Abstract: Arbuscular mycorrhizal fungi (AMF) usually form beneficial symbioses with roots of many plants in order to allow them to maintain themselves and grow well under relatively harsh conditions. Some primary benefits of mycorrhizae are enhanced host plant acquisition of mineral nutrients. Fungal hyphae normally transport phosphorus over longer distances from depleted zones compared to roots. The AM especially benefit plants grown in soils where P is likely to limit plant growth. A reduced effectiveness of AM colonization of roots often occurs when soluble soil P levels increase. This review gives an overview on the role of mycorrhizae in absorbing phosphorus.

Key words: Arbuscular mycorrhizal fungi, Phosphorous, Absorb.

INTRODUCTION

One of the natural cases which cause increase in the efficiency of plants' performance is coexistent relations. Although coexistent of creatures in nature has an ancient history, in the year 1879 Dabary for the first time called the relationship between different types of living creatures as Symbioses (Alizadeh, 2010). Of all considerable cases of living creatures coexistent in nature, we can mention the coexistent of fungi and plants under the mycorrhizal title (Alizadeh et al., 2010). The phrase Mycorrhize was applied to the cooperation between fungi and palmary plant roots by Frank in the year A.D 1885. Though Frank used the phrase Mycorrhize for the first time, but before that some work was done in this field, for example in year 1847 Reissek proved the existence of Hyphaes in variety of hidden seeds cells. In the year 1884 Cany Canski produced a report of fungi Hyphaes Corporation with plant and showed complete layers of fungi around the roots (Alizadeh, 2010). The results of the first researches with regards to creating coexistent relations between Rhizophagus genus fungi that belong to Endogonaceae, all indicate the establishment of this coexistent. Although it is known that VAM fungi form symbiotic relationships with more than 90 percent of plant species, but the inoculation intensity is not uniform in all. The higher percentage of the root that gets colonized by the mycorrhizal fungus, the more Mycorrhizal desire there is. Communication between VAM fungi is not equall, and the concept that plants have a different mycirrhizal tendency is certain (Brundett and Kendrik, 1988) Internal and external factors' affect the intensity of desire is Mycorrhize that it can effect on phosphorous absorption. Which will be pointed out in the next paragraph.

Mycorrhizal inoculation essence

It consists of an equal mixture of planting environment along with spores, chains with no roots and mycorrhizal roots which in comparison to the rest of the types, it usually has the most ability of polluting the host plants root. At the same time the great mass of usable inoculation essence which exceeds few tons per hectare has put the production and usage in large scales to
serious problem. In the method of using spores as the inoculation essence, they only use mycorrhizal fungi spores in the way of moist sieve from the host plant roots’ soil. In the other method, the root of the mycorrhized plant is used as the inoculation essence where by using the pre-colonised roots, roots that have extremely been colonised by mycorrhized fungi, are used as inoculation essence. The method of tissue cultivation is also a way of producing root inoculation essence and for those plants that have many subsidiary thin roots; it can easily grow and reproduce through tissue cultivation (Alizadeh and Nasr, 2010).

**Location and time for colonisation**

When the chains and mycorrhized root tissues are near each other, connection will be made through structural combination and practical connection. In this method a cell will show reaction especially as a result of cooperation with one another and should receive information of others, information that should be transferred through chemical or physical signs. Herbal solution factors can clearly make the growth of fungi before physical connection with root level apparent. The extract of the non host plants does not show this result. The phenolic compounds show the first stages of connection between plant and coexistent pathogen/bacteria’s. Adding phelavonoieds on cultivation environment shows the increase in the amount of spore sprout as well as chain diverges (Mukerji, 1996). VA fungi are only formed on new and young root tissues. Therefore they can form on young roots with no peripheral thickness; especially root levels might be more capable for colonisation. Mathematics models show that root tissues behind the meristem compared to the other sections, show more talent to be colonised, the cellular level characters might also have an effect on the colonisation stages (Mukerji, 1996).

**Mycorrhizal expansion and colonisation**

Colonisation can occur in plant root systems with fungi spore, external mycelium and pre colonised roots and the admixture of the above is called Propagules. If spores are used as the source of colonisation, they’ll cause faster growth compared to the growth mood of a simple root, because spores can produce one or many growing roots. With the presence of fungi, the plant motivates fungi by discharging hormones such as Cytokinins, indol astick acid and it will attract the fungi to itself. The main chain with a diameter of 20-3- micrometer can produce fan-like sections from lateral divergence which have a diameter of about 2-7 micrometer and are separated from the main chain by phenomenal wall. The root colonisation is usually done by the fan-like sections and in each colonisation a unit of divergence enters into the cortex cellular and can produce bifurcate arbuscule divergence. After a time period, arbuscules or spiral chains will get destructed and create mass like sections.

**The phosphorous nutrition of VAM fungi**

The high efficiency of VAM fungi in absorbing phosphorous in soils where the amount of absorbable phosphorous is low is very obvious (Al keraki and Al--radad, 1997). VAM fungi decrease the need of phosphate dung through providing the needed phosphorous of the plant in the balanced surfaces of phosphorous (meaning surfaces that don’t prevent fungi activity) (Bethlen falvay and Linderman, 1992). In addition to the expansion of absorption surface, ability of absorbing more ion by the chains compared to the abruption system of the root, faster transfer of elements through chains to the root compared to the route of the soil to root and possiblly the ability of mycorrhizal fungi usage of insoluble or low soluble phosphates resources, have been considered effective in increase of absorption and also the synerjisty relation with soluble microorganisms of none absorbable phosphates in plants have been considered as one of the effective factors in absorbing phosphorous (Bolan, 1991).

In an experiment performed by Alizadeh et al., (2010) regarding the speed of phosphorous absorption in the sorghum plant using three types of fungi, he showed that reforming the phosphorous nutrition in plant through mycorrhizal coexistent is followed by the increase of the speed of phosphorous and he related this to the early stages of plant growth and type of VAM fungi.

The result that was gained on an experiment on corn showed that the increase percentage of root becoming mycorrhized has had a significant effect on absorbing phosphorous, zinc and copper (Alizadeh et al., 2008).

Roots experiments specify that more than 80% of plants’ phosphorous through external VAM fungi chains can be freed towards the root from a distance more than 10 centimetres from the root surface (Li et al., 1991). Overall increase of growth in root inoculation with mycorrhizal fungi was because of increase of phosphorous.
absorption and it specially is affected from phosphorous resources (Bolan et al., 1991). Li and colleagues reported that plants in the mechanism of producing mycorrhize through more growth of root and hairy roots, help more to the mobile building of phosphorous and also external VAM fungi chains infiltrate H+ Ions which cause the soil around itself to be acidic (Li et al., 1991). By getting help from marked phosphorous, Bowen and colleagues specified that transferring phosphorous to the plants’ air organs takes place very quickly and specialised mycorrhize alkaline phosphorous to the plants’ air organs takes place and colleagues specified that transferring phosphorous to the host plants, in mycorrhizal activity by Mokerji (1997) include:

- Mutual effect of mycorrhizal fungi with soluble phosphate bacterias
- Production of phosphates through mycorrhized fungi
- Production of organic acids through chains of mycorrhize that mineralise phosphorous

So as a result absorbing phosphate from soil through plant is mainly limited because of low phosphate movement in soil. In soils where absorption capacity of phosphorous in them is high, the thickness of phosphate ion in soil solution is very low and as a result propagating it towards the root will be very sluggish (Jayachandran et al., 1992).

**Capture and transport of phosphorus by VAM fungi**

VAM fungi increase phosphorus uptake of food and may have an especial beneficial effect on the seeds. (Barea et al, 1987).

With increasing absorption, three mechanisms have been proposed. First, the mycorrhizal has decreased the distribution distance of food to plant: roots and has increased the absorption level. This is why mycorrhize has been more usefull in plants with short, thick, low dense roots. Second, the rate of food uptake by the roots has been more in Mycorrhizal toots compared to non Mycorrhizal roots. Third, row of mycorrhizal fungi may be capable of increasing the food absorption through plant by chemical ways (George et al., 1995). Phosphorus transfer from soil to plants through fungi consists of three stages. The first stage is absorbing the Phosphorus through fungi rows, then Phosphorus moves across from row to row towards the root, which in this stage phosphorus inside the chains in the vacuoles by poly-phosphate kinas is converted to poly-phosphate and this poly-phosphate by the Cytoplasm flow is transferred in the chain and during the final step where phosphate is transferred from fungus to plant. Poly-phosphate is broken in the arbescle by alkaline poly phosphate and it will enter into the roots of host plants.

The AM hyphae normally transport P located at greater distances from the root than do non-AM roots (Tinker et al., 1992). For example, the soil P depletion zone away from roots for non-AM white clover (Trifolium repens) plants was 10 mm compared to > 20 mm for Glomus (G.) mosseae plants (Li et al., 1991) Increased availability of less soluble sources of P to plants has been attributed to AM. For example, AM plants received more P and grew better than non-AM plants when sparingly soluble inorganic sources of P like Fe-, Al-, and Ca-phosphates (Graw, 1979; Bolan et al., 1987) and organic sources like RNA (Jayachandran et al., 1992) and phytate (Nurlaeny et al., 1996) were applied to soil. The AM somehow may have been able to provide extended hyphal lengths to access more P or to facilitate conversion of sparingly soluble P compounds to available forms for enhanced host plant acquisition. Hyphae of AM may excrete ethylene (Ishii et al., 1996), flavonoids (Ishii et al., 1997), volatile substances (Gemma and Koske, 1988), and growth regulating compounds (Barea and Azcon-Aguilar, 1982; Danneberg et al., 1992) like cytokinins (Danneberg et al., 1992; Thiagarajan and Ahmad, 1994) to stimulate growth and potentially increase hyphal growth. Formation and/ or excretion of organic substances by AM hyphae or AM- roots to solubilize non-available forms of P might be important to facilitate host plant access to available P (Hetrick, 1989; Bolan, 1991). Oxalic acid has been reported to be produced by ectomycorrhizal fungi (Cromack et al., 1979), but production of organic acids such as oxalic or citric to solubilize sparingly soluble P sources has not been reported for AM. The
availability of soil P may be altered by changes in rhizosphere pH (Bolan, 1991; Marschner, 1991). Increasing soil pH usually increases the availability of Al-and Fe-phosphates, and decreases the availability of Ca-phosphates (Lindsay and Moreno, 1960).

An increased uptake of P by AM hyphae should result in increased P uptake per root length. For example, uptake of P per unit root length was 1.3 fold higher for AM over non-AM plants (Tinker et al., 1992).

The acquisition of P by AM plants differs with not only plant species/ cultivar (Quintero-Ramos et al., 1993; Khalil et al., 1994), but with AM solute colonizing roots.

REFERENCES


Barea JM, Azcon-Aguilar E, Azcon R (1987) Vesicular-arbuscular mycorrhiza im-prove both symbiotic N2 fixation and N uptake from soil as assessed with a I-


