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VEGETATIVE PROPAGATION OF THE LARGE SOUR PLUM (*Ximenia caffra* Sond) BY ROOTING OF PLAGIOTROPIC STEM CUTTINGS

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ABSTRACT

An investigation was undertaken to establish the influence of rooting media and application of hormones and length of cutting on survival and rooting of plagiotropic stem cuttings of large sour plum (*Ximenia caffra* sond) at Botanical garden of the Department of Botany and Horticulture, at Maseno University, Kenya during the year 2006-2007. Cuttings were collected from Kitmikayi and Gembe Hills sacred site in Lake Victoria region in Kenya. Two experiments were established. The first experiment evaluated the effect of three media substrates [Sand (SA), sawdust (Sd), sand: sawdust mixture (Sa/Sd)] and two stem-cutting sizes (single and double node) on components of rooting and eventual rooting of the stem cuttings. The second experiment evaluated the effect of different concentrations of ∝-Naphthallic acetic acid hormone (0, 20, 80,140, and 200 mg/l) and two types of rooting substrates on survival and rooting of plagiotropic stem cuttings. Rooting media, stem cutting size and different concentrations of ∝-NAA hormone had no significant influence on survival, callus formation, formation of root primordia and rooting of the stem cuttings ($p \geq 0.05$). Single node cuttings had similar survival (59%), with double node stem cuttings (56%) in sand substrate. The study presents evidence of successful rooting of large sour plum using the two types of substrates with or without hormone treatment. The use of these substrates with single node stem cuttings could facilitate faster domestication of large sour plum in an effort to improve income for poor subsistence farmers in the Lake Victoria basin.

Keywords: vegetative propagation, ximenia caffra, rooting media, node plagiotropic stem cuttings.

INTRODUCTION

Sacred habitats on the landscape of the L. Victoria region constitute the only source of remnant diversity of community treasured plant species. The large sour plum (*Ximenia caffra* Sond) was found to be one of community top ranked fruit tree species for rescue from imminent threat of extinction within sacred sites in the Lake Victoria region of Kenya and Uganda (Owuor *et al*, 2006). As a means to enhancing community initiatives with domestication in rescuing the species diversity, vegetative propagation through rooting of stem cuttings was considered of strategic significance. Rooted cuttings of physiologically mature trees already in the fruiting phase are known for their earliness in production. Furthermore rooting cuttings induces a dwarfing growth habit in trees with the resultant wider canopy that improves pruning and harvesting, two important agronomic attributes in fruit tree improvement. Lastly vegetative propagation by fixing the genotype under multiplication enables faster genetic gains in tree improvement to be attained and is often resorted to whenever opportune. This is especially relevant in early phases of tree species domestication and in circumstances of rampant poverty where new technologies to be adopted on farm must respond within the immediate to short term timescale.

While seed propagation of the large sour plum is straightforward it's longevity in coming into production is not yet known, but is suspected to be at least 5years and thus could frustrate adoption of the species for conservation through domestication under circumstances of rampant poverty.

There is hardly any information on vegetative propagation of the large sour plum and an urgent need exists to select an appropriate rooting medium among locally available materials as well as to establish the conditions for rooting of stem cuttings that can easily be adopted by start up nursery enterprises among youth and women groups in the community.

In an attempt to root stem cuttings, Mialoundana *et al*., 2002 investigated a range of substrate types including sawdust, sand, and a mixture of the two substrates. Other workers using a standard medium of a mature horticultural pearlite and peat (Jetter *et al*., 2005) have tested the influence of cutting length and hormone application on rooting stem cuttings of Hemlocks.

The objectives of this study were to determine the most suitable medium for rooting plagiotropic stem cuttings of sour plum while simultaneously observing the influence of the auxin hormone Naphthalic acetic acid (NAA) application as well as influence of length of cutting for the same purpose.

MATERIALS AND METHODS

Three types of rooting media substrates were tested; river sand (sa), rotted saw dust, (sd) and a 1:1 mixture sand and sawdust (sa/sd). Each media received two types of plagiotropic stem softwood cuttings; single node or double node. The trial was laid out as a

completely randomized block design in three replicates in a non-mist propagator (Mialondama *et al;* Owuor, 2000).

NAA hormone powder was dissolved in a solution containing 50% ethanol and 50 % water and the basal ends of the cuttings were dipped in respective NAA solutions for 10 to 15 seconds. Control cuttings were treated with a solution without NAA. Cuttings were assessed weekly (weeks 2-21). During the experimental period data were recorded and included cuttings surviving, cuttings with callus formation, cuttings with root primordia, rooted cuttings and length of longest root. Periodically the experiment was sprayed with fungicide and fertilized with commercially available foliar fertilizer (2g in a liter of water of Easy gro®). Calcium 14 % N, 0%P_20_5, 2% K_2O, 13% Ca, 2.5% mg, plus all essential microelements. Mean minimum and maximum temperatures during the study period were respectively 25-30^oC.

Data were subjected to analysis of variance and mean separation performed with Duncan's Multiple Range Test using Costat Statistical Package. Because the analysis of variance indicated no significant interaction between media, stem cutting size and NAA hormone concentration, data pooled over the two experiments are presented.

RESULTS

Double node cuttings had higher trend of survival in sand media than in sawdust and sand: sawdust mixture (Figure-1a). Single node cuttings survived well than double node cuttings in experiment one, even though there were no significant differences among treatments in survival count, callus formation, root primordial formation and rooting (Table-1; Figures 1a, 1b and Plate-1).

There were non-significant differences in components of rooting including cuttings survival, callus formation, root primordial formation and in root formation between sawdust and sand: sawdust (1:1) mixture with cuttings treated with NAA hormone (Table-2). Sawdust showed a trend of better rooting of the stem cuttings as compared to sand: sawdust mixture (1:1), since the longest roots in sawdust media and cuttings treated with hormone measured 22.0 $\pm$ 0.1 cm (Plate-1). While those in Sand/Sawdust media, with cuttings treated with hormone, only averaged 5.0 $\pm$ 0.1cm. In general, cuttings showed good response to sawdust and sand: sawdust media in developing longer roots throughout the study period (Plate-1).

Table-1. Effect of rooting media and cutting size on rooting ability and survival of stem cuttings of large sour plum (*Ximenia caffra* Sond).

Parameter	Treatment	Mean	Parameter	Treatment	Mean
Cuttings survival	Sand	3.5a	Cuttings with root primordia	Sand	1a
	Sawdust	3.5a		Sawdust	1.5a
	Sand:sawdust (1:1)	3.17a		Sand:sawdust (1:1)	1.6a
	LSD 0.05	**1.52**		**LSD 0.05**	**1.039**
	Single node	3.78a		Single node	1.375a
	Double node	3a		Double node	1.375a
	LSD 0.05	**1.24**		**LSD 0.05**	**0.821**
Cuttings with callus	Sand	2.5a	Cuttings with roots	Sand	1a
	Sawdust	2.33a		Sawdust	1.6a
	Sand:sawdust (1:1)	2.83a		Sand:sawdust (1:1)	1.6a
	LSD 0.05	**0.872**		**LSD 0.05**	**1.047**
	Single node	2.67a		Single node	1.43a
	Double node	2.44a		Double node	1.38a
	LSD 0.05	**1.07**		**LSD 0.05**	**0.885**

Means followed by the same letters are not statistically different from each other at 5%level of probability.

Table-2. Effect of rooting media and NAA hormone treatment on rooting ability and survival of stem cuttings of large sour plum (*Ximenia caffra* Sond).

Parameter	Treatment	Mean	Parameter	Treatment	Mean
Survival count	0 mg/l	3.5a	Cuttings with root primordia	0 mg/l	1.2 a
	20 mg/l	3.875 a		20 mg/l	1.4a
	80 mg/l	3.86a		80 mg/l	1.6 7a
	140 mg/l	2.875a		140 mg/l	1.4 a
	200mg/l	4a		200mg/l	1.33 a
	LSD 0.05	**1.607**		**LSD 0.05**	**0.981**
	Sa:Sd mixture (1:1)	2.31b		Sa:Sd mixture (1:1)	1.214a
	Sd	4.6a		Sd	1.714 a
	LSD 0.05	**0.899**		**LSD 0.05**	**0.642**
	Coefficient of variation	34.274537%		Coefficient of variation	37.7%
Cuttings with callus	0 mg/l	1.8 a	Cuttings with roots	0 mg/l	1a
	20 mg/l	1.8 a		20 mg/l	1.2 a
	80 mg/l	2.25a		80 mg/l	1.67a
	140 mg/l	2 a		140 mg/l	1a
	200mg/l	2.67 a		200mg/l	1.33a
	LSD 0.05	**1.342**		**LSD 0.05**	**0.506**
	Sa:Sd mixture (1:1)	2.13b		Sa:Sd mixture (1:1)	1.07a
	Sd	1.86 a		Sd	1.3a
	LSD 0.05	**0.88**		**LSD 0.05**	**0.277**
	Coefficient of variation	35.5%		Coefficient of variation	24.1%

Means followed by the same letters are not statistically different from each other at 5%level of probability.

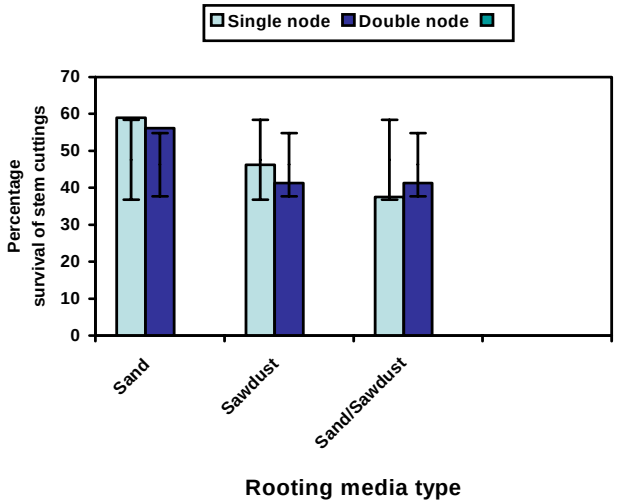

Figure-1a. Interactive effects of media and stem cutting size on percentage survival of large sour plum stem cuttings after 21 weeks of propagation. Data points are means of three replicates ± SD.

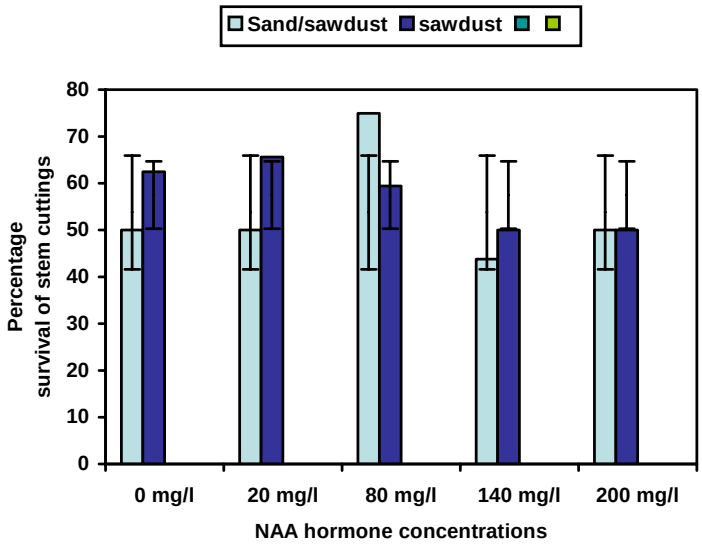

Figure-1b. Interactive effect of media and NAA hormone concentration on stem cuttings survival in large sour plum after 21 weeks of propagation. Data points are means of four replicates ± SD.

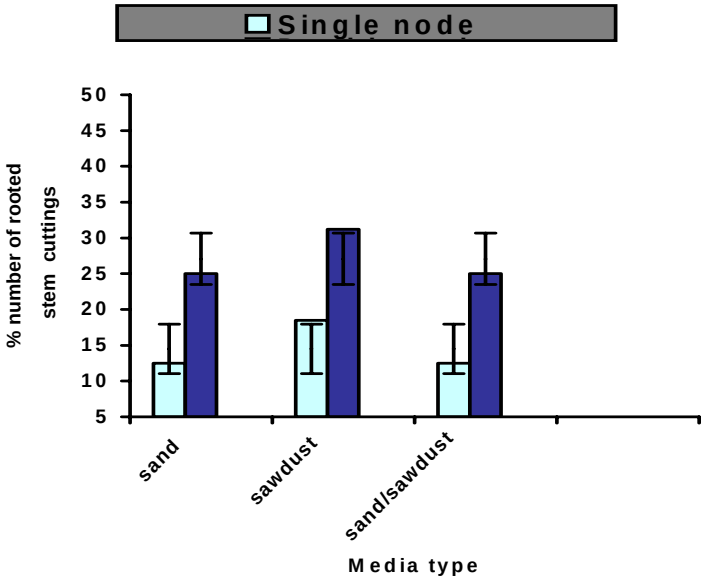

Figure-2. Interactive effects of cuttings size and media type on root formation of large sour plum stem cuttings after 21 weeks of propagation. Data values are means of three replicates ±S.D.

Plate-1a. Callus formation from the stems of large sour plum (Ximenia caffra)

Plate-1b. Stems of large sour plum (Ximenia caffra) showing the formation of roots after 16 weeks of propagation in sand: sawdust media.

Plate-1c. Large sour plum (Ximenia caffra) stem cuttings showing the longest root after 21 weeks of propagation in sawdust media.

DISCUSSIONS

Vegetative propagation provides the best opportunity to multiply valuable trees for cultivation (Mialoundama *et al.*, 2002). Rooting ability of stem cuttings depends on several factors. The purpose of treating the cuttings, with auxin is to increase the percentage of rooting (Ullah *et al.*, 2005). Rooting was relatively insensitive to different NAA concentrations. In the present study, sawdust gave the best results followed by sand: sawdust mixture with hormone treatment. The good rooting and survival of cuttings recorded in sawdust may be explained by the high water retention of sawdust (Mialondou *et al.*, 2002) and faster initiation of root formation by NAA hormone application. Hoever in this study there were non-significant differences between media types. Among the exogenous rooting hormones, alpha naphthalene acetic acid (NAA) has been found to be reliable in rooting of cuttings. According to Hartmann *et al.*, (1997) there are compounds within stem cuttings such as phenolics that interact with auxins to promote rooting, and increase root length. Some species tend to root better in certain substrates with or without hormone treatment, and this is linked to their hydromorphic or xeromorphic status (Mialondou *et al.*, 2002).

Media and cutting size interaction did not show significant differences in cuttings survival. However, single node cuttings had higher survival percentage in sand media compared to double node cuttings. Cuttings could root well whether sand, sawdust or sand: sawdust mixture was used as a growing medium. Presence of leaves plays important role in rooting and initiation of roots of many plant species (Newton *et al.,* 1992). Leaves considerably influence rooting of cuttings because of their ability to produce endogenous auxins, carbohydrates by means of photosynthesis and due to their influence on water status of the cuttings. Drying and death of leaves in some of the cuttings during the experimental period may have also contributed to poor survival of the cuttings.

Most frequently used medium contains a combination of sand, peet, sphagnum compost, and shredded bark/sawdust (Hartmann *et al.,* 1997). This observation may be attributed to the differences in moisture holding capacity and chemical properties of the three media. On the contrary more roots were produced with sand media than with sawdust and sand: sawdust media. Results of this experiment showed that rooting ability of large sour plum is not significantly affected by hormone treatment despite the longer roots in sawdust substrate treated with NAA hormone. The study reveals that the large sour plum plants can be propagated either in sand, sawdust or sand: sawdust media with or without hormone. Cuttings propagated in sawdust with hormone treatment produced long and slender roots. Our findings are in agreement with the results by Mialoundama *et al.* (2002). Application of NAA hormone tended to increase the rate of root growth. Sand media without hormone application had higher survival of single node stem cuttings. The results show that single node stem cuttings are better planting materials for successful survival and of large plum. There could be differences in aeration between media; or even the pH of the media. Small responses of large sour plum cuttings to hormone application could be due to high supplements of endogenous auxins in the shoots of the cuttings and these might interact negatively with the applied NAA hormones. Similar findings were reported by Ofori *et al.* (1996) while rooting Milicia excelsa. Other factors could interact with media to affect root growth and development (Loach, 1992). Roots of the cuttings grown in sand media were short, coarse and brittle, while when media such as mixture of sand: sawdust were used, the cuttings had well branched "slender" and flexible root types, which were suitable for transplanting. Our findings also agree well with the findings by Hartmann and Kester (1983). The observations could be explained by the high moisture holding capacity and good aeration of the sawdust media. Pure sawdust has been found to have high moisture holding capacity and also a lower air/water ratio than coarse and fine sand in the propagation of Nauclea diderrichii cuttings (Leakey, 1990).

CONCLUSIONS

It is concluded from the present study that a trend of relatively better survival and rooting of stem cuttings was obtained with single node cuttings with sawdust and sand: sawdust mixture producing longest and slender roots as compared to sand media. The observed results could perhaps be linked to better aeration and high water holding capacity of sawdust and sand: sawdust media. The study has revealed that vegetative propagation of large sour plum is possible with the two media types with or without NAA hormone supplements. Further studies should evaluate the effect of other rooting hormones and media on successful rooting of large Sour plum to facilitate faster domestication and conservation as a tree for income generation for poor subsistence farmers in the Lake Victoria basin.

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