World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:19, No:07, 2025

Sustainable Biostimulant and Bioprotective Compound for the Control of Fungal Diseases in Agricultural Crops

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Abstract : Certified agricultural products are important components of the food industry. However, certifiers have been expanding the list of restricted or prohibited pesticides, limiting the options of products for phytosanitary control of plant diseases, but without offering alternatives to the farmers. Soybean and coffee leaf rust, brown eye spots, and Phoma leaf spots are the main fungal diseases that pose a serious threat to soybean and coffee cultivation worldwide. In conventional farming systems, these diseases are controlled by using synthetic fungicides, which, in addition to intensify the occurrence of fungal resistance, are highly toxic to the environment, farmers and consumers. In organic, agroecological, or regenerative farming systems, product options for plant protection are limited, being available only copper-based compounds, biodefensives or non-standard homemade products. Therefore, there is a growing demand for effective bioprotectors with low environmental impact for adoption in more sustainable agricultural systems. Then, to contribute with the covering of such a gap, we have developed a compound based on plant extracts and metallic elements for foliar application. This product has both biostimulant and bioprotective action, which promotes sustainable disease control, increases productivity as well as reduces the dependence on imported technologies the damages to the environment. The product's components have complementary mechanisms that promote protection against the disease by directly acting on the pathogens and activating the plant's natural defense system. The protective ability of the product against three coffee diseases (coffee leaf rust, brown eye spot, and Phoma leaf spot) and against soybean rust disease was evaluated, in addition to its ability to promote plant growth. Our goal is to offer an effective alternative to control the main coffee fungal diseases and soybean fungal diseases, with a biostimulant effect and low toxicity. The proposed product can also be part of the integrated management of coffee and soybean diseases in conventional farming associated with chemical and biological pesticides, offering the market a sustainable coffee and soybean with high added value and low residue content. Experiments were carried out under controlled conditions to evaluate the effectiveness of the product in controlling rust, phoma, and cercosporiosis in comparison to a control-inoculated plants that did not receive the product. The in vitro and in vivo effects of the product on the pathogen were evaluated using light microscopy and scanning electron microscopy, respectively. The fungistatic action of the product was demonstrated by a reduction of 85% and 95% in spore germination and disease symptoms severity on the leaves of coffee plants, respectively. The formulation had both a protective effect, acting to prevent infection by coffee leaf rust, and a curative effect, reducing the rust symptoms after its establishment.

Keywords : plant disease, natural fungicide, plant health, sustainability, alternative disease management
Conference Title : ICBBE 2025 : International Conference on Bioenergy and Bioproducts Engineering
Conference Location : Berlin, Germany
Conference Dates : July 22-23, 2025