LOCALIZATION OF NITRATE REDUCTION IN SOME PISUM GENOTYPES

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Pea plants assimilate nitrogen both by symbiotic nitrogen fixation and by nitrate reduction. The location of nitrate reduction within a plant may have an influence on the energy costs of nitrate metabolism. Apparently, less energy is required if the nitrate reduction process occurs in illuminated green tissue than in the roots (5). In pea, most of the nitrate taken up is reduced in the roots (4). Some studies (1,2) indicate, however, that substantial amounts of nitrate may be reduced in the shoot. The present study was conducted to determine if Pisum contains genetic variability for within-plant activity and localization of nitrate reductase (NR).

Uninoculated plants of 14 genotypes were grown in pots containing vermiculite and were watered with a nutrient solution containing basic nutrients and 5 mM KNO_3. The pots were arranged in a randomized block experiment with four replicates in a growth chamber and exposed to a 16h light/8h dark cycle at 20/13C. Plants were harvested 2 1 days after sowing. The roots were washed in demineralized water and the shoots were separated into two fractions: a leaf fraction (leaflets and stipules) and a "stem" fraction (stem, petioles, and tendrils). Grams fresh weight (gfw) was determined on each plant part. An In vivo NR activity (NRA) assay (3) with minor modifications and including 0.1 M NO_3 in the incubation medium was used to determine the potential NRA on samples from the different tissue fractions (Table 1) and the distribution of total plant NRA (Fig. 1). Potential NRA is considered to be an indicator of nitrate reduction in the tissue when the substrate is not limiting.

Significant genetic variability for potential NRA per gfw was found for all tissue fractions (Table 1). Root, stem, and leaf NRA varied 2.7-, 2.2-, and 1.7-fold, respectively, among the 14 genotypes. In ten of the 14 genotypes the NRA per gfw could be ranked as follows: leaf>root>s tern. In 'Afghanistan', 'Frison', and 'Sugarsnap, root NRA was higher than leaf NRA. 'Alaska' pea had the lowest root and stem NRA, but the highest leaf NRA (Table 1). The capacity for nitrate reduction in the root as percent of total plant activity varied between 38 and 64% (Fig. 1). Total plant activity (Fig. 1) was positively correlated with the NR activity per gfw of the leaf fraction (r=0.716**). The distribution of total plant NRA among plant parts may depend on the level of nitrate in the growth medium. The higher the level and plant uptake of nitrate the higher may be the contribution from green plant parts to total plant NRA. No relationship was found between total plant activity and the proportion of total NRA located in the green plant parts (Fig. I). In the present experiment only a single level of nitrate was used, since the genotype comparison was of prime interest.

The results indicate that pea genotypes differ in their capacity for nitrate reduction in the root and shoot system. The significance of these differences in relation to the effect of nitrate on symbiotic nitrogen fixation will be studied in more detail.

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Table 1. Potential NRA in the root, stem and leaf tissue of 14 pea genotypes.

Genotype	NRA µmol NO_2-N produced $(gfw)^{-1} h^{-1}$		
	Root	Stem	Leaf
Alaska	1.1	0.6	3.1
Rondo	1.2	1.2	1.8
Finale	1.4	0.9	1.8
Bodil	1.4	1.0	2.1
Meteor	1.7	0.8	2.0
Trapper	1.8	0.9	2.1
Lysima	1.8	1.1	2.8
Filby*	1.9	1.3	0
Sugarsnap	2.1	0.6	1.9
Timo	2.1	0.8	2.4
Solara**	2.2	1.2	2.3
DSP***	2.2	1.2	2.2
Frisson	2.6	1.3	2.1
Afghanistan	3.0	1.2	2.2
LSD (0.05)	0.9	0.4	0.6

* af, st, Tl genotype
** af, St, Tl genotype
*** Dark Skin Perfection

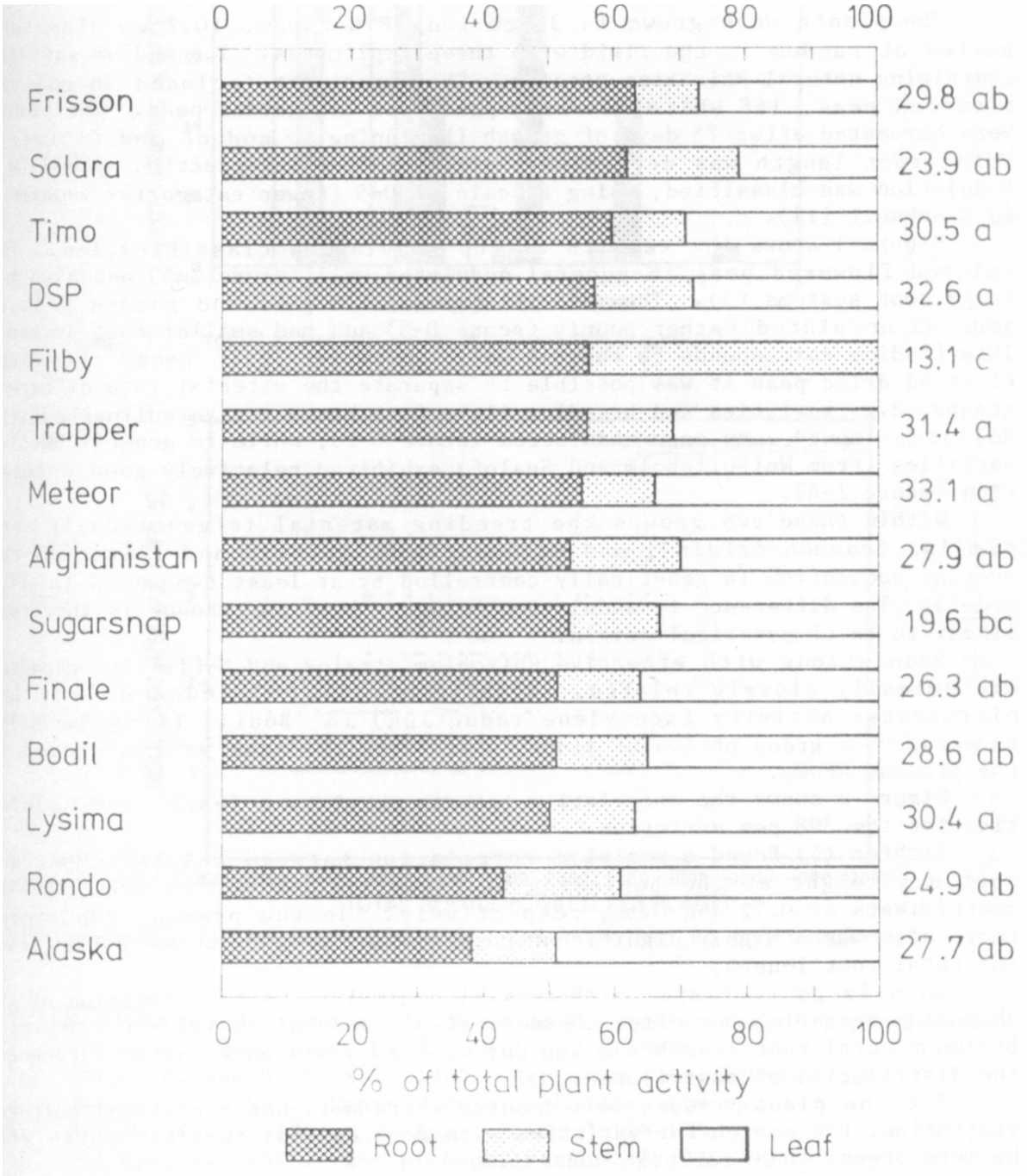

Fig. 1. Distribution of total NRA among plant. parts. Total plant NRA (mcmol NO_2-N produced $plant^{-1}$ h^{-1}) are shown at the right side of the figure. Means that are followed by the same letter are not significantly different at the 5% level of probability.

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