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# Study of Correlation and Path Analysis in the Selected Okra Genotypes

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

An experiment was conducted at the experimental farm, Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur from March 2008 to July 2008 to study the correlation and path analysis in the selected okra genotypes. The experiment was carried out in Randomized Complete Block Design with thee replications. The results indicated that different genotypes varied significantly regarding all the studied characters. The Fruits per plant and fruit weight of different genotypes had a high degree of significant positive association with fruit yield and a high positive direct effect indicated that these characters had a major contribution towards the fruit yield of the genotypes. The days to first flowering and days to first fruit harvest showed a significant positive correlation with picking duration both genotypic and phenotypic levels. The Picking duration showed a highly significant positive genotypic correlation with fruit diameter and fruit length. At the final harvest plant height showed a highly significant positive genotypic correlation with fruit length and fruit weight at the genotypic level. The fruit length showed a highly

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significant positive genotypic correlation with fruit weight and fruit diameter and genotypic level. The fruits per plant showed a highly significant positive genotypic and phenotypic correlation with fruit yield. A significant positive genotypic correlation with fruit yield was shown by fruit weight. The fruits per plant (0.979) and fruit weight (0.554) also showed a high positive direct effect on fruit yield.

*Keywords: Abelmoschus esculentus L.; correlation; path coefficient analysis.*

## 1. INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) belongs to the family Malvaceae [1] (with 2n = 2x =72 or 144 chromosome. It is also known as lady's finger [2] and an important spring-summer and rainy season vegetable crop cultivated in tropical and subtropical parts of the world [3,4]. According to Santos et al. [1], Okra is native to North Eastern Africa in the area of Ethiopia and Sudan. It is cultivated in various tropical, subtropical and Meditterean regions of the world [5]. It is an annual herbaceous vegetable crop grown for its tender fruits [6]. It is a warm-season vegetable [7,8] (and can tolerant more heat and drought [9]. It is grown for fresh table use or for processing [7,8], its tender green fruits for consumption as a fried or boiled vegetable [10,2]. It is a self-pollinated crop; having an outcrossing rate to an extent of 4 to 19% with the maximum of 42.2% [11]. This self-pollinating crop is an example that requires a separation between varieties to maintain purity [12]. It is one of the important vegetables that is cultivated and consumed in all parts of Bangladesh. Okra contains good alkaline pH which contributes to its relieving effect in gastrointestinal ulcer by neutralizing digestive acid [13]. Mucilage from Okra has been reported to be effective as blood volume expander and has the potential to alleviate renal disease, reduce proteinuria and improve renal function [14]. Yield is a polygenic trait, which is governed by numbers of genes. However, direct selection for yield alone is usually not very effective or may often be misleading. Hence, selection based on its contributing characters could be more efficient and reliable [15,16]. For sorting out the total correlation into direct and indirect effects path coefficient analysis helps and is useful for choosing the most useful traits to be used for yield improvement through selection. The study of correlation between plant characters is of great importance to a plant breeder as it provides a measure of the degree of association between yield and other yield attributes [17]. The path coefficient analysis is partitioned the correlation in direct and indirect effects and thus may be useful in choosing the characters that have direct and indirect effects on yield. Hence, study of correlations (genotypic and phenotypic) and path coefficient analysis of yield would be of help in selection of yield component traits in the genetic improvement of quantitative traits, which are positively correlated [17]. In complex inherited traits, such information reveals the possibility of simultaneous improvement of different attributes and also helps in increasing the efficiency of selection. Keeping in the view of above facts, the objectives of the present investigation was to study the association of yield and its component traits and the direct and indirect effects of yield component traits on fruit yield in okra genotypes.

## 2. MATERIALS AND METHODS

### 2.1 Plant Material, Experimental Design and Growing Condition

This experiment was conducted at the experimental farm of the Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Salna, Gazipur, Bangladesh from March 2008 to July 2008. With an elevation of 8.2 m from sea level, the location of the site is 24.09°N latitude and 90.26°E longitude [18]. The climate of the experimental location is marked by heavy shower from May to September and insufficient during the rest of the year. The soil was sandy loam in texture and relate to the silty clay loam of shallow red-brown terrace under the Salna series having a pH of 6.3. In this experiment, fourteen diverse genotypes of okra were used. In Table 1, the name of the genotypes with their country of origin and name of organization or company is presented. The experiment was carried out in Randomized Complete Block Design (RCBD) with three replications. The unit plot size was 4.0 m X 1.5 m. Each of the unit plots was separated by 0.50 m and block to block were 1.0 m apart. Every unit plot had 3 rows with 10 plants of each row. So, the total number of plants per plot was 30.

To get a good tilth, the field was plowed and cross-plowed several times. By the addition of well-decomposed cowdung at the rate of 5 t/ha, weeds and stubbles were removed and the land was finally prepared. The plots were raised 10 cm from the soil surface to keeping the drain around the plot. In the experiment field, manure and fertilizer doses and their methods of application were applied as recommended by Rashid [19] are shown in Table 2.

In rows of the raised bed, the seeds were sown. Row to row and plant to plant spacing was maintained about 50 cm and 40 cm, respectively. In each pit, two or three seeds were sown. With fine soil, the seeds were covered by hand. For the proper growth and development of the plants, necessary intercultural operations were done throughout the cropping season. 5 to 6 days after germination only one healthy seedling was kept and other seedlings were removed from each pit. After the germination of seedling up to fruiting, irrigation was given as and when required. At the time of heavy rain, static water was effectively drained out. To break the soil crust, weeding and mulching were done at regular intervals and to keep the plots free from weeds. For controlling borer insect, Malathion @ 0.2 ml/L was sprayed thrice in an interval of 7 days started as soon as the pest appeared. Admare @ 0.5 ml/L was sprayed three times in an interval of 7 days when hopper and Jassid found in the experiment field. From each plot, ten plants were selected at random for collecting data. Characters studied of this experiment were plant height, branches per plant, while regarding yield attributes, days to first flowering, days to first fruit harvest, fruit length, fruit diameter, fruit weight, fruits per plant, picking duration, yield per plant, yield and virus infestation.

### 2.2 Statistical Analysis

By the formulae of Al-Jibouri et al. [20], correlation co-efficient was estimated among all possible character combinations. To know the direct and indirect effect of the morphological traits on plant yield path co-efficient analysis suggested by several authors [21,22] was carried out. The mean values of the collected data were used for calculating correlation co-efficient and also direct and indirect effects of path co-efficient and are presented in Tables 3 and 4.

## 3. RESULTS AND DISCUSSION

Yield is a complex quantitative trait that depends on a number of other associated traits. Therefore, yield can be improved by direct as well as indirect selection. To identify yield component characters, correlation is an important biometrical tool. Further, estimates of correlation at genotypic as well as at phenotypic

**Table 1. List of the selected okra genotypes**

| Genotypes | Origin/Country | Company/Organization |
|---|---|---|
| Anamika | India | Chad seed company |
| Antara | India | Rajib seed store |
| ArkaAnamika | India | United seed store |
| BARI Dherosh 1 | Bangladesh | BARI, Gazipur |
| Ghinuk | Bangladesh | United seed store |
| Green Boy | Bangladesh | United seed store |
| Green Glory | Bangladesh | East west seed ltd. |
| IPSA Okra | Bangladesh | BSMRAU, Gazipur |
| Jhalok | Bangladesh | United seed store |
| Kanchan | Bangladesh | United seed store |
| Liza-151 | India | Hi seed company |
| Rupaly | Bangladesh | United seed store |
| Seminis | USA | Hi seed company |
| Sobuj Bangla | Bangladesh | United seed store |

**Table 2. Manure and fertilizer doses with their application methods**

| Manure/fertilizer | Total amount (kg/ha) | Basal dose (kg/ha) | Top dressing (kg/ha) | |
|---|---|---|---|---|
| | | | First (25 days after sowing) | Second (40 days after sowing) |
| Cowdung | 5000 | Entire amount | - | - |
| Urea | 150 | - | 75 | 75 |
| TSP | 120 | Entire amount | - | - |
| MoP | 110 | Entire amount | - | - |

levels is more informative. The results of genotypic and phenotypic correlation coefficient of yield and its contributing characters of different genotypes of okra are shown in Table 3 and discussed character-wise as follows:

## 3.1 Analysis of Results

### 3.1.1 Days to first flowering

The days to first flowering found to display significant positive relationships with picking duration at genotypic and phenotypic levels. Days to first flowering showed an insignificant positive correlation with days to first fruit harvest, plant height, fruit length, and fruit weight but an insignificant negative association with fruits per plant and yield both at the genotypic and phenotypic levels. Days to first flowering also showed insignificant positive genotypic correlation with branches per plant, plant height and fruit diameter were as days to first flowering showed an insignificant negative correlation with these two characters phenotypically (Table 3). These results corroborate the findings of [23,24, 25] in okra. The days to first flowering positively and significantly correlated with fruit weight (0.2975) reported by Yadav et al. [26]. Somashekhar et al. [27] also observed negative association between days to 50% flowering and fruit yield.

### 3.1.2 Days to first fruit harvest

A highly significant positive relationship with picking duration at genotypic and phenotypic levels was found fordays to first fruit harvest. Days to first fruit harvest showed a highly significant negative correlation with fruit weight and significant negative correlation with fruits per plant and yield at genotypic level but insignificant negative correlation with these three traits at the phenotypic level. The character reflected an insignificant negative association with plant height and fruit length and an insignificant positive association with fruit diameter at the genotypic level. Days to first fruit harvest also showed an insignificant positive correlation with branches per plant at the genotypic and phenotypic levels. Days to first fruit harvest also showed an insignificant negative association with fruit diameter and insignificant positive association with plant height and fruit length at the phenotypic level (Table 3). Several authors [28,29] stated that days to first picking showed negative and highly significant correlation with fruit yield/plant. It indicates that selection of plants showing early flowering and early maturity can provide better results for improvement of fruit yield/plant.

### 3.1.3 Picking duration

This character displayed a highly significant positive relationship with fruit diameter and significant positive relationship correlation with fruit length at the genotypic level but the insignificant and considerable positive association was observed at the phenotypic level. It appeared from the results that increasing picking duration caused the plants to increase fruit length. The character showed insignificant positive relationships with plant height and insignificant negative relationships with fruits per plant, fruit weight and yield at both levels. It also showed an insignificant negative correlation with branches per plant at the phenotypic level and an insignificant positive correlation with this trait at the genotypic level (Table 3). But Koundinya and Dhankhar [30] reported that picking duration showed a positive correlation with a yield.

### 3.1.4 Plant height (cm)

Plant height showed a highly significant positive relationship with fruit length and fruit weight at genotypic level but insignificant positive relationships with these two traits at the phenotypic level. It appeared from the results that increasing plant height caused the plants to increase fruit length and fruit weight. The character showed an insignificant positive relationship with branches per plant and an insignificant negative relationship with fruits per plant and yield at the genotypic and phenotypic levels. It also showed an insignificant negative correlation with fruit diameter at the phenotypic level and insignificant positive correlation with this trait at the genotypic level (Table 3). Plant height recorded positive and significant correlation with fresh fruit weight [31].

### 3.1.5 Branches per plant

Branches per plant displayed a significant negative relationship with fruit weight at genotypic level and insignificant negative association with this trait at the phenotypic level (Table 3). It appeared from the results that increasing plant height caused the plants to produce lesser fruit weight. It showed insignificant negative relationships with fruit length, fruit diameter, fruits per plant and yield at the genotypic level and phenotypic level. Raval et al. [28] found that number of branches/plant showed positive relation with plant height at final harvest while Gatade et al., 2019 stated that number of branches per plant was negatively associated with fruit diameter (rg = -0.9030), fruit weight (rg =-0.2863).

#### 3.1.6 Fruit length (cm)

Fruit length showed a highly significant positive relationship with fruit weight and p with fruit diameter at the genotypic level. It appeared from the results that increasing fruit length caused the plants to produce higher fruit weight and fruit diameter. It showed insignificant positive relationships with fruits per plant and yield at the genotypic and phenotypic levels. It also showed an insignificant positive correlation with fruit diameter and fruit weight at the phenotypic level (Table 3). [28,32,33,34] Reported that fruit weight had positive and highly significant correlation with fruit length.

#### 3.1.7 Fruit diameter (mm)

Fruit diameter showed an insignificant positive relationship with fruits per plant, fruit weight and yield at genotypic and phenotypic levels. It appeared from the results that increasing fruit length also increased fruits per plant, fruit weight and yield. Gatade et al. [35] stated that fruit diameter was positively associated with fruit weight (rg =0.5856) (Table 3).

#### 3.1.8 Fruits per plant

Fruits per plant showed a highly significant positive relationship with the yield at the genotypic and phenotypic levels. It appeared from the results that direct yield was increased with the increase in the number of fruits per plant. The character showed a positive relationship with fruit weight at the genotypic and phenotypic levels (Table 3). Reddy et al. [36] reported that fruit weight and number of fruits per plant had high positive effect on fruit yield per plant.

#### 3.1.9 Fruit weight (g)

Fruit weight showed a significant positive relationship with the yield at the genotypic level. It appeared from the results that the increasing weight of fruit also increased the yield of okra. The character showed an insignificant positive relationship with the yield at the phenotypic level. In the present findings, fruit yield exhibited positive and highly significant correlation with number of fruits/plants and fruit weight (Table 3). Adiger et al. [37] reported that fruit weight showed highest positive effect fruit yield. Similar results were obtained by [38,39,40,41,42] for number of fruits/plant and fruit weight of okra.

### 3.2 Path Coefficient Analysis

Partitioning of genotypic correlation of yield into its contributing traits in genotypes of okra is shown in Table 4 and discussed character wise as follows:

#### 3.2.1 Days to first flowering

Days to first flowering showed a positive direct effect on fruit yield (0.047). Days to first flowering showed positive indirect effect through fruit length (0.040) followed by fruit diameter (0.020), fruit weight (0.009) and branches per plant (0.004). The negative indirect effect of this character on yield via fruits per plant (-0.441) was the highest followed by picking duration (-0.067) and plant height which finally made an insignificant negative correlation between days to first flowering and fruit yield (-0.434) (Table 4). Days to first flowering showed the positive direct effect on fruit yield in the present experiment which supports the findings of Aminu et al. [33] in okra.

#### 3.2.2 Days to first fruit harvest

Days to first flowering are the indicator of earliness in okra. The days to first fruit harvest after anthesis showed the negative direct effect on fruit yield (-0.001). Days to first fruit harvest showed maximum positive indirect effect through days to first flowering (0.018) followed by fruit diameter (0.013) and plant height (0.005). The negative indirect effect of this character via fruits per plant (-0.479) was the highest followed by fruit weight (-0.102), picking duration (-0.087) and fruit length (-0.018) which finally made a significant negative correlation between days to first flowering and fruit weight (-0.652) (Table 4). Days to first fruit harvest showed the negative direct effect on fruit yield.

#### 3.2.3 Picking duration

Picking duration showed a negative direct effect on fruit yield (-0.113). This character, however, showed positive indirect effect through fruit length (0.061), fruit diameter (0.044), days to first flowering (0.025) and branches per plant (0.002). The negative indirect effect via fruits per plant

(-0.089), plant height (-0.024), fruit weight (-0.007) and days to first fruit harvest (-0.001) was contributed to the result from totally insignificant negative genotypic correlation with fruit yield (-0.113) (Table 4). Picking duration showed the negative direct effect on fruit yield.

### 3.2.4 Plant height (cm)

A negative direct effect was observed for plant height on fruit yield (-0.096). The indirect effect via fruit length (0.094), fruit weight (0.082), days to first flowering (0.021), branches per plant (0.016) and fruit diameter (0.012) was found to be positive. The negative high indirect effect via fruits per plant (-0.123) followed by the duration of picking (-0.031) was contributed to result from a totally insignificant negative genotypic correlation with fruit yield (-0.026) (Table 4). Plant height showed the negative direct effect on fruit yield. Rathod et al. [43] stated that plant height negative direct effect on fruit yield/plant. Similar result was reported by Gogineni et al. [44].

### 3.2.5 Branches per plant

Branches per plant showed a positive direct effect on fruit yield (0.034). Branches per plant showed positive indirect effect through days to first flowering (0.005) but negative indirect effect through fruits per plant (-0.347) followed by fruit weight (-0.099), plant height (-0.045), fruit diameter (-0.026), fruit length (-0.011) and picking duration (-0.008) was contributed to result in totally insignificant negative genotypic correlation with fruit yield (-0.497) (Table 4). Branches per plant showed a positive direct effect on fruit yield of okra. Rathod et al. [43] stated that branches per plant had a positive direct effect on fruit yield. Umesh et al. [45] reported similar result.

### 3.2.6 Fruit length (cm)

A positive direct effect was observed for fruit length on fruit yield (0.114). The indirect effect via plant height (-0.079), picking duration (-0.067) and branches per plant (-0.003) were found to be negative. The positive indirect effect via fruits per plant (0.277), fruit weight (0.142), fruit diameter (0.041 and days to first flowering (0.016) was contributed to result in a totally insignificant positive genotypic correlation with fruit yield (0.442)(Table 4). Fruit length showed a positive direct effect on fruit yield of okra. Positive direct effect was found by Raval et al. [46], between fruit yield/plant and fruit length. Similar results were reported by [45,47,48,49, 50] for fruit length. Direct selection practiced on this character will result in improvement in yield.

### 3.2.7 Fruit diameter (mm)

Fruit diameter showed a positive direct effect on fruit yield (0.064). The negative indirect effect was observed via picking duration (-0.087), plant height (-0.018) and branches per plant (-0.014). The positive indirect effect via fruits per plant (0.392), individual fruit weight (0.074), fruit length (0.074) and days to first flowering (0.014) was contributed to result totally insignificant positive genotypic correlation with fruit yield (0.500) (Table 4). Fruit diameter showed a positive direct effect on fruit yield. Rathod et al. [43] found that diameter of fruit had a positive direct effect on yield of fruit. Similar results were reported by Patil et al. [51] for fruit diameter.

### 3.2.8 Fruits per plant

Fruits per plant showed a positive direct effect on fruit yield (0.866). The negative indirect effect of this character on yield via days to first flowering (-0.024) was the highest followed by branches per plant (-0.013). Fruits per plant showed maximum positive indirect effect through fruit weight (0.058) followed by fruit length (0.037), fruit diameter (0.029), plant height (0.014), picking duration (0.013) and days to first fruit harvest (0.001) which finally made highly significant positive correlation between fruits per plant and fruit yield (0.979)(Table 4). The fruit yield of okra would be significantly increased by the direct selection of genotypes based on this character. The fruits per plant showed a positive direct effect on fruit yield in the present experiment which supports the findings of Mishra et al. [52] in okra.

### 3.2.9 Fruit weight (g)

A positive and considerable direct effect was observed for fruit weight on fruit yield (0.153). Fruit weight showed a negative indirect effect through plant height (-0.051) and branches per plant (-0.022). The positive indirect effect of fruit weight via fruits per plant (0.329) was the highest followed by fruit length (0.106), fruit diameter (0.031), picking duration (0.005), days to first flowering (0.003) and days to first fruit harvest (0.001) which finally made significant positive correlation between fruit weight and fruit yield (0.554)(Table 4). So selection based on fruit weight increased fruit yield significantly.

**Table 3. Genotypic ($r_g$) and phenotypic ($r_p$) correlation coefficient among yield and its contributing characters of different genotypes of okra**

| Parameter | | Days to first fruit harvest | Picking duration | Plant height (cm) | Branches per plant | Fruit length (cm) | Fruit diameter (mm) | Fruits per plant | Fruit weight (g) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|---|
| Days to first flowering | $r_g$ | 0.385 | 0.534* | 0.459 | 0.116 | 0.349 | 0.306 | -0.509 | 0.056 | -0.434 |
| | $r_p$ | 0.357 | 0.602* | 0.213 | -0.051 | 0.079 | -0.029 | -0.283 | 0.023 | -0.249 |
| Days to first fruit harvest | $r_g$ | | 0.698** | -0.047 | 0.005 | -0.160 | 0.202 | -0.553* | -0.666** | -0.652* |
| | $r_p$ | | 0.716** | 0.068 | 0.046 | 0.016 | -0.074 | -0.406 | -0.323 | -0.408 |
| Picking duration | $r_g$ | | | 0.247 | 0.067 | 0.532* | 0.694** | -0.103 | -0.043 | -0.113 |
| | $r_p$ | | | 0.206 | -0.003 | 0.346 | 0.206 | -0.059 | -0.021 | -0.031 |
| Plant height (cm) | $r_g$ | | | | 0.467 | 0.819** | 0.186 | -0.143 | 0.535* | -0.026 |
| | $r_p$ | | | | 0.229 | 0.389 | -0.040 | -0.048 | 0.107 | -0.010 |
| Branches per plant | $r_g$ | | | | | -0.095 | -0.405 | -0.400 | -0.647* | -0.497 |
| | $r_p$ | | | | | -0.109 | -0.191 | -0.325 | -0.380 | -0.355 |
| Fruit length (cm) | $r_g$ | | | | | | 0.646* | 0.320 | 0.925** | 0.442 |
| | $r_p$ | | | | | | 0.527 | 0.260 | 0.294 | 0.365 |
| Fruit diameter (mm) | $r_g$ | | | | | | | 0.453 | 0.486 | 0.500 |
| | $r_p$ | | | | | | | 0.205 | 0.174 | 0.237 |
| Fruits per plant | $r_g$ | | | | | | | | 0.380 | 0.979** |
| | $r_p$ | | | | | | | | 0.278 | 0.894** |
| Fruit weight (g ) | $r_g$ | | | | | | | | | 0.554* |
| | $r_p$ | | | | | | | | | 0.501 |

*** Indicates significant at the 0.01 level*
**indicates significant at the 0.05 level*
*, $r_g$ = genotypic level and*
*$r_p$ = phenotypic level*

**Table 4. Partitioning of genotypic correlation of fruit yield into direct (bold) and indirect effect with yield contributing traits in okra genotypes**

| Parameter | Days to first flowering | Days to first fruit harvest | Picking duration | Plant height (cm) | Branches per plant | Fruit length(cm) | Fruit diameter(mm) | Fruits per plant | Fruit weight (g) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|---|
| Days to first flowering | **0.047** | 0.000 | -0.067 | -0.044 | 0.004 | 0.040 | 0.020 | -0.441 | 0.009 | -0.434 |
| Days to first fruit harvest | 0.018 | **-0.001** | -0.087 | 0.005 | 0.000 | -0.018 | 0.013 | -0.479 | -0.102 | -0.652* |
| Picking duration | 0.025 | -0.001 | **-0.125** | -0.024 | 0.002 | 0.061 | 0.044 | -0.089 | -0.007 | -0.113 |
| Plant height (cm) | 0.021 | 0.000 | -0.031 | **-0.096** | 0.016 | 0.094 | 0.012 | -0.123 | 0.082 | -0.026 |
| Branches per plant | 0.005 | 0.000 | -0.008 | -0.045 | **0.034** | -0.011 | -0.026 | -0.347 | -0.099 | -0.497 |
| Fruit length (cm) | 0.016 | 0.000 | -0.067 | -0.079 | -0.003 | **0.114** | 0.041 | 0.277 | 0.142 | 0.442 |
| Fruit diameter (mm) | 0.014 | 0.000 | -0.087 | -0.018 | -0.014 | 0.074 | **0.064** | 0.392 | 0.074 | 0.500 |
| Fruits per plant | -0.024 | 0.001 | 0.013 | 0.014 | -0.013 | 0.037 | 0.029 | **0.866** | 0.058 | 0.979** |
| Fruit weight (g) | 0.003 | 0.001 | 0.005 | -0.051 | -0.022 | 0.106 | 0.031 | 0.329 | **0.153** | 0.554* |

*Residual effect (R) = 0.0644*
*** indicates significant at the 0.01 level*
** indicates significant at the 0.05 level*

A positive and considerable direct effect was observed for fruit weight on fruit yield in the present experiment which supports the findings of Patil et al. [51] in okra. Umesh et al. [43] found that fruit weight had a positive direct effect on yield of fruit. Similar results were reported by Nwangburuka et al. [53] for fruit weight.

## 4. CONCLUSION

The days to first flowering showed a significant positive correlation with picking duration both genotypic and phenotypic levels. Days to first fruit harvest showed highly significant positive genotypic and phenotypic correlation with picking duration and highly significant negative genotypic correlation with fruit weight and significant negative genotypic correlation with fruits per plant and fruit yield. Picking duration showed a highly significant positive genotypic correlation with fruit diameter and fruit length. Plant height at the final harvest showed a highly significant positive genotypic correlation with fruit length and fruit weight at the genotypic level. Branches per plant showed a significant negative association with fruit weight at the genotypic level. Fruit length showed a highly significant positive genotypic correlation with fruit weight and fruit diameter and genotypic level. Fruits per plant showed a highly significant positive genotypic and phenotypic correlation with fruit yield. Fruit weight showed a significant positive genotypic correlation with fruit yield. Fruits per plant (0.979) and fruit weight (0.554) showed a high positive direct effect on fruit yield. Days to first fruit harvest showed the highest negative direct effect on fruit yield.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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