INNSPUB

International Journal of Agronomy and Agricultural Research (IJAAR)
ISSN: 2223-7054 (Print) 2225-3610 (Online)
http://www.innspub.net
Vol. 9, No. 6, p. 26-32, 2016

RESEARCH PAPER OPEN ACCESS

Evaluation of some biochemical and agronomic parameters of an Ivory Coast forest plant: *Telfairia occidentalis* Hook. F.

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Article published on December 20, 2016

Key words: Nutrient components, *Telfairia occidentalis*, air-dried, germinate, Transplantation

Abstract

This study determined the nutrient components in *Telfairia occidentalis* seeds. The reponses of *T. occidentalis* seeds to transplantation and germination after drying were also investigated. To this end the rate of humidity, protein, fat, carbohydrate were determined according to the reference methods of AOAC. Besides, a comparison of the seeding of the air-dried seeds and that undried was estimated as well as the effect of the age of plants in tree nursery on the transplantation. The results indicate that *T. occidentalis* contains approximately 50 % of fat, 27 % of carbohydrate and 14 % of protein. This plant has a rate of fat upper to that of *Lagenaria siceraria* and *Curcumis melo*. Besides the big seeds stemming from long fruits germinate better than the small seeds. Furthermore, 97 % of seeds sowed directly germinated when only 50 % of those air-dried germinated. Besides, a transplantation 10 days after levying stress less the plants than a transplantation 25 days after levying. This work showed the nutritional value of *T. occidentalis* of ivorian forest. Otherwise, the seeds should be sown without drying and transplanted 10 days after emergence.

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Introduction

The economy of Ivory Coast is essentially based on the income of agricultural exports. The farming sector represents 20 % of the GDP (Gross Domestic Product) and the agricultural and agro-industrial exports in 2012 represented 53 % of the global exports of the country (DGPAAT, 2012). This economic boom was made to the detriment of the forest spaces of the country. Indeed the agricultural practices of subsistences changed in the implementation of extensive business concerns of coffee, cocoa and hevea. This increasing dynamics of the exploitations of cultures of pension entailed conversely a regression of the Ivory Coast forest place setting. Indeed, the forest cover passed from 9 million hectares in 1955 to approximately 4 million hectares in 1980 (Fairhead and Leach, 1998). Parren and De Graaf (1995) estimated the Ivory Coast forest about 2,7 million hectares. The current estimations place it under the bar of the 2 millions of ha. Of more the populations coming from the sub-region and those of the other regions of the official list of ivory invested the protected zones and threatened to destroy them. That is why besides the strategies of collaboration in the conservation with the waterside populations, the researchers more and more lead studies for the preservation and the taming of forest resources. Because these forests are reservoirs of new therapeutic molecules and top-grade food resources. It is the case of *Telfairia Occidentalis* (Curcubitaceae) used by certain populations of the South of Ivory Coast (Region of Agneby Tiassa) for their food. If "Lomi" (in local language) is appreciated, it is because it has the same texture, the same taste as the "pistachio nuts": legumes cultivated for the preparation of ceremonies sauces and by big events in Ivory Coast. However, this substitution forest product in "pistachio nuts" risks of disappears without we know the real nutritional values as well as the possibilities that he could establish a possible revenue stream for the populations. The agronomic characterization and the genetics of numerous exotic plants cultivated in the tropics was realized; however, just like of numerous traditional and forest resources of rural areas in the tropics, *Telfairia Occidentalis*("Lomi") was the object of no scientific research in Ivory Coast.

Materials and methods

Plant materials

The plant material is constituted by seeds of *Telfairia occidentalis* collected in the forest of Odoguié (Fig. 1), village situated to approximately 10,5 km of Azaguié (the South coastal). The GPS address and coordinates are following them: 5°37 ' 29 " N and 4°12 ' 11 " W. Seeds were extracted from mature fluted pumpkin fruits.

Methods

Morphological characteristics of seeds

The measurements of both tested lots of seeds were recorded. It was about diameter, thickness and mass of seeds.

Study of some biochemical parameters of T. occidentalis in Ivory Coast

Moisture content

The used method is the one in the steam room (AOAC, 1990). It consists in eliminating water contained in the sample by drying in the steam room. The empty capsules are dried beforehand 60 °C during 15 - 30 min and weighed (M1). Then, 5 g (Pe) of every sample is put in every empty capsule.

Then, capsules containing samples are put in the steam room (SELECTA) in 105 °C during 24 hour. After elimination of the water, the capsules containing samples is weighed (M2).

$$\% \text{ H} = \frac{(\text{M1} + \text{Pe}) - \text{M2}}{\text{Pe}} \times 100$$

% H: percentage of humidity or moisture content
M1: mass of the empty capsule
M2: mass of the empty capsule and the sample after drying in the steam room
Pe: trial grip

Protein content

The dosage of the nitrogen was made according to Kjeldhal method (AOAC, 1990). In an organic product, the nitrogen can be under mineral or organic form. For the dosage in its entirety, it is necessary to destroy organic compounds so as to obtain all the nitrogen under the same mineral shape. We make for it a mineralization, then a distillation.

The nitrogen is then measured by acido-basic titration. The analysis takes place in three stages which are:

Mineralisation: in 0,5 g (Pe) of every sample is added 1 g of catalyst and 10 ml of concentrated sulphuric acid (98 %) in a matras. Then, the mixture is heated until appearance of the green tint.

Distillation: after the mineralisation, the nitrogen is in the form of NH4 + in the product. The ions ammonium of the product being in an excess of sulphuric acid, we cannot measure them directly. In a flat-bottomed ball, the mineral deposit is decanted by adding it 300 ml of distilled water, 50 ml of soda (10 N) and 2 in 3 drops of phenolphtalein. The mixture is homogenised. In an erlenmeyer, 25 ml of boric acid (4 %) and some drops of red of methyl (0,02 %) are introduced. The distillation is made until the obtaining of 150 ml of distillate.

Dosage: the distillate is measured with the sulphuric acid (0,1 N) until the obtaining of the pink tint.

$$\% P = \frac{0{,}1 \times (V_{H_2SO_4} - V_B) \times 14}{10 \times P_e} \times 6{,}25$$

% P: percentage in raw (gross) proteins
VH_2SO_4: volume of the fall of oil can with the sample
VB: volume of the fall of oil can for the white
14: mass molar of the nitrogen
0,1:normality of the sulphuric acid
6,25: conversion factor of the nitrogen in protein
Pe: trial grip.

Fat content

Total lipids are extracted by heating with ebb, then weighed after evaporation. The determination of the fat content consists in extracting lipids contained in the sample with an organic solvent (hexane).

The method consists in introducing 10 g of flour into the cartridge of Whatman, some cotton is placed in the opening of the cartridge to avoid that the sample is carry away by the solvent during the extraction. In a ball of extraction, 300 ml of hexane are introduced, the ballis placed on a block of heating and the connections of the various elements of the device are made.

The faucet of the cooler is opened and the block of heating is started up during 6 hours. After this time of extraction, the ball is removed from the extractor SOXHLET (realized in tube Pyrex France of 250 mL), and is placed in the rotary evaporator to separate the oil and the solvent. The set (ball + fat) is then dried in the steam room and cooled in the hanging dessiccateur 15 min, then weighed (P1).

$$\% MG = \frac{(B_H - B_V)}{P_e} \times 100$$

% MG: percentage in fat
BV: mass of the empty ball
BH: mass of the empty ball and the oil after extraction
Pe: trial grip.

Ash content

The used method is the one of the oven with mitten (AOAC, 1990). It consists in putting the high-temperature sample to eliminate all the organic substances which it contains.
The empty crucible (M0) and 5 g (Pe) of every sample was weighed. Then, crucible containing samples were put in the oven with miold (NABERTHERM) in 550 °C during 24 h to cremate some organic matter. After the incineration, crucible containing ashes was cooled in the dessiccateur and weighed (M1).

$$\% C = \frac{M_1 - M_0}{P_e} \times 100$$

% C: percentage in ashes
M1: mass of the crucible pot and the ashes
M0: mass of the crucible
Pe: trial grip

Content in total carbohydrates

The content in total carbohydrates was determined by difference of the total material to the other biochemical compounds according to the following formula:

$$\% G = 100 - (\% H + \% C + \% P + \% MG)$$

% G: percentage in carbohydrates total
% H: percentage of humidity
% P: percentage in raw proteins
MG: percentage in fat
% C: percentage in ashes

Energy Value

The energy value was calculated with 4 Kcal / g for carbohydrates, 4 Kcal / g for proteins and 9 Kcal / g for the fat according to Atwater and Benedict (1902):

$$VE = 4 \times \% G + 4 \times \% P + 9 \times \% MG$$

VE: energy Value in Kcal Kcal /100 g of matter dries
% G: percentage in carbohydrates total
% P: percentage in raw proteins
MG: percentage in fat

NB: The biochemical results arise from average values of three repetitions and seeds were air-dried free under shelters during 10 days. Optimization of the rate of seeding of seeds *T. occidentalis*. In the optics to optimize the rate of emergences of the plants of *T. occidentalis*, two treatments of seed were estimated.

Impact of seeds size and mass on seedling emergence of T. occidentalis

The test was performed using two samples of *T.occidentalis* seed (type 1 and type 2). Sample 1 (type 1) was characterised by small seed and sample 2 (type 2) by large seed. Both samples were also weighted. 30 seeds per type were then sown in bags of polyethylene containing 350 g of soil mixed in the dung of cow (proportion 1/3). The soil and the dung of cow were beforehand dried in the sun during two weeks. The experiment was repeated three times.

Optimization of the rate of seeding of seeds T. occidentalis

In order to optimize the rate of emergences of of *T. occidentalis*, two treatments of seed were estimated. The first treatment consisted in the fermentation of 30 seeds during 3 days of type1 seeds.

Then, these seeds were air-dried ventilated during 5 days. In second treatment, the seeds of type 2 (30 seeds also) were directly sowed two days after they are taken out of pods without the stage of the drying.

Seeds were put in seeding in bags of polyethylene containing 350 g of soil mixed in the dung of cow (proportion 1/3). The soil and the dung of cow were beforehand dried in the sun during two weeks. The experiment was repeated three times.

Impact of the duration of plants in tree nursery on the transplantation

Plants in tree nursery were transplanted for the lot1 25 days after the levying whereas the second lot was transplanted 10 days after the levying. The stress after transplantation was noted for both lots and the time of resumption after transplantation was also recorded.

Statistical analysis

A statistical analysis in one criterion of classification was made to test the typical effect of fruit on the diameter, the thickness and the mass of the seed. A test of comparison of the averages of Newman and Keuls was made to distinguish the groups of homogeneity according to the average values to be tested. A test of correlation of the percentage of seeding by the mass, the diameter and the thickness of the seed was made. The threshold of meaning is 5 %. The used software is Statistica 7.1.

Results and discussion

Morphological characteristics of *T. occidentalis* seeds and fruits collected (Size, thickness and mass) allowed to differentiate two types of fruit. The first type (type1) has 33 cm fruit long (Fig. 2). Its seeds have an average diameter of 2.65 cm for an average thickness of 1.07 cms (Table 1). The seed of *T. occidentalis* of type1 has an average mass of 4.87 g (with its envelope). With a length of 50 cm fruit, the seed of type 2 has an average diameter of 3.90 cms on a 1.43 cm thickness (Fig. 2; Table 1).

Table 1. Measurements of two types of seed of *T.occidentalis*.

Type of fruit	Seed		
	Mass	Diameter	thickness
Type 1	2.6513.75± 0.08	1.07313.75± 0.04	4.87± 0.16
Type 2	3.9013.75± 0.11	1.4313.75± 0.05	13.75± 0.89

On average a seed of type 2 has a mass of 13,75 g (with its envelope). These results are similar to those of Chukwudi and Agbo (2014) who determined three types of fruit of *T. occidentalis* in Nigeria according to the size. Indeed, these researchers classified three groups of fruits according to the length: wide Fruits, means fruit and small fruit. Big fruits are the ones whose size exceeds 50 cm (mass averages = 15.56 g) while the means are the ones the size of which is between 34 cm and 50 cm (mass averages = 13.93 g). When the size is lower than 34 cm, the fruit is said small (mass averages = 10,31 g).

Table 2. Biochemical Potentialities of *T. occidentalis* of Ivory Coast.

Parameter	Proportion / 100 g		
	T. occidentalis	*Lagenaria siceraria**	*Curcumis melo**
Moisture	3.26±0.23	9.07	5.20
Protein	14.33±0.11	25.24	15.75
Ashes	6.35±0.025	3.90	5.69
Fat	49.30±0.17	40.56	22.23
Carbohydrate	26.76±0.32		
Energetic Value	608.04±0.15 Kcal		

The values are the average of three repetitions.

*Proportions of *Lagenaria siceraria* and *Curcumis melo* are reference values of Ibeabuchi (2014) and Mariod*etal.* (2009).

Proximate composition of T. occidentalis seeds

The results of biochemical composition of *T. occidentalis* seeds from Odoguié's forest (South of Ivory Coast) were analysed.

Fig. 1. *Telfairia occidentalis* Fruit in natural forest.

The protein, carbohydrate and fat contents of 100 g seed of "lomi" were found to be 14,33 %, 26,7 % and 49,30 % respectively (Table 2). These results were similar to those given by Alegbejo (2012) who showed that 100 g of these seeds in Nigeria contains 45 g of fat and 23 g of carbohydrate. However, the quantity of protein found by the same author (20.5/100 g) is more important than fact obtained by our study (14 g/100 g).

These variabilities were indicated by Odiaka and Schippers (2004) which showed that the rate of protein could vary from 20 to 37 % whereas the fat is estimated between 40 and 56 %. These differences may be attributed to genetic variations, as well as climate, environmental and geographical factors. The seeds of *T. Occidentalis* highlighted in our study have strong energy value because 100 g of these seeds supplies energy of 608 Kcal (Table 2). Indeed, these seeds have 65 Kcal more than those tested by Odiaka and Schippers (2004).

Effect of seed size and seed mass on seedling emergence of T. occidentalis

Telfairia occidentalis seeds emergence is positively correlated by their mass and their size (Fig. 3 and Fig. 4). The rate of emergence increased when seeds mass or size enhanced. This result is in agreement with the study of Ugesse *etal.* (2008) that reported the positive correlation of the emergence and the vigour of the seedlings of *Vitellaria paradoxa* Gaertn F. by the mass. Amico *et al.* (1994) reported that higher vigour that occurred in larger seeds were due to the large food reserves in such seeds. Seed size plays an important role in germination and establishment of vigorous seedlings that is essential to

achieving high yield (Nik *et al*., 2011). Nerson (2002) showed that small muskmelon seeds had the lowest seedling growth which demonstrated that there is an association between seed physical parameters and seed quality.

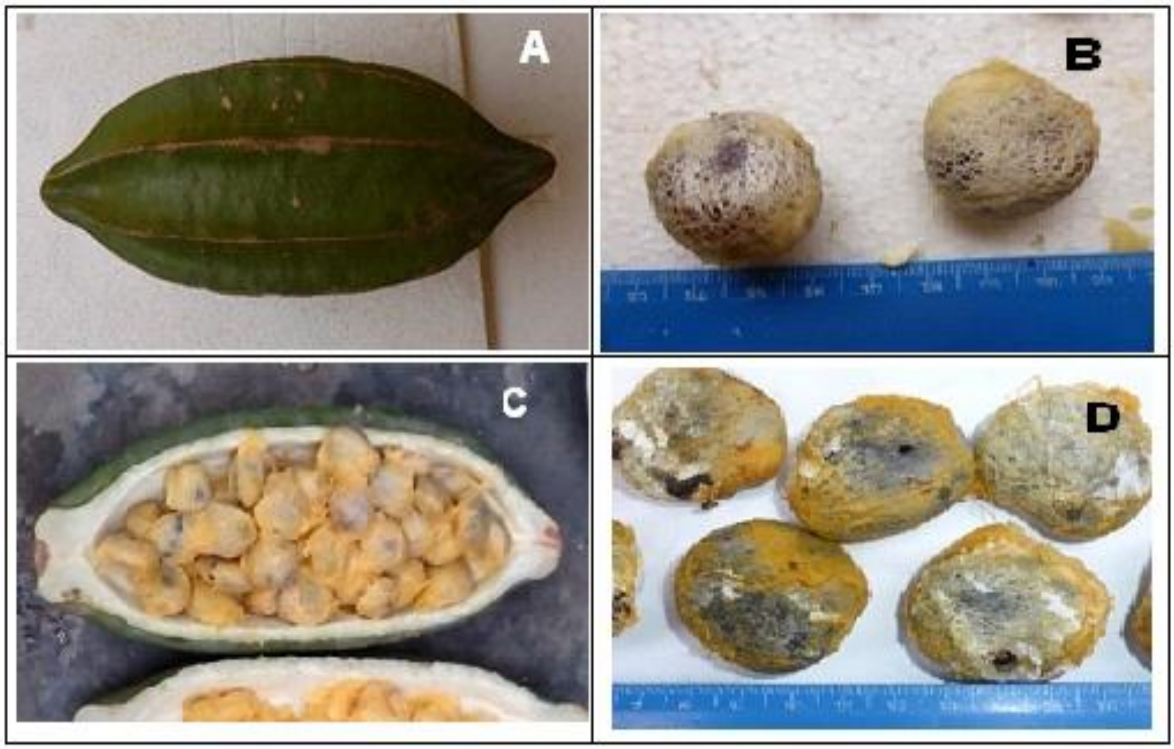

Fig. 2. Fruit and seeds of *T. occidentalis* : type1 (A and B) and type 2 (C and D).

Comparison of two seed treatments before sowing

The results show that seeds fermented then dried during 5 days have a rate of emergence significantly ($p < 0.05$) less important than not fermented seeds and undried. The rate of emergence is 49,99 % and 96,66 % after drying and undrying respectively. Ajayi *et al.* (2006) highlighted the sensibility of *T. occidentalis* in the dehydration. According to this study, the flash or slow drying of seeds caused the fast declension of the seeding. However, the seeding in fast dehydration is 25 % more important than that in slow dehydration. It is what explains the low rate of seeding which our study made observe when seeds were air-dried free during 5 days.

Effect of the duration of of T. occidentalis plants in tree nursery on the transplantation

The plants of *T. occidentalis* transplanted as well 10 days after the emergence as 25 days later did not undergo mortality after the transplantation. However plants transplanted late underwent a stress with light yellowings of the basal leaves.

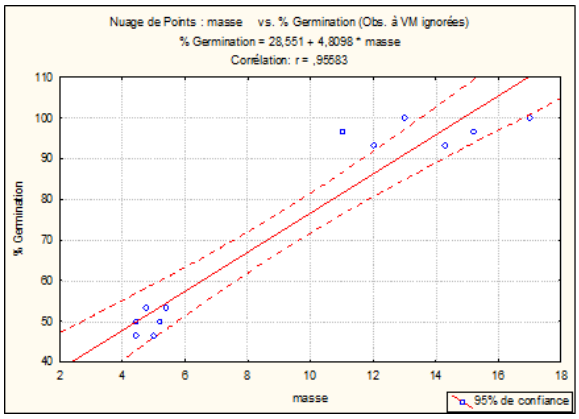

Fig. 3. Relation between *T. occidentalis* seeds mass and their seeding.

The resumption of these plants was effective that one week after the transplantation. On the other hand plants transplanted early (ten days after the emergence) underwent no stress and developed normally. This situation would be due to the important development of roots of plants transplanted late. According to Atger (1992) old roots show difficulties to regenerate. The speed and the performance of the regeneration decline with the age

and the volume of root sectioned. The cutting of bags during transplantation would have damaged certain roots. This try showed the capacity of *T.occidentalis* to be transplanted.

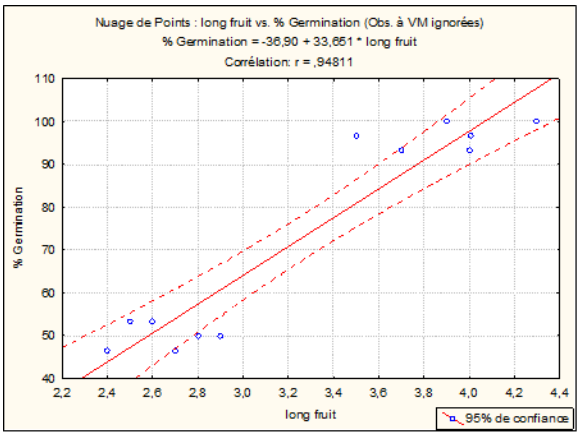

Fig. 4. Relation between *T. occidentalis* seeds size and their seeding.

Conclusion

Telfairia occidentalis is one of Ivory Coast forest plants used by the rural populations. Its fruit is collected from forest and seeds are used for the meals of ceremonies in the same way as *Lagenaria* sp and *Curcumis* sp. The first data indicate that this plant has an enormous nutritional potential. Thus, the possibilities of its culture and its popularization are to be explored.

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