Research Application Summary

Vegetative propagation of *Vitellaria paradoxa* by stem cuttings: Effects of rooting substrate and planting technique

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Abstract

A study to evaluate the effects of rooting substrate and planting techniques on the rooting of *Vitellaria paradoxa* stem cuttings is being conducted at Ngetta Zonal Agricultural Research and Development Institute (Lira district-Northern Uganda). Between October 2011 and April 2012, coppice cuttings of both soft and recent growth have been evaluated under three different substrates and survival rate assessed using two planting techniques (planting singly in pots and placement in mass of substrate). Cuttings rooted in vermiculite produced a significantly higher number of rooted cuttings than those rooted in other substrates. Although pine bark supported formation of new shoots considerably, no rooting was observed in cuttings rooted in this medium. The placement of cuttings in pots significantly enhanced their survival rate.

Key words: Shea butter tree, shoot formation, rooting substrate, stem-cuttings, *Vitellaria paradoxa*

Résumé

Une étude visant à évaluer les effets du substrat d'enracinement et des techniques de plantage sur l'enracinement des boutures de *Vitellaria paradoxa* est menée à l'Institut Zonal de Développement et de Recherche Agronomique de Ngetta (dans le District de Lira- au Nord de l'Ouganda). Entre Octobre 2011 et Avril 2012, les boutures en taillis de la croissance à la fois tendre et récente ont été évaluées dans trois substrats différents et le taux de survie évaluée à l'aide de deux techniques de plantage (le plantage séparément dans des pots et le placement dans la masse du substrat). Les boutures enracinées dans la vermiculite ont produit un nombre significativement plus élevé de boutures enracinées que celles fixées dans d'autres substrats. Bien que l'écorce de pin ait supporté considérablement la formation de nouvelles pousses, aucun enracinement n'a été observé dans les boutures enracinées dans ce milieu. Le

placement des boutures dans des pots a considérablement amélioré leur taux de survie.

Mots clés: Beurre de karité, formation de pousses, substrat d'enracinement, boutures, *Vitellaria paradoxa*

Background

Vitellaria paradoxa (Shea butter tree) is an indigenous fruit tree species that has the potential to improve nutrition, boost food supply in the "annual hungry season" (Masters *et al.*, 2010), in addition to fostering rural development and supporting sustainable land use (National Research Council, 2006). In Uganda, *V. paradoxa* grows mainly in the West Nile, Acholi, Lango, Teso, Karamoja and Buruli sub-regions where it is variously locally called: Kumere, Komoro, Kamiro (Lugbara-West Nile); Yaa (Acholi), Yao (Lango), Ekungur (Ateso), Awa (Madi-West Nile), Komure (Kakwa –West Nile).

It is mostly found within an altitude range of 600-1100 m above sea level and mean annual rainfall of 600-1400 mm (Katende *et al*., 1995). Most of the areas where the shea butter tree is found are subject to mean annual temperature of 25-29^{o}C. The tree grows slowly taking almost 15 to 30 years to mature (Hall *et al.*, 1996).

Although *V. paradoxa* came to world attention at the end of eighteenth century (Hall *et al*., 1996), the existing *V. paradoxa* population remains essentially unmanaged and grows wild. The tree has many uses to man and its demand is ever increasing although productivity is decreasing (Okiror *et al.* 2011). There is thus a need to investigate appropriate propagation techniques for cuttings as a viable option to multiply and conserve *V. parodoxa.*

Literature Summary

The concept of vegetative propagation is derived from the fact that the exact copies of the genomes of mother plants are made and continue with new individuals. Vegetative propagation allows the domestication and rapid improvement of species by capturing their important traits that would otherwise disappear or get diluted through sexual propagation. Traits such as straightness of the bole for timber species or fruit quality can thus be maintained and exploited through vegetative propagation (Hannah and Beniest, 2002).

Vegetative propagation methods have also been useful in the development of high value species for lucrative export

markets, in which cultivars of mangoes, oranges, macadamia nuts and apples have been developed. The concept of vegetative propagation has also been used in the development of uniform timber trees in plantations (Hannah and Beniest, 2002) and the development of pest resistant plant stocks (Ofori *et al.,* 1996) by cloning tropical timber species such as *Milicia excelsa* and the African mahogany. Vegetative propagation by cuttings has been investigated as an alternative method of supplying planting material of *V. paradoxa* (Yeboah *et al.*, 2009). Rooting of stem cuttings provides the advantage of greater genetic uniformity and availability of superior stock in a short period of time for afforestation works. This method has been tried sufficiently in a number of gymnosperms as well as angiosperms trees (Nandi *et al.,* 2002).

Study Description

The study was carried out at Ngetta Zonal Agricultural Research and Development Institute. The site is located in Lira district (Northern Uganda) at latitudinal ranges of 2° 202 03 N, longitudinal ranges of 33° 62 03 E and 1,080m above sea level. Coppice cuttings of soft and recent branch growth were obtained from healthy individual *V. paradoxa* coppices in October 2011. Coppice cuttings were chosen over softwood and semi-hardwood cuttings because of their ability to root better than the former two (Yeboah *et al.,* 2009). These cuttings were sliced to 10 cm, stored in cool boxes and thereafter transported to the research institute where they were reduced to 8cm, dipped in Seradix 3 rooting powder at the basal end and then firmly placed in propagation tunnels containing a rooting substrate. Prior to placement in the tunnels, leaf biomass was reduced by 75% leaving only of a pair of leaves per cutting.

The tunnels were placed under a black shade net that provided 30% shade intensity. Three types of rooting substrates (sand, vermiculite and pine bark) were evaluated. The survival rate of cuttings was also assessed by planting the cuttings in two different ways; placing them singly in 3 x 4’ (PP) and sowing them in a mass of substrate (MP).

This experiment was set in a randomised block design containing 3 blocks; two planting types (PP, MP); and three replicates; using 40 cuttings per treatment. A total of 240 cuttings were used per replicate and watering was done as deemed necessary. Parameters investigated include level of shoot formation, rooting and survival percentage after transplanting to 6" by 8" pots.

Data on rooting success and above ground biomass was collected at intervals of 90, 120 and 150 days for each treatment.

Research Application

Shoot formation was significantly high for cuttings placed in pine bark ($P < 0.05$) in comparison to the other substrates (Table 1). In the sand and pine bark substrates, cuttings shed off their leaves after 30 – 45 days and developed new shoots after 90 days. Cuttings that were cultured in pine bark also suffered 100% die back after 120 days. Shoot formation was not observed in vermiculite although this substrate had a significantly higher number of rooted cuttings (after 120 days) compared to sand and pine bark media (Table 1).

Table 1. Influence of substrate and planting technique on rooting performance and survival of Shea cuttings.

Substrate	Planting technique	% of cuttings		
		Forming shoots (90 days)	Rooted (120 days)	Surviving after transplanting (150 days)
Pine bark	PP	95.0	0	0
	MP	92.5	0	0
Vermiculite	PP	0	45.0	40.0
	MP	0	40.0	12.5
Sand	PP	25.0	12.5	12.5
	MP	25.0	10.0	0

No rooted cuttings were observed in pine bark and considerably low rooting was observed in the sand substrate (Table 1). Planting the cuttings in pots did not significantly influence the number of rooted cuttings ($P > 0.05$) but significantly enhanced the survival rate of cuttings when transplanted to 6" by 8" pots. This could be attributed to minimum disturbance of the roots during transplanting. The considerably low survival percentage rate of cuttings that rooted in mass substrate could be attributable to them being more prone to root damage despite gentle removal from the substrate. Further investigations with other rooting substrates on *V.paradoxa* stem cuttings is required.

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