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Safety Fungal Fertilizers for Healthy Food Products

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Abstract: Roots are the main and important part of the plant that absorbs water and nutrients from the soil, to be transferred to the aerial parts of the plant to help the plant grow and continue. It is worth noting that there are organisms in the soil that support plant growth by increasing its efficiency in absorbing nutrients, therefore there is the need to study on plant interactions with soil microorganisms. However, caution should be taken when adding beneficial soil organisms as biological fertilizers or pesticides, even if its use brings many and many benefits, such as reducing the use of chemicals in various forms as fertilizer or biocidal, which helps in creating a clean and healthy environment for humans, animals, water and air, on the one hand, and on the other hand, it helps in increasing crop productivity, which helps in achieving food security. With the evolution of omic technologies, it became possible to effectively observe rhizosphere microbial community together with their effects on plant productivity, thus maintaining sustainable agriculture. This has created an incentive and an obsession for researchers to develop microbial species interacts positively with the plant to protect it and increase its production (Berruti *et al*., 2016).

Keywords: Safe fertilizer, Useful organisms, Healthy food products, Plant X soil organisms interaction.

INTRODUCTION

Agriculture at the present time relies on adding chemical fertilizers in large quantities to obtain high and abundant production. It also depends on the use of chemical pesticides that are harmful to humans, animals and the environment alike (Bhardwaj *et al*., 2014).

Scientists are concern to invest beneficial microbes in agriculture, because of its important role in obtaining a safe, healthy food without chemicals, on the other hand, it does not threaten the environment with the danger of pollution in all its forms and ensures sustainable agriculture (Bhardwaj *et al*., 2014).

Practical applications of beneficial and safe microbes have proven their usefulness in increasing plant production, i.e. there are many plants that are a stimulating factor for the growth of Rhizobacteria (plant growth promoting rhizobacteria /PGPRs), endo- and ectomycorrhizal fungi, cyanobacteria and many useful and beneficial organisms, which as a result helps in improving the absorption of nutrients into the soil, it also increases the plant's tolerance to either abiotic or biotic stresses (Bhardwaj *et al*., 2014; Igiehon and Babalola, 2018a).

The fungal interactional relationship between mycorrhizal and rhizobacterial are studied by many researcher (Song *et al*., 2015; Rasmann and Turlings, 2016). Also, host interactive relationship with viruses is of importance, this is due to the difference in the pattern of infection according to the host plant. So it could be concluded that the interaction of the plant with soil organisms may be positive or negative, depending on plant species (Igiehon and Babalola, 2018).

In this article, the positive relationship between plants and soil organisms will be reviewed. Also, the various interactions between different plant species and soil organisms that can be used as a biological fertilizer in plant nutrition, will also be discussed.

Plant-Microbial Interactions

So far this relationship is not clearly understood, to benefit from it in sustainable agricultural development. Therefore, it needs a lot of thoroughly studies to understand it, (Igiehon and Babalola, 2018a).

The area in which the interaction between plants and soil organisms takes place is called “Rhizosphere”, it is the area adjacent to the roots of the plant and filled with diverse organisms (Philippot *et al*., 2013; Mendes *et al*., 2014).

Soil organisms that located in huge numbers affect plant growth and productivity (Philippot *et al*., 2013; Mendes *et al*., 2014).

Many substances secreted by the roots of the plants regulate the relationship between it and soil organisms i.e. different organic acids and cutin monomers,flavonoids, besides gene expression of microorganisms. The effect of these secreted substances from the roots of plants is to send chemical signals to the organisms in the soil, which work to direct them to provide the roots of the plant with what it needs for growth (Venturi and Keel (2016).

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Many studies have clarified the mechanism by which chemical signals are transmitted from plants to soil useful organisms, which motivate plant growth (Bednarek *et al*., 2010; Rosier Rosier *et al*., 2016). There are many forms of interaction of soil organisms with each other, and the nature of this interaction varies with the different types of organisms, and this reaction is reflected on the plant. It could cited an example of those interactions namely: virus versus virus, bacterium versus bacterium, protozoan versus protozoan, fungus versus fungus, bacterium versus fungus, fungus versus plant or animal, plant or animal versus bacterium, plant or animal versus virus, plant or animal versus protozoa , plant or animal versus bacterium versus fungus, in addition to other parasitic and symbiotic associations, that has unique mechanisms that lead to enhanced host plant growth (Igiehon and Babalola, 2018).

The researchers (Flor-Peregrín *et al*., 2014) showed in Figure (1) a clear model of the relationship between the bacterium *Pasteuria penetrans* and root-knots nematode in the area adjacent to the roots of the plant, where bacteria penetrate the nematode and multiply inside it and work to decompose it, causing it to die, to spread and releases into the soil.

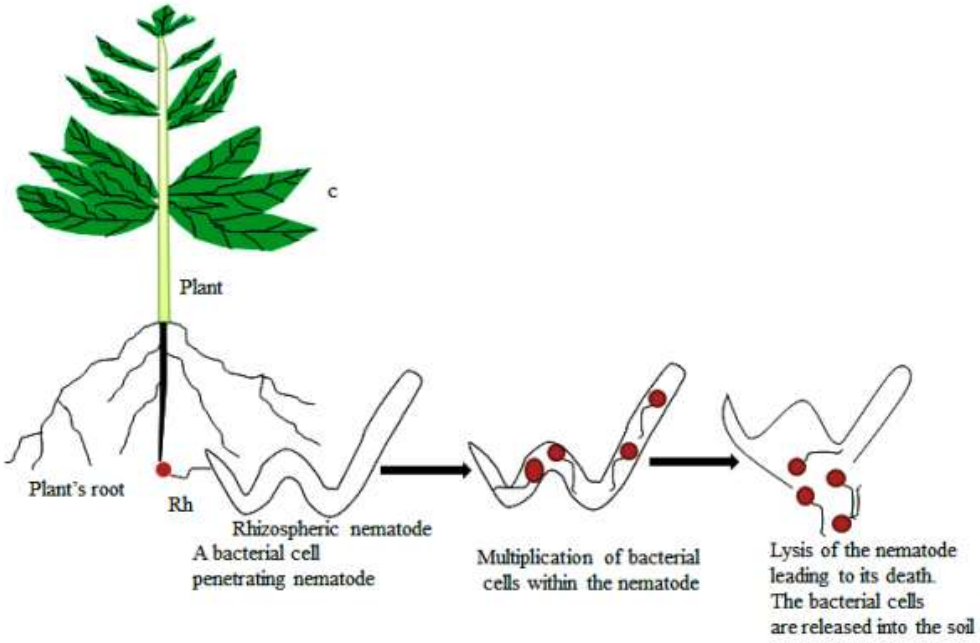

Figure1. Interaction between Parasitic the bacterium Pasteuria penetrans and root-knots rhizosphere in the nematode (Flor-Peregrín *et al.,* 2014).

Reciprocates benefits with 80% of plants by forming a group of roots Arbuscular Mycorrhizal Fungi (AMF). This fungus provides the plant with water, nutrients, and protection from diseases, and in return it obtains photosynthesis products (Berruti *et al*., 2016). The AMF fungi also improves the texture of the soil (Rillig and Mummey, 2006; Leif heit *et al*., 2014, 2015; Rillig *et al*., 2015)

The part of a plant that is located above the surface of the soil is called "phyllosphere" specifically, the circumference of the leaves. The interaction that occurs in the rhizosphere and phyllosphere has an effect on herbivores and carnivores (Philippot *et al.,* 2013). For example, the two fungi MF, *Bacillus* and *Pseudomonas* have the ability to stimulate systemic plant immunity against many diseases caused by soil microorganisms (Zamioudis and Pieterse, 2012; Philippot *et al.,* 2013). Also, some plants that are attacked by insects excrete Volatile Organic Compounds (VOCs) generated systemically. These compounds travel in the air as signals to alert other plants to stimulate their immune system to fight these insects, besides these compounds also travel through plant roots to the rhizosphere. For example, the common mycelial networks that motivate the transfer of signaling compounds from the attacked plant to un-infested to be careful of infestation with these insects as shown in Figure (2).

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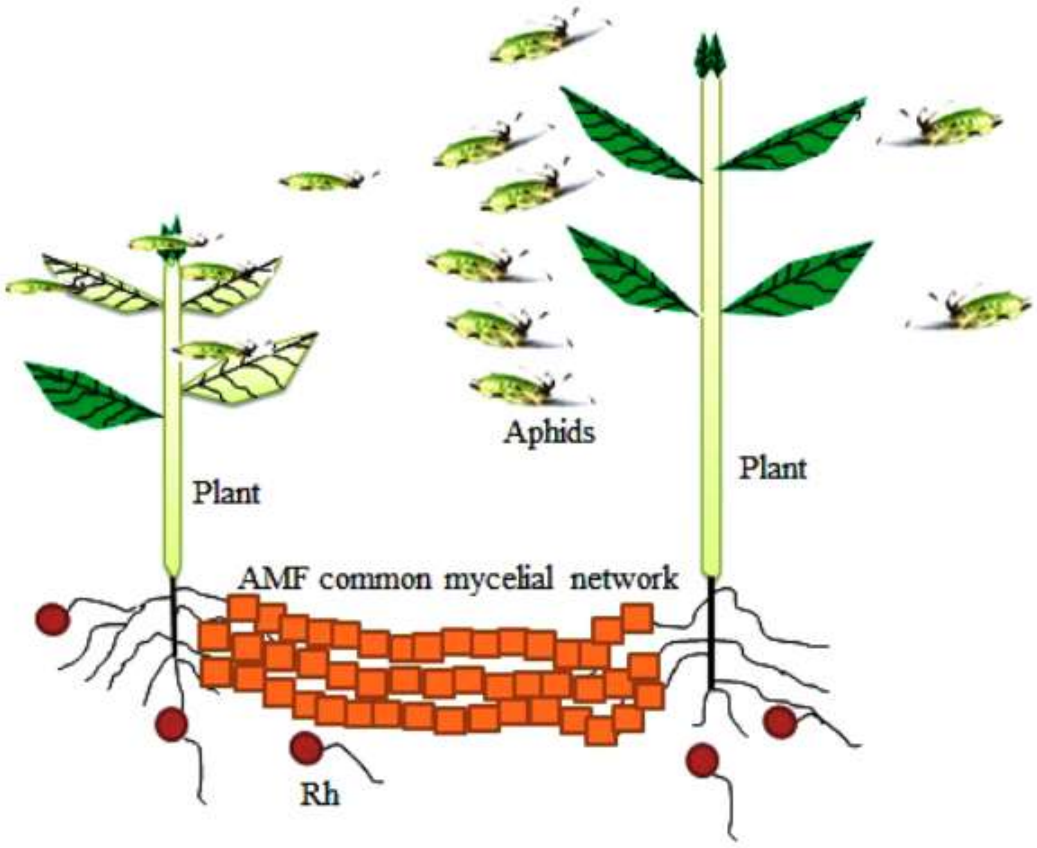

Figure 2. The attacked plants (left) by aphids secrete volatile organic compound that transmitted through common mycelial system to prevent aphids attack on other plants (right).

FUTURE PROSPECTS AND CONCLUSIONS

Due to the positive effect of AMF inoculation into the soil, which helps the plant to take advantage of the nutrients in the soil and prevent many diseases caused by microorganisms in the rizhosphere, thus increasing plant productivity, without adding and somtimes reducing the addition of chemicals that harm the environment, human and animal health. That being the case, it is important to more extensive thoughtfully by adding these AMF in agriculture, after accomplish a number of field trials and studying the economic benefit analyses of as presented in Ceballos *et al*., (2013) this technology.

Since many studies have shown that AMF that existed in each different soil are equally or even better performing than commercial, it is better for the farmers to produce their AMF inocula, to make this technology (bio-fertilizers) available, especially for the third world countries, which need to greatly sustain agriculture.

There are many interactions between many plants and soil organisms that have not been studied yet, which needs to be clarified, as it has been shown by Babalola and Glick (2012).

If the interaction between plants and soil organisms is explained, soil inoculants can be developed (Babalola, 2010; Alori *et al.*, 2017; Igiehon and Babalola, 2018b). Also, it will be reflected positively in mitigating the negative effects of chemical pesticides on human health, reducing environmental pollution and obtaining a clean product.

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