

# Agrochemicals for pest control in Brazil: a critical analysis of the use of the term *agrotóxico* as a tool for risk communication

## Agroquímicos para controle de pragas no Brasil: análise crítica do uso do termo *agrotóxico* como ferramenta de comunicação de risco

### ABSTRACT

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Due to their potential in causing harm to human health and the environment, agrochemicals used for pest control are among the most controversial and regulated substances worldwide. In Brazil, the controversy starts with the name given to these products, including the one stated in Law n. 7802/89 - *agrotóxicos*, only adopted in the country. This paper covers the historical context that led to the inclusion of this term in the Law, and shows data indicating that this action did not affect the safety practices adopted by farmers, or the number of intoxications, nor did it affect the commercialization of these products, which were the primary goals of the governmental authorities. Furthermore, the paper discusses terms used in other countries, considering the key factors that could affect the risks and the use of these products. The authors concluded that the term *agrotóxico* does not contain the necessary technical or semantic attributes to be adopted in a legal text, and that the use of neologisms, whether they send positive or negative messages, are not appropriate for communicating the risks posed by these products to the general population and farmers, in an honest, responsible and technically supported way.

**KEYWORDS:** Agrochemicals; Legislation; Communication; Risk

### RESUMO

Devido ao seu potencial de causar danos à saúde e ao meio ambiente, os agroquímicos utilizados para o controle de pragas estão entre as substâncias mais controversas e reguladas no mundo. No Brasil, a polêmica começa pelo nome que se dá a esses produtos, incluindo a denominação *agrotóxicos* prevista na Lei nº 7.802, de 11 de julho de 1989, de estrutura semântica pouco ortodoxa e só adotada no país. O presente texto aborda o contexto histórico nacional que levou à incorporação do termo na Lei e apresenta dados que indicam não ter havido sinais de que esta medida tenha exercido influência efetiva sobre as práticas de segurança adotadas pelos agricultores, as intoxicações e tampouco impactou na comercialização desses produtos, apesar de terem sido estes os objetivos iniciais das autoridades. Discute, ainda, as terminologias adotadas em outros países para denominá-los, à luz dos fatores que verdadeiramente impactam na redução dos riscos e do uso dessas substâncias. Os autores concluíram que o termo *agrotóxico* não possui os atributos técnicos nem semânticos necessários para uma adoção legal, e o uso de neologismos, seja com conotações negativas ou positivas, não é apropriado para comunicar o risco destas substâncias aos trabalhadores e à população geral, de forma honesta, responsável e tecnicamente embasada.

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## INTRODUCTION

Organosynthetic substances were introduced in agriculture from the 1940s, after the discovery of the insecticidal properties of Dichloro-Diphenyl-Trichloroethane (DDT) by Swiss chemist Paul Müller, which earned him the Nobel Prize for Physiology or Medicine in 1948<sup>1,2</sup>.

This initially led to a positive impact on food production, as well as on the control of vectors responsible for the transmission of serious diseases like yellow fever and malaria. However, their intensive use, combined with ignorance of their harmful effects on human health and the environment, gave rise to the environmental movement in the United States. This movement soon spread to the rest of the world, and one of its landmarks is a book called *Silent Spring*, by Rachel Carson (1962).

Ever since then, agrochemicals used in pest control, hereinafter referred to as pesticides, began to be questioned. The analysis and the consequences of these questions are outside the scope of this work. Nevertheless, mention should be made of the recent document produced by the Organization for Economic Cooperation and Development (OECD), which highlights the negative consequences of intensive agrochemical-based agriculture with adverse impacts not only on health and biodiversity but also on social, economic and regulatory affairs<sup>3</sup>.

In Brazil, there is increasing tension between the agroindustrial productive sector and the health and environment sectors, particularly with regard to the regulation and marketing authorization of pesticides. While the former claims excess bureaucracy in the process, which reduces Brazil's international competitiveness and causes economic losses and losses to farmers, the latter two argue that there is a need for strict control of these products in order to protect people's health and the environment. They even invoke the Precautionary Principle, to which Brazil has been a signatory since the United Nations Conference on Environment and Development, also called Rio-92<sup>4</sup>.

This tension reached its highest point over the last two years, with the unlocking of bill (PL) 6.299, originally presented on March 13, 2002, to which items of other bills previously processed were added with the objective of amending Law n. 7.802, of July 11, 1989<sup>5</sup>. Of the proposed amendments, we highlight the change in the term "agrototoxic", adopted to designate the chemicals used in pest control in Brazil. Initially, PL n. 6.299/2002 proposed replacing the current term by "phytosanitary product", with the argument that the word "agrototoxic" would attach a negative connotation to this class of products, far from the purpose for which they are used. However, this proposal had a strong negative repercussion among the health and environment sectors, causing controversy and forcing the adoption of amendments through substitutes, including the use of the term "pesticide" to refer to these products. Near the conclusion of this manuscript, the bill was voted and approved in a Special Committee of the Chamber of Deputies. It was then waiting to be selected for deliberation in a plenary session<sup>5</sup>.

The present debate addresses the Brazilian historical context that led to the adoption of the term "agrototoxic" in Law n. 7.802/1989 and discusses whether this communication strategy achieved its objectives in the perception of farmers' risk, occurrence of poisoning episodes, and the marketing of these products.

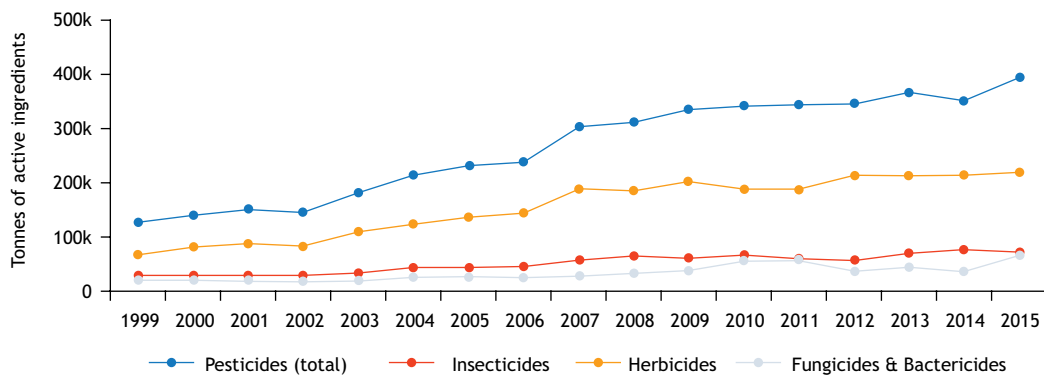
## DISCUSSION

### The use of pesticides and human poisoning in Brazil

Brazil is among the largest users of pesticides on the planet in absolute numbers. China ranks 1st, using 1.8 million tons of active ingredient (ai)/year<sup>6,7</sup>, followed by Brazil and the United States, with approximately 0.4 million ton/year each<sup>7,8</sup>. In market terms, the United States and Brazil have been taking turns in the 1st and 2nd position over the last decade, both with about USD 9.5 billion in sales, followed by China with approximately USD 8 billion<sup>9</sup>. However, absolute parameters are not the best indicators for this type of comparison, given the substantial territorial differences between countries. When considering the amount used per unit of agricultural area, Brazil ranks 28th in the world, using an average of 4.57 kg ai/ha in 2015, behind countries like Italy, Belgium and the Netherlands (7-9 kg ai/ha), South Korea, Japan and China (11-13 kg ai/ha), in addition to Colombia (14.7 kg ai/ha) and Chile (25.07 kg ai/ha)<sup>7</sup>. It is important to note that the agricultural area of Brazil accounts for about 18% of the country, of which only 7.6% is actually under current agricultural occupation<sup>10</sup>. This implies that highly technical Brazilian agriculture is concentrated in smaller pieces of land. Therefore, in practice, the amount of active ingredients applied per hectare is considerably higher in densely farmed agricultural regions, compared to the average Brazilian value.

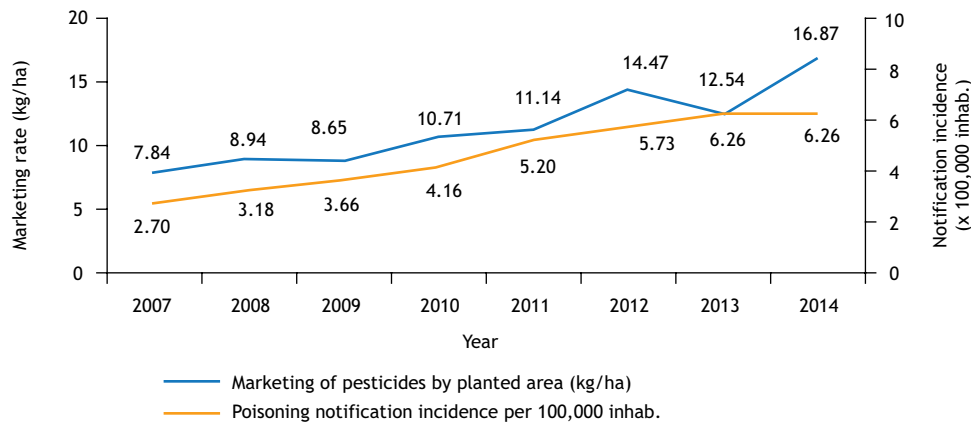
Data from the Food and Agriculture Organization of the United Nations (FAO) indicate an increase in the use of pesticides in the last two decades in Brazil, from a total of 0.13 million ton/year in 1999 to about 0.4 million ton/year in 2015<sup>7</sup> (Figure 1). This is compatible with Brazil's economic and agricultural production growth in the period, fueled, among other factors, by China's entry into the international trade scene as a major buyer of Brazilian commodities. Nevertheless, the number of rural workers in the country has declined over time, from 17.9 million in 1995 to 16.6 million in 2006 and 13.9 million in 2013. This is proportional to the gradual reduction of the total rural population itself<sup>11,12</sup>.

In Brazil, about 7,000 to 9,000 cases of pesticide poisoning are reported every year<sup>13,14</sup>. Figure 2 shows that the steady increase in the incidence of these poisoning episodes from 2007 to 2014 is directly related to the increase in the marketing of these products in the period. These poisoning episodes include suicide attempts. In those cases, the term "agrototoxic" may have influenced some individuals in choosing those agents to try to kill themselves. However, the relationship shown in Figure 2 still persists, since the percentage of attempted suicides with



*Insecticides: insecticides; Herbicides: herbicides, fungicides/bactericides: fungicides/bactericides.*  
Source: FAOSTAT, Food and Agriculture Organization of the United Nations<sup>7</sup>.

Figure 1. Use of pesticides in Brazil between 1999 and 2015, in thousand tons of active ingredient.



Source: Department of Surveillance in Environmental Health and Worker's Health, Ministry of Health<sup>13</sup>.

Figure 2. Correlation between increase in the marketing of agrotoxics (including technical products) and number of poisoning episodes.

pesticides is stable over the analyzed period, corresponding on average to 40% of the poisoning episodes with these products<sup>15</sup>.

It is quite likely, nevertheless, that the number of pesticide poisoning episodes in Brazil is underreported, especially in rural areas. In the United States, underreporting of acute occupational poisoning by rural workers has been estimated at up to 88%<sup>16</sup>, reaching 96% in Tanzania<sup>17</sup> and more than 95% in Nicaragua<sup>18</sup>. Based on these estimates, as well as on studies with family farmers in the Brazilian state of Rio Grande do Sul<sup>19</sup>, we can speculate that the underreporting of acute occupational/accidental poisoning by pesticides in Brazil is at about 95%. This percentage is consistent with the information that only 3% to 7% of the individuals seek hospital care because they present some symptom of poisoning due to exposure to exogenous agents in general<sup>20</sup>. This means that, for each case of acute occupational/accidental pesticide poisoning reported in the Brazilian countryside, there are about 20 non-notified cases, leading to approximately 70,000 acute pesticide poisoning episodes in the country every year. Despite this underreporting, data from the Mortality Information System (SIM) indicate that there were 679 occupational poisoning deaths

with pesticides in Brazil between 2000 and 2009<sup>21</sup>. It should be noted that, among the specifically identified causes, pesticide poisoning episodes were the main causes of death due to work-related accidents in women, considering all agricultural activities in Brazil<sup>22</sup>.

Estimates of pesticide poisoning rarely consider possible chronic effects caused by this exposure, which are seldom reported, given the complexity inherent in establishing causality between exposure and long-term effects<sup>23</sup>. In addition, exposure to pesticides often produces nonspecific clinical symptoms, such as headache, nausea and dizziness, which are not always identified by the farmer or healthcare system as being related to the exposure. Recent World Bank assessment found that the face of world poverty is primarily rural and young, with 80% of those living in extreme poverty and 75% living in moderate poverty occupying rural areas<sup>24</sup>. In this sense, we must also put the numbers in perspective in the context of poor health conditions, poor housing, limited hospital access, nutritional deficiency and exposure to severe heat, which are part of the circumstances of the majority of rural workers in Brazil. These conditions often produce symptoms that may be confused with



effects resulting from pesticide poisoning, generating additional difficulty in attempting to estimate a more realistic number related to poisoning caused by occupational exposure to these products<sup>25</sup>. It is also important to recognize that, in general, about 80% of the cases correspond to poisoning were considered to be of lesser severity and of rapid recovery<sup>19</sup>.

#### Legal definition: historical context

The first federal norm that sought to discipline the use of chemical products in agriculture in Brazil was Decree n. 24.114, of April 12, 1934, which established the Regulation of Plant Health Defense. This decree preceded the introduction of synthetic substances in agriculture, mentioning only insecticides and fungicides, since herbicides and other classes were not yet commercially used<sup>26,27</sup>. The decree was in force for more than half a century, and its gaps were filled by the publication of ministerial ordinances and other norms, until the publication of Law n. 7.802/1989.

The military regime established in Brazil in 1964 had its peak in the 1970s, during the so-called Green Revolution in agriculture. This revolution was characterized by the introduction of new agricultural technologies and cultivation techniques, increasing productivity and constituting a new technological paradigm of agricultural production<sup>28</sup>. Considering that the military regime adopted a developmentalist approach, in addition to the fact that Brazilians were not fully aware of the consequences that this development at all costs could have on human health and the environment, the context was conducive to the implementation of the practices evoked by the Green Revolution in the Brazilian countryside<sup>29</sup>.

During this period, subsidies and incentives were offered so that farmers could have access to the agricultural technologies then considered modern, including the use of pesticides, mainly through the National Program of Agricultural Defenses, created in 1975, which enabled investment in the setup and development of the Brazilian agroindustrial complex<sup>27</sup>. Brazilian agriculture then achieved ever higher levels of agricultural production/productivity, which would be the foundation of the country's model of agrarian development that continues to this day. In effect, grain production in Brazil grew more than six-fold between 1975 and 2017, from 38 million tons to 236 million, while the planted area only doubled<sup>30</sup>. The increase in the yield of wheat (346%), rice (317%) and maize (270%), as well as soybean and beans, which virtually doubled in the analyzed period, should be highlighted.

In the face of the whole package of incentives that the government dedicated to encourage the use of pesticides and other agrochemicals, it was expected that the official name of this class of products at the time would be aligned with the objectives of boosting the growth and modernization of national agriculture. There was not, therefore, much room for discussion about farmers' health or the possible environmental damage that these products could cause. In 1971, the first normative mention was made of the term "*defensivo*" (Ministry of Agriculture Ordinance

n. 295, August 23, 1971), conceptualizing organomercurial pesticides and introducing the notion of "agricultural defenses", without mentioning its potential to cause negative impact. From then on, this term would be used euphemistically even in campaigns to promote the use of these products<sup>27</sup>.

In the 1970s, government concerns regarding the potentially harmful effects on rural workers and the environment resulting from the massive use of these inputs were mainly addressed by initiatives of the Extension Department of the Executive Committee of the Cocoa Plan (Depex/Ceplac), with the implementation of personnel training programs aimed at curbing the indiscriminate use of pesticides, both economically, to avoid waste, and in relation to human health and regional ecology<sup>31</sup>.

Law n. 7.802/1989, which governs the production, import, export, trade and use of these products in agriculture, mentioned the definition of the term "agrototoxic" for the first time in the federal sphere. The environmentalist movement, which grew and gained importance in Brazil in the late 1970s, was at the heart of the coining of this neologism, attributed to Paschoal in a 1977 publication (Figure 3)<sup>32</sup>, and quoted later by himself and other authors<sup>27,33,34,35,36</sup>. In a recent testimony, the creator of the term points out that this designation came to fill a gap

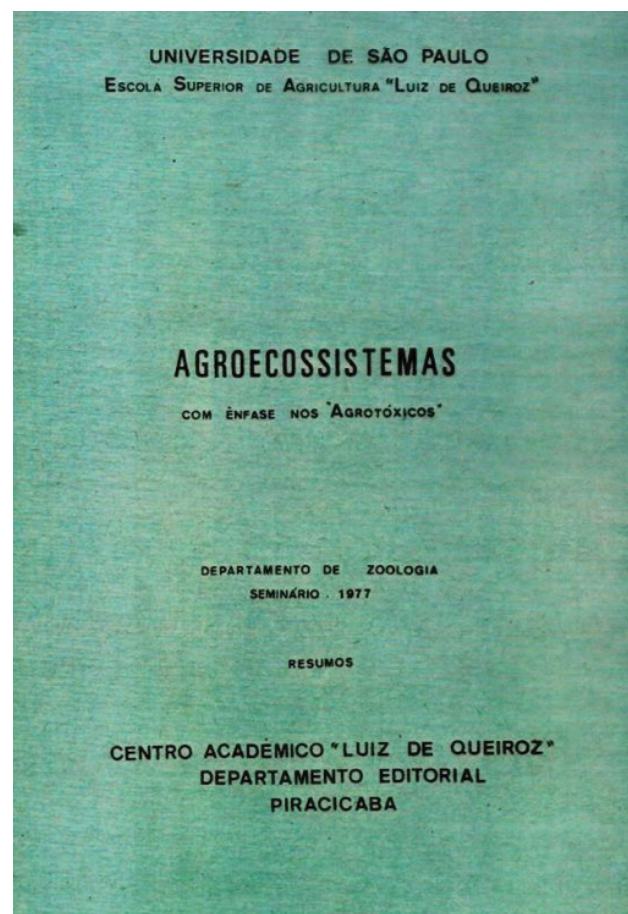


Figure 3. Cover of the first publication mentioning the term "agrototoxic" in Brazil<sup>32</sup>.





because “there was no precise term to indicate the toxicity of the agrochemicals used in the fields,” and that it “worked as an alert to consumers about the presence of a ‘toxic’ component in the food”<sup>37</sup>. This term had previously been introduced in State Law n. 7.747, of December 22, 1982, in the state of Rio Grande do Sul, and later in Paraná (Law n. 7.827, of December 29, 1983), Santa Catarina (Law n. 6.452, of November 19, 1984) and São Paulo (Law n. 4.002, of January 5, 1984).

Therefore, Law n. 7.802/1989 apparently only recorded what was already known to health and environmental activists, at least.

In its Art. 2, the Law defines “agrotoxics and related products” somehow in line with international definitions, but without describing what “related products” means. These products are, therefore, defined indistinctly from agrotoxics:

Art. 2 For the purposes of this law, it is considered:

I - agrotoxics and related products:

(a) products and agents of physical, chemical or biological processes, intended for use in the production, storage and processing of agricultural products, in pastures, in the protection of forests, native or planted, and other ecosystems and urban, water and industrial environments whose purpose is to modify the composition of the flora or fauna in order to preserve them from the harmful action of living beings that are considered harmful;

b) substances and products used as defoliants, desiccants, growth stimulators and inhibitors; [...]

The definition shows that the term “agrotoxic” covers a wide range of products in addition to those of agricultural use, like products for household purposes, for the control of vectors in public health campaigns, for use in aquatic environments, for use in the treatment of wood, besides the products referred to as “of non-agricultural use”, used, for example, in railroads, industrial yards and firebreaks.

It is interesting to evaluate the historical context of Brazil at the time that Law n. 7.802/1989 was enacted. The country had just left 21 years of military rule, a period that did not encourage free expression and exchange of ideas nor any debate of a social nature involving the various strata of society. Only four years after the end of the regime was the Federal Constitution of 1988 (CF/88) enacted. It is considered by some authors to be the most democratic and progressive of all the constitutions Brazil has ever had<sup>38</sup>, with advances and guarantees in the social field, including health, education, environment and consumer rights. Furthermore, the term pesticide is in art. 220, §4, of CF/88, in a particular context, restricted to the advertisement of several products that can be harmful to health. In mentioning it without defining it, CF/88 assumed that the term was already popularly known and culturally assimilated in the country at that time.

Art. 220, § 4 Commercial advertising of tobacco, alcoholic beverages, agrotoxics, medicines and therapies shall

be subject to legal restrictions, pursuant to item II of the preceding paragraph, and shall contain, whenever necessary, a warning about the harm caused by their use.

A remarkable aspect is that the legal-regulatory framework that began to be (re)designed at that time, especially in the areas of greater social sensitivity, often sought to counter the prevailing model or structure of the military regime. It could not have been otherwise with topics related to agrarian issues. Thus, by formalizing the term “agrotoxic” in Federal Law n. 7.802/1989 and in some state laws, the aim of the legislators was to oppose the use of the term “agricultural defense”, embraced not only by the domestic productive sector, but also by the official terminology of regulations of the time, including health agencies (for example: Disad Ministerial Order n. 4, of April 30, 1980). Both terms, while seemingly interchangeable, suggest their own value judgment and express clearly different notions of risk. Whereas “agricultural defense” highlights the positive aspects of these products as regards their protective character, its “agrotoxic” counterpart draws attention to the harm it can cause to health and the environment, trying to communicate a sense of danger/risk. To the best of the authors’ knowledge, neither of the terms is found to be similar in any other language or country.

In the rest of the world, technical terms are primarily used to refer to these particular agrochemicals. In the English and French languages, the term “pesticide”, translated as *pesticide* in Portuguese, is used, whereas in Spanish the term employed is *plaguicida*, or *praguicida* in Portuguese. *Pesticida* and *praguicida* are also the terms preferred by the Brazilian academic community, because, in addition to being technically more appropriate, they do not have semantic inconsistency, as discussed later. Until the present day, “agricultural defense” is the denomination of choice of the public and private sectors linked to the production and research in agroindustry in Brazil, while the legal term “agrotoxic” is mostly used by activist groups in the area of health and the environment.

European Union regulations on the subject adopt the term “plant protection products” (commonly abbreviated to PPP), and even *fitofarmacêuticos* to designate this class of products in Portuguese (Regulation (EC) n. 1.107/2009, of October 21, 2009). These are the closest semantic analogues of “agricultural defense”. It should be noted that in recent decades Europe has had very strict control over the marketing and use of these products<sup>39,40</sup>, as well as over industrial chemicals in general<sup>41</sup>, although the term used on the continent does not directly reflect this concern.

### The semantic inconsistency of the term

The meaning of words, and ultimately the manner in which all things are termed, and which will reflect on how we express ourselves about them, is of paramount importance in all areas of human knowledge, especially in science<sup>42</sup>. Etymologically, “agro-toxic” derives from the junction of the prefix “agros” (from Greek, field) with the suffix “toxicon” (from Greek, poison), and there is no mistake in this derivation<sup>32</sup>. However,



from the semantic point of view (meaning), the junctions involving the suffix “toxic” give more effect to the term used as a prefix. Thus, strictly speaking, the conceptual meaning of “agrototoxic” is “toxic to the field,” just as neurotoxicity denotes “toxicity to the nervous system,” hepatotoxic, to the liver, genotoxic, to genes, and so on. This means that the real sense, semantically speaking, is different from the one purported to have been proposed with the “agro + toxic” combination, since, at least in theory, the agent should not be toxic to the environment in which it is being applied, otherwise nothing could be grown in it, for nothing would survive, including the field itself. At the very least, such terminology produces ambiguity, implying that these substances are toxic to agriculture, which is obviously not their purpose, despite the ecological imbalance they can cause, including the development and proliferation of new pests, many of which were hitherto regarded as beneficial species<sup>33</sup>.

Another misplaced situation generated by the term “agrototoxic” in the Brazilian regulatory framework is due to the fact that its definition also comprises products used in environments other than crops, as already mentioned. This leads to an irreconcilable semantic use of the term, i.e., “agro-toxic” used in households, water and other non-agricultural environments. Thus, the expression “agrototoxics of agricultural use” should be considered a linguistic tautology, but it is not, at least not according to Law n. 7.802/1989, given the existence of “agrototoxics for non-agricultural use” authorized for other purposes.

#### The technical inconsistency of the term

*“All substances are poisons; there is none which is not a poison. The right dose differentiates poison from a remedy”.* With this famous phrase, which may be summarized as “The dose makes the poison,” Paracelsus (1493-1541) laid the foundations of modern toxicology<sup>43</sup>, proving that toxicity is an inherent characteristic in every chemical substance (and its interaction with biological systems) rather than an attribute restricted to a particular class of compounds, sometimes referred to as poisons<sup>44</sup>. That is, all chemical substances, natural or synthetic, are potentially toxic - some more, some less. It is, therefore, a property. Incidentally, the most toxic substances known have not been synthesized by men. These include botulinum toxin, aflatoxin B, tetrodotoxin, strychnine and nicotine<sup>45</sup>. These are also good examples of divergence between common understanding and scientific knowledge<sup>46</sup>.

Therefore, toxicity is not unique to pesticides. Adding the “toxic” suffix to these products may even have negative practical implications, including their use as an agent in suicidal actions. In popular imagination, which most often does not differentiate between the various forms and instances of power in the Public Administration, there is a deep-rooted idea that the government, as an abstract and at the same time omnipresent entity, considers that only pesticides contain toxicity, since they are the only products explicitly labeled as toxic under the law. Subliminally or not, the message conveyed to the population is that other classes of products, such as medicines, home sanitizers

and paints, are not harmful, since they are not formally referred to by a neologism that emphasizes their dangerous nature, although this has been suggested in the case of household products (“domitoxics”), in order to maintain terminological consistency with their agricultural analogues<sup>47</sup>.

#### The inadequacy of defining neologisms in laws

Terms with technical and semantic imprecision, which may convey misconceptions and somehow generate ambiguity in the understanding of their meaning, may not be the most appropriate for use in legal devices, for whatever purpose, however fair it may seem. In fact, the use of neologisms in official texts, although not prohibited, is seen with reservation<sup>48</sup>.

There is apparent consensus that “agrototoxic” and “agricultural defense” are terms that, at their opposite ends, convey bias, each representing an ideological current (against or in favor of their use), whose merit goes beyond the scope of this article. Ideological expressions are legitimate and inherent in human nature. What is debatable is their relevance in legal instruments and official writing. These must consider the constitutional precepts of impersonality, clarity and formality, not in accordance with expressions or jargon that give value judgments<sup>48,49</sup>.

It may be argued that, once mentioned in the Federal Constitution of 1988 (CF/1988), the term “agrototoxic” would become mandatory in subsequent legislation. However, reinforcing the idea that CF/1988 mentions, but does not impose its adoption, we cite Law N. 9.294 of July 15, 1996, which “provides for restrictions on the use and advertising of tobacco products, alcoholic beverages, medicines, therapies and agricultural defenses, pursuant to §4 of art. 220 of the Federal Constitution.” This law, while explicitly invoking the provisions of CF/1988 that allude to agrototoxics, chooses to use a different term, even though it refers to the same class of products.

#### Reporting risk to farmers

Farmers in peripheral countries like Brazil are subject to numerous negative externalities. The most immediate risks are economic, since their labor activity depends on climatic, seasonal and even currency exchange-related factors, on which they have no influence. In addition to these, there are risks involving the health and physical integrity of this population due to exposure to hazardous chemicals, as well as to mechanical and electrical factors and noise pollution in the operation of equipment like tractors and agricultural aircraft. Indirect hazards due to exposure to sunlight, severe heat, pollen, dust and other dispersed particles, as well as worms, viruses and bacteria that proliferate particularly in the rural environment cannot be disregarded<sup>50,51</sup>. In this context, the effective communication of these risks is of paramount importance.

In a process of communication or exchange of information, the recipients must be able to decode the meaning of the information they receive. Misunderstanding is caused both by the inability of the recipients to understand what was meant and



by ambivalent messages from those who sent the information. This is all the more evident when the concept of communication is applied to social sciences, given their greater level of complexity and possibilities of interference<sup>52</sup>. By way of comparison, pictograms on pesticide labels are not always understood by farmers as expected because of differences in sociocultural contexts between the senders and the recipients of the message. These differences are often difficult to predict<sup>53</sup>.

Studies demonstrating the factors associated with the farmers' perception of pesticide risk have been well documented in several regions of the world, and the characteristics are similar among more and less developed countries, including Brazil<sup>54,55</sup>. These are structural, sociocultural and cognitive aspects that permeate the labor universe of rural workers. In general, low levels of education, older age and limited technical assistance proved to be strong determinants of low risk perception, whose main indicators are the non-use of protective equipment, failure to read the safety recommendations contained in the package insert and lack of care in handling and storing the products<sup>54,55,56,57,58,59,60,61,62,63</sup>. None of the studies conducted in these countries reported influence of the term attributed to products or used by farmers on the perception of risk.

In Brazil, in addition to observing similar determinants in the influence of the perception of risk by rural workers<sup>12,63</sup>, some authors analyzed regional aspects of how farmers refer to pesticides. For example, while farmers in the state of Piauí referred to these products as "poison"<sup>64</sup>, most farmers in the municipalities studied in the states of Santa Catarina and Rio Grande do Sul chose to call them "medicines" (for the plant)<sup>65</sup>, which is the same name chosen by farmers in a rural area of Rio de Janeiro<sup>65</sup>. The authors noted that, despite the greater perception of risk presented by farmers from Piauí (who call it "poison"), this did not translate into greater care in the handling and use of the products. These rural workers' practices are similar to those observed in rural workers from Southern and Southeastern Brazil. Such habits include using hands and mouth to unclog spray nozzles and even taste the product with the tip of their tongue, since for them a strong odor/taste is a sign of high efficiency in pest control, no matter whether product is called poison or medicine. In the work done with farmers from the state of Rio de Janeiro<sup>65</sup>, of the 97% who call these products "medicines", 70% stated that they perceive the risks these products pose. The 3% who do not refer to them as "medicines" have reported that they do not use them because they have suffered acute poisoning by these products in the past. In another study carried out in Rio de Janeiro, farmers mentioned various names, including "poison", "medicine", "agrototoxic" and "insecticide". Again, there was no clear correlation between the given name and the perceived risk<sup>66</sup>.

This dichotomous character of pesticides (sometimes poison, sometimes medicine), coupled with the subjective mechanism of denial (of danger) by farmers<sup>67,68</sup> - given their need to use these products - permeate the universe of rural risk perceptions, bearing little or any resemblance to the terminology adopted for those products.

Peter Sandman, one of the pioneers of risk communication in the United States, thinks it is valid that Brazil has adopted the term "agrototoxic" as an instrument to communicate risk, particularly to farmers, considering the scarcity of other notably more effective measures<sup>69</sup>. On the other hand, he added that the introduction of a supposedly neutral term, like pesticide, should not at first change people's perception of risk, since they tend to create cognitive defense mechanisms (distrust or aversion) to the new name that would be introduced. Sandman warns that in English-speaking countries the term "pesticide" causes the same feeling of fear or repulsion as "agrototoxic" in Brazil.

In analyzing the effectiveness of Law n. 7.802/1989 10 years after its publication, Garcia<sup>26</sup> concluded that no significant change occurred in terms of the intensity of use of the products or the number of less toxic products that were registered (toxicological and/or environmental classes III and IV). Over the decades, there have been no signs that the strategy has had an impact on the number and/or severity of poisoning episodes. Moreover, there has been no evidence of stabilization (or less growth) in the marketing of these products as the "agrototoxic" name was being assimilated, as shown in Figures 1 and 2. In fact, it is observed that "agrototoxic" became much more than simply a warning term, but also a symbol of the struggle to reduce the use of these products, in all their forms, even refusing mention of their rational use<sup>70</sup>. With the de-characterization of the bases that would sustain the discourse of some segments of society in favor of the use of this term, the argument for its maintenance in the legislation notably loses strength. Its champions can argue that, in the chronic absence of effective measures to ensure greater protection for rural workers, changing the name was the most feasible action that could have been taken at the time. Many may also argue that, had there not been the creation of the "agrototoxic" neologism and its definition in law, the situation of sales and indiscriminate use of these products in Brazil would be even worse. Of course, there is no way to prove them wrong. However, some comparative data do not support this claim. For example, the estimated annual incidence of acute pesticide poisoning in Nicaragua, which uses the term *plaguicida* to refer to these products, is 2.3%<sup>18</sup>, similar to Brazil's, whose estimated incidence based on a study conducted in the South region was 2.2%<sup>19</sup>. A similar pattern of use and poisoning by these products is observed in Argentina and other Latin American countries<sup>71</sup>.

The fact is that three decades after the adoption of the term "agrototoxic" in Brazil, no other nation dared to take up the same strategy, including its Latin American neighbors, despite the geographical proximity, sociocultural affinities and similarity between languages. According to Peres et al.<sup>72</sup>, the term "pesticide" would have a greater positive connotation of giving crop protection, than negative, to warn people about its harmfulness. However, the subliminal cognitive effects on the human mind caused by the suffix "cide", which overlaps the strength of the prefix "pesti", suggests that it evokes the message of death, extermination. Such cognition is explained by Kahneman<sup>73</sup> as



being related to our mental system responsible for instinct and emotion, which operates predominantly in this type of situation, dictating the component of human beings' intuitive behavior.

It must be pointed out that plague (*peste*) is, in fact, more related to the disease than to the organisms that gave rise to it<sup>32</sup>. *Pesticida* is an example of an English word adopted by the Portuguese language, i.e. a form of Anglicism. From this point of view, *praguicida* can be considered a term of greater etymological consistency in the Portuguese language. However, "pest" in English is also translated by *praga* in Portuguese; in turn, *praga* means both "pest" and "plague", so that their meanings are confused. In fact, of Latin languages, only Spanish adopts the term "plaguicide" (*plaguicida*). "Pesticide" is the preferred name in French, Italian and Portuguese in Portugal<sup>74</sup>. In addition, there is currently no single term that faithfully represents all the attributes of these products, given their diversity of purposes and functions. Therefore, "pesticide" emerges as an option because of its wide use and international acceptance.

It is not uncommon to see public agents employing distinct terms to refer to these products, often in the same standard or regulation. For example, an official publication of 2013 from the Secretariat of Agricultural Defense of the Ministry of Agriculture, Livestock and Supply (SDA/MAPA) used the word *praguicidas* to refer to these substances<sup>75</sup>. In another regulation of this Ministry published in 2018, the terms "agrotoxics", "pesticides", and "agricultural defenses" coexist in different articles<sup>76</sup>. Resolution RDC n. 18 of April 3, 2013 of the Brazilian Health Surveillance Agency (Anvisa) on medicinal plants and herbal medicines incurs similar confusion, mentioning pesticides and agrotoxics in the same sentence, in Art. 150, as if they meant different things<sup>77</sup>.

## CONCLUSIONS

Perhaps today we have already achieved the level of maturity needed to recognize that the historical dispute involving sectors of health and the environment versus the productive sector around the terminology used for agrochemicals for pest control serves stakeholders whose interests are not necessarily consistent with their narratives. The "agrotoxic" name does not have the technical or semantic attributes necessary for legal adoption, despite the praiseworthy initiative of its creators at the time, considering the socioeconomic and political context at the time of its coining. The adoption of terms that denote value

judgment, in addition to being inappropriate in official regulations, can lead individuals to have very different perceptions (and attitudes). The conjunction of structural and psychosocial factors that permeate the complex cognitive universe of their decision-making power and their freedom of choice on which paths to follow or not to follow, must also be considered, particularly when there are risks and benefits involved, albeit sometimes not so clearly perceived.

The legal name given to these products does not seem to influence farmers' perception of risk, with consequent greater care regarding their safety and that of the environment, nor does it act as a factor to minimize their use. On the contrary, the adoption of the term "agrotoxic" may have contributed to the opposite situation, i.e. greater use, considering that many rural workers associate the toxic power of a product with its greater effectiveness against the pests that attack crops. Inappropriate and/or excessive use of pesticides in Brazil, with small adoption of safe practices, is a consequence of several factors, including ineffective control of retail sales, poor rural assistance, inadequate enforcement of Good Agricultural Practices, socioeconomic challenges and the low level of education of this population. This makes it difficult for some to understand the label/package insert of such products, as well as hindering their perception of risk.

The statistics on poisoning and consumption of these substances in Brazil seem to corroborate the thesis that the adopted terminology did not have the expected effect of reducing their use (or misuse). It is important to emphasize that farmers are hardly guided by the law, which is weakly enforced in the countryside. Many farmers probably do not even know the name that is legally defined.

Stakeholders in health regulation should seize the opportunity to delve deeper into the subject and start using effective risk communication strategies in the area of pesticides, based on acquired knowledge and reflecting the international state of the art on this matter. The creation of jargon or neologisms, whether with negative or positive connotations, is not considered appropriate for this fundamental purpose in the context of risk analysis, which is to communicate the risk in an honest, responsible and technically based fashion to workers and the population in general.

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### Conflict of Interest

Authors have no potential conflict of interest to declare, related to this study's political or financial peers and institutions.



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