

THE CHALLENGES OF CROP PROTECTION AND THE PLANT GENETIC RESOURCES IN THE INTERNATIONAL YEAR OF PLANT HEALTH

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Abstract

In the International Year of Plant Health, the control of the disorders that biotic and abiotic factors cause in plants, especially in those that have agroforestry use, has special relevance. For this reason, some aspects of the methods of controlling pests and diseases of diverse agricultural and forest species are briefly reviewed.

Resumen

En el Año Internacional de la Sanidad Vegetal tiene especial relevancia el control de los desórdenes que factores bióticos y abióticos causan en las plantas, especialmente en las que tienen un uso agroforestal. Por ello se revisan brevemente algunos aspectos de los métodos de control de las plagas y enfermedades de diferentes especies agrícolas y forestales.

Key words: additional fertilisation, productivity, soil moisture, winter and spring wheat.

The International Year of Plant Health

Plants are the source of the air we breathe and most of the food we eat, yet we often do not think about keeping them healthy. The Food and Agriculture Organization (FAO) estimates that each year up to 40% of food crops are lost due to plant pests and diseases. This is a serious detriment to many people without enough food and it is a relevant damage for agriculture, the main source of income for many rural communities.

The health of many crops is increasingly under threat. The progressive climate change, and some human activities, have altered ecosystems and agrosystems, reducing agrobiodiversity and creating new niches where diseases and pests can thrive. Additionally, the global interactions regarding travel and trade has increased in the last years and facilitates a quickly spread of crop pests and diseases around the world.

Biotic factors: pests and diseases

Protecting crops from pests and diseases is much more profitable than dealing with the phytosanitary emergencies they can cause. Plant pests and diseases are often impossible to eradicate once they have established themselves and managing them is time consuming and expensive. Therefore, prevention is critical to avoid the impact of pests and diseases on agriculture and food security.

Controlling plant diseases is critical to reliable food production and presents significant problems in agricultural use of land, water, fuel, and other inputs. Natural populations and cultivated varieties may have genetic resistance to diseases and pests, but it is often not enough in many crops, which requires phytosanitary treatments, generally with environmental impact, for which genetic improvement for resistance to these biotic factors is fundamental for plant health. Therefore, progress in the science of plant pathology is needed to improve disease control and control disease pressure caused by the continuous evolution of crop pathogens and by changes in agricultural practices.

Plant pests and diseases cause significant economic losses for farmers around the world. In different regions and on different crops, it is estimated that pests and diseases can reduce yields by 10% each year in more developed environments, but this yield reduction exceeds 20% in less developed environments. To solve this, new methods of detection and early diagnosis of pests and diseases are needed.

Abiotic factors

Abiotic stresses can be due to natural processes such as drought, low or high temperatures, floods, nutrient deficiencies in the soil, wind, storms, and forest fires. Other stresses that are generally considered abiotic can be due to human interventions, such as alterations and contamination of agricultural soils, air pollution, excessive application of agrochemicals, bad agricultural practices, inappropriate urbanization in rural areas and vandalism.

Plant pathology

Plant pathology or phytopathology is the scientific and technical study of plant diseases caused by pathogens and environmental conditions. The pathogenic organisms that cause infectious diseases in crops mainly include fungi, bacteria, viruses, protozoa, nematodes and parasitic plants. There are also pests caused by insects, mites, vertebrates or other pests that affect the health of plants by eating plant tissues. Plant pathology includes identification of pathogenic agents, disease etiology, disease cycles, economic impact, epidemiology of plant diseases, resistance to plant diseases, genetics of pathogens and the management of crop diseases.

A very important aspect is the resistance of plants to pests and diseases, that is, the ability of a plant to prevent and overcome infections by pathogens. The structures that help plants to prevent disease are cuticular layer, cell walls and protective cells of the stomata, which act as a barrier to prevent pathogens from entering the host plant.

Once diseases have overcome these barriers, plant receptors initiate signalling pathways to create molecules that compete against foreign molecules. These pathways are regulated by genes of the host plant and are capable of being manipulated through genetic improvement to create plant varieties that are resistant to pathogenic agents.

Disease and pest management

There are several methodologies for the prevention and treatment of plant pests and diseases, among which the following can be highlighted as methods of control against pathogenic agents.

Methods based on legal regulations

Quarantine refers to a collection of diseased vegetation or individual plants that can be isolated from other displaying healthy growth. Its purpose is to prevent the introduction of harmful non-native organisms by controlling trade and human activity, for which legislation and its effective enforcement are crucial to ensure lasting effectiveness. With respect to legal regulations, it is necessary to consider the inspection of nurseries, in which plants are propagated to be used in small or large-scale cropping systems. In this case, the inspection of the nurseries to detect the possible presence of pathogenic agents and avoid their dispersion is of great relevance. The same could be said about the phytosanitary inspection of sowing seed

Cultural

Agriculture in some areas is practiced on a small scale, on family farms that often use traditional farming techniques. In these cases, the plants often benefit from active external protection by farmers resulting in a lower incidence of pests and diseases. Extensive, large-scale agriculture includes methods such as forest pruning, thinning, etc., that also are relevant for the health of plants.

Crop rotation is often an effective means of preventing a population of pathogens from becoming well established, as an organism that affects one crop may not affect another. Likewise, associated crops of two or more plant species can have a preventive effect on the spread of crop pathogens.

Genetic improvement

Genetic improvement is usually based on crosses, or hybridizations, with individuals or varieties resistant to a pathogenic agent, which act as gene donor to individuals or varieties that lack genetic resistance.

It is also possible to address resistance to a disease through genetic engineering, thus obtaining transgenic plants that have incorporated genes from other species that provide resistance or tolerance to pathogenic agents.

However, the use of existing agroforestry biodiversity is essential for resistance to pests and diseases through genetic improvement, therefore the germplasm collections have a special relevance.

Chemical

Different natural and synthetic compounds (agrochemicals) can be used against crop pests and diseases. The agrochemicals work by directly killing disease-causing organisms or slowing their spread; however, there may occasionally be adverse collateral effects for the local ecosystem.

Biological

Biological control is a very effective method of controlling pests and diseases. It is based on the use of organisms that are harmful to pathogenic agents, being able to partially or completely eliminate them from plants.

Biotechnicals

The use of chemical stimuli, such as the use of pheromones, especially sexual ones, is an interesting control method, being able to act to know the existence of an organism in an area or as a method of confusion or massive trapping. Repellents or attractants could also be used as well as physical stimuli such as light, sound and colour.

Conclusion

Currently the control of pests and diseases is carried out by means of the integrated control system. It means the use in a rational way of all the aforementioned methods, emphasizing the environmentally friendly methods and the diversification of the plant genetic resources. Thus, whenever possible, biological, cultural, and biotechnical methods will be used rather than chemical ones, and in case of having to use chemical methods it should be ensured that they are selective and as respectful as possible with the environment, applying them whenever the requirements exceeded practical economic thresholds.

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