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VEGETATIVE PROPAGATION BY ROOT AND STEM CUTTINGS OF *Leptadenia hastata* (Pers.) Decne., AN EDIBLE SAHELIAN LIANA IN NIGER

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ABSTRACT

The aim of this study was to investigate the possibilities of the propagation of Leptadenia hastata cuttings during the 3 seasons of the year in Sahel. The cuttings of 20 cm of length, collected from the basal, apical and root parts of the plants, were used. Study investigations consisted in observing the buds and leaves appearance on different types of cuttings. The root system was assessed at the end of each experiment and consisted in rootlets counting. The recovery period differs according to the cuttings types and the periods. During the hot, dry season and the rainy season, the apical cuttings began to bud from the fourth (4th) day, whereas it took 9 days in the cold, dry season. During this last period, cuttings from the root and the basal parts emitted their first bud only from the 13th day after planting. The budding period also depends on the cuttings type and the period. For all the periods, it was relatively shorter for the cuttings from root and basal stem segments and longer for those of the apical part. The recovery rate of cuttings was quite low during the hot, dry period (less than 50%). Apical, basal and root part cuttings recorded, respectively, a recovery rate of about40.33%, 8.00% and 4.01%. The highest recovery rates were recorded with the stem cuttings of the apical part in cold, dry period (75.33%) and in that of the rainy one (91.67%). In order to promote the implantation of a food bank based on this liana in the context of seed scarcity, the use of cuttings of the apical part prove to be an ideal solution.

Key words: Cutting, *Leptadenia hastata*, Niger, recovery period, recovery rate,

INTRODUCTION

Niger is a Sahelian country which undergoes the alternation of a rainy season of 3 or 4 months with a dry season of 7 or 9 months. Low rainfall combined with soil poverty leads to poor harvests that cannot meet the food needs of rural households throughout the year. Thus, farmers often experience food deficits that occur from the beginning of the rainy season and extend to the following harvest time. To cope with this difficult period, rural populations develop many survival strategies among which the most common is the use of edible leafy plants, fruits, flowers or tubers (Ouédraogo, 2006).

Niger has a significant potential of food crops (Dan Guimbo *et al.*, 2012), and *Leptadenia hastata* belongs to the spontaneous food plants. This liana of the Asclepiadaceae family classified among the priority species used during food scarcity period is undemanding and grows easily on all types of soil (Thiombiano *et al.*, 2012). It is a perennial and evergreen plant in contrast to most cover plants.

High consumption of inflorescences, young fruits and leaves of this species by both human beings and animals compromise considerably its seed production and reduce its natural regeneration potentialities (Hamza, 2016). It is in this context that the present study undergoes to prospect alternatives to species propagation by

vegetative means with the objective of a possible establishment of food banks. The aim of the study was to investigate the possibilities of *Leptadenia hastata* propagation through roots and stems cuttings.

MATERIALS AND METHOD

Study site

The trial was carried out in the horticulture plot of the Faculty of Agronomy of Abdou Moumouni University of Niamey. It is located between N 13°38'06.5'' and N 13°38'06.3''of latitudes and E 004°01'56.6'' and E 004°01'56.6''of longitudes. The climate is of Sahelian type characterized by a rainy season which extends from 3 to 4 months with an average annual precipitation ranging from 500 to 750 mm (Hamza, 2016).The natural vegetation is composed mainly of *Acacia seyal*, *Bauhinia rufescens* and *Faidherbia albida* forming an agroforestry park where the cultivation of cereals and cowpea is practiced.

Biological material

Leptadenia hastata is a widely distributed species in tropical Africa and is characteristic of dry savanna vegetation in semi-arid areas (Arbonnier, 2000). The leaves (Fig. 1A) are simple and the fruits (Fig. 1B) are pairs of follicles, greenish, glabrous, with many seeds. *L. hastata* is a species that usually multiplies the seeds and is sometimes planted near houses, so that it is available when needed. In some parts of Ethiopia, it is also marketed as a fresh vegetable (UN-EUE, 2001). *L. hastata* will remain an important starvation food in Africa, as it continues to produce under circumstances where other plants die. Its value as a medicinal plant and its potential role in the biological control of several diseases in peanuts, sorghum and cotton illustrate the need for further research. *L. hastata* has been subject of several studies which have demonstrated its anti-inflammatory action, its inhibitory effect on certain tumor cells and its trypanocidal effect (Bayala *et al.*, 2011).

Leptadenia hastata cuttings cultivation

Three types of cuttings were collected from *L. hastata* plants growing in the experimental plot of the Faculty of Agronomy of Abdou Moumouni University in Niamey, Niger. These include stem segments from, respectively, the basal, apical and root parts of the individual plants. These cuttings, of 20 cm long, were used in the implementation of the experimental design.

In order to identify the most favorable period of the trial success, the year period was divided in 3 seasons: the cold-dry season, the hot-dry season and the rainy season. These correspond to the year distribution in the Saheliananarea. Three (3) trialswere then carried out covering the whole year period with a trial during each season. The duration of a trial was about 4 months. The first trial began in December 2015, the second in April 2016 and the third one in July 2016, corresponding respectively for the cold- dry season, the hot- dry season and the rainy season.

Cuttings were transplanted at the rate of one cutting per polyethylene bag, filled with a mixture of ¼ of organic manure from cow dung and ¾ of soil from the site, and exposed directly to sunlight. The experimental design (Fig.2) is a block arranged in 9 sub-blocks and each is composed of 30 polyethylene bags of 25 cm of height and 15 cm of diameter. Each type of cuttings is transplanted in three (3) randomly placed sub-blocks, giving 90 cuttings per type. And watering was done every 2 days.

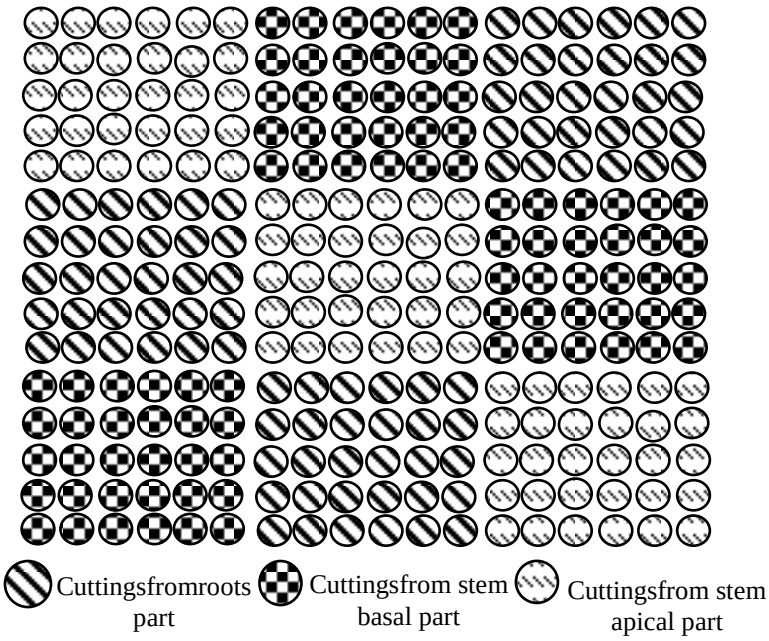

Figure 2: Experimental design

Study investigations consisted in identifying first, the buds appearance on each cutting of the different types, and then the foliage appearance. Observation on the root system was carried out at the end of each trial and consisted inrootlets counting.

The cuttings were monitored daily during 4 months for each season. The recovery of a cutting is characterized by the appearance of a bud.

Data Processing

The following characteristics were defined in order to analyze the data:

i. The recovery period is defined as the period between the cuttings transplanting and the appearance of the first bud on a cutting;
ii. The budding period is considered as the period between the appearance of the first bud on a cutting and the budding of the last viable cutting;
iii. The recovery rate is the ratio between the numbers of cuttings that bear buds over the total number of cuttings transplanted.

Percentages, mean values and standard deviations of the parameters studied were calculated. The difference of these means is evaluated by one-way Analysis of Variance (ANOVA) using SPSS software.

RESULTS

Cuttings recovery parameters

Recovery period differs according to the cuttings types and the seasons (Table 1). Analysis of variance showed that cuttings recovery period varied significantly between the cuttings types ($P<0.05$), except during the hot dry season; the difference was also significant between the seasons of the year (Table 1). During the hot dry and rainy seasons, the apical cuttings began to bud from the 4^{th}day, whereas it took 9 days in the cold dry season. During this last season, the cuttings from the root and the basal parts emitted their first bud only from the 13^{th}day after their transplantation. Irrespectively of the type of cuttings, the recovery period recorded during the cold dry periods was higher than those obtained during the hot- dry and rainy seasons.

Table 1. Variation cuttingsrecovery period (days)

Types of cuttings	Season of the year			Probability
	Cold dry	Hot dry	Rainy	
Root part	13.00±2.00	7.00±1.00	08.00±1.00	0.01*
Basal part	13.00±1.00	8.00±1.00	09.00±2.00	0.01*
Apical part	09.00±1.00	4.00±1.00	04.00±1.00	0.02*
Probability	0.01*	0.04*	0.01*	

Budding period also depends on the type of cuttings and seasons (Table 2). For all seasons, itwas relatively shorter for the cuttings from root and basal parts than those from the apical part. Budding period was greater in cold-dry season and the longest one was recorded with cuttings from the apical part (16 days).

Table 2: Variation of cuttings budding period (in days)

Types of cuttings	Season of the year			Probability
	Cold dry	Hot dry	Rainy	
Root part	7.00±2.00	3.00±2.00	6.00±2.00	0.01*
Basal part	6.00±2.00	3.00±2.00	5.00±2.00	0.03*
Apical part	16.00±2.00	7.00±2.00	13.00±2.00	0.01*
Probability	0.01*	0.04*	0.02*	

Cuttings recovery rate was quite low during the hot-dry period (less than 50%). It was 40.33, 8.00and 4.01% respectively for cuttings from apical, basal and root parts. The highest recovery rates were observed with the cuttings from apical part during the cold dry (75.33%) and rainy seasons (91.67%).

For all seasons of the year, the basal part has a recovery rate lower than that of other cutting types (Fig. 3).

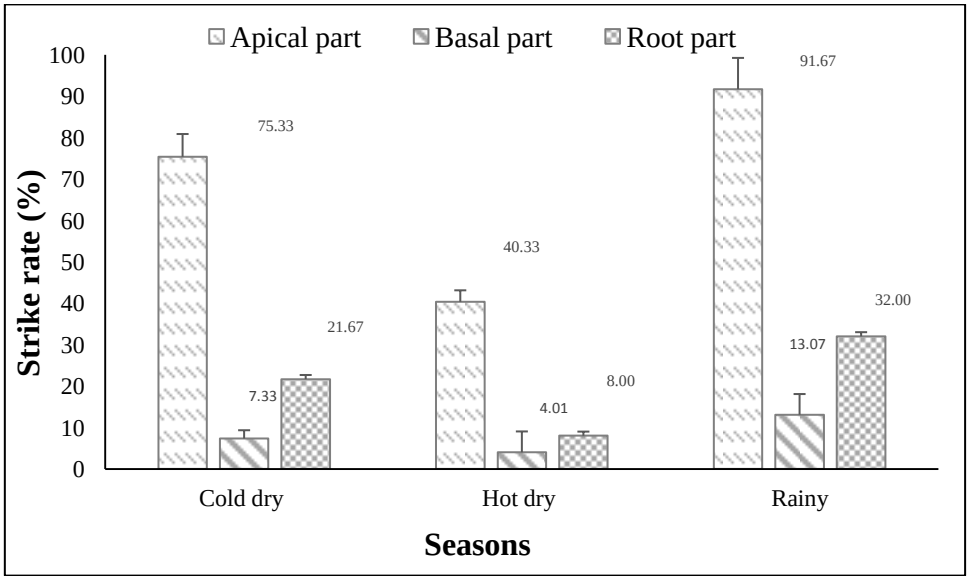

Figure 3: Cuttings strike rates

Leaf morphology

Two morphological types of leaves were observed during the trials. These are the broad-leaf type (Fig. 4A) and the linear leaf type (Fig. 4B). Cuttings from stem segments of the apical part gave mainly large leaves. Cuttings from basal and root parts gave only linear leaves.

Figure 4: Leaves aspects of apical (A) and basal (B) cuttings

The analysis of variance of leaf size data collected during the rainy season showed a significant difference.

Root development

The observed rootlets number, 4 months after cuttings transplanting, was greater in the rainy season for all the cutting types (Table 4). It was counted 27, 11 and 14rootlets with the cuttings from respectively the apical, basal and root parts. Whatever the season, cutting from basal part has a significantly reduced number of rootlets compared to the other cuttings types.

Table 3: Average leaf size by type of cuttings in the rainy season

Types of cuttings	Dimensions	
	Length	Width
Root part	13.75±2.10	3.15±2.10
Basal part	14.01±1.64	4.07±1.67
Apical part	11.35±1.12	8.42±0.74
Probability	0.03*	0.01*

Table 4: Average number of roots per type of cuttings per season

Types of cuttings	Season of the year			Probability
	Cold dry	Hot dry	Rainy	
Root part	7.00±2.00	10.00±3.00	14.00±2.00	0.02*
Basal part	5.00±1.00	7.00±3.00	11.00±1.00	0.01*
Apical part	13.00±2.00	21.00±3.00	27.00±3.00	0.03*
Probability	0.02*	0.01*	0.04*	

Figure 5: Root system aspects of different cuttings

DISCUSSION

The recovery of a cutting is due to a revival of activities at the level of one or more vegetative buds which will give later a branch (Diatta, 2007). The presence of undifferentiated meristematic cells, capable of rapid multiplication, forms the necessary tissues which, in turn, form organs such as buds and rootlets (Hannah and Jan, 2003). The short recovery period obtained in the hot dry season and the rainy season compared to that obtained in the cold dry season is related to the physiological activity of the buds. Indeed, for most Sahelian and tropical species, buds activities are slowed down in the cold season (Mahamane *et al.*, 2007). Amina *et al.* (2006) noted the dormancy of apple buds in winter. Budding period is short for all the cutting types during the dry season. This period is characterized by a high evaporation in the Sahelianarea. Cuttings do not maintain their viability for a long time. Recovery rate of cuttings from the root and basal parts is smaller compared to that of apical part for all the seasons of the year. Indeed, the low number of vegetative buds recorded with cuttings of the basal and root types could be explained by the drying of their epidermis, leading to their death (Diatta, 2007).

The phytohormones, responsible of cell differentiation, are synthesized at the bud level. In rainy and dry seasons, periods where photosynthetic activity is important, cuttings of apical part with a large number of buds maximize the concentration of these hormones and increase the capacity of roots production. For all the cuttings types, results become more important during the rainy season. Indeed, during this period, a higher rate of recovery was observed than those of the dry periods of the year. During these periods, plants of *L. hastata* undergo water deficiency. Mainly, cuttings from root and basal stems were the most affected, which illustrates the low recorded results. On the other hand, during the rainy season, plants are filled with sap which is responsible of rhizogenesis, explaining the low rates obtained during the other seasons at the root parts. Leaf morphology was of two types, broad and linear types. Leaves of linear type are those usually observed with this species. Endogenous factors related mainly to the cuttings physiological state could explain the appearance of those two (2) different types of leaves.

CONCLUSION

This work has studied the possibility of root and stem cuttings propagation of *L. hastata*. Three different types of cuttings were cultivated and results differed according to the seasons. The observed main characteristics of the species cuttings indicate that latency period varies from one plant part to the other of the sampling. Results show that the stem apical parts were the most suitable for vegetative propagation of this species. This finding would make it possible to envisage the possibility of developing the cultivation of this species in the Sahelian zone. This could ultimately lead to an additional food source for local populations.

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