Characterisation of Orchards and Diseases of Sugar Cane (*Saccharum Officinaruml.*) in Côte D'ivoire: Case of Sugar Complexes of Borotoukoro and Zuenoula

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Abstract— *As part of a study to develop a bacterial biocontrol agent against phytopathogens of sugarcane (Saccharum officinarum L.) in Côte d'Ivoire, an orchard diagnosis was carried out by conducting a survey in two sugar complexes, Zuenoula and Borotoukoro. The aim of this work was to collect socio-demographic data on sugarcane growers and to identify the pathologies encountered in these orchards. A sample of 220 growers was surveyed, with 110 growers per sugar complex. The results of this study showed that the majority of growers are Ivorian (95.5-100 %), with a high percentage of men (80-90.9 %) and more than half are illiterate (46.4-53.6 %). The frequency of phytosanitary treatments is limited to an average of two applications of chemical pesticides per year. None of the growers use biocontrol agents to treat their plantations. Symptoms of fungal diseases (smut, red snot and Pokka boeng) and viral diseases (mosaic dash) are present in the sugarcane plantations surveyed.*

Keywords— Survey, Sugar cane, sociodemographic data, pathologies, Côte d'Ivoire.

I. INTRODUCTION

Sugar cane (*Saccharum officinarum* L.) is a plant whose cultivation is very widespread in the world because of its importance in terms of food, economic and energy. It is a perennial grass from the Poaceae family. It is generally grown in tropical and subtropical regions, mainly for the exploitation of sugar (sucrose) contained in its stems. Indeed, the latter can have a saccharin richness of up to 19% each **(Péné *et al*., 2012).** World sugar consumption is growing continuously, hence the need for increased sugar production. For example, the 2021-2022 sugar season ended with sugar production of 184.4 Mt, up 2.5 Mt from the previous year **(FranceAgriMer, 2022)**. Apart from beets and sweeteners, sugar cane alone accounts for 80% of global sugar production **(FAOSTAT, 2018)**. In Côte d'Ivoire, its cultivation is carried out by two private companies (SUCAF-CI and SUCRIVOIRE) on a distribution area of more than 25,000 ha located in the north and central-west of the country **(Kouamé *et al*., 2009).** According to **Traoré et al., (2019)**, the country is ranked 53rd world and 16th African. Cane production amounts to about 330,000 t of sugar, or 50% of consumption in the WAEMU (West African Economic and Monetary Union). In the medium term, the WAEMU market offers good development prospects for Ivorian sugar companies **(Kouamé *et al*., 2009)**.

Despite its socio-economic importance, the cultivation of sugar cane in Côte d'Ivoire, its culture faces biotic constraints due to viruses, stem-boring insects such as Eldana saccharinaWalker, bacteria such as *Xanthomonas albilineans* and fungi such as *Sporisorium scitamineum*, responsible for anthrax (**Kouamé *et al*., 2010).** On the other hand, it faces a decline in biological soil fertility due to monoculture sugar cane farming practices carried out for more than 30 years in the various sugar complexes **(Mauboussin, 1988; Marion, 2000)**. All these factors play a very important role in lowering sugar cane yields in the country's sugar complexes **(Péné *et al*., 2012).** In the sugar complexes of Borotoukoro and Zuenoula, producers are confronted with various diseases of fungal, viral and bacterial origin. These diseases may have a negative impact on the yield of the canned crop in Côte d'Ivoire. As part of a study for the development of a bacterial biocontrol agent against these diseases, The aim of

this study was to collect sociodemographic data on sugar cane producers and to identify the pathologies encountered in these orchards.

II. MATERIAL AND METHODS

2.1 Material:

The material used for this study consisted of a survey sheet with a questionnaire, pens and a GPS for taking geographical coordinates.

2.2 Methods:

2.2.1 Study area:

This study was carried out in two sugar cane production areas: the Zuenoula Integrated Agricultural Unit (IAU), located between 7°30 and 7°40 north latitude, and between 6°50 and 6°15 west longitude and the Integrated Agricultural Unit (UAI) of Borotoukoro, located between latitude 08°31 North and longitude 7°17 West **(Figure 1)**.

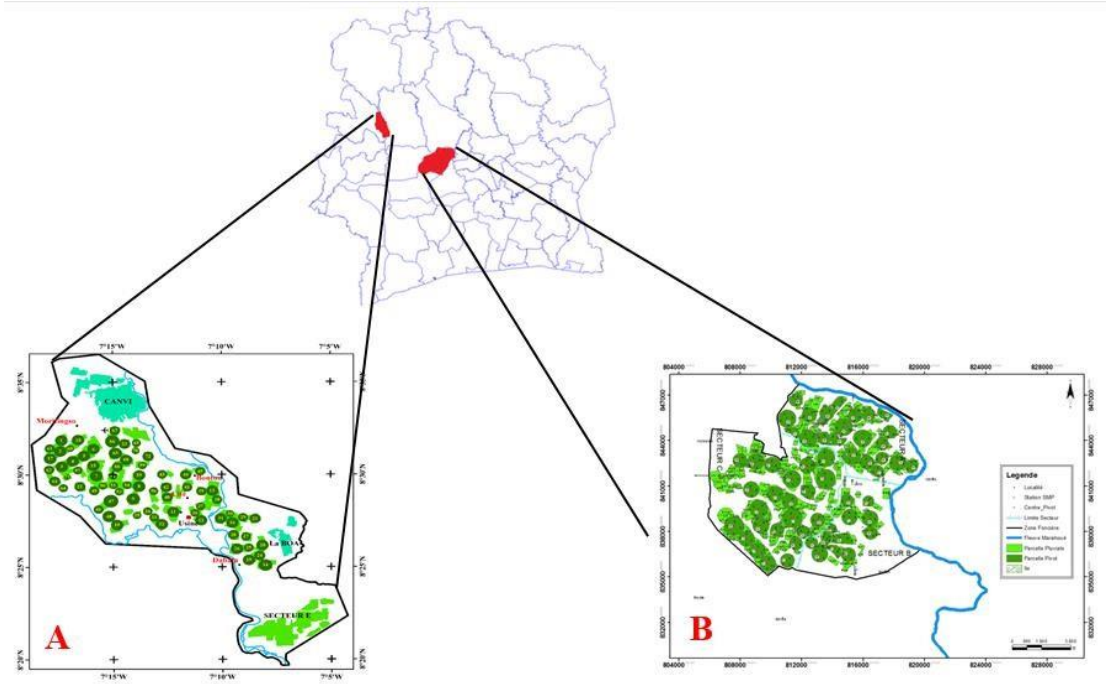

FIGURE 1: Study area

A- UAI Borotoukoro Plot Map and B-UAI Zuenoula Plot Map

2.2.2 Conducting the survey

The survey was carried among sugar cane producers in the Borotoukoro and Zuenoula sugar complexes. interviewed, or one hundred and ten (110) producers per complex. The information was collected using a questionnaire sheet addressed to producers. The interviews focused on the identity of the producers, the description of the farmers, the method of harvesting sugar cane, the typology of the diseases, the losses due to the diseases and the methods of control used against these diseases.

III. RESULTS

3.1 Socio-demographic characteristics of producers:

The socio-demographic profile of sugar cane producers interviewed in the localities of Borotoukoro is recorded in Table I.It appears that of the 110 people interviewed in Borotoukoro, 95.5% were Ivorians and 90.9% were men. In terms of educational attainment, 53.6% of those surveyed were illiterate. The dominant age group was between 41 and 60 with a rate of 58.2%. Almost all the people surveyed regularly produced sugar cane and the cultural experience was mostly over 15 years with a rate of 45.5%. On the other hand, in Zuenoula all the people interviewed had the Ivorian nationality. Of the 110 respondents, 80% were male. In terms of educational attainment, 46.4% of those surveyed were illiterate. The dominant age

group was between 41 and 60 with a rate of 49.1%. 108 of the respondents produced sugar cane on a regular basis, and the majority of their farming experience was over 15 years (**Table II).**

TABLE 1
SOCIODEMOGRAPHIC PROFILE OF SUGAR CANE PRODUCERS IN THE BOROTOUKORO AREA

Variable	Categories	Staff (n=110)	Percentage (%)
Nationality (n=110)	Ivorian Foreign	105 5	95,5 4,5
Sex (n=110)	Man Woman	100 10	90,9 9,1
Age group (n=110)	18-40 years 41-60 years Over 61 years	26 64 20	23,6 58,2 18,2
Level of education (n=110)	None Primary Secondary Superior	59 23 28 0	53,6 20,9 25,5 0,0
Cultural experience (n=110)	4-6 years 7-10 years 10-15 years Over 15 years	9 17 34 50	8,2 15,5 30,9 45,5

TABLE 2
SOCIODEMOGRAPHIC PROFILE OF SUGAR CANE PRODUCERS IN THE ZUENOULA AREA

Variable	Categories	Staff (n=110)	Percentage (%)
Nationality (n=110)	Ivorian Foreign	110 0	100 0,0
Sex (n=110)	Man Woman	88 22	80,0 20,0
Age group (n=110)	18-40 years 41-60 years Over 61 years	18 54 38	16,4 49,1 34,5
Level of education (n=110)	None Primary Secondary Superior	51 31 27 1	46,4 28,2 24,5 0,9
Cultural experience (n=110)	1-3 years 4-6 years 7-10 years 10-15 years Over 15 years	1 2 16 27 64	0,9 1,8 14,5 24,5 58,2

3.2 Types of diseases observed in sugar cane plantations in surveyed areas:

The most reported pathologies in the two sugar cane complexes were mosaic with a rate of 90.0% in the locality of Zuenoula against a rate of 86.4% in the locality of Borotoukoro. Thus, 87.3% of the 110 people surveyed in Zuenoula say that they observed on the plots of Coal against a rate of 83.6% in the locality of Borotoukoro. 76.4% of people observed Pokka boeng in the locality of Zuenoula against a rate of 56.4% of people surveyed in the locality of Borotoukoro. However 68.2% of producers surveyed in Zuenoula confirmed the presence of other pathologies against a rate of 52.7% in the locality of Borotoukoro **(Table III and IV)**.

TABLE 3
DISEASES OBSERVED IN THE BOROTOUKORO AREA

Variable	Categories	Staff (n=110)	Percentage (%)
Coal (n=110)	Yes	92	83,6
	Non	18	16,4
Pokka boeng (n=110)	Yes	62	56,4
	Non	48	43,6
Mosaic (n=110)	Yes	95	86,4
	Non	15	16,6
Other diseases (n=110)	Yes	58	52,7
	Non	52	47,3

TABLE 4
DISEASES OBSERVED IN THE ZUENOULA AREA

Variable	Categories	Staff (n=110)	Percentage (%)
Coal (n=110)	Yes	96	87,3
	Non	14	12,7
Pokka boeng (n=110)	Yes	84	76,4
	Non	26	23,6
Mosaic (n=110)	Yes	99	90,0
	Non	11	10,0
Other diseases (n=110)	Yes	75	68,2
	Non	35	31,8

3.3 Means of combating diseases:

In both complexes, all surveyed producers claimed that the only means of controlling these diseases was essentially chemical. No planter uses bacterial biocontrol agents.

3.4 Causes of post-harvest losses:

In the locality of Zuenoula, 71.8% of the producers surveyed believe that the losses are due to microorganisms against 62.7% producers in the locality of Borotou-koro. For losses due to pests in the locality of Zuenoula on 110 productions questioned, 75 producers or a rate of 68.2% think that the losses are due to pests against 57 producers or a rate of 51.8% in the locality of Borotou-koro, 53.6% of producers questioned in the locality of Borotou-koro found that the losses are due to bush fires against a rate of 22.7% in the locality of Zuenoula. In both localities, most of the producers questioned agree that in addition to the causes already listed, there are other reasons that can explain the post-harvest losses, a rate of 89.1% in the locality of Zuenoula against a rate of 70,0% in Borotou-koro **(Table V and IV)**.

TABLE 5
CAUSES OF POST-HARVEST LOSSES IN BOROTOUKORO

Variable	Categories	Staff (n=110)	Percentage (%)
Microorganisms (n=110)	Yes	69	62,7
	Non	41	37,3
Pests (n=110)	Yes	57	51,8
	Non	53	48,2
Bush fires (n=110)	Yes	59	53,6
	Non	51	46,4
Other causes (n=110)	Yes	77	70,0
	Non	33	30,0

TABLE 6
CAUSES OF POST-HARVEST LOSSES IN ZUENOULA

Variable	Categories	Staff (n=110)	Percentage (%)
Microorganisms (n=110)	Yes	79	71,8
	Non	31	28,2
Pests (n=110)	Yes	75	68,2
	Non	35	31,8
Bush fires (n=110)	Yes	25	22,7
	Non	85	77,3
Other causes (n=110)	Yes	98	89,1
	Non	12	10,9

IV. DISCUSSION

The objective of this work was to collect sociodemographic data of sugar cane producers and identify the pathologies encountered in these orchards. The results of the investigation revealed that the majority of sugar cane producers in the Borotou-Koro and Zuenoula areas are men and have Ivorian nationality. These results could be explained by the fact that field work is exclusively reserved for men because of their painful nature. According to FAO (2011), in agricultural regions of Africa, men often dominate the agricultural workforce. However, it is important to note that more than half of those surveyed are illiterate. In Côte d'Ivoire, the lack of schooling of a large segment of the population explains the high level of illiteracy. This can have a negative impact on access to agricultural information and good agricultural practices. Similar results were obtained in **Koffi's (2018)** work on risk factors for pineapple fruit spoilage in production areas. Producers have a dominant age range between 41 and 60, suggesting that sugar cane is an agricultural activity that attracts mainly middle-aged farmers. This could have implications for the transmission of agricultural knowledge and practices to younger generations. The sector is therefore part of sustainability. The growers' growing experience is also a key factor. In both localities, a significant proportion of producers with a cultivation experience of more than 15 years, suggesting a thorough knowledge of sugar cane cultivation. The high rates of diseases, such as Mosaic, Coal and Pokka Boeng, in both localities underline the endemic nature of these diseases. Managing these diseases in sugar cane cultivation remains a major challenge. The Mosaic, in particular, is a major concern with a prevalence rate of 90% in Zuénoula. Similar results have been observed in Africa, particularly in Nigeria where coal, red snot and mosaic have been detected on sugar cane plots **(Wada *et al.*, 2016)**. These diseases are caused by various pathogens, including fungi and viruses **(Rott *et al.*, 2000; Baudin, 1963)**. Finally, other diseases have been cited by producers such as red snot or red rot, rust, gum, scald leaves and annular spots. Producers identify several causes of post-harvest losses, including microorganisms and pests. These post-harvest losses are major problems for sugar cane producers in both localities. According to **Kouamé *et al.* (2010)**, biotic constraints in sugar cane cultivation can be summarized as insect pest attacks and microorganisms. Anthropogenic activities such as bush fires have also been reported as a cause of losses, particularly in Borotou-Koro. Producers in both communities are aware that there are other reasons for post-harvest losses, including weeds and maintenance of crop plots. Indeed, a maintenance time of 4 months is necessary so that the cane does not suffer a measurable yield loss following competition induced by weeds **(Traoré *et al.*, 2019)**. In addition, the soil between cropping cycles and the use of heavy harvesting machinery have led to physical, chemical and biological degradation of sugarcane soils and, as a result, the development of various soil organisms harmful to sugarcane growth according to **Péné *et al.*, (2012)**.

V. CONCLUSION

This study contributed to the provision of socio-demographic data and the pathologies encountered in sugarcane production in Côte d'Ivoire. The study revealed that sugar cane cultivation is a male activity, practised by illiterate people on village plantations. Crop losses are caused by micro-organisms responsible for diseases such as smut, red glanders and Pokkah Boeng. The overuse of chemical pesticides could result in the development of resistance to plant pathogens, hence the need to develop biological control through the development of biopesticides.

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