English Version

Technology of application of agricultural defensives and relations with the risk of contamination of the water and the soil

Edicleia de Oliveira[1], Marcio Furlan Maggi[2], Eliza de Matos[3], Moisés Sheifter de Ramos[4], Marcus Winicius Vagner[5], Edina Cristiane Lopes[6]

Abstract

Focused on the great importance of the water and the soil to guarantee the survival of the living beings, the technological sector and the agribusiness together have sought alternative ways to reduce the environmental alterations, caused mainly by the excessive use of agrochemicals. It compromises the quality of the soil and the water from the underground as well as the water from the ground level. This work describes the relation among the conventional use of agrochemicals with the aerial spraying. It also shows some Laws, related to manufacturers, sellers and customers, about the irrational and excessive use of agrochemical and the right destination of its packages. These Laws aim to guarantee the integrity, quality and preservation of the environment.

Key words: pollution; agrochemicals agriculture; hydric resources; environmental legislation

Introduction

The population growth generated the necessity to increase the area of agricultural production and, consequently, there was also an increase in the use of agrochemical, with the result that Brazil was included to the list of the largest consumers of these products. The excessive and badly controlled use of the agricultural defensives in the crops has been considered an important agent of contamination of the soil and water. Considering that water is a finite resource and that we depend on its quality and also on the soil to survive, it has been increasing the concern of the governors and environmentalists about the preservation of these important natural resources (water and soil).

Due to the concern with the environment, some alternatives has been searched by the technological sector in order to reduce the index of contamination, having in the market mounted sprayer, which enable the relation of the triple-rinsed under pressure, of the packages and the nozzles of sprayers which enable the reduction of the solution drift (agrochemicals). Some owners that are more aware have a structure in their properties which diminish the impacts to the mean. These are the water supplies, which enable the supply of the sprayer avoiding the direct contact of the equipment with the water sources.

The present work had as objective to perform an evaluation of the general characteristics of the application of agricultural defensives, emphasizing differences between the application with tractors in the land and with agricultural aviation, and focusing on some effects caused by the continuous and inappropriate use of these products over the environment, besides possibilities of reduction of the environmental impacts of the use of defensives trough the infrastructure available in the areas of production.

Use of agricultural defensives

According to Raij (2003), the concern with the environment increased a lot in the last decades, trough the verification that the current pace of the use of natural resources and soil, water and air degradation surpasses the limits that can be tolerated to the safety of the mankind in the Earth. The increase in the world population, associated to a fast

1 Curso Epecializaçao em Manejo Sustentavel do Meio Ambiente – Unicentro. E-mail: edicleia@hotmail.com. Autor para correspondência.

2 Prof. Doutor, Universidade Estadual do Oeste do Paraná, Cascavel, PR, E-mail: mfmaggi2003@yahoo.com.br

3 Curso Epecializaçao em Gestao Ambiental – Unicentro.

4 Acadêmico Departamento de Agronomia Universidade Estadual do Centro Oeste Paraná. UNICENTRO

5 Curso de Mestrado em Agronomia UNICENTRO.

6 Curso de Mestrado em Agronomia UNICENTRO.

urbanization, has been demanding the expansion of the agricultural production, which occurred in the last years, including in Brazil, more due to the productivity than to the expansion of the cultivated area.

In the past, the undesirable organisms to the agriculture were controlled trough the application of a small number of inorganic compounds based on copper and arsenic, besides some insecticides of natural occurrence as pyrethrins. Until the World War II the development and effective use of organic compounds was slow, however, with the discovery of the insecticide property of the dichloro-diphenyl-trichlorethane (DDT), it began the expansion and development of the use characteristic in the last 40 years. In function of the model of agriculture adopted, which is based on the use of agrichemicals, this substances passed, thus, to be widely used, affirms Tomita and Beyruth (2002).

For these authors, it can not be denied that these products enable the increase of the agricultural productivity and have helped in the control of vectors of several diseases, however, its disordered and excessive use has been caused several impacts over the environment. Among the effects that are harmful for the environment, it can be observed the presence of residues in the soil, water, air, plants and animals. Besides the contamination of the environment, these residues may reach man trough the food chain and cause damages to health.

Agrochemicals are part of the set of technologies linked to the process of modernization of the agriculture which occurs in Brazil from the decade of 60, aiming to meet the challenges of the increasing world demand of food. With the generalized use of agrochemicals in the most different environmental conditions, several problems began to be noticed and diagnosed, as the occurrence of residues in food, the soil and water contamination and still causing an unbalance in the local biodiversity (CAMPANHOLA and BETTIOL, 2003).

These authors describe still that the process of intensification of the agriculture made it dependent on external income which consist in the use of seed with improved varieties, of the mechanization, fertilizers and agrochemicals. The acceleration of the use of these inputs have provided negative impacts on the different compartments of the ecosystems, represented by erosion and soil compaction, contamination of the superficial and undersurface water, chemical residues in soil and water, effect on the soil and water organisms and damages to the human health.

For Campanhola et al. (1998), the intensive use of agrochemicals has caused the negative impact, either inside or outside the agroecosystem. The intensive use of agrochemicals generates dependence of the product, since it causes biological unbalances which eliminate the natural enemies of the plagues and pathogens, as well as the appearance of new plagues and diseases of plants and animals, favoring thus the recidivism of high populations of plagues which were under the natural control. There is still a higher potential for the development of the plague resistance, of the phytopathogens and the invader plants to the agrochemicals, which results in the necessity of using higher doses, or increase the frequency of the spraying, increasing even more the potential of damage to the environment, mainly to man.

According to BETTIOL et al. (2003), a good part of the agricultural defensives applied in the field is lost. It is estimated that 90% of the products applied do not achieve the target, being dissipated to the environment and having as final point water reservoirs and mainly the soil.

Due to the advances of agriculture and also to a higher awareness in relation to the environmental issue, the technologic market has been offering alternatives which contribute to the obtaining of better results in relation to cost/benefit, having, however, higher concern with the environmental pollution. One of these alternatives which has gradually been occupying space in the Brazilian agribusiness is the agricultural aviation. According to Rezende et al. (2004), the aerial system is more efficient in the development of the activity of dispersion of defensives in relation to the norms of safety and environmental care, mainly in relation to water sources. Other characteristic affirmed by the same author is referent to the special care with the destination of the packages.

The infrastructure to be made available by airfields involves the availability of tanks of water

supply, mixing tanks and decontamination sites. These characteristics are differentials which are practically non-existent in the conventional agriculture and reduce drastically the disordered thrown of agricultural defensives to the environment (OZEKI and KUNZ, 1990).

Water pollution

Governments, organizations of the civil society and scientists have been calling attention to the importance of maintaining the quality of the water in the world. The preservation of the water resources has become an issue of major importance. It concerns the water sources located in streams, rivers, lakes and lagoons or undersurface aquifers which are used to supply the domestic, agricultural and industrial demands.

The quality of the water has been considered a crucial factor from some time. According to ONU, in the developing countries until 90% of the sewage is delivered in the water without treatment. Every year, from 300 to 500 million tones of heavy metals, solvents, toxic products and other waste are thrown in rivers, lakes and streams, every day. Despite being such a fragile and scarce resource, water is still wasted. Of all the water used, 10% goes to human consumption, 20% is used in industries and 70% is used in agriculture. According to Quadrado (2003), with the new technologies available nowadays, agriculture could reduce its rate in until 50% and industries up to 90% and the cities in one third, without harming the economic production or the quality of life.

According to Braga (2005), great part of the problem with the water resources is due to certain agricultural practices, mainly those related to the prevalent agricultural model. Among them, it is noteworthy the excessive and inappropriate use of agrochemicals, the destruction of the vegetal cover of soils to planting, the non preservation of the riparian area and vegetation which protect the springs, the neglect with the soil conservation and the big work of irrigation, deviation and impoundment of water.

The world practice of use of agrochemicals for long periods, frequently indiscriminate and abusive, has been bringing preoccupations to the public authorities and to those involved with public health and sustainability of the natural resources, in consequence of the environmental contamination (UETA, 2005).

For Callisto (2004), to avoid the contamination of the potable water sources is important to the public health, since it consequently reduced the expenses with the treatments of water-borne diseases. CARVALHO (2005) affirms that water is an irreplaceable natural resource to maintain the healthy life and the well being of the man, as well as to guarantee economical self-sufficiency of the rural property. However, in the last decades, the deforestation of the slopes and riparian forest, besides the inappropriate use of the soil, has contributed to the reduction of the amount and quality of water. According to UETA (2005), the results of several works have revealed the alarming presence of agrochemicals and their products of degradation in soils and superficial and underground water, causing changes in the water cycle and reduction in the volume of water available.

The greatest consequences of these agricultural practices in relation to the alterations of the water resources are the pollution of the water courses and water tables, the changes in the water cycles and the reduction of the volume of water available, since, besides affecting the water courses, the pollutants reach the water tables, whose decontamination presents great difficulty, or else total impossibility. Due to the water cycles, several places are polluted by application of agrotoxics made in other areas, sometimes even distant from the place of origin of the pollutant (BRAGA, 2005).

According to Bettiol (2003), the behavior of the agrochemicals in the environment is closely related to the physical-chemical properties of the formula and the active ingredients (solubility in water, coefficient of participation, hydrolysis, ionization, vapor pressure, reactivity), with the quantity and frequency of use, with the methods of application, with the biotic and abiotic characteristics of the environment and with the meteorological conditions.

For Bettiol and Guini (2003), after the application of the agrochemicals, they do not remain intact, but they are submitted to a series of transformations and movements which may

increase their potential of environmental damage. According to the same authors, the main processes which determine the destination of the agrochemicals in the environment are: retention, chemical and biochemical transformation transport to the atmosphere, underground water and superficial water. Several times the original agrochemical is transformed in other chemical molecule which presents characteristics different from the original molecule, and may be, even, more toxic.

The process of absorption to the soil of certain agrochemical, when associated to the process of erosion, may result in a higher damage to the water resources, since the soil particles carry with them the agrochemicals to which they are adsorbed (CAMPANHOLA, 2003).

Although agriculture is one of the several diffuse sources of pollution, it is presented as the largest contributors of all. Depending on the physical-chemical characteristic, the residues of the agrochemicals in the water may bind to the suspended particulate material, as well as be deposited in the sediment of the bottom or be absorbed by microorganisms.

These residues may be transported trough the water system by diffusion in the running water or in the bodies of the water organisms. Some agrochemical and/or metabolites may also return to the atmosphere by volatilization. Thus, it is evidenced that there is a continuous interaction of the agrochemicals between sediment and water, influenced by the movement of the water, turbulence and temperature. From this interaction, it may result even more time of exposition of the water organisms to the toxic compounds (TOMITA and BEYRUTH, 2002).

Some agricultural practices as the excessive and inappropriate use of agrochemicals, the destruction of the vegetal cover of the soils for planting, the non-preservation of the riparian forests and the forests which protect the springs, among other factors, are responsible for great part of the problems with water resources. Nonetheless, Oliveira (1985) emphasizes that some measures concerning the agricultural area has been taken to ease the causes of the river pollution, as avoiding the disordered occupation for harvesting, aiming to protect the ecological balance and the preservation of the riparian forest, as well as the preoccupation with the uncontrolled use of the defensives. These may reach the water environments trough the intentional application, drift and run-off from areas in which there was application.

However, Bettiol and Guini (2003) affirm that in a general way, the contamination of the water environments in Brazil with agrochemical residues may be considered as moderated and comparatively higher than the present in countries of the North hemisphere, with exception of highly polluted areas.

Soil pollution

Soil has been contaminated with several chemical substances, as metals, pesticides and organic compounds in a general way. These substances may have different origins, from the inputs used in the agriculture, as pesticides and fertilizers, to organic or inorganic residues from urban or industrial origin, as compound of garbage or sewage sludge. Many times the addition of residues to the soil is illegal, creating serious difficulties for the environmental preservation organs in the identification and delimitation of the problems (RAIJ, 2003).

For this author, the inappropriate use of the soil must be faced under the wide environmental optic, and it should be established limits that define the point up to which the human activity may affect the soil capacity of functioning as environmental integrator. Currently, there has been a concern with water scarcity, and with this it drawn attention over the role of the soil in its caption. The care with the soil represents an important step in the care with the water.

Oliveira and Alves (2005) emphasize that the soil preservation has direct relation with the quality and quantity of water resources, since the indiscriminate use of agrochemicals contaminate the soil and, consequently, water. In this process, agrochemicals penetrate in the soil porosity and may reach the underwater water resources or they can be taken to rivers, lakes and lagoons trough the torrent caused by high amount of rainfall. According to the same author, as these phenomenons occur, surely the quality of the water will be changed and the reflexes will be sensed by the beings which depend of this

resource to survive. The amount of water also suffers direct impact of the degradation effected in the soil, since the removal of the vegetation or the irregular agriculture cause erosion and losses of tones of fertile lands, which silt rivers, lakes and lagoons.

According to RODRIGUES (2003), the soil contamination trough agrochemicals leads to the formation of residues that may remain in soil for long periods polluting the soil environment. These residues accumulate in the soils and, in the end, may be absorbed by the cultivated plants.

For OLIVEIRA and ALVES (2005), society has contributed for the advance of the environmental degradation, trough attitudes which compromise the stability of the environment, as the occupation of fertile plains, the devastation of riparian forests and headland vegetation, substitution of forests by fields and pasture, construction of stems, exhaustive monocultures, implantation of homogenous forests, implantation of industries and industrial districts, occupation of areas of rivers. These actions do not affect only affect the soil quality, once the fertile areas of the soil are lost in function of the implanted actions, but also flora and fauna are widely harmed, what occur as well with the quantity and quality of the water resources.

According to what was presented, it may be observed that the concern with the soil and water preservation has increased and, consequently, generated debate among environmentalists, ecologists, authorities and society as a whole. However, it can be observed that no significant progress has been achieved concerning changes in habits and attitudes.

Aerial application and Conventional Application

Even tough the technological means have been innovating, mainly in relation to the system of application of defensives, it is still estimated that a great part of the most used product does not reach the target. These losses are due to the fact that the application is made in an inappropriate way, either concerning technology, or the moment of application. In some cases, the application is made to protect plants from plagues or pathogens which are not present in the area, i.e., spraying is performed based on the calendar and not on the occurrence of the problem. The use of a significant amount of chemical products would be avoided if it was taken measures of control only when the levels of economical damage were achieved (BETTIOL and GUINI, 2003).

The technological development has collaborated for the adoption of more sustainable systems, since many of these technologies were developed with emphasis in the sustainability and conservation of the environment. For Campanhola and Bettiol (2003), the technologies of agriculture of precision enable the use of agrochemical only in the place where there is the occurrence of the disease, plague or invasive plant and not the whole areas, when this kind of control is agronomically recommended, reducing substantially the use of agricultural defensives. Therefore, technology increases the efficiency, minimizes the environmental impacts and increases the competitiveness of the agricultural product.

The types of application, the use of agricultural airplanes have as main attractive the speed in the execution of the works and the quality in the application (CARVALHO, 2005). For Manera (2005), in the last years it occurred an evolutionary process in the system of agricultural aviation aiming to ease some problems which persisted in the activity since it was created, in the decade of 40. One of them is the uniform spraying and adjusted over the considered area, which was solved in the last years, with the adoption of the DGPS (Differential Global Positioning System), which eliminated the presence of people who determined the visual limits of the applications.

The aero agricultural applications are performed with the acting of a team that must plan the work so that it is avoided spraying outside the planned area, reducing the use of products and avoiding the contamination of the environment, improving the application of the inputs, avoiding waste and reducing at a maximum the possibility of environmental damage (CARVALHO, 2005).

The concern with the wind position and speed, obstacles, forest reservation, rivers, houses, etc., is a responsible of the team which is formed by qualified professionals for this kind of work. The law demand that this activity is developed with trained

and qualified professionals, which is formed by an Agronomic Engineer with special qualification to coordinate the activity, an Agricultural Technique qualified to monitor the execution of the activity of application, the pilot which is trained to perform this work, which does not happen always with the producers of the conventional systems, mainly the medium and small producers (REZENDE et al., 2004).

For the authors, due to a great advance of the agricultural activities in the country, the option for the areal system of application has been gradually assuming place in the market. This highly technified system brings some advantages to the farmers, mainly in which it is concerned to cost/benefit and in the speed of the process of application of the defensives. The efficiency of the aerial system, either in the application of defensives or in the performance of other activities as: seeding of green cover and pasture, repopulation and dissemination of forestry species, etc., has surpassed the conventional system.

OZEKI (1990) emphasizes that the aerial system has been developing advanced technologies which provide better exploitation of the product and also with economy of time, depending only on natural conditions. The reduced volume of volume used in the aerial system uses adjuvants which help to protect drops against evaporation and drift. This system allows a good distribution in plants, using a reduced volume of defensives and consequently reducing the costs of the application.

In order to enlighten the impacts caused to the environment, consequents of the use of chemical products, the system of agricultural aviation uses an infra-structure containing water reservoir, mixture tanks, where it is performed the package wash, decontamination sites containing a residue reservoir and other apparatus which are standardized by the Ministry of Agriculture and which help to reduce the problems which may be caused by the inappropriate management of the defensive residues.

According to prerogatives of this ministry, the remaining agricultural defensives in the plane after the application and the residues of the washing and cleaning shall be discarded only in appropriated places, as decontamination site or over the crop. The packages should pass trough the process of triple-rinsed and sent to the places indicated in the invoice of purchase of the product so that they send them to the appropriated place for the incineration. Therefore, the companies hired to performed the spraying are obliged to deliver the packaged to the contractors, i.e., the company only applies, and the packages are a responsibility of the contractor.

According to REZENDE et al. (2004), the care recommended by the norms is generally fulfilled in a rigorous way, considering that they tend to reduce the index of environmental pollution and also because there is a charge by the inspection agency over the companies which develop activities of agriculture aviation.

Even tough there is a national law and norms regulating the use and discard of the packages of the agricultural defensives, the common practice among some local farmers is to leave the empty packages or the rest of products scattered over the field. Certainly, trough the rainfall and irrigation water there is the drift of residues rough soil until they reach reservoirs and water courses, which may result in contamination of water by agricultural defensives of several chemical natures in the same moment, resulting in the multiple exposition of all the water ecosystem as well as man (ARAÚJO et al., 2000), quoted by Tomita and Beyruth (2002).

Legislation

Due to the great advance in the agricultural sector, as well as the expansion of the agricultural borders, the introduction of new intensive techniques of production, the innovation of technologies of mechanization and also the development of seeds genetically modified, it began a concern with the environmental quality. At the same time, it may be affirmed that there was an advance in the Brazilian environmental legislation concerning the increasing concern of the society with the impacting activities. The Brazilian environmental policy had its main mark with the institution of the Política Nacional do Meio Ambiente (PNMA – National Environmental Policy), trough the Law n° 6938, from August 31 1981, in which it is verified an emerging posture of conciliation of the economical growth with the preservation of the natural resources.

With the constitutional review of 1988, it was devoted increased attention to the necessity of evaluation of environmental impacts, as well as the environmental planning and the recovery of degraded areas. As a result of this new phase of the Brazilian low, it can be used as example the promulgation of the Law of the Agrochemicals, in 1989, and the demand of ecotoxiological evaluations for the registration and commerce of agrochemicals. With the increasing demand over the risk of use of these products, there were significant advance in the legislation of registration and use of these chemical products in several countries (CAMPANHOLA, 2003).

The Federal Law n° 9974 establishes the final and correct destination for the empty packages of agricultural defensives, either for the farmer, as well as for the reseller and the manufacturer. This contributes to ease the environmental impacts.

The Brazilian environmental legislation is one of the most complete of the world. Even tough it is not enforced in the appropriate way; the most important environmental laws may guarantee the preservation of the wide environmental patrimony of the country (EMBRAPA, 2005).

Law of the agrochemicals – number 7802 from September 10 1989

It regulates from the research and manufacturing of the agrotoxics until its commerce, application, control, supervision and also the destination of the package. Imposed demands:

Requirement of the agronomic recipe for the commerce of agrotoxics to the consumer;

Register of products in the Ministry of Agriculture and Ministry of Health;

Register in the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis – IBAMA (Brazilian Institute of Renewable Natural Resources) (the breach of this Law may cause fines and reclusion).

Law of environmental crimes – number 9605 of February 12 1998.

The Law rearranges the Brazilian environmental legislation in which it is concerned infractions and punishments. The entities, author or co-author of the environmental infraction, may be punished, reaching to the liquidation of the company, if it is created or used to facilitate or occult an environmental crime. The punishment may be extinct if it is proved the recovery of the environmental damage, charges vary from R$50.00 to R$ 50 million.

Law of the Agricultural Policy – number 8171 from January 17 1991.

This law has the protection of the environment as one of its objectives and one of its tools. It defines that the public authorities must discipline and inspect the rational use of soil, water, fauna and flora. It must also perform agroecological zoning to order the occupation of several productive activities, develop programs of environmental education, boost the production of native species, among others.

Law of the National Policy of the Environment – number 6938 from January 17 1981.

It is the most important environmental law and it defines that the pollutants are obliged to indemnify the environmental damages that they cause, independent on the guilt. The Public Ministry may propose actions of civil liability per damages in the environment, imposing to the pollutant the obligation of recover and/or indemnify the harm cause. This law created the obligation of studies and respective reports of the Environmental Impact (EIA-RIMA).

Law of the Water Resources – number 9433 from January 08 1997.

It institutes the Política Nacional de Recursos Hídricos (National Policy of Water Resources) and creates the Sistema Nacional de Recursos Hídricos (National System of Water Resources). It defines water as a limited natural resource, with economical value, which can have multiple uses (human consumption, production of energy, transport, dumping of sewage). The law also plans the creation of the Sistema Nacional de Informação sobre Recursos Hídricos (National System of Information

about Water Resources) for the capture, treatment, storage and recovery of information about water resources and intervenient factors in its management.

Overall considerations about the issue

The development of agricultural activities had great boost in the last years, and this resulted in the elevation of the use of agricultural defensives. However, it is known that the excessive use and little controlled of these products may result in serious environmental changes, compromise mainly the soil quality and the water resources, putting the integrity of the health and the population wellbeing at risk.

The continuous use of the defensives in the crops is considered the main agent of the soil and superficial water contamination, and may still compromise the quality of the underground water resources. The inappropriate management of the package of the defensives contributes to the advance of the environmental pollution.

Even with the existence of laws which determine the appropriate processes in the management of chemical products, it is still possible to verify the lack of consideration for the laws and mainly for the environment.

The existent legislation directs the responsibilities not only to the producers, but also to the sellers and assistants, concerning the final destination of the packages. Since there is a demand in the compliance of the laws directed to the agricultural sector, works of awareness have contributed to reduce the number of packages left in crops, roads and margins of rivers or steams.

The system of agricultural aviation is obliged by law to have a structure in the aerodrome which reduced the impacts in the environment, caused by the inappropriate management of the agricultural defensives. For the conventional system there were no specific laws, however due to the alarming index of pollution caused by the chemical products used in the agriculture, some owners have water supplies, places structured with a water reservoir in appropriated place which ease the supply of spraying equipments, avoiding, thus, the direct contact of the agricultural implements with the water of the rivers and steams, reducing the index of contamination of rivers.

Another alternative already used by the system of agricultural aviation, which has been transferred and adopted in the system of conventional land spraying are the tanks with pre-mixture, adapted in the spraying itself. This system facilitates the emptying of the packages and mainly their washing, since it is a practice and efficient system which has a flow under water pressure direct to the package.

Conclusion

The use of agricultural defensives in Brazil is increasing in the last decades. However, for a long time these products were launched in agriculture without the proper care to avoid the contamination of soil, water resources and even the farmer. Nowadays there is the availability of equipments and technologies for the controlled and correct application of these products. However, the lack of access to the information and the low adhesion to the use of technologies and equipments of application maintain the conventional agricultural activity as risk of pollution of the water and soil resources, being generator of expressive effects of environmental degradation.

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