Trophobiosis

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Trophobiosis is a field of knowledge that allows us to understand that pests and diseases do not attack any plant at random, but only those that serve as suitable food for that particular pest or disease. This theory, developed by French researcher Francis Chaboussou (2006), is an approach that seeks to understand how plants defend themselves through their metabolism. Controlling these pests and diseases is a challenge for agricultural production, and trophobiosis is one of several complementary strategies for achieving healthy crops.

The word trophobiosis means food (tropho) for a way of life (biosis). In other words, for a plant to be attacked, its sap must contain exactly the food that an insect, mite, nematode, or microorganism (fungus or bacterium) needs. This food consists mainly of amino acids, simple substances that are easily absorbed.

Amino acids bind together to form proteins, like links in a chain. Pests and disease-causing species have a limited variety of digestive enzymes, which are necessary to break down amino acid chains. This reduces their ability to fully utilize large (complex) molecules, such as proteins.

When it comes to proteins, a plant's metabolism involves two opposing processes: synthesis (proteosynthesis) and decomposition (proteolysis). During proteosynthesis, a plant combines the amino acids circulating in its sap to form proteins, resulting in less food available for pests and diseases. Conversely, during proteolysis, the amount of free amino acids circulating in the sap increases, meaning that more food is available for pests and diseases. The more intense the protein synthesis, the fewer free amino acids, sugars, and soluble minerals will remain. In addition, efficient protein formation increases the plant's respiration and photosynthesis levels, improving its overall function.

Therefore, the key to reducing the likelihood of a plant being attacked by pests and diseases is to maximize protein synthesis and minimize proteolysis. To achieve this, it is important to understand which factors influence plant metabolism, favoring or hindering both processes. Based on this, it is possible to make decisions aimed at optimizing those factors that increase plant resistance.

The important factors affecting plant resistance are: 1) plant species or variety (genetics); 2) age of the plant or age of the part of the plant; 3) soil; 4) climate (light, temperature, humidity, wind); 5) organic fertilizers; 6) low-solubility mineral fertilizers; 7) nutritional treatments; 8) cultural practices (weeding, pruning); 9) grafts; 10) chemical fertilizers (NPK); and 11) pesticides. Below is a brief definition of each of these factors.

1) Plant species or variety: The genetic adaptation of the plant to its growing environment increases its protein synthesis capacity, as in the case of traditional seeds. Greater adaptation translates into better nutrient absorption capacity in the roots and greater photosynthetic capacity in the leaves, for example. Conversely, if the species or variety is not well adapted, the plant's function is impaired, favoring proteolysis.

2) Age of the plant or part of it: Proteolysis is most intense during the sprouting and flowering phase. All plants store reserves for times of need, such as the reproductive season. During this phase, stored proteins are broken down so that they can be mobilized and form shoots and flowers. This is a period in which the plant is naturally more sensitive and fragile, as the nutrient load it receives is very high and its capacity to use the incoming energy is still insufficient, accumulating soluble substances that serve as food for pests and diseases. On the other hand, normal protein breakdown also occurs in older leaves, allowing products and minerals to be mobilized and reused by younger leaves. As a result, older leaves are more affected than mature ones.

3) Soil: Good soil fertility, achieved through adequate physical conditions (loose soil), good nutrient diversity, and high microbial activity, increases plants′ ability to absorb and select nutrients, which promotes protein synthesis. Conversely, weak, overworked, worn, compacted, and bare soils reduce plants′ ability to select and absorb nutrients, hindering protein synthesis and facilitating the accumulation of soluble substances.

4) Climate: Climatic factors affect plant metabolism in various ways. Among these factors is light, as a lack of sunlight reduces photosynthesis, which hinders protein synthesis. Therefore, when there are several cloudy days, insect problems or plant diseases can be expected. Another factor is humidity, as its lack or excess causes imbalances in plants, which means that their functioning worsens, decreasing protein synthesis or causing proteolysis. Water is one of the factors that promotes nutrient absorption in plants. Excess water in the soil can reduce the availability of air (oxygen) to the roots, making nutrient absorption difficult.

5) Organic fertilizers: Organic matter applied to the soil increases protein synthesis in plants thanks to its organic compounds and its diversity of macro and micronutrients. It is well known that plants in soils rich in organic matter that receive supplemental organic fertilizers are much less susceptible to insects and diseases. Organic matter improves plant resistance because, in addition to improving the physical structure of the soil, it contains macro- and micronutrients in balanced amounts, which plants absorb according to their needs, selecting quality and quantity, thereby increasing the level of protein synthesis. Micronutrients are essential for protein synthesis, both because they are part of enzymes and because they activate them, and enzymes are the tools that regulate plant metabolism. Organic matter also improves plant resistance because it contains growth substances that increase respiration and photosynthesis (phytohormones).

6) Low-solubility mineral fertilizers: These fertilizers gradually become available for root absorption and stimulate root growth, increasing their ability to draw water and nutrients from the soil. Unlike concentrated soluble chemical fertilizers, they do not harm soil macro- and micro-life, optimizing the proteosynthesis/proteolysis ratio in plants. Examples include natural phosphates, limestone, and rock powder, used in moderate amounts.

7) Nutritional treatments: Organic substances and a variety of micronutrients are essential for optimal physiological balance and, consequently, greater plant health. Examples of nutritional treatments include the use of ash, biofertilizers enriched with wild herbs or specific micronutrients, and whey, as all have beneficial effects on plant metabolism, increasing proteosynthesis.

8) Cultural Treatments: weeding, plowing, harrowing, cutting roots, and poorly done pruning, harm the normal metabolism of plants, as they cause wounds that have to be healed and, as in the case of budding and flowering, the plant has to decompose its reserves, take them to the wound and rebuild the structures that were damaged by cultural treatments, which increases proteolysis.

9) Grafting: Where the rootstock and scion meet, a natural filter forms for the nutrients in the plant's sap, and not everything absorbed by the root reaches the crown. In grafted plants, optimal soil conditions are not always sufficient, and in many cases, this filter must be compensated for with periodic foliar sprays (with biofertilizers, ash water, whey, or milk, for example) to ensure optimal proteosynthetic capacity.

10) Chemical fertilizers (NPK): These products reduce proteosynthesis because they alter plant function. The components of these fertilizers end up being toxic due to their high solubility, as they are absorbed very quickly by plants, and also due to their excessive nutrient concentrations, which cause problems with plant growth. Soluble chemical fertilizers, which are acidic and saline, also destroy the soil's useful life, impairing all processes involving the removal of nutrients such as phosphorus, calcium, potassium, nitrogen, and others. They also hinder the fixation of nitrogen from the air, which is carried out by bacteria in the roots of legumes (beans, soybeans, clover, green beans, peas, etc.) or by other organisms that are free-living in the soil. They also hinder the release of phosphorus and many other minerals by mycorrhizae, which are beneficial fungi associated with plant roots. Thus, urea, NPK, potassium chloride, and superphosphates directly and indirectly harm plant metabolism, making them less resilient.

11) Pesticides: The application of pesticides negatively affects proteosynthesis in two main ways. The first is direct, through its effect on the plant. The second is indirect, through its effect on the soil. All pesticides can enter the plant through the leaves, roots, fruits, seeds, branches, or trunks. In other words, they not only kill insects, mites, nematodes, pathogens, or plants (in the case of herbicides), but also have a high potential to poison crops. They can reduce plant respiration, transpiration, and photosynthesis, affecting proteosynthesis and harming plant resistance. Like chemical fertilizers, pesticides also destroy soil life, impairing the availability of nutrients for plants.

A healthy, well-nourished, well-managed, and locally adapted plant is unlikely to be attacked by insects or diseases, as these pests and diseases starve a healthy plant, as they have nothing to feed on. Thus, insects, mites, nematodes, fungi, bacteria, and viruses are the consequence of unhealthy plants, not the cause of the problem. In practice, they are biological indicators that something in the management is not being done properly.

Learning to identify what these indicators tell us makes it easier to decide what to do to control the problems. Understanding trophobiosis provides us with an objective tool, especially important during the agroecological transition period.

References:

[1] CHABOUSSOU, F. Plants sick from the use of pesticides. 2006, 320 p.

To learn more

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