Nodulation of *Lathyrus* and *Vicia* spp. in non-agricultural soils in East Scotland

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Introduction, Aims and Methods

•Legumes in the genera *Lathyrus*, *Pisum* and *Vicia* can have all their N-requirements supplied by forming N_2-fixing symbioses with a common soil bacterium called *Rhizobium leguminosarum* bv. *vicieae* (Rlv).

•Some of these legumes, such as faba bean (*Vicia faba*), are of great economical and agricultural importance, and are widely grown in temperate regions, including East Scotland.

•Seedlings of native rare and/or scarce species of *Lathyrus* and *Vicia* ("vetches") were grown in soil from their native environments (coastal, woodlands or highland) in order to induce nodulation by "trapping" the indigenous Rlv rhizobia.

•Effectiveness of nodulation was determined by acetylene reduction assays and by microscopical analysis of nodules.

Fig. 1. *Lathyrus* and *Vicia* species in various undisturbed ecosystems in East Scotland: **A**, *L. japonicus* ("sea pea") growing on the seashore at Carnoustie, Angus; **B**, *L. linifolius* ("bitter vetch") growing in woodland in Crombie Country Park, Angus; **C**, *Vicia lutea* ("yellow vetch") growing near the seashore at Monifieth, Angus; and **D,** *V. sylvatica* ("wood vetch") on scree slopes at Arthur's Seat, Edinburgh.

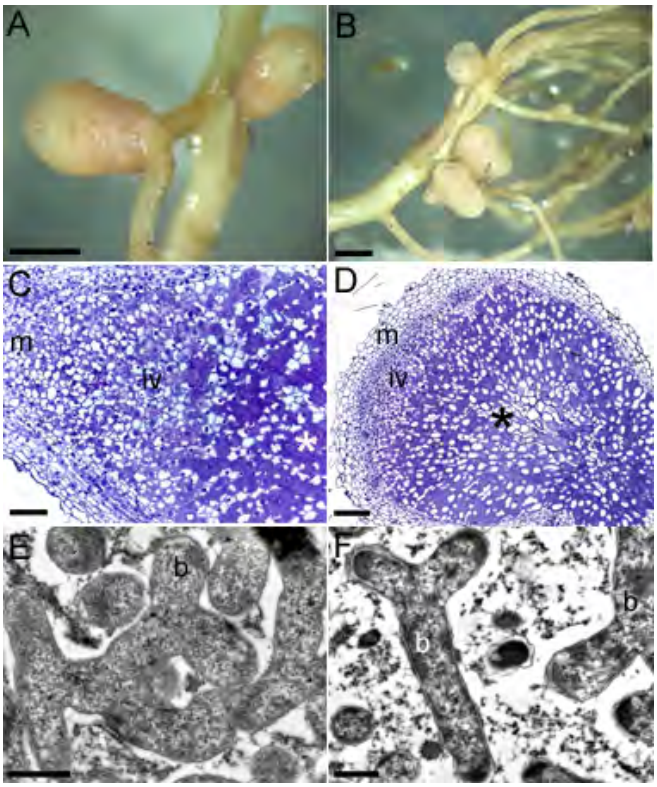

Fig. 2. Light and electron micrographs of nodules of *Lathyrus japonicus* (A, C, E) and *Vicia lutea* (B, D, F) grown in native rhizosphere soil: A, Nodules on a root of *L. japonicus*; B, Nodules on a root of *V. lutea*; C, Longitudinal section (LS) through a *L. japonicus* nodule showing the meristem (m), invasion zone (it) and the N_2-fixing zone (*); D, LS of a *V. lutea* nodule; E, Electron micrograph (EM) of a pleomorphic bacteroid (b) in a *L. japonicus* nodule; and F, EM of *V. lutea* bacteroids. Bars, 250 µm (A, B), 20 µm (C), 40 µm (D), 500 nm (E), 1 µm (F).

Species/rhizosphere soil	*Lathyrus japonicus*	*Lathyrus linifolius*	*Lathyrus linifolius*	*Vicia lutea*	*Vicia sylvatica*	*Vicia sylvatica*
Environment	Seashore	Woodland	Woodland	Seashore	Screeslope	Cliff
%N in soil	0.00204	0.31930	0.34086	0.00184	0.00357	0.13357
L. japonicus	**	0 nodules	n.d.	*	n.d.	*
L. linifolius	**	*	* (n.a.)	*	*	n.d.
V. lutea	***	n.a.	n.d.	***	***	**
V. sylvatica	**	n.d.	n.d.	**	**	**
V. sativa	**	n.d.	* (n.a.)	**	0 nodules	**

Table 1. *Symbiotic nodulation of uncommon/rare* Lathyrus *and* Vicia *spp. from coastal, woodland and highland locations in East Scotland as determined by visual observation of effective nodules (see Fig. 2), and by acetylene reduction assays of nitrogenase activity. The activities of all plants were determined at 2 – 3 months after planting of seedlings grown as "trap" plants in soil obtained from the rhizospheres of the various parent plants. The common legume* Vicia sativa *was planted in the same soils and was tested in parallel.*

*** >1000 nmol C_2H_4 plant-1 h-1, ** 200 – 1000 nmol C_2H_4 plant-1 h-1, * 10 – 100 nmol C_2H_4 plant-1 h-1
n.a. = nodules present, but no nitrogenase activity detected, n.d. = not determined

Results and Further work

•Coastal soils with very low N concentrations resulted in highly effective nodulation of most species examined (Fig. 2, Table 1).

•However, some species, such as *L. linifolius*, which live in more fertile woodland soils may have less use for symbiotic N_2 fixation (Table 1).

•Rlv isolates from all the plant/soil combinations are now the subject of a molecular analysis of their core "housekeeping" (16S rRNA, *recA*) and their symbiosis-related genes (*nodD*) to see how they compare with rhizobia that can nodulate the crop species *P. sativum* and *V. faba* (Mutch & Young, 2004).

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Further Reading
Mutch L A, Young J P W. 2004. Diversity and specificity of *Rhizobium leguminosarum* biovar *viciae* on wild and cultivated legumes. *Molecular Ecology* 13:2435-2444