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Active ingredients for weed control of food and vegetable crops in northern Côte d'Ivoire

N. S. Singo^{1,2}, A. Touré², N. J. Kouakou², Y. R. Baka², J. Ipou IPou²

¹African Center of Excellence for Climate Change, Biodiversity and Sustainable Agriculture (CEA-CCBAD), Félix Houphouët-Boigny University; ²Botany Laboratory, UFR Biosciences, Félix Houphouët-Boigny University 22 BP 582 Abidjan 22, Côte d'Ivoire

ABSTRACT

Agriculture in the north of Côte d'Ivoire, like the rest of the country, is undergoing genuine development. This situation is leading producers to adopt new cultivation techniques, including the use of herbicides for weed control. Herbicides have advantages and disadvantages in their handling. Knowing how dangerous these products can be, identifying them would be advantageous, hence this study. The main objective of this study is to establish a list of herbicides used on vegetable and food crops in the study area. In the departments of Boundiali, Ferké, Korhogo, and Séguéla directed interviews were conducted with traders, producers, and firms. They focused on the active ingredients of the herbicides, the type, and the mode of use. At the end of the study, seventy-seven herbicides divided into twenty-two active ingredients were identified. Glyphosate was the most present followed by nicosulfuron. To conclude, it should be noted that herbicides are present in the habits of the producers in our study area. They still do not use the products according to the standards. These results will help improve the quality and sustainability of agriculture.

Keywords: Actives ingredients; Weeds control; Food et vegetable crops; Côte d'Ivoire

*Correspondence to Author:

N. S. Singo^{1,2}

¹African Center of Excellence for Climate Change, Biodiversity and Sustainable Agriculture (CEA-CCBAD), Félix Houphouët-Boigny University; ²Botany Laboratory, UFR Biosciences, Félix Houphouët-Boigny University 22 BP 582 Abidjan 22, Côte d'Ivoire

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INTRODUCTION

Côte d'Ivoire's agriculture has made great progress and remains the driving force of the Ivorian economy to this day (N'Guessan et al., 2019). The north of Côte d'Ivoire, which is today one of the country's granaries, is no exception to the rule. Family-based agriculture in this region is now an important source of income for producers. There is a diversity of industrial and food Crops. In addition to industrial crops, the main food crops are rice, yams, corn, and vegetables. The production of food crops and market garden products is increasingly important in this part of the country. This situation has led producers to use new techniques in their cultivation habits. Indeed, the achievement of agricultural performance often leads to behavioral changes in the practice of farming activities (Doumbia et al, 2009; Glounhao, 2012). These changes can be observed both in the setting up of plots and in their maintenance during which, according to N'Guessan et al. 2019, the use of pesticides is encouraged to improve performance. Plot maintenance is very important because of the numerous pests. Among them, weeds have a high percentage of dangerousness. McCully and Klaus (2004), state that weed control occupies most of the farmers' working time. They are also responsible for 5% of crop losses in temperate zones and generally more than 25% in tropical zones (Boudjedjou, 2010). For optimal control, the chemical method is combined with traditional methods. This chemical control is done using herbicides. In a study conducted in Tapéguia in the west of the country by N'Guessan et al. (2019), herbicides represent the most widely used group of pesticides because of their regular use in both food and perennial crops. They are products that provide weed control. Herbicides have many advantages, although their intensive use has some disadvantages (Yao, 2016). While

these products were used in industrial crops because of the size of the plots, they have been used in food and vegetable crops for some years now. The different protocols governing the production of these substances favor their diversification. During a study, it was shown that the majority of agricultural pesticides used in the sub-prefecture of Tapéguia are manufactured by international companies (Bayer, SBCI China, etc.), reformulated (trade name) and distributed by approved firms in Côte d'Ivoire (Ipou Ipou et al., 2015). Indeed, several production firms exist on the market and the import of pesticides is not prohibited even if it is subject to strict control. As with any chemical product, the use of herbicides has disadvantages and their use must be done with great care. However, the high illiteracy rate of most producers in our tropics could impact the use of these products. This fact could directly or indirectly affect the quality of agriculture. This situation allows us to look at this important aspect of agriculture, namely the active ingredients present in our country's agricultural environment. In the context of biodiversity conservation and organic farming development, the data collected will broaden the scope of reflection of the sector's decision-makers. This to provide beneficial solutions for producers and consumers.

1. MATERIALS AND METHODS

1.1 Study area

Côte d'Ivoire is a country which is approximately enclosed within a square whose vertices have the coordinates 4°30 and 10°30 north latitude and 2°30 and 8°30 west longitude (Avenard, 1971). According to Sangaré et al (2009), the country enjoys a favorable climate for the development of agriculture. According to the same authors, the country is divided into four agro-ecological zones. Our study was carried out in the northern zone precisely in the departments of Korhogo, Boundiali, Ferkéssédougou, and Sé-

guéla. In the north, the vegetation is dominated by a so-called western Sudanese savanna characterized by a clear forest of shrubs, trees, and grasses (Guillaumet & Adjanohoun, 1971; Yao et al., 2013). The department of Séguéla located lower than the others is dotted with forest galleries. The climate is of two types in this part of the country. A semi-arid or Sudanese climate in the extreme north located on the Malian border. And a dry tropical climate which is below the semi-arid strip. The relief is rather flat with many hills. The population is cosmopolitan with a dominance of the natives belonging to the Gour and Northern Mandés groups.

1.2 Herbicides

In agriculture, weed control occupies the majority of farmers' working time (McCully and Klaus, 2004). Weeds are responsible for 5% of crop losses in temperate zones and generally more than 25% in tropical zones (Boudjedjou, 2010). This fact shows the dangerousness of weeds in agriculture. Already in 1986, Déat had shown that traditional methods (burning, manual weeding, and shifting cultivation) practiced in developing countries were unfortunately no longer sufficiently effective in a farming system that was meant to be modern. As a result, widespread chemical weeding in countries with advanced agricultural systems has been introduced into the agricultural habits of producers in the tropics. It aims to promote crop growth by significantly reducing weed competition (Marnotte, 1995). Because of its advantages, herbicides are used in industrial crops as well as in food and vegetable crops. Their use in general facilitates the work of producers while reducing production costs. However, their misuse leads to certain problems. While in the immediate term it may result in the elimination of weeds and crops if the appropriate product is not used (Bender, 1990; Regehr, 1993), in the long term, the entire

biodiversity of the plot may be transformed (Des-saint et al., 1990).

1.3 Materials

To carry out this study, various materials were used:

1.3.1 Human materials

- Managers of plant protection product stores and branches of plant protection companies,
- Officials of the regional directorates of the Ministry of Agriculture,
- The producers of the plots visited,
- A guide to translation.

1.3.2 Technical equipment

- Survey forms,
- A camera for taking pictures,
- A motorcycle for the trip.

1.3.3 Chemical and biological materials

The herbicides encountered as well as the weeds and crops encountered in the plots visited during the surveys.

1.4 Methods

1.4.1 Data collection

Data collection was mainly carried out through surveys of the regional directorates of the Ministry of Agriculture, dealers, and producers. From the regional directorates, the complete list of herbicides registered by the Ivorian State was obtained. This list is drawn up by the Directorate of Plant Protection and Quality Control because it is this Directorate that is in charge of pesticide registrations in Côte d'Ivoire. Resellers' questionnaires asked about the trade names of the herbicides they sold, those that were successful with customers. We then noted the active ingredient, the type of herbicide, and the periods of use of the products. At the grower level, the questions focused more on the names of the herbicides used, how they were used, why they were used, and their impressions of the products.

1.4.2 Data exploitation

The collected data is sent to the laboratory for further processing.

1.4.2.1 Quantitative study of herbicides

The number of products identified is determined. The active ingredients are identified and their number is known. Finally, the most frequent ones are identified.

1.4.2.2 Qualitative study of herbicides

Families of active ingredients and herbicide types are determined.

2. RESULTS AND DISCUSSION

2.1 Results

2.1.1 Diversity of active ingredients

Our survey identified seventy-seven (77) herbicides used by market gardeners and food producers in the north of the country. These herbicides are divided into twenty-two (22) active

ingredients divided in turn into 14 chemical families. Aminophosphanate is the most represented chemical family. The least represented are numerous; Oxydiazole and Triazolinone are a few. The most

represented active ingredients are Glyphosate and its derivatives with 37 p.c. They are followed by Nicosulfuron at 12 p.c. Pendimethalin and Propanil+Triclopyr finish with 9 and 8 p.c. respectively (Figure 1). Total herbicides are the most numerous. They are followed by those used in food crops, mainly in cereal crops. Herbicides used in market gardening are very little present.

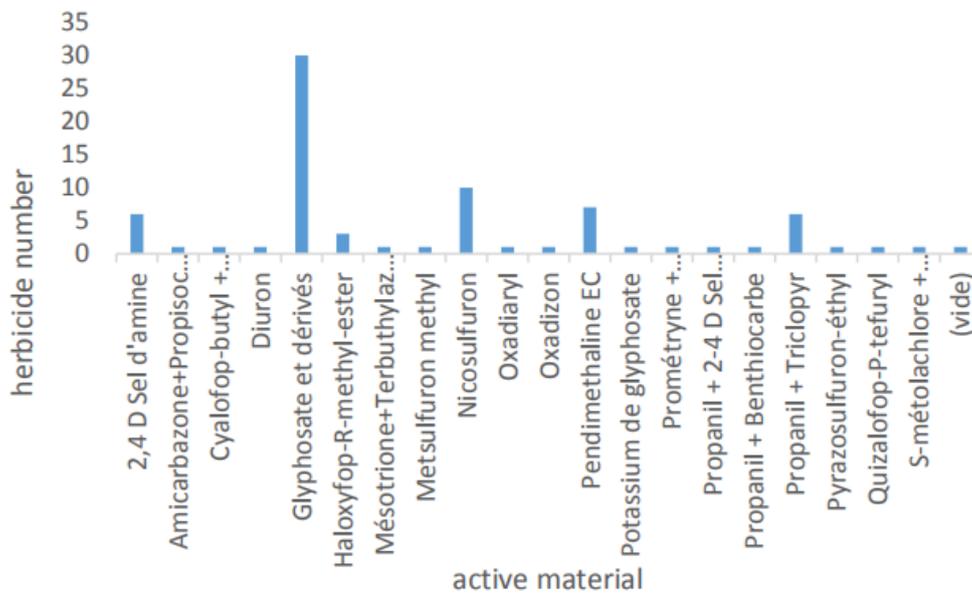


Figure 1: Distribution of herbicides by active ingredients

2.1.2 Mode of use

Total herbicides are generally used before crops are planted. Seventy-four percent of the herbicides are applied post-emergence to weeds, 21 percent are applied pre-emergence and 5 percent are applied post-emergence or pre-emergence depending on the type of crop (Figure 2). The latter will be applied post-emergence in perennial crops and they will be applied pre-emergence in annual crops. All herbicides have an optimum registered use rate expressed on a per

hectare basis. However, the rate is not always respected by growers. Either they are used at an under- or over application rate. Some growers even mix herbicides in mixtures that they do not recommend for the best results. The general observation is that, apart from professionals and certain producers monitored by agricultural agents, the use of products is made according to the expectations, the understanding, and the means of use.

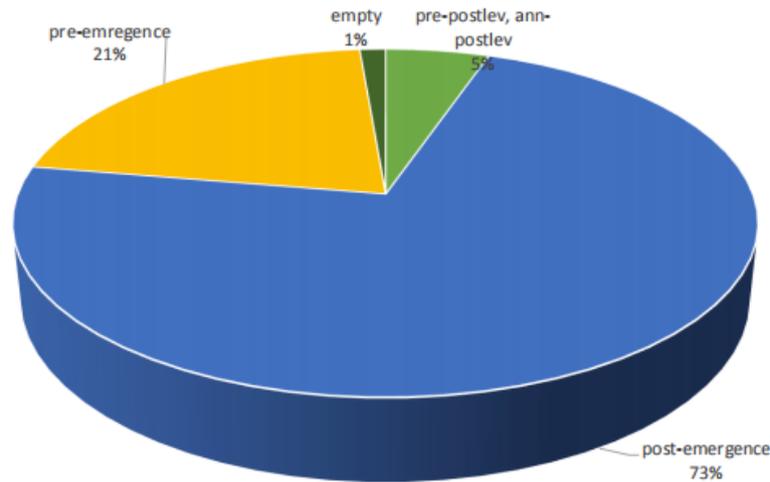


Figure 2: Spectrum of herbicide use periods

2.2 Discussion

The large number of herbicides encountered reflects the strong demand for these products on the market. Indeed, chemical control has long held a prominent place in the fight against pests. Producers in the north of the country are no exception to this rule. Today this part of the country is one of the most important food granaries. However, the sector is subject to the same problems encountered elsewhere. The lack of agricultural labour is one of the main ones. Indeed, as is the case everywhere in our tropics, the return of young people to the land is not yet optimal. Agricultural work is seen as devaluing and demanding enough effort. As a result, most producers are of advanced age. The decline in their physical strength coupled with the need to maintain plot size, therefore, pushes producers to use new farming techniques. This situation pushes them to opt for chemical control as part of the maintenance of their plots. The latter is considered less demanding in terms of physical effort and is also less costly according to the farmers. This situation is similar to that encountered by Fleischer et al. (1998). According to their study, high pesticide use was considered a prerequisite for the success of a rapid agricultural development strategy. At the time, this view had already

favoured the extensive use of plant protection products to increase agricultural production, especially for export crops. The high rate of use of chemical products observed in our study is also observed in France. According to Bathélemy et al. (2020), in 2008 the Ecophyto plan was initiated in France. Its objective is to reduce the use of phytosanitary products in France (reduction of 25% by 2020 and 50% by 2025 according to the Ecophyto 2 plan). And yet today this issue of chemicals in agriculture is still on the table given their study. This is because initial assessments have shown an increase in use rather than a decrease (Guichard et al., 2017). It should be noted that already at that time, after insecticides, the most used pesticides were herbicides, which accounted for more than 20% of the volume and 25% of the total market value (UNIPHYTO, 1997). Glyphosate is the most common active ingredient in total herbicides. This is because it is the main active ingredient in total herbicides. Total herbicides have no target weeds. Their use in fallow land or in crop plots to be eliminated to put a new one is less restrictive and more reassuring for producers. This is consistent with Beckie (2006) who in his study showed that growers used Glyphosate in pre-planting and pre-seeding to eradicate weeds and reduce tillage before planting a crop.

Green (2016) showed that for 15 years Glyphosate was the only method of weed control. However, there are a significant number of crop-specific active ingredients. They are used less than the total because of the agricultural habits of producers. It should be noted that growers visit the field daily when the field is established. The weeds they encounter during their rounds are generally pulled by hand or hoe. Chemical control is generally used when the plot is large enough and when the weeds have a high propagation capacity. This is most often found in export crops. but also, cereal crops such as rice and maize, hence the high percentage of Nicosulfuron behind Glyphosate. This active ingredient is the main component of the herbicides generally recommended in the maintenance of the cereal plots that are widely cultivated in the north of the country. The high consumption of pesticides by cereal crops has been reported by (Fleisher et al., 1998). According to the authors, rice is the food crop that consumes the most plant protection products, its main phytosanitary problem being that of weeds, especially in irrigated systems where direct seeding is practiced (Fleisher et al., 1998). According to the same authors, the research message recommending preventive herbicide treatment before sowing is not a given among rice farmers. Rice growers prefer to wait and see weeds before treating them. This is consistent with the high rate of selective herbicide use in cereal crops.

CONCLUSION

The use of herbicides for pest control in northern Côte d'Ivoire is a reality. The market offers a diversity of products and active ingredients whose use is not always respected by producers. While specific active ingredients are present in the markets and the habits of growers, Glyphosate, which is a total herbicide, remains the one of choice in chemical control. However, it is fair to

note that the assessments of the results of these products differ. While some are satisfied, others, on the other hand, would like even more powerful products in this context of biodiversity conservation and, above all, the promotion of organic farming. A context that they know exists but whose application seems almost impossible for them.

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