UNIVERSITY OF COPENHAGEN
FACULTY OF SCIENCE

Green manure crops for low fertility soils

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Introduction

Organic crop production is growing, but crop yields are still below potential. The purpose of our project "Nutrients for higher organic yields (NutHY)" is to increase yields and resource efficiency in organic crop production by optimizing nutrient supply. Growing green manure is an important tool to improve fertilization by biological nitrogen (N) fixation but also by mobilization and release of other nutrients such as phosphorus (P). However, development and performance of green manure are affected by low soil nutrient availability that is often reported as a problem in organic arable farms, especially with regard to P.

Conclusion

In this study, we present our preliminary results indicating that:

- While white lupin and buckwheat were efficient green manure crops to grow on low fertility soil,
- garden sorrel and oilseed radish resulted in highest P mobilization after 80 days of incubation,
- and the application of garden sorrel and oilseed radish significantly increased the growth of ryegrass.

Objectives

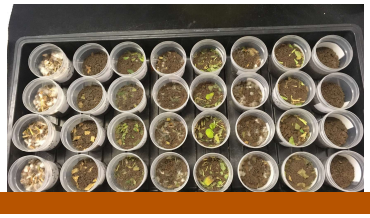
The purpose of this study was therefore to identify efficient green manure crops that are able to establish and grow fast in soils with low plant nutrient availability. We used fields and soil from the long-term nutrient depletion trial at the University of Copenhagen to study the effect of different soil fertility levels on growth of green manure and on their fertilizing effect on subsequent crops.

Methods

Field trial

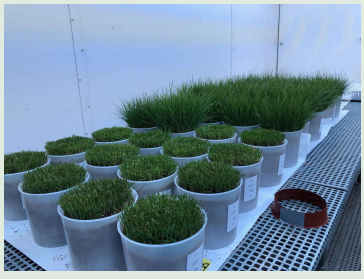
Six different species of green manure, white lupin (*Lupinus albus*), winter vetch (*Vicia villosa*), crimson clover (*Trifolium incarnatum*), buckwheat (*Fagopyrum esculentum*), oilseed radish (*Raphanus sativus*) and winter rye (*Secale cereale*)) were sown after harvest of oilseed rape in plots with either low or moderate soil fertility with 6 and 16 mg Olsen-P kg soil^{-1}, respectively.

Incubation study



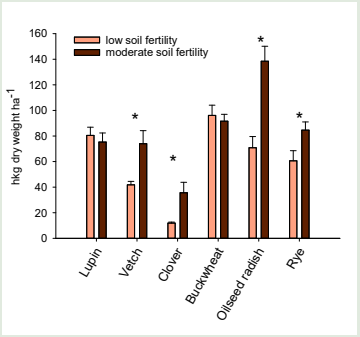
In an incubation study, we studied the mobilization of P after soil amendment of aboveground biomass of white lupin, winter vetch, garden sorrel (*Rumex acetosa*), crimson clover, buckwheat, oilseed radish and ryegrass (*Lolium multiflorum*) at low temperature

Pot trial



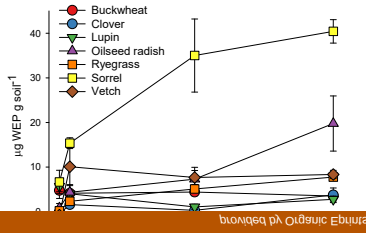
In a subsequent pot experiment with low fertility soil from the long-term field trial, we investigated the P fertilizing value of 5 different species (buckwheat, oilseed radish, garden sorrel, white lupin and winter vetch), added at a rate of 50 mg P kg soil^{-1}.

Results

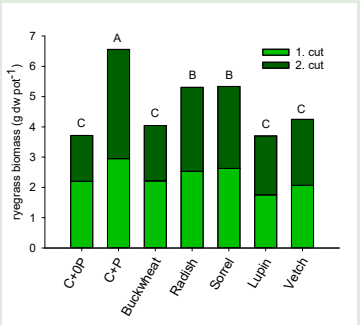


* Significant effect of soil fertility, $p < 0.05$

Biomass sampling in autumn revealed that biomass production of winter vetch, crimson clover, oilseed radish and winter rye were significantly decreased when growing at low soil fertility whereas white lupin and buckwheat showed the same growth at both fertility levels.



After 80 days of incubation, the treatments receiving sorrel and oil seed radish revealed the highest P mobilization, with an increase of water-extractable P (WEP) corresponding to 50 and 31%, respectively, of the added P.



Different letters indicate significant effect between green manure species, $p < 0.05$

After 40 days of ryegrass growth, the addition of oilseed radish and sorrel significantly increased the growth of ryegrass by 43 and 44 % compared to the 0P control, respectively, confirming their value as green manure plants for crop P nutrition.

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