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Correlation and path coefficient analyses of yield and yield components of eggplant (*Solanum melongena*) in a coarse-textured Ultisol

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ABSTRACT

Assessment of variability and understanding of traits relationship in eggplant species are vital pre-requisite for formulating an effective breeding programme. We studied 23 genotypes of eggplants in a coarse-textured Ultisol using a randomized complete block design experiment with three replications. Data were collected on number of branches, number of leaves, number of nodes and internodes, stem diameter, plant height, floral and yield traits. Results revealed significant ($p = 0.05$) variation in the flowering and fruiting pattern of the genotypes. 'Yalo x K3BC2P1' gave the highest individual fruit weight of 80.8 g. Individual fruit weight contributed the highest direct positive effect on the fruit yield. It acted majorly through plant height, number of branches, number of leaves and number of days to first fruit set as revealed in the path coefficient result. Individual fruit weight, number of fruits per plant, plant height, number of days to 50% flowering, number of branches, numbers of days to first flowering and 50% fruit set had positive direct effect on yield. These traits should be considered in developing high yielding eggplant breeding programme.

1. Introduction

Eggplant (*Solanum melongena*) is the third most important crop from the Solanaceae family after tomato (*Solanum lycopersicon*) and potato (*Ipomoea batatas* L.) in Nigeria [1]. The fruit contains protein, minerals, vitamins and iron [2]. Its extracts are used in the treatment of skin problems, uterine complaints and as a purgative [3]. In Africa and Asia, it is a major source of income to rural women [4] and supplements starchy foods. It serves cultural purpose as a sign of hospitality.

Eggplant varies considerably in several agronomic traits. This wide variation has been observed in the fruit shape, colour, size, branching habit, flowering time, duration of fruit maturity, weight and number of fruits per plant [5,6]. Bonsu et al. [7] identified about 25 species of eggplant in Nigeria. This genetic variability observed at morphological and molecular

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levels can be effectively used to develop more promising eggplant cultivars that will adapt to the changing climate.

The knowledge of the inheritance mechanism of agronomic traits is very important for a plant breeder to formulate appropriate breeding strategy for the improvement of any crop. Assessment of variability in eggplant species is an essential pre-requisite for formulating an effective breeding programme. Exploitation of hybrid vigour or heterosis by intervarietal hybridization has been a very promising line of varietal improvement in many vegetables including tomato, chilli, sweet pepper and eggplant [8]. Compared with other tropical vegetable crops, the genetic variation in eggplant is not well documented [9]. The physiological activities of eggplant have not been adequately studied. It is important to ascertain the physiological behavior of existing material in the plant genetic pool and to understand major traits affecting the yield. The influence of plant growing environment like soil can affect its genetic expression [10,11]. Attempts to genetically improve the available indigenous genotypes are low because the plant is maintained as landrace by farmers due to their distinctiveness. To commercialize eggplant, there is need to develop varieties that can adapt to different climes while satisfying market requirements. To the best of our knowledge no study had shown the relationship among growth and yield components in eggplant grown in an Ultisol. The objective of this study was to evaluate the relationships among growth and yield component parameters and yield of eggplant in an Ultisol.

2. Materials and method

2.1. Description of study site

This study was conducted at the Department of Crop Science's Research Farm, University of Nigeria, Nsukka Enugu State Nigeria. Nsukka is located on latitude 06° 52′ N, longitude 07° 24′ E and altitude 447.26 m above the sea level in the derived savannah zone of Nigeria. The area has a tropical humid climate with two distinct seasons; the rainy season (April - October) and the dry season (November - March). The mean annual total rainfall, minimum and maximum annual temperature are about 1600 mm, 21 °C and 31 °C, respectively. The soil at the experimental site, derived from false-bedded sandstones, is deeply weathered, brownish red in colour, coarse-textured, excessively porous and well drained. It is characterized by low pH and low to moderate soil organic carbon content in the topsoil [12]. The soil is classified as Ultisol by the Soil Taxonomy of the USDA [13].

2.2. Plant materials

A total of 23 genotypes of eggplants were studied in a randomized complete block design experiment with three replications in 2015 and repeated in 2016. Eight of the genotypes were parents (Table 1), while the remaining fifteen were crosses and backcrosses (BC) to the parents. The crossings and selection history based on fruit yield are detailed in [6,14].

The genotypes used were 'Ewa', 'Iyoyo', 'Kaduna1′, 'Kaduna2′, 'Kaduna3′, 'Uyo', 'Ogbojioroke', 'Yalo', 'K3 x IyoyoBC2P1′, 'K3 x IyoyoBC2P2′, 'K3 x IyoyoF2′, 'K3 x IyoyoF3′, 'Uyo x IyoyoBC2P1′, 'Uyo x IyoyoBC2P2′, 'Uyo x IyoyoF2′, 'Uyo x IyoyoF3′, 'Yalo x IyoyoBC2P2′, 'Yalo x IyoyoF2′, 'Yalo x IyoyoF3′, 'Yalo x K3BC2P1′, 'Yalo x K3BC2P2′, 'Yalo x K3F2′ and 'Yalo x K3F3′.

2.3. Experimental design and cultivation

A nursery media containing topsoil, poultry manure and river sand in the volume ratio of 3:2:1 were used for the garden egg seed germination. The nursery was established on 19th September 2015 with shade and irrigation provided. After four weeks in the nursery, 30 vigorous seedlings were selected from each genotype and transplanted to the field spaced at 1 m x 0.6 m. The experiment was laid out in a randomized complete block design with three replications.

A total land area of 260 m^2 (20 × 13) was mechanically cleared, ploughed, harrowed and ridged. The field was divided into three blocks with each block containing 23 ridges according to genotypes. Poultry manure was incorporated into the soil one week before transplanting at the rate of 5.7 t ha^{-1}. NPK (20:10:10) fertilizer was applied at the rate of 300 kg ha^{-1} at two weeks after transplanting. The field was manually kept weed free.

2.4. Trait measurements

Two weeks after transplanting (WAT), number of branches, number of leaves, number of nodes and internodes per plant were counted and recorded while stem diameter and plant height were measured with Vernier caliper and meter rule,

Table 1 – Origins and source of Garden egg parents used in the study.

S/N	Parents	State of Collection	Remarks
1	Kaduna1	Kaduna, Kaduna State	Medium round green fruits
2	Kaduna2	Kaduna, Kaduna State	Big round white fruits
3	Kaduna3	Kaduna, Kaduna State	Big oblong light green fruits
4	Yalo	Nsukka, Enugu State	Big round stripe green fruits
5	Ewa	Umudike, Abia State	Small round light green fruits
6	Iyoyo	Umudike, Abia State	Small round light green fruits
7	Ogbojioroke	Umudike, Abia State	Tiny round dark fruits
8	Uyo	Uyo, Akwa Ibom State	Medium round deep green fruits

respectively. These parameters were measured biweekly until the 6th WAT. The plants were monitored to determine the number of days it took the first flower to open and the number of days it took 50% and 100% of the plants to flower in each plot. Also, the number of days it took the first fruit to form, number of days it took 50% and 100% of the plants to form fruits were recorded. At harvest, the total number of fruits per plant was recorded and their weight obtained. The total fruit weight was divided by number of fruits to obtain the individual fruit weight.

2.5. *Data analysis*

The data collected were analyzed using GenStat Discovery edition 4 [15] according to the procedure for randomized complete block design for field experiment. F-LSD at 5% level of probability was used to separate the means when there is significant F-test in the analysis of variance. Pearson correlation coefficient analysis was done using the computer statistical software package, SPSS version 16. The sets of correlation coefficients were subjected to path coefficient analysis. The direct and indirect effects were estimated according to the method of [16] to show the relationships between traits and their contributions towards fruit yield in garden egg.

3. Results

3.1. *Growth traits*

'Ogbojioroke' produced the highest number of branches, leaves, nodes and internodes that was significantly higher than the other genotypes at 2 WAT (Table 2, Figs. 1 and 2). The largest plant girth and tallest plant were obtained from 'Kaduna 2′ and 'K3 x IyoyoF3′, respectively. 'Kaduna 1′ had the lowest number of leaves and plant height while the smallest stem diameter was produced by 'Uyo' genotype at 2 WAT.

At 4 WAT, the results obtained followed a similar trend as at 2 WAT with 'Ogbojioroke' genotype giving the highest significant mean for all the traits studied except in number of nodes and plant height where 'Yalo x K3BC2P2′ and 'K3 x IyoyoF3′genotypes gave the highest means, respectively (Table 3, Figs. 1–3). Also, 'Kaduna 1′ genotype gave the least mean in number of leaves, stem diameter and height as at 2 WAT.

'Ogbojioroke' genotype maintained its lead in number of branches and leaves at 6 WAT while 'K3 x IyoyoF3′ gave the highest significant mean in number of nodes, internodes and plant height (Table 4). 'Yalo x K3F2′ genotypes produced the widest stem diameter that was similar to 'Ogbojioroke' and 'K3 x IyoyoF3′ genotypes but significantly different from the other genotypes.

There was significant variation in the flowering and fruiting pattern of the genotypes (Table 5). 'K3 x IyoyoBC2P2′ took the lowest significant number of days to start flowering. It also maintained the lead in shortest number of days to attain 50 and 100% flowering of the plants. Similar trend in flowering was repeated in fruit set. The 'Kaduna series' parent lines were significantly higher in number of days to flowering and fruit set. Among the parents, 'Ogbojioroke' had the shortest number of days to first, 50% and 100% flowering and fruit set. It was consistently followed by 'Iyoyo' genotype in these traits. Among the parents and their progenies, 'K3 x

Table 2 – Main effect of genotypes on morphological growth parameters of garden egg two weeks after transplanting.

Genotype	NOB	NOIN	NOL	NON	SD	PH
'Ewa'	3.5	6.5	19.8	7.5	7.1	24.8
'Iyoyo'	3.3	6.2	23.7	7.2	6.1	19.7
'K1′	1.0	8.0	8.8	9.0	6.2	12.8
'K2′	2.2	7.0	22.5	8.0	10.2	20.0
'K3′	1.2	6.5	11.2	7.7	5.9	18.7
'Uyo'	1.2	4.5	9.3	5.5	5.4	15.3
'Ogbojioroke'	7.8	9.2	88.5	13.0	7.4	40.5
'Yalo'	1.3	8.0	18.8	9.0	7.8	19.7
'K3 x IyoyoBC2P1′	1.8	5.2	21.3	6.2	6.8	26.7
'K3 x IyoyoBC2P2′	3.3	5.3	30.0	6.3	6.5	27.0
'K3 x IyoyoF2′	3.2	6.3	21.8	7.3	6.9	21.0
'K3 x IyoyoF3′	3.7	7.7	27.8	8.7	7.3	43.8
'Uyo x IyoyoBC2P1′	2.7	5.8	25.0	6.8	6.7	28.0
'Uyo x IyoyoBC2P2′	2.0	5.5	21.5	6.5	6.2	27.3
'Uyo x IyoyoF2′	3.0	6.7	23.0	7.7	7.1	25.8
'Uyo x IyoyoF3′	2.7	5.7	21.7	6.7	6.7	29.5
'Yalo x IyoyoBC2P2′	2.2	3.7	18.3	4.7	7.5	19.7
'Yalo x IyoyoF2′	2.2	4.2	18.0	5.2	5.9	19.3
'Yalo x IyoyoF3′	2.5	5.7	21.8	6.7	6.2	16.7
'Yalo x K3BC2P1′	1.8	4.5	15.7	5.5	7.4	15.2
'Yalo x K3BC2P2′	1.5	5.0	20.5	6.0	8.1	27.5
'Yalo x K3F2′	0.7	4.7	14.3	5.7	7.3	18.0
'Yalo x K3F3′	0.8	4.5	14.5	5.5	6.7	15.0
LSD $_{(0.05)}$	0.8	0.9	4.2	0.9	0.6	3.3

NOB = number of branches, NON = number of nodes, NOL = number of leaves, NOIN = number of internodes, SD = Stem diameter (mm) and PH = Plant height (cm).

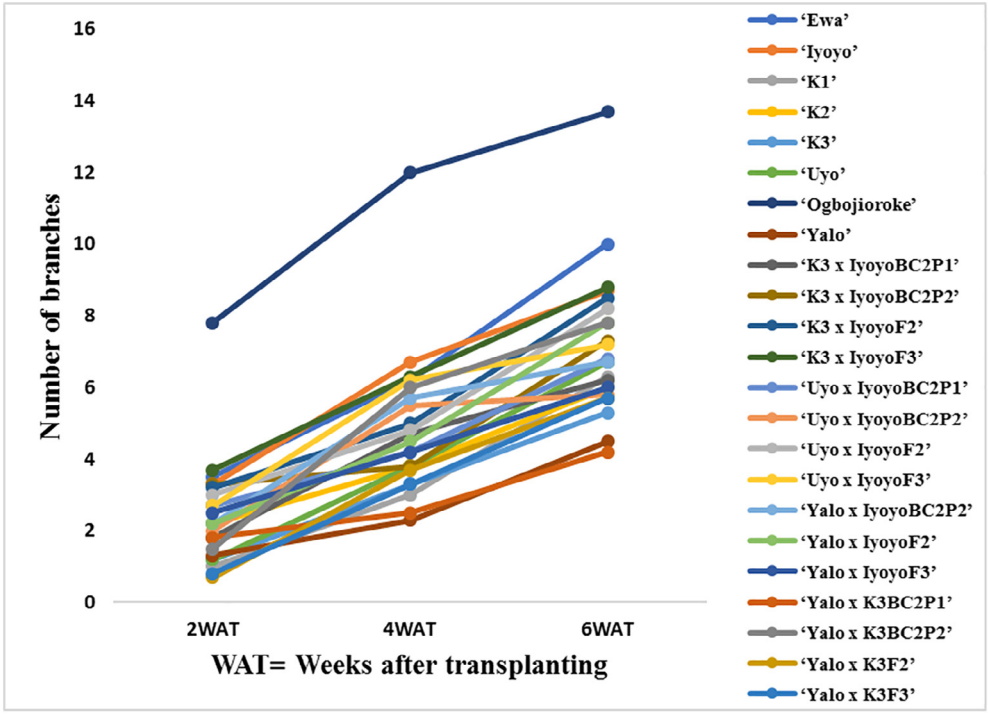

Fig. 1 – Effect of genotypes on number of branches of garden egg.

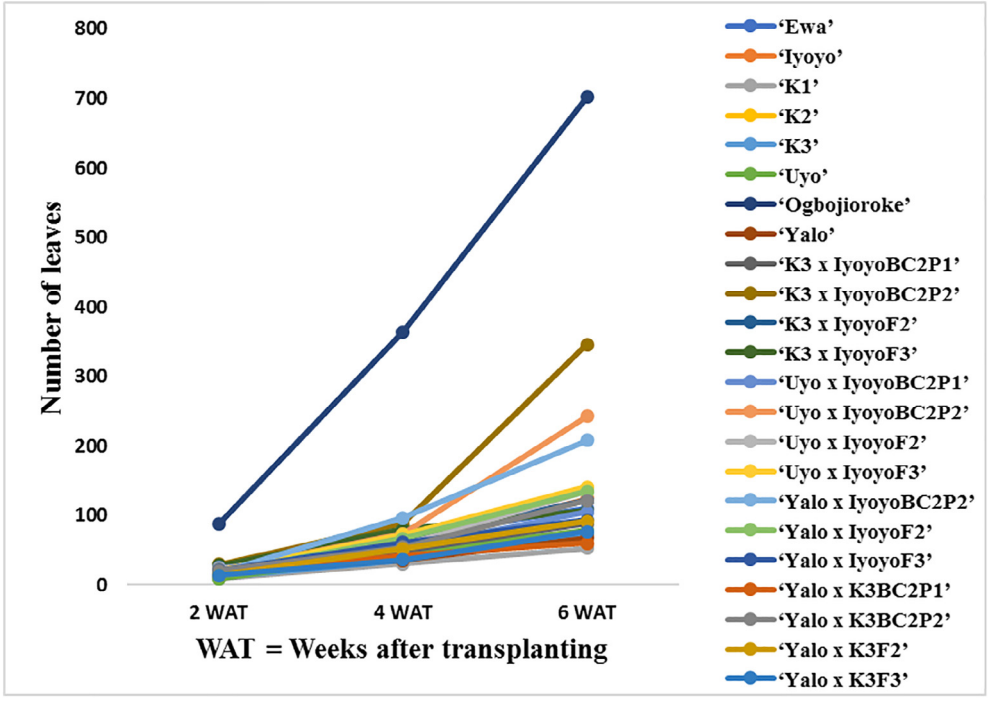

Fig. 2 – Effect of genotypes on number of leaves of garden egg.

IyoyoBC2P2′ genotype produced the overall shortest number of days to flowering and fruit set. The second shortest number of days to flowering and fruit set was observed in 'Uyo x IyoyoF2′. This was followed by 'Yalo x IyoyoF2′, 'Yalo x IyoyoF3′ and 'K3 x IyoyoF3′ genotypes. 'Ogbojioroke' genotype gave a significantly higher number of fruits per plant than the other parents and progenies. Among the progenies, 'Uyo x IyoyoBC2P2′ genotype produced the highest number of fruits per plant. This was followed by 'K3 x IyoyoBC2P2′ and 'K3 x IyoyoF3′ genotypes while the least number of fruits per plant was obtained from 'Yalo x K3BC2P1′ genotype. The progeny 'Yalo x K3F3′ gave significantly highest fruit weight per plant when compared among other progenies and parents. This was followed by 'Yalo x K3F2′ and 'Yalo x IyoyoF2′ genotypes.

Table 3 – Main effect of genotypes on morphological growth parameters of garden egg four weeks after transplanting.

Genotype	NOB	NOIN	NOL	NON	SD	PH
'Ewa'	6.2	7.5	69.8	8.5	10.4	43.2
'Iyoyo'	6.7	7.3	56.5	8.3	8.8	33.8
'K1′	3.0	6.7	31.0	7.7	7.5	20.8
'K2′	3.8	7.8	53.2	8.8	13.1	26.5
'K3′	3.3	6.7	36.3	7.7	9.3	27.0
'Uyo'	3.8	5.5	46.3	6.5	9.2	23.7
'Ogbojioroke'	12.0	11.5	364.0	12.5	14.5	43.5
'Yalo'	2.3	7.3	35.8	8.3	10.0	25.0
'K3 x IyoyoBC2P1′	4.7	7.8	50.0	8.8	10.7	42.3
'K3 x IyoyoBC2P2′	3.8	8.0	88.2	11.0	10.6	38.7
'K3 x IyoyoF2′	5.0	7.3	64.0	8.3	11.3	44.3
'K3 x IyoyoF3′	6.3	10.3	80.0	12.2	12.5	58.8
'Uyo x IyoyoBC2P1′	4.2	5.8	51.7	7.8	10.9	37.5
'Uyo x IyoyoBC2P2′	5.5	6.0	73.5	9.0	10.0	50.7
'Uyo x IyoyoF2′	4.8	9.2	58.0	10.2	11.9	42.2
'Uyo x IyoyoF3′	6.2	8.5	72.5	9.5	12.0	50.0
'Yalo x IyoyoBC2P2′	5.7	6.8	96.3	11.3	11.6	47.7
'Yalo x IyoyoF2′	4.5	8.5	66.7	9.5	11.0	40.2
'Yalo x IyoyoF3′	4.2	8.5	61.3	8.3	10.6	32.7
'Yalo x K3BC2P1′	2.5	7.2	42.2	8.2	11.1	31.0
'Yalo x K3BC2P2′	6.0	6.5	54.7	12.8	12.8	44.0
'Yalo x K3F2′	3.7	7.7	51.8	8.7	13.6	33.0
'Yalo x K3F3′	3.3	6.3	36.0	7.3	11.9	23.5
LSD ($_{0.05}$)	0.8	0.8	5.6	0.8	0.6	4.2

NOB = number of branches, NON = number of nodes, NOL = number of leaves, NOIN = number of internodes, SD = stem diameter (mm) and PH = Plant height (cm).

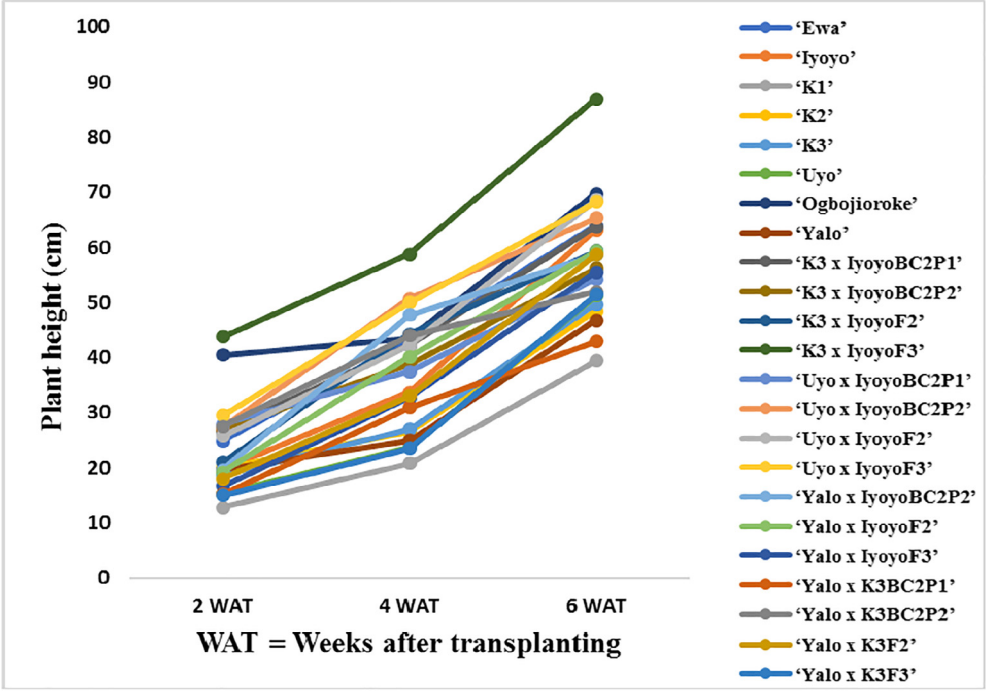

Fig. 3 – Effect of genotypes on plant height of garden egg.

The result of the average individual fruit weight showed that the highest individual fruit weight of 80.8 g was recorded in 'Yalo x K3BC2P1′ genotype. This was followed by 'Yalo x K3BC2P2′ (54.9 g), 'Yalo x K3F3′ (52.9 g) and 'Yalo x K3F2′ (43.2 g) genotypes. 'Yalo' genotype gave the highest average individual fruit weight when compared with the other parent lines. 'Ogbojioroke' produced the smallest average individual fruit weight accompanied by the highest number of fruits per plant. 'Yalo x K3BC2P1′ gave the highest individual fruit weight with the least number of fruits per plant.

Table 4 – Main effect of genotypes on morphological growth parameters of garden egg six weeks after transplanting.

Genotype	NOB	NOIN	NOL	NON	SD	PH
'Ewa'	10.0	9.7	109.5	10.7	13.6	64.0
'Iyoyo'	8.7	10.0	123.8	11.0	11.7	63.2
'K1′	6.3	8.3	52.7	9.3	10.9	39.5
'K2′	6.0	9.0	76.0	10.0	14.3	48.5
'K3′	5.3	8.3	74.5	9.3	12.1	49.7
'Uyo'	6.7	7.8	78.7	9.0	13.7	51.3
'Ogbojioroke'	13.7	11.2	701.8	14.0	17.1	69.8
'Yalo'	4.5	8.5	67.8	9.7	12.1	46.8
'K3 x IyoyoBC2P1′	6.2	8.8	88.8	9.8	13.2	63.8
'K3 x IyoyoBC2P2′	7.3	11.0	345.7	12.0	13.7	56.2
'K3 x IyoyoF2′	8.5	9.5	121.2	10.5	14.7	59.3
'K3 x IyoyoF3′	8.8	14.0	106.3	15.0	16.1	87.0
'Uyo x IyoyoBC2P1′	6.8	8.5	105.3	9.5	14.3	54.3
'Uyo x IyoyoBC2P2′	5.8	10.0	242.5	11.0	12.6	65.3
'Uyo x IyoyoF2′	8.2	12.7	135.2	13.7	14.3	68.7
'Uyo x IyoyoF3′	7.2	10.2	141.2	11.0	15.8	68.2
'Yalo x IyoyoBC2P2′	6.7	10.8	208.5	11.7	15.3	58.7
'Yalo x IyoyoF2′	7.8	11.7	134.8	12.7	14.1	59.3
'Yalo x IyoyoF3′	6.0	10.2	93.2	11.0	13.6	55.5
'Yalo x K3BC2P1′	4.2	8.2	60.5	9.2	15.1	43.0
'Yalo x K3BC2P2′	7.8	12.3	121.3	13.3	15.0	52.0
'Yalo x K3F2′	5.7	10.0	92.0	11.0	17.3	58.7
'Yalo x K3F3′	5.7	9.2	77.2	10.2	14.7	51.5
LSD ($_{0.05}$)	1.2	1.4	16.2	0.9	1.4	3.1

NOB = number of branches, NON = number of nodes, NOL = number of leaves, NOIN = number of internodes, SD = Stem diameter (mm) and PH = Plant height (cm).

Table 5 – Main effects of genotypes and season on floral and yield parameters of garden egg.

Genotype	D1FL	D50FL	D100FL	D1FR	D50FR	D100FR	FNPP	FWPP	IFW
'Ewa'	22.8	24.2	27.0	29.3	30.3	32.8	16.0	96.5	6.6
'Iyoyo'	17.0	18.5	22.0	22.7	25.8	27.0	18.5	64.7	3.5
'K1′	27.3	28.2	30.7	31.8	33.3	36.3	2.8	19.8	6.5
'K2′	25.0	25.8	29.5	31.2	34.2	35.8	6.5	99.8	12.4
'K3′	25.2	27.7	30.8	32.5	34.2	37.7	4.7	19.3	4.4
'Uyo'	21.7	23.3	26.2	26.5	27.7	31.2	8.8	175.5	15.6
'Ogbojioroke'	11.7	12.0	14.2	18.0	19.2	20.8	225.3	188.5	0.7
'Yalo'	24.0	26.0	28.3	30.3	31.3	35.0	4.7	216.2	37.3
'K3 x IyoyoBC2P1′	17.7	20.2	21.5	23.3	27.0	31.3	8.2	151.3	20.9
'K3 x IyoyoBC2P2′	9.3	9.7	11.7	13.3	14.2	16.5	10.5	75.3	6.6
'K3 x IyoyoF2′	19.2	20.5	23.5	24.8	27.7	29.7	10.5	110.0	10.4
'K3 x IyoyoF3′	14.8	17.0	18.0	20.5	22.0	23.7	7.0	85.5	14.4
'Uyo x IyoyoBC2P1′	16.3	18.7	19.8	22.3	24.2	27.0	8.8	246.2	23.2
'Uyo x IyoyoBC2P2′	19.3	20.7	21.5	24.2	27.5	31.2	12.8	121.8	7.4
'Uyo x IyoyoF2′	9.8	13.2	16.0	16.2	16.7	19.8	9.2	113.5	13.1
'Uyo x IyoyoF3′	18.2	18.8	19.2	23.3	24.3	28.2	9.7	121.2	12.0
'Yalo x IyoyoBC2P2′	21.7	23.7	24.8	26.2	27.0	31.8	9.5	105.5	9.9
'Yalo x IyoyoF2′	11.2	13.7	16.2	16.8	18.7	20.5	9.5	258.0	24.5
'Yalo x IyoyoF3′	12.0	13.2	14.3	17.2	18.7	23.2	8.8	150.3	18.4
'Yalo x K3BC2P1′	20.7	22.5	23.5	26.2	27.8	30.2	2.0	139.0	80.8
'Yalo x K3BC2P2′	21.2	23.0	23.3	26.2	27.5	28.8	4.2	229.5	54.9
'Yalo x K3F2′	20.8	23.3	25.7	26.7	28.7	31.7	6.5	333.3	43.2
'Yalo x K3F3′	22.2	24.0	25.2	29.3	30.5	32.0	6.8	449.7	52.9
LSD ($_{0.05}$)	2.1	2.5	2.5	2.2	2.3	2.5	4.9	62.1	9.4

D1Fl = number of days to first flower opening, D50Fl = number of days to 50% flowering, D100Fl = number of days to 100% flowering, D1Fr = number of days to first fruit set, D50Fr = number of days to 50% fruit set, D100Fr = number of days to 100% fruit set, FNPP = number of fruit per plant, FWPP = fruit weight per plant, IFW = individual fruit weight and n.s. = non-significant.

3.2. Correlation coefficient

The result of the correlation coefficient showed that number of days to first flowering had the highest significant coefficient (r = 0.97, n = 138) with number of days to first fruit set (Table 6). The floral and fruit set traits measured showed highly strong significant positive correlation values among themselves but exhibited negative correlation with the other growth and yield traits studied. Number of leaves was positively and significantly correlated with number of fruits per plant and number of branches while individual fruit weight correlated more with fruit weight per plant, stem diameter and height. Plant height showed highly significantly positive and strong correlation coefficient of 0.84 and 0.72 with number of branches and stem diameter, respectively. Number of fruit and fruit weight per plant showed significant and positive correlation with plant height, stem diameter, number of leaves, number of branches and nodes but correlated negatively with the floral traits measured.

3.3. Path coefficient

Individual fruit weight had the highest positive direct effect of 0.574 on fruit weight per plant (Table 7). It had positive indirect effect through number of days to 50% flowering, number of days to first fruit set, plant height, number of leaves, branches and nodes. The second highest positive direct effect was observed in plant height. The contribution of plant height to fruit weight per plant was mainly through number of days to first fruit set, number of branches, individual fruit weight and number of fruits per plant. After individual fruit weight and plant height, number of fruits per plant was next in line to the parameters that had positive direct effect on eggplant yield. Its effect was influenced by contributions through the positive indirect effects of number of days to first fruit set, plant height and number of branches.

Plant height, number of fruits per plant, number of branches, number of days to 50% flowering, number of days to first flower opening and 50% fruit set gave positive direct effect on fruit weight per plant. While number of days to first fruit set, number of branches, number of leaves, number of nodes and stem diameter had negative direct effect on fruit weight per plant.

4. Discussion

Genetic variation in gene pool is vital for successful selection and yield improvement in each crop species. Genetic divergent population provides vast desirable traits from which selection can be made for crop improvement. The significant differences observed among the parents at the vegetative growth stage are indication of their genetic diversity. An earlier study by [6] on these parents showed similar diversity. This report agrees with the findings of [8,17] where the presence of genetic diversity in eggplant had been reported.

In the earlier evaluation of the parents [14] 'Yalo', 'Kaduna 3′ and 'Iyoyo' parents were found to have good general combing abilities. The higher values obtained from the progenies over the parents (excluding 'Ogbojioroke') in the vegetative traits is a progress in these eggplants' improvement. Attempts are on-going to obtain successful cross between 'Ogbojioroke' genotype and other genotypes to incorporate its desirable traits into the improvement program. There may be flower incompatibility between 'Ogbojioroke' genotype and other genotypes as the crossed flowers kept aborting.

The number of days to flowering recorded in this study (including the 28 days spent in the nursery) is within the range of 38–61 days reported by [18]. High number of days to flowering and fruit set observed in some of the parents were absent in their progenies. Hence, the progenies commenced flowering earlier than their parents. This earliness to

Table 6 – Correlation coefficients between growth and yield parameters of 23 genotypes of garden egg.

	PH	NOL	NOB	NON	NOIN	SD	D1Fl	D50Fl	D100Fl	D1Fr	D50Fr	D100Fr	FNPP	FWPP	IFW
PH	1														
NOL	0.452**	1													
NOB	0.842**	0.588**	1												
NON	0.479**	0.308**	0.514**	1											
NOIN	0.435**	0.103	0.389**	0.907**	1										
SD	0.717**	0.381**	0.675**	0.294**	0.240**	1									
D1Fl	-0.360**	-0.348**	-0.331**	-0.465**	-0.428**	-0.208*	1								
D50Fl	-0.417**	-0.427**	-0.401**	-0.483**	-0.433**	-0.234**	0.961**	1							
D100Fl	-0.418**	-0.403**	-0.376**	-0.518**	-0.480**	-0.264**	0.937**	0.967**	1						
D1Fr	-0.405**	-0.394**	-0.373**	-0.462**	-0.417**	-0.250**	0.971**	0.946**	0.927**	1					
D50Fr	-0.320**	-0.373**	-0.314**	-0.446**	-0.403**	-0.215*	0.942**	0.918**	0.904**	0.968**	1				
D100Fr	-0.255**	-0.360**	-0.287**	-0.470**	-0.423**	-0.175*	0.893**	0.864**	0.848**	0.894**	0.938**	1			
FNPP	0.198*	0.853**	0.431**	0.237**	−0.014	0.202*	-0.225**	-0.272**	-0.246**	-0.250**	-0.243**	-0.245**	1		
FWPP	0.536**	0.250**	0.483**	0.211*	0.143	0.521**	-0.207*	-0.214*	-0.222**	-0.252**	-0.198*	−0.126	0.184*	1	
IFW	0.193*	−0.116	0.085	−0.026	−0.01	0.361**	−0.012	0.007	−0.038	−0.034	−0.008	0.032	−0.143	0.630**	1

NOB = number of branches, NON = number of nodes, NOL = number of leaves, NOIN = number of internodes, SD = stem diameter (mm), PH = Plant height (cm), D1Fl = number of days to first flower opening, D50Fl = number of days to 50% flowering, D100Fl = number of days to 100% flowering, D1Fr = number of days to first fruit set, D50Fr = number of days to 50% fruit set, D100Fr = number of days to 100% fruit set, FNPP = number of fruit per plant, FWPP = fruit weight per plant and IFW = individual fruit weight.

Table 7 – Direct (Diagonal and bold) and indirect effect of some growth and yield parameters of 23 genotypes of garden egg.

	PH	NOL	NOB	NON	SD	D1Fl	D50Fl	D1Fr	D50Fr	FNPP	IFW	FWPP
PH	**0.310**	−0.052	0.129	−0.015	−0.019	−0.026	−0.073	0.145	−0.022	0.048	0.111	0.536
NOL	0.140	**−0.115**	0.090	−0.010	−0.010	−0.025	−0.074	0.141	−0.025	0.205	−0.067	0.250
NOB	0.261	−0.068	**0.154**	−0.017	−0.018	−0.024	−0.070	0.134	−0.021	0.103	0.049	0.483
NON	0.148	−0.035	0.079	**−0.032**	−0.008	−0.034	−0.084	0.165	−0.030	0.057	−0.015	0.211
SD	0.222	−0.044	0.104	−0.010	**−0.026**	−0.015	−0.041	0.090	−0.014	0.049	0.207	0.521
D1Fl	−0.112	0.040	−0.051	0.015	0.005	**0.072**	0.168	−0.347	0.063	−0.054	−0.007	−0.207
D50Fl	−0.129	0.049	−0.062	0.016	0.006	0.070	**0.174**	−0.338	0.062	−0.065	0.004	−0.214
D1Fr	−0.125	0.045	−0.057	0.015	0.007	0.070	0.165	**−0.358**	0.065	−0.060	−0.019	−0.252
D50Fr	−0.099	0.043	−0.048	0.014	0.006	0.068	0.160	−0.346	**0.067**	−0.058	−0.004	−0.198
FNPP	0.061	−0.098	0.066	−0.008	−0.005	−0.016	−0.048	0.090	−0.016	**0.240**	−0.082	0.184
IFW	0.060	0.013	0.013	0.001	−0.009	−0.001	0.001	0.012	−0.001	−0.034	**0.574**	0.630
Residual												0.379

PH = Plant height (cm), NOL = number of leaves, NOB = number of branches, NON = number of nodes, SD = stem diameter (mm), D1Fl = number of days to first flower opening, D50Fl = number of days to 50% flowering, D1Fr = number of days to first fruit set, D50Fr = number of days to 50% fruit set, FNPP = number of fruit per plant, FWPP = fruit weight per plant and IFW = individual fruit weight.

flowering gave adequate time for fruit filling resulting in better yield. The strong correlation coefficient values between the flowering and fruit set traits indicated that improvement in one of the traits can lead to improvement in the other. The positive correlation of number of fruits per plant with fruit weight and number of branches observed in this study agreed with earlier report of [19] on the same traits in eggplant. Also, the negative value (−0.4) observed between number of branches and days to 50% flowering is in line with [6], however, no significant relationship was reported by them. This difference might be due to the number of genotypes or entries used in the analysis. A significant negative correlation of yield was observed with days to first flowering. The same negative association on yield was also observed by [19].

In the present study, individual fruit weight contributed the highest direct magnitude to fruit yield. It acted majorly through plant height, number of leaves, number of branches and number of days to first fruit set as revealed in the path coefficient result. Reduced number of days to first fruit set in eggplant will improve its fruit filling stage. Long period of fruit filling will ensure that adequate photosynthates are translocated to the sink. Sink filling is a function of the source activity in sink source relationship. Plant height, number of leaves and number of branches are source related traits that influenced fruit yield in eggplant through their action on individual fruit weight. Number of branches will increase with increase in plant height as indicated by the strong positive correlation coefficient between the two traits. Increase in plant height will ensure adequate spacing of the plant canopy. Leaf overlapping will reduce the photosynthetic capacity of the plant as less light will be intercepted. In addition to the positive indirect effects of plant height and number of branches to fruit weight through individual fruit weight, these traits had direct positive effect on fruit yield. These traits should be selected in developing high yielding eggplant varieties. Similar result was reported by [20] on path coefficient studies in eggplant.

Floral traits showed low magnitude among the traits with direct positive effects. Uddin et al. [21] reported that number of days to 50% flowering was important in eggplant selection but accounts less to its variability. Emphasis must be given to characters having high direct effect during selection to improve the eggplant yield [19].

5. Conclusion

The better performance of some selected progenies in individual fruit weight, total fruit weight per plant, plant height, stem diameter and flowering time over the parents is advancement in their genetic make-up. Individual fruit weight, number of fruits per plant, plant height, number of days to 50% flowering, number of branches, number of days to first flowering and 50% fruit set that had positive direct effect on yield should be considered in developing high yielding eggplant varieties. Further studies are recommended to transfer the superior characters of 'Ogbojioroke' genotypes in numbers of branches, leaves and fruit per plant to the eggplant breeding lines and to stabilize the genotypes before release to farmers.

Conflict of interest

The authors declared that there is no conflict of interest.

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