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Morphological and Histological Changes in the Roots of Finger Millet *Eleusine coracana* Colonized by V A Mycorrhiza

D DYALA DOSS†, D J BAGYARAJ† and JOSHI SYAMASUNDAR*
†Department of Agricultural Microbiology and
**Department of Botany, University of Agricultural Sciences, G K V K Campus, Bangalore 560 065*

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Morphological and histological differences between non-mycorrhizal and mycorrhizal roots of finger millet were studied. The diameters of the root cells, root cap, meristematic zone of root apex and R_2 region of the root were more in mycorrhizal plants compared to non-mycorrhizal plants.

Key Words: *Glomus fasciculatum*, **Finger millet, Histology, Root morphology, V A mycorrhiza**

Introduction

Considerable amount of work has been done on the effect of Vesicular-arbuscular (VA) mycorrhizal colonization on the gross morphology of the hosts and this has been summarized in the reviews by Mosee (1973) and Gerdemann (1975). Daft and Okusanya (1973) reported increased xylem lignification and starch accumulation in the stem of tomato and petunia plants colonized by V A mycorrhiza. Krishna et al. (1981) observed an increase in the leaf thickness, the size of the midrib vein, the mesophyll cells and the number of plastids in mycorrhizal plants of finger millet. However, there is no information on the anatomical and histological changes brought about in the host root by mycorrhizal colonization (Bonfante-Fasolo 1984). In the present paper morphological and histological differences in the roots of finger millet plants colonized by a VA mycorrhizal fungus are examined.

Materials and Methods

Finger millet cv. Indaf 5 was grown on sterilized soils in 30 cm pots with 10 kg soil. The soil used was a phosphorus deficient (3mg available phosphorus per kg) red sandy loam of pH 5.6

Mycorrhizal inoculum used was a sand: soil mixture containing chlamydospores and root segments of *Panicum maximum* colonized by *Glomus fasciculatum*. To inoculate finger millet plants a thin layer of mycorrhizal inoculum was placed 2.0 cm below the surface of the soil before sowing seeds. Control (non-mycorrhizal) pots received similar amounts of uninfected sand: soil mixture. Plant density was adjusted to two plants per pot, with 20 replicate pots for each treatment.

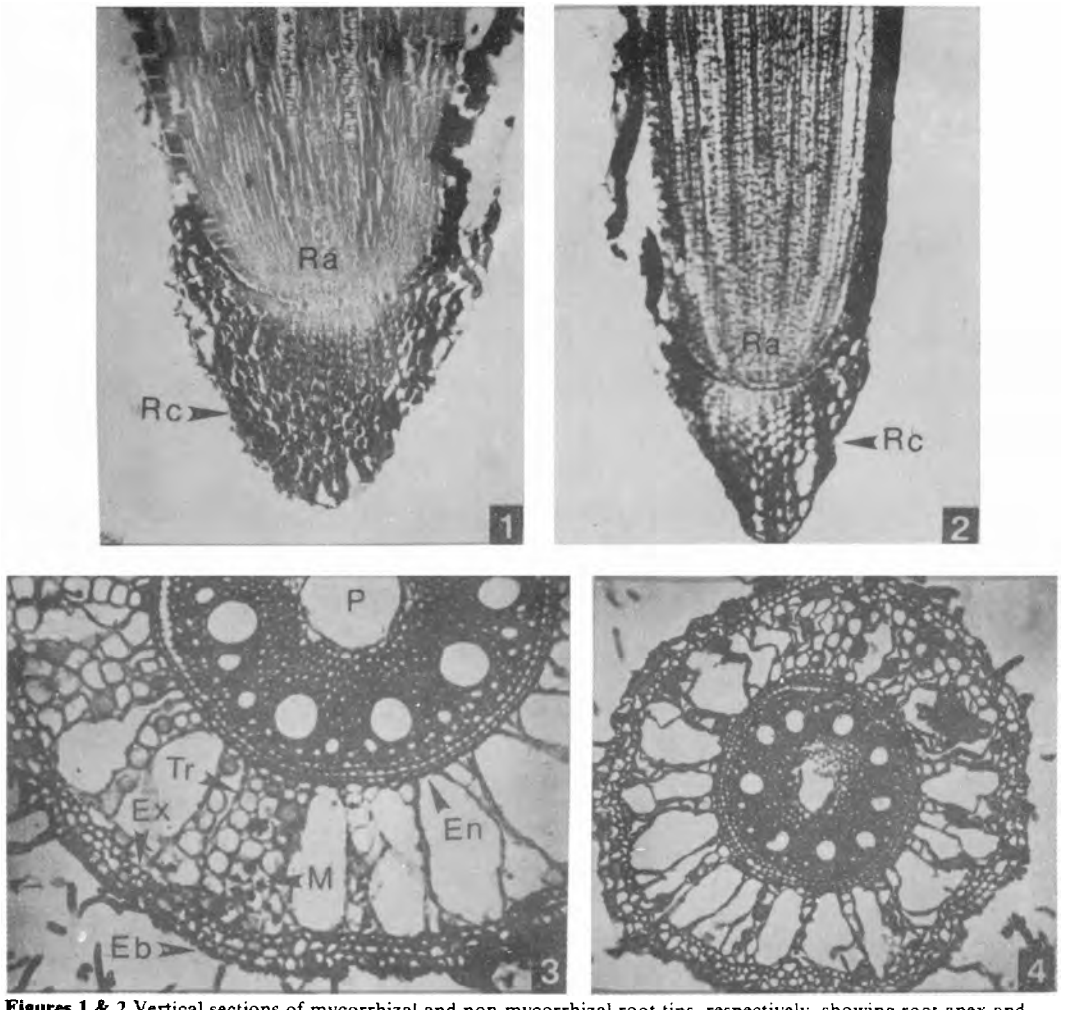
Plants were harvested 60 days after sowing. Root systems were rinsed with water and separated into the following three regions (i) root cap region (ii) apical region (Meristematic tissues) and (iii) region at higher level near the root origin (R_2 region).

The root samples were fixed in Carnoy's B (6:3:1 ethyl alcohol: chloroform: acetic acid) for 1 hr, dehydrated using n-butanol series and embedded in 56°C paraffin wax. Serial sections of 7 μm thickness were stained by the Periodic acid Schiff's (PAS) method (Jensen 1962).

Results and Discussion

The root cap and its component structures in the mycorrhizal plants were considerably larger than those of non-mycorrhizal plants (table 1 & figures 1, 2). In mycorrhizal plants, the root cap cells were more in number and larger in size and they possessed larger nuclei as compared to non-mycorrhizal plants.

The root apex consisted of a layer of epiblema, covering periblem and plerome successively. The cells



Figures 1 & 2 Vertical sections of mycorrhizal and non-mycorrhizal root tips, respectively, showing root apex and root cap (£ 200)

Figures 3 & 4 Transverse sections of mycorrhizal and non-mycorrhizal roots, respectively, at R_2 region showing epiblema, exodermis, trabeculae with mycorrhizal fungus, endodermis, stele and pith (£ 200)

EB, Epiblema, EN, Endodermis, EX, Exodermis, M, Mycorrhizal fungus, P, Pith, RA, Root apex, RC, Root cap, TR, Trabeculae

in all the histogens in mycorrhizal plants were larger and their walls were more densely PAS positive than those in the corresponding zones in non-mycorrhizal plants (table 1).

In the R_2 region, mycorrhizal plants had larger roots, root hairs, epidermal cells, exodermal cells, outer and inner cortical cells, stele and its component structures as compared to non-mycorrhizal plants (table 2 & figures 3 & 4). Daft and Okusanya (1973) have earlier observed increased xylem lignification and starch accumulation in the stem of tomato and petunia plants colonized by V A mycorrhiza. Pericycle which is concerned with the initiation of lateral roots primordia was prominent and well differentiated in mycorrhizal roots which in turn may be responsible for the production of more number of lateral roots in mycorrhizal plants, to exploit larger volumes of soil for better nutrient and water uptake beyond the zone of 'P' depletion. The present study thus helps us to understand one of the possible mechanisms by which mycorrhizal plants have lower resistance to water transport.

Table 1 *Comparison of the root cap and root apex of mycorrhizal and non-mycorrhizal plants*

Root structures	Mycorrhizal (μm)	Non-mycorrhizal (μm)	Significance
ROOT CAP			
Diameter	90.00	48.00	**
No. of cells	2250.00	878.00	**
Diameter at			
Proximal region	9.0	6.0	**
Middle region	13.5	10.5	**
Size of nucleus	4.5	3.0	**
ROOT APEX			
Diameter of			
Apex region	432.0	192.0	**
Epidermal cells	12.0	6.0	**
Nucleus in			
epidermal cells	3.0	3.0	NS
Periblem cells	9.5	7.5	**
Nucleus in			
Periblem cells	4.5	3.0	**
Plerome cells	12.0	9.0	**
Nucleus in			
Plerome cells	3.0	3.0	NS

Values are the means of 40 observations: Significance tested by Student's 't' test ** Significant at P=0.01 NS: not significant

Table 2 *Comparison of the size of root structure at R_2 region of mycorrhizal and non-mycorrhizal plants*

Root structures	Mycorrhizal (μm)	Non-mycorrhizal (μm)	Significance
Diameter of roots	1890.0	1080.0	**
Root hair (dia)	9.0	6.0	**
Epidermal cell	23.0	15.0	**
Exodermal cell	29.0	24.0	**
Sclerencymatous cell	21.0	15.0	**
Trabecular cell	54.0	33.0	**
Endodermal cell	15.0	12.0	**
Width of cortex	215.0	162.0	**
Diameter of stele	552.0	408.0	**
Metaxylem vessels			
- Number	10.0	8.0	**
- Size	75.0	45.0	**
Protoxylem vessels			
- Number	10.0	8.0	**
- Size	30.0	13.0	**
Pith cells	12.0	9.0	**

Values are the means of 40 observations: Significance tested by Student's 't' test ** Significant at P=0.01

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