



Adaptation Trial of New Cacaoyer Hybrids in the Territory of Bambesa in Lower-Uele Province Democratic Republic of Congo (DRC)

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ABSTRACT

The Bas-Uélé Province is entirely agricultural, the crops grown in the past were peanuts, cotton and coffee. Currently, the food crops grown cannot alone solve the problem of poverty from which the population suffers. It is therefore time to think about introducing cash crops, especially cocoa from the Bambesa Territory. This part of the study which consisted in evaluating the phenological behavior of the cultivars of Yangambi showed that the cocoa tree can be cultivated in the pedoclimatic conditions of Bambesa: All the three hybrids introduced in Bambesa behaved well and can be disseminated as for their behavior thus their capacity of adaptation.

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1.1 Introduction

The province of Bas-Uélé, like most provinces in the Democratic Republic of Congo, no longer has any functional industries on which it can rely for its development. It is entirely agricultural. For a long time, the main crops grown in the province were peanuts, cotton and coffee. At present, only peanut cultivation is still practiced but timidly. However, the province faces many development challenges, as do other new provinces. The monoculture of peanuts in particular and food crops in general alone cannot efficiently solve the problem of poverty from which the population suffers. Lacking mining industries, the province must think about introducing cash crops, especially cocoa.

Cocoa is a crop of definite economic interest, the case of Côte d'Ivoire, which has built its economy essentially on cocoa, is a paradigm known to all (Chen-Yen-Su, 2014).

According to Thirion (1950), in Bas-Uélé, the climatic factors are the least favorable to the cocoa tree, while the edaphic characteristics appear satisfactory. And yet the characteristics put forward by Mossu are close to those of the Bambesa Station: rainfall 1500 mm against 1579.8 mm in Bambesa, temperature 24°C against 25°C in Bambesa, the duration of the dry season 3 months against 4 months in Bambesa, Dubois, (1959). Mossu, (1990), Annual report GCRN Bambesa 2017, If the province wants to revive its economy and raise the social situation of its population, it must invest in perennial crops especially cocoa cultivation. Indeed, according to a 2007 World Bank study on cash crops in the DRC, it has been shown that cocoa is undoubtedly the best activity to promote to improve the income of the Congolese peasant. It should be noted that this crop can be

grown advantageously in nearly half of the new provinces (26) of the DRC.

Given all the above, we thought it was necessary to install a multilocal trial, aiming at introducing this crop in the province of Bas Uélé from the Territory of Bambesa with performing material coming from INERA Yangambi.

The study is divided into two parts: the first one, which is discussed in this work, takes the phenological aspects of growth and the second one will take the production component.

The main objective of this study is to improve the social conditions of the population by the introduction of this cash crop and in a specific way, the study would like to: 1) Evaluate the behavior of the Yangambi hybrids in the environment of Bambesa, 2) Select among the Yangambi hybrids those which would adapt better in relation to the growth factors, in the environment of Bambesa for the diffusion.

Our hypothesis is articulated as follows: given the edaphic and climatic conditions of Bambesa which are close to those of Yangambi as well as the standard conditions, the hybrids coming from Yangambi would find favorable conditions for their development in Bambesa.

Study Environment, Material And Method

2.1. Study Environment

The trial was conducted at the INERA Bambesa Station, located 2 km from the chief town of the Territory on the way to Buta in Bas-Uélé Province, Democratic Republic of Congo.

Bambesa is 656 m above sea level, at 03°28' 09,3" north latitude and 025° 42' 04,9" east longitude (GPS 62s Garmin) (GCRN antenna). Located about 165 km from

Buta and 55 km from Dingila, Bambesa Station has a climate belonging to the AW3N type according to Köppen's classification (CLAESSENS, 1959); characterized by two rainy seasons A and B respectively (March to June) and (July to December), with a long dry period from December 15 to March 15 and a short dry period from the end of June to July 15, which is often not very marked. The average annual rainfall is 1579.8mm, the average annual temperature is 24-25°C. These are the average figures for most of Bas-Uélé province. The bambesa territory is covered by dense semi-deciduous forest with patches of shrubby savannah (Dubois, 1959).

2.2 Materials

Biological Material

The biological material consisted of 3 hybrids of the Yangambi selection. Their identities and characteristics are given in Table 1 below:

Table 1. Characteristics of the hybrids of the Yangambi selection

Order number	Color of pod	Average number of pods /tree	Average number of seed/pod	Pod average weight of a dry seed
CRY 211	Red	135	31	1.20
CRY 321	Green	107	46	1.73
CRY 725	Green	96	29.0	1.72

Legend: CRY: Yangambi Research Center

2.3 Method

Nursery

Polyethylene bags for sowing had been filled with decomposed soil, harvested from under the palms and sifted. The seeds were sown on 07/3/2017 flat and the bags placed under shade. The experimental setup was that of complete blocks randomized into 4 replicates in space with at least 6 seeds per replicate depending on the number of seeds available.

Watering was provided in the morning and evening during dry periods and once a day during rainy periods. The average rate of emergence 50% was realized after 12 days of emergence, the measurements in relation to the diameter of the plants were taken at 10 cm from the collar, the height of the plants from the collar, the whole 4 months before the installation.

Field

The planting of the seedlings had taken place 4 months after sowing, i.e. on 27/7/2017

The experimental set-up was that of randomized blocks in 4 repetitions in space, the dimensions of the blocks were 10 m x 6 m and 5 m between the blocks and the distances were 3 m between the lines and 2.5 m in the line. The same parameters observed and measured in the nursery were measured in the field but 5 months after establishment. The growth rate was calculated as follows:

For diameter increment: the diameter measured 5 months after establishment minus the diameter at establishment divided by 540 days (18 months), For height: the height measured 5 months after planting minus the height at planting divided by 540 days (18 months).

After the observations were collected, the results were entered into Excel and subjected to statistical analysis using the Analysis of Variance and Tukey's test (Statistics Course, 2010).

3. Results

The fauna population was not very important, it was represented by: the religious *Mente*; grasshoppers;

Caterpillars; Locusts; Molluscs; Black ants and aphids, which did not cause significant damage to the crop.

Table 2. Data from nursery observations.

HYBRIDS	Emergence 50(%)	ANLP(%)	Ø at collar (mm)	Ht. average cm
CRY 725	50,00c	88,24a	8,5a	27,6b
CRY 321	55,56b	61,11b	7,1a	33,2a
CRY211	70,83a	83,33a	8,3a	34,0a
SIGNIFICANCE (P)	0,0000** *	0,0000** *	0,238 3	0,0030*

Legend- NMPV: Average number of living plants

The average emergence rate in 12 days of three hybrids tested in the agroclimatic conditions of Bambesa is 58.80%. Comparing the three hybrids tested, it was found that the hybrid CRY 211 had a higher emergence rate (70.83%) than the other hybrids, while the rest of the candidates had a lower rate than the average (58.79%). The average height of the plants in the nursery was 31.60 cm. It is noticed that, the variety CRY 211 gave on average the most developed plants in nursery, that is to say an average of 34,00 cm, followed respectively by CRY 321 (33,20 cm) and CRY 725 (27,60 cm); the average diameter of plants at the collar was 7,9 mm. But comparing the three varieties, it is revealed that the variety CRY 725 was more giant (8.5mm) followed respectively by CRY 211 (8.3mm) and CRY 321 (7.1mm).

The diameter at the base and the height of the plants were observed 5 months and 23 months after field placement and the results are given in Tables III and IV.

Table 3. Diameter 5 months and 23 months after placement.

Hybrids	5 months after(cm)	23months after(cm)	Growth variation
CRY 725	56,55a	179,78a	0,228mm/jrs
CRY 321	67,80a	195,35a	0,236mm/jrs
CRY211	64,75a	199,20a	0,248mm/jrs
Significance (P)	0,1621 ns	0,2823ns	

Legend: ns =not significant

This Table III shows that in terms of mean diameter, 5 months after placement, CRY725 (17.6mm) is above the mean (16.46mm), followed by CRY321 (15.74mm), and CRY211 (16.06mm). At 23 months after placement, CRY321 (56.67mm) and CRY211 (53.37mm) are above average (53.02mm). On the other hand CRY725 did not reach the average (53.02mm).

Table 4. Height of plants 5 and 23 months after planting

Hybrids	5 months after(cm)	23months after(cm)	Growth variation
CRY 725	56,55a	179,78a	0,228mm/jrs
CRY 321	67,80a	195,35a	0,236mm/jrs
CRY211	64,75a	199,20a	0,248mm/jrs
SIGNIFICANCE(P)	0,1621 NS	0,2823 NS	

Looking at the results in Table IV, CRY725, 5 and 23 months after gave lower than average results (63.03cm) and (191.44cm) while the other two gave respectively 67.80cm and 64.75cm for CRY321 and CRY211, 5 months after and, 195.35cm and 199.20cm 23 months after respectively.

Results of the first year of production

Hybrides	Longueur cabosse(cm)	Circonference(cm)	Poids Cabbse(g)	P.Contenu frais(g)	Epaisseur Coque(mm)	Nbre de graines/cabosse	Poids graine seche(g)
CRY 725	21,90a	26,90a	587,40a	167,40a	12,80a	39,50a	1,005a
CRY 321	18,50b	17,80b	498,40b	160,60a	12,60a	36,10a	0,967a
CRY 211	20,30a	27,20a	532,80a	160,20a	11,80a	40,00a	0,793b
SIGNIFICATION(P)	0,0023**	0,0000***	0,0578*	0,8500NS	0,3415NS	0,1906NS	0,0000***

SIGNIFICANCE : (P) 0.0023** 0.0000*** 0.0578* 0.8500NS 0.3415NS 0.1906NS 0.0000***

Legend

P: probability

* :significant difference,

** : highly significant difference

***:very highly significant differen

Looking at the results of the first year of production, we can see that for the length of the pod CRY 321 did not reach the average (20.23 cm) while the other two CRY 725 and CRY 211 gave respectively 21.90 cm and 20.30 cm. For the circumference, CRY 321 is below the average (23.96 cm), the other two are above the average CRY 211 (27.20 cm) and CRY 725 (26.90 cm). The average weight of the pod being (539.53 cm) we can see that CRY 725 (587.40cm) is above average, the other two CRY 211 and CRY 321 gave respectively (532.80cm) and (498.40cm). Regarding the fresh weight only CRY 725 (167.40cm) is higher than the average (162.73cm), CRY 321(160,60cm) and CRY 211(160,20cm) are lower than the average. The average thickness of the shell is (12.4mm) we note that CRY 211(11.80mm) is below average the other two CRY 725 and CRY 321 are above average and gave (12.80mm) and (12.60mm) respectively. The average number of seeds per pod is (38.53), CRY 321 gave the nobre of seeds below average (36.10), CRY 211 and CRY 725 are above average and gave respectively 40.0 and 39.50. In addition, the average weight of a dry seed is (0.921g), comparing the three hybrids in Bambesa medium we can see that CRY 211 (0.793g) is below average while CRY 725 and CRY 321 gave (1.005g) and (0.967g) respectively.

4. Discussion

Statistically, the difference was very highly significant in the nursery between the three hybrids in terms of 50% emergence rate and NMPV at $P = 0.05$. The emergence was very good for CRY211(70.83%), followed by CRY321(55.56%) and finally CRY725(50.0%). As for the number of living plants before planting, CRY725 had a higher number of living plants (88.24) followed by CRY 211 (83.33) and CRY 321 (61.11) (Table II). This observed difference is due among other reasons, to the different number of seeds sown.

In the field, the following factors were observed: diameter at 10cm collar and plant height 5 and 23 months after planting. It was found that there was no significant difference between the candidates at the 0.05 observation point (Table III). However, the growth variation was significant for CRY321(0.075mm/d) followed by CRY211(0.069mm/d) and finally CRY725(0.058mm/d). This variation in growth does not differ much from that found in the environment of origin of our candidates which is on average 0.072mm/d for the same age (PNRC Yangambi 2007). Since we did not find a significant difference between the candidates, our hybrids are doing wonderfully.

5. Conclusion and Recommendations

5.1. Conclusion

The study that we have just conducted is the first in Bas-Uélé Province in general, and in Bambesa Territory in

particular. It is an "observation" that consisted of observing the behavior of Yangambi hybrids in the Bambesa Station. Our reference was, as will be seen, the behavior of these same hybrids in the Yangambi environment. The objective of this study was the introduction of cocoa cultivation in the cultivation habits of the Province and the Territory in particular, from the performing materials of the Yangambi Research Center. It emerged from this study that the hybrids behaved well in the environment of Bambesa. So our hypothesis has been verified. It is therefore time to think about introducing cash crops, in particular cocoa, from the Bambesa territory.

In the nursery, the parameters monitored for each hybrid were: the average rate of emergence 50% after 12 days of emergence, the diameter of the plants at 10 cm from the collar, the height of the plants from ground level 4 months before planting. In the field, the diameter at the base and the height of the plants were measured 5 months and 23 months after planting.

Results obtained in the nursery showed significant differences in the 50% lifting of the 3 hybrids, while statistically, the average number of living plants was comparable between the hybrids CRY725 and CRY 211, all different from CRY321. As for the average diameter at the collar, the 3 hybrids did not show any difference between them. However, from the point of view of average height, the hybrids CRY321 and CRY 211 were not statistically different.

In the field, statistically, the three hybrids behaved similarly in terms of crown diameter at 5 and 23 months after planting. However, there was some variation in growth between candidates ranging from 0.058mm/day to 0.075mm/day. In terms of height measurement, there is no statistical difference between candidates 5 and 23 months after placement and the growth variation ranges from 0.228 to 0.248mm/day. It appears from all the above that Bambesa meets the conditions required for the phenological development of the cocoa tree, the second part of this work, which will consist of evaluating the production, will determine the yield of this crop in the territory of Bambesa in particular and in the province of Bas-élé in gene

Recommendation

If the Province wants to boost its economy, fight poverty and combat the destruction of its forest, it must encourage the introduction of cocoa cultivation into the cultural habits of its population. The Bambesa Station will serve as a relay for obtaining selected seeds from the Yangambi Research Center. The Province must take advantage of the current absence of insect damage to develop cocoa cultivation in its environment

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