekar *et al.* (2019) [1], Chaudhari (2019) [4], Pradhan *et al.* (2021) [13] in bitter gourd, Mali *et al.* (2015) [15], Gaikwad in muskmelon and Naik *et al.* (2016) [12], Vijaykumar *et al.* (2020) [18] in ridge gourd.

High heritability with moderate and low genetic advance as per cent of mean was observed for the characters *viz.* days to first male flowering, days to first female flowering, node at which first female flower appeared, sex ratio, days to first harvest, number of fruits per vine and weight of fruit this was indicated that prevalence of non-additive components and there can be little response to selection and these traits can be exploited through heterosis breeding which agrees with the findings of Kumar *et al.* (2017) [8], Muttur *et al.* (2017) [11], Sampath *et al.* (2017) [14], Shrikanth *et al.* (2017) [15], Kanal *et al.* (2019) [7], Ingole *et al.* (2021) [6] in pumpkin, Alekar *et al.* (2019) [1], Chaudhari (2019) [4], Pradhan *et al.* (2021) [13] in bitter gourd, Mali *et al.* (2015) [15], Gaikwad (2016) in muskmelon and Naik *et al.* (2016) [12], Vijaykumar *et al.* (2020) [18] in ridge gourd.

### 3.3 Correlation

Correlation co-efficient for yield and yield contributing characters of RHR PK-18-3-1-2-12 × RHR PK-9-4-6-3-3 ($C_1$: 1 × 2) in $F_6$ generation present in the Table 2. Significant and positive correlation at both phenotypic and genotypic levels between fruit yield per vine and vine length, number of primary branches per vine, number of fruits per vine, weight of fruit and flesh thickness. This means that selection of these traits would result in superior fruit yield per vine. This agrees with the finding of Sultana *et al.* (2015) [17], Muttur *et al.* (2017) [11], Ingole *et al.* (2021) [6] in pumpkin, Mali *et al.* (2015) [15], Gaikwad (2016) [5] in musk melon and Alekar *et al.* (2019) [1] in bitter gourd.

Significant and negative correlation at both phenotypic and genotypic levels were observed between fruit yield per vine and days to first male flower appearance, days to first female flower appearance and days to first harvest. This means that selection of these traits would result in early and superior fruit yield per vine which agrees with the findings of Sultana *et al.* (2015) [17], Muttur *et al.* (2017) [11], Ingole *et al.* (2021) [6] in pumpkin, Mali *et al.* (2015) [15], Gaikwad (2016) [5] in musk melon and Alekar *et al.* (2019) [1] in bitter gourd.

## 4. Conclusions

Moderate GCV, PCV, high heritability with high genetic advance as per cent of mean were observed for characters *viz.* final vine length, number of primary branches per vine, length of fruit, diameter of fruit, yield per vine, yield per hectare, fruit flesh thickness, number of ridges per fruit, seed cavity length, seed cavity width, number of seeds per fruit, 100 seed weight, TSS and β-carotene. These findings indicate presence of additive gene action and the traits were less influenced by environment and selecting the genotypes based on such characters could be effective. Fruit yield per vine recorded positive and significant correlation with vine length, number of primary branches per vine, number of fruits per vine, weight of fruit and flesh thickness. Negative and significant correlation was observed for most of the flowering characters. Thus, association of these traits should be considered for improvement.

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