Stripes of 45cm width are covered with grass. Maize will grow in between. (Beat Wyss (Oberramsern, Switzerland))

Maize strip tillage (Switzerland)

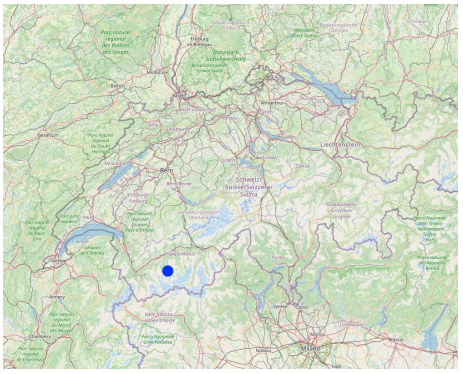
Streifenfrässaat (German)

DESCRIPTION

A cropping system for maize which reduces the reworking of the soil to the stripes, in which the seeds are planted.

Maize strip tillage is a mixture between no tillage and conventional agriculture. The reworking of the soil greatly reduced. Instead of ploughing and harrowing a special rotary tiller including a grubber is being used. The working depht of the rotary tiller is 10-15cm, the grubber reaches to 20-25cm depht. The machine reworks the soil on stripes of 30cm width. This is where the seeds are planted. In between there are stripes of 45cm width, which are left untouched.
In Switzerland farms usually are small. A major part of the arable land is used to produce fodder. (For example maize, grain, fodder beet)
Usually maize strip tillage is being used to avoid soil erosion or for economical reasons. Compared to conventional agriculture several working steps can be saved. The reworking of the soil, manuring, seeding and applying of herbicides can be done at once.
Since the machine is expensive and a strong tractor is needed, farmers usually don't buy it on their own. In most cases a contractor will be tasked to do this work. Of course this is not for free. But since several working step are saved, there is more time left to do other work (6.5h/ha).
The reduced reworking of the soil holds remarkable ecological advantages. Occurrence of erosion is very seldom, because the stripes covered by plant residual significantly reduce the speed of surface water. To increase this effect, the stripes are laid along the height countours, if possible. Since the soil structure is not disturbed in the stripes between the seeds, the risk of compaction is reduced there. For that reason maize strip tillage is often used before potatoes in a crop rotation. This is a crop that is very sensitive to soil compaction.
The technique brings along an ecological disadvantage, too. Before sowings the precedent crop needs to be treated with a total herbicide (glyphosat) to avoid unwanted competition. Only in wet areas, where there is enough water available it is possible to not use glyphosat. Also in long time studies, residues of glyphosat could not be detected in the soil. But if ever weeds will develop a resitance against it, that would certainly be a major problem.
The enhanced risk of crop loss is another disadvantage of the technology. In conventional agriculture the soil is left to dry for a few days after ploughing. maize strip tillage does not hold that possibility. If the conditions are wet, risk of crop failure can be a problem. However, if conditions are good (dry enough), both quality and crop yield are similar to conventional agriculture.

LOCATION



Location: Oberramsern, Kanton Solothurn, Switzerland

No. of Technology sites analysed:

Geo-reference of selected sites
- 7.4697, 46.1136

Spread of the Technology:

In a permanently protected area?:

Date of implementation: 10-50 years ago

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

The machine includes a rotary tiller, manure distributor and grubber. The spraying device is not shown. (Althaus AG (Ersigen, Switzerland))

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

Cropland

- Annual cropping: cereals - maize
- Perennial (non-woody) cropping
- hay

Number of growing seasons per year: 1

Water supply

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

Purpose related to land degradation

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

Degradation addressed

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

physical soil deterioration - Pc: compaction

biological degradation - Bc: reduction of vegetation cover, Bl: loss of soil life

SLM group

- cross-slope measure

SLM measures

agronomic measures - A1: Vegetation/ soil cover

TECHNICAL DRAWING

Technical specifications

The rotary tillers working depth is 10-15cm. The grubber reaches to 20-25cm depth. This is to obtain a loose soil structure. Manure is brought into the soil while tilling.
Immediately after that the seeds are brought into the soil. Finally a selective herbicide can be sprayed. Stripes of 45cm width are not reworked and help to avoid soil erosion and compaction.

Technical knowledge required for field staff / advisors: moderate

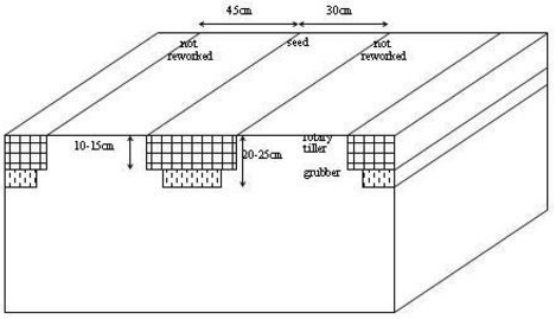
Technical knowledge required for land users: moderate

Main technical functions: improvement of ground cover, improvement of topsoil structure (compaction)

Secondary technical functions: control of raindrop splash, improvement of surface structure (crusting, sealing), increase of infiltration, increase / maintain water stored in soil

Contour planting / strip cropping
Material/ species: Maize

Minimum tillage
Remarks: The stripes are laid along the contours



Author: Roman Wyler, Bern, Switzerland

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated:
- Currency used for cost calculation: **Swiss Franc**
- Exchange rate (to USD): 1 USD = 1.13 Swiss Franc
- Average wage cost of hired labour per day: n.a

Most important factors affecting the costs

The machine is very expensive. In addition a strong tractor is needed (ca. 150hp). Thats why most farmer task a contractor with the seeding. In this case no initial investment needs to be done. The machine in this case study is used for about 60ha per year. A bigger workload would be possible.

Establishment activities

1. Buy a "Streifenfräse" (Timing/ frequency: None)
2. Buy a tractor (Timing/ frequency: None)

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit (Swiss Franc)	Total costs per input (Swiss Franc)	% of costs borne by land users
Equipment					
Streifenfräse	Machine	1.0	42000.0	42000.0	100.0
Tractor	Machine	1.0	115000.0	115000.0	100.0
Total costs for establishment of the Technology				**157'000.0**	
Total costs for establishment of the Technology in USD				*138'938.05*	

Maintenance activities

1. application of glyphosat (total herbicide) (Timing/ frequency: 1 per growing period)
2. tillage of stripes including seeding, manuring, spraying of herbicide (Timing/ frequency: 1 per growing period)

Maintenance inputs and costs

Specify input	Unit	Quantity	Costs per Unit (Swiss Franc)	Total costs per input (Swiss Franc)	% of costs borne by land users
Labour					
tillage of stripes, seeding,	ha	1.0	393.0	393.0	100.0
appliance of total herbicide	ha	1.0	88.0	88.0	100.0
Fertilizers and biocides					
Biocides	ha	1.0	53.0	53.0	100.0
Total costs for maintenance of the Technology				**534.0**	
Total costs for maintenance of the Technology in USD				*472.57*	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [x] 751-1,000 mm
- [x] 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
Thermal climate class: temperate

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

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

Altitude
- [ ] 0-100 m a.s.l.
- [x] 101-500 m a.s.l.
- [x] 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)
- [x] shallow (21-50 cm)
- [x] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [ ] very deep (> 120 cm)

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

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

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

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

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

Water quality (untreated)
- [x] 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
- [x] medium
- [ ] low

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

Off-farm income
- [ ] less than 10% of all income
- [ ] 10-50% of all income
- [x] > 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
- [ ] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

Individuals or groups
- [x] 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
- [x] 5-15 ha
- [x] 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
- [x] individual, titled

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

Water use rights
- [ ] open access (unorganized)
- [x] 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	steeper hills can be cultivated since the risk for erosion is reduced
fodder quality	decreased ✓ increased	
risk of production failure	increased ✓ decreased	droughts: less water scarcity, intense rain: less erosion but the weather needs to be dryer in spring, since the soil cannot be left to dry between ploughing and seeding
production area (new land under cultivation/ use)	decreased ✓ increased	
expenses on agricultural inputs	increased ✓ decreased	Less worksteps need to be done, income remains the same. But a total herbicide and sometimes a little more manure is needed
diversity of income sources	decreased ✓ increased	Since the work is usually outsourced to a contractor, the farmer can use his time for other activities
workload	increased ✓ decreased	less worksteps need to be done

Socio-cultural impacts

cultural opportunities (eg spiritual, aesthetic, others)	reduced ✓ improved	Reduced independence if contractors are tasked

Ecological impacts

soil cover	reduced ✓ improved	
soil loss	increased ✓ decreased	
soil crusting/ sealing	increased ✓ reduced	
soil compaction	increased ✓ reduced	
beneficial species (predators, earthworms, pollinators)	decreased ✓ increased	more earthworms

Off-site impacts

damage on neighbours' fields	increased ✓ reduced	
damage on public/ private infrastructure	increased ✓ reduced	

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	

The farmer portaited bought a machine on his own. If a contractor were tasked short-returns would be positive too.

CLIMATE CHANGE

Gradual climate change

annual temperature increase	not well at all very well	Answer: not known

Climate-related extremes (disasters)

local rainstorm	not well at all ✓ very well	
local windstorm	not well at all very well	Answer: not known
drought	not well at all ✓ very well	
general (river) flood	not well at all very well	Answer: not known

Other climate-related consequences

reduced growing period	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%
- [x] 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

- The number of worksteps is greatly reduced. Thats why money and time can be saved.

  How can they be sustained / enhanced? Since less work needs to be done, the farmer can concentrate on other activities to enhance income.
- Soil structure is improved. Risk of compaction is reduced.

  How can they be sustained / enhanced? Still heavy machinery should not be used under wet conditions.
- Soil erosion is reduced very much.

  How can they be sustained / enhanced? The technology applies for maize only. Other conservation techniques should be used for other crops.

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

- Steeper hills can be cultivated without risking erosion.

  How can they be sustained / enhanced? the stripes should in general be laid along the contours.

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

- Risk of crop failure is enhanced if seeding under too wet conditions. The time of seeding is critical and should be chosen carefully. If conditions are too wet, ploughing might be a better choice.
- The machine is very expensive. Single farmers usually cannot afford it. Cost can be shared with other parties or a contractor can be tasked.
- In general a total herbicide must be applied before sowing. The amount of glyphosat should be adapted to the number of weeds.

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

- Reworking of the soil is still intense.
- A powerful tractor is needed. Fuel consumption is still high.

REFERENCES

Compiler
Joana Eichenberger

Editors
Unknown User
Tatenda Lemann
Maria Eliza Turek

Reviewer
Alexandra Gavilano
Fabian Ottiger
Joana Eichenberger

Date of documentation: March 10, 2011

Last update: Sept. 19, 2023

Resource persons
Roman Wyler - SLM specialist
Beat Wyss - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_1006/

Linked SLM data
Approaches: Soil support program for conservation agriculture https://qcat.wocat.net/en/wocat/approaches/view/approaches_2525/
Approaches: Direktzahlungssystem https://qcat.wocat.net/en/wocat/approaches/view/approaches_2601/
Approaches: Förderprogramm Boden https://qcat.wocat.net/en/wocat/approaches/view/approaches_2527/

Documentation was faciliated by

Institution
- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project
- OPtimal strategies to retAIN and re-use water and nutrients in small agricultural catchments across different soil-climatic regions in Europe (OPTAIN)

Key references

- report on DVD: von Bauern für Bauern: www.vonbauernfuerbauern.ch CHF 20.-