RHIZOSHEATHS

A little known characteristic of many of our grass species

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Have you ever uprooted a grass plant and wondered about that persistent sandy coating around the roots? These sandy coatings, or rhizosheaths, are common in South African grass species. They encircle the entire length of the roots on which they occur and are particularly noticeable in the members of the *Eragrostis* genus - the love grasses. Sheaths occur on plants of all ages, even on young seedlings. It was initially thought that these sheaths were a result of mycorrhizal associations (a symbiotic relationship between fungal hyphae and plant tissue) in the root area. They consist of sand particles that are matted together by the intertwining growth of prolific epidermal hairs produced by the roots. These epidermal hairs are extremely long relative to those on other roots and vary from species to species.

The sheaths are not, as the name may suggest, separate from the root. They are in fact connected to the stelar region (the vascular cylinder of the root). The reason why they were thought to be distinct from the root could be because the cortical tissue disintegrates in dried specimens, leaving a gap between the stelar region and the epidermis (with the sheath). This gap is obvious when a cross section of the dried root is observed under a microscope. (See accompanying photo.)

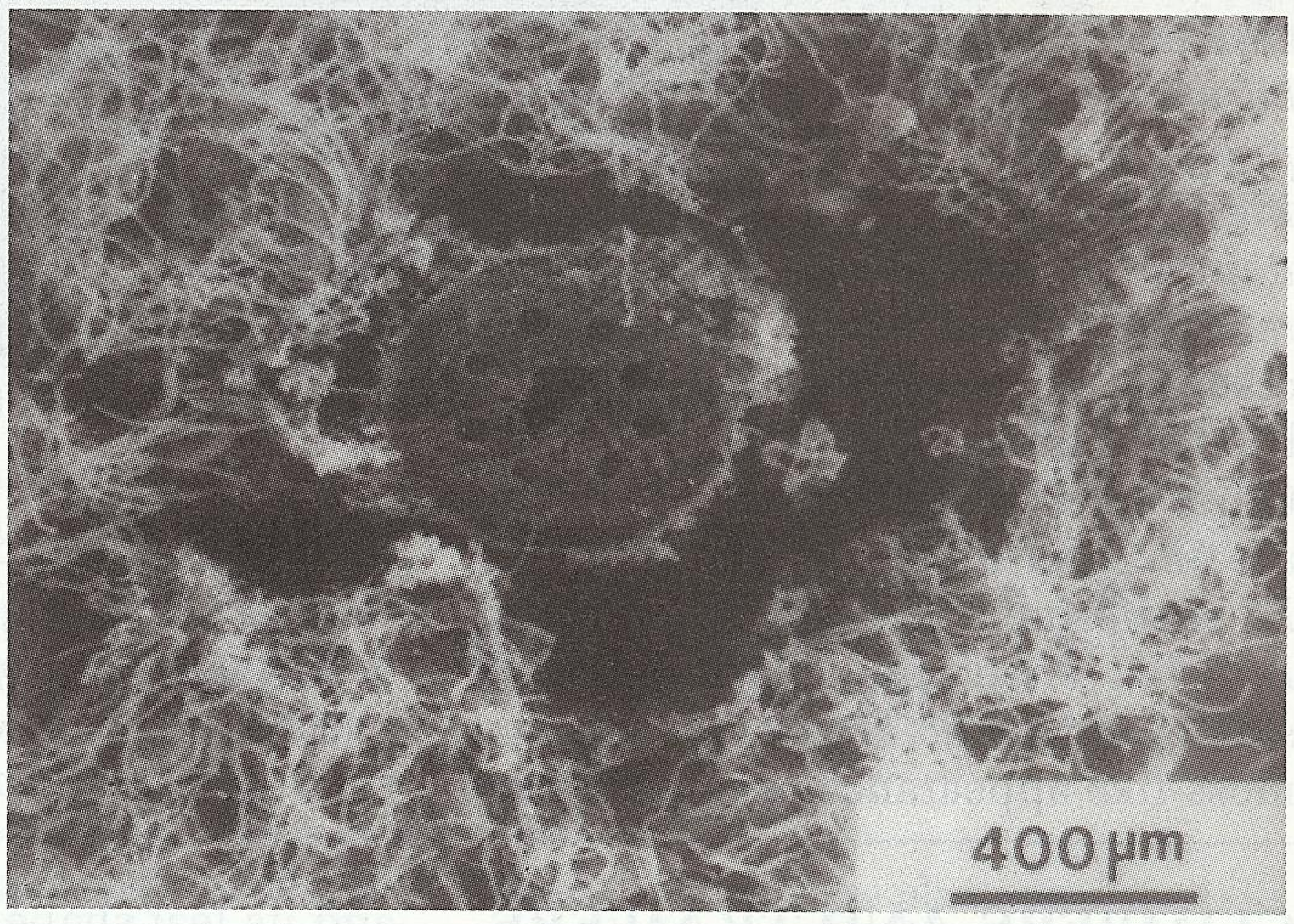
Until recently, rhizosheaths, or 'sand grain root sheaths' as they have been referred to, were thought to be peculiar to grasses adapted to growing in arid sandy soil, such as *Anthephora pubescens* (wool grass). This however, is not entirely true. The rhizosheaths do possibly have a role in keeping the roots moist, as they maintain the root in a humid environment. However, an extensive herbarium survey in which 130 species of grasses were studied revealed that sheath-forming grasses occur throughout the country. In arid areas, the proportion of individuals producing sheaths was found to be greater than in the wetter areas. Rhizosheaths occurred on 107 of the 130 species and many of the 23 non-sheath-forming individuals did not have representative individuals in arid areas. This widespread occurrence indicates that their presence is not just a response to arid conditions.

Among the grasses studied, there was a general trend for rhizosheaths to become thicker, with the soil particles becoming more tightly bound to the sheaths, on grasses growing in sandy soil. However, they also develop on species growing in clayey soil. Roots in sandy soil produce more epidermal hairs than roots of the same species in less sandy soil, and the more hairs there are, the more soil particles are bound to the sheath. This bonding between soil particles and epidermal hairs is extremely strong.

Results of a growth experiment using *Anthephora pubescens, Eragrostis pallens* and *Digitaria eriantha* showed that the sandier the soil, the thicker the sheaths, and that while species have a genetic predisposition to sheath development, the extent to which they develop is a response to soil texture.

The close association between the sheath and the regions of the root responsible for nutrient and water uptake as well as the fact that sheaths develop to a greater extent in sandy, nutrient deficient soil prompted the idea that the sheaths may facilitate nutrient uptake by the roots. A study was undertaken to assess the influence of rhizosheaths on phosphorus uptake by two sheath-forming species, *Anthephora pubescens* and *Digitaria eriantha*. Phosphorus was chosen because it is a relatively immobile nutrient in the soil and its uptake is limited more by the rate of transfer **to** the root surface than transfer **into** the root. Individuals of the two species were induced to grow sheaths of different thicknesses by planting the seeds in soils with different sand:clay ratios and the difference in phosphorus uptake by the differently sheathed individuals was assessed. Results showed that the greater the extent of sheath development, the greater the amount of phosphorus extracted from the soil, especially in individuals growing in soils with a low phosphorus availability. A possible explanation for this enhanced uptake is that the sheaths allow close contact between the absorbing surface of the roots and epidermal hairs and the soil particles and soil solution which could aid the uptake of nutrients.

Above. **Rhizosheaths covering the roots of *Eragrostis pallens*, uprooted from sandy soil.**
Below. **A scanning electron micrograph of dried grass showing the gap that is left between the rhizosheath and the stele of the root after the cortical tissue disintegrates.**



WHAT DOES THAT MEAN?

Cortical tissue
The tissue between the epidermis and the stele in the stem or root.

Epidermal root hairs
Projections from the epidermis, responsible for the first stage in the absorption of water and solutes from the soil.

Epidermis
In this case, the outermost cells of the root, the main function of which is to protect the underlying tissues from water loss.

Stele
The central core of the stems and roots of vascular plants.

It appears that these sandy coatings enhance the plant's ability to survive in soils with a low nutrient content, especially in sandy soils that drain freely.

Further reading

Bailey, CL and Scholes, MC. 1997. Rhizosheath occurrence in South African grasses. *South African Journal of Botany.* **63**(6), 484-490.