Use of mycorrhiza in organic farming

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Abstract. In this review we discussed the role of mycorrhiza in organic farming. How mycorrhizal association, will help to improve and encouraging the idea of organic farming. How mycorrhizal association help the plants to grow and yield better without applying of chemical fertilizers and following the conventional farming practices. We discussed how AMF help plant to uptake nutrients, releasing chemicals which help plants to grow proper, developing resistance against weeds, pest and other microbes.
1. Introduction
Mycorrhizae is actually the association between fungal hyphae and underground plant parts of Bryophytes or Pteridophytes or roots of seed plants and also sporophytic of most Pteridophytes. First of all, Frank (German Pathologist) used the term mycorrhiza (Fungus roots) in 1885. Plant root and fungus combined, results in a single structure through which exchange of nutrients and carbon takes place. Plants are conferred many characteristics by mycorrhiza such as increase in the growth rate due to increase uptake of minerals and nutrients survival in the harsh conditions as well as reduced the risk of diseases. The survival of the both participants (plant and fungus) is required in the mycorrhizal symbiosis [1]. The different structures formed by the root tip and the hyphae, of the different fungi are described by the mycorrhizae.

The organic farming is always considered better and preferred on conventional agricultural practices. The recent organic farming practices are very diverse [2] but the term organic also explain the other alternative farming practices like biodynamic, organic and biological organic [3]. The conventional and organic farming are different from one another because of two main reasons which are (i) in organic farms the traditional soluble fertilizers are replaced with the leguminous crops and less soluble or processed fertilizers [4,5] or even in some condition no fertilizer will be used. (ii) In organic farming the manufactured and chemical biocides replaced with the natural and organic alternatives. The use of organic fertilizers shows a great impact on the soil structure and improves its physical properties and this is also because of mycorrhizal association in the soil [6]. For the success of organic farming one of the key factors is the presence of soil microbial communities and their interaction with the crop [7]. In organic farming many complex biological practices have been followed and used for achieving the maximum results. These management practices may affect more than one component of the soil for example if it effect in improving the soil structure and controlling weeds but on the other hand it may increase the mineralization of certain nutrients which are not required by plant. That’s how it challenges the nature and developing the organic farming.

2. Mycorrhizal association
The plant roots formed association with the Arbuscular mycorrhizal fungi which are very common in nature and agricultural ecosystem. Mycorrhizal association increases the root absorptive area from 10 to 1000 times for uptake of soil nutrients most importantly phosphorous [8] and all other major 15 macro and micro nutrients [9]. It also controls the diseases and drought stress in host plant. Through various researches it is now proved the importance of AMF in agricultural system because of their ability to interact with soil components, improving soil structure, other soil microbial interaction and maintain the structure of plant community. AM fungi considered as the intermediate between the host plant and the nutrient and that’s why considered very important as regulator for nutrient uptake but if there is already enough amount of P present in the soil or because of application of fertilizers the presence of AMF reduced in the soil [10]. In organic farming it is highly appreciated to use biological regulators for providing nutrients to the plants instead of forced-fed of readily soluble inorganic nutrients by application of fertilizers [5] and organic farming can increased the AMF inoculum in the soil [11,12]. Role of mycorrhizal association was understood in ecosystem due to the advance research in this field. This advancement in mycorrhizal research has increased the applicability in different fields like agriculture, horticulture and forestry.

3. Mycorrhizal fungi in organic farming
The AMF are playing key role in nutrients uptake, decreasing the diseases and helpful in pathogen control in organic farming. The organic farming is emerges as the uniform group of farming practices which work
on the basis of International Federation of Organic of Agricultural Movements [13]. The general rule of this is replacing the biocides and fertilizers with organic regulators and crop rotation [14], because of restriction of using readily soluble fertilizers there is limited amount of P in the soil [15]. To overcome the pathogenic fungi biocontrol agents also used which does not harm the AMF [16, 17]. The only macronutrient which is not available for plants is P and because of hyphae formed by mycorrhizal fungi, this major nutrient along with N is available for plants thus the farmers are no more depend on the fertilizers to meet the plants demand for P [18]. Mycorrhizal association is very important for legume plants for its requirement of P for maximum growth and also for nitrogen fixation and nodulation [19]. Improved nitrogen fixation by Rhizobium and P uptake by AMF reduced the requirement for chemical fertilizers hence the water and air pollution by chemical fertilizers controlled. Crop production by following these techniques is of great importance in Bangladesh [20]. Citrus, coffee, tea, rubber and oil palm are important trees which have mycorrhizal association. Early establishment and increased growth can be witnessed when AMF inoculation applied to the fields.

4. Mycorrhiza favored organic farming
In organic farming many practices have been carried out like crop rotation inter and intra cropping and manuring resulting in increased fertility of the soil. This will leads to the production of healthy crops. That’s why the soil managed by organically has large number of AMF spores, colonization of roots and inoculum potential than the conventionally managed soil [12, 21–24] but it is not always the same that low input practices will leads to increase in biodiversity [25,26]. The population of AMF can be influenced by use of fertility building crops, cash crops, avoid using chemicals for weeds and fungicides [27]. That’s how the number of spore difference increases with time in organic and conventional farming. On the other hand the decomposition of different organic matter in soil and metabolites production by soil microbes may affect the mycelium of mycorrizal fungi [28].

5. Benefits of mycorrhiza in organic farming
Mycorrhizal association results in many benefits to plants as well as to the soil and organic farming system. Mycorrhizal association help in improving the soil structure [29] by producing humic compounds and organic glues as well which help in improving the soil porosity and formation of aggregates and that’s how plant growth increased because of improved aeration, water movement, growth of roots etc. Mycorrhiza increased the growth of plants by producing certain hormones like cytokinins and gibberellins. AMF increased the root surface area for absorption thus increase the roots longevity, improved usage of nutrients which are not available in excess and nutrients storage, reduced the interaction with soil colloids and increased the nodulation and nitrogen fixation. The crop yield improved by mycorrhizal association [30] specifically in infertile soils [31] by providing P in the soil which is not readily available to plants for growth [32]. Plant growth increased because of mycorrhizal association help in uptake of nutrients especially P (33) Carbon [34] and Nitrogen [35] and other micro nutrients specifically zinc and copper [36]. AMF are important because of its role in pest management [37] because of presence of mantle which is a physical barrier against those soil borne pests, nematodes and pathogens. Mycorrhizal association also help to control the weeds in a safest way as compared to chemicals used to control growth of weeds. Mycorrhizal association also helps in land rehabilitation [38]. Because of mycorrhizal association help in uptake of nutrients under water stress condition that’s how plants develop resistance against drought stress [39]. This association also helped the plant to grow in salinity [40], nutrient deficient condition, degraded soil, damaged soil, eroded and land with coal wastes [41].
Normally, macronutrient use increases crop production, growth and quality [42–49]. A number of studies have also shown that low productivity is largely connected to management activities, such as low productivity and rising agricultural costs [50–56]. Research has shown that temperature, fertilizer applications, plant populations and planting date are significantly linked [57–72]. Mycorrhizal association is one of the most important phenomena occurring in nature and can be considered as organic fertilizer. Numerous studies indicate that the availability of nutrients is important for plant growth, particularly in the case of weeds that influence and inhibit crop growth for nutrients in the soil [73–93]. Active organic matter provides habitat and nutrition for beneficial soil organisms that help to create soil structure and porosity, provide plant nutrients, and improve soil ability to retain water [93–107].

6. Conclusion
Mycorrhizal interaction offers plants, soil and sustainable agriculture a number of advantages. Mycorrhizal association helps improve soil structure by creating humic compounds and organic glues that help improve soil porosity and aggregate formation, and that's how plant growth increased due to improved aeration, water movement, root growth.

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