FACULTY OF AGRICULTURAL SCIENCES
DEPARTMENT OF HORTICULTURE
AARHUS UNIVERSITY

Effects of catch crops on the content of sulfur (S) and selenium (Se) in vegetables

Eleftheria Stavridou[1], Kristian Thorup-Kristensen[2], Kristian Holst Laursen[3]
[1,2] University of Aarhus, Faculty of Agricultural Sciences, Dept. of Horticulture, Research Centre Aarslev, Kirstinebjergvej 10, DK-5792 Aarslev, Denmark
[3] University of Copenhagen, Faculty of Life Sciences, Dept. of Agriculture and Ecology, Plant and Soil Science Laboratory, Thorvaldsensvej 40, DK-1871 Frederiksberg C, Copenhagen, Denmark

Introduction

Selenium is an essential nutrient for animals, humans and microorganisms. Se deficiency in humans has been linked to a plethora of physiological disorders. Increasing evidences point to an anti-carcinogenic potential of Se-compounds (Se-methylselenocysteine and γ-glutamyl-Se-methylselenocysteine), which have been shown to provide chemoprotective effects against certain types of cancer in humans (Rayman 2000). To address Se deficiency in the human diet and to benefit form the medical properties of the organoselenium compounds, agronomists and plant breeders are pursuing complementary strategies to produce crops with greater Se concentrations (White *et al*. 2007).
Catch crops have been used successfully in agriculture by improving soil fertility, increasing nitrogen and sulfur content in the soil and avoiding nutrient leaching (Eriksen *et al*. 2004; Thorup-Kristensen 1994). Studies have demonstrated that several forage plant species absorb Se when grown in soil where Se enriched plant tissues are incorporated (Bañuelos *et al*. 1992; Dhillon *et al*. 2007).

Objective

To determine whether some types of catch crops, with different S uptake, can be used to increase the content of sulfur and selenium compounds in species, which are able to incorporate high quantities of Se and to produce selenoamino acids that are potentially bioactive for nutrition purposes and normally implicated the S pathways.

Experimental Design

Study site: Research Center Aarslev.

Experimental years: 2007,2008,2009.

Plot layout: Randomized complete block design with four replicates for each crop.

Tested crops:
- Cabbage (*Brassica oleracea* var. *ca pitata*)
- Onion (*Allium cepa*)
- Spring wheat (*Triticum aestivum* L.)

Plot size:
- Cabbage: 8 m^2
- Onion: 8 m^2
- Wheat: 9 m^2 (4 m^2: main plot, 5 m^2: soil and catch crop sampling)

Figure 1: Experimental layout

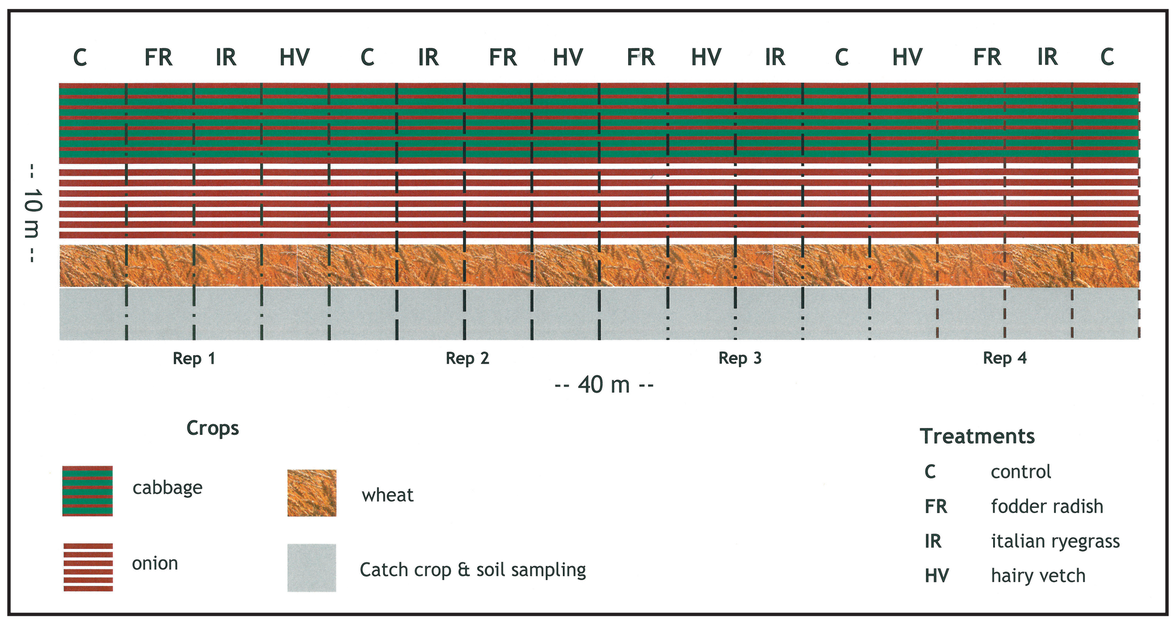

Figure 2: Catch crop treatments. From left to right: control, fodder radish, hairy vetch, italian ryegrass

Figure 3: The catch crop treatments for the three randomized block designs

Figure 4: Cabbage, onion and wheat primo of August

Treatments (3 catch crops):
- Fodder radish (*Raphanus sativus* L.)
- Italian ryegrass (*Lolium multiflo rum* Lam.)
- Hairy vetch (*Vicia villosa*)
- Control, no catch crop (bare soil)

Crop establishment:
- Catch crops: begin of August
- Main crops: after catch crop's in corporation

Sampling:
- Soil sampling: 3 times (end of autumn, before catch crop's incorporation and early May) in three soil layers (0-25 cm, 25-75 cm and 75-150 cm)
- Catch crop sampling: 1 m^2 late in autumn and before incorporation
- Main crop sampling: August

Cultivation treatments:
- No irrigation applied
- Catch crop incorporation: March
- Weed management: mechanically among the rows, manually pulling around the plants
- No fertilization applied
- Manual plant sampling

Laboratory Methods and Analyses

Sample preparation:
- Surface decontamination with Milli-Q-water or de-ionized water
- Freeze drying
- Homogenisation (in a grinding mill equipped with a titanium rotor)
- Micro oven digestion (using nitric acid and hydrogen peroxide)

Elemental analysis: Inductively Coupled Plasma Mass Spectrometry (Agilent 7500ce ICP-MS)

References

Bañuelos GS, Mead R, Wu L, Beuselinck P, Akohoue S (1992) Differential selenium accumulation among forage plant species grown in soils amended with selenium-enriched plant tissue. Journal of Soil and Water Conservation 47, 338-342.
Dhillon SK, Hundal BK, Dhillon KS (2007). Bioavailability of selenium to forage crops in a sandy loam soil amended with Se-rich plant materials. Chemosphere 66, 1734-1743.
Eriksen J, Thorup-Kristensen K, Askegaard M (2004) Plant availability of catch crop sulfur following spring incorporation. Journal of Plant Nutrition and Soil Science 167, 609-615.
Rayman MP (2000) The importance of selenium to human health. The Lancet 356, 233-241.
Thorup-Kristensen K (1994) The effect of nitrogen catch crop species on the nitrogen nutrition of succeeding crops. Nutrient Cycling in Agroecosystems 37, 227-234.
White PJ, Broadley MR, Bowen HC, Johnson SE (2007) Selenium and its relationship with sulfur. In 'Sulfur in plants: an ecological perspective'. pp. 225-252.