Chlorpyrifos in Costa Rica: Country Situation Report

EXECUTIVE SUMMARY

Organophosphate insecticides have been on the agrochemical market for a long time. In Costa Rica there have been import records since the 1970s. Chlorpyrifos is an insecticide belonging to this chemical group and is currently one of the most widely used insecticides in Costa Rica and in the world. In recent years, more than 250,000 kilograms of chlorpyrifos as an active ingredient are imported into Costa Rica annually.

This group of organophosphate pesticides inhibits the enzyme acetylcholinesterase, which prevents the normal transmission of the nerve impulse in organisms such as insects, birds, reptiles, fish, mammals and many other types of animals, thus causing acute poisoning. Organophosphate insecticides cause the highest number of deaths among pesticides globally. In Costa Rica organophosphates produce the greatest number of acute poisonings reported to official entities.

Chlorpyrifos has physicochemical characteristics that give it properties of persistence, bioaccumulation, ability to travel over long distances, and cause adverse effects on human health and the environment. It is considered a Highly Hazardous Pesticide (HPP) under the criteria of FAO/WHO and PAN. The health effects of chlorpyrifos include, in addition to cholinesterase inhibition and subsequent nervous overstimulation that can end in death, brain development disorders in children, even with prenatal exposures, delays in children's cognitive functions, attention problems, greater probability of suffering from autism, permanent nervous effects, and other negative chronic conditions.

Human exposure to chlorpyrifos and other pesticides occurs through several routes: workers who handle, formulate, and sell the pesticide, farmers who apply it, and consumers of food that has been treated with the insecticide. Chlorpyrifos has been found contaminating entire populations that live near plantations where it is used in banana bags, contaminating fruits, vegetables, vegetables. In Costa Rica it is the pesticide with the fourth-highest breaches of the Maximum Residue Limits in these foods.

This insecticide is an extremely acutely toxic substance for aquatic organisms and pollinators, and is highly toxic to birds. Upon reaching the water, it can accumulate in the tissues of fish and other organisms that are exposed to or consume it. In Costa Rica, it is common to find residues of chlorpyrifos for many years in the surface waters of streams, rivers, and lakes in many regions, in marine biota, and in wild animals.

Based on its persistence, bioaccumulation and toxicity, and its presence in many environmental compartments, the use of chlorpyrifos generates significant adverse effects on human health and the environment, justifying legal action and the application of lower impact alternatives, for the management of organisms that, due to selection pressure, have evolved as pests in intensive crops. In this way, several countries have banned chlorpyrifos. Currently, its use is totally prohibited in 41 countries, including the 27 nations of the European Union.

Several other countries have partial prohibitions against its use in agricultural crops, which is not the case in Costa Rica.

There are countless alternatives to chlorpyrifos, applicable in many crops and situations, to avoid the negative consequences that this insecticide can cause in general ecosystem health. Above all, a paradigm shift is necessary so as not to depend on chemical control when pests appear. In this sense, agroecological practices emerge as cleaner, more respectful and sustainable alternatives, which should be encouraged both in systems of small producers and in large extensive agricultural farms. There are several management tactics within agroecology that meet the requirements sought.

Preventive management aims to be prepared before the appearance of possible pest organisms, especially new pests, which can reach a region, farm or specific plot. This includes taking care of the entry of quality and healthy materials into the area, such as seeds, substrates, equipment, tools to ensure they are free of insect eggs or pupae. Maintaining live fences, hedges, nectar plants, attractants, and other types of barriers are ways to preventatively manage pests.

Another type of component is cultural management, which refers to practices to generate favorable conditions for cultivation but inhospitable to pests. Among these practices are adequate soil preparation, which includes minimum tillage or use of stubble as cover and enrichment of soil microorganisms, crop rotation, planting of mixed crops, adequate planting density, and other practices, preferably combined, that enrich the biodiversity of the agroecosystem, which bring larger ecosystem benefits.

Physical management practices include tools to control insects without the use of poisons. Among these are traps of various types: sticky, soapy, polychromatic, with or without attractants, light, combined, suitable for many growing situations (outdoors, protected environments, etc.) and various activities. Another physical practice is soil solarization and biofumigation that seeks to control various pests, including insect larvae and pupae and nematodes, either directly in the soil or in substrates used for cultivation. Also, the enrichment of the soil with chitin sources favors soil microorganisms that consume chitin, a substance present in insect eggs and nematodes, thus reducing these pest populations. Another very novel and little-studied source is the application of ozone (O3) by irrigation water or in oil emulsion, which is effective in controlling soft insects and mites. Mechanical driving tactics can also be applied. From the collection and burial of organs or crops infested with pests, to the mechanical removal of insects with blowers or vacuum cleaners.

Very important is biological management, which is based on the action of natural enemies of pests, which can be predators, parasitoids, fungi, bacteria, viruses, nematodes, among others. All this maintaining an adequate population of, for example, nectar plants or organic matter in soils, which protect and perpetuate these beneficial organisms; and obviously the non-use of biocidal pesticides that break that balance. There are many successful experiences in the use of parasitoids of mainly eggs, of pest insects such as *Trichogramma* sp and *Cotesia* sp; of predators such as Chrysopas, Ladybugs, wasps and other organisms that are even sold commercially as "Systems" and include mites, bugs and predatory beetles, entomopathogenic

nematodes and nematophagous. There are also entomopathogens such as *Bacillus* sp, *Beauveria bassiana*, *Metharrizium* sp, P*aecelomyces* sp, *Lecanicillium* sp, among many others.

Botanical extracts, repellents and natural insecticides, such as Neem, pyrethrums and various other local plants, must not be neglected. Likewise, substances with a lower impact on health and the environment such as sulfur, lime, cytokinins, potassium salts and other extracts. There is no doubt that the current offer of alternatives is large and is suitable for many pest management situations, and there is hope that new discoveries in the area of agroecology will fill current gaps. Along these lines, at the end of the document, case studies of Costa Rican commercial farms and various crops are presented, demonstrating that chlorpyrifos or any other organophosphate insecticide is essential in food production systems, whether for small or large agribusiness.