Environment & Ecology 35 (2D) : 1512—1515, April—June 2017
Website: environmentandecology.com ISSN 0970-0420

# Effect of AM Fungi (*Glomus intraradices*) on the Growth and Phosphorus Content of *In-Vitro* Propagated Banana cv Grande Naine Plantlets

**Obed Chisho, C. S. Maiti, Sentirenla Jamir**

Received 10 August 2016; Accepted 15 September 2016; Published online 2 October 2016

**Abstract** The effect of AM fungi (*Glomus intraradices*) on growth and phosphorus content on micropropagated banana plantlets, during the hardening phase under 75% shade net condition was investigated. Ten days after transplanting in polybags, the AM fungi were inoculated at depth of 6–8 cm below the rooting media. The experiment was laid out in a two factor completely randomized design, with three replications with the following treatments; $PN_1$ (sterilized rooting media + AMF inoculation), $PN_2$ (sterilized rooting media + AMF non-inoculation), $FN_1$ (unsterilized rooting media + AMF inoculation) and $FN_2$ (unsterilized rooting media + AMF non-inoculation). The data were collected upto 75 days after inoculation. The effect of sterilization of rooting media and AM fungi inoculation on growth parameters had significant beneficial effect than the untreated control plants. Plantlets inoculated with *Glomus intraradices* had significantly higher plant P content (0.83%) compared with non-inoculated plantlets (0.60%) after secondary hardening. Thus, the application of sterilized rooting media along with AM fungi provides an array of benefits and could be considered during the acclimatization phase.

**Keywords** AM fungi, Vegetative growth, Phosphorus, *In-vitro*, Banana.

## Introduction

*In vitro* propagation technique has got several successful applications but there are still certain hindrances. The greatest challenge is to overcome the factors affecting the growth and survival of the plantlets following their transfer from *in vitro* to ex vitro conditions. It has been observed that tissue cultured plantlets have very divergent leaf anatomy and physiology and therefore require an acclimatization period during the transition from culture vessel to greenhouse or field conditions, where desiccation and wilting are the main causes for the low survival. There are suggestions about the role of arbuscular mycorrhizal (AM) fingi symbiosis in stimulating the growth and

O. Chisho, C. S. Maiti*, S. Jamir
Department of Horticulture,
School of Agricultural Sciences and
Rural Development Nagaland University,
Medziphema Campus, Medziphema 797106,
Nagaland, India
e-mail : csmaiti@yahoo.co.in
*Correspondence

**Table 1.** Effect of sterilization and inoculation of *Glomus intraradices* on leaf growth paramenters at 75 DAT. Data in parenthesis are angular transformed values. NS–Not significant.

| Treatments | Number of leaves | Leaf length (cm) | Leaf width (cm) |
|---|---|---|---|
| $PN_1$ | 10.50 (3.32) | 17.08 | 6.80 |
| $PN_2$ | 7.93 (2.90) | 13.73 | 4.93 |
| $FN_1$ | 8.82 (3.05) | 15.06 | 5.30 |
| $FN_2$ | 7.55 (2.84) | 12.74 | 5.16 |
| SEm± | 0.05 | 0.43 | 0.26 |
| CD 0.05 | NS | NS | 1.28 |

**Table 2.** Effect of sterilization and inoculation of *Glomus intraradices* on root and plant growth parameters at 75 DAT. Data in parentheses are angular transformed values. NS–Not significant.

| Treatments | Number of roots | Root length (cm) | Pseudostem height (cm) | Pseudostem girth (cm) |
|---|---|---|---|---|
| $PN_1$ | 12.97 (3.67) | 17.57 | 33.24 | 5.07 |
| $PN_2$ | 11.73 (3.50) | 13.52 | 29.58 | 3.87 |
| $FN_1$ | 11.91 (3.52) | 15.45 | 30.82 | 3.99 |
| $FN_2$ | 10.61 (3.33) | 12.91 | 29.31 | 3.82 |
| SEm± | 0.02 | 0.31 | 0.30 | 0.13 |
| CD 0.05 | NS | NS | 1.50 | 0.63 |

development of micropropagated plantlets, in sustainable agro ecosystems, improving plant performance under environmental stress conditions and may facilitate plant adaptation to the nursery. However, its application in the acclimatization phase of the *in vitro* derived plantlets still remains least explored. An attempt has therefore been made to ascertain the effectiveness of AM fungi symbiotic association on hardening success and plant phosphorus content.

## Materials and Methods

The investigation was conducted at the Experimental Farm of the Department of Horticulture SASRD, Medziphema, Nagaland, during the year 2012-13, at 75% shade net condition. Primary hardened banana cv Grande Naine was collected from plant tissue culture laboratory NU: SASRD, Nagaland. Plantlets of 9.5 cm ht (approx) were planted in black polybags of 16 × 8 cm size, with equal rooting mixture ratio (1:1:1:1) of soil, sand, FYM and coco-pith. AM fungi capsules (2.5 g) were inoculated at around 6–8 cm below the rooting media, 10 days after transplanting in polybags. The experiment was laid out in a two factor completely randomized design, with three replications, 10 numbers of plantlet per replication. The treatments were: $PN_1$ (sterilized rooting media + AMF inoculation), $PN_2$ (sterilized rooting media + AMF non-inoculation), $FN_1$ (unsterilized rooting media + AMF inoculation) and $FN_2$ (unsterilized rooting media + AMF non-inoculation). All the recommended cultural practices were followed at regular imtervals.

Data were recorded on growth parameters viz. number of leaves, leaf length (cm), leaf width (cm), plant height (cm), number of roots, root length (cm) and pseudostem girth (cm). Observations were done at 75 DAI. Estimation of plant P content (%) was done by vanado molybdate yellow color method. Statistical analysis for each quantitative character was worked out by the method of analysis of variance using two factor (CRD split plot with sterilization of rooting media as main plot factor and *Glomus intraradices* inoculation as sub-plot factor.

## Results and Discussion

### Effect on leaf growth parameters

Leaves are the site of photosynthesis and as such its effective number, length and width is considered an important factor in determining the growth and productivity of the crop. At 75 DAT, the treatment $PN_1$ recorded maximum leaf number (10.50) and leaf length (17.08 cm) followed by $FN_1$ (Table 1). On the other hand, the minimum was recorded where unsterilized rooting media and non-inoculation AMF were used. The leaf width was significantly pronounced in $PN_1$ (6.80 cm) while minimum leaf width of 4.93 cm was observed in $PN_2$ at 75 DAT. These findings were in accordance with the findings were reported significant increase in leaf number and leaf surface area upon inoculation of *Glomus* sp. irrespective of the soil type used [1]. The positive effect of VAM on growth and

**Table 3.** Effect of sterilization and inoculation of *Glomus intraradices* concentration of P in plantlets.

| Treatments | Initial plant P (%) | Plant P (%) at 75 DAT |
|---|---|---|
| $PN_1$ | 0.46 | 0.83 |
| $PN_2$ | 0.46 | 0.60 |
| $FN_1$ | 0.46 | 0.78 |
| $FN_2$ | 0.46 | 0.61 |
| SEm(±) | – | 0.03 |
| CD 0.05 | – | 0.17 |

nutrient parameters compared to non-mycorrhizal control in banana was reported [2].

Effect on root and plant growth parameters

The findings of the present investigation also revealed that plantlets inoculated with AM fungi strain *Glomus intradices* recorded the highest value under sterilized rooting media (Table 2).

At 75 DAT, the treatment $PN_1$ had maximum influence on the root number which recorded the highest at 12.97 while the lowest was obtained in $FN_2$ (10.61). The interaction of sterilization of rooting media and AM fungi inoculation did not record any significant influence on the root length. The highest root length of 17.57 cm was recorded in $PN_1$ while treatment $FN_2$ recorded the lowest at 75 DAT.

Maximum pseudostem height of 33.24 cm was observed in $PN_1$ at 75 DAI while the lowest value of 24.70 cm was recorded in $FN_2$. The data recorded for the interaction effect of sterilization and AM fungi showed a marked variation in the pseudostem girth. Maximum girth was recorded in $PN_1$ (5.07 cm) followed by $FN_1$ (3.99 cm) and minimum in $FN_2$. Inoculation of pomegranate plantlets with *Glomus mosseae* resulted in increased plant height and root length [3]. In another experiment with micropropagated banana responded positive on banana root system development that leads to an improvement in plant nutrition and health in inoculated plantlets [4, 5].

The findings discussed above may be attributed to AM fungi inoculation and could be due to synergistic interaction between AM fungi and other beneficial micro organisms present in the soil and their consequential beneficial effect on growth of the plants. This AM fungi are not capable of fixing atmospheric $N_2$ but may combine with phosfate solubelising micro-organisms and may accelerate nitrogen and phosphorus uptake resulting in increased plant growth as well as root length and root numbers.

Plantlet survivability

Secondary hardening done in polybags filled with rooting mixture comprising of soil, sand, FYM and coco-pith in equal proportion of 1:1:1:1 served as an optimal growth media with 100% survivability irrespective of sterilization or non-sterilization of rooting media. These findings were in close conformity with the other workers [3, 6].

Effect on the concentration of phosphorus in plants

Application of AM fungi either in sterilized or unsterilized rooting media was found beneficial in respect to phosphorus content (Table 3). Plantlets inoculated with Glomus intraradices had significantly higher plant P content (0.83%) compared with non-inoculated plantlets (0.60%) after secondary hardening. This study suggests that combined interaction of sterilized rooting media and *Glomus intraradices* enhances P uptake under acidic soil conditions. It could be due to multiplication of AM fungi which are known to increase the uptake of P and other micronutrients involved in N fixation [2].

## Conclusion

The investigation revealed that the inoculation of AM fungi strain as bio-hardening agent for tissue cultured plantlets enhanced early establishment and promoted vegetative growth and developments by increasing nutrient uptake specially phosphorus through symbiotic association. The results suggest that growing of banana plantlets in sterilized rooting media along with AM fungi inoculation during the hardening phase would provide an array of benefits and significantly influence banana plantlets growth

by increased uptake of diffusion limited nutrients and water mineral uptake. These findings could be due to synergistic interaction between AM fungi and other beneficial micro organisms present in the soil and their consequential beneficial effect on growth of the plants.

**References**


1. Tsange G, Fogain R, Achard R, Foko J (2005) Impact of arbascular mycorrhizal on growth of planting *in vitro* plants on soil with different fertility under controlled conditions in Cameroon. Fruits (Paris) 60 : 303—309.
2. Singh A, Singh SP (2004) Response of banana (*Musa* spp.) to vesicular arbascular mycorrhizae and varied levels of inorganic fertilizers. Ind J Hort 61 : 109—113.
3. Singh NV, Singh SK, Meshram DT, Suroshe SS, Mishra DC (2012) Arbascular mycorrhizal fungi (AMF) induced hardening of micropropagated pomegranate (*Punica granatum* L.) plantlets. Scientia Hort 136 : 122—127.
4. Jaisme-Vega MC, Rodriguiez- Romero AS, Pinero Guerra MS (2005) Effect of arbuscular mycorrhizal fungi (AMF) and other rhizospore microorganisms on development of the banana root system. INIBAP, pp 178—192.
5. Mandhare VK, Suryawanshi AV (2005) Biotization of banana tissues cultured plantlets with VAM fungi. Agric Sci Digest 25 : 65—67.
6. Vasane SR, Korhari RM (2008) An integrated approach to primary and secondary hardening of banana var Grande Naine. Ind J Biotechnol 7 : 240—245.