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Characteristics of the Main Fruit and Vegetables Grown in Côte d'Ivoire and Most Commonly Consumed in the City of Abidjan (Côte d'Ivoire)

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ABSTRACT

The use of pesticides is the best pest control option for Ivorian food crop growers. This practice is used to increase production and meet the ever-growing food needs of city dwellers. In this study, some of the main locally-grown vegetables and fruit most consumed in Abidjan and from the main production areas were identified, along with their phytosanitary characteristics. Various surveys and a literature review have enabled us to identify the main vegetables and fruit and some of their phytosanitary characteristics. This work revealed that white aubergines, tomatoes and pineapples were among the main locally-grown vegetables and fruit most eaten by the people of Abidjan. The main local production areas were the Goh region, the Indénié-Djuablin region and the Sud-Comoé region. The pesticides used on these crops were insecticides, fungicides and herbicides respectively. Substances not authorised for use on these crops were found, including acetamiprid+cypermethrin (40EC), imidacloprid+ bifenthrin, dimethomorph+fluazinam (400 SC), profenos+cypermethrin (440 EC) and emamectin benzoate+abamectin. The choice of crop protection products as a whole, the method and place of storage and the post-harvest period were not in accordance with the manufacturer's instructions. The main local fruit and vegetables consumed by Abidjan residents have the same phytosanitary characteristics, regardless of where they are grown. An analysis of the risks associated with consuming these foods should be considered.

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Key Words

Côte d'ivoire, consumption, local fruits and vegetables, large cultivation area, phytosanitary

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INTRODUCTION

Fruit and vegetables are a dietary source of fibre, vitamins, vegetable proteins and micro nutrients. The consumption of fruit and vegetables is considered by many bodies to be a public health issue and is the subject of nutritional recommendations at global level by the FAO and the WHO[1]. Sangaré[2] stated in a report that vegetables and fruit are the staple crops essential for food security, alongside cereals, root and tuber crops and protein crops. According to Oudin[3], vegetables such as okra, African aubergines, chillies and tomatoes play an important role in the Ivory Coast diet. In Côte d'Ivoire, they are much more commonly used in sauces, which are the centrepiece of the nutritional balance of the Ivorian consumer thanks to the variety of nutrients they provide. These condiments are highly prized and their consumption is increasing daily in line with the need for basic foodstuffs (rice, bananas, yams, etc.) due to the growing population of Côte d'Ivoire, especially in large non-agricultural urban areas. Fruit consumption is almost non-existent at mealtimes in Côte d'Ivoire. Cependant, les populations sont de plus en plus tournées vers la consommation des fruits pour la pulpe ou le jus[4,5]. Indeed, strong population growth in urban areas is the main factor influencing the increase in food requirements in these areas and the main motivation for the dedication of market gardeners and fruit growers to produce more, given that they have a large and wealthy clientele[6,7]. According to the latest general population census, the population of Abidjan will rise from 4.8 million in 2014-5,616,633 in 2021[8]. A growing population means increased demand for essential foods such as fruit and vegetables. However, to increase their production, growers practise intensive agriculture and use a lot of pesticides because fruit and vegetables are a prime target for a large number of pests and diseases[1,9-12]. These poorly stored and misused plant protection products are the cause of health and environmental problems and must continually attract the attention of decision-makers, especially in developing countries[13]. The use of pesticides or any other non-integrated methods to control insect vectors, diseases and pests can therefore, depending on their nature and the way they are used, cause environmental and even socio-health damage[14,15]. Given that market garden produce is a short-cycle crop and that fruit is eaten raw, the correlation between the growth rate of the Abidjan population and the production rate, as well as the production rate and the pesticide use rate, raises questions about the risks of people being exposed to pesticide residues through the consumption of fruit and vegetables. It is also important to stress that in Côte d'Ivoire, food crops are rarely subject to health checks. Although studies have been carried out on market gardening on the outskirts and inside the city of Abidjan, the supply of these products to the city of Abidjan is largely from other production areas in the country[6,16,-18]. A survey was carried out to identify a number of characteristics of the main fruit and vegetables consumed in Abidjan, including the products used to combat pests and diseases, the method of treatment and the post-harvest period.

MATERIALS AND METHODS

Survey Population: To determine the main fruits and vegetables grown in Côte d'Ivoire and most commonly consumed in Abidjan, a survey was carried out among wholesale sellers of at least three (03) fruits or three (03) vegetables and the heads of cooperatives or groups of traders in these products. Rural development agents (ADRs) were also interviewed to identify the main players involved in growing these products in the main production areas identified. Finally, these main players indicated by the ADRs were the respondents from whom the data on plant protection products used in the cultivation of the main fruit and vegetables grown and most consumed in Abidjan were collected.

Survey Sheets: A survey sheet was drawn up to identify the main fruit and vegetables grown in Côte d'Ivoire and sold in Abidjan. The form contained three sections: the respondent's socio-demographic characteristics., the origin, processing and packaging of local vegetables sold in Abidjan and the respondent's clinical history. A second survey form was used to record respondents' opinions on the use of plant protection products in fruit and vegetable growing.

Identification of the Main Fruits and Vegetables Grown in Côte d'Ivoire and Most Commonly Consumed in Abidjan: Based on production and consumption data from a literature review, the fruits and vegetables grown locally and most consumed by the population of Abidjan were determined. In addition, a survey was carried out on the fruit and vegetables grown in Côte d'Ivoire and sold most frequently on markets in Abidjan. The data from each study was cross-referenced to determine the main fruits and vegetables grown in Côte d'Ivoire and most commonly consumed in Abidjan.

The Survey: The location of the survey on the main fruits and vegetables grown in Côte d'Ivoire and most consumed by the population of the city of Abidjan was determined on the basis of the supply mode of Abidjan households mentioned by authors Harre[19] Bricas[20] Lancon and Boyer[7]. According to them, markets are where Abidjan's housewives buy fresh produce, the staple of the family diet. These markets are supplied from wholesale food markets. The locally grown fruit and vegetables most consumed in the city of Abidjan were identified on the basis of availability and rate of

sale on these wholesale markets in the city of Abidjan, using a structured, single-pass questionnaire. Among other things, the questions focused on which of the locally-grown fruits or vegetables sold by the respondent were the most widely sold and available, where they came from and how they were processed and packaged. In addition, the respondent's clinical history was questioned. Only wholesalers who had at least three (03) different products in stock during the study period and who had agreed to take part in the study were interviewed. Survey data were entered using EpiData version 3.1 software and statistical analyses were carried out using IBM SPSS Statistics version 20 software.

Determination of Phytosanitary Practices: This study concerns the main locally-grown vegetables and one locally-grown fruit that are most widely consumed in the city of Abidjan. Phytosanitary practices were determined by observing plots of these crops and then surveying the reference growers of these commodities. The survey sheet was used to obtain some characteristics of the crop plot and the practices for using plant protection products.

Survey Areas and Production Sites: Based on existing data, the main production areas for the target fruit and the main production areas for vegetables were identified. In the case of vegetables, the zones selected were those covering different crops at the same time. As for the growing plots, the choice was made among reference growers in the sector in the area. The sector's benchmark growers are those designated by the zone's ADR or by growers in the sector on the basis of their ability to produce in large quantities and who have a customer base that supplies the Abidjan city market. They are either heads of cooperatives, associations or agricultural groups, or private farmers. The characteristics of the reference producer are: producing in large quantities, having a clientele that supplies the Abidjan city market, training or advising other producers. In addition to having all these characteristics, the reference producer had to be in production at the time of the study.

RESULTS AND DISCUSSIONS

Identification of the Main Fruits and Vegetables Grown in Côte d'Ivoire and Most Commonly Consumed in Abidjan: According to FAOSTAT production data for 2018-2021, dessert bananas are the most widely produced fruit in Côte d'Ivoire, followed by mangoes, oranges, avocados and pineapples (Table 1). In Côte d'Ivoire, dessert bananas and pineapples are produced for export and grown in modern units. However, while most banana production is controlled by large subsidiaries, pineapple production is carried out by a large number of small growers. Current mango production is based on traditional techniques, with cultivation taking place along roadsides at the edge of fields and mainly in village plantations[4,21,22]. As for oranges and avocados, outside the plantations associated with industrial complexes, they are mainly grown, in association with other crops, to provide shade in villages or urban centres[23,24]. There is also a local market for these fruits[22]. The fruit wholesalers in the main wholesale markets in Abidjan (46 wholesalers surveyed in total) identified orange (26%) as the fruit most consumed in Abidjan, followed by papaya (13%). However, 11% of respondents cited avocado, mango and pineapple at the same time, behind papaya (Fig. 1). As far as fruit is concerned, dessert bananas and papaya are grown by large international industrialists who are not easily accessible for this type of study. Mangoes are grown using traditional methods, as are oranges and avocados, which are rarely subject to phytosanitary plans[22,25]. On the other hand, pineapple cultivation is mainly in the hands of small farmers, who are more accessible and more willing to carry out this type of study. Pineapple, like the dessert banana, mango, orange and avocado, which are more widely produced than pineapple, is a highly prized food and is grown mainly in the south of the country near the city of Abidjan[3,5,26,27]. This fruit is harvested when ripe, both ripe and unripe and stored in bulk. They are stored without any protection against pests. The most widely produced vegetables are okra, aubergine, tomato and chilli (table 1)[27,28]. For the 44 wholesalers interviewed (Fig. 2), chillies were the most widely consumed vegetable (25%), followed by aubergines and tomatoes (18% each). The vegetables identified above did not undergo any post-harvest treatment and were harvested when ripe. Chillies and aubergines were mainly packaged from transport to sale in polypropylene bags (52%) and net bags (32%) respectively. Tomatoes, on the other hand, were mainly stored in baskets or tubs (25%) or in cardboard boxes (20.5%). What's more, none of these vegetables have been protected against pests. In Côte d'Ivoire, these vegetables play an important role in the diet. They are the main ingredients in typical Abidjanese dishes[3,26,29]. However, of these main vegetables, chilli is the ingredient used in small quantities in the preparation and consumption of meals. The increase in the production and consumption of these foodstuffs is the result of numerous health awareness campaigns. This is much more noticeable in large urban areas, particularly the city of Abidjan in Côte d'Ivoire[5,6,30-32]. Unlike fruit, vegetables have always been part of the eating habits of African city-dwellers like the Abidjan people, whose main fresh vegetables include white aubergines and tomatoes. This assertion is supported by their volume of production and their very important place in the eating habits of Ivorians[3,26-28].

Table 1: Production of the Main Fruit and Vegetables Grown in Côte d'Ivoire in Tonnes

		2018	2019	2020	2021
Fruits	Banana	270.000	499.600	625.980,5	619.140,5
	Mango *	93.267	98.900	103.420	180.000
	Orange	41.151,65	41.533,07	40.834,9	41.173,2
	Lawyer	35.837,54	36.032,49	36.110,01	35.993,35
	Pineapple	32.500	49.100	30.000	23.833,87
	Grapefruit and pomelos	24.307,54	24.458,44	24.514,09	24.426,69
	Papaya	14.201,74	14.029,12	14.142,36	14.124,41
Vegetables	Okra	152 522	181.337	188.736	193.193,65
	White aubergine	102.995	106.085	109.052	110.380,02
	Tomato	38 154	45.400	47.283	48.804,26
	Hot peppers and green peppers	27.584,06	27.764,71	27.993,64	27.780,8

Source:*Soungari[27], Faostat[28]

Table 2: List of Plant Protection Products Identified in White Aubergine and Tomato Cultivation in the Gôh Region

Types of pesticides	Active ingredients	Trade name of pesticide	Number of times quoted
Insecticides	Cypermethrin	Cypercal50EC, Cypermax 50 EC, Espoir 50 EC	6,4,3
	Lambdacythalothrin+ace-tamiprid,	K-Optimal, K-Total 35 EC	19,2
	Lambda cythalothrin	Lambdax 2,5 EC, Lambda super 25 EC, Lambda 25 EC, Lambda powe	10,9,9,
		25 EC, Karaté 5 EC, Elanto plus 25 EC, Delmix 25 EC	8,2,2,2
	Deltamethrin	Decis 25 EC	10
	Profenos+cypermethrin	Pichen 440 EC	1
	Abamectin	Abalone 18 EC	8
	Acetamiprid+cyperme-thrin	Cacaorè 40 EC	3
	Emamectin benzoate+abamectin	Kapass	13
	Imidacloprid+Bifenthrin	Grosudine Super 50	2
	Indoxacarb+acetamiprid	Viper 46 EC	7
		Furadan	1
	Chloropyriphos ethyl	Pyrical 5 G	5
Fungicides	Mancozeb	Mancomax 80 WP, Ivory 8 % WP, Mon Jardinier 80 WP	
		Mancozan 80 WP, Mancotop 80 WP,	10,9,7, 5,2
	Mancozeb+metalaxyl	Manax 72% WP	2
	Maneb	Almaneb 80 WP	2
	Chlorothalonil+carbendazim	Banko Plus 650 SC	12
	Copper oxychloride	Callicuivre 50 % WP	9
Herbicides	Glyphosate	Puissance 780 SG, Kalach 360 SL, Fanga 777 SG, Sunphosate G 757 WSG	
		Ranfor 480 SL, Rangro 757 WG, Weed-Out 360 SL	9,7,2,2,1,1,1
	Glyphosate isopropylamine	Bibana 480 SL, Ladaba 480 SL, Lamachette 480 SL,	10,8,2
	Metsulfuron methyl	Titan 100 WP	10

Table 3: List of Plant Protection Products Identified in White Aubergine and Tomato Cultivation in the Idénié-Djuablin Region

Types of pesticides	Active ingredients	Trade name of pesticide	Number of times quoted
Insecticides	Cypermethrin	Cypercal50EC, Cypermax 50 EC	3,2
	Lambdacythalothrin+acetamiprid	K-Total 35 EC, K-Optimal	19,6
	Lambda cythalothrin	Lambda 25 EC, Delmix 25 EC Lambda power 25 EC, Lambdax 2,5 EC,	
		Lambda super 25 EC, Elanto plus 25 EC,	5,5,3,2,1, 1,
	Deltamethrin	Decis 25 EC	33
	Chlorpyrifos-ethyl	Tricel 480 EC, Durexa 2,5 DP, Termix480 EC	1,1,1
	Abamectin	Abamectin 3.6% EC	1
	Thiamethoxam	Actara	2
	Emamectin benzoate+abamectine	Kapass	1
	Imidacloprid	Imidacloprid SC	3
	Imidacloprid+Bifenthrin	Grosudine Super 50	3
	Indoxacarb+acetamiprid	Viper 46 EC	4
	Carbofuran	Furadan	4
	Sulphur	Sulfa 80 WDG	8
	Acephate	Orthene	1
	Lambda cythalothrine+Dimethoate	Rainlambda Plus EC	1
	Chlorpyrifos+Cypermethrine	Attack	1
	Bacillus thuringiensis	Batik WG	1
Fungicides	Mancozeb	Mancozan 80 WP, Ivory 8 % WP, Cotzeb 80% WP, Mancomax	
		80 WP, Sanito 80 WP, Mancotop 80 WP,	22,6,4,3,2,1
	Mancozeb+metalaxyl	Manax 72% WP	31
	Maneb	Almaneb 80 WP	12
	Chlorothalonil+carbendazi-me	Banko Plus 650 SC	6
	Copper oxychloride	Callicuivre 50 % WP	5
	Thiophanate-methyl	Top-m 70% WP	7
	Copper hydroxide	Funguran-OH	12
	Copper oxychloride	Copper oxychloride 50% WP	3
	Dimethomorphe+Fluaziname	Banjo Forte 400 SC	3
Herbicides	Glyphosate	Rangro 480 SL, Adomwura, Weed-Out 360 SL Tako kélé 757 SG	
`		Sunphosate G 757 WSG, Rangro 757 WG, Hercule 480 SL	
		Fanga 777 SG	15,7,4,3,3,3,3 ; 2
	Isopropylamine de glyphosate	Lamachette 480 SL, Bibana 480 SL, Ladaba 480 SL	7,2,1
	Metsulfuron methyl	Titan 100 WP	3
	Glyphosate+ammonium salt	Tasman 757 SG	7
	Paraquat	Gramoxone	8

Table 4 : List of Plant Protection Products Identified in Pineapple Cultivation in the Sud-Comoé Region

Types of pesticides	Active ingredients	Trade name of pesticide	Number of times quoted
Insecticides	Bifenthrin+Acetamiprid	Callifan Super 40 EC	29
	Imidacloprid+Bifenthrin	Grosudine super 50	5
	Indoxacarb+acetamiprid	Optimal Duo 50 EC	27
	Chlorpyriphos	Pyrical 5 G, Tricel 48 %	24, 13
Fongicides	Mancozeb	Mancomax 80 WP	
	Aluminium phosethyl	Aliette 80 WG	23
Herbicides	Bromacil + Diuron	Spécial 30 WP	29
	Glyphosate isopropylamine	Bibana 480 SL	9
Growth regulator	Ethephon	Hevetex 5% PA	2
		Callel 5% PA	30
		Ethrel 480 G/L	25
Nematicide	Oxamyl	Vedette 240 SL	9

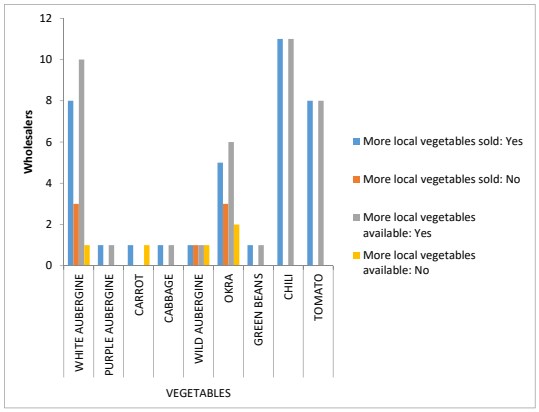

Fig. 1: The Main Locally Grown Fruits Consumed in Abidjan

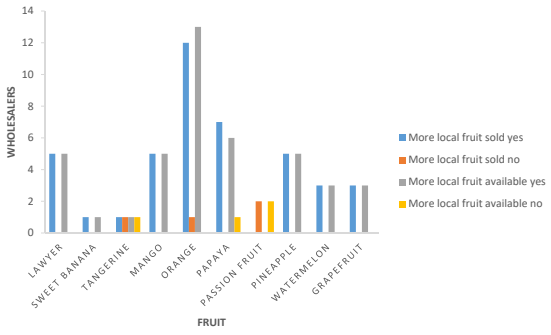

Fig. 2: The Main Locally-Grown Vegetables Consumed in the City of Abidjan

Study Area: The Gôh and Indénié-Djuablin regions were the most important production areas for both aubergines and tomatoes, according to OCPV documents[18]. Although aubergines and tomatoes are grown all over the country, there are large production areas. Huber[33], who have worked on food crops in general, confirm this assertion. Over the last few decades, the main locally-grown vegetables consumed in Abidjan, notably white aubergines or African aubergines and tomatoes, have mainly come from the outskirts of the city and from other towns in the country. The Sud-Comoé region, in the south-east of Côte d'Ivoire, is a major pineapple-producing area. A total of twenty-two (22) cooperative managers and five (05) individual reference farmers were interviewed in the Goh region in south-west Côte d'Ivoire. In this region, just over half the respondents had no formal education and 22% had primary or secondary education. Their plot was unirrigated, exposed to the wind and located on either flat or sloping ground. In the Indénié-Djuablin region in eastern Côte d'Ivoire, thirty-two (32) cooperative managers and three (03) individual reference farmers were interviewed. Of these, 60% had no education at all, 20% had primary education and 8% had secondary or higher education. Their plot was also unirrigated and exposed to the wind. However, the crops were grown in low-lying areas (66%) or on flat land (46%). In the Sud-Comoé region, thirty (30) small pineapple producers were questioned, 46.7% of them at primary level, 40% with no schooling and 13.3% at secondary level. They grew their crops on unirrigated, wind-exposed plots on flat and sloping land.

Determination of Phytosanitary Characteristics: At the time of the study, the types of plant protection products most commonly used in these main production zones were insecticides, fungicides and herbicides respectively (Tables 2, 3 and 4). However, insecticide-fungicide and nematicide products have been used, particularly in Indénié-Djuablin. Depending on the region studied, these products represented a poison for 55% of users in the Goh region, a medicine or product that posed no problem for 52% of users in the Indénié-Djuablin region and for 64% of users in the Sud-Comoé region. It should be emphasized that the major constraint on intensive market gardening and fruit growing is pest pressure, which is the biggest source of damage[5,34,35]. As in the urban and peri-urban market-gardening areas of the country studied, the major production areas for these products in the deep country use synthetic chemical plant protection products to control pests[33]. This is the case in the Gôh and Indénié-Djuablin regions for white aubergine and tomato cultivation and in the Sud-Comoé region for pineapple cultivation, where the study revealed that plant protection products, starting with insecticides,

followed by fungicides and herbicides, were widely used. Furthermore, according to data on pesticide imports by Côte d'Ivoire in 2019 and 2020, herbicides, insecticides and fungicides are the top three pesticides imported into the country[36]. These pesticides were also found in the Gôh and Indénié-Djuablin regions, which were the focus of a study on pesticide management[37]. Although Kouamé and Kpangni[25] have noted the practice of organic pineapple growing, particularly for export, conventional production requiring phytosanitary products continues. According to these authors, abuse of these phytosanitary products has been reported. Some of these plant protection products are not authorised for use on vegetables, notably aubergines, tomatoes and pineapples. These include insecticides such as cacaorè 40 EC and Grosudine Super 50 and fungicides such as Funguran OH and Banjo Forte 400 SC used in cocoa cultivation. In addition, insecticides such as Pichen 440 EC and Kapass are used in cotton growing. The various plant protection products used on these different crops are classified as toxicity II or III by the WHO. With regard to the choice of treatment products, 89% of respondents in the Gôh region and 97% of respondents in Indénié-Djuablin and the Sud-comoé region chose plant protection products on the basis of the experience of users and failing that on the recommendation of retailers. What's more, these plant protection products were purchased from unauthorized retailers. In the main white aubergine, tomato and pineapple production areas, the plant protection products used were chosen and applied by the farmers themselves, without any prior training. The choice of treatment products was mainly based on its experience in treatment. This practice has been noted in studies carried out by MEMINADER[15] in the north of Côte d'Ivoire. This approach, which is very common in these crops, prioritises the efficacy of the crop protection product against diseases and pests, a guarantee of crop safety, over the hygiene of the food harvested[16]. This approach to the choice of treatment products may justify the presence and use of obsolete or unregistered plant protection products for white aubergine, tomato and pineapple in the various regions studied. Contrary to the reason given above, the MEMINADER study[37] indicates that for food crops such as aubergine and tomato, the use of unregistered plant protection products by growers is due to the high cost of registered pesticides compared with unregistered ones. The study also revealed the unavailability of approved plant protection products to growers (sold on local markets) and the difficulty of accessing approved pesticides for food crops (in terms of proximity). This disparity can be explained by the fact that our study interviewed only large producers (with large harvests, etc.). In general, the phytosanitary products used in white aubergine, tomato and pineapple crops are registered, but require precautions in their use, even though they are of toxicity II or III according to the WHO classification[37]. Our study also revealed that in the cultivation of white aubergines and tomatoes, the storage of phytosanitary products after use was much more common in the field (72% in Goh, 81% in Indénié-Djuablin) than in bushes or under a shed. Small pineapple growers, on the other hand, preferred to store plant protection products after use in a hiding place in the house. These products were handled by the market gardeners and small pineapple growers themselves (90% in Goh, 97.1% in Indénié-Djuablin and 100% in Sud-Comoé), who are not formally trained applicators. Irrespective of the study area, the start of crop treatment was based on the experience of the applicators who were also growers (63% of market gardeners in Gôh, 87% in Indénier-Djuablin and 97% in Sud-Comoé) or on observation of the plot. Spraying was carried out exclusively with backpack sprayers, which were neither checked nor maintained (apart from washing and rinsing). In most cases, all the prepared porridge was used, especially in Gôh (85%), Indénié-Djuablin (57%) and Sud-Comoé (84%). On the other hand, when there was a remainder, 43% of market gardeners in Indénié-Djuablin and 25% in Gôh and Sud-Comoé reused the remaining slurry either the next day or at the next treatment. The data collected during the survey showed that in each study area and for each crop, the precautions taken before treatment were mainly to take climatic conditions into consideration (93% in Gôh, 97.1% in Indénié-Djuablin and 50% in Sud-Comoé) and, to a lesser extent, to wear a mask (30% in Gôh, 40% in Indénié-Djuablin and 14% in Sud-Comoé). After treatment, only body washing and hand washing were recorded among pineapple growers in Sud-Comoé (64% and 40% respectively). According to the survey, dosages and the post-harvest period were determined at the grower's discretion. The results showed that 60% of farmers surveyed in Indénié-Djuablin, 66.7% in Gôh and 100% in Sud-Comoé were in favour of dosages. As for the post-harvest period set by the applicators themselves, the results showed 90% in Sud-Comoé, 55% in Indénié-Djuablin and 33% in Goh. In addition, 33% of users in the Goh survey set themselves a deadline depending on the persistence of attacks. 29% of users in Indénié-Djuablin set themselves a one-week deadline, regardless of the crop protection product used and 20% of users in Sud-Comoé set themselves a two-week deadline or a deadline based on the

persistence of attacks. Problems of discomfort due to the smell of the products and skin irritation during treatment were reported by respondents in the Gôh region (33.3% and 37% respectively). In the Indénié-Djuablin region, 23% of respondents reported discomfort due to both odour and irritation. Apart from the problems mentioned above, no health or environmental incidents were mentioned by respondents. Finally, the survey revealed that the vegetables harvested were most often sorted and packaged in the field before being sold. The fact that growers rely on their own experience when it comes to treatment influences other phytosanitary practices such as dosage, treatment, storage of phytosanitary products and the post-harvest period. White aubergines, tomatoes and pineapples, for example, were grown in large production areas using plant protection products stored in poor conditions after opening and dosed randomly or differently from the manufacturer's instructions. All these characteristics of the plant protection products used in the major aubergine, tomato and pineapple production areas correspond to those of food crops generally produced in large or small production areas[14,38]. Based on the survey data, tomato, aubergine and pineapple growers in the main production areas are largely illiterate, from one region to another. In the best of cases, they have only a low level of schooling. Hence the failure to read the labels on plant protection products and the inappropriate way and place of storing plant protection products used on aubergine, tomato and pineapple crops. This affects the effectiveness of the products, which is the main reason for buying them and can also lead to overdosing. This reflects the approximate level of knowledge among grower-applicators about the products used, the doses, the frequency of treatment, the period of application and the harmful impacts that these could have, as noted in a study carried out by MEMINADER[15]. It is therefore possible that many of the risks of contaminating consumers and the environment are at their highest if those involved in the marketing, distribution and application of plant protection products do not know how to handle and apply these pesticides safely[13,14,38].

CONCLUSION

In Côte d'Ivoire, white aubergines and tomatoes are widely produced in the country and are more common in the meals of the people of Abidjan than many other vegetables. Pineapple production is also important for export, but this much-loved fruit is increasingly present on the local market. These foods, which play an important role in the diets of the people of Abidjan and which come from the major production areas, are protected almost entirely from pests and diseases by chemical products used in their cultivation. The phytosanitary practices used in the major production areas for these crops have virtually the same characteristics as those used in crops of the same commodities grown in other production areas for the local market (small, medium, etc.). The same applies to other vegetable crops. Thus, the choice of treatment products, their dosage, the time of treatment, the method of storing the plant protection products and the post-harvest period do not comply with good plant protection practice, but are carried out according to the habits acquired by the farmer who also applies them when treating these crops. The characteristics of phytosanitary practices for aubergine, tomato and pineapple cultivation sold on the local market could constitute risks of contamination of these products by residues of phytosanitary products.

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