to be polar[2]. Hair, biological tissues and such materials containing oriented collagen molecules are known to be piezoelectric as well as pyroelectric[3,4]. The hysteresis loops found with fish scales could arise from the piezo-pyroelectric effects, since ferroelectric materials should necessarily be pyroelectric.

It is not clear whether the hysteresis loop exhibited by fish scales can be used to any advantage. However, the high dielectric constants of these scales at low frequencies (around 1 kHz) suggest that they could, in principle, be used for capacitor applications. Although the fish scale itself is not thermally stable, the hydroxy-apatite left after removal of organic matter could be useful as a linear-capacitor material.

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Occurrence of vesicular-arbuscular mycorrhiza in *Casuarina equisetifolia* L.

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***Casuarina equisetifolia* is a fast growing and promising fuelwood tree. Vesicular-arbuscular mycorrhizal (VAM) fungi improve seedling growth by facilitating nutrient uptake. Two VAM fungi were found to colonize the roots of *C. equisetifolia*. These were identified as *Glomus fasiculatum* and *Scutellospora calospora*. Application of VAM fungi can be successfully used for plantation of this species especially in degraded soils.**

SELECTION and cultivation of fuelwood tree or shrub species suitable for waste, marginal or degraded lands are [illegible]. Apart from the traditional fuelwood [illegible]nderutilized taxa are being investi-[illegible]s for growing in low fertility soils. [illegible]a, *Casuarina* is gradually gaining fast growing and promising fuelwood tree particularly in coastal India. *Casuarina equisetifolia* L., introduced in the sixties of the last century, has been the most successful species of *Casuarina* because of its hardiness in degraded soils. Presence of N fixing symbiont *Frankia*, association of VAM fungi and their interaction with *Frankia*[1] has prompted scientists to investigate the species for wasteland utilization.

When available phosphorus levels in the soils are low, VAM stimulate significant increase in P uptake resulting in a dramatic increase in plant growth[2,3]. It would facilitate fast growth and high biomass which are the desired traits in fuelwood plantations. Survey of the literature revealed that no systematic work has been undertaken on VAM association in *Casuarina* except for a report on occurrence of *Glomus mosseae* in *C. equisetifolia*[1].

Casuarina germplasm are being investigated under species × site trials for their potential as fuelwood trees for salt-affected sodic alkaline soils at Biomass Research Centre of National Botanical Research Institute, Lucknow. The present communication on the association of vesicular-arbuscular mycorrhizal (VAM) fungi with *Casuarina equisetifolia* is a part of the biomass studies on the role of VAM fungi in fuelwood tree establishment in alkaline soils.

Root samples along with surrounding soil were collected from one year old plants of *C. equisetifolia* growing in the research centre. Terminal feeder roots attached to lower order roots were collected, washed carefully and cleared with 10% KOH. The roots were then washed with 5N HCl, stained with tryphan blue, mounted in lactophenol following the method described by Phillip and Hayman[4] and examined under light microscope. The spores of VAM fungi were isolated from the soil surrounding the roots by wet sieving and decanting method of Gerdemann and Nicolson[5]. Identification of VAM fungi was made following the keys suggested by Trappe[6] and Schenck and Perez[7].

Two VAM fungi were found to colonize the roots of *C. equisetifolia* (Figure 1*a*). These fungi were identified as *Glomus fasiculatum* (Thax. sensu Gerd.) Gerd. and Trappe and *Scutellospora calospora* (Nicol. and Gerd.) Walker and Sand. Chlamydospores (Figure 1*b*) were subglobose to obovate or ellipsoidal or cylindrical, hyaline to light yellow to yellow, (41.2)-82.4-(123.6) μm, occulate opening in the subtending hyphae, one to two walled. The VAM fungus was identified as *Glomus fasiculatum*[7]. Chlamydospores were mostly globose, spherical, occasionally broader than long, hyaline to pale greenish yellow (144.2)-272.9-(401.7) μm, 3 to 4 walled, outer thick and smooth, attached to hyaline to yellow bulbous suspensor, 20.6-(41.0)-61.5 μm. Septa formed below the suspensor tip (Figure 1*c*). Germination shield often oval and present along the margin. The fungus was identified as *Scutellospora calospora*[7].

The present study indicates the association of two

Figure 1. *a*, Cleared and stained root showing vesicles and hyphal network of endomycorrhizae. Scale bar, 50 μm. *b*, Chlamydospore of *Glomus fasiculatum*; outer wall is thicker than the inner. Note occulate opening at the attachment. Scale bar, 30 μm. *c*, Crushed azygospore of *Scutellospora calospora* showing wall layers and suspensor. Note the bulbous cell at the attachment. Scale bar, 50 μm.

VAM fungi, *G. fasiculatum* and *S. calospora* with *C. equisetifolia*. Except for a report on occurrence of *G. mosseae* in *Casuarina* growing in Australia[1], there has been no study on the association of VAM fungi with this taxon. The association of VAM fungi shows considerable promise for selection of suitable endomycorrhizae for improving the productivity of *Casuarina* species in alkaline soils.

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Anatomical observations on roots of finger millet colonized by VA mycorrhiza

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Anatomical observations on roots of finger millet colonized by vesicular-arbuscular mycorrhizae revealed, for the first time, the presence of the mycorrhizal fungus within lignified sclerenchymatous cells.

THE overall improvement in crop plants that can be brought about by vesicular-arbuscular (VA) mycorrhizal colonization has been well established. Research on beneficial aspects of VA mycorrhizae proved better uptake of minerals, resistance to water stress and synergistic interaction[1,2]. However, information about fine structure and anatomical changes due to VA mycorrhizal colonization in host is scanty[3].

Finger millet (*Elusine coracana* Gertn.) cv. Indaf-5 was grown on sterilized, phosphorus-deficient (3 mg available P/kg) red sandy loam soil. For mycorrhizal