Tests to optimize the multiplication of oleander (Apocynaceae) in soil and water matrices

ABSTRACT

The vegetative propagation of oleander (Apocynaceae), an ornamental plant for aesthetic use, is based on the technique of cuttings. This study focused on optimizing this multiplication. To do this, two types of matrix were used, in particular soil and water. Cuttings were taken from oleander plants and the apical, middle and basal parts of the stems were cultured in water and soil. The results showed that after 3 weeks the cuttings, thus installed, constitute the seat of the formation of the roots and the neoformation of the buds. The characteristics of this cuttings were established with cuttings from plantations obtained by artificial regeneration. Thus, on a stem twig, we distinguished basal, middle and apical cuttings. Recovery time varies from one category of cuttings to another, but the highest recovery rate (86.7%) was obtained with middle cuttings. The results obtained are of paramount importance in the success of the rapid multiplication of this ornamental species highly prized by urban florists in Niger.

Key words : Ornamental plant, Oleander, Apocynaceae, Vegetative propagation.

INTRODUCTION

The world is facing unprecedented urbanization. Indeed, according to the [1], the urban population has become the majority. About 3.3 billion people now actually live in cities [2]. Urbanization in many developing countries will continue. For example, from 2000 to 2030, the Asian urban population is expected to double, from 1.36 to 2.64 billion city dwellers [3]. In Africa, the population living in cities will increase from 294 million to 742. By 2050, 95% of urban growth (in terms of population) will be absorbed in African cities (Damon, 2011).

In Niger, the process of urbanization is a major concern. To this end, large infrastructure construction sites as well as other means of beautification in the major Nigerien cities have been launched to give them a very beautiful image by making them more aesthetic, such as the planting of ornamental plants. The current state of scientific knowledge on the benefits of plants and flowers in the daily lives of citizens indicates that these ornamental plants have economic benefits (reduction of energy costs, increase in property values), environmental benefits *(*moderation urban climate extremes, oxygen production, carbon sequestration, pollution reduction) and finally lifestyle benefits (reduced stress, increased productivity at work and at school, improved human health) [4].

Thus, in the capital Niamey, there is a multitude of exotic ornamental plants. They should be safeguarded by an adequate enhancement of their decorative potential. Among these plants, the most abundant families are those of Fabaceae, Acanthaceae and Apocynaceae. Many peoples love Apocynaceae for their beauty alone [5].

However, these ornamental plants face problems related to the regression of plant cover but also stray animals that prevent the proper development and growth of these decorative species. Thus, the search for unpalatable ornamental plants arises acutely. In other words, species likely to constitute an obstacle to animals which are notably straying in the city of Niamey.

Nerium oleander, commonly known as oleander seems best suited for various reasons. Indeed, it is an unpalatable and toxic plant for animals [6]. Flowers large, bright pink (rarely white), giving off a sweet fragrance, with corolla in a cylindrical tube and 5 wide, asymmetrical lobes, each bearing at the base a scale deeply divided into acute lobes grouped in terminal corymbs Dry, cylindrical fruits, slender, contain many seeds with a pappus and all parts of the plant are poisonous [7]. This means that it is not at all palatable to animals. But it requires well-drained and rich soil.

However, one of the biggest problems with silvicultural techniques is the large-scale propagation of naturally regenerating *Nerium oleander* by seed propagation. Research should focus on vegetative propagation which offers multiple benefits [8]. This is why it would be important to study the rapid multiplication of oleander in view of the enormous demand.

It is within this framework that the present work falls, the general objective of which is to conduct trials in order to optimize the rapid production of oleander plants by vegetative means.

I. MATERIALS AND METHODS

1.1. Study site

The trial was conducted in the horticulture plot of the Faculty of Agronomy of Abdou Moumouni University in Niamey located between latitude 13°30' North and longitude 2°08' East with an altitude of 216 m. The climate is of the Sahelian type and is characterized by a rainy season which extends from 3 to 4 months with an average annual precipitation varying from 500 to 750 mm.
Figure 1 indicates the geographical location of the Faculty of Agronomy of Niamey.

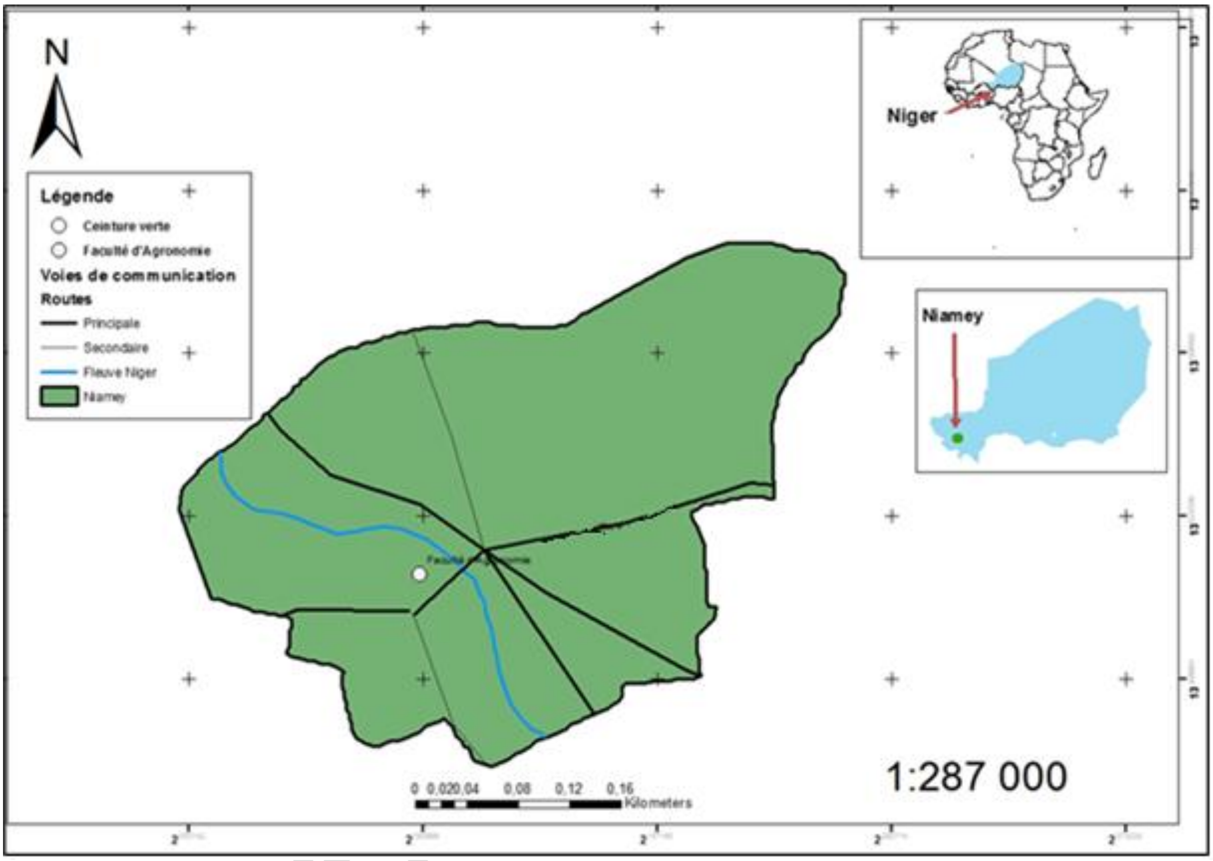

Figure 1: Geographical location of the Faculty of Agronomy of Niamey.

1.2. plant material

The plant material used in this study consists of oleander cuttings. They were taken from the oleander plantations installed in the domain of the Abdou Moumouni University of Niamey in a hedge on either side of the main road (Figure 2).

Figure 2: Laurel hedge on the main road at Abdou Moumouni University in Niamey.

1.3. Collection of cuttings

The cuttings were taken using pruning shears from plants that were healthy and free from the appearance of pests or diseases. On each laurel branch taken, 3 parts or types of cuttings were distinguished. These are the basal, middle and apical parts as shown in Figure 3.

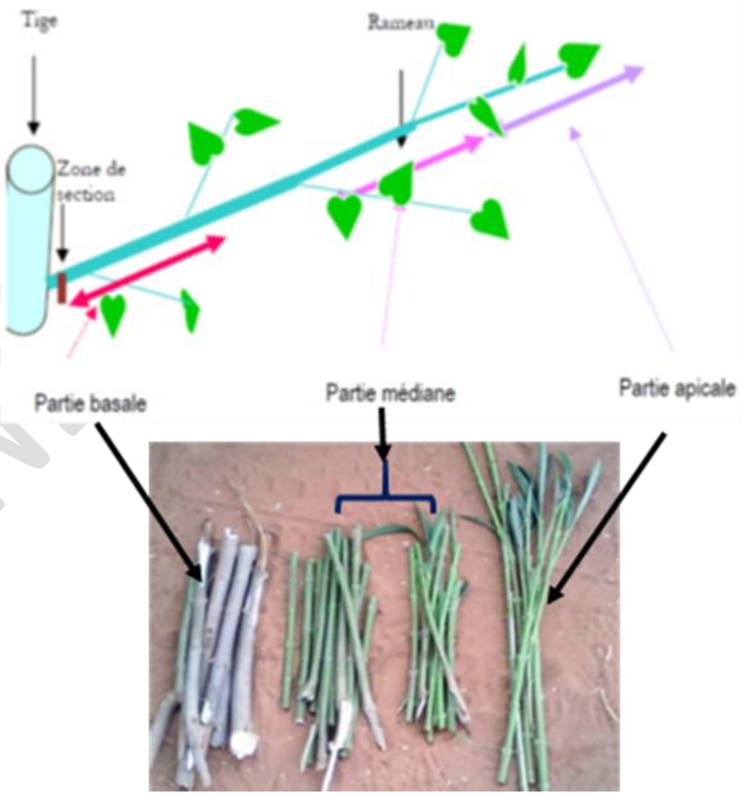

Figure 3: Position of the different types of cuttings on a twig of oleander.

Each part is therefore represented by 90 cuttings. Table 1 summarizes the numbers of cuttings taken.

Table I1: Number of cuttings according to cultivation methods.

Terms	Types of cuttings	Name
Immersion in the water	Basic	90
	Median	90
	Apical	90
Cans filled with substrate	Basic	90
	Median	90
	Apical	90
Total		**540**

1.4. Soil and water samples

The soil that served as substrate was sampled at the Faculty of Agronomy of Niamey (Study site) at 0-10 cm. This substrate has a sandy to sandy-loamy texture with a slightly acidic pH (5.5 to 6.5). As for the water, it comes from tap water distributed by the Société d'Exploitation des Eaux du Niger.

1.5. Types of treatment

Among the 90 cuttings, 45 cuttings first stayed in water (Figure 4.A) and 45 cuttings placed directly in plastic bags 20 cm in diameter and 45 cm in height (Figure 4.B) and filled of substrate. This substrate consists of 1/3 cow dung and 2/3 sand. This substrate composition is recommended for good development of seedlings in the nursery [9].

These pots are arranged in 3 blocks of 20 pots (Photo 1).

Photo 1: Treatments carried out on the cuttings: ***(A)*** Cuttings placed in water; ***(B)*** Cuttings directly in pots.

This method involves soaking the cuttings in water until roots appear and buds emerge. The cuttings are placed as follows:

In addition, the water is renewed twice a week but every 2 days if the evaporation is strong, it is thought to add water to these containers kept in a shaded area.

1.6. Tracking settings

1.6.1. Appearance of roots

The appearance of roots on each bud was monitored. Indeed, the appearance and development of the roots constitute the major element of success in the production of a vigorous plant intended for transplantation in a permanent environment. The calculation of the root appearance rate (TAR) for each category of cuttings was carried out according to the following formula:

$$TAR = \frac{Number\ of\ cuttings\ that\ produced\ roots\ x\ 100}{Total\ number\ of\ cuttings}$$

1.6.2. Appearance of buds

The appearance of roots on each bud was monitored. Indeed, the induction of the buds allows the defoliated cutting to begin the synthesis of the nutritive elements allowing it to develop these organs, in particular the leaves and the roots. The Bud Appearance Rate (TAB) was calculated using the following formula:

$$TAB = \frac{Number\ of\ cuttings\ having\ emerged\ the\ buds\ x\ 100}{Total\ number\ of\ cuttings}$$

1.6.3. Determination of recovery

Recovery is considered to be the number of cuttings per category that emerged from buds and roots after cuttings.

1.6.4. Growth determination

Growth was considered to be the factor indicating the development of branching. It was appreciated by the number and growth of offshoots.

1.7. Data processing

The data collected was processed using the Microsoft Office pack (Word, Power Point and Excel) 2009. Excel was used to calculate the averages associated with the coefficient of variation. The tests of X^2 made it possible to carry out the comparisons.

II. RESULTS

2.1. Recovery of cuttings

The oleander cuttings gave a total recovery by type of cutting in the water treatment for 3 months; on the other hand, in the soil treatment, recovery is not total and the recovery rate is different for each type of cutting (Table 2).

Table 2: Recovery rate by type of cuttings in water and in soil according to periods of 1 to 3 months.

Treatments	Types of cutting	Recovery rate at 1 month (%)	Revision rate at 2 months (%)	Recovery rate at 3 months (%)
Water	Apical	100	100	100
	Median	100	100	100
	Basal	100	100	100
Substrate	Apical	0	6.67	8.89
	Median	13.33	15.56	15.56
	Basal	32.22	32.22	32.22

It emerges from the analysis of this table that the recovery is 100% in water whereas it is different in the ground at different periods. Indeed, after 1 month, only the median and basal buds showed a recovery of 13.33% and 32.22% respectively. At 2 months, the recovery rate for the apical, median and basal butts is 6.67% respectively; 15.56% and 32.22%. However, it was found that the recovery rate at 3 months did not change for the median and basal buds and increased (8.89%) for the apical buds.

2.2. Growth of offshoots

For the growth of ramifications, two aspects were followed, in particular the number of ramifications and the average size of ramifications whether in the water treatment or in the soil treatment. Thus, in the water treatment, the middle cutting has more ramifications than the other cuttings (apical and basal). However, its average size is less than 10 cm even in the sand treatment with 10 ramifications of average size greater than 6.7 cm (Table 3).

Table 3: Number and size of branching (in cm) by type of cuttings in water and in soil.

Treatments	Type of cutting	Branch number	Branch size (cm)
Water	Apical	41	12
	Median	52	10.33

	Basal	48	12
Sand	Apical	2	0.7
	Median	10	6.7
	Basal	5	3

Analysis of Table III shows that in the water treatment, the number of ramifications is 41; 52 and 48 respectively for apical cuttings; median and basal versus 2; 10 and 48 for cuttings in the ground. The size of the ramifications varies between 10.33 and 12 cm in water and between 0.7 and 3 cm in sand.

Photo 2 illustrates the root development of oleander cuttings in water and in soil.

Photo 2: Illustration of the development of the root system of oleander cuttings. ***(A):*** in water at 2 weeks; ***(B):*** in soil at 2 weeks; ***(C):*** in water at 4 weeks; ***(D):*** in soil at 4 weeks.

III. DISCUSSION

This work thus carried out on the technique of cuttings in the oleander made it possible to follow the evolution of the three main parts of the cuttings which were taken. These are the apical, middle and basal parts. Each of the parts constituted a modality. Firstly for those who use the technique of cuttings in pots, this one is admitted to failure because we have not been able to record the emergence of roots and buds. Indeed, this failure could be explained by biological and ecological factors because the oleander is a very demanding plant in terms of humidity and fairly low temperature requirements. So, given the context in which this study was conducted (March, April) where the temperature was particularly high and the humidity was not at all permanent, which constitutes an obstacle for the root development of these cuttings placed in the jars.

Secondly, concerning the technique of cuttings in water, this made it possible to observe the appearance of roots and the emergence of cuttings. At this level the different types of cuttings were placed in boxes 115mm high and 1.5 liters containing water; these constitute the seat for the emergence of the cuttings. The observations focused on the latency time, the recovery time of the cuttings and the cutting capacity of the species.

In addition, the main characteristics of cuttings of the oleander species have shown that the latency time is everywhere the same, there is uniformity therefore the latency time does not depend on the type of cutting. The capacity of cuttings depends only on the position of the fragment at the level of the stem; it is better with the fragment of the median type. Indeed, when the cutting has one or more buds, the main organogenesis phenomenon corresponds to caulogenesis. When it is a fragment without buds, the cutting must give rise to meristems, that is to say young, undifferentiated cells capable of multiplying rapidly [10].

The difference observed vis-à-vis the caulogenesis (new formation of buds) at the level of the different types of cuttings, is explained by several biological and genetic factors of the cuttings. So the neoformation of buds is dependent on biological factors specific to the cutting. These physiological correlations involve hormonal controls (auxins). The application of auxins stimulates caulogenesis. Furthermore, horticultural practice also shows that rooting depends on the origin of the cutting. Genetic factors, the reserves provided by the cutting, the age of the mother plant and the place of removal from the plant play a determining role [11].

These observations, which agree with those reported by Diatta (2007), however, show little different values indicating that the speed of recovery, which is accelerated from the second week. In effect [12] studies the possibilities of cuttings in Maerua crassifiolia Forsk., Capparaceae, a woody Sahelian fodder, also using the technique of cuttings in water. In this study the fragments (cuttings) of the apical, middle and basal parts were placed in containers so two weeks later the cuttings generated roots and buds which gradually multiplied with more speed from the second week until at a maximum threshold observed in the cuttings of the apical part (86.7 %) followed by the middle part (76.3 %) and finally the basal part (65.5 %). These results show that the technique of cuttings in water marks the difference in relation to the emergence of roots and buds at the level of the cuttings of the different parts placed, which implies not only where the genetic potential is stronger on the plant but also the reasons for the evolution of the cuttings from the second week. So one would think that this is the time when most cuttings would recover from the stress caused by their isolation from the mother plant.

CONCLUSION

In short, the objective of the authorities vis-à-vis the decoration of main roads, public places and institutions (with resistant and defensive ornamental plants) can be achieved by focusing on the vegetative propagation of oleander (*Apocynaceae*). The oleander is easy to propagate by the technique of cuttings. Indeed, the stems taken are cut into 3 categories of cuttings, namely the cuttings of the apical part, the cuttings of the middle part and the cuttings of the basal part. After 21 days, these cuttings thus placed in containers containing water have generated roots and buds which should then be introduced and monitored in pots for the regeneration of other organs (leaves, flowers, fruits). In addition, we note that the formation of roots and buds is faster in the cuttings of the middle part where we note the particularly high recovery capacity. However, the roots appear before the buds, but the formation of buds considerably increases the number of roots. So cuttings in water are both the easiest and the most fun to implement when vegetatively propagating oleander. Beyond this simplicity of culture, the oleander presents a rather important socio-economic aspect; a decorative aspect which makes it a highly sought-after ornamental plant on the market and a toxic aspect as well as pruning which protects the plant against human or animal threats.

At the end of this study, we note that the vegetative propagation of oleander should use the technique of cuttings which would consist of placing several cuttings, preferably those of the middle part, in containers well filled with water and waiting for the formation of roots. To keep water odor free. Water must be added if evaporation is too strong. After about twenty days the roots should appear. Once the roots are well developed, the cuttings could be installed in individual pots, acting with caution because the roots produced in water are fragile and brittle.

For all these reasons, this study should be carried out over the hot dry period, that is to say during the dry and hot seasons over a period of 4 months. This should make it possible to assess the recovery time during these months.

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