

Project report 2020 to SLU Ekoforsk

## **Facilitating reduced- and no-tillage organic grain legume production systems through integration of cover crop mulch for weed control**

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### **Background**

Aim of this research project is the development, testing and dissemination of reduced- and no-tillage cropping systems for organic production of field beans and lupines. An early flowering variety of winter rye will be used as cover crop, providing rapid production of biomass and thus strong competition for light, water and nutrients, during autumn, winter and early spring. The growth of the cover crop will be terminated by either mulching or roller crimping in spring. The residual biomass is expected to provide a physical barrier and source of allelopathic substances, inhibiting the emergence and growth of weeds throughout the grain legume growing season. In addition, the high C:N ratio in rye biomass is expected to lead to a nitrogen deficiency in the soil, which gives grain legumes an additional advantage in relation to both annual and perennial weeds. This project aims to shed light on the mechanisms and consequences of this cultivation system and to provide a holistic view of the interplay between the availability of soil nitrogen and the dynamics of the weed population and crops. Furthermore the agronomic and economic feasibility of the system will be assessed under the given pedoclimatic conditions.

### **Experimental design**

Field experiments were started in autumn 2020 at two experimental sites with contrasting pedoclimatic conditions, Vreta Kloster (Östergötland) and Lövsta (Uppland). Four grain legume cropping systems will be compared (Table 1):

#### **I. Standard farmers practice system**

Inversion tillage in autumn followed by winter fallow without cover crop. Standard seeding time of field beans and lupines in spring (latest Mai 15). Inter-row hoeing up to three times during the vegetative growth period.

#### **II. Reduced tillage system**

Seeding of rye in early autumn after stubble cultivation. Mulching of rye in spring with crosscutter discs followed by direct seeding of field beans and lupines (latest Mai 15). Inter-row hoeing up to three times during the vegetative growth period.

### **III.No-tillage / roller crimping system**

Seeding of rye in early autumn after stubble cultivation. Roller crimping of rye at the beginning of anthesis with simultaneous direct seeding of field beans and lupines. No further direct weed control measures during the cropping season.

### **IV.No-tillage / relay intercropping system**

Seeding of rye in early autumn after stubble cultivation. Seeding of field beans and lupines in spring into the standing rye (latest Mai 15). Roller crimping of rye at beginning of rye anthesis. No further direct weed control measures during the cropping season.

In early autumn 2020, winter rye cultivar Herakles was sown with 400 seeds m<sup>-2</sup> and at a row distance of 12.5 cm in plots designated for strategies II – IV. Sowing of grain legumes will take place in spring 2021. The cropping systems were arranged in a randomised block design with four replicates. Plots have a width of 9 m and a length of 25 m. The experiments will be repeated over two years. A summer annual cereal crop will be sown in 2022 after experiment 1&2 for investigating changes in weed community as well as soil nitrogen dynamics.

### **Cropping system assessments planned for 2021**

Soil sensors for monitoring of soil temperature, soil moisture and electronic conductivity have been installed at both experimental sites and in all cropping systems. Biomass and C:N ratio of the cover crop will be measured in spring after termination. Soil total N and mineral N content will be determined after termination of winter rye, after the legume harvest, before seeding of the subsequent spring cereal and at harvest of the cereal to assess N availability to crops and weeds as well as N effect of the legumes and different management strategies on the subsequent crop. Nitrogen fixation based on the natural abundance of <sup>15</sup>N and N harvest index of the legumes will be measured to allow N budget calculations of the legumes under different management strategies. Weed and crop density, phenological development and biomass accumulation will be assessed throughout the experimental phase from early spring until crop harvest. Crops will be harvested for yield, yield parameter and quality determination. Economic comparison of the tested strategies will be done through full cost calculation.

Table 1 Cropping systems realised in the two field experiments

| Time / treatment        | (I)<br>Standard farmers practice | (II)<br>Reduced tillage            | (III)<br>No-tillage / roller<br>crimping                         | (IV)<br>No-tillage / relay<br>intercropping             |
|-------------------------|----------------------------------|------------------------------------|------------------------------------------------------------------|---------------------------------------------------------|
| Early autumn 2020       | Ploughing                        | Rye seeding                        | Rye seeding                                                      | Rye seeding                                             |
| Early spring<br>(April) | Seedbed preparation              | Mulching of rye                    | -                                                                | -                                                       |
| Spring (latest Mai 15)  | Grain legume seeding             | Direct seeding of grain<br>legumes | -                                                                | Direct seeding of grain<br>legumes into standing<br>rye |
| Rye flowering           | -                                | -                                  | Roller-crimping of rye<br>and direct seeding of<br>grain legumes | Roller-crimping of rye                                  |
| During the season       | Row hoeing up to 3x              | Row hoeing up to 3x                | -                                                                | -                                                       |