



Environmental and toxicological analysis of pesticides in Brazil: A profile of the last 10 years

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ABSTRACT

The objective of this research was to analyze the release of pesticides in Brazil in the last ten years in relation to the unfolding of the toxicological classification, as well as in the environmental evaluation. The research was carried out from August 2022 to July 2023 in the database of the Official Gazette of the Union through a personalized search in the Acts published in the periods from January 2012 to December 2022. The data described in the acts of the General Coordination of Pesticides and Related Substances of the Department of Plant Health and Agricultural Inputs of the Secretariat of Agricultural Defense of the Ministry of Agriculture, Livestock and Supply, reveal that there was a significant increase in the number of new



pesticide products approved for use in Brazil in the period between 2012 (168 products) and 2022 (652 products).

Keywords: Research, Objective, Development.

1 INTRODUCTION

The country has been expanding, year after year, the consumption of pesticides. In 1991, for example, Brazil consumed approximately seven times less pesticides than the United States; in 2015, the consumption of Brazil and the United States were close, each accounting for almost 10% of world consumption. As the Brazilian consumption of pesticides expands, the interests of rural producers and pesticide producers in avoiding greater rigor in regulations are expanding. Another factor contributing to the increase in consumption in Brazil is the reduction and/or prohibition of certain pesticides in several other countries, thus increasing the importance of the Brazilian market. Added to this is the significant increase in Brazilian agricultural production and the extension of cultivated areas. The growth in these dimensions contributes to the expansion of pesticide consumption in Brazil (MORAES, 2019).

In recent years, researchers have shown that there has been an increase in the use of pesticides in Brazil. A relevant study on the subject was developed in 2015 by the Brazilian Association of Collective Health (Abrasco). This work, called "Abrasco Dossier: an alert on the impacts of pesticides on health", had since warned about the process of deregulation of pesticides in Brazil, causing an increase in registrations and consumption (CARNEIRO, 2015).

In practical terms, a pesticide only enters the national scenario after registration with the Government. For this registration, the action of public structures of agriculture is necessary, through the Ministry of Agriculture itself, of Health, through the National Health Surveillance Agency (Anvisa), and of the Environment, through the Institute of the Environment (Ibama) (VIPIEVSKI JR., 2022).

The registration of pesticides does not have an expiration date in Brazil, that is, once a product is registered and enters the market, there is no normative provision for automatic reevaluation. Until 2018, products were only re-evaluated if there was any demand, usually from the Judiciary or the Public Prosecutor's Office. In 2018, Anvisa, in an innovative way, created its own procedure for the reassessment of pesticides, through Collegiate Board Resolution (RDC) 221/2018, enabling certain pesticides to be banned with the review, if not approved in the reassessment (ANVISA, 2019). The pesticide re-evaluation tool, created by Anvisa, is a very interesting mechanism since it allows the State to remove products from the market that have already been outdated.

This procedure helps to prevent the trade and use of products that, with scientific and technological advances, have proven to be extremely harmful, and their use needs to be stopped. The reassessment also



contributes to modernization in the area, by preventing the use of pesticides for which there are already substitutes on the market that are less aggressive to the environment and public health (VIPIEVSKI JR., 2022).

The regulation of the use of pesticides has two well-evidenced faces, on the one hand they are essential to mitigate damage to human health and the environment, on the other hand, the imposition of restrictions implies additional costs to producers, less productivity, more extensive use of areas (MORAES, 2019). The aforementioned norms do not exhaust the Brazilian legislation on pesticides. It should be noted that there are several other laws, decrees, ordinances, normative instructions and resolutions that deal with pesticides and the like. It should also be noted that in Brazil, due to the constitutional division of competences, States and Municipalities also legislate on the subject.

In the current scenario, there is a strong tension in the sense of reducing the regulation, as some of the bills that are being processed in the National Congress will be presented. The forces that drive or stop these projects come from groups organized around the matter, such as rural producers, agribusiness entrepreneurs, environmentalists, among other groups that use all their power of influence over the legislature, in order to make their interests prevail.

The regulation of pesticides here in Brazil is one of the strictest in the world. There are approximately 20 years between the research for the discovery of new active ingredients and the approval of a new product. Pesticides are evaluated by three major national institutions: the National Health Surveillance Agency (ANVISA), which proves the safety of the products for human health; The Brazilian Institute of the Environment (IBAMA), which validates safety for the environment, and the Ministry of Agriculture (MAPA), which conducts agronomic efficacy studies

2 OBJECTIVE

The objective of this study was to analyze the release of pesticides in Brazil in the last ten years with regard to the unfolding of the toxicological classification, as well as in the environmental assessment and to correlate the registered active ingredients with the permissiveness in other world markets.

3 METHODOLOGY

The research was carried out from August 2022 to July 2023 in the database of the Official Gazette of the Union through a personalized search in the Acts published in the periods from January 2012 to December 2022. The data described in the acts were filtered for analysis only for information from the General Coordination of Pesticides and Related Substances of the Department of Plant Health and Agricultural Inputs of the Secretariat of Livestock Defense and Supply. After defining the research metric,



the acts that publicized the summary of pesticide and related registrations granted in the aforementioned period were analyzed.

Each act was analyzed and information was collected regarding the active ingredient of the product, class of use, country of manufacture, toxicological classification, environmental hazard, indication of use and whether it was a new active ingredient in the Brazilian market or if it was a technical product or an equivalent technical product.

The data were tabulated and descriptive and inferential statistics were performed to better construct the panorama. Frequency distribution of the data was made, as well as measures of central tendency were calculated. In addition, analysis of variance of the data and mean test at the level of 5% probability were performed. Data were analyzed using Microsoft Excel from Office 365.

4 DEVELOPMENT

Pesticides are synthetic chemicals used to kill insects, pests, or plants in the rural and urban environment. Plants absorb part of these substances and these residues end up on most of the table of Brazilians, in foods that we eat every day. These substances are not only present in fresh foods such as fruits, vegetables and greens, but also in industrialized food products, which have wheat, corn and soybeans as ingredients, for example. They can still be present in the meat and milk of animals that feed on feed with traces of pesticides and even in breast milk (CUNHA, 2014).

In April 2015, the National Cancer Institute released a report on the use of pesticides in the country's crops and their impacts on the environment and health. According to the institute, Brazil is the world's largest consumer of pesticides. The country is one of the largest agricultural producers in the world and uses pesticides on a large scale. For the farmer, pesticides are resources to combat pests, control the appearance of diseases and increase production. In ten years, the sale of pesticides in the Brazilian agricultural market increased from R\$ 6 billion to R\$ 26 billion. Currently, the country has surpassed the mark of 1 million tons, which is equivalent to an average consumption of 5.2 kg of pesticides per year per person. In addition to environmental damage, the Inca team warns about the risks of diseases such as cancer. According to the report, what makes a food healthy is its composition. Pesticides in food can alter the normal functioning of cells in the human body, causing mutations and a greater likelihood of developing diseases in the future.

Godoy et al. (2014) analyzed the relationship between different types of genotypes and their relationship with the higher probability of poisoning in those exposed to pesticides, but did not find significant differences between the groups. A study also showed that organochlorines can exert adverse effects on hematopoietic tissue and liver in populations chronically exposed to elevated levels of these compounds. These substances have also been linked to hormonal changes and thyroid hormone levels.

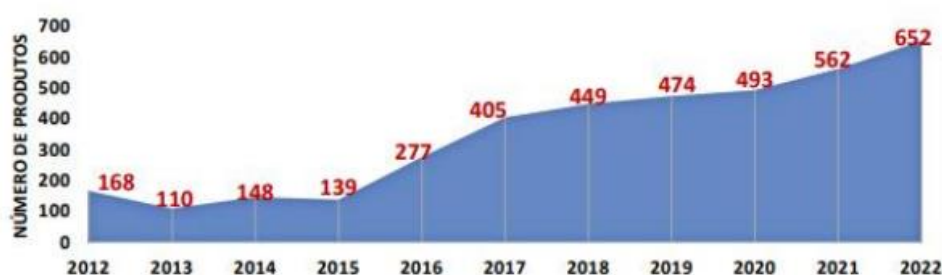


Even in the face of such exposure to pesticide-related diseases, studies reveal that many farmers do not have the perception of this risk and that there is still a shortage of so-called occupational safety and health practices. Often, workers store such poisons at home by burning or burying empty pesticide containers. In this context, it is important to develop studies that address the risk analysis of both human and environmental health of pesticides consumed in Brazil. In addition, it is important to understand this conservative view so that strategies for a possible agroecological transition can be considered. It is to be expected that farmers will feel little motivation to engage in the transition process when the cost of switching to a pesticide substitute model is high and when the losses that would result from this change constitute a large percentage of their savings.

5 RESULTS

The data described in the acts of the General Coordination of Pesticides and Related Substances of the Department of Plant Health and Agricultural Inputs of the Secretariat of Agricultural Defense of the Ministry of Agriculture, Livestock and Supply (BRASIL, 2022) reveal that there was a large increase in the number of new pesticide products approved for use in Brazil in the period between 2012 (168 products) and 2022 (652 products). The increase was significantly higher from 2016. Between January 1, 2012 and December 31, 2022, 3,877 new registrations were approved for use in the country, of which 78% (3,035 registrations) were approved in the last 5 years (Figure 01).

Figura 01: Número de registros de agrotóxicos liberados no Brasil nos últimos dez anos.



In 2022 alone, 652 pesticides were released, an increase of 16% compared to 2016 and the highest number ever recorded by the historical series of the General Coordination of Pesticides and Related Products (CGAA) of the Ministry of Agriculture, Livestock and Supply (MAPA) (Figure 01). According to MAPA, the high number of releases is related to a reorganization in 2016 of the National Health Surveillance Agency (Anvisa) that analyzes the risks of pesticides to human health. One of the changes was the attraction of



servers from other areas of Anvisa to the sector, a possibility of updating and modernizing with more efficient and less toxic products.

The survey also shows that of the 3,877 pesticides released in the last 10 years, 311 are unprecedented, presenting a new active ingredient inserted in the Brazilian market, especially in 2022, which presented a record in the historical series (43 new pesticides). The rest are considered generic, that is, they are "copies" of new raw materials or final products based on ingredients already on the market. Of the total releases, 2610 are chemical and 467 are biological. Biologicals have a low environmental impact and are aimed at organic agriculture – according to Brazilian legislation, they are also called pesticides (Table 01).

Table 01: Classification of pesticides released in Brazil in the last ten years.

CLASSIFICAÇÃO	ANO										
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Produto Técnico	0	1	0	0	1	0	0	1	3	3	4
Produto Técnico a Base de Ingrediente Ativo Novo	1	2	5	2	1	5	2	3	0	7	8
Produto Técnico Equivalente	64	45	79	46	160	177	193	268	291	291	257
Pré-Mistura	0	0	0	0	1	4	2	0	2	3	6
Produto Formulado	10	18	16	12	19	36	48	36	42	41	52
Produto Formulado a Base de Ingrediente Ativo Novo	1	3	7	1	10	9	4	19	0	12	35
Produto Formulado à base de Produto Técnico Equivalente	75	30	33	47	46	132	148	104	123	149	154
Bio - Produto Formulado Biológico, Microbiológico, Bioquímico, Extrato Vegetal, Regulador de Crescimento ou Semioquímico; de Baixo Risco	5	6	1	7	15	21	35	31	20	40	112
Bio/Org - Produto Formulado Biológico, Microbiológico, Bioquímico, Extrato Vegetal, Regulador de Crescimento ou Semioquímico, para a Agricultura Orgânica	12	5	7	24	24	21	17	12	12	16	24
Total Geral	168	110	148	139	277	405	449	474	493	562	652

According to the current legislation, it is the responsibility of the Ministry of Agriculture and Food Supply to carry out the evaluation of agronomic efficacy, the Ministry of Health to carry out the toxicological evaluation and classification, and the Ministry of the Environment, through the Brazilian Institute of the Environment and Renewable Natural Resources (Ibama), to evaluate and classify the potential for environmental hazard. State agencies and those of the Federal District, within their area of competence, must control and supervise the sale and use of these products in their jurisdiction.

The classification of pesticides according to the health effects resulting from human exposure to these agents can result in different toxicological classes, summarized in Table 02. This classification is based on the results of tests or studies carried out in laboratories, which try to establish the lethal dosage (DL) of the pesticide in 50% of the animals used at that concentration.

Among the pesticides approved for use in Brazil in the last 10 years, it was observed that more than half of them were classified as moderately toxic (Category 3) for toxicological classification (Table 02) and



as a very dangerous product for the environment (Class II) for the degree of environmental hazard (Table 03)

Table 02: Toxicological classification of pesticides released in Brazil in the last ten years

Classificação da Periculosidade Ambiental	ANO										
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Classe I - Produto altamente perigoso ao meio ambiente	3	6	3	5	14	13	6	14	13	18	22
Classe II - Produto muito perigoso ao meio ambiente	89	51	65	52	122	203	228	232	241	265	296
Classe III - Produto perigoso ao meio ambiente	59	41	70	50	102	141	163	183	202	235	271
Classe IV - Produto pouco perigoso ao meio ambiente	17	12	10	32	39	48	52	45	37	44	63
Total	168	110	148	139	277	405	449	474	493	562	652

Table 03: Toxicological classification of pesticides released in Brazil in the last ten years.

Classificação Toxicológica	ANO										
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Categoria 1 - Extremamente tóxico	57	31	59	41	105	134	125	134	137	143	181
Categoria 2 - Altamente tóxico	44	22	22	16	35	56	58	67	71	88	108
Categoria 3 - Medianamente tóxico	50	47	60	52	89	165	205	208	212	232	265
Categoria 4 - Pouco tóxico	6	7	2	18	44	44	55	58	64	86	92
Produto não classificado	0	0	0	0	0	0	0	5	6	8	4
Não determinada devido à natureza do produto	11	3	5	12	4	6	6	2	3	5	2
Total	168	110	148	139	277	405	449	474	493	562	652

The environmental assessment, which is carried out by Ibama, is based on documentation provided by companies interested in registration, including studies and tests carried out by national and foreign laboratories, and on complementary information. Other data obtained from the literature and specialized databases are also taken into account. The evaluation and classification of the potential for environmental hazard of a pesticide are based on physicochemical, toxicological and ecotoxicological studies, which support any change, restriction, granting or not of registration.

According to these parameters, pesticides are classified as environmentally hazardous in classes ranging from I to IV: products that prevent them from obtaining registration, products that are highly hazardous to the environment (Class I); products that are very hazardous to the environment (Class II); products that are hazardous to the environment (Class III); and products that are not hazardous to the environment (Class IV).

The data in Tables 01 and 02 reveal that, in this period, despite the new instruments offered by the Law, commercial pesticides (formulated) derived from "new" A.I., i.e., substances registered under the new Law, were still a minority.



The permanence of products that were already registered before the Law, by itself, could perhaps be considered sufficient to explain the high proportion of products classified in toxicological classes I and II, which are more dangerous. However, Table 3 shows that, even after the Law was passed, there was still a large proportion of records in Classes I and II, which were more dangerous. The case of insecticides stands out, which is still the Class of Use that offers the greatest potential for acute health problems.

6 FINAL THOUGHTS

It is recommended to reinstate the mandatory periodic re-evaluation of registered substances and products, as well as to better regulate the aspects that prohibit the registration of products of greater danger for the same purpose. Another aspect raised by the results is that it is likely to be easier and consequent faster to register products derived from substances that have already been registered, even if these substances are of greater toxicity than other new ones, not yet registered. The WHO points out that in developed countries few new compounds reach the market annually due to the high cost of developing these substances to meet the strict requirements on toxicological and environmental effects.



REFERENCES

ABRAMOVAY, R. Agricultura familiar e desenvolvimento territorial reforma agrária. Revista da Associação Brasileira de Reforma Agrária, v. 29, 1999. Disponível em: <https://wp.ufpel.edu.br/ppgdtas/files/2014/10/Texto-Abramovay-R.-Agriculturafamiliaredesenvolvimento-territorial.pdf>. Acesso em: 02 jun. 2023.

ANVISA. Agência Nacional de Vigilância Sanitária. Agrotóxicos: Anvisa é contrária ao PL 6299/02. Brasília, 2018. Disponível em: <https://www.gov.br/anvisa/ptbr/assuntos/noticiasanvisa/2018/agrotoxicos-anvisacontrariaao-pl-6299-02>. Acesso em: 23 jun. 2023

FRIEDRICH, K.; SILVEIRA, G. R.; AMAZONAS, J. C.; GURGEL, A. M.; ALMEIDA, V. E. S. de; SARPA, M. Situação regulatória internacional de agrotóxicos com uso autorizado no Brasil: potencial de danos sobre a saúde e impactos ambientais.

Caderno de Saúde Pública, Rio de Janeiro, 2021. Disponível em: <http://cadernos.ensp.fiocruz.br/csp/artigo/1383/situacao-regulatoria-internacionaldeagrotoxicos-com-uso-autorizado-nobrasil-potencial-de-danos-sobre-a-saudeeimpactos-ambientais>. Acesso em: 06 jun. 2023

IBAMA. Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis. Nota Técnica N° 2/2018/CGASQ/CGFIN. Brasília, 2018. Disponível em: http://www.ibama.gov.br/phocadownload/noticias/noticias2018/SEI_02000.000406_2016_93.pdf. Acesso em: 23 jun. 2023

MAPA. Ministério da Agricultura, Pecuária e Abastecimento. Informações Técnicas. Brasília, 2021. Disponível em: <https://www.gov.br/agricultura/ptbr/assuntos/insumosagropecuarios/insumosagricolas/agrotoxicos/informacoes-tecnicas>. Acesso em: 17 fev. 2023.

MORAES, R. F. de. Agrotóxicos no Brasil: padrões de uso, política da regulação e prevenção da captura regulatória. Brasília, 2019. Disponível em: https://www.ipea.gov.br/portal/index.php?option=com_content&view=article&id=35016:td2506-agrotoxicos-no-brasil-padroesdeusopolitica-da-regulacao-e-prevencaodacapturaregulatoria&catid=419:2019&directory=1. Acesso em: 06 jun. 2023.

VALADARES, A.; ALVES, F.; GALIZA, M. O Crescimento do uso de agrotóxicos: uma análise descritiva dos resultados de Censo Agropecuário 2017. Brasília, 2020. Disponível em: https://www.ipea.gov.br/portal/images/stories/PDFs/nota_tecnica/200429_nt_disoc_n65.pdf. Acesso em: 23 jun. 2023.