Project title:

The use of natural amino acids as a nitrogen source in organic farming

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Background

The dynamics of nitrogen in terrestrial environments may be fundamentally flawed due to the lack of consideration of the uptake of organic N by plants (Chapin et al., 1993 (Jones et al.2005)). Crops that possess the ability to compete for and absorb dissolved organic N (DON) may gain a significant competitive advantage compared to those relying on inorganic N forms produced by mineralization (Chapin et al.1993).

So far, nitrate has been considered the mobile N component in agricultural soils. However, a recent review by Jones et al. (2005) concludes that dissolved organic nitrogen (DON) constitutes a major soluble N pool in most ecosystem soils but direct proof that plant uptake of DON constitutes a major nitrogen source for crops in agricultural settings is still lacking. However, its potential flux into plants has however been clearly demonstrated (Näsholm et al.2000) and recently (Thornton and Robinson2005) showed the importance of considering multiple N forms in N acquisition studies. In addition, Persson and Näsholm (2002) found a lack of down-regulation of the amino acid uptake by improved plant N status of conifers. Recent studies showed that plants are capable of taking up soluble organic nitrogen actively under both forest and field systems. Special attentions were given to the active uptake of amino acids and transporters involved in that process, free amino acids represents major part of the soluble organic nitrogen in soil. The uptake of amino acids under field conditions is still under debate, moreover information about the kinetics and dynamics of amino acids active uptake by higher plant is scarce.

From applied point of view, during the growing of vegetable or high demanding crops, organic growers used to treat plants with supplementary organic fertilizers. Traditionally in many parts of the world, farmers are using similar techniques such as liquid compost, seaweed extracts, hydrolyzed and degraded soybean protein, and plant extracts etc.. However many reports showed the positive effect of such on-farm produced soluble organic fertilizer; there are no clear explanations for such effect. Information about mode of action for these products is scarce. Some researchers stressed the role of amino acids content in these soluble plant extracts, but this is still under debate.

The PhD project includes field and lab trials in order to investigate the uptake of N from amino acids and plant water extracts and its applications in organic farming systems
Objectives

Investigate the nitrogen degradation and transformation during plant extraction with water as affected by time, temperature and plant material. And explore the potential of plant extracts as nitrogen source.

Study the amino acids uptake kinetics and dynamics by wheat plants.

Determine the mechanism by which, crops could benefit from the applied amino acids or plant extracts.

Progress – 2005

Field trial:
Field experiment was carried out during the first half of 2005. The field trial was done in sandy soils 90 North West of Cairo, Egypt and under drip irrigation system. The aim of the experiment was to determine the response of lettuce and squash as high nitrogen demanding crops to nitrogen from ammonium sulfate, clover and alfalfa extracts and glycine. $^{15}$N was used to determine the nitrogen uptake by lettuce and squash

Lab analysis:
120 samples were analyzed for amino acid content using HPLC. Analysis of amino acids expected to be completed before the end of 2005.

Scientific activities:
Poster at the Focus on Soils Symposium ‘’Plant aqueous extracts as a supplementary nitrogen source in organic farming’’ September 14 - 16, 2005, Uppsala, Sweden

Pass the SOAR Summer School course ‘’Globalisation: Threat or Opportunity for Organic Farming?’’ 3-7 October 2005, Funen, Denmark

Plans – 2006

Perform a greenhouse experiment, to compare the nitrogen uptake from $^{15}$N labelled plant extract and labelled organic matter (01-12-05: 01-3-06)
Submission of papers I, II, III (01-12-05), (01-02-06), (01-05-06)
Submission of PhD thesis (01-07-06)

Publications
‘’Crop responses to foliar fertilization with organic and inorganic N sources’’ In preparations
‘’Kinetics and dynamics of amino acids uptake by wheat under sterilized conditions’’ In preparations