Leader: Christian Frasconi (Centro di Ricerche Agro-Ambientali "Enrico Avanzi" (CIRAA))

Partner: DONDI SpA (DONDI), Scuola Superiore Sant’Anna (SSSA)

Other stakeholders:

IWMPRAISE supports the implementation of innovative and effective Integrated Weed Management (IWM) practices in European agriculture to improve agronomic, economic and environmental sustainability.

✔ WP 2 The overall objectives are to create new knowledge and tools and revisit existing knowledge and tools for the implementation of IWM strategies and weed monitoring to further reduce herbicide dependency.

✔ Task 2.5 Cover crops are of special interest for IWM programs. The main challenges to improve large-scale uptake of cover crops/mulches in conventional cropping systems are related to 1) development of adapted varieties, 2) decrease the reliance on glyphosate for cover/mulch termination and 3) quantification of trade-offs.

✔ Sub Task 2.5.2 In this task, partners study possibilities for adaptation of existing farm machinery to optimise sowing or under-sowing and non-chemical termination of cover crops, as well as the agronomical management of their mulches and green manures and the sowing or planting of the subsequent crop in the context of a cropping system. Planting and direct drilling are particularly relevant in no-till systems where the mulch-layer may hinder this operation. Efficacy of the improved tools and machinery will be evaluated by measuring the effects on weeds and crop yield, but also by comparing the balance between costs and savings of these operations compared to the standard methods applied for the tested crops/cropping systems. Effects on soil organic matter and soil fertility will also be evaluated.

In particular, this subtask aims to provide farmers new solutions for the mechanical termination of cover crops, also in light of the uncertainty on the use of glyphosate as direct chemical tool for cover crop termination in the future.

The focus will be on testing tools which have been not specifically designed for this operation but that farmers can use for other purposes, i.e. management of crop residues after harvest, minimum tillage, etc. This is because farmers often complain about the costs of buying specific equipment for cover crop management. Special attention will be drawn to non-PTO powered machines in order to reduce also the costs for field operation.
Summary description of cropping system

Winter cover crops (rye, vetch, rye-vetch mixture) grown in between winter cereals and spring crops with the aim to keep the soil covered during winter time and to suppress weeds in the following cash crop managed under no-till through the maintenance on soil surface of the dead mulch of cover crop biomass

Partners: CIRAA, DONDI, SSSA

Adaptation of “cut-roller” as roller-crimper

Objective:
Test the effectiveness of the “cut-roller” (produced by DONDI S.p.A. and marketed as a tool for crop residue management) when used as roller-crimper for the mechanical termination of some of the most common winter cover crops for arable cropping systems. Besides fine-tuning working parameters and blade typology, special focus will be on weed suppression and soil compaction.

Hypothesis:
H1: Winter cover crops terminated in early spring and retained on soil surface as dead mulch can prevent weed infestation in winter time and also in the following spring crop (e.g. maize)
H2: Cut-roller, designed as non-PTO powered and high-speed machine for crop residue management, can be cost-effectively operated for the mechanical termination of several types of cover crops (e.g. legumes, grasses or mixture of the both) by simple adjustments of working parameters and blade configuration
H3: A mixture of grass (winter rye) and legume (hairy vetch) cover crops can suppress weeds better than pure stands of the same species, by combining the functional traits of the two species.
H4: There will be differences in N status of the maize following the different cover crop treatments

Experimental design
The experimental field is located at the Centre for Agro-Environmental Research of the University of Pisa (CIRAA), in San Piero a Grado (Pisa, Tuscany). Here 3 different cover crops (rye, hairy vetch, rye-hairy vetch mixture) have been drilled in October 2017 on 3 different fields sizing 30x260 m each. The sowing rates were 180, 120 and 90:60 kg ha⁻¹ respectively for rye in the pure stand, vetch in the pure stand and rye and vetch in the mixture. The inter row space was 15 cm. Each field will be split in 6 strips 3m wide and 260 m long. In each strip, a combination of blade typology (sharpened vs non-sharpened) and working speed (5, 10, 15 km hr⁻¹) will be tested.
Performance parameters assessed per each combination of cover crop x blade typology x working speed

- Biomass and soil cover produced by cover crops at different stages
- Weed abundance and composition in cover crops
- Number of crimps per stem
- Killing rate of cover crops
- Mulch thickness
- Mulch persistence
- Weed suppression in the maize crop
- Effects on maize growth and yield
- Soil compaction
- Energy consumption and economic issues

Fig. 1 Experimental field at CIRAA (43°39’30.64”N, 10°18’08.85” E) (Immagini ©2017 Google)

Fig. 2 DONDI Cut-roller, original version