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# Sustainability Issues and Consumption Requirements, Agricultural Land Production Practices from a Climate Change Perspective †

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**Abstract:** The paper brings to the fore the de facto image of agricultural systems in terms of the relativity of climate change forecasts. The relationship of the agricultural economy to development regions places the rural space as the first factor in achieving innovative agricultural production in which all agricultural activities from improving soil quality to applied plant protection products, customized to agricultural production to pursue and protect the biosphere. It presents a staging of risk factors generated by agricultural practices applied from generation to generation in villages through local traditions, as well as the role of these traditional practices today, agricultural products are a major part of culture, local identity putting its mark on agriculture through its regions. To analyze developments in agricultural markets. Prioritizing action on vulnerabilities favors a more environmentally friendly approach to agriculture. Maintaining a low level of greenhouse gas emissions generated by the agricultural sector is a priority and the purpose of research is the primary factor in reducing or abandoning chemical fertilizers and pesticides. The present analysis aims to collect data and information on the most efficient management models that will create the premises for the production of production models that will respond in the future to the challenges of climate change, especially from the perspective of reducing greenhouse gases, depending on the quality of soil. Implementation of sustainable agricultural practices, can lead to an increase in carbon sequestration in the soil through proper land management, thus making possible improvements in its quality in response to climate change.

**Keywords:** climate change; agricultural; posphate fertilization; sustainability

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## 1. Introduction

Sustainability is first introduced as an image strategy of a factual situation in the awareness of globalization and the effects increased on it by the risk of natural resource loss by intensifying the expansion activities of the industry. In light of the impact of harsh development activities, the natural environment has suffered and natural resources such as phosphorus, which is increasingly used as fertilizer in agriculture, have been reduced, having effects on the costs of phosphorus-based fertilizers.

Phosphate fertilization is used especially since phosphates have a much lower solubility, accumulating in the mineral fraction.

Current agricultural practices at the level of agricultural farms in Romania are aimed at complying with the minimum level of standard imposed by cross-compliance, so that farmers can benefit from subsidies but does not seem to be a strategy to adapt practices to soil erosion effects, ensuring coverage minimum amount of land during the winter, in the arable area especially to small farms. It is generally practiced to fertilize arable land, especially with chemical fertilizers. Usual agricultural practices are not adapted to the effects of climate change, especially on small farms, which is why, in the absence of the use of large-scale irrigation, the efficiency of agriculture in Romania is closely dependent on the manifestation of climatic conditions. Measures on the conservation of wild flora and fauna in the field of water, in the field of pesticide residues in food and feed of vegetal and animal origin are concerns for producers.

Therefore, reducing dependence on pesticide use and protecting human health and the environment from the possible risks associated with pesticide use by achieving timely use of pesticides, reducing risks and their effects on human health and the environment, including by promoting integrated pest management and alternative approaches and techniques, such as nonchemical alternatives to pesticides, are prerequisites for how climate zones are actually managed.

The prevention of the occurrence and at the same time the elimination of harmful organisms should be achieved or supported by several methods and, in particular, by: -crop rotation; -use of appropriate cultivation techniques.

For harmful organisms, the limit values set for the region concerned, specific areas, crops and special climatic conditions must be taken into account before applying the treatments, where possible. This view is based, in our opinion, primarily on knowing the risk of resistance to a plant protection measure and when the level of harmful organisms requires repeated applications of pesticides on crops, the available antiresistance strategies should be applied to maintain product effectiveness. This could include the use of multiple pesticides with different modes of action.

The approach of risk in our research shows the preponderance of actions that affect biodiversity and the resilience of natural capital. On the other hand, the sustainability of agricultural ecosystems can be applied separately depending on the ecosystem to give efficiency, the process being cyclical, and hence the distinct features of agricultural management approaches.

Regarding the agricultural context, the conclusion is that agriculture largely depends on a good working environment, therefore in the conditions of climate risk and the agricultural system suffers with the natural ecosystem. Applied research is needed in a range of areas both for the development of new practices and technologies for climate change mitigation and adaptation, and for the improvement of agricultural practices for the successful use of large-scale biosphere symbiosis.

Some of the urgent needs is to maintain these areas in the soil, the plants forming a circle in which pesticides have their role. The inventory of methods used in agricultural systems does not necessarily reflect a standard of zonal development but a form of biodiversity management, nature protection.

Reducing pollution, soil degradation, and greenhouse gas emissions, maintaining biodiversity, and maintaining balance by improving soil fertility bring into question how much we actually rely on fertilizers and how we reduce consumption while maintaining the same yield.

In recent decades, intensification practices in agriculture have contributed to increased yields.

## 2. Radiography of the Agricultural System

Future population growth, according to the United Nations, will lead to a significant increase in demand for food, feed, and renewable resources. At the international level, the agricultural sector will face major challenges, such as insufficient natural resources and climate change. In this context, agriculture needs to become more efficient and agricultural productivity to be improved to meet the main objectives in the field and, respectively, to reduce the environmental effects/impact as a result of global challenges. An essential factor for increasing agricultural productivity and reducing crop losses is to ensure the phytosanitary protection of crops by applying high-performance plant protection products to obtain quality agricultural products at affordable prices, but with reduced risk to human health and to the environment.

Globally, a set of technology transfers generally have a galloping increase in agricultural products, the purpose of growth being achieved to the detriment of the natural environment aggressed by pesticides used to increase the yield of agricultural production.

This growth has often been attributed to high-yielding varieties such as wheat or rice. However, new varieties have required large amounts of chemical fertilizers and pesticides to produce their high yields, raising concerns about costs and potentially harmful effects on the environment. In the category of cereals, the most important shares belonged to the lands sown with corn and wheat, 44%, respectively, 31% of the total area cultivated with cereals, products that constitute on the one hand the resource for ensuring the food security of the population, animal feed and training exports. The Common Agricultural Policy supports these measures, providing, in the form of subsidies, support for agricultural income, for farmers who ensure environmental protection, and for other activities that improve the competitiveness of the sector, the efficient use of resources and life in rural areas.

In 2016, the European Union used an agricultural area of 178.75 million hectares. Romania ranks 6th in the European Union, with 13.50 million hectares, representing 7.56% of the agricultural area used in the European Union.

The treated agricultural land area and the quantity of plant protection products used in various liquid or solid forms are reflected on the development regions in Romania in Figures 1 and 2. Plant protection products containing active substances, plant protection agents aim to protect plants or plant products against all harmful organisms or prevent the action of these organisms, help actions on the vital processes of plants, other than a nutritional action, also act to destroy parts of plants, ameliorate or prevent unwanted plant growth.

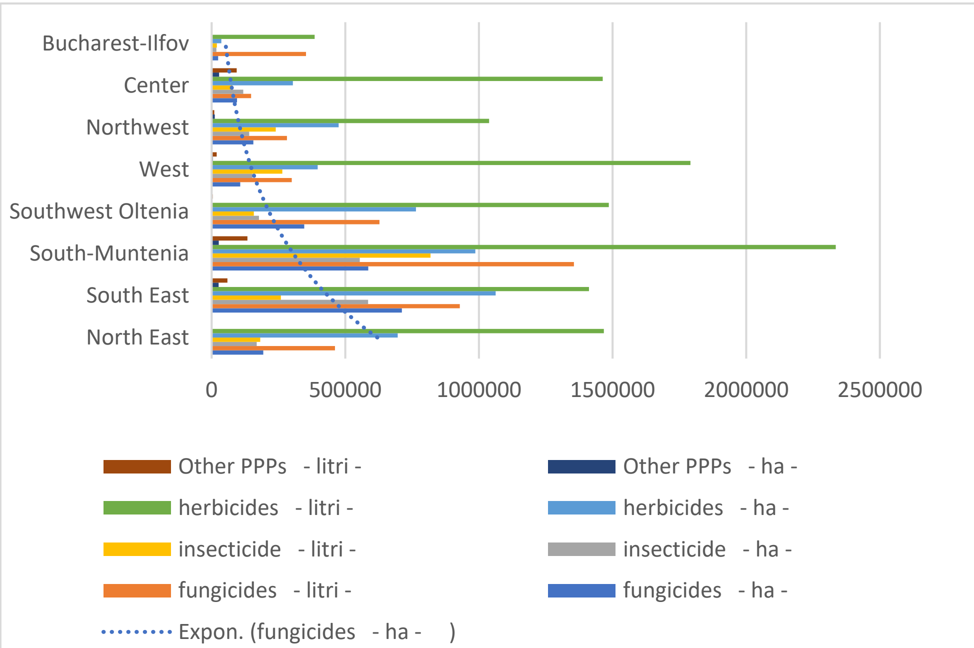


**Figure 1.** Area treated and quantity of plant protection products used, in liquid form, by development, Sources: European Commission, Eurostat and Directorate General for Agriculture and Rural Development).

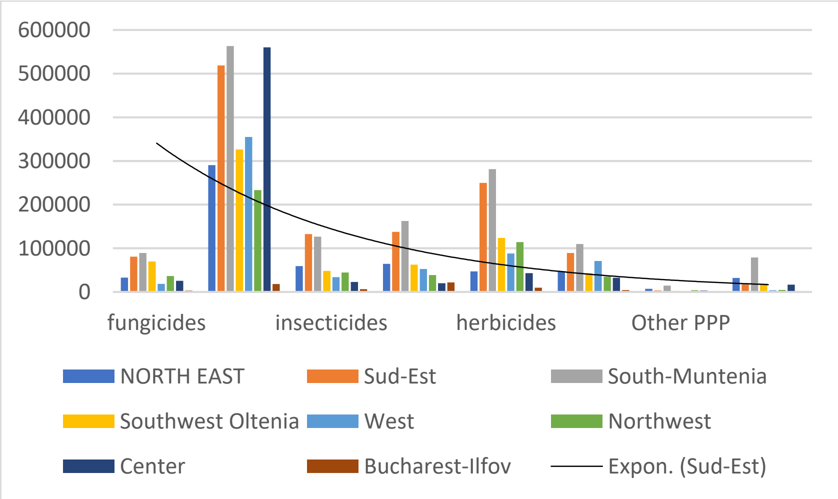


**Figure 2.** Area treated and quantity of plant protection products used, in solid form Sources: European Commission, Eurostat and Directorate General for Agriculture and Rural Development).

## 3. EU Regulations

The objective of Regulation (EC) no. Regulation (EC) No 1.107/2009 of the European Parliament and of the Council of 21 October 2009 on the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC is to reduce dependence on pesticide use and protect human health and the potential risks associated with the use of pesticides to achieve the sustainable use of pesticides by reducing their risks and effects on human health and the environment, including by promoting integrated pest management and alternative approaches and techniques, such as non-chemical alternatives for pesticides.

The integrated pest management system encourages the introduction of plant protection products containing low-risk active substances, alternative techniques to reduce the use of plant protection products. Distributors selling pesticides to nonprofessional users are required to provide general information on the risks to human health and the environment associated with the use of pesticides, in particular as regards: hazards, exposure, proper storage conditions, safe handling, application and disposal of waste. in accordance with the legislation in force on waste as well as on alternative solutions with minimal risk.

### *3.1. Good Agricultural Practices and the Role Of Pesticides*

Increasing the Demand for Fertilizers

FAO's global fertilizer demand forecast suggests that the use of fertilizers worldwide will continue to expand. These indicate increasing levels of the use of phosphate as a fertilizer on the assumption that it is through the increased process of climate change. As an external factor, it is assumed that the demand for phosphate rocks is inextricably linked to the demand for use in agriculture.

Applying plant protection substances to crops, for example, in the case of short-term use of herbicides to preserve the herbicide, it is sometimes good to reduce if it is possible to eradicate resistant weeds but sometimes not, whenever they are used they should not be wasted so we need to know and how we use them, taking into account factors such as soil, water, nutrients and plant stress. This variation is closely related to the Soil-type variation of major influence on agricultural productivity.

Where the risk of resistance to a plant protection measure is known and where the level of harmful organisms requires repeated applications of pesticides on crops, the available antiresistance strategies should be applied to maintain the effectiveness of the products. This could include the use of multiple pesticides with different modes of action to reward their own factors of production.

The transition towards sustainable food systems will bring new opportunities for farmers and operators across the food supply chain. However, to enable this, access to finance and funding will be essential. Among these elements, we highlight the need for Phosphorus (P) for the benefits to the plant both in the early stages of plant development and during the ripening period. The presence of phosphorus ensures the development of roots in young plants, shortens the maturation period, and increases the resistance of plants to stressors. It is an essential element for storing energy and transporting it to the cell. On the other hand, the lack or insufficiency of phosphorus (P) leads to the slowing down of the root growth process, and the leaves color in shades of spots with purple-red. It delays flowering and ripening, and production and quality are affected.

The transition to a mode of use in agricultural production as a fertilizer, requires a combination of elements highlighted in Table 2, knowing that in nature phosphorus can not exist alone and it forms compounds of apatite ($Ca_5(PO_4)3F$) and phosphorite ($Ca_3(PO_4)2$), at the same time phosphorus must be used according to the other nutrients needed by plants.

**Table 1.** Simple phosphate fertilizers.

| Title | Data-Method of Obtaining Components | | Nutrient Content; the Forms and Solubilities of Nutrients; |
| --- | --- | --- | --- |
| Partially solubilized phosphate rock (active phosphori | Product obtained by partial solubilization of ground phosphate rock with sulfuric or phosphoric acid, containing as main component monocalcium phosphate, tricalcium phosphate and calcium sulphate | 20% $P_2O_5$ Phosphorus expressed as soluble $P_2O_5$ in mineral acids, of which at least 40% of the declared content is soluble in water. Particle size: - at least 98% of the product must pass through the meshes of a 0.630 mm sieve | Total phosphorus pentoxide (soluble in mineral acids). Water-soluble phosphorus pentoxide. |
| Ground phosphate rock | Product obtained by grinding phosphate rock, which contains as main components tricalcium phosphate and calcium carbonate | 25% $P_2O_5$ Phosphorus expressed as mineral acid soluble $P_2O_5$, of which at least 55% of the declared $P_2O_5$ content | Total phosphorus pentoxide (soluble in mineral acids) is soluble in 2% formic acid. The mass percentage corresponding to the material passing through a 0.063 mm sieve |

*Source:* MADR-Annex Decision on establishing the conditions for placing on the market chemical fertilizers from domestic production and imports.

Nitrogen mineral fertilizers have a high solubility and have the quality of being able to provide almost entirely the nutrients needed by plants in a form that allows their direct and easy absorption. Another important advantage of chemical mineral fertilizers is that they allow their association and application together with organic or green fertilizers.

Phosphorus mineral fertilizers have a much lower solubility (10–20% in the first year of application in the case of phosphorus and 30–40% for potassium), accumulating in the colloidal mineral formations of the soil, being then blocked as heavy phosphates soluble calcium, magnesium, iron and aluminum.

The amount of phosphate solubilized by water in the soil is largely absorbed by plant roots; the amount entrained by the movement of water in the deeper layers of the soil is very low, the risk of pollution of groundwater with phosphate is very limited because phosphorus has low mobility.

An exception is the situation in which fertilizers of this type are used improperly, in excessive doses, year after year, on sandy soils, very permeable, which allow the passage of fertilizer particles without absorbing them. In this way, the risk of pollution of surface waters with phosphates is high, especially due to the evolutionary erosive runoff processes that generate the transport and accumulation of phosphate-laden soil particles in surface waters. The risk of nitrate pollution is often high due to their high solubility in groundwater and the ease with which they are transported deep into percolation waters.

In a competitive agricultural economy created to predict possible harmful effects on the environment, for example, through agricultural waste, the protection of biodiversity can be offset by good practices. Consequently, the concern at the local level, each region has its own rules marked by climate, geographical area, soil, and rural habitat.

### *3.2. Figures, Tables and Schemes*

To ensure an efficient and economically viable protection of agricultural crops, it is necessary that plant protection products be applied only when strictly necessary is when the conditions for the occurrence of harmful organisms are met.

As shown in Figures 1 and 2, the area treated with herbicides has the largest share in the area treated with pesticides (plant protection products), both in solid form (52.5%) and in liquid form (52.7%).

The surface treated with herbicides has the largest share in the surface treated with pesticides (plant protection products), both in solid form (52.5%) and in liquid form (52.7%).

Of the amount of plant protection products used in solid form, fungicides have the largest share in the total plant protection products used (71.1%), followed by insecticides (13.9%) and herbicides (10.7%).

Of the amount of plant protection products used in liquid form, herbicides have the highest share in the total plant protection products used (62.6%), followed by fungicides (24.5%) and insecticides (11.1%). Of the amount of plant protection products used in solid form, fungicides have the largest share in the total plant protection products used (71.1%), followed by insecticides (13.9%) and herbicides (10.7%).

Of the amount of plant protection products used in liquid form, herbicides have the highest share in the total plant protection products used (62.6%), followed by fungicides (24.5%) and insecticides (11.1%).

An NPK fertilizer containing ground or partially solubilized phosphate rock must not contain Thomas slag, calcined phosphates and calcium and aluminum phosphate. It must be declared in accordance with the solubility.

The advantages of liquid fertilizers in general and concentrated liquid fertilizers in particular compared to solid fertilizers are the following:

- Small investments for manufacturing facilities compared to manufacturing for solid fertilizers
- rapid, controlled and uniform incorporation into the soil;
- no major nutrient losses are recorded and the flexibility of element ratios is ensured; Superior physical quality (do not dust, do not crowd)
- The flexibility of the composition according to the needs and compatibility with fungicides, insecticides, and microelements as well as their simultaneous application, leading to agronomic results superior to solid fertilizers; expanding the range of liquid fertilizers to organic chelating fertilizers for drop spraying;
- easily achieving a desired ratio between previously performed fertilizations, with the possibility of correcting the existing deficiencies in microelements;
- catalyzes soil reactions by accelerating chemical and microbial transformations at the root level, favoring the increase of the export of nutrients from the assimilable soil reserve.

### *3.3. Formatting of Mathematical Components*

Minimum nutrient content. Simple phosphate fertilizer: Concentrated superphosphate Product obtained from the reaction of ground phosphate rock with sulfuric acid and phosphoric acid, containing as main component monocalcium phosphate as well as calcium sulphate.

$$\text{Phosphorus in the earth's crust} = 4 \times 1015 \text{ tons}$$

$$\text{Phosphate rock resources Phosphate rock reserves} = 2 \times 109 \text{ tons of phosphorus}$$

$$P_{tot} = PO^{-}_{4} - P + \text{Polyphosphate} + P_{organic}, \tag{1}$$

$$PO^{-}_{4} - P = 0.326 \times PO^{-}_{4}$$

As I pointed out above, phosphates are used in combination with other substances on an agricultural area of only 0.4 ha cultivated with corn, in this case the maximum amount of nitrogen that can be applied is:

$$0.4 \text{ (ha of corn)} \times 130 \text{ (Kg N/ha/year)} = 52 \text{ kg N/year}.$$

25% $P_2O_5$ Phosphorus expressed as $P_2O_5$ soluble in neutral ammonium citrate, in which at least 93% of the declared content of $P_2O_5$ is soluble in water. Water-soluble phosphorus pentoxide. Knowing these particularities of mineral fertilizers (N and P), it can be appreciated that:

- The risk of groundwater pollution with phosphates is very limited because phosphorus has a reduced mobility. An exception is the situation in which fertilizers of this type are used improperly, in excessive doses, year after year, on sandy soils, very permeable, which allow the passage of fertilizer particles without absorbing them;
- The risk of pollution of surface waters with phosphates is high, generally due to the erosive processes of runoff that cause the transport and accumulation of soil particles loaded with phosphate in surface waters.

Mineral fertilizers must be applied in addition to natural sources to ensure high agronomic efficiency and environmental protection against chemical pollution (especially nitrate water pollution).

In general, the optimal time of application is when the weeds are in the rosette phase. Weed control in vegetation has an effect by saving fertilizer that can be used on other crops, fertilizers act on the bacterium nitrosomonas keeping it inactive, keeping nitrogen in a stable form of ($NH4+$) for as long as possible, this form being less exposed to losses through leaching and de-nitrification. Nitrogen applied to the crop remains available to the plants for a long time and increases the production potential. The dynamics of fertilizers in the soil-plant-hydrosphere system depends on the mechanisms of interaction between the fertilizer components and the colloidal matrix of the soil as well as on the flow of the soil solution in which the mobile forms of mineral fertilizers are dissolved.

## 4. Patents

Phosphorus is an essential element of life. It is an irreplaceable part of modern agriculture, phosphate mineral fertilizers have become the main source of phosphorus in global agricultural production, as well as the initial source of newly introduced phosphorus in the cycle whereas there is no substitute for its use in animal feed and fertilizers. The current situation, which involves waste and losses at every step of the phosphorus life cycle, contributes to concerns about future phosphorus supply and water and soil pollution, both in the EU and globally. The Advisory Communication on the sustainable use of phosphorus in Brussels, 8.7.2013 COM (2013) 517 recommends that measures be taken to use and recycle phosphorus more efficiently. Actions taken to improve the efficiency of phosphorus use and recycling would also have a number of other benefits-for example, better soil management would have benefits for climate and biodiversity. EU regions producing arable crops tend to stabilize phosphorus levels in the soil, but continue to depend on the application of phosphorus mineral fertilizers. Major causes of usable phosphorus loss include soil erosion and percolation, as well as inefficient use of manure, biodegradable waste and wastewater. The extraction and processing of phosphate rocks also uses a large amount of water as a raw material in production.

Thus, although modern mines can reuse 95% of the water taken over, this fact is not exclusively valid. In addition, there is a risk of leakage or infiltration of strongly acidic treatment water, especially from basins on phosphogypsum stacks, which can contaminate aquatic ecosystems. Given that phosphate rock deposits are often found in water-deficient regions, water supply may be a significant limiting factor in the development of phosphate extraction. The extraction process is also a large energy consumer, which has direct implications for production costs. Rising prices for phosphate rocks depend mainly on supply and demand, one of the factors being the increase in demand due to biofuel crops. They also reflect food prices and may be a minor factor in rising food prices. Excess phosphorus, mainly from intensive agriculture and horticulture, is a risk factor for pollution in lakes and rivers. On the background of these concerns, it can be said that mineral fertilizers affect regional imbalances.

Phosphorus is a critical nutrient in agriculture in fertilizers that is extracted from rock phosphate as opposed to nitrogen fertilizer, phosphate fertilizer can not be chemically synthesized. As an economic impact, the lack of phosphorus can generate its price increase on the market. With the increase in the price of phosphorus, production can be reduced, and these effects can be felt by competing consumers.

Economic impacts for farmers are rising costs, farmers will increase, but income will increase due to rising prices. If the demand is very high, most of the impact will be felt by consumers. Phosphorus is an essential product and widely used in agriculture. Thus, after the appearance of the very high consumption of phosphorus, higher costs were generated for consumers, and higher costs for farmers, but also higher incomes.

As characteristics, phosphorus mineral fertilizers have a much lower solubility (10–20% in the first year after application in the case of phosphorus and 30–40% for potassium), accumulating in the colloidal mineral formations of the soil, being then blocked under the form of sparingly soluble calcium, magnesium phosphates. Phosphorus deficiency is shown in Figure 3 in a corn crop.

**Figure 3.** Ground phosphate rock. Source: phosphate winkipedia.

Phosphates have much lower solubility, accumulating in the colloidal mineral fraction of the soil in which they are reversibly adsorbed. The amount of phosphate solubilized by water in the soil is largely absorbed by plant roots; the amount entrained by the movement of water in the deeper layers of the soil is very small. As he argues (Tol, 2019), at present, humanity is facing a new stage, namely, that of climate change.

Improves plant health. The benefits to the environment are the reduction of leaching and the reduction of the amount of nitrates in groundwater and has the role of reducing the release of harmful greenhouse gases into the atmosphere. For example: those in which

$P_2O^5$ predominates are more suitable for straw cereals before sowing, those with a nitrogen ratio are suitable for technical crops, etc. Soil properties influence the use of fertilizers, irrigation and fertilization can be combined, obtaining a simultaneous supply of water and nutrients. Complex fertilizers are recommended to be applied depending on the ratio of nutrients.

What we set out to do is to provide a diagram of the risks of an agricultural economy caused by the assimilation of sustainability in the context of the demands imposed by climate change, but also of their consequences globally. From this perspective, we have emphasized in part why it is important to give priority to the risks in the agricultural system in terms of fertilizers. Thus, some causes such as the effects of climate change, poor yields combined with low selling prices, and agricultural trade are not factors that cause fertilizer consumption. By reversing the decline in production potential and production losses in the absence of chemical protection would highlight the differences that could be exploited in improving more disease-tolerant varieties, which would reduce the need for pesticides without significant reductions in production. Thus, the above analysis highlighted the need to consume liquid or solid fertilizers through good agricultural practices adapted to climatic zones, to make better use of resources used as mineral fertilizers such as phosphorus which continues to be a resource used in world agricultural production.

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