Maize seeding with Strip till (Baptiste Drouet)

Rotation 2+2 of cereals in a no-tillage system (France)

Rotation 2+2

DESCRIPTION

A trial crop rotation system of '2+2', where a succession of two spring crops (maize) followed by two winter crops (wheat) aims to diversify cropping through rotation (sequences and intervals) while limiting weed pressure under a no-tillage system.

The region Pays de Loire in Western France has a temperate climate with warm summers and mild winters. The region has many rural areas, dedicated mostly to agriculture with large economic centres and urban conurbations (e.g. the Nantes area). The rotation 2+2 technology is being applied on a dairy farm in Pays de Loire (La Pouëze), implementing Soil Conservation Agriculture. Fields have not been ploughed for 9 years and direct seeding of cover crops (primarily clover that is cut as green mulch, although may be cut for silage) and winter crops has been used for 4 years.

The rotation Maize/Wheat/Maize/Wheat was changed to a Maize/Maize/Wheat/Wheat rotation (2+2). In the traditional rotation Maize/Wheat/Maize/Wheat, there were 2 sequences (wheat followed by maize and maize followed by wheat) and 1 interval cover cropping (every two years). In the new 2+2 rotation Maize/Maize/Wheat/Wheat, the crops in the rotation are not changed but the number of sequences is doubled (4 sequences: wheat/wheat; maize/maize; wheat/maize; maize/wheat) and there are 2 cover cropping intervals (years 0 & 3) instead of one. This 4 year cycle can then be repeated. This modification allows more diversity in the rotation including variation in timing of the cover crops (some long gaps between wheat and maize, some short between wheat and wheat) and, in our no tillage system, helps to limit weed pressure on both crops.

In a no-tillage system, keeping weed seeds on the surface exposes them to climatic hazards and predators. Thus in this new system regime, during the two years of maize, the wheat weed seeds are neither in optimal conditions for dormancy, nor in optimal conditions for germination, which decreases the stock of seeds of wheat weeds. Thus in our no tillage system, the weed pressure (including resistant rye grass) has been significantly reduced.

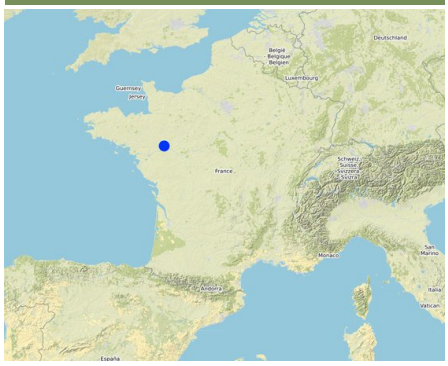
The 2+2 rotation improved production, reduced/prevented land degradation and reduced weed pressure.

Initial investment costs are limited to purchasing the management equipment.

Benefits of the 2+2 rotation include:
Increased: crop production, farm income, water drainage, nutrient cycling, soil organic matter carbon, vegetation cover, beneficial species, habitat diversity
Reduced: risk of production failure, workload/time, fuel surface water runoff, evaporation, soil crusting, soil compaction, impact on soil life, weed emergence

The compilation of this SLM technology is a part of the European Interreg project FABulous Farmers which aims to reduce the reliance on external inputs by encouraging the use of methods and interventions that increase the farm's Functional AgroBiodiversity (FAB). Visit www.fabulousfarmers.eu and www.nweurope.eu/Fabulous-Farmers for more information.

LOCATION



Location: La Pouëze, Pays de la Loire, France

No. of Technology sites analysed: single site

Geo-reference of selected sites
- -0.80395, 47.56577
- -0.80395, 47.56577

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

In a permanently protected area?: No

Date of implementation: less than 10 years ago (recently)

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

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Cover crop in 2+2 rotation (Baptiste Drouet)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- ✓ improve production
- ✓ 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
- ✓ reduced weed pressure

Purpose related to land degradation

- prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Land use

Land use mixed within the same land unit: No

Cropland

- Annual cropping: cereals - maize, cereals - wheat (winter)

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

Water supply

- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion

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

physical soil deterioration - Pc: compaction

biological degradation - Bl: loss of soil life, Bp: increase of pests/ diseases, loss of predators

SLM group

- rotational systems (crop rotation, fallows, shifting cultivation)
- improved ground/ vegetation cover
- minimal soil disturbance

SLM measures

agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility, A3: Soil surface treatment

TECHNICAL DRAWING

Technical specifications

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **1 ha**; conversion factor to one hectare: **1 ha = 1 ha = 2.47 acres**)
- Currency used for cost calculation: **€**
- Exchange rate (to USD): 1 USD = 0.9 €
- Average wage cost of hired labour per day: Not known

Most important factors affecting the costs

There is no change in cost between the initial rotation (wheat-maize-wheat-maize) and the rotation 2+2.

Establishment activities

n.a.

Maintenance activities

1. Seed drill + roller for wheat and cover crop (Timing/ frequency: Each wheat cropping and cover crop season)
2. Strip-Till before maize seeding (Timing/ frequency: Each maize cropping season)
3. Fungicide (Timing/ frequency: During the production cycle (month 2-3 for wheat and 1-2 for maize))
4. Herbicide (Timing/ frequency: Before, during and after crop production)
5. Fertizlier input (Timing/ frequency: During wheat and maize crop)
6. Manure input (Timing/ frequency: Before maize crop)
7. Wheat harvest (Timing/ frequency: June/July)
8. Maize harvest (Timing/ frequency: October/November)

Maintenance inputs and costs (per 1 ha)

Specify input	Unit	Quantity	Costs per Unit (€)	Total costs per input (€)	% of costs borne by land users
Labour					
Workforce	person days per ha	2.0	200.0	400.0	100.0
Equipment					
Seeder + roll for wheat and cover crops	1ha/yr	1.0	35.0	35.0	100.0
Strip till for maize	1ha/yr	1.0	25.0	25.0	100.0
Pneumatic drill for maize	1ha/yr	1.0	18.0	18.0	100.0
Plant material					
Wheat seeds (4 year cycle)	1ha/yr	1.0	15.0	15.0	100.0
Maize seeds (4 year cycle)	1ha/yr	1.0	30.0	30.0	100.0
Cover crop seeds (4 year cycle)	1ha/yr	1.0	5.0	5.0	100.0
Fertilizers and biocides					
Fungicide (1 maize + 1 wheat - 4 year cycle)	1ha/yr	1.0	12.0	12.0	100.0
Herbicide (1 maize + 1 wheat - 4 year cycle)	1ha/yr	1.0	10.0	10.0	100.0
Fertiliser (1 maize + 1 wheat - 4 year cycle)	1ha/yr	1.0	70.0	70.0	100.0
Manure (1 maize - 4 year cycle)	1ha/yr	1.0	5.0	5.0	100.0
Total costs for maintenance of the Technology				**625.0**	
Total costs for maintenance of the Technology in USD				*694.44*	

NATURAL ENVIRONMENT

Average annual rainfall
- ☐ < 250 mm
- ☐ 251-500 mm
- ☑ 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
- ☑ sub-humid
- ☐ semi-arid
- ☐ arid

Specifications on climate
Average annual rainfall in mm: 650.0
Mild and rainy winter, hot dry summer (lately)
Name of the meteorological station: Beaucouzé meteorological station

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

Landforms
- ☑ plateau/plains
- ☐ ridges
- ☐ mountain slopes
- ☐ hill slopes
- ☐ footslopes
- ☐ valley floors

Altitude
- ☑ 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
- ☑ not relevant

Soil depth
- ☐ very shallow (0-20 cm)
- ☐ shallow (21-50 cm)
- ☑ moderately deep (51-80 cm)
- ☐ deep (81-120 cm)
- ☐ very deep (> 120 cm)

Soil texture (topsoil)
- ☐ coarse/ light (sandy)
- ☑ medium (loamy, silty)
- ☐ fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- ☐ coarse/ light (sandy)
- ☑ medium (loamy, silty)
- ☐ fine/ heavy (clay)

Topsoil organic matter content
- ☐ high (>3%)
- ☑ medium (1-3%)
- ☐ low (<1%)

Groundwater table
- ☐ on surface
- ☐ < 5 m
- ☐ 5-50 m
- ☐ > 50 m

Availability of surface water
- ☑ excess
- ☐ good
- ☐ medium
- ☐ poor/ none

Water quality (untreated)
- ☐ good drinking water
- ☐ poor drinking water (treatment required)
- ☐ for agricultural use only (irrigation)
- ☐ unusable

Water quality refers to:

Is salinity a problem?
- ☐ Yes
- ☑ No

Occurrence of flooding
- ☐ Yes
- ☑ No

Species diversity
- ☐ high
- ☑ medium

Habitat diversity
- ☐ high
- ☑ medium

low

low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- 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
- average
- ✓ rich
- very rich

Level of mechanization
- manual work
- animal traction
- ✓ mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- women
- ✓ men

Age
- children
- youth
- ✓ 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
- ✓ 50-100 ha
- 100-500 ha
- 500-1,000 ha
- 1,000-10,000 ha
- > 10,000 ha

Scale
- small-scale
- ✓ medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- individual, not titled
- ✓ individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- ✓ leased
- individual

Water use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ 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

Crop production	decreased	✓ increased
crop quality	decreased	✓ increased
land management	hindered	✓ simplified
expenses on agricultural inputs	increased	✓ decreased
farm income	decreased	✓ increased

Evidence of improved yield and quality in crop with new rotation system due to reduced weed stress

Evidence of improved yield and quality in crop with new rotation system due to reduced weed stress

Significant reduction in the frequency of tool changeover.

Reduction in weed control required

Increased crop production and yield with less weed control management.

Socio-cultural impacts

Ecological impacts

surface runoff	increased	✓ decreased
excess water drainage	reduced	✓ improved
evaporation	increased	✓ decreased
soil moisture	decreased	✓ increased
soil loss	increased	✓ decreased
soil crusting/ sealing	increased	✓ reduced

No till system and continuous crop cover reduces surface run off.

No till system and continuous crop cover for improved rooting system supports better soil infiltration

Continuous crop cover retains moisture better

Continuous crop cover retains moisture better

No till system and continuous crop cover reduces surface run off.

Continuous crop cover and no till system stops soil

soil compaction	increased	reduced	from crusting Continuous crop cover and no till system reduces soil compaction
soil organic matter/ below ground C	decreased	increased	No till system and continuous crop cover for improved rooting systems and increased soil organic matter
vegetation cover	decreased	increased	Continuous crop cover and no till system improves vegetation cover
biomass/ above ground C	decreased	increased	Continuous crop cover and no till system improves vegetation cover

Off-site impacts

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative	very positive
Long-term returns	very negative	very positive

Benefits compared with maintenance costs

Short-term returns	very negative	very positive
Long-term returns	very negative	very positive

CLIMATE CHANGE

Gradual climate change

annual temperature increase	not well at all	very well
annual rainfall decrease	not well at all	very well

ADOPTION AND ADAPTATION

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

- ✓ single cases/ experimental
- 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%
- ✓ 91-100%

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

- Yes
- ✓ 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

- Increased weed control (resistant and non-resistant weeds)

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

- Increased weed control (resistant and non-resistant weeds)
- Only a subtle change to established cropping system but produces many benefits.
- Supports the use of no till system

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Current system only with wheat and cover crop rotation - need for an improved rotation system to improve diversification → Introduce new crop in the rotation as alfalfa or protein crops

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Crop rotation of a wider range of crops would be beneficial. → Introduce an additional crop into the rotation

REFERENCES

Compiler
Alan Radbourne

Reviewer
William Critchley
Rima Mekdaschi Studer

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Resource persons
Marie-Line Faure - co-compiler
Denis Colineau - land user
Baptiste Drouet - co-compiler

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_5678/

Linked SLM data
n.a.

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Project
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Key references

- Agroécologie : Guide de la nouvelle agriculture, Year : 2016, author : Dominique SOLTNER ; collection : Sciences et techniques agricoles: www.soltner.fr