Highly Hazardous Pesticides (HHPs) Registered and Their Use in Sub-Saharan Africa

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Abstract: To sustain agricultural production, pesticides are highly recommended. In sub-Saharan Africa, two regulatory bodies are in charge of pesticide registration, for more than 10 years of duty, the impact of their activity has not yet best carried out. The present investigation aimed to evaluate the evolution in the quality of pesticides in agriculture in sub-Saharan Africa. Registration of pesticides began in Cameroon in 1996. There, less than 5% of pesticides used in 2004 were registered and more than 80% of producers were not aware of this legal process. In 2014, 85% of pesticides used are registered. In sub-Saharan Africa, Highly Hazardous Pesticides (HHPs) registered are rondenticides, insecticides and nematocides. They are frequently used for the protection of stored products. Ilicit Persistent Organic Pollutants (POPs) (heptachlore, chlorobenzene) and HHP (alluminium phosphide, terbufos, abamectine, ethropophos, etc.) are frequently used to protect stored grains. And 40% are registered for use in intensive bananas production (28% for nematodes control alone and 10% for control of both insects and nematodes). Moreover, 20% of HHPs registered are for the control of rodents.

Key words: Sub-Saharan Africa, chemical pest control, highly hazardous pesticides, alternatives.

1. Introduction

The population of the African continent was estimated at 1.03 billion in 2011, it will double by the year 2050 [1]. There is a need to increase agricultural production by increasing productions or preventing pre- and post-harvest losses [2, 3]. Many pests attack and destroy crops on fields and during storage. The most useful tools to avoid losses are chemical pesticides [4].

A closer look on pesticides frequently used in crop protection in sub-Saharan Africa makes obvious their poor quality. Around 30% counterfeit pesticides are available on markets, many of registered pesticides seem to be ignored by farmers and many pesticides in use are not registered [4].

A permanent survey of the conventional pesticides used in the Northern Cameroon and Western Chad from 2004 till 2011 pointed out that: 12% of the pesticides are obsoletes and mainly Persistent Organic Pollutants (POPs), 12% belong to the class Ib (Highly Hazardous Pesticides (HHPs)) of the World Health Organization (WHO) classification of pesticides by hazards, 60% belong to the class II (moderately hazardous) and 16% to the class III (slightly hazardous) [4, 5]. Depending on their structure, pesticides currently used in the Logone valley and Northern Cameroon belong to four major families, the

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most important are the organochlorinated compounds (56%), followed by pyrethrinoids (21%), organophosphorous compounds (17%) and carbamates (6%) [6, 7].

So in Cameroon, less than five out of 550 pesticide formulations registered are bio insecticides that may be used as suitable alternatives [7]. They have as active ingredient spinosad, azadiratin, bacterial toxin of *Bacillus thuringiensis*. The most popular active ingredient in both Central Africa (Central Africa Committee for Pesticides (CACP)) and West Africa (Sahelian Committee for Pesticides (SCP)) is the cypermethrin, contributing to the formulation of more than 30 commercial products [8].

The management of pesticides in sub-Saharan countries is in accordance with the rules and regulations of the CACP and SCP. In spite of all these regulating bodies, frequent mismanagements of pesticides are observed in this area. There is a need to urgently address this chemical management problem, the present investigation aimed to contribute to that.

2. Materials and Methods

To access the diversity of pesticides used by smallholders to protect crops from insect pest attack, since 2004, yearly sampling of names of pesticides used and collection of pesticides containers were carried out in the three northern regions of Cameroon (Adamoua, North and Far North). Moreover, the list of authorized pesticides was established by consulting two official releases. To know if these chemicals are authorized to Cameroon and Economic and Monetary Committee of the Central Africa zone, the lists of chemicals accepted by authorities in charge of agriculture and crop protection were consulted [4, 9-11]. These products are also used in neighbouring countries in Central Africa where no registration authority is functioning. The list is from the CSP who is in charge of the registration of all pesticides in use in the West Africa countries [8]. These lists are updated twice a year. The cited pesticides are classified according to their hazards following the guidelines to classification [5, 12, 13].

3. Results and Discussion

3.1 Typology of the Pesticides in the Hands of Smallholders for Crop Protection

Pesticides registered for Central or for West Africa include 10 categories of products: avicides, fungicides, herbicides, insecticides-fungicides, insecticides-acaricides, insecticides-nematocides, insecticides, nematocides, molluscides and rodenticides.

In Central Africa, four other categories are added: adjuvants, growth regulators, public hygiene products and resistant activators. A last category is that of pesticides receiving temporary authorization to be sold.

Since its launch, the first pesticides registration commission was held in 1996. As from there, Cameroon government is improving the quality and the availability of pesticides offered to producers. Less than 5% of the farmers in 2004 used registered pesticides, after 10 years, more than 80% of the pesticides on the list are registered [9]. In the same, the amount of users ignoring registered pesticides is reducing from 50% in 2004 to less than 10% after 10 years.

The compilation of the pesticide names extracted from user’s citation or read on containers collected in their farms and houses allows coming to a list of pesticides in use. This list was made and regularly updated on yearly basis. In comparison with the list of the pesticides registered, three situations were currently observed:

- Pesticides used that are registered;
- Pesticides used that are not registered;
- Pesticides registered that are not used nor known by producers (Fig. 1).

It comes clear that during the 10 years period, the quality and the legal status of pesticides in use was significantly improved in sub-Saharan Africa.
3.2 Occurrence and Uses of HHPs

The classification of active ingredients according to the WHO recommended classification of pesticides by hazard was used to categorize pesticides on the list of agricultural chemicals registered. A total of nine highly hazardous active ingredients of pesticides are currently used in Central and West Africa in the formulation of fungicides, herbicides, insecticides, insecticides-acaricides, insecticides-nematocides, insecticides-fungicides, nematocides, molluscides and rodenticides [9-13]. These uses are in relationship with some phytosanitary problems occurring in targeted crops (Fig. 2).

Among these licit chemicals, some are hazardous to human and environment [13], 40% are registered for use in bananas production with 28% for nematodes control alone and 10% for control of both insects and nematodes. Moreover, 20% of HHPs registered are for the control of rodents. In sub-Saharan Africa, registered HHPs are rondenticides, insecticides and...
nematocides, frequently used in banana production and for protection of stored products (Table 1).

Considering the specific situation of protection of stored grains from the attacks of insect pests, from 2004 to 2014, 29 active ingredients used in the formulation of more than 60 insecticides are registered and regularly used (Table 2). Among them, six active ingredients are obsoletes according to the WHO classification (Fig. 3). They are heptahlore, lindane, chlorobenzene, endosulfan, landrin and dieldrin. Aluminium phosphide and cyflutrin are respectively in the class Ia (highly hazardous) and Ib (hazardous) of the same classification (Fig. 3, Table 2). These hazardous chemicals were most used from 2004 to 2013, as from 2014, the eight active ingredients are used to formulate registrated pesticides used in treatment of stored products. They belong to the classes: III (pyrimiphos methyl, mamathion), II (permethrin, deltamethrin, chlorpyriphos ethyl), Ia (aluminium phosphide) and O (lindane, heptachlore).

Illicit POP (heptachlore, chlorobenzène) and HHP (aluminium phosphide, terbufos, abamectine, ethropophos, etc.) are frequently used to protect stored grains [7]. In fact, these products have adverse effects like the pollution of environment, human poisoning,
and development of resistant strains of pests and kill of not target insects as bees [13]. In cotton production, lindane and HCH are used. The active ingredients of some commercial chemicals like MARSHALL, GENERAL, CALTHIO, POUmROX, CELPHOS banned in European Union continue to be used in Northern Cameroon [14].

Some advances these recent years pointed out the registration of some moderately and slightly hazardous pesticides as alternatives to the extremely and HHPs.

Table 2  Insecticides registered in Central Africa for the protection of stored cereals and used from 2004 to 2014 and their status according to the classification of the FAO/WHO (2009).

| Families* | Active ingredients | Formulations | Classes** | 2004 | 2007 | 2011 | 2013 | 2014 | 2015 |
|----------|--------------------|--------------|-----------|------|------|------|------|------|------|
| 1 OP Pyrimiphos methyl | ACTELICT ACTALM SUPER, PROTECT DP | III |
| 2 Pyr Cypermethrin | CYPERCAL; CIGOGNE; CYGA; CYPALM | II |
| 3 OC Chlorobenzene | HCH (POUDRE BLANCHE) CAMPHER | O |
| 4 OP Malathion | POUmROX, FYFANON 880EC | III |
| 5 Pyr Permethrin | ANTOUKA SUPER, PERCAL | II |
| 6 OC Lindane | TERMITOX, Red Powder, | O |
| 7 OP Profenofos | CALFOS; CALIFE; CALLIX, PROFENALM | II |
| 8 Neonico Acetamipride | BENJI; OPTIMAL MATADOR; KRIS | III |
| 9 Carb Indoxacarbd |AVAUnT; STEWART | II |
| 10 OP Thiodicarb | ALTERNAx | II |
| 11 OP Lamda-cyhalothrin | LAMDACAL 100EC | II |
| 12 Carb Triazophos | TRIALM 400EC; TRIAZOFOmRe 400EC | Ib |
| 13 OC Endosulfan (+ thirame) | CALTIOE; SULTAN; THIONEX, THIODAN | O |
| 14 OP Dichlorvos | DD FORCE; PEST OFF | Ib |
| 15 Carb Carbosulfan | MARSHALL; GENERAL | II |
| 16 OC Heptachlore | THIORAL | O |
| 17 Pyr Deltametrin | MALAGRAIN SUPER; STARGRAIN 2 DP KO BIOL | II |
| 18 OC Dieldrine | DIELDREX, DIEmDRINE | O |
| 19 Carb Benfuracarb | ONCOL | II |
| 20 OC Landrine | LANDRINE | O |
| 21 Neonico Imidaclcloprid + thirame | INSECTART; MONTmAZ 45WS | II |
| 22 OP Propoxur | PROmALM 2 DP | II |
| 23 Pyr Cypermethrin + profenofos | CYPERCAL | II |
| 24 OP Chlopyrifos-ethyl + thirame | CALTHIO C | II |
| 25 Carb Carbosulfan | WORMFORCE | Ib |
| 26 OP Fenitrothion | FENICAL | II |
| 27 IGR Emmamectin benzoate | CAIAN B | III |
| 28 Pyr Cyflutrin | ACTALM SUPER | Ib |
| 29 FM Aluminium phosphide | ALADIN; PHOSPHINION, PHOSTOXIn, JUSTOXIN, CELPHOS, CYCLOmE | Ia |

* OP: organo phosphorous; OC: organo chlorinated; Pyr: pyrethrinoid; Carb: carbamates; IGR: inhibitors of growth regulators; FM: fumigant; Neonico: neonicotinoids.

** Classification of WHO (FAO/WHO, 2009): class Ia = extremely hazardous; Ib = highly hazardous; clas II = moderately hazardous; class III = slightly hazardous; class O = obsolete.

present during investigation.
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Table 3  Active ingredients and commercial names of alternative pesticides registered in Central and West Africa with their toxicological classes and their targeted pests.

| Active ingredients | Classes | Targeted pests/ecosystems | Registrations |
|--------------------|---------|----------------------------|---------------|
| West Africa (Sahelian Committee for Pesticides) |
| 1 Bacillus thuringiensis | III | Mousquito/indoor Caterpillars/sprouts | Baviteck Batik WG |
| 2 Spinosad | III | Insect pests/tomato farm Insects/stored products & human foods Fruits flies/mango | Laser 480 SC Spintor Poudre 1.25 |
| 3 Azadirachtin | III | Insect pests/cotton | Succes Appat Suneem 1.1%EC |
| Central Africa (Cameroon) |
| 1 Gibberelin A3 40% III | Post-harvest ripening regulator/fruits | Ryzup 40SG |

available (Table 3). Implementation of this change in the dependence on hazardous pesticides is more important in West African than it is the case of Central Africa. The Sahelian Commitee of Pesticide registered till date three major biopesticides produced from the formulation of natural active ingredients. In Central Africa, especially in Cameroon, only one is registered.

4. Conclusions

Investigations presented in the present work illustrate improvement in the quality of pesticides in agriculture during the last 15 years in sub-Saharan Africa. A consequence of the very poor post-registration survey made is the large amount of counterfeit pesticides and frequent mismanagement of stocks. Registration of biopesticides is to be enhanced by all stakeholders. Slightly hazardous pesticides as alternatives tools are progressively occurring on markets.

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