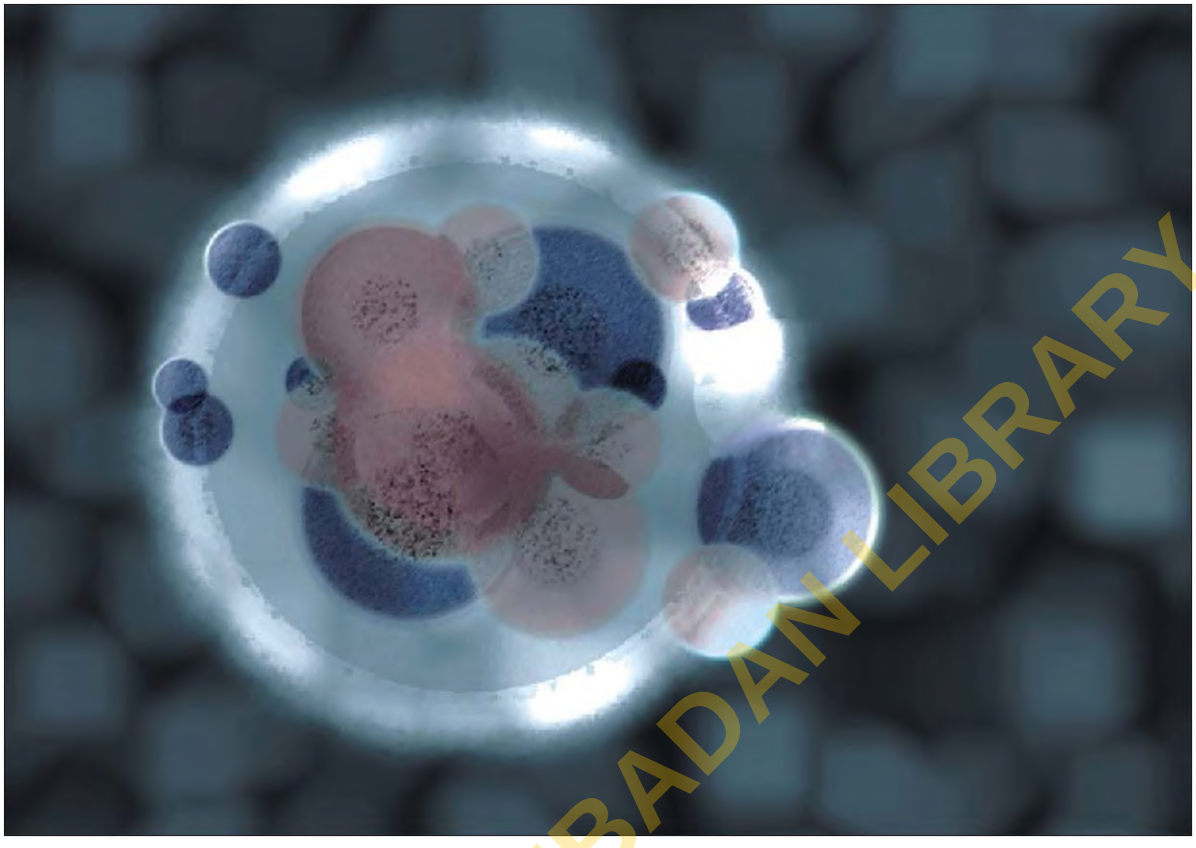

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Morphological studies in *Lycopersicon esculentum* Mill. lines in Southwestern Nigeria

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Abstract: Morphological studies of thirty lines of *Lycopersicon esculentum* Mill were carried out in order to find out characters, which may be used for the delimitation of the cultivars in Nigeria. The quantitative and qualitative characters studied include leaf type, leaf length, leaf shape, leaf breadth, petiole length, number of leaves per plant, number of leaflets per leaf, number of serration per leaflet days taken for germination, days taken for first picking, stem diameter, fruit diameter, fruit shape, fruit colour, stem type, stem colour, stem texture, leaf arrangement and growth habit. Morphological characters that indicate close affinity amongst the cultivars include leaf type, leaf base, leaf shape, leaf apex, leaf margin, leaf arrangement stem colour, fruit colour, number of calyx and corolla. However, the features that are taxonomically relevant in the delimitation of lines of *L. esculentum* are fruiting habit, fruit shape and presence or absence of ridges on the fruits. The three cultivars recognized are Ibadan local, hybrid and Roma VF. Numerical analysis of the qualitative and quantitative characters data using cluster analysis-average linkage, single linkage, complete linkage and centroid method delimit all the thirty lines into three major groups which conform to the results of the morphological analysis.

Key words: Morphology, *Lycopersicon*, Nigeria

INTRODUCTION

Lycopersicon esculentum Mill. (Solanaceae) is an important vegetable crop grown mainly for its edible fruits and sometimes leaves. As a popular vegetable crop, it ranks second in importance to the potatoes in many countries (Heywood, 1982). Tomato was probably introduced into Nigeria through early trade mission of the Portuguese to Africa and freed slaves from West Indies, but over the years, it has assumed a prominent position in the farming systems and diets of Nigerians (Denton and Swarup, 1983). *Lycopersicum* is a relatively small genus consisting of a little over ten species including the cultivated tomato (*L. esculentum*) and other closely related wild species (Rick, 1979; Phillips and Rix, 1993). These species are native to South America but widely cultivated and naturalized in warm temperate and tropical regions of the world (Phillips and Rix, 1993; Wagner *et al*., 1999). Apart from *L. esculentum*, the other species common to the West African region is *L. cerasiforme* Duval (Hutchinson and Dalziel, 1963).

Tomatoes are good sources of vitamins A and C and can help alleviate deficiencies of these vitamins in many developing countries (Villareal, 1971). Furthermore, the leaves are boiled and applied as poultices to relieve pain (Dalziel, 1948) while the leaves are pulped for embrocating areas of local pain (Burkill, 2000). The infusion of the leaves is also used in the treatment of gonorrhoea. In Nigeria, the leaves are considered antibiotic and fungicidal on sores (Burkill, 2000).

There are many cultivars of *L. esculentum,* some introduce and some local (Quinn and Crowther, 1976). These are generally classified according to their growing habit, fruit shape, cultivation method (outdoor or greenhouse production) and whether the fruit is a fresh market or for processing. There are however local cultivars which evolved from varieties introduced by the Portuguese. The introduced cultivars are often more susceptible to disease while the local cultivars are more tolerant to several diseases (Norman, 1992). As with some other vegetable crops in cultivation, for example, *Solanum* Linn. species, extensive crosses have been done on *L. esculentum* all over the world resulting in several varieties, cultivars and complexes. In Nigeria, while different cultivars have been recommended for specific ecological zones of the country (Adelana, 1976; Adelana and Oyedokun, 1979) the cultivars in Western Nigeria are known to be different especially in fruit shape, from those grown in Southern Nigeria as a result of geographical or ecological isolation (Norman, 1992).

The objective of this study is to examine the available lines of *L. esculentum* in the southwestern part of Nigeria and attempt to use the morphological characters so obtained to delimit the lines.

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MATERIALS AND METHODS

Collection of materials: Seeds of twenty-five lines of *L. esculentum* were collected from the Genetic Resources and Biotechnology unit of National Horticultural Research Institute (NIHORT) Idi-Isin, Ibadan, Nigeria. In addition, five ripe tomato fruits of different shapes were bought at Bodija market, Ibadan, Oyo State, Nigeria. A list of the thirty lines is presented in Table 1. The seeds were removed, washed and spread on sheets of Newspaper under the shade to dry for one week.

All the thirty lines of tomato seeds were sown in planting pots filled with top soil of 10 kg each. Watering was done regularly. After four weeks of sowing, seedlings were transplanted to the field. The seedlings were planted at a spacing of 60×30 cm on one meter wide beds as recommended by Adelana (1976). The planting was carried out in the Botanical Nursery of the Department of Botany and Microbiology, University of Ibadan, Ibadan, Nigeria.

Data collection: After six weeks of planting, quantitative morphological characters which include plant height, leaf length, leaf breadth, petiole length, stem diameter were measured using standardized metre rule and Venier Caliper. The average of ten measurements taken for each character was recorded. The average number of leaves per plant, number of serration per leaflet, primary branches per plant, days taken for germination, days taken for flowering, days taken for first picking, number of calyx and corolla were also recorded. At maturity (at about twelve weeks), qualitative morphological characters which include leaf apex, leaf base, leaf shape, leaf margin, leaf texture, leaf arrangement, leaf orientation, fruiting habit, stem type, stem colour, fruit shape, fruit size, fruit colour (both matured and immature fruits), fruit lobes, fruit pedicel area and fruit pistil scar were assessed.

Table 1: List of lines of *L. esculentum* studied

S/No.	Lines of *L. esculentum*
1	J. B
2	Ibadan Local
3	OLA 99/2
4	OLA 99/20
5	DT 95/41A
6	JM 94/52
7	JM 94/63
8	DT 95/64
9	DT 95/74
10	DT 95/118
11	DT 95/158
12	DT 95/165
13	DT 95/207
14	DT 95/215
15	DT 95/250
16	DT 95/258
17	DT 96/269
18	DT 95/285
19	DT 95/302
20	DT 95/327A
21	DT 95/327B
22	DT 95/337
23	DT 95/349
24	DT 95 / 349
25	DT 95/350
26	DT 95/360
27	DT 95/365
28	DT 95/370
29	DT 96/374
30	DT 95/415

Numerical taxonomy

Selection of Operational Taxonomic Units (OTUS): Altogether, forty characters were used for the analyses. These included both qualitative and quantitative morphological characters. Data matrix comprising of forty characters by thirty OTUS was used.

Data analysis: The data matrix was analysed using hierarchical cluster analysis. The agglomeration schedule employed were the average linkage between groups, complete linkage, single linkage and the centroid method Euclidean distance was used to measure the distance between OTUS

$$\left[D_E = \left[\sum_{i=1}^{n} \left(X_{ij} - X_{ik} \right)^2 \right]^{\frac{1}{2}} \right]$$

In this statistics X_{ij} is the character state value for character I in j and X_{ik} is that for line K. The programmes were run on a portable personal computer using the statistical package for social sciences (SPSS) for windows.

RESULTS

Table 2-7 and Fig. 1-4 give the summaries of the results of this study. The average plant height recorded was 99.6 cm (Table 2). The fruiting habit of the plant was found to affect the weight. Determinate types (Hybrid and Roma VF) with erect stems are taller than the indeterminate type with prostrate stem. Leaves are longer, wider and broader in Ibadan local cultivar than in other cultivars recognised but Roma VF and the hybrid had higher number of leaves than Ibadan local cultivar (Table 2). Number of leaflets per leaf (7) is uniform for all the three cultivars (Table 1) except in some few lines with nine leaflets. Seed germination occurred five days after planting, Ibadan local cultivar germinated first and hence produced flowers and fruits earlier than the other two

Table 2: Quantitative morphological features of *Lycopersicon esculentum*

Characters	Mean values (cm) for all lines studied
Plant height	77.9 (99.6±1.5) 101.1
Leaf length	3.6 (5.5±0.2) 7.0
Leaf breadth	2.0 (2.8±0.1) 3.9
No. of leaves per plant	18.0 (27.9±1.7) 57.0
No. of serration per leaflet	7.0 (10.30±0.3) 13.0
No. of leaflets per leaf	7.0 (7.9±0.2) 11.0
Days taken for germination	5.0 (6.5±0.3) 7.0
Days taken for flowering	42.0 (56.5±1.0) 63.0
Days taken for first picking	88.0 (99.3±0.8) 107.0
Primary branches per plant	14.0 (22.4±0.8) 28.0
Stem diameter	1.0 (2.12±0.5) 3.7
Fruit diameter	2.9 (6.8±0.4) 10.0
No. of fruits per bunch	3.0 (4.0±0.2) 8.0
Petiole length	0.6 (1.13±0.1) 2.3

Table 3: Morphological characters of each of the three cultivars recognised

Characters	IB. Local	Hybrid	Roma VF
Growth	Indeterminate	Determinate	Determinate
Leaf shape	Ovate	Ovate	Ovate
Leaf type	Compound	Compound	Compound
Leaf margin	Serrate	Serrate	Serrate
Leaf arrangement	Alternate	Alternate	Alternate
Leaf apex	Acute	Acute	Acute
Leaf base	Oblique	Oblique	Oblique
Stem type	Postrate	Erect	Erect
Stem texture	Hairy	Hairy	Glabrous
Stem colour	Green	Green	Green
Calyx colour	Green	Green	Green
Corolla colour	Yellow	Yellow	Yellow
Fruit shape	Flattened	Heart-shaped	High round
Fmit sizes	Large	Medium	Medium
Fruit lobes	Multilobed	Bilobed	Unlobed
Fruit colour	Red	Red	Red
Fruit blossom end	Indented	Pointed	Flat
Pistil scar	Irregular	Stellate	Dot-like
Fruit pedicel area	Strongly depressed	Slightly depressed	Flat
Colour of immatured fruits	Green	Green	Green
Leaf orientation	Horizontal	Semi-erect	Drooping

Table 4: Diagnostic features of each of the three cultivars recognised

Characters	IB. Local	Hybrid	Roma VF
Growth	Indeterminate	Determinate	Determinate
Stem type	Postrate	Erect	Erect
Stem texture	Hairy	Hairy	Glabrous
Fruit shape	Flattened	Heart shaped	High round
Fruit lobes	Multilobed	Bilobed	Unlobed
Fruit pedicel area	Strongly depressed	Slightly depressed	Flat
Pistil scar	Irregular	Stellate	Dot-like
Fruit blossom end shape	Indented	Pointed	Flat
Transverse section of fruit shape	Irregular	Angular	Round
Leaf orientation	Horizontal	Semi-erect	Drooping

cultivars. The average days taken for germination is 6.5 (Table 2). The petiole length ranges between 0.60-2.3 cm. Fruits of Ibadan local cultivar are the largest among the three cultivars, the fruits diameter ranges between 3 and 10 cm. There was an overlap in the number of fruits per bunch among the cultivars. Some lines had between 3 and 5 fruits while others had between 5 and 8 fruits (Table 2).

Table 5: Grouping of OTU'S according to the method of analysis

Groups	SL	AV	CL	CM
A	1, 2, 4, 5, 9 14, 20, 21, 25, 30	1, 2, 4, 5, 9, 14, 19, 21, 25, 27, 28, 30	1, 2, 4, 5, 9, 14, 20, 21, 25, 30	1, 2, 4, 5, 9, 13, 14, 20, 21, 25, 30
B	3, 6, 15, 19, 22, 24	8, 10, 12, 18, 24	3, 6, 15, 19, 22, 24	3, 6, 15, 19, 22,24
C	7, 8, 10, 11, 12, 16, 17 18, 23, 26, 27, 28, 29	3, 6, 7, 11, 13 15, 16, 17, 20 22, 23, 26 29	7, 8, 10, 11, 12, 16, 17, 18, 23, 26 27, 28, 29	7, 8, 10, 11, 12, 15, 18, 23, 29

A = Roma VF, B = Hybrid, C = Ibadan local, AV = Average linkage, CL = Complete linkage, CM = Centroid method, SL = Single linkage

The qualitative morphological studies showed a very close relationship between the thirty lines. All the lines had the same floral, leaf and stem morphology (Table 2). From the observations, the lines are thus grouped into three different cultivars; these are Ibadan local, hybrid and Roma VF. Morphological features used in the delimitation of cultivars are the presence or absence of ridge on the fruit, fruiting habit, leaf orientation and general fruit morphology (Table 3 and 4).

Morphological description of the cultivars recognised

Ibadan local: This is an annual herb with indeterminate growth. It grows up to 1 m in height. The stem is much branched and prostrate, green with hairy surface. The leaves are compound, ovate, alternate, petiolate, up to 7.0 cm long and 4.0 cm wide, margin serrated, apex acute, base oblique. The petiole is up to 1.6 cm long.

Flowers are yellow, pedicel length 0.6 cm long, calyx green, four to five and gamosepalous. Corolla yellow, four to five and gamopetalous. The fruit is a berry, deep green when immature, red when mature, up to 12 cm in diameter, flattened to slightly flattened, multilobed and strongly depressed, pistil scar irregular and blossom end shape indented.

Hybrid: Growth is determinate. It grows up to 1.7 m in height. The stem is erect, green and glabrous to hairy. The leaves are compound with 7-9 leaflets, ovate, alternate, petiolate, up to 6.5 cm long and 4.0 cm wide, margin serrated, apex acute, base oblique. The petiole is up to 1.8 cm long. Calyx is green, corolla yellow, four to five and fused. The fruit is a berry, light green when immature, red when mature, up to 8.5 cm in diameter, heart shaped, bilobed, slightly depressed, pistil scar stellate and blossom end shape flat.

Roma VF: This is an annual herbaceous plant with determinate growth. The height is about 1.2 m. The stem is erect, green, glabrous and up to 8.0 cm in diameter. The leaves are compound with 7-9 leaflets, ovate, alternate,

Table 6: Qualitative morphological characters of lines of *L. esculentum* studied

Characters/ lines	Growth type	Leaf shape	Leaf type	Leaf margin	Leaf texture	Leaf arrangement	Leaf apex	Leaf base	Stem type	Stem texture	Stem colour	Stem flexibility
1	Indeterminate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Postrate	Hairy	D green	Inflexible
2	Indeterminate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Postrate	Hairy	D green	Inflexible
3	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Hairy	L green	Flexible
4	Indeterminate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Postrate	Hairy	D green	Inflexible
5	Indeterminate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Postrate	Hairy	D green	Inflexible
6	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Hairy	L green	Flexible
7	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Glabrous	L green	Flexible
8	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Glabrous	L green	Flexible
9	Indeterminate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Postrate	Hairy	D green	Inflexible
10	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Glabrous	L green	Flexible
11	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Hairy	L green	Flexible
12	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Glabrous	L green	Flexible
13	Indeterminate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Postrate	Hairy	D green	Inflexible
14	Indeterminate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Postrate	Hairy	D green	Inflexible
15	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Hairy	L green	Flexible
16	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Glabrous	L green	Flexible
17	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Glabrous	L green	Flexible
18	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Glabrous	L green	Flexible
19	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Hairy	L green	Flexible
20	Indeterminate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Postrate	Hairy	D green	Inflexible
21	Indeterminate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Postrate	Hairy	D green	Flexible
22	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Hairy	L green	Flexible
23	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Glabrous	L green	Flexible
24	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Hairy	L green	Inflexible
25	Indeterminate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Postrate	Hairy	D green	Inflexible
26	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Glabrous	L green	Flexible
27	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Glabrous	L green	Flexible
28	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Glabrous	L green	Flexible
29	Determinate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Erect	Glabrous	L green	Flexible
30	Indeterminate	Ovate	Compound	Serrate	Hairy	Alternate	Acute	Oblique	Postrate	Hairy	D green	Inflexible

The lines are as numbered in Table 1

Table 7: Quantitative morphological characters of lines of *L. esculentum* studied

Lines	Plant height	Leaf length	Leaf breadth	Petiole length	No. of leaves per plant	No. of serration per leaflet	No. of leaflets per leaf	Days taken for Germination	Days taken for flowering	Days taken for first picking	Primary branches per plant	Stem diameter
1	77.9	6.5	2.6	0.9	28	11	07	5	50	95	31	1.7
2	78.3	8.6	2.3	0.8	24	11	11	5	63	92	27	2.5
3	85.5	5.4	3.8	0.6	28	11	09	7	61	102	20	1.7
4	79.0	7.6	3.0	0.6	18	11	07	5	47	92	28	2.7
5	80.0	8.4	2.9	1.0	32	11	07	6	46	88	26	1.0
6	79.8	4.6	2.6	1.7	26	13	07	7	60	100	23	2.3
7	100.4	6.4	2.1	1.0	30	11	07	7	65	98	21	2.3
8	99.5	5.7	3.4	0.9	30	10	07	6	57	98	20	2.3
9	78.1	5.5	2.5	0.6	22	10	07	5	42	102	24	2.5
10	101.0	4.8	3.0	0.7	22	13	07	7	56	100	20	1.3
11	89.7	4.6	2.5	0.9	22	11	09	6	56	97	26	1.0
12	86.5	4.2	2.8	1.0	25	09	09	7	62	105	20	1.0
13	80.4	7.9	2.3	1.2	26	09	09	6	61	100	26	1.5
14	82.0	8.5	2.6	1.5	30	09	07	6	51	95	16	1.4
15	82.3	6.2	2.0	1.1	25	11	07	7	50	98	19	2.6
16	88.0	6.4	3.4	0.9	34	07	07	7	52	94	18	1.5
17	91.4	5.8	2.3	0.8	24	11	07	6	62	103	22	1.9
18	90.5	5.5	3.7	1.3	48	11	07	6	58	98	20	3.4
19	90.6	5.5	2.2	1.3	54	09	07	7	57	100	19	1.9
20	78.2	6.0	2.7	0.7	24	13	07	6	63	104	14	2.9
21	82.4	7.7	2.5	0.6	24	09	07	6	63	107	25	2.0
22	88.7	4.2	3.0	1.2	24	11	07	6	62	102	28	2.3
23	93.2	5.0	3.7	2.3	24	11	07	5	56	100	26	2.2
24	87.4	4.7	3.9	1.8	24	13	07	7	58	102	16	2.2
25	83.0	7.0	2.4	1.5	24	13	11	6	53	100	31	1.7
26	98.4	6.3	2.6	1.6	21	11	07	6	62	105	24	3.7
27	93.0	6.8	3.9	1.2	38	09	07	7	60	1000	26	3.0
28	97.4	5.4	2.4	2.1	57	11	07	7	60	102	20	2.6
29	90.2	5.1	2.9	1.8	34	11	07	7	60	104	17	2.9
30	86.4	6.0	2.8	0.9	24	09	07	5	52	98	20	1.6

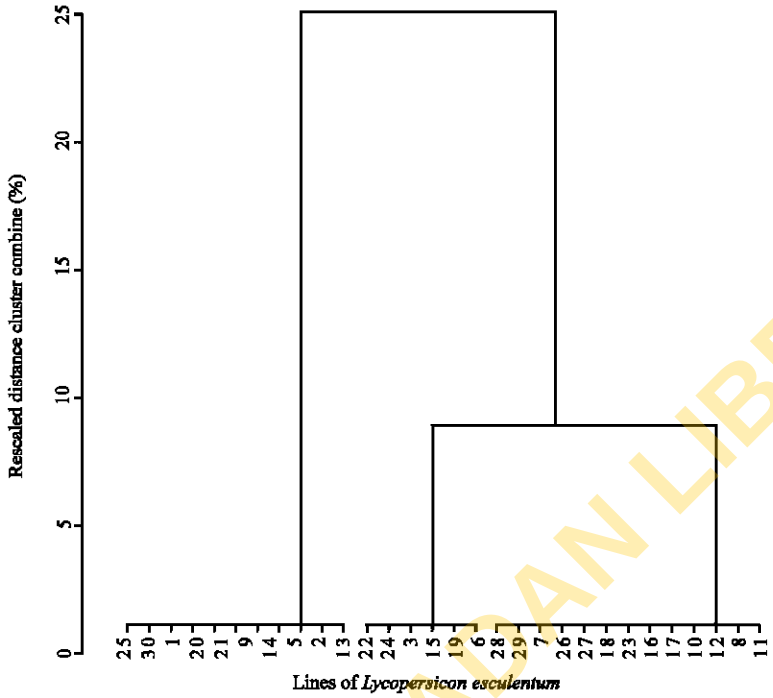

Fig. 1: Dendrogram using average linkage (between groups). The lines are as numbered in Table 1

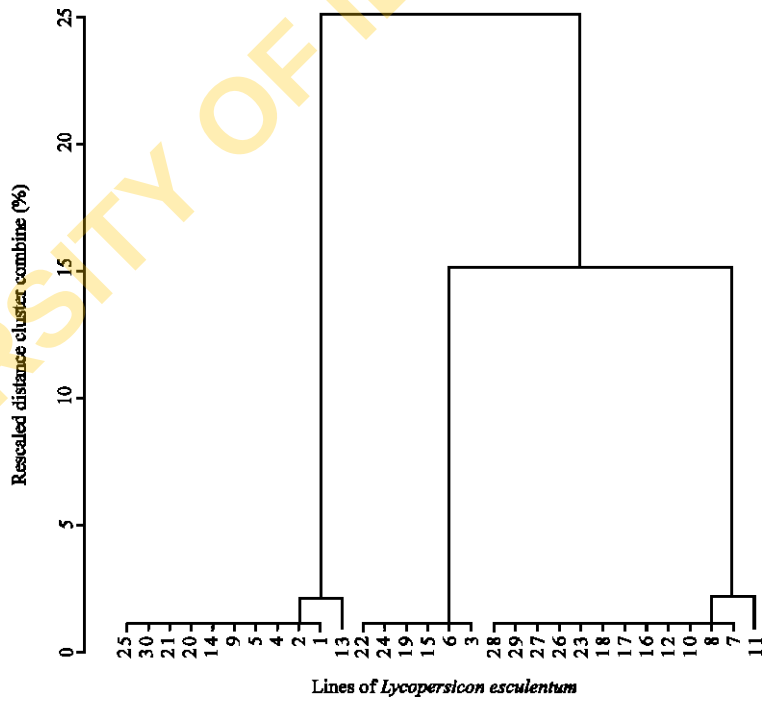

Fig. 2: Dendrogram using average linkage. The lines are as numbered in Table 1

petiolate up to 6.8 cm long and 4.1 cm wide, margin serrated, apex acute, base oblique. The petiole is up to 2.1 cm long. The calyx is green and corolla yellow. Fruit is a berry, green when immature, red when mature, up to 8.5 cm in diameter, high round, unlobed without ribbing, pistil scar dot-like and blossom end shape flat to pointed.

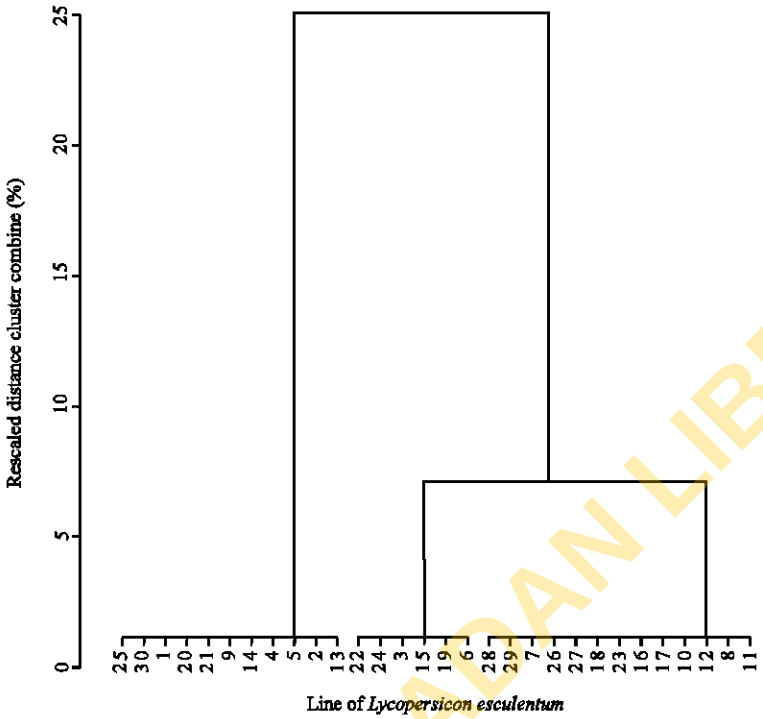

Fig. 3: Dendrogram using complete linkage. The lines are as numbered in Table 1

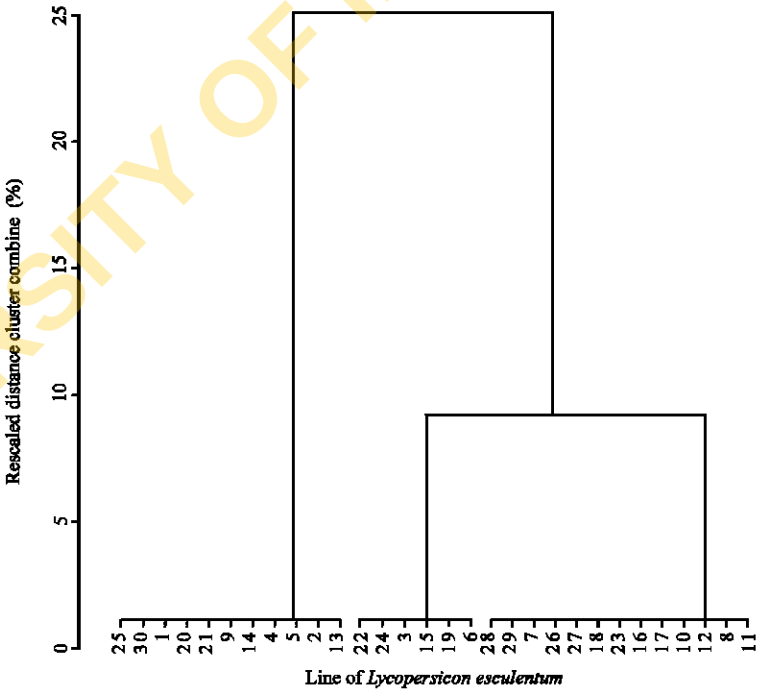

Fig. 4: Dendrogram using the centroid method. The lines are as numbered in Table 1

Numerical analysis: The results of hierarchical clustering procedures are presented in form of phenograms, which are diagrams of relationship. The abscissa shows the spacing out of the lines employed in the study while the ordinate on the other hand represents degree of similarity between and among the lines. The numbers represent

the lines as in Table 1. Figure 1-4 are phenograms of 40×30 data matrix obtained from Average Linkage Cluster Analysis (ALCA), Complete Linkage Cluster Analysis (CLCA), Single Linkage Cluster Analysis (SLCA) and Centroid Method (CM), respectively using qualitative morphological characters.

Three phenetic clusters are recognised from the four methods of analysis used (Fig. 1-4). These are groups A, B and C, which correspond to ROMA VF, Hybrid and Ibadan local, respectively (Table 5). Although branching occurred at low phenon levels which show broad similarities among the cultivars, there are some lines that stand as outliers and do not correspond to any group of the three cultivars recognised. Also some lines were found to overlap in all the three cultivars.

DISCUSSION

The results of the morphological studies showed a very close relationship among the cultivars. From the study, qualitative leaf, stem and floral morphological characters are similar in all lines while the cultivars exhibit variations in growth habit and fruit morphology (Table 3 and 4). All the cultivars have compound, ovate leaves with serrated margins, acute apex and oblique base with alternate arrangement (Table 3).

The floral morphology showed the presence of four to five, green, gamosepalous calyx and four to five, yellow, gamopetalous corolla. Stamens alternate with petals and there are two or more joined carpels in all the cultivars. There is a little variation in stem morphology among the three cultivars. Ibadan local has a deep green, hairy and prostrate stem; Roma VF has a light green, glabrous and erect stem while the Hybrid was found to be intermediate between the two cultivars. Roma VF with erect stem exhibited a determinate growth, Ibadan local has indeterminate growth. Fruit morphology is the major qualitative character used in the delimitation and identification of each cultivar. The major diagnostic feature is the fruit shape. Ibadan local is slightly flat to flat in shape with many lobes on the fruit surface. The Hybrid is heart shaped and it is bilobed while Roma VF is high round with smooth unlobed surface.

The shapes of the scar on the fruits also vary among the cultivars; it is irregular in Ibadan local, stellate in the hybrid and do-like in Roma VF. Ibadan local has indented blossom end shape, the hybrid has pointed end while Roma VF has a flat end shape. The average plant height recorded was 99.6 cm. The determinate cultivars with erect stems were found to be taller than the indeterminate cultivars with prostrate stems. Ibadan local germinated first and produced flowers and fruits earlier than the other cultivars. The average days taken for germination was 6.5 and this falls within the range of 6-7 days reported by Norman (1992). Number of leaflets per leaf was uniform for all the cultivars which were predominantly seven except in some lines with eleven leaflets. The number of serration per leaflets for all the cultivars was eleven.

The result of the clustering analysis showed that branching occurred at very low phenon line, which suggests a broad and over all similarities among the cultivars. This can be attributed to Hybridization and ability of tomato to self pollinate (Heywood, 1982). This analysis conforms to the delimitation of the thirty lines into three major groups using morphological characters but there are discrepancies in the sorting of the lines into the component groups. These discrepancies are not unconnected with the clustering methods used i.e., Average Linkage (AL) complete Linkage (CL), Single Linkage (SL) and Centroid Method (CM). In the average linkage, there is always an attempt to relate the new OTU to an average value of extant group rather than to the similarity or difference within it. The complete Linkage or Farthest Neighbour clustering on the other hand joins an OTU to a cluster based on the greatest similarity with the farthest OTU already within the same cluster (Lance and Williams, 1976b). The centroid method has a marked defect in that there is the tendency towards Chaining (Lance and Williams, 1976a) in which most of the OTUs join an initial cluster one at a time. This does not produce a convenient hierarchical classification of the OTUs.

Three groups of *L. esculentum* were recognised from this study. The delimitation of these groups was based entirely on the fruiting habit and fruit morphology i.e. fruit shape and presence or absence of ridges (lobes) on the fruits. Ibadan local, which is commonly cultivated in southern Nigeria, is an annual indeterminate plant with prostrate stem and flattened shaped fruits which many ridges. Roma VF popularly called Hausa tomato because of its prevalence in Northern Nigeria is an annual determinate plant with erect stem and high round to heart shaped fruits with no ridge (unlobed fruits). Because of its intermediate attributes between the two existing cultivars in Nigeria, the third group of the cultivars studied is recognized as a Hybrid in this study. The hybrid is a determinate plant with erect stem and pear shaped fruits with two to three lobes.

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