Shoot samples were removed from each pot and were collected in separate paper bags that were labeled accordingly. Then soil form each pot was washed away to collect root sample and almost 50g of soil sample was taken from each pot to check the pH and EC of rhizosphere to observe the effects of mycorrhizae and roots. Soil samples were air dried for 48 hours. Fresh weight of shoot and root samples were measured. Oven dried samples root:shoot ratio was measured. Roots were stained by **Jan Jansa** method, which allows colonization of roots by AMF to measure the association under different textures of soil.

3. RESULTS AND DISCUSSION

Vesicular arbuscular mycorrhizae colonize its roots and significantly increase its growth rate, nutrient uptake. VAM not only positively affects plant growth but also impacts positively on rhizosphere soil and increase nutrient availability to roots. It effects on Root: Shoot ratio of plant species. VAM response varies from plant species to species, texture to texture of soil.

3.1 Root: Shoot Ratio

Results show that root: shoot ratio is 1.5 in T_0 and 1.4 in T_1. Root: shoot ratio was found to be negatively related with growth. It increases during stress conditions like moisture stress, salt stress, less availability of nutrients. There was general trend that root: shoot ratio to increase as soil texture changes from clay to sand [12]. Root: Shoot ratio is high in T_0, because of less ability of retaining moisture and nutrients in sand. Root: Shoot ratio decreases as the moisture availability increases [13-15]. T_1 has more ability to retain nutrient and moisture as compared to T_0 and T_2, because of more clay and silt content in T_1.

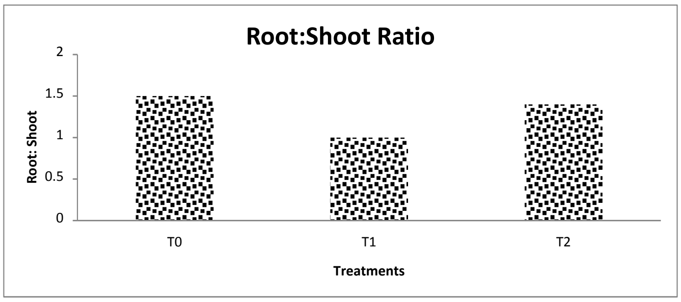


Figure 1: Root: Shoot ratio is high in T0 (sand) and T2 (Sand+Soil), because of stress on these treatment plants as compared to T1 (soil).

3.2 Plant Biomass

The results showed that the fresh and dry weight of shoots increased as the soil concentration increased. The treatment having high soil contents has greatest biomass. Naturally occurring mycorrhizae in soil affected the plant significantly. Plants colonized by AMF also have greater ability to absorb nutrients like P, N, K, Ca, Mg, and water which results in better survival under stressed conditions [16].

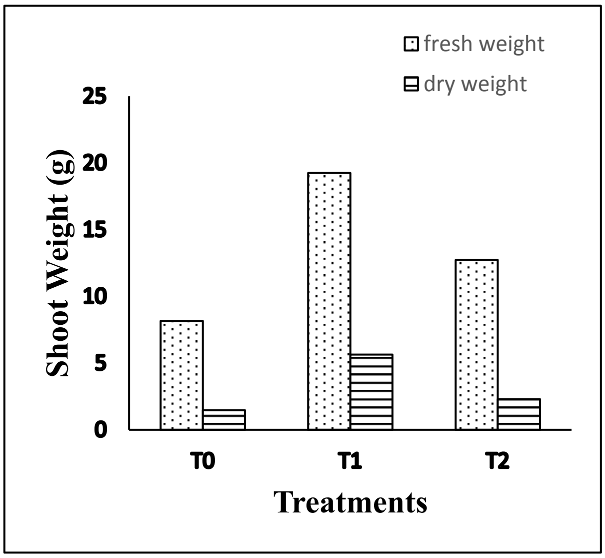


Figure 2: Fresh & dry weight of plant shoots showing high biomass in treatment with more soil content as compared to treatment with sand only

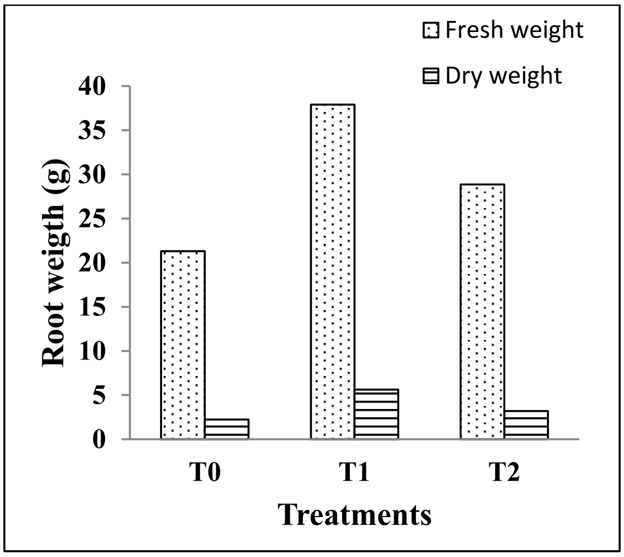


Figure 3: Fresh and dry weight of plant roots presents more root biomass in T1.

3.3 Change in EC and pH

The result shows that there is a decrease in rhizosphere soil pH. It may be increase or decrease up to two units in the rhizosphere owing to be release and uptake of ions by roots. Root induced changes affects the mineral nutrition of plants by various methods. Root exudates solubilize iron an aluminum phosphates cause net excretion of H^+ in soil solution and increase in reducing capacity [17]. Respiration of microflora in rhizosphere alters soil pH. More activity and population of microflora, then pH of rhizosphere lowers than that of surrounding soil.

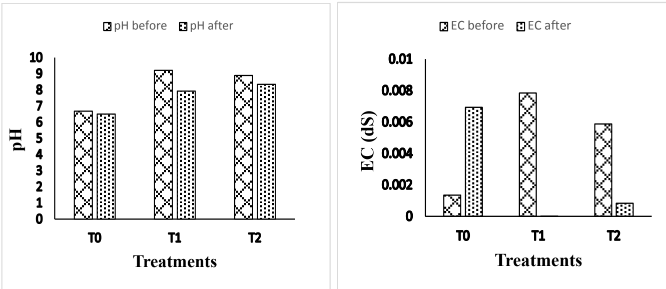
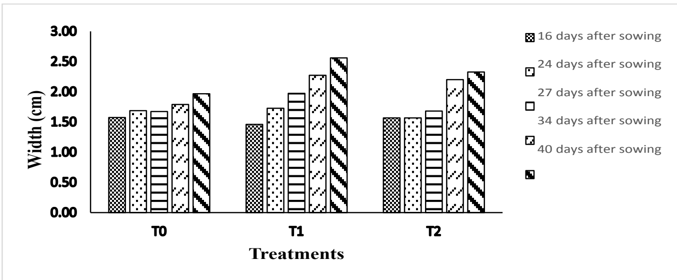
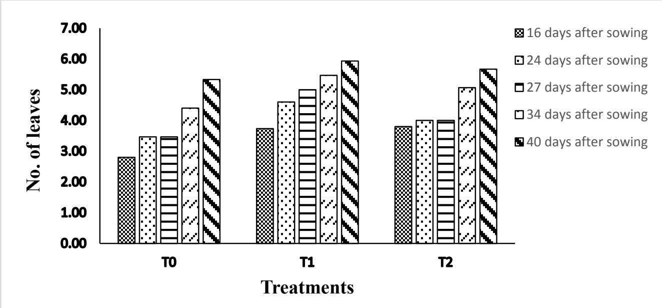


Figure 4: a and b shows pH and EC of soil. There is a decline in rhizosphere pH of all treatments while pH of T_1 decline significantly after harvesting of plant.

3.4 Growth Rate

There was significantly change in growth parameter among different soil texture treatments. Growth rate was high in treatment which had more soil contents as compared to sand. The results showed that the plant height increased T_1. Whereas the treatments with 100% sand (T_0) and 50% sand (T_2) had plants with less height, comparatively. As the plant grow on seed nutrients, emergence of plants and the width of plant leaves were good in sandy soil (T_0) as compared to other treatments. Later when plant depended on soil for nutrient uptake, its growth declined because sand has poor nutrient availability. The results showed that the plants grown in soil with naturally occurring mycorrhizae have better leaves width and growth. Number of leaves per pot showed similar results in all treatments.T_2 plants growth was in between both treatments. We concluded that the plants of T_1 had good nutrient availability which leads to better vegetative growth of plants.





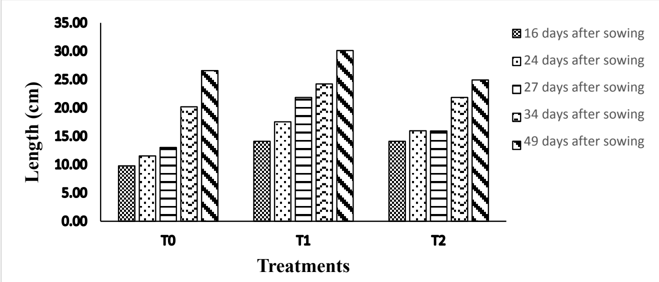


Figure 5: a, b, c shows the physical increment in growth rate e.g. width of leaves, number of leaves and length of leaves respectively.

Length & width of leaves was more prominent in sand during the early stage of plant growth but after utilization of stored food in seed, growth rate start declining. Number of leaves was almost same in all treatments. Treatment with more soil content show better results as compare to others because of more availability of nutrients and more moisture retaining capacity as compared to other treatments.

3.5 Root Colonization

Root colonization is high in T_0 treatments. In general, clayey soils are more fertile than sandy ones because clay has a higher capacity for adsorbing ions from the soil solution [18]. High cationic exchange capacity was observed in the clayey soil, and this greater nutrient concentration could have limited VAM development, as shown in several studies [19,20]. Additionally, the mechanical impediment, caused by a finer soil texture, favors the deposition of suberin on the epidermis, which increases resistance to infection by VAM [21-23]. With reduced space between the soil particles, mechanical stress on the roots is increased, so that breakage of the cortical layers is increased and the colonization sites are lost.

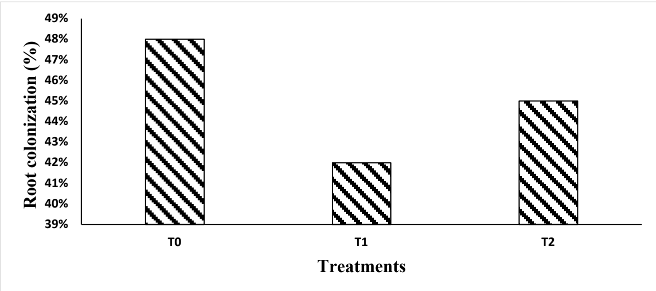


Figure 6: VAM colonization is high in T0 (Sand), because sandy soils have more pores, more soil temperature and less nutrients which favors the growth of roots and less nutrients availability. Nutrient availability retards the growth of mycorrhizae [19,20].

Sandy soils are usually more porous, warmer, drier, and less fertile than those of a finer texture and these conditions have direct and indirect effects on AMF [24]. Good soil aeration is a prerequisite for optimum AMF development [25]. Soil temperature from 30 to 35^{0}C favors spores germination, spread of root colonization and arbuscule formation [26, 27]. Soils with low fertility limit plant development and increase the dependence of plants on mycorrhizal association. Under these circumstances, fungi grow more extensively inside the root to support the development and functioning of external hyphae. Arbuscles are important structures for nutrient exchange and were observed on 10 to 48% of the roots examined indicating a functional interaction between AMF and plant.

4. CONCLUSIONS

From above discussion it is concluded that VAM showed better result in medium texture soil as compared to clayey and sandy. By this research, it was confirmed that root colonization is better in coarse textured soils as compared to fine textured soil. In this experiment, VAM colonization was more in loose texture soil and affect growth parameter and improve plant growth. To analyze the growth factor further experiments be will conducted by the scientists in future.

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