Actinorhizal plants and Frankia in Japan (Biological Interactions in Arable Land-Grassland-Forest Continuums and their Impact on the Ecosystem Functions, 7th International Symposium on Integrated Field Science)

Actinorhizal plants and *Frankia* in Japan

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The actinomycetal genus *Frankia* forms root nodules in some woody plants that fix atmospheric nitrogen. Such plants are called *actinorhizal plants*. Actinorhizal plants indigenous to Japan are the genus *Alnus*, *Myrica*, *Elaeagnus* and *Coriaria* as well as the introduced species *Casuarina* and *Hippophaë*. Among these plants, 12 species from six genera of actinorhizal plants were examined in terms of the morphological characteristics of root nodules and of *Frankia* strains isolated.

Actinorhizal root nodules are generally perennial, with coralloid structures consisting of multiple nodule lobes. The tissue of the nodule lobe consists of a nodule meristem at the tip of the nodule, vascular tissue, cortical tissue and a superficial periderm. In contrast to legume root nodules in which microsymbiont-infected cells are surrounded by vascular tissue, *Frankia*-infected cells are distributed in the cortical tissue around vesicular tissue. Root nodules of *Alnus* are dark orange to brown, with the color becoming lighter towards the apex of the nodule. The size and shape of the nodule vary; nodule lobes of *A. japonica* are densely packed, whereas those of *A. sieboldiana* and *A. firma* are discrete. *Alnus serrulatoides* has tiny and discrete nodule lobes (Fig. 1). *Myrica* nodules are khaki to sandy-brown with nodule roots from the apices of the nodule. *Elaeagnus* nodules are light brown with dark-brown scales. *Coriaria japonica* has pale golden nodules in which vascular tissue is not central. *Casuarina* nodules are light yellow with nodule roots.

Frankia strains have been isolated from actinorhizal plants from four genera. The color of these isolates varied: *Alnus* strains were white to light gray/light purple. *Casuarina* strains were light gray. Strains from *Myrica*, *Elaeagnus* and *Hippophaë* were light pink to pink. Under a microscope, these strains have round or highly irregular sporangia filled with spores and vesicles, the sites of nitrogen fixation (Fig. 2), both of which are characteristics of *Frankia*.

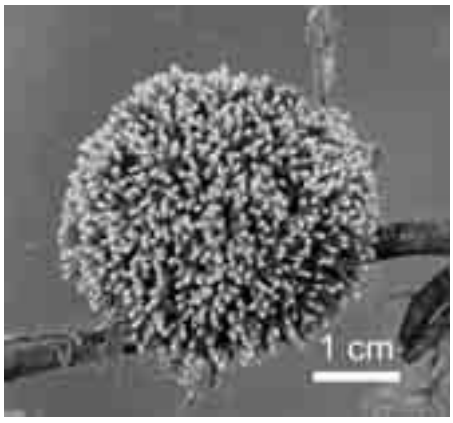

Fig. 1. Root nodule of *Alnus serrulatoides*

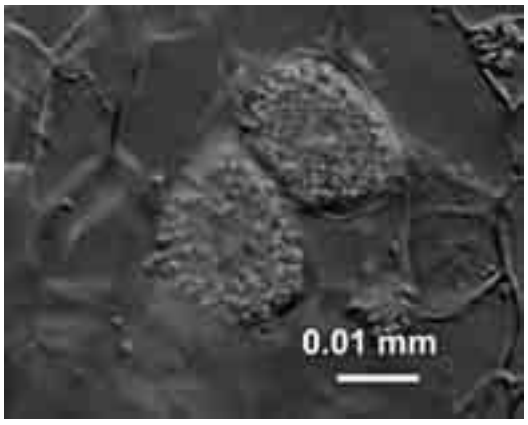

Fig. 2. Vesicules in cortical cells in a root nodule of *Alnus sieboldiana*

References

Yamanaka, T. and H. Okabe (2008) Actinorhizal plants and *Frankia* in Japan. Bulletin of FFPRI 7: 67-80 (In Japanese with English summary).