INFLUENCE OF ARBUSCULAR MYCORRHIZA IN THE HARDENING OF IN *VITRO* PROPAGATED WESTERN GHATS CULTIVAR - *COLOCASIA ESCULENTA*

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Abstract :

AM fungi are established and extensive mainly in agriculture. They play a significant role in both healthy growth and productivity of plants. They possess capacity to augment seedling tolerance to drought, high temperatures, toxic heavy metals, high or low pH and even extreme soil acidity. In recent years, the cultivation of medicinal and herbal plants using AM has assumed greater due to their incredible potential in modern and traditional medicine. AM fungi can play an effective role in the conservation of some valuable medicinal plants. Inoculation of AM fungi during an early stage of acclimatization process has become an alternative strategy for better establishment by improving the plant growth. The studies suggest the potential use of AM fungi for promoting growth in *Colocasia esculenta* that was propagated *in vitro*. A protocol was generated for *ex vitro* hardening of *In vitro* raised plantlets using VAM consortia in different media mixtures, and their effect was observed on plant survival and growth. Maximum percent survival, maximum plant height, maximum root fresh weight, maximum leaf length, maximum root length were observed in treatment comprising of Soil + Coir compost (3:1) + 50 g VAM consortia, followed by treatment comprising Soil + Vermicompost (1:1)+ 50 g VAM consortia and control media comprising of only soil. Also, Media comprising of Soil + FYM (1:1) + 10 g VAM consortia. Maximum percent colonization was showed in media comprising of Soil + Vermicompost (3:1) + 50 g VAM consortia, while lowest root colonization was found in media comprising of Soil + FYM (1:1) + 10 g VAM consortia. Control treatment showed no root colonization. It was concluded that the treatment with a mixture of Soil + Vermicompost (3:1) with 50 g VAM consortia showed the best results in diverse aspects of plant growth.

Index Terms - Arbuscular Mycorrhiza, *Colocasia esculenta*, *In vitro* Propagation, Hardening.

I. INTRODUCTION

Plants have played a significant role in maintaining human health and improving quality of human life since long and have served humans well as valuable components of medicines, seasoning, beverages, cosmetics, and dyes. The quality of medicinal plants to obtain therapeutics is associated with its environmental conditions.According to Frank, 1885, The term 'Mycorrhiza' describe the symbiotic association between a fungus and a root of higher plant. The host plant and fungi are mutually benefited from such association (Powel and Bagyaraj, 1984). Nearly 80% of all terrestrial plant species constitutes endomycorrhiza *viz.*

Arbuscular Mycorrhizal (AM) symbiosis or Vesicular Arbuscular Mycorrhiza (VAM). AM are ubiquitous in their distribution and occur in abundance. Most of the flowering plants have the strong association of VAM fungi. There is a increasing appreciability of VAM in augmenting food production. The inoculation of Arbuscular mycorrhizal fungi into the roots can play a major role in the development of growth and vigour and increasing in production of bioactive compounds of the medicinal plants. AM fungi have shown to have benefits to host plants by escalating tolerance to heavy metal and herbivore, pollination, stability of soil. Also it may be responsible for improved uptake of mineral nutrients especially phosphorus from the soil by the host plants and thereby enhancing vigor. The utilization of AM fungi as biofertilizers in agriculture, horticulture, landscape restoration, and soil remediation has been for almost two decades.

Mass production of AM fungi has been achieved with several species such as *Glomus clarum*, *G. etunicatum*, *G. intraradices*, *G. mosseae*, *Gigaspora ramisporophora and Gigaspora rosea* are the most common inoculum of endomycorrhizae products. Hence, realizing the importance of AM to improve the quality and quantity of therapeutics produced from native medicinal plants in moderately shorter phase and at lesser expenditure, the *Colocasia esculenta* has been used as the specimen for the current investigation**.** *Colocasia esculenta* is commonly referred to as taro. They are cherished for their rich taste, nutritional and medicinal properties. These potentials of symbiotic association between VAM (Vesicular Arbuscular Mycorrhiza) fungal species and plant roots strengthen the belief of its significance in averting the transplantation shock brought about by unfavorable environmental conditions such as alteration in humidity and nutritional conditions. VAM is a fungus that penetrates the roots of a vascular plant in order to help them to capture nutrients from the soil. These fungi are scientifically well known for their ability to uptake and transport mineral nutrients from the soil directly into host plant roots. The main beneficial effects reported are the avoidance of transplanting shock, shorter weaning phase, and higher plant growth variants. Micro propagated plants usually have weak stomatal control. Moreover, AMF (Arbuscular Mycorrhizal Fungi) colonization of plants can improve growth by increasing the uptake of phosphorus, zinc and other minerals, reducing disease, increasing transplanting uniformity by increasing survival percentage, improving water relations of the host plant and increasing drought resistance.The current study has been undertaken to realize the importance of the effect of AM on hardening of *in vitro* propagated *Colocasia esculenta.*

II. MATERIALS AND METHODS

Specimen collection

The *in vitro* propagated Western Ghats cultivar- *Colocasia esculenta* roots were washed with distilled water and were transferred onto the pots containing media for hardening.

Hardening: Ex vitro

The *in vitro* rooted *Colocasia esculenta,* that was developed from micro propagation were hardened under *ex vitro* environment using VAM consortia. The VAM consortia were used to examine their effect on plant survival and development. The quantity of soil, FYM and Vermicompost were measured. Different potting mixtures used with different VAM consortia.

Growth parameters

The diverse growth parameters were recorded on the source of average plant height of 20 plants that survived in each treatment after 15, 30 and 45 days. The range of parameters recorded were plant height (cm), plant width (cm), Root fresh weight (g), Root length (cm), Shoot fresh weight (g) and Leaf length (cm).

Data analysis

Each experiment was repeated thrice and the reported data are the means of three experiments. Wherever applicable the data are presented as mean ± standard error.

III. RESULTS AND DISCUSSION

Media Treatment (s)	survival (%)	Plant height (cm)	Shoot fresh weight (g)	Root fresh weight (g)	Leaf length (cm)	Root length (cm)
T_0- Soil only(control)	72.50 (58.37)*±1.44	26.00± 1.08	0.27± 0.03	0.14 ±0.03	8.06± 0.02	10.27± 0.11
T_1 -Soil + FYM (1:1) + 10 g VAM consortia	79.00 (67.33)±2.04	27.55± 3.68	0.34± 0.02	0.28 ±0.03	5.97± 0.09	14.05± 0.06
T_2- Soil + Coir compost (1:1) + 50 g VAM consortia	74.87 (73.46) ±0.83	21.2± 1.31	0.28± 0.02	0.24 ±0.02	3.98± 0.07	15.21± 0.07
T_3- Soil+ Vermicompost (1:1) + 50 g VAM consortia	81.87 (72.41)±0.55	29.5 ± 0.29	0.36± 0.02	0.3 ±0.02	6.02 ±0.058	14.57± 0.19
T_4- Soil + Coir compost (3:1) + 50 g VAM consortia	85.00 (73.62)±0.91	30.75± 4.62	0.36± 0.03	0.34 ±0.01	8.15 ±0.03	15.47± 0.05
T_5- Soil + Vermicompost (3:1) + 50 g VAM consortia	91.50 (73.10)±0.96	34.75± 2.46	0.57± 0.02	0.42± 0.02	10.4 ±0.20	15.19± 1.10

TABLE: 1:-Effect of VAM inoculation on *ex vitro* establishment

Media Treatment (s)	**Colonization of Roots by AMF (%)**
T_0– control – SOIL	0.00 (0.00)±0.00
T_1-Soil + FYM (1:1) + 10 g VAM consortia	48.52 (40.43)±0.81
T2- Soil + Coir compost (1:1) + 50 g VAM consortia	41.08 (46.3)±0.80
T_3- Soil+ Vermicompost (1:1) + 50 g VAM consortia	50.3 (45.70)±1.21
T_4- Soil + Coir compost (3:1) + 50 g VAM consortia	55.60 (49.12)±0.30
T_5- Soil + Vermicompost (3:1) + 50 g VAM consortia	61.78 (50.21)±1.07

TABLE: 2:-Root Colonization by VAM species

FIG 1: Picture showing VAM untreated and treated *Colocasia esculenta*

The experiment showed that the maximum per cent survival in treatment with Soil + Vermicompost (3:1) + 50 g VAM consortia followed by Soil + Vermicompost (3:1) + 50 g VAM consortia and Soil + Coir compost (3:1) + 50 g VAM consortia; Soil + Vermicompost (1:1) + 50 g VAM consortia ; Soil + FYM (3:1) + 10 g VAM consortia; Soil + Coir compost (1:1) + 50 g VAM consortia, While minimum percent survival was observed as in control treatment (with soil), followed by treatment with Soil + Coir compost (1:1) + 50 g VAM.

Per cent root colonization

The maximum per cent of colonization (61.78) was observed in treatment with Soil + Vermicompost (3:1)+50 g VAM consortia, followed by 55.6 % in treatment with Soil + Coir compost (3:1) + 50 g VAM consortia and 50.3% in treatment with Soil + Vermicompost (1:1)+ 50 g VAM consortia and 48.52% in Soil + FYM (3:1) + 20 g VAM consortia, While the lowest root colonization of 41.08 % was found in treatment with Soil + Coir compost (3:1) + 50 g VAM consortia. There was no root colonization in Control treatment with soil alone.

Plant height (cm)

The highest plant height (34.00 cm) was observed in treatment with Soil + Vermicompost (3:1) + 50 g VAM consortia followed by Soil + Vermicompost (3:1) + 50 g VAM consortia and Soil + Coir compost (3:1) + 50 g VAM consortia; Soil + Vermicompost (1:1) + 50 g VAM consortia ; Soil + FYM (3:1) + 10 g VAM consortia; Soil + Coir compost (1:1) + 50 g VAM consortia in treatment with Soil + FYM (1:1) + 10 g VAM consortia. It is shown that all the treatments were significantly different over control, with soil only (Table2).

Shoot fresh weight (g)

There was a maximum fresh weight of shoot (0.57 g) in treatment with Soil + Vermicompost (3:1) + 50 g VAM consortia followed by Soil + Vermicompost (3:1) + 50 g VAM consortia and Soil + Coir compost (3:1) + 50 g VAM consortia; Soil + Vermicompost (1:1) + 50 g VAM consortia ; Soil + FYM (3:1) + 10 g VAM consortia; Soil + Coir compost (1:1) + 50 g VAM consortia.

Root fresh weight (g)

The highest root fresh weight (0.42 g) was observed in treatment with Soil + Vermicompost (3:1) + 50 g VAM consortia followed by Soil + Vermicompost (3:1) + 50 g VAM consortia and Soil + Coir compost (3:1) + 50 g VAM consortia; Soil + Vermicompost (1:1) + 50 g VAM consortia ; Soil + FYM (3:1) + 10 g VAM consortia; Soil + Coir compost (1:1) + 50 g VAM consortia.

Leaf length (cm)

The highest leaf length(10.4 cm) was observed in treatment with Soil + Vermicompost (3:1) + 50 g VAM consortia followed by Soil + Vermicompost (3:1) + 50 g VAM consortia and Soil + Coir compost (3:1) + 50 g VAM consortia; Soil + Vermicompost (1:1) + 50 g VAM consortia ; Soil + FYM (3:1) + 10 g VAM consortia; Soil + Coir compost (1:1) + 50 g VAM consortia

Root length (cm)

The highest root length (15.19 cm) was observed in treatment with Soil + Vermicompost (3:1) + 50 g VAM consortia followed by Soil + Vermicompost (3:1) + 50 g VAM consortia and Soil + Coir compost (3:1) + 50 g VAM consortia; Soil + Vermicompost (1:1) + 50 g VAM consortia ; Soil + FYM (3:1) + 10 g VAM consortia; Soil + Coir compost (1:1) + 50 g VAM

IV. CONCLUSION

The hardening of *colocasia esculenta* in a greenhouse soon after the micro propagation showed the AMF colonization in good level than the control. The plants were found to be better in most of the evaluated parameters. Thus VAM colonization of plants can improve growth by raising the uptake of phosphorus, zinc and other minerals, reducing disease, growing transplanting consistency by mounting survival percentage, improving water relations of the host plant and increasing drought resistance.

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