



Tentative project title:

Fibre crops with phytoremediation potential and improved nutritional quality

Introduction/ Rationale:

Twenty years ago - **no data in literature on metal elements (both toxic and essential ones) content** in two economically important fibre crops - flax and hemp.

Due to their mostly industrial (non-food) utilization, both crops seemed to be an excellent candidates for **phytoremediation utilization, particularly phytoextraction of toxic heavy metals**.

Last decade – AGRITEC contribution to research of biological/economical potential of both fibre crops as related to **uptake, transport and accumulation of toxic heavy metals** with the stress to cadmium and lead.

- Screening of germplasm resources /commercial cultivars for heavy metal tolerance (Bjelková et al. 2001, Griga et al. 2003)
- Agrotechnological treatments affecting HMs bioavailability (Bjelková et al. 2013)
- *In vitro* methodology for screening heavy metal tolerance (Smýkalová et al. 2010)
- The first proteomic study in flax as related to Cd-stress tolerance (Hradilová et al. 2010)
- Phytochelatin induction by Cd-stress (Vrbová et al. 2009)
- Creation of transgenic flax with improved tolerance/accumulation of Cd (Vrbová et al. 2013)
- Economical aspects of phytoextraction (Bjelková and Griga 2013).

In contrast - **flaxseed has been also known from ancient times for its „medicinal“ effects**, which historical knowledge was confirmed by recent scientific studies – flaxseed is the richest source of lignans with antitumor and antioxidant effects and estrogenic and antiestrogenic activity (Krajčová et al. 2009).

Thus, it is efficient and reasonable – during the studies of metal elements – to follow both aspects, i.e. phytoremediation of toxic metal elements in parallel with improvement of essential elements in order to improve biological/nutritional/medicinal quality of flaxseed.

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Main objectives:

- Utilization of traditional European fibre crops (flax – *Linum usitatissimum* L. and hemp – *Cannabis sativa* L.) as plant models for phytoextraction of toxic metals (Cd, Pb, As) from polluted soils.
- Improvement of content of essential metal elements (Se, Zn, Fe, Mo) in flaxseed for fortified food and feed (healthy food, nutritional supplements) and for better fibre quality (Si).

Main activities:

- The mutual interactions of toxic and essential metal elements – uptake, transport and accumulation of Cd, Pb, Zn, Fe, Cu, Co, Mo and Se in the organs of flax/hemp as a result of selenium fertilization in the field-simulated and field conditions
- *In vitro* testing of arsenic (As) for the flax/hemp tolerance and accumulation
- The effect of Si application (fertilization) on the yield and quality of flax fibre
- The ability of GM flax with engineered mammalian metallothionein to improve Se accumulation (in vitro, greenhouse and field experiments – GM release into environment)
- Transformation of flax and hemp with „heavy metal transporters“ from mycorrhizal fungi (or other biological sources)

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Planned outputs/results:

- (1) new theoretical knowledge,
 - (2) new methodological knowledge – know-how,
 - (3) new biological materials – molecularly, genetically and phenotypically characterized plant lines/cultivars with desired traits.
- Knowledge on mutual effects of selected metal elements during their uptake, transport and accumulation in flax and hemp.
 - Knowledge on the effect of Si application (fertilization) on the yield and quality of flax fibre.
 - Knowledge on biological effects of arsenic (As) on flax/hemp growth and development.
 - Agrotechnologies affecting either improved or suppressed uptake, transport and accumulation of metal elements of interest (phytoremediation x fortified food).
 - Genetic materials (lines, cultivars; both conventional and transgenic) characterized by their specific behavior as related to both toxic and essential elements.

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Knowledge-based and technical background for proposed research:

Why is AGRITEC a suitable organization/partner for proposed research?

- Long-lasting tradition in complex agrobiological research and breeding of fibre crops (since 1942).
- Responsible institution in CR for maintenance and management of germplasm resources of flax and hemp.
- AGRITEC have bred and licensed its own flax/linseed varieties (Texa, Venica, Rina, Amon, Raciol).
- Highly qualified and experienced personell for above-mentioned activities.
- Own land for field experiments and complex field machinery for field trials with fibre crops.
- Equipped laboratories for tissue cultures and molecular biology (permission for contained GM work as well as for release of GM crops into the environment) and analytical chemistry (AAS for metal elements detection).
- Priority results from last decade as related to fibre crops and heavy metals (see papers in printed material).
- Last but not least – previous experience with „Norway grants“ project (A/CZ0046/1/0024: Utilizing legume-cereal intercropping to increase self-sufficiency with animal fodder and maintain soil quality on organic farms in the Czech Republic; 2008-2010).