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Comparative study between traditional cultural practices and conventional cultivation practices of cassava in a Farmer Field School in Pissa, Central African Republic

Adonise F. Valam Zango [1], Innocent Zinga [2*], Ephrem Kosh Komba [2], Igor Gorgon Toukia [3], Regis Dimitri Longue Soukpe [2], Christian Armand Simplice Ballot [2], Prosper Yandia [2], Semballa Silla [2], Joseph Mabanza [4]

[1] *Laboratory of Biological and Agronomic Sciences for Development (LBASD), University of Bangui, Bangui, Central African Republic*
[2] *Laboratory of Biological and Agronomic Sciences for Development (LBASD), University of Bangui, Bangui, Central African Republic*
[3] *Higher Institute of Rural Development (ISDR), University of Bangui, Central African Republic*
[4] *Faculty of Science and Technology, Marien Ngouabi University of Brazzaville, Congo*

Abstract

The objective of our study is to make a comparative evaluation in a Farmer Field School (FFS) approach between farmers farming practices and conventional practices in order to have convincing arguments to sensitize producers on best cultural practices. Three adapted varieties of cassava (Rendre, Togo blanc and Gabon) were experimented by both practices. The study revealed that the plot of conventional techniques of all the varieties combined yielded an average of 46.9 t / ha of fresh tuber against 23.15 t / ha for traditional cultivation techniques with a very significant difference. In tuber number 5.7 for first plot and 4.4 for second plot with a significant difference. These results show that the Root variety is very sensitive to mosaic (80% incidence) and is rather a tolerant variety, because its yield potential is 50t / ha in the case of conventional cultivation practices. The study revealed that the Togo Blanc variety developed a 100% resistance on both plots and showed a high yield of 50t / ha on the conventional plot.

Keywords: Farmer Field School; Cultural Practices; Cassava Mosaic; Resistant Variety; Fresh Tuber Yield

[*] Corresponding author. *E-mail address:* zinga.innocent37@googlemail.com

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1. Introduction

Cassava (Manihot esculenta) is an economically important food crop that feeds nearly 700 million people, particularly in sub-Saharan Africa and Asian countries (Stone, 2002). It produces good yields even on soils that are low in nutrients and in drought conditions. It is a perennial plant that can be harvested at any times, it is often grown in developing countries as a plant reserve (El-Sharkawy et al., 2004). Cassava is grown on a total global area of 18.6 million hectares with a total production of 270 million tons worldwide, half of which is provided by the African continent (FAOSTAT, 2014). In the Central African Republic (CAR) cassava is the main food crop with a production of 700,000 tons of chips in front of yam at 450,000 tons and maize at 165,000 tons (FAOSTAT, 2013). It plays an important role in household food security, particularly in rural communities and is the staple food of more than 95% of Central Africans (Zinga et al., 2008).

Cassava is vulnerable to some 20 viral diseases, the most important of which are currently in Africa are cassava mosaic disease (CMD) and cassava brown streak disease (CBSD) (Legg et al., 2006; Patil and Fauquet, 2009). Cassava mosaic has been reported in several sub-Saharan African countries (Ndunguru et al., 2005, Ndunguru et al., 2006; Patil and Fauquet, 2009) where it causes serious performance problems (Legg and Ogwal, 1998).

Surveys carried out in the Central African Republic between 2005 and 2012 showed that cassava cultivation faces constraints mainly related to mosaic with an average incidence of 85% and that 79% of cuttings used for replanting by producers were contaminated by mosaic (Zinga et al., 2008; Zinga et al., 2013). The same surveys identified two species of Central African cassava begomovirus: ACMV and EACMV-UG (Zinga et al., 2013). Surveys carried out by a regional project gave the same trends (PRASAC 2015). Thus with the support of PARRAF project and PRASAC project a Farmer Field School was set up to strengthen the capacity of producers on cassava cultivation techniques and improve their knowledge on the impact of the disease on production. The objective of this approach is to help producers better manage the disease in order to capitalize production. Varieties used in this study were a susceptible variety (Render) and two resistant varieties (Gabon and White Togo) with mosaic. Two parcels of the same size were created in a Farmer's Field School approach. On the first plot the producers transplanted the three varieties with their cultivation techniques and on the second plot the researchers transplanted the same varieties with conventional cultivation techniques. Both plots were

followed for 12 months. Agronomic and phytosanitary parameters were evaluated and compared between the two plots.

2. Materials and method

2.1. Experimental conduct

The plant material uses for the study were: Gabon, Togo Blanc, resistant varieties and Rendre, susceptible variety. These varieties are collected on the Laboratory of biological and agronomic sciences for development (LaSBAD) Wood Park.

It is a structured group, made up of 22 active people including 12 women and 10 men.

The experiment was carried out in rural areas in Pissa village at 75 km on M'baïki road at 4 ° 27 "north latitude and 18 ° 87" east longitude and 380 m altitude.

The climate is of Guinean-forest type characterized by a rainy season of 8 months (from March to October) and a dry season which lasts 4 months (from November to March). The average annual rainfall varies between 1500 and 1600 mm. The relative humidity of the air is very high around 70%. The average monthly temperature varies between 24 ° C and 27 ° C.

The parcel plan consists of two small plots with a surface area of 38 m X 26 m (988 m^2), which were put in place on August 15, 2015: one plot for farmers farming techniques (FFT) and another plot for conventional farming techniques (CFT). .The plot of farmers was randomized with a random distribution; the distance between the cassava feet varying from 50 m to 80 cm, the length of the cuttings was not proportional varying from 20 cm to 35 cm. 816 cuttings at a rate of 272 per variety were planted on the plot of the producers.

The conventional plot consisted of 6 subplots of 100 m^2 each. The spacing between the elementary plots was 2 m, the distance between the cassava feet was 1 m, and the cuttings length was 25 cm. The six plots were distributed over an area of 988 m^2. The cutting was done online and in an inclined manner. 726 cuttings at a rate of 242 per variety were transplanted to the conventional plot.

Both plots were weeded 3 times before harvest. At harvest the following parameters were measured: incidence and severity of mosaic, height of stems, and number of tuber and yield of fresh tuber weight.

2.2. Molecular detection cassava begomovirus

For the 2 plots, 10 samples of cassava leaves of the asymptomatic white Togo cultivar were taken and brought to the Laboratory of Biological and Agronomic Sciences for Development for the detection by PCR of the viruses in order to check molecularly its phytosanitary state. Some mg of dehydrated cassava leaf samples were weighed, milled. DNA extraction was performed using the CATB kit (Cetyl trimethyl ammonium bromide) (Table 1).

Table 1. Composition of the CATB kit

Reagents	Volume	Con. Final
1 M Tris HCl pH 8.0	100 ml	100mM
0,5 M EDTA	20 ml	10mM
Nacl	81,8 g	1.4 M
CATB*	20 g	2%
Eau distillée (H_2O)	QSP 1L	

Con. Final: concentration finale

The mixture was made with stirring to obtain the DNA extraction buffer. Detection of begomoviruses on leaf samples was performed using the PCR method using universal primers that recognize all species. These are the pair of primers VD1863 / TCRTCAATGACGTTGTACCA and C12D2391 / TTTCCAYCCVAACATTCARGG.

3. Data processing

The data was entered and coded on the Excel spreadsheet version 2010 and all the data were submitted to the ANOVA test (Anova Model.9) on the XLSTAT software and the histograms were constructed using the pivot table.

4. Results

4.1. Incidence of the disease

The average incidence of mosaic was 0%, 82% and 8% respectively on the Togo white, Rendre and Gabon varieties with a significant difference between the three varieties (p = 2e-16).(Figure 1).

4.2. Mosaic severity

The severity of the disease on the Rendre variety was 2 on the conventional plot and 2.3 on the plot of producers. On the Gabon variety it was 0.20 on the conventional plot and 0.23 on the plot of the producers. The severity was zero on both plots with regard to the Togo Blanc variety. The severity of the Render variety is very important as that of the other varieties with a highly significant difference (p = 2e-16) (Figure 2).

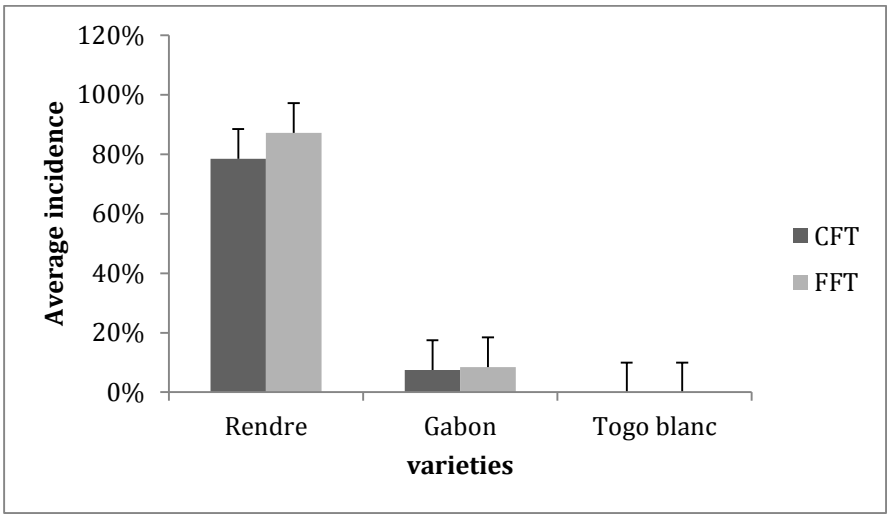

Figure 1. incidence of cassava disease according to varieties and crop systems (CFT: Conventional Farming Techniques; FFT: Farmers Farming Techniques)

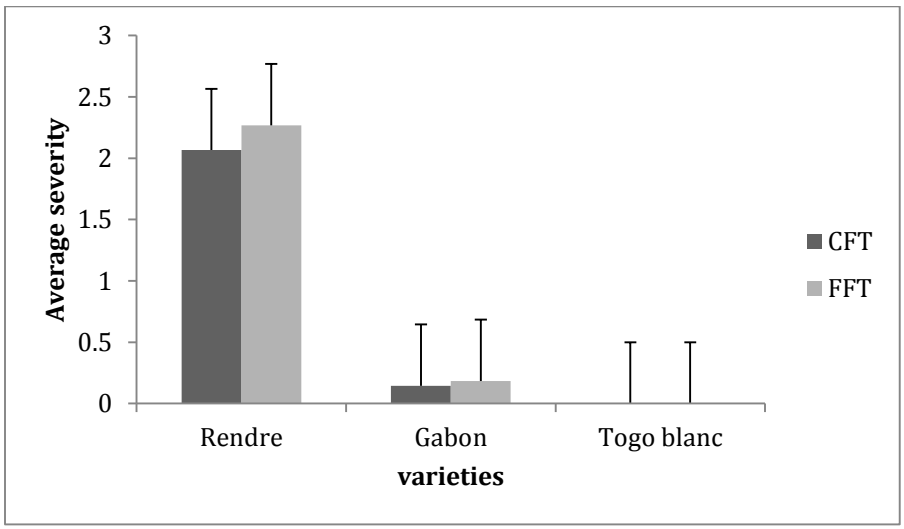

Figure 2. Severity according to variety and cultural practices (**CFT:** Conventional Farming Techniques; **FFT:** Farmers Farming Techniques)

4.3. Number of tubers

The results of the study reveal that the average number of tubers for all varieties combined is 5.7 for the conventional field while it is 4.4 for the plot of producers. The number of tubers of the conventional plot exceeds that of the plot of producers with a significant difference ($p = 2e\text{-}16$). The Rendre variety produced on average in both cropping systems 6 tubers, 5.2 tubers for white Togo and 4.3 tubers for Gabon (Figure 3).

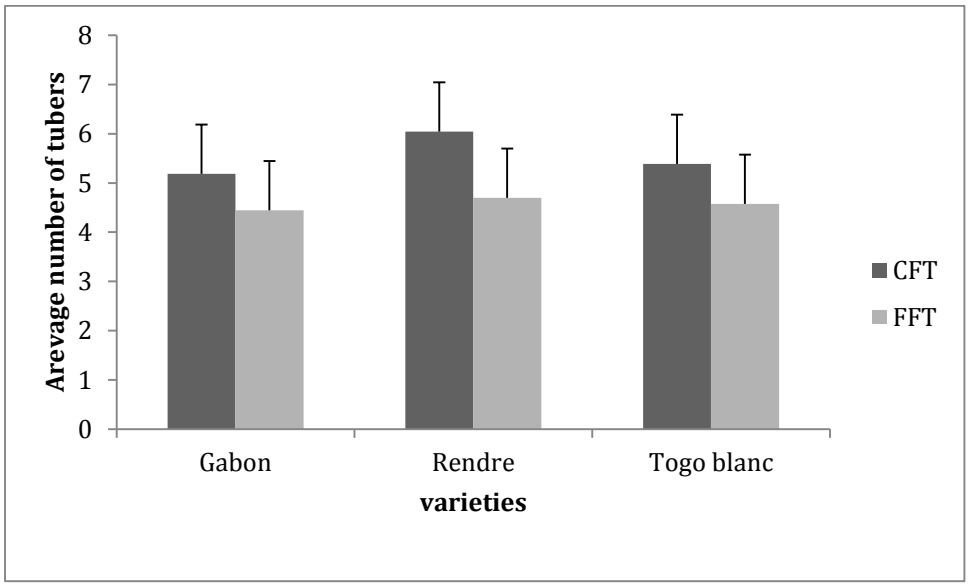

Figure 3. Number of tubers according to varieties and cultural practices. (CFT: Conventional Farming Techniques; FFT: Farmers Farming Techniques)

4.4. The weight of fresh tubers

The average weight of tubers was 23,15t / ha obtained on the plot of the producers and 46,9 t / ha on the conventional plot with a very significant difference (p = 2e-16). The yield of the three varieties on the two plots is respectively: Rendre (Producers: 28kg / foot, conventional: 50kg / foot), Gabon (Producers: 18kg / foot, conventional: 28kg / foot), White Togo (Producers: 29kg / foot, conventional: 50kg / foot), (Figure 4) with a very significant difference. (p = 2e-16) (Figure 4)

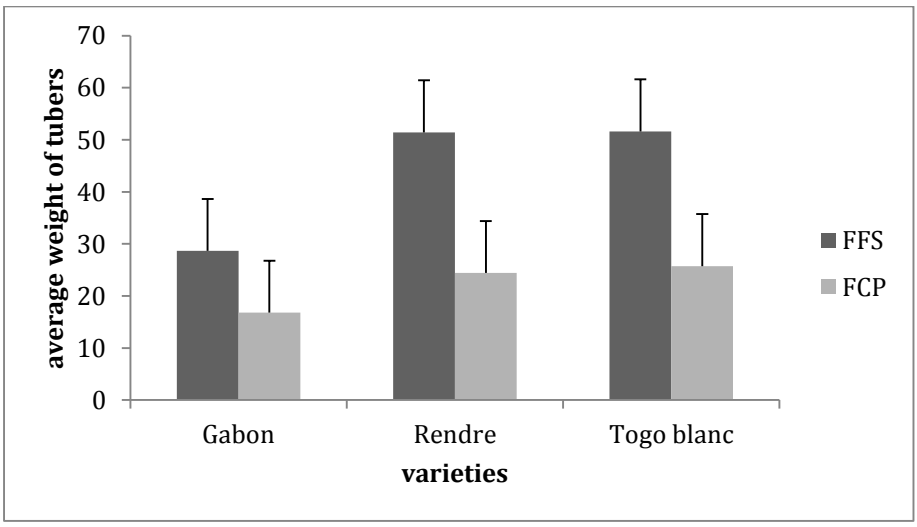

Figure 4. Tuber weights according to varieties and cultural practices. (CFT: Conventional Farming Techniques; FFT: Farmers Farming Techniques)

4.5. Molecular detection

On the 10 samples of asymptomatic white Togo leaves, no virus was detected by PCR. On the other hand, the two samples showing symptoms from Rendre and Gabon varieties were positive by PCR (Table 2). These results show that the asymptotic samples of the Togo Blanc variety are free from the virus.

Table 2. Virus Detection in Leaf Samples

samples	PCR with degenerate primers
TB1	**-**
TB2	**-**
TB3	**-**
TB4	**-**
TB5	**-**
TBP1	**-**
TBP2	**-**
TBP3	**-**
TBP4	**-**
TBP5	**-**
GB	**+**
RD	**+**

TB: Togo blanc-CFT, TBP: Togo blanc-FFT, GB: Gabon, RD: Rendre

5. Discussion

A Farmer Field School of cassava was set up to evaluate the effectiveness of conventional farming techniques implemented by researchers against traditional farming techniques developed by farmers in the village of Pissa. This study shows that the incidence and severity of the mosaic are almost homogeneous with a non-significant difference. On the other hand, the study revealed that the plot of conventional techniques of all the varieties combined produced an average of 46.9 t / ha of fresh tuber against 23.15 t / ha for traditional cultivation techniques with a very significant difference. And also the plot of conventional techniques of all

varieties combined produced on average 5.7 of tuber against 4.4 for traditional farming techniques with a significant difference. We can conclude that conventional cropping techniques improve double cassava production compared to those practiced by farmers. The phenomenon is observed in all varieties studied with a very significant difference and is divided respectively as follows: Rendre (Producers techniques: 28kg /ha, conventional techniques: 50kg /ha); Gabon (Producers techniques: 18kg / ha, conventional techniques: 28kg /ha) and White Togo (Producers techniques: 29kg /ha, conventional techniques: 50kg /ha). The number of tubers is also improved by conventional techniques. The spacing between the feet of cassava was 1m X 1m applied with in-line cuttings on the conventional plot whereas it ranged from 0.5m x 0.5m to 0.8m x 0.8m with non-linear cuttings on the plot of producers. The size of the cuttings was 25 cm in the conventional plot whereas it varied from 20 cm to 35 cm in the traditional plot. We can deduce that the poor production recorded on the plot of the producers was related to the density of the plants which exceeded the norm and certainly generated a phenomenon of nutritional competition between the feet with a negative effect on the yield. On an area of 988 m^2 were planted 726 cuttings in the conventional plot against 816 cuttings in the traditional plot.

Another phenomenon which would have had a negative effect on the yield of the varieties in the plot of the producers is the lack of sufficient aeration preventing the diffusion of the solar radiation thus inhibiting the photosynthesis with repercussions on the chlorophyll content of the plants and the productivity of the plant cassava (Fauquet and Fargette 1990; Zinga et al., 2008, 2016a). An interesting result that this study reveals is that the Rendre variety is very sensitive to mosaic but with a high yield potential of 50t / ha in the case of conventional cultivation practices. In view of these results we can conclude that the Rendre variety is a mosaic tolerant variety, because despite its high sensitivity it has given a very good yield (Zinga et al., 2016b). On the other hand, the Gabon variety is resistant with a yield potential of 18t / ha in the traditional plot and 30t / ha in the conventional partial. This study is in line with recent work carried out between 2010 and 2011 in the Central African Republic (Zinga et al., 2016b).

The study also reveals that the Togo Blanc variety that has developed a 100% resistance is a highly resistant variety with a high yield potential in the conventional plot (50t / ha). The analysis of the 10 samples of the asymptotic leaves of the white Togo variety taken from the two plots was negative (Harrison, 1987). This confirms that this variety is really and highly resistant to mosaic. It is a variety of great interest and potential and should play an important role in the strategy of tackling mosaic, hunger and poverty in the country (Mallowa et al., 2011).

6. Conclusion

In conclusion, the cassava cultivation techniques applied in our study had no effect on the phytosanitary parameters, but they influenced the agronomic parameters. It is therefore preferable for cassava producers to make use of conventional farming practices to significantly increase yields and ensure food security for the Central African population. To avoid propagation and losses, the use of the Togo white variety is more advisable. The results of the study show that cassava production is double when using conventional cropping practices. The three varieties of cassava studied have better agronomic potential. It would be desirable to carry

out genetic cross-breeding studies between these clones to generate new varieties agronomical interesting. The TOGO BLANC variety has been highly resistant to diseases and pests. The identification of the gene responsible for this resistance may be useful in agricultural research and improvement of production. The results of this study need to be popularized on a large scale to sensitize producers on the importance of using best agricultural practices.

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