Mycopath (2014) 12(1): 37-42 **Research Article**

Comparative morphological relationship in eleven traits of *Corchorus olitorious* cultivars

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Abstract

The present study was conducted to evaluate the genetic diversity available in the cultivars of *Corchorus olitorious* L. with the aim of broadening their genetic base. Eleven cultivars of *C. olitorious*, including BUC_1, BUC_2, Oniyaya, BUC_3, $NHCO_{12}$, $NHCO_{21}$, BUC_4, BUC_5, BUC_6, BUC_7 and BUC_8 were evaluated for their morphological relationship. Plant height, leaf number, leaf area, leaf weight and root weight were used as agronomic indices. Seeds were sourced from Babcock University and National Institute of Horticultural Research (NIHORT) and germplasm were treated using the recommended wet heat treatment method in order to break seed dormancy. The seeds were then sown using a randomized Complete Block Design with the *C. olitorious* cultivars as the treatment. Results showed significant differences in all traits evaluated for the eleven cultivars except seedling fresh leaf weight, which was not significantly different for all the cultivars. Significant positive variations also existed among some of the paired traits. The present study indicated enough diversity among the *C. olitorious* cultivars that can help to broaden the genetic bases of new cultivars.

Keywords: Cultivars, genetic diversity, morphological relationship, traits.

Introduction

Availability, increased diversity and growing health awareness have been important reasons for increased consumption of leafy vegetables in developed countries. For example, the dietary benefit of fresh produce is the major reason for the 25% increase in fresh vegetable consumption in the United States during 1977–1999 (Regmi and Gehlar, 2001). On the other hand, increased participation by women in the labour market has created demand for processed, ready-to-eat convenience vegetable products. In this connection, *Corchorus* leaves are consumed in the cuisines of various countries. The genus *Corchorus* consist of more than 40 species of flowering plants in the family Malvaceae, native to tropical and subtropical regions throughout the world (Fondio and Grubben, 2004). *Corchorus olitorius* L. (Jute mallow) is widely grown in most parts of Nigeria, and the seed are available in local markets especially in the southwest of the country. Such seeds are obtained from local farmer's plots and they are usually made up of a mixture of different types as most farmers grow a mixture of two or more types on the same plot. This infers that little significance is attached to the knowledge of varietal purity in vegetable husbandry methods by peasant farmers (Olufolaji, 1980).

The crop of *C. olitorius* is cultivated for its leaves which are made into a slimy soup. This slimy property is the reason it is consumed. It is eaten with solid foods made from staple food crops and the soup aids swallowing of these solid foods (Denton, 1997).

The leaves of *C. olitorius* contain calcium, iron, and other vitamins such as carotene, thiamine, riboflavin, niacin, ascorbic acid and folic acid which are essential for proper growth, good eye sight, and strong teeth and bones development (Plattt, 1965; West *et al*., 1966; Norman, 1972). Production of *C. olitorius* in Nigeria is mainly rain-fed with about 80% of annual production during the raining season of June to September. While dry season production attracts higher price it however requires adequate irrigation for good yield (Denton, 1997). Jute mallow, responds well to organic manure. Application of 1.5-2.0 kg of dried chicken manure (or well-decomposed cattle or goat manure) plus 100 g of ash per m^2 bed is considered suitable for optimum production. When organic manure is not available, application of 15-15-15 fertilizer at a rate of 25 g per m^2 can be adopted (Fodio and Grubben, 2004). *C. olitorius* can be planted on flat but planting on beds is better for good crop yield. Planting is quite adequate at an interval of two weeks in order to

spread the marketing period and reduce the risk of poor sale during periods of oversupply. Frequent irrigation is needed for a good yield especially during the dry season. Pests and diseases infection on the crop is limited and are rarely a significant problem.

C. olitorious is highly perishable and the harvested shoots have a short shelf life when placed in polythene bags without diffusion holes. However, the shelf life of the shoots can be extended for 1-2 days by maintaining a moist temperature with a sheet of perforated cloth wrapped around the shoots during the day (Denton and Nwangburuka, 2012).

Studying the genetic variability and diversity in leafy vegetables like *C. olitorius* has been observed as key to early and adequate exploitation of the desirable nutritional properties of the crop (Oguntona and Akinyele, 1995) for better nutrition and good health especially among the rural communities in Africa. There are numerous cultivars of *C. olitorius* from which improvement can be made with recommendation of improved varieties to farmers. High yielding varieties with acceptable leaf size, colour, shape and plant height and early vegetative yield can be produced for better returns to the farmers. Local farmers are growing local cultivars. Many of the cultivars have undesirable characteristics and the vegetative yields of such cultivars are not known yet. The selection of high yielding, improved varieties of *C. olitorius* will certainly lead to increase in yield per cultivated area and higher income for the farmers. However, there are only few recommended varieties but such varieties are not readily available (Olufolaji, 1980).

The purpose of this project work was to identify new varieties of *C. olitorius* with desirable traits. Such varieties can be recommended to farmers, could be used by researchers for genetic improvement of the crop and also breeding types that are suitable for use in the further genetic improvement of available cultivars in the University Ilishan-Remo, Nigeria collection.

Materials and Methods

Source of plant accessions

Eleven cultivars of *C. olitorius* were used for the research. These included: BUC_1, BUC_2, Oniyaya, BUC_3, $NHCO_{12}$, $NHCO_{21}$, BUC_4, BUC_5, BUC_6, BUC_7 and BUC_8. They were sourced from National Horticultural Research Institute and Babcock University Germplasm units.

Field experiment

The research was conducted at the Horticultural unit of the School of Agriculture and Industrial Technology, Babcock University Ilishan Remo Ogun State; located in the tropical rain forest at a latitude 6° 43E and longitude 6° N of the equator in south-western Nigeria between the period of December 2007 and January 2008. The soil type in the area is sandy-loam and with an average annual rainfall of 1,500 mm.

The field planting started with the pre-planting operations which included land clearing, weeding and marking of seedbeds. Each bed was 2 m long, 1.5 m wide and 15 cm high. A total of twelve beds were made with a spacing of 50 cm between two beds for ease of field observations and operations. Before planting, seeds were subjected to wet heat treatment to break the dormancy and improve germination. This was done by immersing a piece cloth containing the seeds, in hot simmering water for 10-15 seconds after which the cloth was then put in cold water for 10 seconds. The seeds were then placed on a dry cloth where they were allowed to dry under room temperature. The dried seeds were mixed with fine river sand at a rate of 1gm seed to 10 kg soil before drilling on the beds to allow even distribution of the seeds during planting. The seeds were drilled vertically in rows on the beds. Each row was 2.0 m long and there were three rows on each bed with spacing of 20 cm between two rows on each bed. One crown cork of seed was drilled into each row. After planting, the beds were mulched with dry grass to reduce loss of moisture by evaporation and the beds were watered regularly during dry periods. Each plot, consisting of a single drilled row of 2 m long was planted to a variety. The entire plots were completely randomized and each plot was replicated three times. There were eleven plots in the entire experiment.

Data collection

Samples of each cultivar, consisting of about 10 plants per plot were collected randomly at seven weeks after planting. The plants were harvested by uprooting and were examined for some agro-morphological traits. These traits included: fresh leaf weight (weight of all harvested leaves), dry leaf weight (dry weight of all harvested leaves), fresh root weight (weight of plant root), fry root weight (dry weight of plant root), fresh stem weight (weight of fresh stem and branches), dry stem weight (dry weight of stem and branches), leaf area (cm) (the surface area of the harvested leaves), plant height (height of the

plant from the ground to tip of the plant) and number of leaves (the number of leaves on the harvested plant).

Dry weights of the traits were determined after drying sample in an oven at 50 °C until the samples attained constant weight. The leaf area was determined by measuring the length and width of the leaf blade. Data collected were subjected to analysis of variance (ANOVA), and means of treatments separated with Duncan's Multiple Range Tests (SAS, 1999). Correlation analysis was also carried out to determine relationships among traits of the plant.

Result and Discussion

There was no significant difference in fresh leaf weight of the eleven cultivars of *C. olitorius*, but fresh stem weight of the cultivars was significantly different from cultivar 5 ($NHCO_{12}$) having the highest mean value of 1.23 g, while cultivar 9 (BUC) had the lowest mean value of 0.35 g (Table 1). There was also significant difference in fresh root weight among the cultivars; with cultivar 5 ($NHCO_{12}$) recording the highest mean value of 0.32 g which is not significantly different from cultivar 3 "ONIYAYA", while cultivar 2 (BUC2) had the lowest mean value of 0.09 g (Table 1).

There was significant difference in dry leaf weight among the cultivars of *C. olitorius* evaluated. Cultivar 3 "ONIYAYA" was significantly different for all accessions with the highest mean value of 0.03 g, while the remaining cultivars did not exhibit any significant difference for this trait but maintained a low mean value of 0.02 g (Table 2). There was also significant difference in dry stem weight among the cultivars, with cultivar 5 ($NHCO_{12}$) having the highest mean value of 0.88g, while cultivar 9 (BUC6) had the lowest mean value of 0.23 g (Table 2). Dry root weights were significantly different among the cultivars, with cultivar 5 ($NHCO_{12}$) having the highest mean value of 0.26 g, while cultivar 9 (BUC6) had the lowest mean value of 0.08 g (Table 2).

There was significant difference in leaf area among the *C. olitorius* cultivars evaluated. Cultivar 6 ($NHCO_{21}$) had the highest mean value of 38.64 cm, while cultivar 2 (BUC2) had the lowest mean value of 19.67cm. Fresh root weights were also different among the cultivars, with cultivar 6 ($NHCO_{21}$) having the highest mean value of 28.11, while cultivar 1 BUC1 had the lowest mean value of 10.11 (Table 3). Plant height also followed the same trend.

Results of relationships among the variables of *C. olitorious* cultivars evaluated were shown in Table 4. There were positive correlations among dry leaf weight, dry root weight, dry stem weight, fresh leaf weight, fresh root weight, fresh stem weight, leaf area, leaf number and plant height. The following had significant positive relationships: fresh stem weight and dry root weight; fresh root weight and dry stem weight; fresh stem weight and fresh root weight; fresh root weight and dry root weight; fresh root weight and dry stem weight; dry stem weight and dry root weight; leaf area and dry leaf weight ; leaf area and dry root weight; leaf area and dry stem weight; leaf area and fresh root weight; leaf area and fresh root weight; leaf number and dry root weight; leaf number and dry stem weight; leaf number and fresh root weight; leaf number and fresh stem weight; leaf number and fresh stem weight; leaf number and leaf area; plant height and dry root weight; plant height and dry stem weight; plant height and fresh root weight; plant height and fresh stem weight; plant height and leaf area; plant height and leaf number. While dry root weight and dry leaf weight, fresh root weight and dry leaf weight were highly significant ($P \leq 0.01$). The pairs of dry stem weight and dry leaf weight, fresh leaf weight and dry root weight, fresh leaf weight and dry stem weight, fresh root weight and fresh leaf weight, fresh stem weight and fresh weight, leaf area and fresh leaf weight, leaf number and dry leaf weight, leaf number and fresh leaf weight, plant height and dry leaf weight, plant height and fresh leaf weight were however not significant. The strength of relationships among these traits is thus high enough to suggest sufficient variability among the cultivars and within the traits (Torkpol *et al*., 2006).

Results of this study indicated that significant variations occur among the cultivars for eight out of the nine measured traits. Fresh stem weight, fresh root weight, dry leave weight, dry stem weight, dry root weight, leaf area, leaf number and plant height, except for the fresh plant leaf which showed no significant difference among any of the eleven cultivars. The most outstanding cultivars were cultivars 3 "ONIYAYA" 5 ($NHCO_{12}$) 6 ($NHCO_{21}$) and 10 (BUC7), which showed superior performance for different characters. Cultivar 6 ($NHCO_{21}$) had the highest mean for leaf area, leaf number, plant height, and fresh stem weight which are characters desired by consumers, while cultivar 3 "ONIYAYA" had the highest mean value for dry leaf area and fresh root weight this suggest that both cultivars could be improved to combine the

characters for an improved cultivar that can be introduced to farmers. Cultivar 5 ($NHCO_{12}$) had the highest mean value for dry root weight; dry stem weight and fresh root weight. Cultivar 10 (BUC6) however had the highest value for fresh leaf weight. Cultivars 1 (BUC1), 2 (BUC2) and 9 (BUC6) were the lowest performing of the 11 cultivars of *C. olitorius* evaluated. Cultivar 1 (BUC1) had the lowest value for mean value for leaf number while cultivar 2 (BUC2) had lower values for plant height and fresh root weight. Cultivar 9 (BUC6) had the lowest mean value for most traits which include leaf area, dry leaf weight, dry root weight, dry stem weight, fresh leaf weight and fresh stem weight, this suggest that cultivar 9 (BUC6) may not be a good choice for selection in the improvement programme of *Corchorus*. Further selection among cultivars 3 "ONIYAYA", 5 ($NHCO_{12}$) and 6 ($NHCO_{21}$) might yield good result due to their relatively high performance in the measured traits compared to the other cultivars in the experiment. Opabode and Adeboye (2005) thus suggested that transformation system (such as Agrobacterium tumefaciens-mediated gene transfer) should be developed to drive novel genes into elite *Corchorus* genome.

Plant height showed the highest level of variation of all the nine traits evaluated. Results of relationships among variables of the plant showed positive correlation amongst all traits with varying levels of significance. However the economic traits that are highly significant are the leaf area and number. The pairs of leaf number and dry root weight; leaf number and dry stem weight; leaf number and fresh root weight; leaf number and fresh stem weight; leaf number and leaf area are significant; as such one of any of the pairs can be used as bases for selecting the other in the improvement of *Corchorus*. The pair of leaf number with dry leaf weight or fresh leaf weight is however not significant and as such may not be used in the selection of either of the traits. The pair of leaf number and dry leaf weight, leaf number and dry root weight, leaf number and dry stem weight, leaf number and fresh root weight, leaf number and fresh stem weight could be used in the selection of either of the traits.

The variation observed among the cultivars is an indication that progress can be achieved through selection of suitable cultivars for further improvement and production. Such possibility is more pronounced in characters where statistical analysis showed significant differences among the cultivars. The characters include fresh stem weight, fresh root weight, dry leave weight, dry stem weight, dry root weight, leaf area, leaf number and plant height. The variation and the scope for selection varied for the different characters. The variation is wide for fresh stem weight, fresh root weight, dry root weight, and leaf number; and low for dry leave weight, dry stem weight, leaf area, and plant height. Similarly, the most outstanding cultivar varied for different characters and no single cultivar can be regarded as most suitable for all the characters measured. Therefore none of the cultivars can be regarded as suitable for recommendation on the basis of being the most outstanding for all the characters. However, any of the cultivars with appreciable performance in the desirable economic characters, especially leaf number/plant and leaf size can be considered for interim recommendation pending the production of improved varieties through the processes of crossing, recombination and selection.

Table 1: Fresh weight of leaf, root and stem in eleven cultivars of *Corchorus olitorius.*

Cultivars	Fresh leaf wt (g)	Fresh root wt (g)	Fresh stem wt (g)
1	0.03±0.01 a	0.13±0.00a-c	0.080±0.02 ab
2	0.02±0.00 a	0.09±0.07c	0.39±0.11c
3	0.04±0.01a	0.31±0.09a	0.73±0.12ab
4	0.02±0.00a	0.15±0.03a-c	0.57±0.12ab
5	0.09±0.06a	0.32±0.10a	1.23±0.46a
6	0.03±0.00a	0.28±0.05ab	1.08±0.28ab
7	0.10±0.08a	0.14±0.05a-c	0.57±0.18ab
8	0.02±0.00a	0.12±0.03a-c	0.47±0.04b
9	0.02±0.00a	0.09±0.01bc	0.35±0.02b
10	0.12±0.10a	0.16±0.06a-c	0.66±0.33b
11	0.02±0.00a	0.13±0.04a-c	0.54±0.18ab

Means with the same letter(s) along a column are not significantly different ($P \leq 0.05$).

Table 2: Dry weight of leaf, root and stem in eleven cultivars of *Corchorus olitorius*.

Cultivars	Dry leaf wt (g)	Dry root wt (g)	Dry stem wt (g)
1	0.02±0.00ab	0.11±0.01bc	0.35±0.04 ab
2	0.02±0.00b	0.11±0.02bc	0.03±0.08b
3	0.03±0.00a	0.2±0.05abc	0.60±0.07ab
4	0.02±0.00ab	0.13±0.02abc	0.39±0.09ab
5	0.02±0.00ab	0.26±0.09a	0.88±0.34ab
6	0.02±0.00ab	0.22±0.03ab	0.76±0.15ab
7	0.02±0.00ab	0.11±0.03bc	0.40±0.11ab
8	0.02±0.00ab	0.10±0.01bc	0.34±0.02ab
9	0.02±0.01b	0.08±0.01c	0.23±0.06b
10	0.02±0.00ab	0.14±0.06bc	0.48±0.27ab
11	0.02±0.00ab	0.11±0.03bc	0.40±0.12ab

Means with the same letter in a column are not significantly different ($P \leq 0.05$).

Table 3: Leaf area, leaf number and plant height in eleven cultivars of *Corchorus olitorius*.

Cultivars	Leaf area (cm^2)	Leaf number	Plant height (cm^2)
1	9.65±2.06b	10.11±1.38c	25.18±2.88ab
2	7.37±0.92b	16.50±3.82abc	19.67±4.06ab
3	10.14±1.10b	24.05±3.36ab	35.88±3.85ab
4	10.68±1.59ab	15.22±2.75bc	28.79±4.36ab
5	11.33±1.98ab	20.35±6.67abc	38.50±9.34ab
6	16.98±2.68a	28.11±4.95a	38.64±1.96a
7	7.05±1.50b	15.33±3.37bc	25.84±4.21ab
8	7.25±1.83b	14.13±1.88bc	26.58±1.35ab
9	4.85±1.47b	14.34±1.14bc	19.90±1.18ab
10	9.83±2.33b	15.78±4.36bc	26.53±9.25ab
11	10.98±3.31ab	14.78±1.89bc	28.17±7.07ab

Means with the same letters in a column are not significantly different ($P \leq 0.05$).

Table 4: Relationships among variables evaluated for eleven cultivars of *Corchorus olitorious*.

Variable	Root dry wt	Dry stem wt	Fresh leaf wt	Fresh root wt	Fresh stem wt	Leaf area	Leaf number	Plant height
Leaf dry wt	0.30*	0.28^{NS}	0.25^{NS}	0.35^{*}	0.18^{S}	0.43^{**}	0.17^{NS}	0.28^{NS}
Root dry wt.		0.96^{**}	0.25^{NS}	0.95^{**}	0.87^{**}	0.61^{**}	0.82^{**}	0.85^{**}
Dry stem wt			0.27^{NS}	0.89^{**}	0.96^{**}	0.61^{**}	0.84^{**}	0.91^{**}
Fresh leaf wt				0.27^{NS}	0.29^{NS}	0.18^{NS}	0.13^{NS}	0.21^{NS}
Fresh root wt					0.79^{**}	0.55^{**}	0.77^{**}	0.80^{**}
Fresh stem wt						0.63^{**}	0.82^{**}	0.88^{**}
Leaf area							0.58^{**}	0.57^{**}
Leaf number								0.79^{**}

*, **, Significant at $P \leq 0.05$ and $P \leq 0.01$, respectively. NS = non-significant.

In this trial, cultivars 3 "ONIYAYA", 5 ($NHCO_{12}$), 6 ($NHCO_{21}$) and 10 (BUC7) appeared promising for these traits. The most important traits are leaf number and leaf size; but other characters such as stem weight, number of branches and plant height constitute major component of biomass obtainable per unit area.

The experiment suggestsed that enough variation existed amongst the eleven cultivars of *C. olitorius* to enhance improvement and selection of desired characters. Cultivar 6 ($NHCO_{21}$) was the best cultivar for a total of four characters out of the total of nine characters. Cultivars 3, 5 and 10 have potential for further improvements and this is because of their above average performance for most of the measured characters. All the outstanding cultivars for different characters can thus be combined in various ways through breeding to produce desirable varieties.

References

Denton L, 1997. A review of *Corchorus olitorius* in Nigeria. In: African indigenous vegetables workshop proceedings, Limbe, Cameroon, January 1997. Edited by Schippers, R, R and Budd, L (eds) Chatham, UK: IPGRI/ Natural Resources Institute.

Denton OA, Nwangburuka CC, 2012. Morphological diversity among *Corchorus olitorius* accessions based on single linkage cluster analysis and principal component analysis. *Jordan J. Biol. Sci.,* **5**: 191-196.

Fondio F Grubben GJH. 2004. *Corchorus olitorius* In: GJH Grubben & OA Denton (Eds.). Plant Resources of Tropical Africa 2. Vegetables. PROTA Foundation, Wageningen, Netherlands/Backhuys Publishers, Leiden. pp. 217-221.

Norman JC, 1972. Tropical leafy vegetable in Ghana. *World Crops*, **24**: 217-219.

Oguntona EB, Akinyele IO, 1995. Nutrient composition of commonly eaten foods in Nigeria-Raw, Processed and Prepared.

Olufolaji AO, 1980. The effect of varieties, spacing and fertilizer on the growth and development of *Amaranthus* spp and Celosia Argentia. Thesis: Department of Agricultural Biology Faculty of Agriculture and Forestry University of Ibadan.

Opabode O, Adeboye A, 2005. Application of Biotechnology for the improvement of Nigerian indigenous leaf vegetables. *Afr. J. Biotechnol.,* **4**: 138-142.

Platt BS, 1965. Table of Representative values of foods commonly used in Tropical Countries. Med. Res Council special report series No. 302. London.

Regmi A, Gehlar M, 2001. Consumer preferences and concerns shape global food trade. *Food Rev.,* **24**: 2-8.

SAS, 1999. Statistical Analysis Software (SAS). Systems for windows. SAS Users' Guide; Statistics, Version 9.1. SAS Institute Inc. Cary. NC, USA. pp. 1028.

Torkpol SK, Danquah EY, Offei SK, Blay ET, 2006. Esterase, total protein and seed storage protein diversity in okra (*Abelmoschus esculentus*, L. Moench). *West Afr. J. Appl. Ecol*., **9:** 1-7.

West ES, Todd WR, Mason HS, Van bruggen JT, 1966. Text Book of Biochemistry. 4th edition, pp. 1376-1413.