
A motorised hoe is used to sow the grass under the maize. Combined with GPS, this can be done from an early crop stage. (Gert Van de Ven)

# Undersowing grass in maize as a cover crop (Belgium)

Onderzaai/gelijktijdige zaai van gras in mais

## DESCRIPTION

**Undersowing of grass into maize helps prevent leaching of nitrogen in sandy soils, and keeps the soil surface covered year-round. However, the time of sowing, choice of grass variety and seeding rate are all crucial to its success.**

Hooibeekhoeve (a farm education and research facility) started to experiment with undersowing in 2015. The aim was to have a well-developed catch crop/cover crop in the field during autumn and winter that could prevent nitrogen leaching. Initially, the grass was sown together with the maize, or when the maize reached the 8-10 leaf stage. But both techniques have their weaknesses and a better alternative proved to be undersowing the grass at the 4-6 leaf stage. This has been the practice since 2019, and gives the best of both worlds.

Considerations regarding time of undersowing include the following:
•Sowing at the 8-10 leaf stage is often confronted with adverse the field/weather conditions which are almost never optimal.
•Sowing together increases competition between grass and maize, and therefore lower yields of maize: however, the earlier you sow the grass, the better the effect on prevention of nitrogen leaching.
•Timing of sowing has an influence on the choice of grass and the amount of seed required:
- Early stage (simultaneous sowing and at the 1-2 leaf stage): tall fescue (Festuca arundinacea) develops and grows slowly and therefore leads to less competition with the maize: 15 kg/ha of seed is required.
- When sowing at the 4-6 leaf stage, a combination of perennial ryegrass (Lolium perenne) and cocksfoot (Dactylis glomerata) is the preferred grass mixture: again, sown at 15 kg/ha. The effect on maize yield is even positive when sowing at this stage - possibly due to the mechanical weed control, which stimulates mineralisation.
- Sowing at the 8-10 leaf stage: Italian ryegrass (Lolium multiflorum) is used at 20 kg/ha. This has the vigour to grow under the maize when maize is already tall enough tolerate this dominating grass.

The grass must be sown between, and not within the maize rows. A motorised hoe with seed box is used. This machine weeds between the rows of the maize and at the same time sows the grass. RTK-GPS tracking is needed to do this correctly.

Weed control is not an easy job in this system, and the earlier you sow the grass, the more difficult is the problem. Because there are two different crops in the field at the same time, you have to keep both in consideration when selecting plant protection products. Therefore, it is not recommended to use this technique in fields with high weed pressure, especially not where there are grassy weeds.

After the harvest, the cover crop – grass – has already formed a dense carpet. This gives protection to the soil during harvest and no further soil tillage is needed, or desirable in the autumn. The grass can then be ploughed in or killed with a herbicide in the early-spring ready for a new crop.

This undersowing technique demonstrates a decrease of N residue compared to 'no catch/ cover crop' and 'sowing of catch/ cover crop after harvest' every year and at every location. This is a positive finding. However, farmers find it hard to implement, due to the possible negative effect on the yield of the maize and difficulties with weed control.

## LOCATION

**Location:** Antwerpen, Belgium

**No. of Technology sites analysed:** 2-10 sites

**Geo-reference of selected sites**
- 5.01793, 50.90468
- 4.98016, 50.99257
- 5.00144, 51.38816

**Spread of the Technology:** evenly spread over an area (approx. 0.1-1 km2)

**In a permanently protected area?:** No

**Date of implementation:** 2015

**Type of introduction**
- ☐ through land users' innovation
- ☐ as part of a traditional system (> 50 years)
- ☑ during experiments/ research
- ☐ through projects/ external interventions

June: view of the undersown grass planted at the 4th leaf stage of the maize. (Gert Van de Ven)

June: view of the undersown grass planted together with maize. (Gert Van de Ven)

## CLASSIFICATION OF THE TECHNOLOGY

### Main purpose

- [ ] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [ ] reduce risk of disasters
- [ ] adapt to climate change/ extremes and its impacts
- [ ] mitigate climate change and its impacts
- [ ] create beneficial economic impact
- [ ] create beneficial social impact

### Land use

Land use mixed within the same land unit: No

**Cropland**

- Annual cropping

Number of growing seasons per year: 1
Is intercropping practiced? Yes
Is crop rotation practiced? No

### Water supply

- [x] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation

### Purpose related to land degradation

- [x] prevent land degradation
- [ ] reduce land degradation
- [ ] restore/ rehabilitate severely degraded land
- [ ] adapt to land degradation
- [ ] not applicable

### Degradation addressed

**chemical soil deterioration** - Cn: fertility decline and reduced organic matter content (not caused by erosion)

### SLM group

- improved ground/ vegetation cover
- integrated soil fertility management

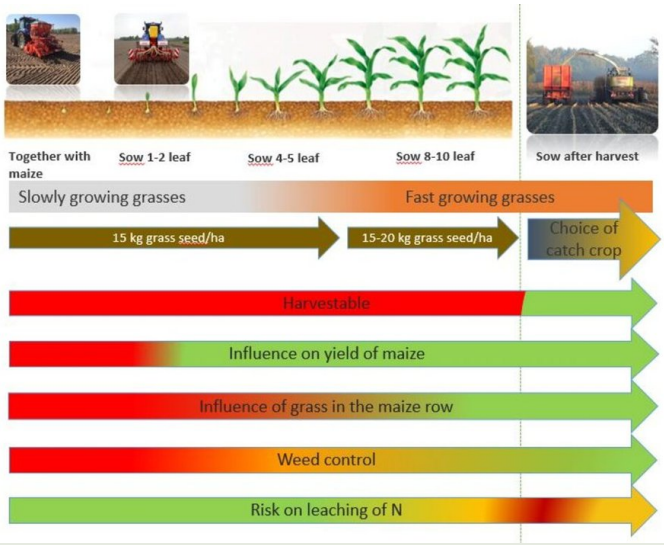
### SLM measures

**agronomic measures** - A1: Vegetation/ soil cover

## TECHNICAL DRAWING

### Technical specifications

The choice of the grass and the amount of seed is different at the various possible several stages of undersowing:
-Early stage (together and maize at the 1-2 leaf stage): tall fescue (Festuca arundinacea) was used. This grass develops and grows slowly and therefor only little competition with the maize: seeding rate = 15 kg/ha.
-4-6 leaf: a combination of English ryegrass (Lolium perenne) and cock's foot (Dactylis glomerata) was used at 15 kg/ha.
-8-10 leaf: Italian ryegrass (Lolium multiflorum): 20 kg/ha is used. This type of grass still has the vigour to grow under the maize and the maize is already tall enough to deal with this dominating grass.
Dimensions: 75 cm between each row of maize. In between the maize are 5 rows of grass. Between the maize row and the grass is a bare soil of 12.5 cm at each side of the maize row.
In case of 4-6 or 8-10 leaf, the sowing can be combined with mechanical weed control.

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## ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

### Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **ha**)
- Currency used for cost calculation: **Euro**
- Exchange rate (to USD): 1 USD = 0.91 Euro
- Average wage cost of hired labour per day: n.a

### Most important factors affecting the costs

The way of sowing, the seed and the use of plant protection products

### Establishment activities

n.a.

### Maintenance activities

1. Mechanical weed control, combined with seeding of the cover crop (Timing/ frequency: Dependent on the time of undersowing: together with maize, in 1-2 leaf stage, in 4-6 leaf stage or in 10-12 leaf stage (see above))

### Maintenance inputs and costs (per ha)

| Specify input | Unit | Quantity | Costs per Unit (Euro) | Total costs per input (Euro) | % of costs borne by land users |
|---|---|---|---|---|---|
| **Labour** | | | | | |
| Chemical weed control (product & labour) | ha | 1.0 | 70.0 | 70.0 | 100.0 |
| **Equipment** | | | | | |
| Hoeing combined with sowing cover crop | euro/ha | 1.0 | 70.0 | 70.0 | 100.0 |
| **Plant material** | | | | | |
| Seed cover crop | euro/kg | 15.0 | 25.0 | 375.0 | 100.0 |
| **Total costs for maintenance of the Technology** | | | | **515.0** | |
| *Total costs for maintenance of the Technology in USD* | | | | *565.93* | |

## NATURAL ENVIRONMENT

### Average annual rainfall

- [ ] < 250 mm
- [ ] 251-500 mm
- [x] 501-750 mm
- [ ] 751-1,000 mm
- [ ] 1,001-1,500 mm
- [ ] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

### Agro-climatic zone

- [ ] humid
- [x] sub-humid
- [ ] semi-arid
- [ ] arid

### Specifications on climate

n.a.

### Slope

- [x] flat (0-2%)
- [ ] gentle (3-5%)
- [ ] moderate (6-10%)
- [ ] rolling (11-15%)
- [ ] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

### Landforms

- [x] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [ ] footslopes
- [ ] valley floors

### Altitude

- [x] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [ ] 1,001-1,500 m a.s.l.
- [ ] 1,501-2,000 m a.s.l.
- [ ] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

### Technology is applied in

- [ ] convex situations
- [ ] concave situations
- [x] not relevant

**Soil depth**
- [ ] very shallow (0-20 cm)
- [ ] shallow (21-50 cm)
- [ ] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [x] very deep (> 120 cm)

**Soil texture (topsoil)**
- [x] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

**Soil texture (> 20 cm below surface)**
- [x] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

**Topsoil organic matter content**
- [ ] high (>3%)
- [x] medium (1-3%)
- [ ] low (<1%)

**Groundwater table**
- [ ] on surface
- [x] < 5 m
- [ ] 5-50 m
- [ ] > 50 m

**Availability of surface water**
- [ ] excess
- [x] good
- [ ] medium
- [ ] poor/ none

**Water quality (untreated)**
- [ ] good drinking water
- [x] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

*Water quality refers to:*

**Is salinity a problem?**
- [ ] Yes
- [x] No

**Occurrence of flooding**
- [ ] Yes
- [x] No

**Species diversity**
- [ ] high
- [x] medium
- [ ] low

**Habitat diversity**
- [x] high
- [ ] medium
- [ ] low

## CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

**Market orientation**
- [x] subsistence (self-supply)
- [ ] mixed (subsistence/ commercial)
- [ ] commercial/ market

**Off-farm income**
- [ ] less than 10% of all income
- [ ] 10-50% of all income
- [ ] > 50% of all income

**Relative level of wealth**
- [ ] very poor
- [ ] poor
- [x] average
- [ ] rich
- [ ] very rich

**Level of mechanization**
- [ ] manual work
- [ ] animal traction
- [x] mechanized/ motorized

**Sedentary or nomadic**
- [x] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

**Individuals or groups**
- [ ] individual/ household
- [ ] groups/ community
- [ ] cooperative
- [x] employee (company, government)

**Gender**
- [ ] women
- [x] men

**Age**
- [ ] children
- [ ] youth
- [x] middle-aged
- [ ] elderly

**Area used per household**
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [ ] 5-15 ha
- [ ] 15-50 ha
- [x] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

**Scale**
- [ ] small-scale
- [x] medium-scale
- [ ] large-scale

**Land ownership**
- [x] state
- [ ] company
- [ ] communal/ village
- [ ] group
- [ ] individual, not titled
- [ ] individual, titled

**Land use rights**
- [ ] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [x] individual

**Water use rights**
- [ ] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [x] individual

**Access to services and infrastructure**

| | |
|---|---|
| health | poor ✓ good |
| education | poor ✓ good |
| technical assistance | poor ✓ good |
| employment (e.g. off-farm) | poor ✓ good |
| markets | poor ✓ good |
| energy | poor ✓ good |
| roads and transport | poor ✓ good |
| drinking water and sanitation | poor ✓ good |
| financial services | poor ✓ good |

## IMPACTS

**Socio-economic impacts**

| | | |
|---|---|---|
| fodder production | decreased ✓ increased | Depends on the time of undersowing (+ in 4-leafstage) |
| fodder quality | decreased ✓ increased | |
| product diversity | decreased ✓ increased | |
| land management | hindered ✓ simplified | More difficult in use of plant protection products (2 crops at same time in field) |
| workload | increased ✓ decreased | |

**Socio-cultural impacts**

**Ecological impacts**

water quality — decreased / increased — Less leaching of N and other nutrients

soil cover — reduced / improved

nutrient cycling/ recharge — decreased / increased

vegetation cover — decreased / increased

biomass/ above ground C — decreased / increased — Since the cover crop can develop in better conditions, the generated biomass of the cover crop is higher compared to sowing after harvest of maize

plant diversity — decreased / increased

flood impacts — increased / decreased — Due to higher C-content, the soils sponginess is better. Therefore water infiltration is better and it is longer available for the crop.

drought impacts — increased / decreased — Due to higher C-content, the soils sponginess is better. Therefor the water infiltration is better and it is longer available for the crop

**Off-site impacts**

groundwater/ river pollution — increased / reduced — Less leaching of N and other elements

buffering/ filtering capacity (by soil, vegetation, wetlands) — reduced / improved — Less leaching of N and other nutrients

## COST-BENEFIT ANALYSIS

**Benefits compared with establishment costs**

**Benefits compared with maintenance costs**

Short-term returns — very negative / very positive

Long-term returns — very negative / very positive

Recurrent costs (has to be done every year).

## CLIMATE CHANGE

**Gradual climate change**

annual temperature increase — not well at all / very well

## ADOPTION AND ADAPTATION

**Percentage of land users in the area who have adopted the Technology**

- [ ] single cases/ experimental
- [x] 1-10%
- [ ] 11-50%
- [ ] > 50%

**Of all those who have adopted the Technology, how many have done so without receiving material incentives?**

- [ ] 0-10%
- [ ] 11-50%
- [ ] 51-90%
- [x] 91-100%

**Has the Technology been modified recently to adapt to changing conditions?**

- [ ] Yes
- [x] No

**To which changing conditions?**

- [ ] climatic change/ extremes
- [ ] changing markets
- [ ] labour availability (e.g. due to migration)

## CONCLUSIONS AND LESSONS LEARNT

**Strengths: land user's view**

- More resilient to climate change
- More resilient to plagues and diseases
- Increase of the percentage C in the soil
- Increased yield and income

**Strengths: compiler's or other key resource person's view**

- Increase of the percentage C in the soil
- Food security

**Weaknesses/ disadvantages/ risks: land user's viewhow to overcome**

- Feed value of the 'new' crops Analysis of the crops in standardized tables
- More cultivation exercise necessary Demonstrations / network sessions / literature
- investment costs (other machinery) NA

**Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome**

## REFERENCES

**Compiler**
Alan Radbourne

**Editors**

**Reviewer**
William Critchley
Rima Mekdaschi Studer

**Date of documentation**: July 25, 2023

**Last update**: Aug. 3, 2023

**Resource persons**
Gert Van de Ven - SLM specialist

**Full description in the WOCAT database**
https://qcat.wocat.net/en/wocat/technologies/view/technologies_6876/

**Linked SLM data**
n.a.

**Documentation was faciliated by**

Institution
- n.a.

Project
- European Interreg project FABulous Farmers

**Links to relevant information which is available online**
- Article on use of cover crops in/after maize: 1)http://www.lcvvzw.be/wp-content/uploads/2020/03/A2020_3-Vanggewassen-in-ma%C3%AFs-is-onderzaai-een-optie.pdf
- Article on use of cover crops in/after maize (2022): 2)https://www.lcvvzw.be/wp-content/uploads/2022/07/B2022_1-Brochure-Functionele-leidraad-groenbedekkers-bij-mais.pdf
- Article on this technique in grain maize: 3)https://www.lcvvzw.be/wp-content/uploads/2022/04/A2022_13-Groenbedekkers-bij-korrelmais.pdf
- Article on undersowing after grassland tearing: 4)https://www.lcvvzw.be/wp-content/uploads/2022/04/A2022_12-gelijk-en-onderzaai-bij-mais-na-gescheurd-grasland.pdf