[1.]Ana-Maria TĂBĂRAŞU, [1.]Mihai MATACHE, [1.]IonGRIGORE, [1.]Laurentiu Constantin VLĂDUŢOIU, [2.]Nicoleta UNGUREANU, [2.]Sorin Stefan BIRIŞ

ENVIRONMENTAL POLLUTION CAUSED BY AGRICULTURAL ACTIVITIES

[1.] The National Institute of Research – Development for Machines and Installations Designed for Agriculture and Food Industry – INMA Bucharest, ROMANIA
[2.]University Politehnica of Bucharest, ROMANIA

Abstract: Environmental pollution is due to several factors such as: industry, agriculture, tourism, services, etc., and at first sight the industry is seen by all as the main polluter of the planet. On the other hand, agriculture also seems to play an important role in terms of environmental pollution. Among the factors in agriculture that have a high proportion in environmental pollution there are: animal husbandry and agricultural works, among which can be listed: works of establishment and maintenance of agricultural crops (soil pollution with chemical and organic fertilizers), works of plant protection (application of products used in plant protection). This paper presents some considerations regarding the main agricultural works that have a high impact on the environment in terms of pollution, respectively some measures that are required to combat this pollution.
Keywords: environment, pollution, agriculture, measures, impact

INTRODUCTION

Agriculture in general is largely polluting, and the phenomenon of pollution is largely known to environmentalists. It is true that pollution, as a process of degradation of the quality of environmental factors vital for human health, has not been recognized by political factors in the very recent past, as well as the fact that there were lacking and still lack the equipment needed to highlight all aspects involved in pollution. The main aspects of environmental pollution caused by agricultural activities can be summarized in (https://ro.ripleybelieves.com/what-is-environmental-impact-of-agriculture-7534):

- Discharge of several million cubic meters of wastewater, untreated or incompletely treated, from industrial complexes for growing of pig, poultry and cattle, into the surface water and the drainage system. To these is added the deep infiltration of wastewater, during the period of storage in ponds, battles and basins, affecting the quality of groundwater used as a source of drinking water in many rural localities.
- The use on agricultural land, for dual purposes of fertilization and irrigation, of sludge and wastewater from livestock farms, containing harmful salts and contaminating pathogens to the soil, plants, animals and humans.
- The administration on agricultural lands adjacent to the livestock complexes of exaggerated norms of manure (over 100 t/ha), at intervals of 2-3 years, which by far exceed the needs of plants and determine the accumulation of nitrates in feed, as well as the leaching of nitrates in groundwater.
- The use of chemical fertilizers (especially nitrogen) in too high doses and at times not related to consumption in different stages of development of the cultivated plants. Often, their application is made on frozen ground with a thick layer of snow, which is why due to sudden melting and favored by the slope of the land they reach, by washing, into the running water used as drinking water sources.
- Application of chemical products (pesticides), in order to control diseases, insects, rodents, nematodes and weeds in agricultural crops and fruit-wine orchards, by poorly trained people. Applying too large amounts and concentrations at inappropriate times and by using products with a high degree of toxicity and long shelf life has multiple negative effects on plants, animals and humans.
- Not to be neglected are the aspects related to the preparation of pesticide solutions, washing and dumping in illegal places of the remaining solutions from the agricultural apparatus and equipment used for their administration.
- Uncontrolled storage of manure and the lack of collection basins for liquid manure from animals belonging to many private households have as negative effects their runoff into running water, as well as nitrate infestation of groundwater.
- Aggravation of soil erosion on sloping lands, due to the practice of an inadequate agricultural system, respectively: poor organization of the territory, execution of soil works from hill to valley, crop rotations with a high share of weeding plants, lack of organic fertilization.
- Degradation of the physical state of the soils (structure, porosity, permeability, resistance to plowing) due to the decrease of the organic matter content and the exaggerated traffic with agricultural equipment on the field having an inadequate soil moisture.

In terms of animal husbandry, even some domestic animals irretrievably destroy the growing tree vegetation, preventing the regeneration of forests. Also, pet farms can also pose serious problems of environmental pollution with animal waste. The exodus of some animal populations can create

ecological catastrophes. In animal husbandry, in addition to insecticides, other chemicals are also used that give unwanted side effects, namely substances administered to influence the development of animal production. These substances are harmful because they are excreted in the urine and are found in the drinking water of other batches of animals (for which the substance is contraindicated) or they can reach to humans when administered until the last days before slaughter.

In the organization of modern agriculture, a very important role is played by landscaping works and especially by water management. Dams and irrigation canals not only change the hydrological regime in the area, but also the local ecological systems by changing soil factors. Both positive effects (territorial expansion of cultivated areas and increased productivity) and negative ones (salt pollution: salification, salting) can occur. Irrigation played a very important role in the development of the great ancient civilizations. Today, more than 500 million ha are irrigated, and this represents 50 times more than in 1800.

Agriculture is mainly responsible for water and soil contamination, this being caused by the increasing use of pesticides, as well as the intensive nature of agricultural production (Petre et al, 2019). Almost all pesticides are made from chemical substances that are designed to keep diseases and pests away from crops. However, in the long run, the whole environment suffers - a paradox that ultimately affects human health and therefore technical solutions are needed for a rational application of herbicides / chemicals (Bolintineanu et al, 2009; Bungescu et al, 2009; Matache et al, 2010; Niţu et al, 2012; Vlăduţ et al, 2010a; Vlăduţ et al, 2010b).

Moreover, as agriculture becomes more intensive, in order to feed the growing population, many ecosystems are destroyed to make room for crops. Entire forests are cut down to eventually get agricultural crops, but people forget that in the long run we are actually destroying the planet's lungs. Solutions consist in the recovery of degraded soils through different treatment / improvement methods (Pruteanu et al, 2019), treatment of wastewater from animal husbandry (Tociu et al, 2019; Ungureanu et al, 2019a; Popa et al, 2019), respectively the use of different methods and solutions for depollution of soils (Vanghele et al, 2019).

Organic farming is a viable alternative but it is still too expensive for many agricultural producers and also for potential buyers of products thus obtained. In the future, however, the adoption of cultivation techniques using agrochemical analysis of soil (Borland et al, 1981), organic and pest control equipment that does not involve the use of pesticides and other pollutants (Zhu et al, 2007), which uses advanced materials (Cârdei et al, 2012), will be a solution to prevent soil pollution.

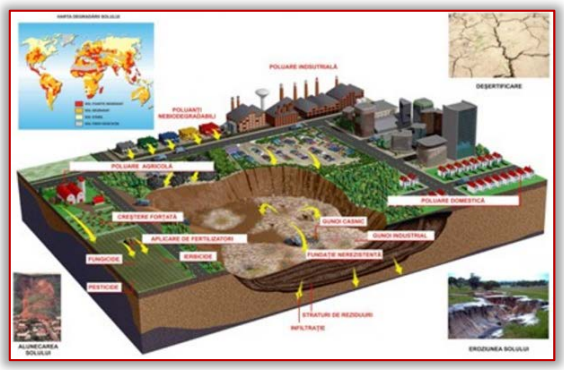
MATERIALS AND METHODS

Paradoxically, the very branches of the human economy, which are mostly based on relations with the environment, are also sources of pollution. Agriculture can be a source of environmental pollution by: triggering and favoring soil degradation processes following the erosion processes (land clearing leads to soil erosion), salting, compaction (Ungureanu et al, 2019b); the use of pesticides (insecticides that destroy all insects, including the useful ones); excessive use of chemical fertilizers.

According to specialists, out of the total agricultural area of our country, only 30 % are soils with a high fertility potential, the rest having different states and stages of degradation. Of the 5 million ha of land affected by erosion only half were landscaped anti-erosion and thus led to increased productivity per hectare (compared to the previous period). Through the erosion process, 150 million tons of soil are lost annually, of which 1.5 million tons of humus.

Excessive deforestation in the upper part of most river basins, as well as the irrational use of agricultural land, have had a negative influence on the flow of water on the slopes, causing severe processes of soil erosion. The forest fund of our country is of 6.4 million ha, which represents a strong imbalance, predominating the young forest, and the one of over 80 years (exploitable) has a deficit of 500 thousand ha, causing an acute lack of wood for timber and veneer.

Due to intensive agriculture and to the use of pesticides and chemical fertilizers, the soil is the main environmental factor affected. Most soils lose their nutrients and organic matter to a greater extent than the process of supplementing them, which ultimately leads to their depletion.



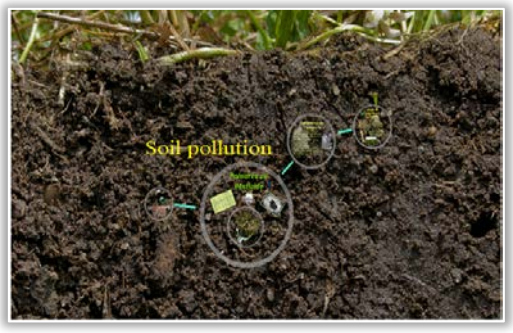


Figure 1. Soil pollution (Borlan et al., 1981)

Soil pollution means any action that disrupts the normal functioning of the soil as a support and living environment in natural or man-made ecosystems. Soil disturbances can be:

a) physical: the phenomenon of compaction and damage to the structure generated by improper work;
b) chemical: generated by soil pollution with heavy metals, pesticides, fertilizers, changing the pH of soil solution;

c) biological: generated by soil pollution with germs of diseases transmissible to plants and animals;
d) radioactive: soils capture very easily radioactive pollution that they transmit to plants and animals for a long time (Borlan et al, 1981).

RESULTS

— **Soil pollution with chemical and organic fertilizers - works for the establishment and maintenance of agricultural crops**

Intensive agriculture, widely practiced in all countries of the world, involves the administration of chemical fertilizers in order to increase the productivity of crop plants. This process aims to return to the soil the equivalent of the amounts of nutrients extracted from it by plants. The most important and most used are nitrogen-based fertilizers (ammonium, calcium and potassium nitrates), sulfur (ammonium sulphate and superphosphate) and potassium. The polluting effect is mainly determined by the excessive amounts used, well above the necessary ones used repeatedly over the years and, secondarily, by the introduction into the soil of toxic impurities contained in fertilizers (Vlad et al, 2018; Vlăduţ et al, 2008).

The polluting effects are given by (Munteanu et al, 2011):

≡ impurities, residues from the manufacturing process;
≡ imbalances of certain biogeochemical cycles, which lead to soil degradation;
≡ contamination of groundwater;
≡ lack of purification and cleaning of industrial fertilizers due to production costs; they contain toxic metals and metalloids (arsenic, cadmium, chromium, copper, lead, zinc) with risks of soil and food contamination;
≡ excess of nitrates due to superfertilization with nitrogen fertilizers in the biosphere circuit, estimated at 9 million tons/year, which accumulates in the hydrosphere through leaching processes of soils degraded by superfertilization (misuse of nitrogen fertilizers).

Research shows that nitrates usually accumulate in green leaves, and in this sense, Rondest J. (1972) found that in spinach and lettuce leaves there were such large amounts of nitrates that consumers' health was endangered. Nitrates reaching the human intestine are converted to nitrosamines, which are powerful carcinogens. The misuse of chemical fertilizers has the following negative effects:

≡ modifies the biogeochemical circuit of nitrogen and phosphorus;
≡ inhibits or blocks the recycling of organic substances and humus, the process causing their decrease, manifested by the decline of the clay-humic absorbent complex;
≡ causes groundwater and surface water pollution and thereby induces a decrease in the biodiversity of aquatic ecosystems and their biological productivity.

Of the total amount of fertilizers applied on an agricultural area, a maximum of 50 % is found in the vegetable mass; the rest remains in the soil or is entrained in groundwater and surface water. Through links in the food chains, nitrogen from the plant mass is taken up by animals and humans. Through metabolic processes, nitrates are transformed into nitrites that have a high affinity for hemoglobin, together with which they form methemoglobin, a stable product that drastically reduces the oxygenation capacity of tissues. Nitrates usually reach the food chain through milk, the main food for children. In the '80s, in the areas of Galati, Braila and Ialomiţa, poisonings were reported because the concentration of nitrates in milk exceeded 850 ppm, compared to 75 ppm set as the maximum limit by the WHO and FAO (Tuomisto et al, 2017a).

Superfertilization with phosphate fertilizers causes the excess of phosphorus entrained yearly by inland waters into the lakes and seas to cause the phenomenon of eutrophication, which through its long-term action, makes the water increasingly poor in oxygen, finally destroying the aquatic fauna (fish, etc.).

Figure 2. Soil pollution with chemical and organic fertilizers (Tuomisto et al, 2017)

— **Pollution with pesticides and their residues - maintenance works of agricultural crops**

Soil pollution with pesticides is an important component of agricultural pollution of the environment in general. Unlike other pollutants, pesticides are deliberately dispersed in the wild to destroy certain parasites of humans, domestic animals or crops (Tuomisto et al, 2017b).

Modern pesticides are mostly synthetic organic substances intended for the destruction of harmful insects (insecticides), phytophagous fungi (fungicides), weeds in crops (herbicides), rodents (rodenticides) or nematodes (nematocides). Current synthetic insecticides are divided into three main groups: organochlorines, esters and carbonates. Contamination of soils and vegetation with pesticides has important consequences for species and biocenoses (Pisante et al, 2012).

Despite the important advantages of using pesticides in the agriculture (increased production, reduced labor, etc.), their use on a large scale and in large and repeated doses causes many ecological disadvantages. Their application leads to a

number of changes in the ecosystems in which they were introduced, among which are mentioned:

- has a very intense spectrum of toxicity for both animal and plant organisms;
- have a fairly low degree of selectivity and are often used against populations and not against individuals;
- their effect does not depend on the density although their application takes into account the density;
- many of them have a high degree of persistence in the soil which can be of the order of months or even years;
- some pesticides are dispersed over very long distances and are incorporated into biomass, ocean waters or soil;
- through their biological action, they destroy not only the target organisms, but also some useful ones;
- persistence in the environment, accumulation of some of them and their penetration into food chains.

These effects can be of demoecological nature (those that affect the populations and especially their density), respectively of biocenotic nature (those that cause disruptions of biocenotic balances). Being toxic to weeds, diseases and pests, pesticides pose a risk of harm to humans, pets, venison and birds. For this purpose, various procedures are used, such as:

- incorporation of activated carbon in the soil;
- administration in the soil of adjuvants, products that retain or degrade the pesticides;
- cultivation of plants (corn, sorghum) that have the ability to depollute the soil of atrazine by organic absorption into the soil in large quantities;
- integrated control of diseases and pests as a measure to prevent soil pollution with pesticides.

Due to the high risks, it is recommended to use those pesticides that comply with the following rules: to use the least toxic products; to avoid the introduction into the ecosystem of biologically degradable pesticides, those with high residuality; to avoid the use of easily leachable products, which reach the groundwater faster; products that due to their persistence easily enter the food chain plants - animals - humans are no longer accepted. A safe way to achieve this goal is the introduction of integrated protection (integrated management), which is based on:

- combining methods: agrotechnical, physical, biological, chemical;
- the application of control measures only when they are economically justified.

If in the not too distant past it was expected to liquidate, eradicate pests to the last specimen, in integrated management the concept is combated and abandoned. In reality, pathogenic pests and weeds produce crop losses only when they have a certain density. It is therefore recommended to use the economic damage threshold before using pesticides to determine exactly how much pesticide is needed (https://ec.europa.eu/agriculture/envir_en).

Figure 3. Pesticide pollution
(https://ec.europa.eu/agriculture/envir_en)

— **Plant protection**

Plant protection is the science that deals with the study of harmful organisms (phytopathogens, phytophagous arthropods, weeds, rodents, etc.), in order to establish the most effective measures to combat the damage / economic losses caused by them. It is estimated that about a third of the potential crop yield is destroyed ("tithed") by harmful organisms, so plant protection, as an applied biological discipline, contributes to increasing crop yields and improving crop quality.

Pest control of agricultural crops is achieved by several methods: chemical (using pesticides), biological (using antagonistic organisms and natural products), genetic (by improving the resistance of plants to harmful organisms), agrotechnical (by soil work, including weeding) and physical-mechanical (thermal disinfection of seeds, plant surgery, seed clearing, etc.).

Pesticides are either mobile or highly absorbed by soil organic matter. They can be volatile, persistent or rapidly degradable. Pesticides are chemical means of plant protection, obtained by formulating and conditioning of biologically active ingredient(s). With very few exceptions (such as plant growth regulators, used to control plant growth, or products that act by activating systemically manifested resistance in plants, and which are a kind of "vaccines" for plants) biologically active ingredients are toxic ingredients. This toxicity actually requires the existence of a code of good practice for the distribution and use of pesticides. The following categories of substances are also included in the category of pesticides: growth regulators, defoliants, desiccants, systemically activated resistance activators, vegetable and fruit cleaners, substances applied to prevent fruit falling, as well as substances applied before or after harvest to control pests acting during storage and transportation of the crop (http://www.farmer.com.cn/wlb/nmrb/nb8/).

Biopreparations are biological means made on the basis of microorganisms useful to crop plants or on the basis of natural compounds (plant extracts, suggestively called in English "botanicals"). The use of biopreparations is an important orientation in today's agriculture due to its advantages:

≡ reducing environmental and food pollution;
≡ avoiding the occurrence of pest populations resistant to control treatments;
≡ the possibility of using unqualified personnel in conditions of total security (both for crops and for the user);
≡ sustainable use of a useful resource from the agricultural systems unexplited so far.

There is a widespread but wrong practice on farms to voluntarily dispose of waste and pesticide residues in ditches, canals, surface waters or on agricultural land. They come from:

≡ excess spray liquid;
≡ washing of the machines;
≡ losses of spray liquids during their supply or during technological operations;
≡ losses due to uneven distribution;
≡ packaging and containers which still contain pesticides and which are disposed of or stored improperly;
≡ residual liquids from immersion baths or sheep bathing;
≡ waters that were used to wash the agricultural products;
≡ leakage from broken or cracked packaging or containers;
≡ pesticides eliminated due to expiry date.

The cultivation of vegetables and ornamental plants in greenhouses and solariums is an important source of complex local pollution, with pesticides and fertilizers. Pollutants reach the surface waters through other circuits than in the case of agricultural crops, namely:

a) eaves spills (condensation water or artificial rain) that carry the fertilizers and pesticides deposited on the windows inside;
b) irrigation that is used concomitantly with fertilization and for the administration of pesticides;
c) waters of glazing washes on both sides;
d) wastewater from special flower treatments.

All this water must be recovered in watertight concrete ponds and followed by a closed circuit by recirculation, without being discharged outside.

Pesticide depots will not be located near water bodies or in areas where groundwater is present at shallow depths. The location will be at least 200 m from homes, water sources, fodder, fields and agricultural land, farms and animal depots. Warehouses will be constructed of durable, non-flammable materials with sufficient and adequate storage capacity.

The pesticide depot must be able to keep the products safe in the event of spills or spills. The floor must be impermeable and located below the ground surface to form a retention basin or there must be sills on doors and walls that prevent liquids from passing through them and that retain the scattered material. (Zhu Liya et al, 2007).

— **Application of products used in plant protection, and water and soil protection measures**

The strategies to reduce the impact on the environment through the intake of pesticides can be addressed in various ways, from prevention at source to treatment of symptoms related to the adverse environmental effects. Next are some of them (https://www.ncbi.nlm.nih.gov/pmc/):

a) reducing the basic needs of crop protection by chemical means by using practices and methods that reduce crop diseases (judicious crop rotation, cultivation of varieties resistant to diseases and pests, seeds, seedlings, disease-free and pest-free cuttings, adequate measures of hygiene to limit the spread of disease and pest attacks) as well as by the strict use of chemicals to the minimum in order to combat crop diseases;
b) choosing with great discernment of only authorized pesticides that do not harm the environment, such as selective ones;
c) personnel using these products must be trained, certified and authorized;
d) strict supervision of the regime and use of pesticides;
e) interdiction of using air treatments, especially when the treated agricultural land is close to water bodies;
f) limiting the administration of fertilizers because there is a situation that certain diseases and pests are favored by increasing the yield and productivity of crops;
g) reduction of the preventive use of pesticides taking into account the fact that the presence of parasitic organisms is a normal situation, their problem being reconsidered only when there is an estimated danger or a certain degree of harm is exceeded;
h) partial replacement of the use of pesticides by ecologically clean means and methods, other than chemical ones (biological methods, preventive methods, traps, manual removal of pest nests, etc.).

The following complementary measures are recommended to reduce the amount of pesticides dispersed in the environment:

≡ equipping the spray devices with anti-dispersion screens that limit the spread of pesticides outside the strictly targeted areas;
≡ sprayers and especially their most important component - the nozzle must be maintained in the best operating condition at optimal parameters; for this purpose, periodic checks will be carried out with the immediate replacement of defective, worn or improper parts; strict correlation between the capacity and efficiency of the spraying equipment and the load of pesticides supported by the environment;
≡ prohibition of the establishment of orchards in the immediate vicinity of water bodies;
≡ the establishment of forest curtains against the predominant winds;
≡ the establishment of pesticide-free areas 10 m wide in the immediate vicinity of a body of water.

Chemical control treatments are applied curatively or preventively, either in vegetation, or by seed treatment, or by

soil treatment. Pesticides are usually applied by wet treatments, in the form of spraying, pulverization or aerosols (toxic mist).

Many widely used pesticides (bentazone, atrazine, simazine, dinoseb, etc.) are included in the category of substances with a high risk of pollution of surface water and groundwater. When such pesticides are identified in the groundwater, it can be assumed that there will be an increase in their concentration given that the movement through the pedological columns can take place in a relatively long time.

Seed treatment is done either by wet or dry methods (depending on the type of product) using special seed treatment machines. The most dangerous products for the environment and human health are dust powders. In Romania there are practically no products formulated in this way, with the notable exception of sulfur, which is a product with ecological consonance, being natural, biodegradable and with low toxicity for non-target organisms.

Usually, all pesticides are biologically active substances that have side effects on the environment and human health. When there is a choice, the product that has the least impact on the environment and presents the lowest risk to human health will always be chosen.

Pesticides should only be applied on warning. Treatment warning is done when a pest tends to grow above the economic damage threshold (EDT), which is the level of the pest population that causes a higher damage to the total costs (ecological and economic) of the treatment with plant protection means (pesticides, biopreparations). In general, the treatment warnings are made by the County Plant Protection Inspectorates, having a weighted value at county level. However, the most accurate and advantageous are the computerized forecasting and warning systems used locally.

Pesticide treatments must be notified in advance (in writing) to local authorities, specifying: type of treatment; crops to be protected; the plots on which treatments will be applied; the period of application;the type(s) of pesticide(s) used.

In areas with surface water, good agricultural practices require the limiting of using aero means of treatment (helicopters, gliders, planes, etc.), because these means of treatment are too widespread. A similar situation is the case of the use of strongly blowing mechanical means such as those used in vineyards and orchards.

In areas with surface water, treatments with toxic insecticides for fish (e.g. synthetic pyrethroid insecticides) should be avoided as much as possible. If it is not possible to give up these pesticides, appropriate risk management measures will be taken (precise delimitation of the treatment perimeter with a minimum distance of 10 m to the waterfront, equipping the spraying machines with anti-dispersion screens, strict correlation between machine capacity spraying and the surface to be treated, application of treatments at a maximum wind speed of 4 m/s, complete prohibition of discharges of water polluted with pesticides from washing machines, etc.).

The application of pesticides will be done in meteorological conditions provided by the technologies in force. Treatments will not be made at very high temperatures and during the afternoon, and for products with inverse temperature coefficient the maximum indicated temperature will be observed. Do not apply to rain (or before and after) and do not apply pesticides when the humidity is high. In case of strong wind, the treatments will be performed in the morning or in the evening.

In Romania, however, the practice of using illegally traded pesticides is quite common. These illegal pesticides are:

- brought by the small border traffic from the neighboring countries;
- from expired pesticide stocks (including DDT stocks!);
- extracted from the waste dumps of chemical factories.

In order to ensure a proper operation, the sprayers will be regularly tested and certified. Each of the dispensing devices (spray nozzles, rotary sprinklers, etc.) will have to discharge similar amounts of solution / suspension, in a constant and reproducible manner. The fastening system of these spraying devices must allow strict adjustment of the distance to the treated plants. Worn parts must be replaced immediately with new parts. Spraying systems must ensure a strictly localized distribution on the row of plants and not on the entire field. Untreated and / or double-treated areas should be avoided. This is done by marking the area to be treated, and the equipment to be applied pesticides must allow compliance with the markings.

The dose of pesticide applied per ha must be strictly correlated with the watering norm established by the Interministerial Commission for the Approval of Phytosanitary Products. Watering norms are established according to the type and age of the crop and vary between 330 - 1100 l/ha. To facilitate the compliance with the pesticide dose, the recommendations for use usually include both the recommended dose and concentration at the appropriate watering rate.

The user has the obligation to choose the appropriate nozzle to the specifics of the work to be performed. The user must also avoid the use of worn, dirty, clogged nozzles, because they, even if they were initially very good, cause disturbances in the work process, leading to the formation of asymmetrical jets, with large drops and uneven distribution. These also increase the risk of high concentrations of solution reaching certain areas on the plant and in the soil, which leads to increased pollution.

The sprayer with ramps for the application of treatments to field crops must be checked, making sure that all nozzles show the same amount of solution in the unit of time.

The water from washing the packages will be transferred to the spraying solution, in compliance with the watering norm. The equipment will be washed with pressure jet, in specially arranged areas, provided with inactivation bases for the pesticides from the washing waters. The bases for inactivating the washing waters will be delimited and marked accordingly "Danger, poisoned area!". The location of the inactivation bases will be set at a suitable distance from houses, wells, animal shelters, and agricultural crops (https://www.girisudecris.ro/).

Figure 4. Application of products used in plant protection (https://www.girisudecris.ro)

CONCLUSIONS

Intensive agriculture, which uses large amounts of pesticides and fertilizers, affects the environment, the irrational exploitation of land leading, in addition to the effect of soil degradation, to the losses of agricultural land, soil pollution, water and thus the environmental pollution. One solution is to promote organic but mechanized agriculture.

The European Union, through the Common Agricultural Policy, promotes the sustainable agriculture but due to population growth, implicitly increasing the need for food, the agriculture will face in the coming years a great challenge: to provide food for the population but without polluting the environment. Unfortunately, the green revolution has only solved one problem, that of food.

Acknowledgement

This work was supported by a grant of the Romanian Research and Innovation Ministry, through Sectorial Plan, contract no. 1PS/2019 and through Programme 1 – Development of the national research-development system, sub-programme 1.2 – Institutional performance – Projects for financing excellence in RDI, contract no. 16 PFE and UEFISCDI.

Note: This paper is based on the paper presented at ISB–INMA TEH' 2020 International Symposium (Agricultural and Mechanical Engineering), organized by Politehnica University of Bucharest – Faculty of Biotechnical Systems Engineering (ISB), National Institute of Research–Development for Machines and Installations Designed to Agriculture and Food Industry (INMA Bucharest), Romanian Agricultural Mechanical Engineers Society (SIMAR), National Research & Development Institute for Food Bioresources (IBA Bucharest), National Institute for Research and Development in Environmental Protection (INCDPM), Research-Development Institute for Plant Protection (ICDPP), Research and Development Institute for Processing and Marketing of the Horticultural Products (HORTING), Hydraulics and Pneumatics Research Institute (INOE 2000 IHP) and "Food for Life Technological Platform", in Bucharest, ROMANIA, 30 October, 2020.

References

[1] Environmental Protection Agency, Bihor, Material Resources and Waste (Agentia pentru protectia mediului, Bihor, Resursele materiale si deseurile), https://www.girisudecris.ro/documente/8e33b7dc8e66ba941a73760e653e207c.pdf;

[2] Bolintineanu Gh., Matache M., Mihai M., Vlăduţ V., Voicea I., (2009), Centralized system for working monitoring of the parameters of the equipment to be applied phytosanitary treatments (Sistem centralizat de monitorizare în lucru a parametrilor echipamentelor de aplicat tratamente fitosanitare), OSIM, Patent application no. A-00960 / 23.11.2009;

[3] Borlan Z., Răuţă C., (1981), Methodology of agrochemical analysis of soils in order to establish the need for fertilizers, vol. I: Methods of chemical analysis of soils, Academy of Agricultural and Forestry Sciences, I.C.P.A. Bucharest (Metodologia de analiză agrochimică a solurilor în vederea stablirii necesarului de îngrăşăminte, vol. I: Metode de analiză chimică a solurilor, Academia de Ştiinţe Agricole şi Silvice, I.C.P.A. Bucureşti);

[4] Bungescu S., Stahli W., Vlăduţ V., Biriş S., Nagy M., Iancu T., (2009)., Verification the equipment to combat pests and diseases in Romania in order to eliminate environmental pollution with toxic substances, Proceedings of the Second International Conference "Research People and Actual Tasks on Multidisciplinary Sciences", pp. 153-162, Lozenec, Bulgaria;

[5] Cârdei P., Constantin N., Grădinaru V., Marin E., Manea D., Matache M., Muraru V., Muraru C., Pirnă I., Sfîru R., Sorică C., Stanciu L., Vlăduţ V., (2012), Structural analysis and new materials focused on mechanics, mechatronics, maintenance and operation of technical equipment for agriculture and food industry (Analiza structurală şi materiale noi focalizate pe mecanică, mecatronică, mentenanţă şi exploatarea echipamentelor tehnice pentru agricultură şi industrie alimentară), "Terra Nova" Publishing, Iaşi;

[6] Matache M., Vlăduţ V., Voicea I., Bolintineanu Gh., (2010), Reducing the environment pollution using monitoring and warning system, XI International Scientific Conference "Modern Problems of Agricultural Mechanics", section Machines and Means of Mechanization, vol. 144 (3), pp. 368-376;

[7] Munteanu C., Dumitraşcu M., Iliuţă R-A., (2011), Ecology and protection of environmental quality (Ecologie şi protecţia calităţii mediului), Balnear Publishing Bucharest (http://bioclima.ro/ECO.pdf);

[8] Niţu M., Matache M., Postelnicu E., Vlăduţ V., (2012), Reduction of environmental pollution by the equipments of herbicides administration and spraying by integrating of a centralized system for their monitoring and warning, Annals of the University of Craiova, Series - Biology, Horticulture, Technology of Agricultural Product Processing, Environmental Engineering, vol. 17(2), pp. 383-389;

[9] Petre A., Voicea I., Vlăduț V., Vlăduțoiu L., (2019), Considerations on monitoring the state of soil and vegetation pollution in the affected areas, International Conference on Hydraulics, Pneumatics, Sealing Systems, Precision Mechanics, Tools, Specific Electronic Devices & Mechatronics, HERVEX, Băile Govora, Vâlcea, România, pp. 301-307;
[10] Pisante M., Stagnari F., Grant C.A., (2012), Agricultural innovations for sustainable crop production intensification, Italian Journal of Agronomy, vol. 7(e40), pp. 300-311;
[11] Popa M., Ungureanu N., Vlăduț V., Biriș S.Șt., Zăbavă B.Șt., (2019), Types of treatment plants for livestock wastewater. Proceedings of 6th International Conference „Research People and Actual Tasks on Multidisciplinary Sciences", pp. 206-211, ISSN 1313-7735, Printing House "Angel Kanchev" University of Ruse, 12–15.06.2019, Lozenec, Bulgaria;
[12] Pruteanu A., Vlăduț V., Voicea I., Bordean D., (2019), Method for improving the agricultural soils contaminated with heavy metals (Metodă de îmbunătățire a solurilor agricole contaminate cu metale grele), OSIM, Patent application no. A-00677/24.10.2019;
[13] Tociu C., Deak G., Maria C., Ciobotaru I.E., Ivanov Al.A., Marcu E., Vlăduț V., Manea D., (2019), Advanced treatment process for wastewater from livestock farms (Procedeu de epurare avansată a apelor uzate provenite de la fermele zootehnice), OSIM, Patent application no. A-00399/02.07.2019;
[14] Tuomisto H.L. Scheelbeek P.F.D., Chalabi Z., Green R., Smith R.D., Haines A., Dangour Alan D., (2017), European Commission, Agriculture and the environment, Wellcome Open Research, vol. 2 (21), pp. 1-32;
[15] Tuomisto H.L., Scheelbeek P.F.D., Chalabi Z., Green R., Smith R.D., Haines A., Dangour A. D., (2017), Effects of environmental change on agriculture, nutrition and health: A framework with a focus on fruits and vegetables, Wellcome Open Research, vol. 2 (21), pp. 1-32;
[16] Ungureanu N., Vlăduț V., Istrate I.A., Zăbavă B.Șt., Tociu C., Ferdeș M., Dincă M., (2019a), Advanced electrochemical treatment of the wastewater from cattle farm, Proceedings of the 47th International Symposium „Actual Tasks on Agricultural Engineering", pp. 147-157, ISSN 1848-4425, 5–7.03.2019, Croația, Opatija;
[17] Ungureanu N., Vlăduț V., Cujbescu D., (2019b), Soil compaction under the wheel of a sprayer, 8th International Conference on Thermal Equipment, Renewable Energy and Rural Development (TE-RE-RD 2019), E3S Web-of-Conferences, vol. 112, 03027, 6-8.06.2019,Târgoviște, Romania;
[18] Vanghele N., Vlăduț V., Voicea I., Pruteanu A., (2019), Research on methods of de-pollution soils contaminated with heavy metals, International Conference on Hydraulics, Pneumatics, Sealing Systems, Precision Mechanics, Tools, Specific Electronic Devices & Mechatronics, HERVEX, Băile Govora, Vâlcea, România, pp. 283-290;
[19] Vlad C., Cujbescu D., Matache M., Vlăduț V., (2018), Information bulletin of standard costs for mechanized works - plowing, disking, germinative beed preparation (Buletin informativ de costuri standard pentru lucrări mecanizate – arat, discuit, pregătit pat germinativ), "Terra Nova" Publishing, Iași;
[20] Vlăduț V., Matache M., Voicea I., Bungescu S., Biriș S., Parashiv G., (2010a), Environmental and soil pollution reduction by using of a monitoring and warning centralized system, International Scientific Conference on "Environment and Biodiversity" – Ecologica, vol. 17 (59), Godina XVII, pp. 301-308, Beograd, Serbia;
[21] Vlăduț V., Voicea I., Matache M., Bungescu S., Biriș S., (2010b), Reducing soil and environment pollution by sprayer machines using monitoring system, Research Journal Of Agricultural Science, pp. 680-688, Timișoara;
[22] Vlăduț V. Uceanu E., Bolintineanu Gh., Voicea I., Matache M., (2008), Guidance on the quality of soil works (Îndrumar privind calitatea lucrărilor solului), Printech Publishing, Bucharest;
[23] Voicea I., Matache M., Vlăduț V., Cujbescu D., Persu C., Marian M., (2014), Integrated system and process for obtaining extracts with the role of foliar biofertilizer / bioinsecticide in organic agriculture (Sistem integrat și procedeu de obținere extracte cu rol de biofertilizator / bioinsecticid foliar în agricultura ecologică), OSIM, Patent application no. A-00963/ 08.12.2014;
[24] Zhu L., Yanyan Q.I., Qidong B.I., (2007), Economic analysis of environmental pollution of agriculture, Environmental Science and Management, vol. 6, pp. 140-144;
[25] http://www.farmer.com.cn/wlb/nmrb/nb8/20090225006 9.htm2009-02-25;
[26] https://ro.ripleybelieves.com/what-is-environmental-impact-of-agriculture-7534;
[27] https://ec.europa.eu/agriculture/envir_en.

ISSN: 2067-3809