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RESEARCH ARTICLE OPEN ACCESS

INVENTORY OF PESTICIDES USE IN CASHEW NUTS ORCHARDS IN THE NORTH OF CÔTE D'IVOIRE

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ABSTRACT

The majority of cashew farmers in the North of Cote d'Ivoire use many types of pesticides to control pests and diseases that attack this crop. This utilization doesn't respect good agricultural practices. Study was based on the use of questionnaires and interviews that were conducted in Poro (Korhogo), Tchologo (Ferké), Bagoué (Boundiali) Gbêkê (Bouaké) and Gontougo (Bondoukou) Districts. It investigates farmer's practices on cashew pest management using pesticides and related orchards density and seeds origin. The types of products used by the farmers in the study areas were herbicides (70%) and insecticides (29%) and fungicides (1%). About a 60% of the farmers which not applied pesticides, up to 10% used 3 applications by year. This study show that the government can develop a tool to quantify the cost of pesticide in Northern Cote d'Ivoire and formulate a text of good phytosanitary practices for cashew nuts.

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INTRODUCTION

Cashew nut cultivation has grown exponentially in Cote d'Ivoire and has contributed to reducing the poverty line in the northern, central and northeastern areas of the country. The cashew tree orchard covers more than 3 million hectares to date and the country has become the world's leading producer with a production of 750,000 tons of raw nuts (Afrique Économie, 2020). This extension of the cultivation area is not without consequences on the health of cashew trees and their yield per hectare (Koné *et al*., 2015). The non-respect of existing technical itineraries combined with poor management of the plots favors a proliferation of parasites causing diseases and insect pests responsible for the damage (Soro *et al*., 2015; Ouali *et al.,* 2019). This leads farmers to use pesticides often at non-recommended rates to protect orchards from pest attacks. If orchards need to be treated, the quantity and frequency of products applied remains a fundamental step for political leaders in the sector. Most farmers in northern Cote d'Ivoire are not sufficiently informed about the dangers of chemicals (Ajayi, 2000).

Farmers use pesticides without fully understanding their impact on human health and environmental protection (Ajayi, 2000; Ngowi *et al*., 2001; Ngowi and Partanen, 2002). Faced with this constraint, which could be detrimental to the quality label for Ivorian cashew nuts, actions have been taken both at the level of the Cotton and Cashew Nut Council and at the level of scientific research. Despite the mobilization of resources, the risk of misuse of pesticides remains in this crop. In order to prevent an unforeseen drop in production due to damage caused by pests and to ensure the use of registered products, an inventory of pesticide molecules applied and the frequency or dose of application have been studied during the 2017-2018 in Côte d'Ivoire. The study took place in the northern zone of the country in the Poro, Tchologo, Bagoué, Gbêkê and Gontougo Regions.

MATERIAL AND METHODS

Material: The cashew trees in orchards were used as the plant material. Their age was between 10 to 20 years and the packaging and/or chemicals used by farmers.

Methods: The study was conducted from october 2017 to january 2018 in Cote d'Ivoire. It consisted of interviews with farmers and farm workers in rural areas in Northern of Côte d'Ivoire where cashew crops were mostly cultivated using farm inputs, particularly pesticides. The sample farmers from whom information was collected comprised of 500 farmers selected from Poro, Tchologo, Bagoué, Gbêkê and Gontougo. The study aimed at exploring the relationship between the pesticides homologate and the others, their frequencies uses in cashew orchard. The study included the development of methodologies to assess the type and nature of the pesticide, application frequencies, and farmers satisfaction after use. The study also collected descriptive data on application rates and other types of control used by farmers. The sites were selected based on crops grown, pesticide usage, doses and frequency, cooperation from local leaders and willingness of farmers/farm workers to participate. The study group was selected with the help of village leaders and agricultural extension staff on the grounds that they cultivate cashew that require application of chemical pesticides.

The data collection has been done by the packaging and/or chemicals used by farmers which were collected to determine the different pesticides or a questionnaire. It was consisting of structured, semi-structured and unstructured items was designed based on published literature on the subject as well as experiences of the authors in the field. Data was collected through a farm survey by face-to-face interviews with farmers/farm workers during farming activities. The questionnaire was designed in french the national language, which is understood by the majority of the farmers and pre-tested using small samples of farmers in the same areas before using it in this study. The data collected included the biodata such as name, sex, contact address; source of income from the farm and the age of the farm; pest problems; pesticides used and source. Data were recorded from october 2017 to January 2018 by the investigators, who are scientist with an experience in pesticide related research. Computer data entry in Microsoft access was done and analysis was done using Statistica 7.1. statistical software. Statements made on open-ended questions that were not coded were also used to substantiate the numerical data.

RESULTS

Types of pesticides use by the farmers: The majority of farmers used in totality 28 different pesticides. The study showed that the different pesticide formulation types used by farmers in the area most were herbicides (70%), insecticides (29%) and fungicides (1%) (Table 1). Insecticides used included pyrethroids (such as cypermethrin, deltamethrin, permethrin, and lamda-cyhalothrin); Organophosphates (such as pirimiphos-methyl, profenofos, chlorpyrifos, fenitrothion) and carbamates (carbofuran). Only one fungicide (Azoxystrobine and Difenoconazole) of Strobilurines and Triazoles families, was used by farmers.

Inventory of control methods used by producers: Out of a total of 500 farmers surveyed, 69.25% reported pest attacks in their orchards. When asked if they knew of a method to control cashew tree pests, only 10% of the growers answered in the affirmative. This question (Do you do chemical treatments ?) received 18.20% yes and more than 60% no answers. Pesticide applications in the cashew tree orchard are still below the tolerance level.

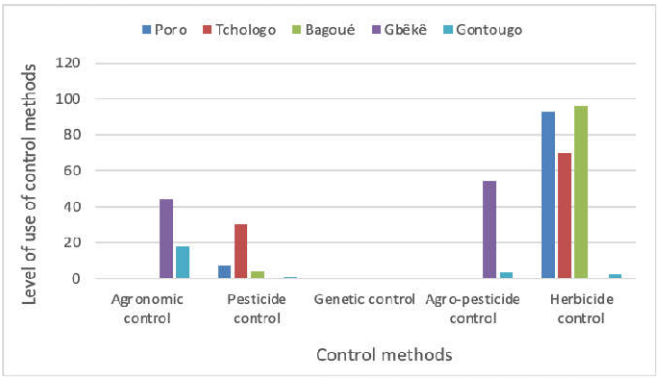

Figure 1. Level of adoption of control methods in cashew farms in Cote d'Ivoire

Figure 1 shows the percentage of adoption of control methods by cashew farmers in Cote d'Ivoire. The difference in adoption of the control method differs from one region to another. The majority of producers prefer a combination of agronomic and chemical methods in Gbêkê, while in the Bagoué region (96.0%), herbicides are favored, as in the Poro (92.54%) and Tchologo (69.57%) regions.

Application doses of the pesticides in cashew farms: Figure 2 shows the different rates of pesticides applied in cashew tree orchards in Côte d'Ivoire. Very few farmers use chemicals in the orchards. It is in the Bagoué Region in Boundiali that some producers use pesticides at extreme doses.

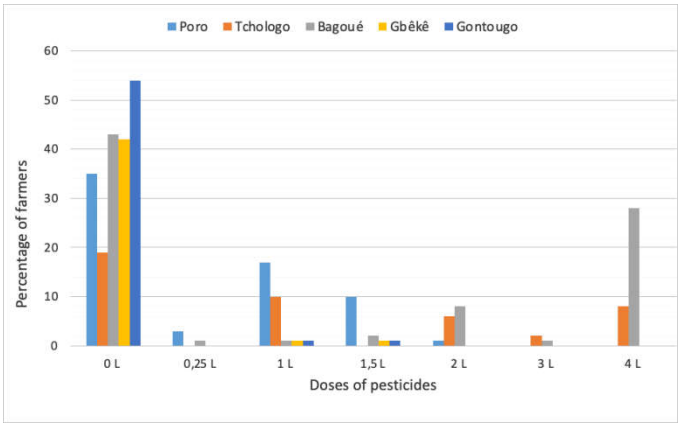

Figure 2. Doses of pesticides applied in cashew farms in Cote d'Ivoire

Frequency of applications of the pesticides in cashew farms: Figure 3 shows the frequencies of pesticide application combined in cashew orchards in Cote d'Ivoire. The number of farmers who do not apply pesticides is much higher than for all classes of chemical use combined. The average application of pesticides in cashew orchards is once a year. The Poro and Tchlogo regions have pesticide application frequencies of more than three times a year.

Number of control methods used by producers: Figure 4 shows the number of control methods used by farmers to manage pests and insect pests in their orchards. It shows that more farmers are not using any control methods. The Gbêkê Region has a peculiarity in the use of control methods. Unlike Poro, Tchologo and Bagoué, this Region uses a combination of up to four control methods, and it is also practically the only Region where all farmers have adopted at least one

Table 1. List of chemicals found in the cashew sector in Cote d'Ivoire

Chemical product	Trade name	Name of substance	Chemical family	Target pests
Herbicide	Agrazine 900 SL	Atrazine 900 g/kg	Triazines	Weeds
Herbicide	Gramoxone Super 200 SL	Paraquat 200 g/l	Pyridines	Weeds
Herbicide	Sikosto 120 SL	Glyphosate 120 g/l	Phosphonoglycines	Weeds
Herbicide	Roundup 360 SL	Glyphosate 360 g/l	Phosphonoglycines	Weeds
Insecticide	Armada 360 SL	Glyphosate 90 g/l	Phosphonoglycines	Weeds
Insecticide	Kalach 360 SL	Glyphosate 360 g/l	Phosphonoglycines	Weeds
Herbicide	Folar 525 SC	Terbutylazine 345 g/l + Glyphosate 180 g/l	Triazines Phosphonoglycines	Weeds
Herbicide	Calliherbe 2,4-D	Sel d'amine 720 g/l	Aryloxyacides	Weeds
Herbicide	Glyphader 120 SL	Glyphosate 360 g/l	Phosphonoglycines	Weeds
Herbicide	Kalach 120 SL	Glyphosate 120 g/l	Phosphonoglycines	Weeds
Herbicide	Roundup 120	Glyphosate 120 g/l	Phosphonoglycines	Weeds
Herbicide	Basta 60 SL	Glufosinate ammonium 60 g/l	Amino-phosphinates	Weeds
Herbicide	Herbextra 2,4-D 720 SL	Sel d'amine 720 g/l	Aryloxyacides	Weeds
Herbicide	Action 800 SC	Diuron 800 g/l	Phénylamines	Weeds
Herbicide	Basta F1 200 SC	Glufosinate ammonium 200 g/l	Amino-phosphinates	Weeds
Herbicide	Glyphogan 360 SC	Glyphosate 360 g/l	Phosphonoglycines	Weeds
Herbicide	Glyphosalm 360 SC	Glyphosate 360 g/l	Phosphonoglycines	Weeds
Herbicide	Glyphazine Combi 525 SC	Glyphosate 180 g/l + Terbuthylazine 345 g/l	Phosphonoglycines	Weeds
Herbicide	Roundup Biosec 640 SC	Glyphosate 640 g/kg	Phosphonoglycines	Weeds
Herbicide	Primagram Gold 660 SC	S-metolachlor 290 g/l +Atrazine 370 g/l	Chloroacétamides Triazines	Weeds
Herbicide	Glyphos 360 SC	Glyphosate 360 g/l	Phosphonoglycines	Weeds
Herbicide	Herbalm 720 SC	2,4-D 720 g/l	Aryloxyacides	Weeds
Insecticide	Altes 45 EC	Acétamipride 20 g/+ Cyperméthrine 25 g/l	Néonicotinoïdes Pyréthrinoïdes	Insect
Insecticide	Dantop 45 SC	Imidaclopride : 30 g/l Deltaméthrine : 15 g/l	Néonicotinoïdes Pyréthrinoïdes	Insect
Insecticide	Somon 40 EC	Cypermethrine : 20 g/l Acetamipride : 20 g/l	Pyréthrinoïdes Néonicotinoïdes	Insect
Insecticide	Merveil 50 EC	Imidaclopride : 30 g/l + Bifenthrine : 20 g/l	Néonicotinoïdes Pyréthrinoïdes	Insect
Insecticide	Pimex 25 EC	Imidaclopride : 15 g/l Lambdacyhalothrine : 10 g/l	Néonicotinoïdes Pyréthrinoïdes	Insect
Insecticide	Procarde 50 SC	Acetamipride : 30 g/l Bifenthrine : 20 g/l	Néonicotinoïdes Pyréthrinoïdes	Insect
Insecticide	Tefan 45 SC	Imidaclopride : 30 g/l Lambdacyhalothrine : 15 g/l	Néonicotinoïdes Pyréthrinoïdes	Insect
Fungicide	Ortiva Top 325 SC	Azoxystrobin : 200 g/l Difenoconazole : 125 g/l	Strobilurines Triazoles	Fungi

combination of control methods. The Integrated Pest Management method; combines two or more methods of control of a pest or insect pest. The technique here consists, in the case of cashew trees, in respecting the technical itinerary before the use of any pesticide.

DISCUSSION

The farmers use different pesticides in cashew orchards in the North of Cote d'Ivoire. The herbicides are the first pesticide use in this Region probably because farmers say there is a labour problem. They thought also that the only solution to pest problems is to spray more pesticides (Dinham, 2003). Farmers were not receiving agricultural extension service hence have attempted various means especially in pesticides use when dealing with pest problems but were constrained by the lack of appropriate knowledge (Ngowi, 2003).

On the other hand, this is a typical situation in many developing countries where the choice of pesticides to be used by farmers is influenced by the suppliers (Snoo *et al.,* 1997; Epstein and Bassein, 2003). In fact, pesticide usage was highly influenced by manufacturers and pesticides vendors who were carrying out their business right in the farming communities and very interested in achieving large sales of their pesticides (Abate *et al.,* 2000). In Cote d'Ivoire, like in African countries, many government extension programs encourage the use of pesticides, but do not consider their effects in the environment and health risks (Epstein & Bassein, 2003). Farmers used more pesticides because they thought it will increase their production. Herbicides were the most used because weeds were the most serious problem in cashew orchards in the north. This was followed by insecticides usage, indicating that pests leave in the weeds and come to attack cashew trees. Herbicides were hight in use probably because weeding could not easily be done manually by community members. Nowadays the community members were not deployed in duties like in the old time.

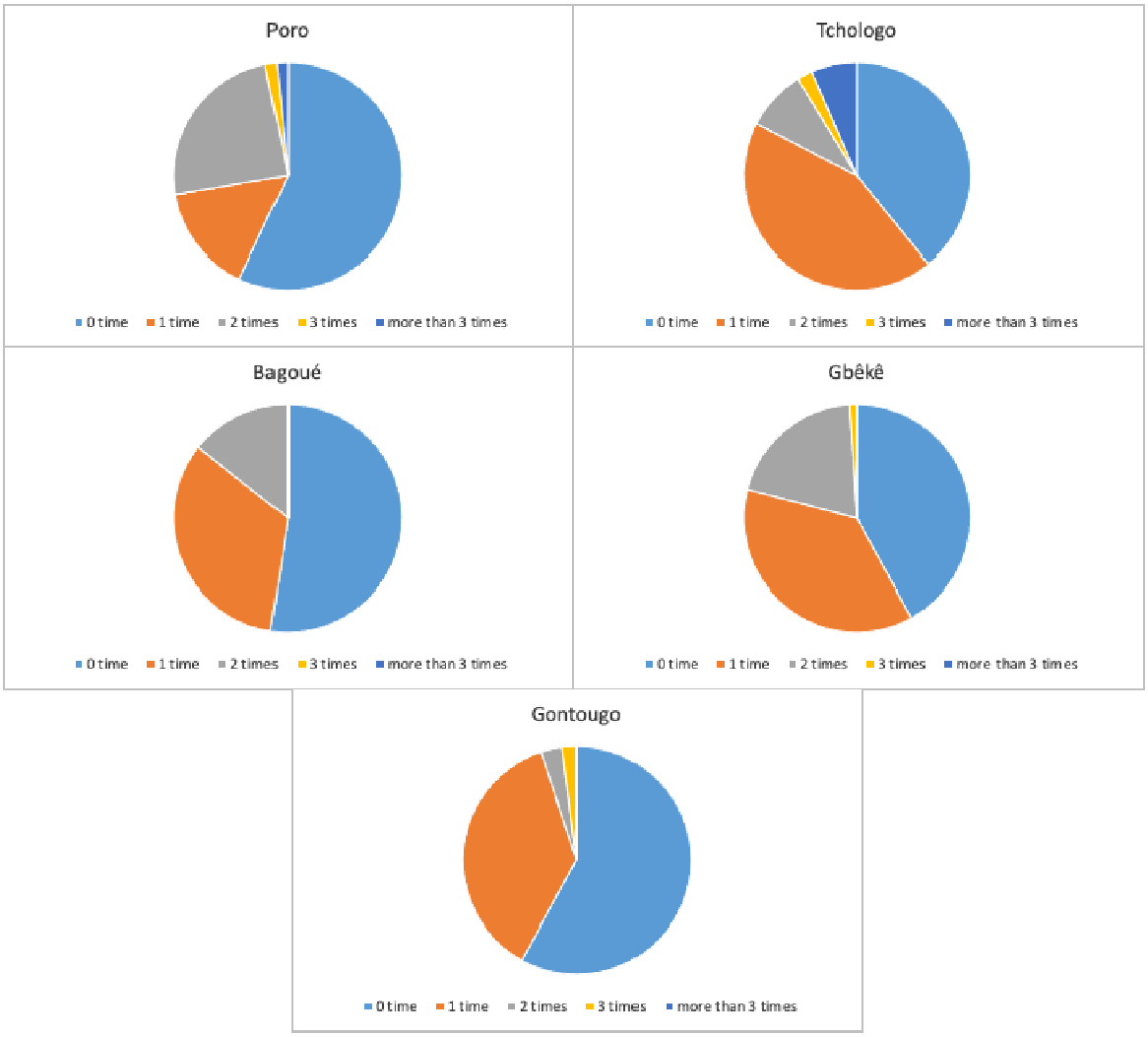

Figure 3. Frequency of pesticide applications in cashew tree orchards in Cote d'Ivoire

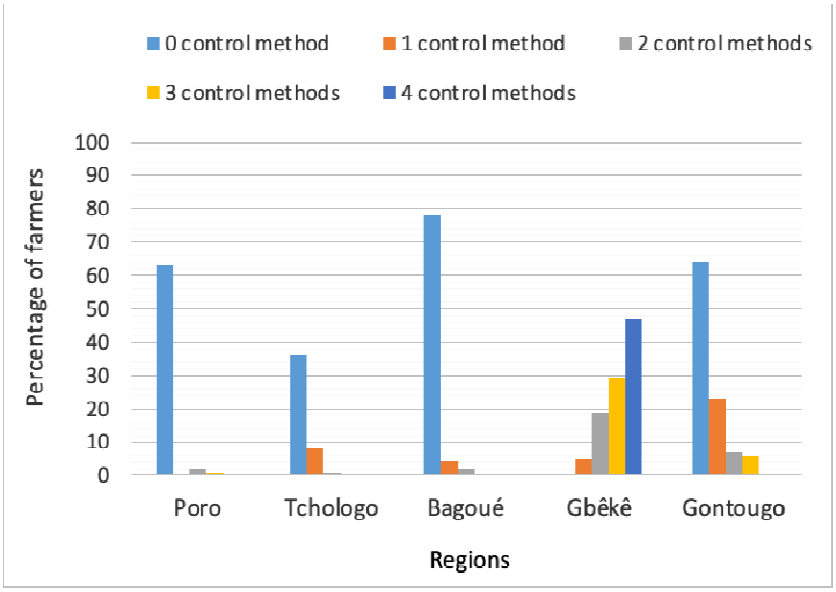

Figure 4. Number of control methods used by farmers

The combined use of chemicals shows that farmers lack basic knowledge about pesticides. Some growers mix pesticides for application in the orchard (Smit *et al.,* 2002). The frequency of pesticide application by farmers remains very low in the study area; certainly because of the cost of purchasing the products.

The low use of pesticides could be explained by the disinterest of farmers in orchard management or the lack of information on application strategies for these products. Nevertheless, it is necessary to draw the attention of these farmers to alternative pest management strategies that are profitable and environmentally friendly (Soro *et al*., 2019). The use of

glyphosate which is a phosphonoglycine herbicide is very dangerous. It is applied in liquid form to the soil to control weeds. It can cause side effects on the health of farmers, non-target organisms and the environment (Gupta, 1994; Santo *et al*., 2002; World Health Organization, 1990).

CONCLUSION

This study revealed a diversity of pesticides applied against cashew tree pathogens and insect pests in Côte d'Ivoire. The three main groups of pesticides, herbicides, insecticides and fungicides, were found in the study area at a tolerable application threshold. However, the Cuncil of Coton Cashew (CCA) should sensitize producers that the majority of diseases and insect pests that cause more damage and losses in cashew orchards have a beginning of solution by respecting the technical and phytosanitary itineraries. In addition, some growers use non-conventional pesticides, which can pose an environmental health problem in the long term.

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