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A diagnostic study on the sanitary status of mango trees in some different localities in the Benoue and Diamare divisions

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Mangoes account for approximately half of all tropical fruits produced worldwide. The Sudano-sahelian agro-ecological zone is one of the largest mango producing zones in Cameroon). From this zone, 91 producers were interviewed using a 'Questioner' on the sanitary status of the Mango plant. From the interview it was noticed that 41.6% were illiterates, 44.4% literates and 14% farmers with technical agricultural training in Benoue, meanwhile in Diamare had 67.2% illiterates, 25.5% literates and 7.3% farmers with technical agricultural training. Moreover, it gathered 22 varieties of mangoes in Diamare and 18 in Benoue and were diagnosed some common vectors, mostly insects attacking these plants such as termites, fruit flies (*Ceratitis cosyra* and *Bactrocera invadens*), stem borers, red and black ants. In these researchers have been evaluated the productivity of 2016 with respect to the different varieties which gave a 56% sold, 28% damaged and 16% consumed in the North and a 47% sold, 34% damaged and 19% consumed in the Far North. The disease incidence, severity and prevalence rated in Benoue was (DI = 24, DS = 40, DP = 81.25) lower than that of Diamare (DI = 26, DS = 45.3, DP = 93.75). This result indicates that the damage effect is significant, according to the Horsfall-Barrat rating scale in 1945.

KEY WORDS: varieties, phytosanitary management, vectors, disease severity, incidence and prevalence.

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INTRODUCTION

Renowned as one of the most popular fruits in the world, mango trees are found in tropical and subtropical climates (Bally, 2006). The first significant collection of mango trees in Africa was established in Foulaya, near Kindia, in Guinea, between 1947 and 1952 with varieties mainly from Guinea, West Indies, Hawaii, Burkina Faso (Amélie), South-East Asia, Indonesia and Florida (Normand *et al.,*2006). Between 1955 and 1962, this basic collection was duplicated in numerous sites such as Maroua in Cameroon, Azaguié in Côte d'Ivoire, Bamako in Mali, Loudima in Congo and Dakar in Senegal (Normand *et al.,* 2006). The normal rate of consummation

of this fruit for a balance diet is far from being realize especially in Savanna Africa where the climate is dry (Diallo, 2003). A study of fruit and vegetable market in Cameroon carry out by Temple (1999, 2001), estimated that the production was close to 22792 tons meanwhile FAO estimated it to be 85 tons per year (FAOSTAT, 2011). This only indicates how insufficient the production of these fruits is with respect to the population demands fixed at 70 kg/person/year (Sougnabe *et al.,* 2009). Mango tree problems such as fruit flies, no mango fruit on trees, ants, stem borers, drought, die back disease, termites causing tree death, have been duly noted as a current scenario in Benoue and Diamare Divisions in the North and Far north Regions of Cameroon respectively. All these problems cause important yield decrease. The presence of diseases and pest constitute a constrain (Kuate *et al.,* 2006) which can even cause farmers to abandoned their orchards. Environmental factors also influence the mango quality and quantity; this does not depend on the varieties used. This research contribute in the identification of the actors implicated in the production of these fruits, identifying the varieties cultivated in these regions, identify the major cause of diseases attacking these fruits, estimate the volume of annual production and evaluate the production damages.

MATERIALS AND METHODES

Presentation of the Area of study

Study was carried out in the North and Far North Region of Cameroon; we worked in the Benoue Division in the North Region of Cameroon and the Diamare Division in the Far North of Cameroon. In each Division we went to 4 Sub-Divisions and carried out the research study in at least 4 localities in each Sub-division as seen on table 1.

Description of the Study Area

The Benoue valley and the Diamare plains are in the Sudano-Sahelian Agroecological Zone of Cameroon. This zone consists of degraded shrubby steppes on sandy clay soils and periodically grassy flood plains. The Benoue Division is situated between latitude 9°.0'Nand longitude 14°.0'S. The Diamare Division is located at latitude 10°.5N and longitude 14°.5S. Ecologically, the North is the most fragile zone in Cameroon with a sahelien climate and vegetation. Barren soils constitute some 25-30% of the surface area of these Regions (Ernest et Cornelius, 2015). The mean annual rainfall in the Sudano-Sahelian zone ranges from 600 to 1000 mm. Temperatures average 26°C, except for the Chad Basin, where they climb to 28°C (IRAD, 2008).

Methodology

Sources of primary and secondary data

Primary data was collected for a period of two months, one month per division. It entailed direct field visits and interview through questioning and physical observation. A 'questioner' was drafted and 91 farmers interviewed with 36 from Benoue and 55 from Diamare. Focus was on the sociological aspects (sex, age, level of education, activity, matrimonial situation, how the land was owned etc.) and the agronomical aspects (surface area, cultural system, common diseases, phytosanitary management, varieties planted, yield per variety, productivity etc.) of the farmers. The secondary data was obtained from the internet and from reports from the IRAD research station Garoua and Maroua.

Data analysis

The disease incidence, severity and prevalence were determined on the branches, trees and farms respectively. The damage impact was then evaluated on the fruits. 20 plants were observed in each farm and focus was on the fruits, branches and tress. The percentages (%) of damages were evaluated on the total number of farms in each Divison. Finally, the collected data and information from the experiments were recorded, tabulated and subjected to the analysis using an appropriate computer software programs and the following formulas.

$$\%DI = \frac{NTA}{TNT} x100$$

Where: DI = Disease Incidence
NTA = Number of Total Affected trees
TNT = Total Number of Trees
% = Percentage

$$\%DS = \frac{NBA}{NTA} x100$$

Where: DS = Disease Severity
NBA = Number of Branches Affected
NTA = Number of Trees Affected
% = Percentage

$$\%DP = \frac{NFA}{TNF} x100$$

Where: DP = Disease Prevalence
NFA = Number of Farms Affected
TNF = Total Number of Farms
% = Percentage

Table 1: Localities where the study was carried out in the Benoue and Diamare Divisions

Divisions	*Subdivisions*	*Localities*
Benoue	*Tcheboa*	*BablaLakare, Njiefatou, Laindekarewa, Lainde*
	Garoua I	*Ouro-wourso, Djamboutou, Camp Chinios*
	Garoua II	*Ouro-lawane, Nigeriare, Liande, Nassarawo*
	Garoua III	*Pitoayel, Sanguere Mafakilda, Jalingo, Kismatari, Sanguerepaul, Sanguerengal*
Diamare	*Maroua I*	*Ndengue, Zillen, Njaringole, Meskine*
	Maroua II	*Domayo, Douggoi, Doursoungo, Makabaya*
	Maroua III	*Palar, Zokok, kakatare, Founangue*
	Gazawa	*Kischematari, Goudouwo, Gouless, Tchekewo 1*

RESULTS AND DISCUSSION

Social Status of Producers

Ages and Gender
Technical Level of Education

In Benoue as in Diamare, most of the farmers are not financially stable so they turn to practice mostly subsistence Agriculture. They scarcely go in for commercial agriculture but those producing cash crops like cotton and fruits do. The majority of farmers lack a good technical knowledge of cultivating this crop; they go about their daily activities in order to succeed. Nevertheless, the level of education differs in the two localities. The illiterate level was seen to be greater in the localities of study in the Diamare Division than in the Benoue Division with a percentage of 67.2% and 41.6% respectively (table 2&3). Literates were more in the localities of Benoue than Diamare as many attended at least the primary school with a percentage of 44.4% and 25.5% respectively (table 2&3). Those with the technical level of education are those who extended their study up to the university and have at least been to an Agricultural institute or received agricultural training through Gic, Cooperatives and or technical agents. More of them are in Benoue than in Diamare with a percentage of 14% and 7.3% respectively. These results are similar with those of Sougnabe et al. (2009). This is one of the major factors contributing to the poor cultural practices seen here in Benoue and Diamare localities as most of the farmers could not read or write.

Different Mango Varieties highly cultivated in the Benoue and Diamare divisions

These species vary both in Benoue and Diamare, with different appelations as can be seen in the table 4. With regards to the scarcity of mango varieties, the producers get only what is around them for planting as the fruits are rare (Magalie *et al*., 2003). Four varieties found in the localities of Diamare were not seen in the locatities of Benoue; meanwhile one variety not found in the localities of Diamare was seen in Benoue. This doesn't mean that these varieties are completely absent, rather they were not found in the area sited for this study. A total of 23 varieties were seen, with the localities of Diamare having 22 meanwhile 18 of these varieties were seen in the localities of the Benoue Division.

Common symptoms and damages found affecting these fruit trees

Symptoms and Damages caused by pest and diseases

In the studied areas mostly find termites, fruit flies, stem borers, ants, caterpillars and birds. All this species of insects and animals contribute greatly to the harvest loses of the peasant farmers of the localities in the Benoue and Diamare Division. Some symptoms are common with respect to the seasonal changes for example, leaf spots, flowers falloff, fruit rot, dry branches and tree death, stem borers effect, caterpillars destroying leafs, and termite mounts around trees. The particularity here is that of the fruit flies on mango fruits, where we had 100% percent of the farmers complaining of their damage effect on fruits. Termites were also a focal point causing tree death. A total of 54.1% of the producers in the localities of Benoue with all the above mention pests and symptoms and 45.9% of these farmers had no signs or effect of termites on their plots. The situation was different in the localities of Diamare where 63.9% of the producers had all these symptoms and pests effect meanwhile 36.1% of these farmers had no signs or symptoms of termites. The high percentage of pest in these localities, in Diamare may be due to the low level of rainfall, for drought is a good motivating factor for termite actions.

Anthracnose is the most important disease of mango in humid production areas (Arauz, 2000; Dodd et al., 1997; Lim and Khoo, 1985; Ploetz and Freeman, 2009; Ploetz and Prakash, 1997; Ploetz, 2003). Although losses occur in the field, postharvest losses cause by this disease are most significant as they cause a total 30% damage in the localities of Benoue and Diamare. Anthracnose presents great challenges for those who are involved in the international commerce of this fruit.

Table 2: Percentage of ages and gender

Area of study	*Age group in percentages*	*Gender in percentages*
Localities of Benoue	*(≤30) : 13%*	*Males (35) 97%*
	(30-60) : 73%	*Female (1) 3%*
	(≥60) : 14%	
Localities of Diamare	*(≤30) : 28%*	*Males (52) 95%*
	(30-60) : 56%	*Females (3) 5%*
	(≥60) : 16%	

Table 3: Technical level of education of farmers having orchards

Area of study	*Level of education*	*Percentage (%)*
Localities of Benoue	*Illiterate*	*41.6*
	Literate	*44.4*
	Technical training	*14*
Localities of Diamare	*Illiterate*	*67.2*
	Literate	*25.5*
	Technical training	*7.3*

Phytosanitory Management

This is to clearly state the type of pesticides employed by the farmers in these zones, so as to reduce the rate of attack of these fruit trees. It is realized that the general treatment is ineffective with respect to the final production. The pesticides commonly used, doses and frequency of application in the different localities of study has been summarized in table 5.

Generally, access to pesticide is usually difficult. This was the case in the peri-urban zones of Maroua where 9.8% of the producers could easily get access to pesticides, 52.5% of producers found it difficult to get as they are not constant in their treatment meanwhile 37.5% of producers never used pesticides at all. In a similar manner, 13.9% of producers easily got access to pesticides in the peri-urban zone of Garoua meanwhile 52.8% struggled hard to get it and 33.3% never had it at all. Other ways the producers used in treating these plants as seen in the field, is by cutting off infected branches and or even trees and replacing them with young once.

Disease incidence, severity and prevalence on the plants in Benoue and Diamare

In the Benoue division as in the Diamare division, were analyzed 16 farms each in 4 different sub divisions. This is to appreciate the diseases severity and diseases prevalence on trees.

The results obtained on the disease incidence (Table 6), severity and prevalence could largely depend mainly on the altitude, tree variety, soil texture, vegetation, temperature, rainfall and management patterns. These results also conforms to that of the previous findings of Kuate *et al*., (2006), where he found that diseases mostly attack susceptible varieties situated on sites above 200 m. These results could be seen clearly when looking at the impact it has on the final production of mango plants. The damage has a great impact on the productivity of these plants, as the disease incidence greatly reduces the quantity and quality of fruits being sold (table 7). This might be due to the low water availability due to limited rainfall leading to drought. Also these plants suffer great damage from wind (10%), insects (60%), and fungi (30%). Varieties like: Amelie, Julie Kassawa, Ngaoundere and Ifac are very much appreciated for their high resistance to diseases and attacks.

The impact of this disease attacking fruits and leaves was seen at all ages of the plants but was most severe at the young stages of about 5 to 15 years just as was equally noticed by Betdogo *et al*., (2015). They cause many lesions on these organs, modifying their sizes and forms or shapes.

Table 4: Different Mango varieties in Benoue and Diamare divisons.

Number	Common names of Mango varieties	Local names of mango varieties	
		Benoue	Diamare
1.	Kent	Teperenua	Teperenua
2.	Ngaoundere	Horewandou	Horewandou
3.	Julie	Julie	Julie
4.	Smith	Njigarije	Njigarije
5.	Springfield	Springfield	Daptcha
6.	Amelie	Amelie	Amelie
7.	Malo	Malo	Malo
8.	Keith	Keith	Ketchebele
9.	Ifac	Mangoro Banane	MangoroBanane
10.	Julie Kassawa	Bt	Greffier
11.	Haden	Haden	Haden
12.	David Haden	David Haden	David Haden
13.	Local Variety	Horé wadou	Tcheoude
14.	Local Variety	Horencholie	Horencholie
15.	Local Varieties	Algiri	Algiri
16.	Brooks	-	Gagaragang
17.	Palmer	Mangue Anana	Mangue Anana
18.	Alicinal	-	Alicinal
19.	Irwin	Irwin	Irwin
20.	Eldon	Eldon	Eldon
21.	Zill	Zill	Zill
22.	Local variety	Paparanda	-
23.	Local variety	-	Daouda

Table 5: Names of pesticides used, doses applied and frequency of application

Common names of Pesticides	Active matter	Doses of application	Frequency of application
Pacha 25EC	Lambda-cyhalothrine 15g/l +acétamipride 10g/l	100g Per 16L Sprayer	once or twice a week
Optimal	Acetamipride 200g/kg	100g Per Sprayer	once or twice a week
Cygogne 360EC	Cypermethrine 50g/l	50ml Per 16l Sprayer	once or twice a week
Cobra 120EC	Acétamipride 64g/l +spinétoram 56g/l	50ml Per 16l Sprayer	once or twice a week
Cypercal	Cypermethrine 50g/l	50ml Per 16l Sprayer	once or twice a week
Rambo aerosol insecticide	Transfluthrin 0,20%	50ml Per 16l Sprayer	once or twice a week
Caiman Rouge P	Permétrine 25g/kg + thirame 250g/kg.	1/4l Per Sprayer	twice a week
Montaz 45TS	Imidaclopride 250g/kg + thirame 200g/kg	A Sachet Per Srayer	once or twice a week
Azox 250SC	Azoxystrobien 250g/l	100g Per Sprayer	once or twice a week
Nordox 75WG	Oxyde de cuivre 86%	100g Per Sprayer	once or twice a week
Fongistar 72%WP	Metalaxyl 80g/kg +mancozebe 640g/kg	A Sachet Per Sprayer	once or twice a week

Table 6: Disease incidence, severity and prevalence in Benoue and Diamare

Area of study	***Diseases incidence***	***Diseases severity***	***Disease prevalence***
	on trees	*on branches*	*on farms*
Localities of Benoue	*24%*	*40%*	*81.25%*
Localities of Diamare	*26%*	*45.3%*	*93.75%*

Table 7: Evaluation in percentage of the damage impact on the fruits of mango plants

Areas of study	***% Damaged***	***% Consumed***	***% Sold***
Localities of Benoue	*28*	*16*	*56*
Localities of Diamare	*34*	*19*	*47*

CONCLUSION

The study of the sanitary status of Mango trees in Benoue and Diamare Divisions respectively in the North and Far North of Cameroon, was a study that came just on time to rescue the current situation which has been a problem for some years now. The climatic conditions of Benoue and Diamare are very harsh with relatively high temperatures leading to hydric stress. This is the first assumption made within this study as termites were seen to be very active in both divisions. Only few of farmers get easy access to pesticides. More of the farmers are men.

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