Interaction between plants and microbes

Microbial ecology is the scientific study of the intimate relationship or interaction of microorganism with its environment either biotic or abiotic (1).

Microbes are omnipresent in our entire world and can also exist in harsh environments such as acidic lakes and tundra’s. Studying microbial ecology can help mankind gain more knowledge about the intimate interactions and how they function which can improve our lives in such a way to preserve and restore our environment.

The field of microbial ecology is so diverse and unique with multiple disciplines such as animal-microbe interaction, microbe-microbe interactions, e. g.: lichens and symbioses, e. g.: beneficial gut microflora but the most interesting relationship is plant-microbe interaction (2).

Plants are a very important factor in our environment and it contributes to human existence through providing oxygen (O2). Plants undergo daily stressors; whether it is to fend off pathogens or protect its apparatus against high temperatures therefore they are extremely diverse in its producing metabolites. Plants that have a close relationship with microorganisms are very successful in growth and performance and have only positive influences in its ecosystem. Not only does the plant benefit but as well the microbes because the plants provide the microbe with sufficient nutrients as well as a suitable territory (3).

The interaction between plants and microbes can have several beneficial aspects as seen in the agricultural and ecological fields. In most countries chemical fertilizers are very commonly used to produce a much higher yield of certain crops especially wheat (and rice

Discussion

- Plant-Microbial communities

Plant-microbe interactions can be either positive or negative depending on the nature of the microbe (6) and what it takes from the plant and excretes into the environment. A rhizosphere is an area consisting of a specific interaction either commensally, where an organism is living on a plant or receiving food from it but neither contributing anything nor doing any harm, or mutualistic, where both the microbe and plant receive equal benefits (10).

In the field of plant-microbe interactions one will find examples of both positive and negative relationships which means that the plant may either benefit from the interaction or experience stress or even disease respectively.

Rhizosphere – the area where there is close interaction or contact between the soil microbes and root (6).

Positive Interactions can be described as a mutualistic or symbiotic relationship between the plant and the microorganisms with examples in mind such as:

Leaf Nodules is a typically known where the bacteria occurs, functions and reproduces within a leaf or plant (7) (See Figure 1 below). Sometimes it’s also referred to as bacterial endophytes (6). There have been recent studies that show these bacteria are not necessarily of any importance to plants and the advantages are very few – the major thing these bacteria produce are phytohormones (6) needed for the plants growth. On the other hand bacteria

gain a lot of advantages within this relationship – the plant provides a physical and save habitat as well as photosynthates (6, 7).

- Typical Leaf Nodule containing endophyte bacteria

Another interesting example is Mycorrhiza which was first described by A. B. Frank (6) which described it as something similar we today refer to as ectomycorrhiza and he hypothesized that the fungi and plant are nutritionally dependant on one another (8). Mycorrhiza mostly occur in plants root system where there are poor soil fertility, the plant provide the fungus with the necessary nutrients for its survival e. g.: carbohydrates whereas the fungi absorb more nutrients from the soil or its surrounding environment. There are two types of functionally important Mycorrhiza namely ectomycorrhiza (see figure 2 below) (6, 9) which are on the exterior of the roots. The most common host plant for this form of fungi is Pine and the most common fungal families are basidiomycetes and ascomycetes (6) and endomycorrhiza are the exact opposite of ectomycorrhiza and are commonly found on the interior of the plants root system. The function of these two is very similar and is mainly to transport assimilated nutrients to the plant helping it to improve its performance and growth, this can also be a form of survival mechanism for the plant when environmental as well as nutritional conditions are unfavourable .

Negative Interactions can occur in the form of a parasite, virus, fungi or bacteria entering the plant and causing infection within the plant (6) entering through different tissues especially openings such as the stomata. When the plant does not have enough immunity in some cases the infection will cause a disease and it may lead to severe agricultural disaster and economical

loss. The pathogenic microbe may become resistant to the plants defences and may secrete a toxin which alter the plants genome and can severe consequences.