Agromorphological Study Of Jute Mallow (*Corchorus Olitorius L.*) Accessions In Nigeria

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Abstract- Corchorus olitorius L. (West African sorrel) is a fibrous flowering plant in the genus Corchorus with a series of cataloging. It is known as a favorite vegetable in virtually every home in Nigeria. The 11 accessions collected from NIHORT and IAR&T, Ibadan, Nigeria, and Thirty- two parameters were considered for both the qualitative and quantitative. Data collected were subjected to statistical analysis using R model version 2.15.3 to ascertain the degree of variation. Variation was recorded in most of the parameters while few parameters exhibit similarities. Plant height, number of leaves, stem circumference, leaf area, node length, and leaf width were significantly different at 95٪ probability level. The correlation coefficient value ranges from -0.93 to -0.99. variation in germination percentage did not affect the general growth and yield of the plant. The results also revealed that the node length cannot be considered for taxonomic purposes similarly, the number of seeds increases as the pods' number increases. The leaf morphology showed that three types exist in Nigeria ('Amugbadu', 'Oniyaya', and 'Eletiehoro'). Late early and late flowering was observed in Nigeria cultivars. The plant height increases with an increase in stem circumference, while the leaf length is related to the plant height and peduncle however, the number of leaves per plant is associated with the leaf width. Likewise, the leaf area is correlated with the leaf width. Conclusively, NG/OA/JUN/09/001, NG/SA/DEC/07/0403/, NHGB/09/147 are the best for higher production while NHCo-2 and NHGB/09/147 are the best in leaves and seed/pod production. Also, early and late maturity exist among the Nigerian jute cultivars. For food security and subsistence farming, NHCo-2 should be considered for it has a shorter period of growth and higher morphological yield. Some of the parameters may be genetic while others are either environmental or genetic.

Index Terms- Agro-morphology, Jute mallow, Variation, Correlation, and Cultivars,

I. Introduction

Jute Mallow or West African sorrel is an annual, herb, and flowering plant in the genus *Corchorus* belonging to the family Malvaceae, and of recent Sparrmanniacea. It has been grouped into several classes such as Capparaceae, Cistaceae, Papaveraceae, and Tiliaceae (Whitlock *et al*., 2003, Simmons, 2003). However, there is a difference of opinion regarding the number of valid species (Jennifer, 1990 and Makinde *et al*., 2009). Yet, the presence of wilder *Corchorus* species in Africa leads to larger genetic diversity with *Corchorus olitorius*, and the wild types are considered important genetic resources for biotic and abiotic stress tolerance and fine fiber traits (Maity *et al*., 2012). It is endowed with higher fiber contents and highly perishable vegetables, also one of the main fiber crops in the world and specifically in the Indian subcontinent (Basu et al., 2004) It has many local names in Nigeria, 'Ewedu' in Yoruba, 'ahihiara' in Igbo, and 'malafiya' or 'rama' in Hausa.

It produces best during hot rainy weather and grows well on sandy loam soils 1,2or marshes. *C. olitorius* L. is most frequently cultivated as a vegetable in Nigeria and tropical Africa is its main derivation (Roy et al., 2006 and Makinde et al., 2009). However, *C. olitorius* cultivars can exist both as early and late flowering with diversity in plant habit and leaf shape.

Large morphological and physiological variation exists among the leaf of *C. olitorius* found on farmers' plots in Nigeria (Nath and Denton 1980) and distinct types based on variation in leaf shapes were separated from local cultivars at NIHORT, Nigeria (Denton, 1997). Apart from the variation in the leaves, considerable variation in other morphological traits still exists within the various local morphotypes (Akoroda, 1985). The two most common types of *Corchorus olitorius* in Nigeria are 'Amugbadu', which grow tall with large finely serrated leaves that are oblong, and 'Oniyaya', which is widely branched with broad, deeply and irregularly serrated (*Corchorus incisifolus*) leaves and highly mucilaginous. In Cameroon and other West African countries, numerous local types are varying among others in height, stem colour, leaf, and fruit shape. 'Oniyaya' in Cameroon is more deeply lobed than those found in Nigeria though there are overlaps. A large, broad-leaved accession from Cameroon with a shorter swallowtail that is commonly cultivated near Yaoundé is called Greant de Bertoua. Its leaf tips are rounder than those of 'Amugbadu', the most common one in Nigeria, which resembles the Cameroonian Ewondo (Pal et al., 2006). There are several other minor local morphotypes, for example, 'Eletiehoro' with small ovate leaves like the ear of a hare, oblong and with fine

serration, and 'Etieku' with a leaf shape like the ear of a rat. Another popular local type is the 'Yaga' (Makinde et al., 2009).
The genus *Corchorus* is highly diversified in benefits such as economic (Chattopadhyay *et al*., 2004, and Indian Jute Industries Research Association) IJIRA), health (James Duke, 1983; Hillocks, 1998, and Pal *et al*., 2006), pharmaceuticals (medicine), cosmetics and paints industries. Another benefit of jute is that it can also be intercropped with food crops and vegetables such as yam, groundnut, watermelon, okra, tomato, and many more (NIHORTPROTA Nigeria, 2002).

Because jute is a very important vegetable in this part of the world, inadequate attention is given to its improvement. Hence, it is a necessity to establish variability in the vegetable for selection of accessions for breeding purposes.

II. Materials and Methods

Eleven accessions of jute were collected from NIHORT and IAR&T, Ibadan, Nigeria. Before sowing, the seeds were carefully examined morphologically and pre-germinated in Petri-dishes to determine their viability. The seeds were treated with hot water to break the dormancy before planting in a woven cotton bag for 10 minutes at 100˚C water. The pre-warmed seeds were dipped in cold water to stop heating action and the seeds were spread to dry. Adequate care was taken to prevent seed injury (Ohio State University, 2012). Peat was mixed with alluvial soil from the University of Ilorin dam bank to lower the soil PH to between 5.1 and 6.8; the planting bag was filled with rich potting soil and wetted before sowing. The seeds were sown on topsoil, separating them by at least one inch. The seeds were covered with the thinnest possible layer of soil. The potted bags were then placed in the screen house and the soil was kept moist by watering twice daily as jute requires more water until it reaches a height of 6-8 inches. The seeds planted in small polythene bags in the screen house were later transplanted into the polythene bags (16.5 by 15.5 inches) in an open field in five replicates per accession at the soil depth of 1-2cm in a randomized complete block design. This was laid at 20cm within and 60cm between the rows, in such a way that all the accessions were exposed to the same atmospheric condition. The polythene bags were perforated to avoid waterlogging and prevent fungi growth. The bags were attached with a corresponding label indicating the date of planting and accession number of the plant. Twenty seeds of each accession were planted in each of the polythene bags. The seedlings were thinned to two seedlings per bag on the 15th day after emergence to reduce competition. Weeds were removed on regular basis from the seedling stage to maturity to minimize competition between the grown plants and the weeds. Harvesting of seeds was done manually.

A total of thirty-one parameters were considered for all the eleven accessions planted. The morphological characters scored include Number of days to emergence, Percentage germination, Height of plant, Number of leaves per plant, Leaf Area of the plant, Leaf length, Leaf Width, Petiole length, Length of peduncle per flower, Node length, Leaf Index, Number of nodes per plant, Number of valves per capsule, Number of branches), Number of Seeds per capsule, Number of pods per plant, Number of days to flowering, Number of days to pod formation, Number of days to maturity, number of pods per plant, Stem circumference of the plant, Length of stipule, Length of pod per plant, Pod circumference, Weight per 100 seeds, Weight of pods per plant, Plants growth pattern, Pod shape, Seeds coat colour, Stem colour, Days to germination. The collected morphological data were subjected to statistical analysis using 'MASS PACKAGING' 2013. R version 2.15.3.

III. Results

Mostly, all the growth traits showed variation in the accessions although some signified similarities (Table 1). The percentage germination also showed variation and similarities in all the accessions studied (Figure 1).

Table 1: Mean number of days to maturity, plant height at maturity, stem circumference, and length of stipule for *C. olitorius* accessions studied

Accession	Number of days to emergence	Mean Number of days to maturity	Mean plant height at maturity (cm)	Stem circumference (cm)	Mean length of stipule (cm)
NG/OA/JUN/09/001	3	171	100.10	2.9	1.3
NG/SA/DEC/07/0403	5	171	98.02	3.0	1.2
NHGB/09/147	3	167	99.10	2.5	1.1
NG/SA/DEC/09/0403	5	194	80.00	2.2	0.9
NG/AA/06/12/177	3	167	79.50	2.2	0.9
NHGB/09/145	3	171	78.70	2.4	0.6
NHCo-2	4	188	100.50	2.7	1.1
NG/OA/02/11/008	3	181	63.00	2.3	0.9
NG/To/02/12/179	3	194	120.00	2.6	0.9
NG/AA/SEP/09/173	4	176	105.04	2.9	0.9
NG/To/02/12/180	3	167	78.90	2.6	1.3

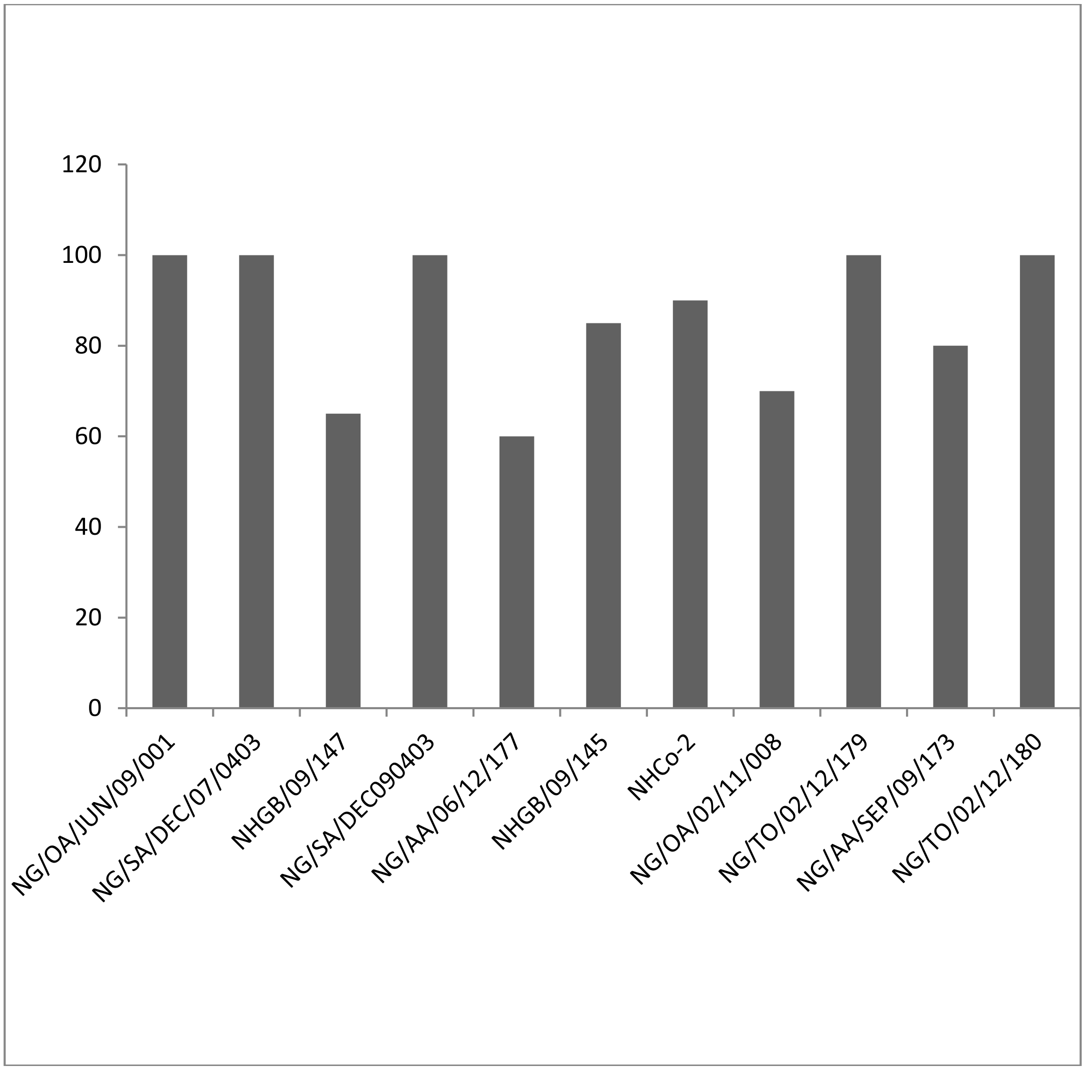

Figure 1: Histogram of percentage seed germination of *Corchorus olitorius* accessions

Table 2: Qualitative characters of Nigeria *C. olitorius* L. accessions

Accession	Branching pattern	Stem colour	Leaf serration	Leaf shape	Venation
NG/OA/JUN/09/001	Less branched	Dark green	Biserrate	Acuminate, broad	Pinnate
NG/SA/DEC/07/0403	Less branched	Dark green	Biserrate	Acuminate, broad	Pinnate
NHGB/09/147	Less branched	Yellowish green	Serrulate	Acuminate, ovate, oblong, lanceolate, broad	Pinnate
NG/SA/DEC/09/0403	Less branched	Yellowish green	Biserrate	Acuminate, small	Pinnate
NG/AA/06/12/177	Heavily branched	Dark green	Serrulate	Acuminate, ovate, oblong, small	Pinnate
NHGB/09/145	Heavily branched	Dark green	Serrulate	Acuminate, ovate, lanceolate, oblong, small	Pinnate

NHCo-2	Less branched	Dark green	Biserrate	Acuminate, broad	Pinnate
NG/OA/02/11/008	Less branched	Dark green	Serrulate	Acuminate, ovate, lanceolate, oblong, small	Pinnate
NG/To/02/12/179	Heavily branched	Dark green	Serrulate	Acuminate, ovate lanceolate, broad	Pinnate
NG/AA/SEP/09/173	Heavily branched	Yellowish green	Serrulate	Acuminate, ovate lanceolate, broad	Pinnate
NG/To/02/12/180	Heavily branched	Yellowish green	Serrulate	Acuminate, ovate, lanceolate, broad	Pinnate

Table 3: Leaf morphology of *Corchorus olitorius* accessions

Accession	Length of the petiole (cm)	Leaf length (cm)	Leaf width (cm)	Leaf index	Leaf area (cm^2)	Node length (cm)	No. of nodes/plant
NG/OA/JUN/09/001	1.7	8.7	5.0	1.74	24.52	1.7	66.2
NG/SA/DEC/07/0403	2.5	9.8	5.4	1.81	28.48	2.8	75.0
NHGB/09/147	2.1	8.6	7.0	1.23	26.04	2.2	67.4
NG/SA/DEC/09/0403	1.8	5.9	5.5	1.07	17.24	1.5	97.2
NG/AA/06/12/177	1.5	4.5	3.1	1.45	12.00	2.1	141.6
NHGB/09/145	1.2	5.5	3.2	1.72	15.04	2.7	113.2
NHCo-2	2.1	8.9	9.5	0.94	44.16	2.4	66.6
NG/OA/02/11/008	1.7	6.7	3.9	1.72	20.80	2.4	99.0
NG/To/02/12/179	1.8	9.2	4.8	1.92	33.72	2.8	87.2
NG/AA/SEP/09/173	2.1	9.0	4.9	1.84	30.96	2.9	149.4
NG/To/02/12/180	1.6	8.3	4.5	1.84	30.16	3.7	127.4

Table 4: Selected flower characters and pod characters among the *C. olitorius* L. accessions

Accession	No. of days to flowering	No. of days from flowering to podding	Peduncle length (cm)	No. of days of sowing to podding	Pod length (cm)	Pod circumference (cm)	No. of pods /plant	Pod shape	No. of valves/ pod
NG/OA/JUN/09/001	51	5	0.2	55	3.9	2.1	222	Slightly curve	5.5
NG/SA/DEC/07/0403	61	12	0.4	72	3.9	1.9	203	Straight	6.3
NHGB/09/147	40	11	0.2	50	4.5	2.2	110	Slightly curve	5.0
NG/SA/DEC/09/0403	50	5	0.2	54	2.4	2.0	159	Straight	5.3
NG/AA/06/12/177	61	2	0.2	62	3.5	1.9	273	Slightly curve	6.3

NHGB/09/145	38	13	0.3	50	3.9	2.1	256	Straight	5.0
NHCo-2	41	10	0.3	50	4.9	2.1	284	Straight	5.2
NG/OA/02/11/008	49	7	0.2	51	4.4	2.3	173	Slightly curve	5.6
NG/To/02/12/179	48	6	0.3	53	4.1	2.0	260	Straight	5.0
NG/AA/SEP/09/173	49	7	0.3	55	4.3	2.1	100	Slightly curve	6.0
NG/To/02/12/180	44	10	0.3	53	5.2	2.2	219	Straight	5.8

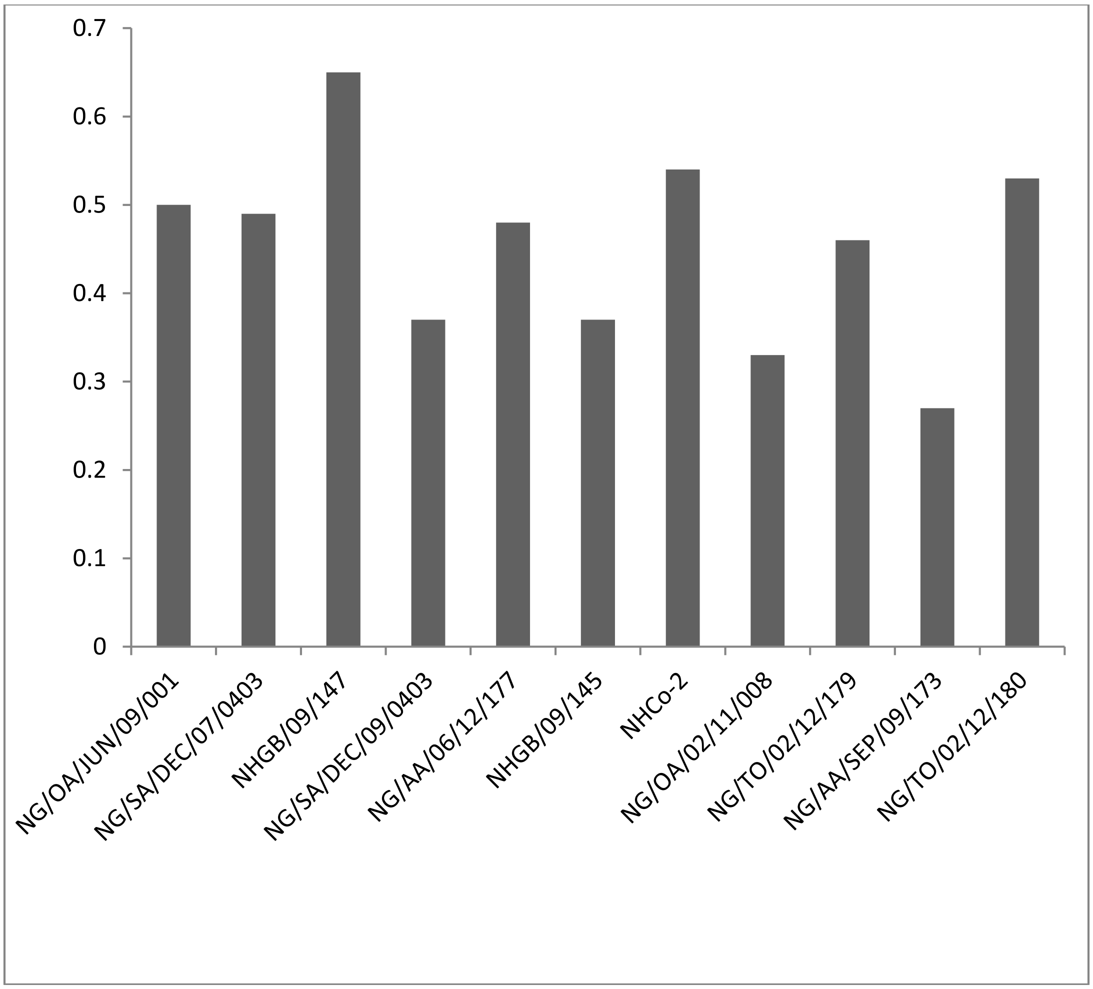

Figure 2: Mean weight per pod for each of the *Corchorus olitorius* L. accessions

Table 5: Seed characters and of Nigeria *Corchorus olitorius* L. accessions

Accession	No. of seeds/pod	wt./100seed
NG/OA/JUN/09/001	93.2	0.2
NG/SA/DEC/07/0403	96.8	0.1
NHGB/09/147	113.4	0.2
NG/SA/DEC/09/0403	89.8	0.2
NG/AA/06/12/177	86.0	0.1
NHGB/09/145	82.4	0.1
NHCo-2	132.6	0.1
NG/OA/02/11/008	76.2	0.1
NG/To/02/12/179	78.8	0.1
NG/AA/SEP/09/173	105.8	0.1
NG/To/02/12/180	112	0.1

Table 6: Results of statistical analysis for Leaf, Plant height, and node length using R

Parameters	Plant height	Number of leaves	Stem circumference	Leaf area	Node length	Leaf width
Residual standard error	0.5752	2.919	3.48	3.304	2.473	3.466

Multiple R-squared	0.996	0.303	0.009184	0.1068	0.4995	0.01734
Adjusted R-squared	0.9905	0.2255	-0.1009	0.007547	0.4439	-0.09185
F-statistic	182 on 11	3.912 on 1	0.08342 on 1	1.076 on 1	8.982 on 1	0.1588 on 1
p-value	2.349e-08	0.07934	0.7793	0.3267	0.01503	0.6996
Correlation coefficient		-0.93	-0.99	-0.95	-0.97	-0.95

Legend: model is significant in all these parameters. Residual error was at 9 degrees of freedom and p-value at 5% probability level

IV. Discussion

Most of the quantitative & qualitative characters studied showed differences. Though only six characters were significantly different among the cultivars. There was no disease-causing organisms' occurrence on or within the plant and its seed this could be as a result of the hot-water treatment before planting, this corroborates with the findings of Sally, 2002 and Emongor *et al*., 2004. The highest germination percentage was 45.45% on the 3rd day, 36.36% on the 5th day, and the least was 18.18% on the 4th day (Figure 1). Despite variation recorded in the percentage germination, the rate of growth and the yield were not affected. However, the delay in germination might be a result of other factors such as water availability to the seed testa, heat, etc. meaning that the germination rate does not determine the proportion of development and output in *C. olitorius* L. studied.
Node length and leaf area are positively correlated, but not strong enough. Node length per plant throughout the growth period increased in NG/AA/06/12/177, whereas in NHCo–2 it decreases and was almost constant in NG/AA/SEP/09/173, but fluctuation was experienced in others, though some cultivars had similar node length this cannot be used in taxonomic classification (Table 2 and 3). Results also showed that the higher the pod production the higher the number of seeds per pod (Table 4). The number of seeds per capsule is directly correlated with the number of loculi and their length (Table 5). The number of pods is directly proportional to the number of seeds produce. Furthermore, the pod weight is directly correlated with the seed weight. NG/OA/JUN/09/001 and NHCo–2 are correlated with the plant height. There was an increment in the number of pods in the first 3 months in NG/To/02/12/179 and NG/AA/SEP/09/173 while in NG/SA/DEC/07/0403, NG/AA/06/12/177, and NG/OA/02/11/008 reverse was the case.

Based on the leaf morphology (Table 2 and 3) all the accessions belong to *C. olitorius* though there was high variability in size, branching, and shape of its fruit and leaves. NG/OA/JUN/09/001, NG/SA/DEC/07/0403, NG/SA/DEC/09/0403 and NHCo–2 fit to 'Oniyaya', while NHGB/09/147, NG/To/02/12/179, NG/AA/SEP/09/173, and NG/To/02/12/180 are 'Amugbadu'. This is in line with (Pal *et al*; 2006) work, while NG/AA/06/12/177, NHGB/09/145, and NG/OA/02/11/008 belong to 'Eleti ehoro'. This is in agreement with the work of (Makinde et al; 2009).

The stem circumference is positively correlated with the plant height. In NG/AA/06/12/177 the stem circumference decreases with an increase in plant height. The variation recorded in the stem colour may be environmental or genetically inclined. The length of the peduncle and the leaf length are highly correlated. In addition, the leaf length is also correlated with the plant height.

Variation in the number of leaves and leaf width are highly and positively correlated, thus the higher the number of leaves the smaller the leaf width. Leaf area and leaf width have the same intercept and are directly correlated. Petiole length in all the cultivars studied varies and maybe as a result of genetics among other factors, this agrees with Nath and Denton, 1980 findings.

Both early and late flowering was observed however, NHGB/09/147, NG/To/02/12/179, NG/AA/SEP/09/173, and NG/To/02/12/180 exhibit only early flowering and also had the widest pod while others exhibit both early and late flowering. This corroborates with the work of Makinde *et al*., 2009. Variation, in this case, may be genetic, but cannot be without factors such as environmental.

In the study, the accessions experienced variation in the length of stipule, but similarity still occurs in some. The analysis of variation for the mean number of days of flowering, peduncle lengths, and the number of days from flowering to podding also indicates variation that could be of genetic importance among the accessions studied. However, the colour and shape of the flower, calyx, and sepals were similar. NA/SA/DEC/07/0403 exhibits rapid growth throughout the growth period. This corroborates the findings of (Akoroda, 1985) which says that apart from the variation in the leaves, considerable variation in other morphological traits still exists within the various local morphotypes.

V. Conclusions

The research work showed that the yield is directly proportional to vegetative growth, as indicated by the various measurement of the leaf which is directly correlated with vegetative growth. The variation may be connected with the environment and genetic makeup of the accessions studied. The genetic variation serves as a tool in the selection of accession for crop production in the locality of the study therefore; NHCo–2 should be considered if the crop is to be improved upon in the locality. NG/SA/DEC/07/0403 can be considered for late pod production, but not leaf production. NHGB/09/147 can be cultivated for its highest weight of pod, the shortest period of pod production, and maturity; this indicates that the accession is the best for consumption and subsistence farming. NHCo–2 and NHGB/09/147 can be bred to give higher yields in pod, seed, and leaves. Though most of the accessions studied have a considerable podding period, their differences in yield are an important factor for selection therefore, NHCo–2 is the best morphologically.

VI. Recommendations

Farmers should be encouraged to use NG/OA/JUN/09/001, NG/SA/DEC/07/0403, and NHGB/09/147for cultivation in the locality of study. These improved seeds should be made available to the farmers. More work should be done on how the genotype can be used in assessing the phylogenetic relationship among related accessions.

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