Root responses to low nutrients in *Capsella bursa-pastoris* & *Arabidopsis thaliana*

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1. Project aims

The aim of the project was to investigate root responses to low nutrients in *Capsella bursa-pastoris* and *Arabidopsis thaliana.* To investigate the responses we looked at root and root hair growth and border cell production in response to low concentrations of Nitrogen and Phosphorus.

Arabidopsis

Capsella

2. Background

Arabidopsis is a model plant for genetic studies and *Capsella* is a closely related arable weed. Root hairs are outgrowths from epidermis cells creating a large surface area that aids the plant in obtaining nutrients, and border cells are thought to attract and stimulate growth in micro-organisms and repel and prevent the growth of others. This study is unique because nobody really knows the function of root border cells under these nutrient conditions.

3. Methods

Six *Capsella* lines were chosen to represent a range of flowering times. Eight *Arabidopsis* lines were chosen with mutations in genes that might affect border cell production. The low phosphorus (Low P) medium was different from the Control in that phosphate nutrient was omitted and the low nitrogen (Low N) had N-containing nutrients diluted by 1/10.

4. *Capsella* root lengths

Low N caused root length to increase relative to control and Low P caused root length to decrease (Figure 1).

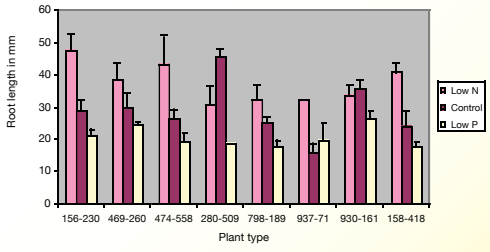

Figure 1 Root length in *Capsella* in response to Low N and Low P

5. *Capsella* root hair lengths

Low P decreased root hair length and low N increased root hair length relative to the control (Figure 2).

Root hair outgrowths

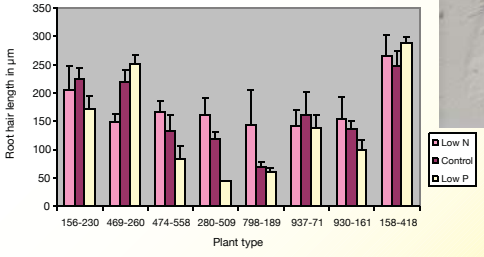

Figure 2 Root hair length in *Capsella* in response to Low N and Low P.

6. Border cell production by *Capsella* and *Arabidopsis*

There was significant variation between the different plant lines (Figure 3 and 4). Low P treatment increased border cell production in both plant species, and Low N had no effect.

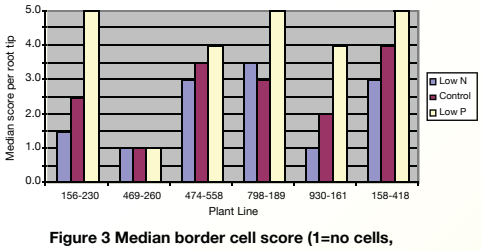

Figure 3 Median border cell score (1=no cells, 5=root covered in cells) in *Capsella* in response to Low N and Low P.

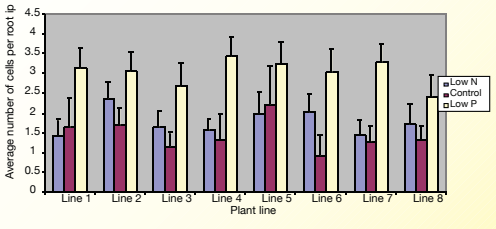

Figure 4 Mean number of border cells per root in *Arabidopsis* in response to Low N and Low P.

Arabidopsis root with no border cells

Arabidopsis root with many border cells

7. Conclusions

1 The low N treatment increases root and root hair length while the low P decreases root and root hair length.

2 Low P treatment stimulates border cell production in both *Arabidopsis* and *Capsella* and the low N decreases root border cell production with *Capsella* and increases it slightly with *Arabidopsis*.

3 This study has provided important information about how plant roots respond to low soil nutrients, which might help future research to understand the processes and genes controlling nutrient uptake by plants.