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Effect of Stem Cutting and Variety on Shoot Development and Seed Yield of Jute Mallow (*Corchorus olitorius* L.)

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Abstract

The effect of stem cutting and variety on shoot development and seed yield of *Corchorus olitorius* was studied during 2008 and 2009 cropping seasons. Seeds of varieties 'Oniyaya' and 'Amugbadu' were steeped in water at about 97^0C for 5 seconds to break dormancy and then sown in the nursery. Seedlings were in the nursery for four weeks before they were transplanted on ridges 75 cm apart; intra–plant spacing was 40 cm. The Randomized Complete Block Design (RCBD) was used in a factorial layout. The five cutting heights used were uncut (control), 50 cm, 40 cm, 30 cm and 20 cm. Harvesting was done when about 85% of the fruits had turned yellow and sun–dried before seeds extracted. Stem-cutting significantly ($P<0.05$) hastened flowering and enhanced branching. It significantly ($P<0.05$) increased overall fruit and seed yields. 'Oniyaya' variety produced significantly more number of productive branches than "Amugbadu". There was no significant interaction effect of variety by cutting height on number of fruits and seed weight but there was a significant interaction effect of variety by cutting height by year on fruit weight. Whereas cutting heights of 50 cm and 40 cm might be optimum for 'Oniyaya', it is not advisable to cut 'Amugbadu' below 50 cm.

Keywords: Stem cutting, 'Óniyaya', 'Amugbadun', uncut and dormancy

1. Introduction

For leaf production, *Corchorus* farmers either harvest their crop by uprooting or by cutting or pruning (Schippers, 2000). In the latter, subsequent cutting is discontinued when plants start flowering. Seeds for future crops are either collected from some selected plants that are not cut at all or from some earlier cut plants. Information seems to be non-existent on the variability that may exist in the yield and quality of the seeds that are obtained from these techniques of seed production.

One of the common methods of harvesting *Corchorus, Celosia* and its relative, *Amaranthus,* for leaf consumption is by cutting. Akande (2006) reported that some farmers harvest *Amaranthus* by cutting the stem, leaving a few centimeters above the ground level for regeneration.

Cutting heights are designed to maximize yield while maintaining high quality seeds and stand longevity (Daniel *et al*., 2007). Schippers (2000) reported that seeds of bitter leaf are harvested faster when cut at 40-50 cm compared to the situation in uncut plant. Zinati (2001) reported that in *Amaranthus,* cutting the plant main stem at 30 cm and 50 cm above soil surface reduced total plant biomass, whereas cutting at 90 cm height increased biomass and seed yield to 310 kg/ha. Even

though average seed yield could be as low as 250 kg/ha (FAO, 2000), yield of about 600 kg/ha has been recorded in Kenya (Onyango, 2000).

Corchorus olitorius seeds are known to exhibit appreciable level of dormancy (Oladiran, 1986). Chin (1994) stated that seeds which are collected and deposited in a seed bank must be of high quality and at maximum viability. Seeds of high quality are obtained by observing proper harvesting and drying techniques during collection and subsequently careful handling in the seed bank to ensure minimal deterioration of the seeds. The ageing of seed is generally indicated by reduced germination percentage (Kalpana and Roa, 1995), reduced germination rate (Chetri *et al.*, 1993), slow growth (Coin *et al.*, 1996), increased susceptibility to environmental stress and reduced resistance to storage under adverse condition and fungal infection (Duffus and Slaughter, 1980). Seedling growth is also affected as seed ages (Oladiran and Munford, 1990).

The objective of this study therefore, was to find out whether uncut or cut *Corchorus* plants at a particular height produce viable and better seed yield and quality using "Oniyaya" and "Amugbadu" varieties.

2. Materials and Methods

The experiment was conducted at the Federal University of Technology, Minna, during 2008 and 2009 cropping seasons. Two varieties of *Corchorus olitorius* ("Oniyaya" and "Amugbadu") were used. Seeds weighing about 50g were tied in cheese cloth, steeped in water at about 97^0C for 5 seconds to break dormancy were immediately steeped in cold water to bring down the temperature (Oladiran, 1986). The treated seeds were air-dried and sown into topsoil contained in polythene bags. Seedlings obtained from the treated seeds of the two cultivars were nursed for four weeks before they were transplanted to the field at an intra-row spacing of 40cm on ridges made 75cm apart. The study was a factorial experiment with two factors viz: stem cutting height (uncut-control, 50, 40, 30 and 20cm) and variety ('Oniyaya' and 'Amugbadu'). This gave a treatment combination of 10 (i.e. 5 x 2). The field layout was based on the Randomized Complete Block Design with three replications. There were 28 plants per plot measuring 3m x 3m as a seedling was planted per stand. Manual hoe weeding was done four, six and nine weeks after transplanting in both years.

Data from the 14 plants in the middle rows, were collected on parameters such as days to 50% flowering, total number of branches per plant, numbers of productive branches per plant. Other parameters included number of fruits per plant, fruit weight per plant (Kg), seed weight per hectare (Kg) and 100-seed weight (g). Fruits were harvested when about 85% of them were yellow in colour, a stage that has been reported by Oladiran (1986) to yield the best seed quality.

All the data collected were subjected to Analysis of Variance (ANOVA) based on Randomized Complete Block Design (RCBD) using Minitab 14 statistical Package. Means were separated using Least Significant Difference (LSD).

3. Results

The soils of the experimental sites were texturally sand clay loam and essentially acidic in reaction (Table 1). Potassium, phosphorus, calcium and sodium were considered moderate. Stem cutting significantly ($P<0.05$) hastened flowering in both years (Tables 2). The uncut plants of "Oniyaya" flowered at 68 and 69 days after transplanting in 2008 and 2009 respectively, plants cut at 20cm reduced flowering time to about 62and 61 days. The same trend was recorded in "Amugbadu" (Tables 2). Stem cutting at heights 40cm and 50cm significantly enhanced branching in the two varieties in 2008 and the values obtained were significantly different from those obtained for height 20cm and uncut plants (Table 3). There was no significant difference between the uncut plants and those stopped at height 20cm; also the difference between height 20cm and 30cm was not

significant. Furthermore, 'Oniyaya' produced significantly more branches than 'Amugbadu'. There was no significant different between cutting height by variety interaction (Table 3). In 2009, significant enhancement of branching was only recorded when cutting was done at heights 40 and 50cm; there were no significant differences between the uncut plant and those stopped at heights 20 and 30cm. No significant difference was observed between the two varieties in 2009. Whereas all the branches produced by plants cut at heights 50cm, 40cm, 30cm and 20cm were productive both in 2008 and 2009 cropping season, most of the branches produced by uncut plants were productive (Tables 4). Neither variety nor cutting height by variety interaction significantly affects this trait.

Table 1 Physio-chemical characteristics of soil taken from experimental site before the establishment of the trial

Soil properties 0-25 cm depth	
Physical properties	
Sand (%)	63.52
Silt (%)	6.48
Clay (%)	30.56
Textural class	Sandy clay loam
Chemical properties	
pH in water	5.8
Organic carbon (%)	1.26
Organic matter (%)	2.17
Total nitrogen (%)	0.06
Available phosphorus (ppm)	0.14
Exchangeable cation (C mol/kg^{-1})	
K	0.15
Mg	14.47
Ca	13.52
Na	0.70
CEC (C mol/kg^{-1})	28.88

Table 2 Effect of cutting heights and variety on days to 50% flowering

Treatment	2008	2009
Varieties		
'Oniyaya'	68.2	69.4
'Amugbadu'	67.8	68.0
F-LSD	NS	NS
Cutting height (cm)		
Uncut	75.5	75.5
50	70.5	71.5
40	67.5	69.5
30	65.0	66.0
20	62.0	61.0
F-LSD	1.8	1.6
Interaction	NS	NS

F-LSD – Fisher's least significant difference, NS- Non significant

Table 3 Effect of cutting heights and variety on number of branches per plant

Treatment	2008	2009
Varieties		
'Oniyaya'	5.7	5.5
'Amugbadu'	4.4	3.9
F-LSD	1.2	NS
Cutting height (cm)		
Uncut	3.7	4..0
50	6.3	5.9
40	6.0	5.6
30	5.2	4.0
20	4.2	4.0
F-LSD	1.9	1.1
Interaction	NS	NS

F-LSD – Fisher's least significant difference, NS- Non significant

Table 4 Effect of cutting heights and variety on number of productive branches per plant

Treatment	2008	2009
Varieties		
'Oniyaya'	5.3	5.2
'Amugbadu'	4.3	3.5
F-LSD	NS	NS
Cutting height (cm)		
Uncut	2.3	2.5
50	6.3	5.9
40	6.0	5.6
30	5.2	4.0
20	4.2	4.0
F-LSD	1.9	1.1
Interaction	NS	NS

F-LSD – Fisher's least significant difference, NS- Non significant

Stem cutting reduced the number of fruits on the main stem significantly in both varieties in 2008 and 2009 (Tables 5). Uncut plants had the highest value of eight fruits for both 'Oniyaya' and 'Amugbadu' varieties in 2008 cropping season while, values from cut plants ranged from one to four (Table 5). In 2009 cropping season uncut plants had seven and eight fruits for 'Oniyaya' and 'Amugbadu' respectively while values for cut plants retained the same as in year 2008 (Table 5). Tables 6 reveals that stem cutting resulted in significantly higher fruit number from the branches in both varieties in 2008 and 2009. Fruit number was highest at the 50cm cutting height and lowest from uncut plants. Furthermore, fruit number was significantly higher in 'Oniyaya' than in 'Amugbadu'. Tables 7, shows that cutting height significantly affected fruit weight in both years. Uncut plants significantly yielded poorer than any of the cut treatments. Among the plants that were cut, 50 cm produced the highest yield while the least was obtained from the plants cut at 20 cm. The effects of variety and cutting height by variety interaction were not significant. Both variety and stem cutting affected seed yield significantly but their interaction did not affect seed yield (Tables 8). Stem cutting at 50cm out-yielded all others in both years. Yield was significantly poorer from uncut plants than from any of the cut plants. Furthermore, 'Oniyaya' yielded significantly higher

than 'Amugbadu' in both cropping season. Averagely, 100-seed weights (g) were significantly higher in cut plants in both 2006 and 2007 and the values were highest when plants were cut at 50cm. There was a significant difference between "Oniyaya" and "Amugbadu", in respect of 100-seed weight with "Amugbadu" producing heavier seeds (Table 9).

Table 5 Effect of cutting heights and variety on number of fruits on the main – stem per plant

Treatment	2008	2009
Varieties		
'Oniyaya'	3.4	3.4
'Amugbadu'	3.1	3.4
F-LSD	NS	NS
Cutting height (cm)		
Uncut	8.2	7.5
50	3.2	3.5
40	2.4	2.5
30	1.7	2.0
20	1.0	1.0
F-LSD	1.0	1.0
Interaction	NS	NS

F-LSD – Fisher's least significant difference, NS- Non significant

Table 6 Effect of cutting heights and variety on number of fruits on the branches per plant

Treatment	2008	2009
Varieties		
'Oniyaya'	183.0	136.5
'Amugbadu'	76.9	79.7
F-LSD	7.6	6.3
Cutting height (cm)		
Uncut	66.7	37.0
50	204.0	179.2
40	167.7	139.5
30	116.4	105.4
20	95.5	79.9
F-LSD	12.0	9.9
Interaction	NS	NS

F-LSD – Fisher's least significant difference, NS- Non significant

Table 7 Effect of cutting heights and variety on dry fruit weight kg/ha

Treatment	2008	2009
Varieties		
'Oniyaya'	1629.2	1552.1
'Amugbadu'	1654.3	1671.4
F-LSD	NS	NS
Cutting height (cm)		
Uncut	479.5	662.5
50	2884.0	2368.7
40	2109.0	2134.5
30	1642.5	1962.9
20	1094.0	930.2
F-LSD	21.6	101.4
Interaction	NS	NS

F-LSD – Fisher's least significant difference, NS- Non significant

Table 8 Effect of cutting heights and variety on seed weight Kg/ ha

Treatment	2008	2009
Varieties		
'Oniyaya'	301.2	300.4
'Amugbadu'	162.8	250.4
F-LSD	13.1	25.4
Cutting height (cm)		
Uncut	126.5	175.4
50	341.0	485.7
40	295.0	288.2
30	236.0	247.4
20	161.5	200.4
F-LSD	20.8	31.1
Interaction	NS	NS

F-LSD – Fisher's least significant difference, NS- Non significant

Table 9 Effect of cutting heights and variety on 100-seed weight

Treatment	2008	2009
Varieties		
'Oniyaya'	0.21	0.20
'Amugbadu'	0.23	0.22
F-LSD	0.01	0.01
Cutting height (cm)		
Uncut	0.20	0.17
50	0.24	0.25
40	0.23	0.23
30	0.23	0.21
20	0.22	0.20
F-LSD	0.01	0.01
Interaction	NS	NS

F-LSD – Fisher's least significant difference, NS- Non significant

4. Discussion

Results from this study show that the number of productive branches was significantly higher in plants that were cut. Plants generally are known to produce more branches when stopped than when allowed to grow naturally. This is due to the removal of apical dominance imposed by the auxin which is produced at the shoot tip and translocated to the buds just behind the growing tip and thereby inhibiting them from developing into lateral branches. Lythrum salicaria plants stem that were cut have also been reported to produce more branches than uncut plants (Cline et al.,, 2006). According to Jones et al. (1989) the normal method of branch production in vegetable crop is by pruning. It is important to note that all the cut plant branches were productive in both cropping seasons but not all the uncut plant branches were productive. This could be attributed to reserved food material in cut plants not being completely used up during plant growth and development, leaving more resources stored in plants to be available for flower and fruit reproduction. This could be as a result of removing the apex (cutting the tip) of a stem stops the auxin (hormones) flow and allows the buds just behind the growing tip to develop into branches. According to Olasantan et al. (2008) pruning contribute to branch production and formation of young leaves. Apical dominance is the central factor that determines branching pattern in plants (Streck, 2005).

Corchorus olitorius flowered earlier in this study when cut at a lower level. This agrees with the report of Schipper (2000) who found that cut plants generally responded by flowering earlier but disagree with Olansantan (2008) who reported that in okra pruning significantly delay flowering and pod formation, the delay is attributed to formation of new branches, leaves and extension of vegetative growth . In an experiment carried out on bitter leaf, seeds were harvested earlier in plants cut at 40 – 50 cm than in uncut ones. This study also revealed expectedly, that there were more fruits on the main–stem of uncut plants than the cut ones. Plants of vegetable types of *Corchorus olitorius* are known to be characterized by a height of up to 2 m or more (Fondio and Grubben, 2004). Stopping the stem by cutting would no doubt reduce the number of fruits on the main stem. However, because cut plants produced more branches, they also yielded more fruits and seeds than the uncut ones. This agrees with Zinati *et al.* (2001) who reported that stem-cutting in *Amaranthus* increased seed yield.

Significantly higher seed yield was recorded from "Oniyaya" variety compared to "Amugbadu" variety in this study. Omidiji (1977) and Akoroda (1985) reported that *Corchorus* seed yield may be affected by cultivars. Epenhuijsen (1974) reported that "Amugbadu" does not set fruits during the dry season when days are longer. The current study was conducted during the wet season and "Amugbadu" still produced significantly fewer fruits and lower seed yield than "Oniyaya". This shows that the former may not be genetically endowed to produce many fruits. Stem cutting at 50 cm gave the highest seed yields of about 453 kg and 229 kg/ha in 2008 cropping season and 519 kg and 452 kg/ha in 2009 cropping seasons for 'Oniyaya' and 'Amugbadu' respectively in this study. Though these figures are lower than the 600 kg/ha reported in Kenya (Onyango, 2000), they are higher than the general average yield of 250 kg/ha (FAO, 2000). The significant increase in lateral branches must have been responsible for the high yields in cut plants. Plant–stopping is known to result in yield maximization (Daniel *et al.,* 2007).

5. Conclusion

It could be concluded from this study that the cutting of *Corchorus* plants resulted in earliness of flowering, it enhanced branching, increased fruits and seed yields. Days to 50% flowering, branching, fruit and seed yields were also affected by variety.

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