

Effect of sunlight on the mycorrhizal associations in rhizomatic plant *Colocasia esculenta* L.

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Abstract

Effect of light and shade on mycorrhizal colonization in roots of “Elephant Ear” (*Colocasia esculenta* L.) was studied. For this purpose; four samples of thin roots of *Elephant Ear* were selected from light and shady area. The roots were stained and observed, microscopically. These roots showed a significant relationship of mycorrhizal colonization with Light & Shade. Percentage of hyphal colonization and arbuscule presence, number of arbuscules and vesicles per field of microscope were studied in both root categories. The overall trend of mycorrhizal infection was higher in Light grown roots as compared to the collected from shady areas. Plant roots grown under direct sunlight not only had the higher hyphal colonization rate than shade grown roots but they also showed the higher number of arbuscules and the higher number of vesicles per field of microscope. These remarkable differences ratify that sunlight has a positive impact on mycorrhizal symbiosis. It is, therefore, indicated that sunlight accelerates the mycorrhizal symbiosis in plant roots through enhancement in the formation of arbuscules and vesicles.

Keywords: Arbuscules, field of microscope, mycorrhizae, vesicles.

Introduction

Mycorrhizal symbiosis acquires a great importance with respect to plant communities. Mycorrhizae not only influence the growth of plants but it also enhances the chances of survival of plants against different biotic and abiotic factors. Arbuscular mycorrhizal fungi (AMF) have the ability to induce systemic resistance against plant parasitic nematodes in a root system, (Elsen *et al.*, 2008). Mycorrhizal colonization provides a bio-protective effect against a broad range of soil-borne fungi (Dehne 1982; Singh *et al.*, 2000) and nematodes (Pinochet *et al.*, 1996; Elsen *et al.*, 2003a, b; Hol and Cook 2005). Mycorrhizae increase the physiologically active area of roots, to provide the unobtainable nutrients to the plants. So, by keeping a view on the biotic interaction between plants and mycorrhizae, we can do something better for our plant communities.

Mycorrhizal associations are significantly beneficial to plants in a way to provide the limiting soil resources, especially nutrients such as P, Cu, Zn, and ammonium. Mycorrhizal fungi are responsible for increase P uptake, phosphatase activities and root excretion of oxalate in soils, but soil pH is decreased under the influence of Mycorrhizal Colonization (Liu *et al.*, 2004a, b). However different plant species give different response against Arbuscular Mycorrhizae (AM), (Wilson and Hartnett 1998). Many plant species

cannot grow without mycorrhizal colonization while many species show a minute effect towards mycorrhizae. Most of the studies concerned with mycorrhizae are based upon individual response of host plants. Elephant Ear (*Colocasia esculenta*) is an ornamental nursery plant. It may be grown as potted plant or on ground in landscapes. It's an herbaceous plant which may be annual or perennial under the influence of environmental factors. It contains 77.9% carbohydrate contents in its starch enabling it as an additive in many food crops (Kresnawati and Yuni, 2011). Additionally, it is directly consumed as food, animal feed and industrial raw materials (e.g. glucose syrup, sugar precursors, manitol, xylitol, sorbitol, and bio-ethanol) in many countries (Gapi and Rindang, 2011). So, it is very important plant worldwide and can be used as test plant for bioassays e.g. mycorrhizal infestation. Current study is, therefore, designed to show the effect of light and shade on mycorrhizae associated with Elephant Ear.

Materials and Methods

Experiment was conducted in Institute of Agricultural Sciences, University of the Punjab, Lahore. Root samples of *Colocasia esculenta* from each category of light and shady area were collected from four different places within the University of the Punjab. During May, average

temperature of Lahore ranges from 23 °C to 39 °C and average precipitation is 22 mm. Plants grown in light and shade were selected and fine roots were obtained from them. Roots were washed to remove dust particles and then cut into small pieces of 1cm length. These pieces were treated with 10% KOH and autoclaved for 10 min. KOH was washed off by distilled water and each sample was dipped in 10% H₂O₂ for few minutes until it gave us a whitish appearance. As the roots started appearing white, 10% H₂O₂ was removed and 0.1N HCl was added to attain the normal pH of roots. After 0.1N HCl, the stain (trypan blue) was added in the roots and each sample was autoclaved again for 10 min. Then roots' pieces were placed side by side on a glass slide and covered with a glass cover slip for their microscopic studies. Number of root pieces having mycorrhizal hyphal infection was calculated and results were concluded as "percentage hyphal infection in light & shade roots". In the same way number of root pieces with arbuscules was also calculated and results were tabulated as "percentage arbuscules presence". Number of arbuscules and vesicles per field of microscope were also calculated. For this purpose, diameter of the visible area under microscope was determined with the help of stage micrometer and then area under observation was calculated with the formula.

$$r = \text{diameter}/2$$

$$\text{Area under observation} = \pi r^2$$

For the comparison of results, graphs were also plotted to analyze the effect of Light on mycorrhizal symbiosis.

Results and Discussion

Light influences mycorrhizal colonization significantly. In the presence of sunlight mycorrhizal hyphae colonize the roots more severely than the Shade (Fig. 1). As the results

show that mycorrhizal hyphal infection was 90.95% in light roots and 69.56% in shade roots (Fig. 2A). Number of roots with arbuscules was more in light roots than the shade roots. In this case the relation was of 90.95% and 28.39% between light and shade roots respectively.

Number of arbuscules in light roots was calculated per field of microscope which was 38.08 arbuscules/15.91 μm^2 & number of arbuscules present in shade roots was also calculated per field of microscope. Quantifying arbuscules shade roots were 3.65 arbuscules/240.62 μm^2 (Fig. 2B). There was an unexpectedly large difference between the numbers arbuscules present in both types of roots. Numbers of vesicles present in Light Roots per field of microscope (240.62 μm^2) were 1.08 with comparison to the 0.15 vesicles present in shade roots per field of microscope (Fig. 2C).

Photosynthesis is directly associated with light. It will be more under intense light and will be less under lesser intensity of light. So, if the photosynthesis is carried out at high rate (as the light intensity is high) then more nutrients and water will be required to plants. To compete with these higher requirements of nutrients mycorrhizal colonization was boosted up significantly. Mycorrhizal hyphal colonization was congested and more arbuscules were formed because arbuscules are the transfer sites of nutrients and other materials between mycobiont and its host plant.

C. esculenta showed a distinctive effect of light in its mycorrhizal colonization of roots. Mycorrhizae is an important way to get nutrients from soil. So during high light intensity and photosynthesis rate, AM colonization is enhanced in the roots of *C. esculenta*.

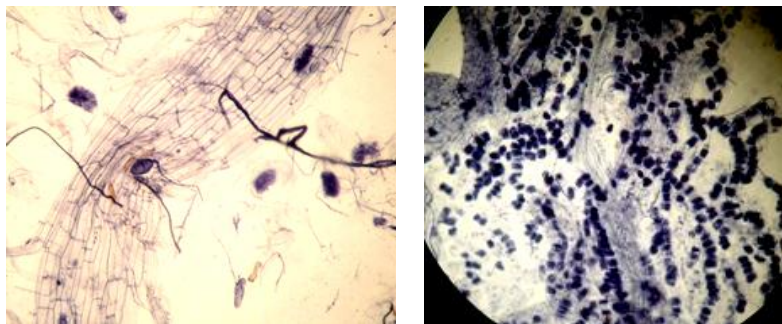


Fig. 1: Arbuscular abundance in shade (A) and light (B) plant roots.

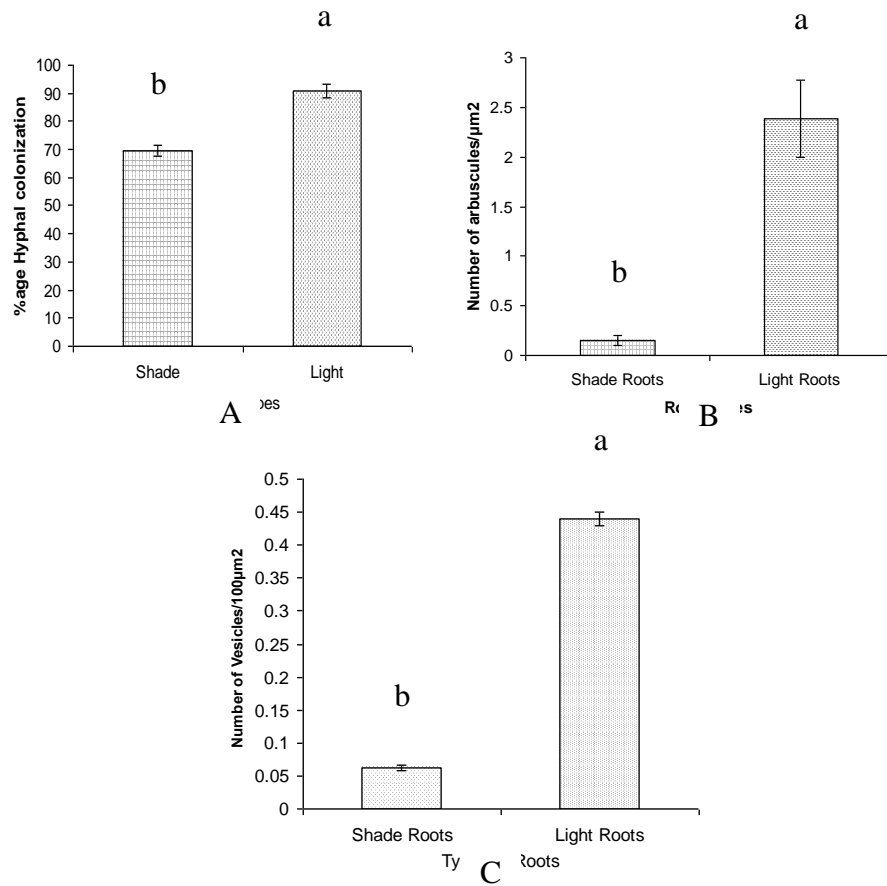
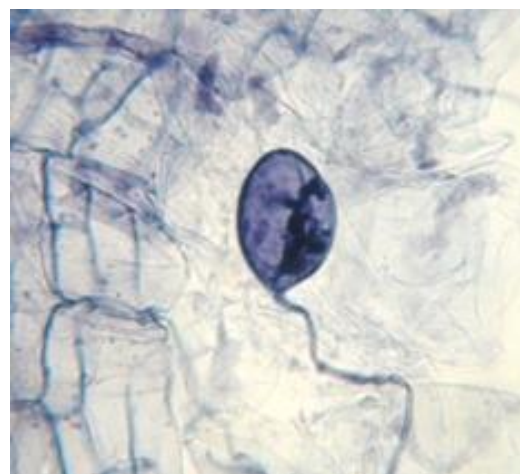


Fig. 2: (A) Percentage hyphal colonization observed in different roots. (B) Number of arbuscules under per field of microscope. (C) Number of vesicles per field of microscope.

Note: Graphs have been plotted as number of vesicles μm^{-2} and number of arbuscules μm^{-2}



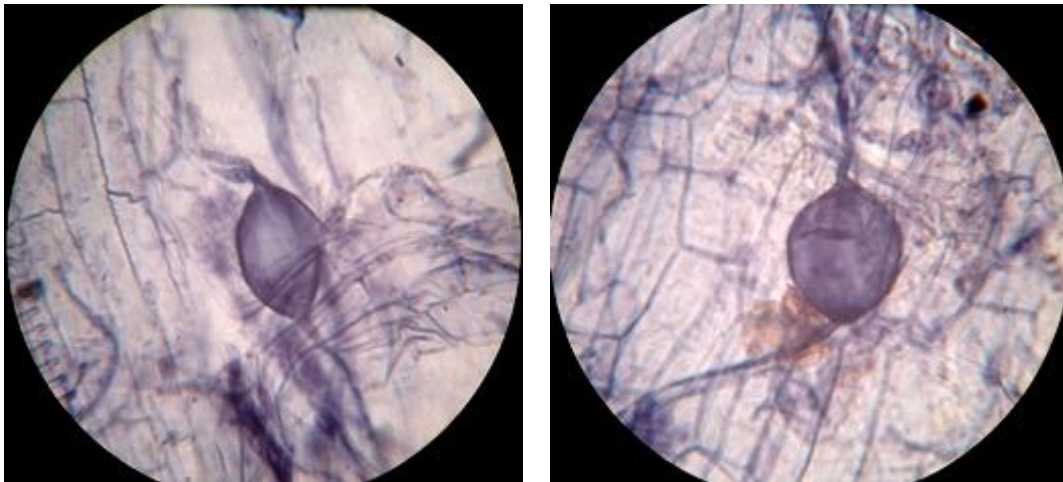


Fig. 3: Abuscule (A); Vesicles (B, C, D).

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