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DI Christine Weinberger

Biogas production from cover crops – assessing effects on water quality in five field experiments

Biogas production from renewable resources

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Conventional biogas production from main crops are criticised for

- **competing with food production**
- **high fertilizer and manure inputs**
- **negative effects on water quality**

Biogas production from cover crops

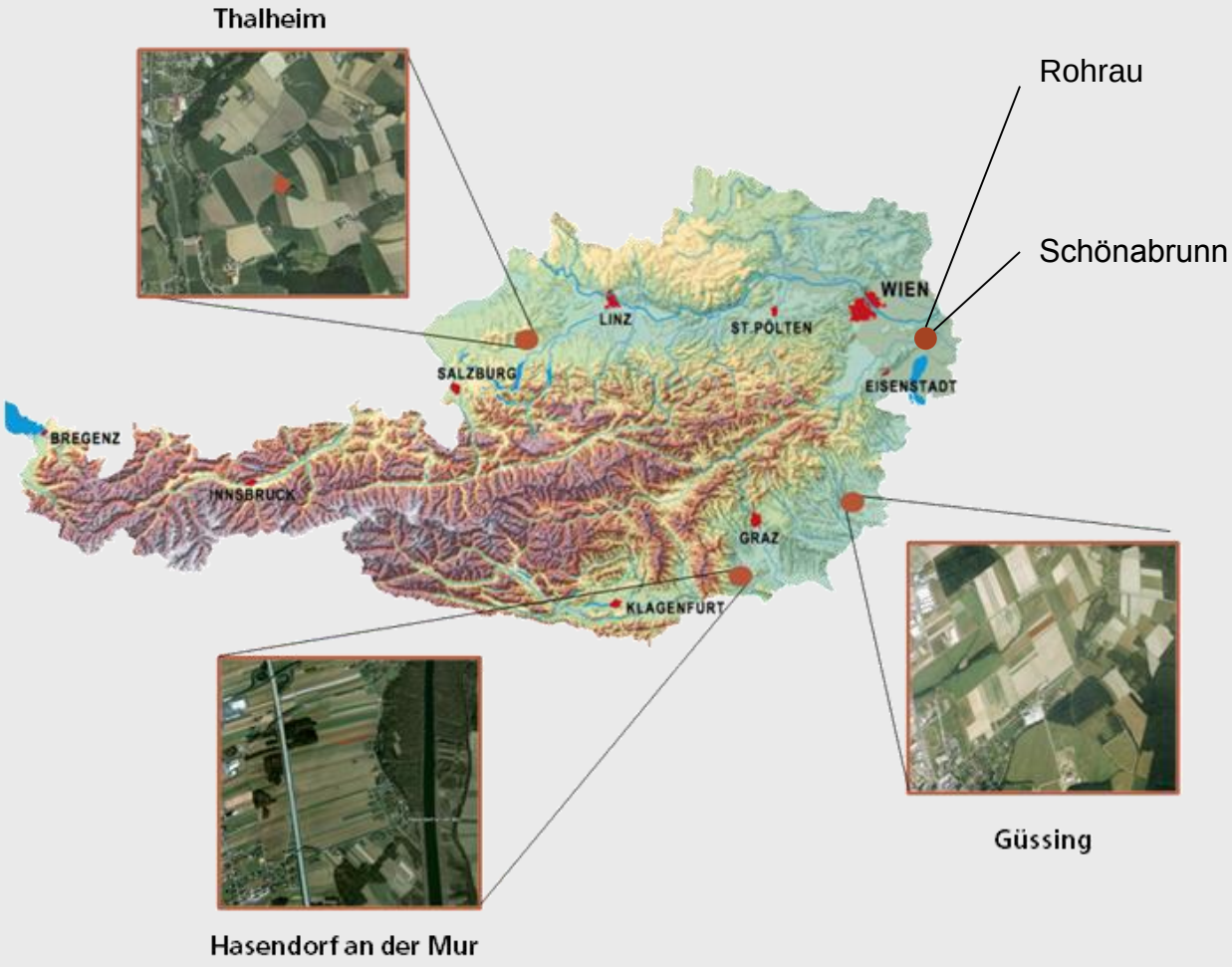
- **enhancement of the sustainability of agriculture**
- **Do the positive effects of cover crops remain?**
  - o Water quality
  - o Erosion

Main topics of the project

Evaluation of the impact of cover crops on:

- **Water Quality**
  - soil nitrate
  - nitrate concentration
  - nitrate leaching
- **Erosion**
  - soil cover by crops or crop residues

Experimental sites



Thalheim (Upper Austria)
750 mm per year
loamy silt, deep soil

Hasendorf (Styria)
910 mm per year
strongly laomy sand, shallow s.

Güssing (Burgenland)
730 mm per year
silty loam, deep soil

Rohrau (Lower Austria)
555 mm per year
silty loam, deep soil

Schönabrunn (Lower Aus.)
555 mm per year
strongly sandy loam, shallow s.

Materials and Methods

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Field Experiments:

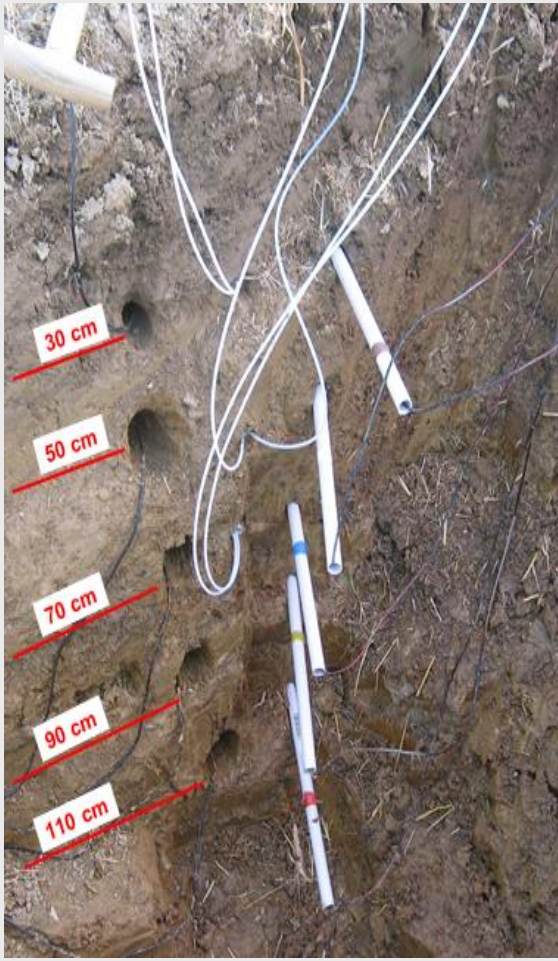
- o Bare fallow
- o Cover crop – green manure
- o Cover crop – fertilized and harvested for biogas production

Measurements:

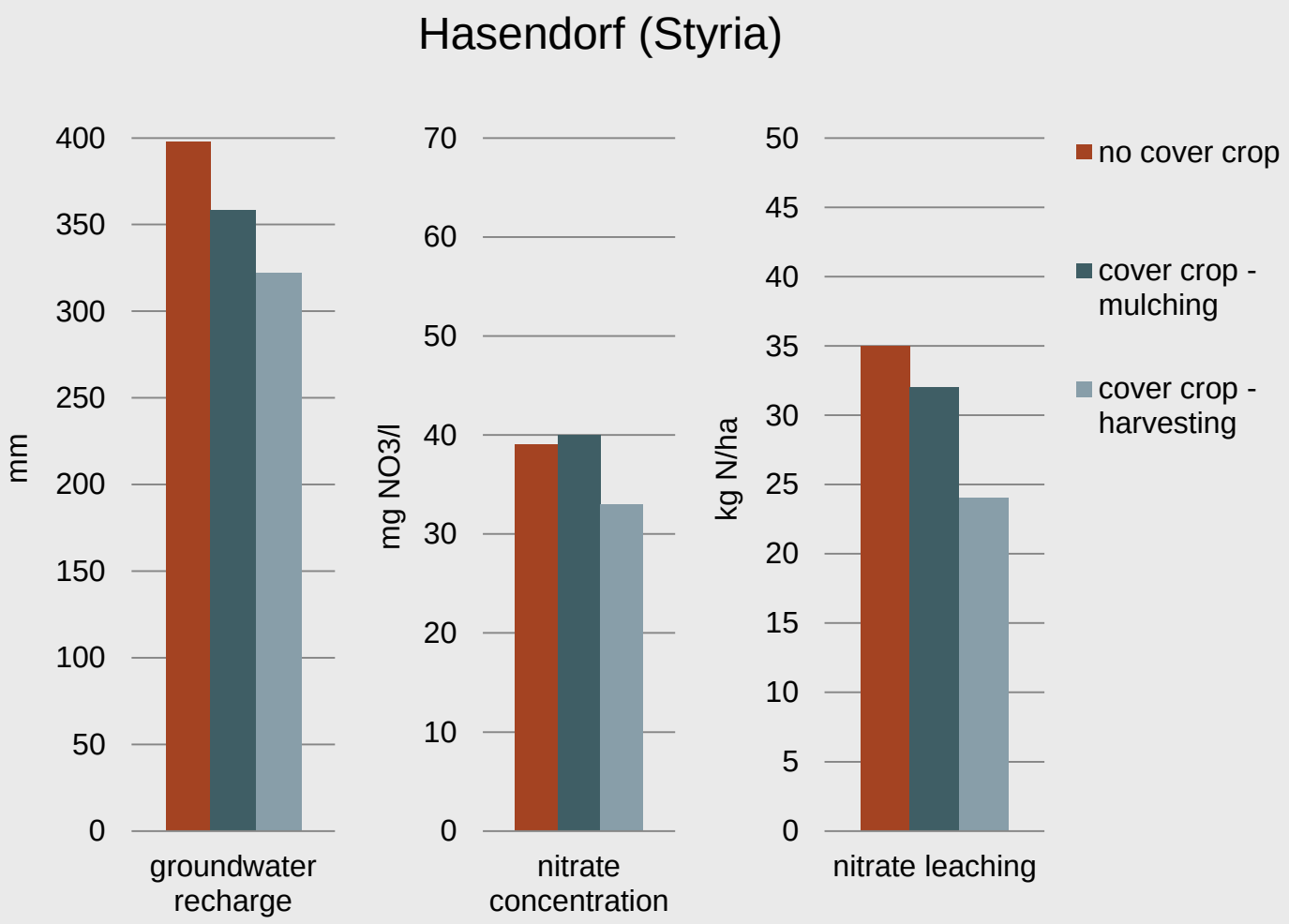
- o Soil water content & tension
- o Soil nitrate
- o Plant mass
- o Soil cover

Modelling:

- o Soil erosion (BoBB)
- o Nitrate leaching (numerical soil plant model SIMWASER/STOTRASIM)



Nitrate leaching
Winter cover crops



Groundwater recharge decreases with increasing biomass production

Cover crop: Concentration is similar or slightly higher

Lower nitrate leaching under harvested cover crops

Exception: in dry regions with light soils (Schönabrunn)

Nitrate leaching
Summer cover crops

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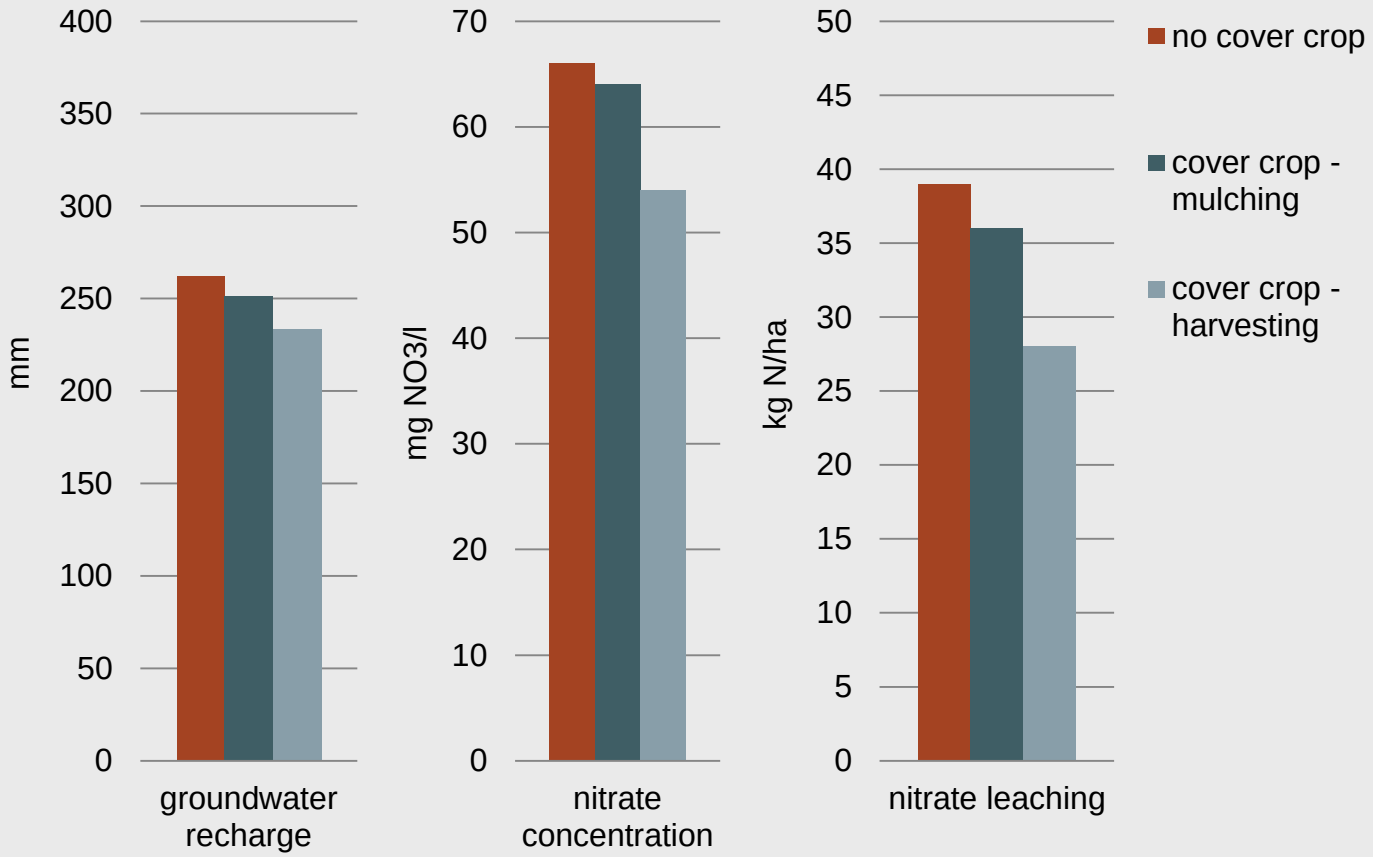

no fertilizer because of legumes (50%)

Nitrate concentration is strongly lower under harvested cover crops

Lower nitrate leaching under harvested cover crops

Soil cover by Winter cover crops

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Soil cover during the year no winter cover crop

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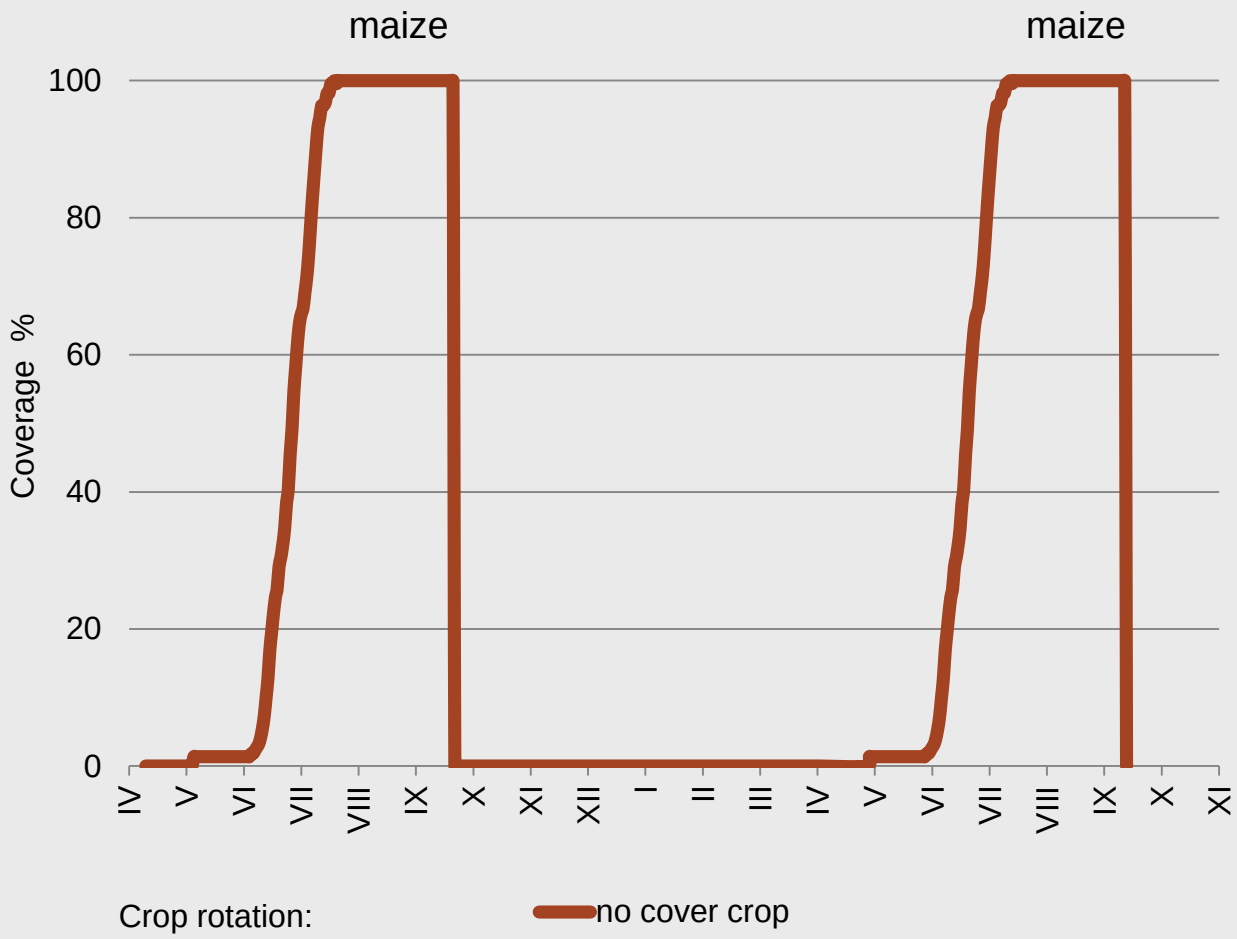

no winter cover crop between maize

Long period between the main crops

Soil is vulnerable to erosion

Soil cover during the year
Winter cover crops

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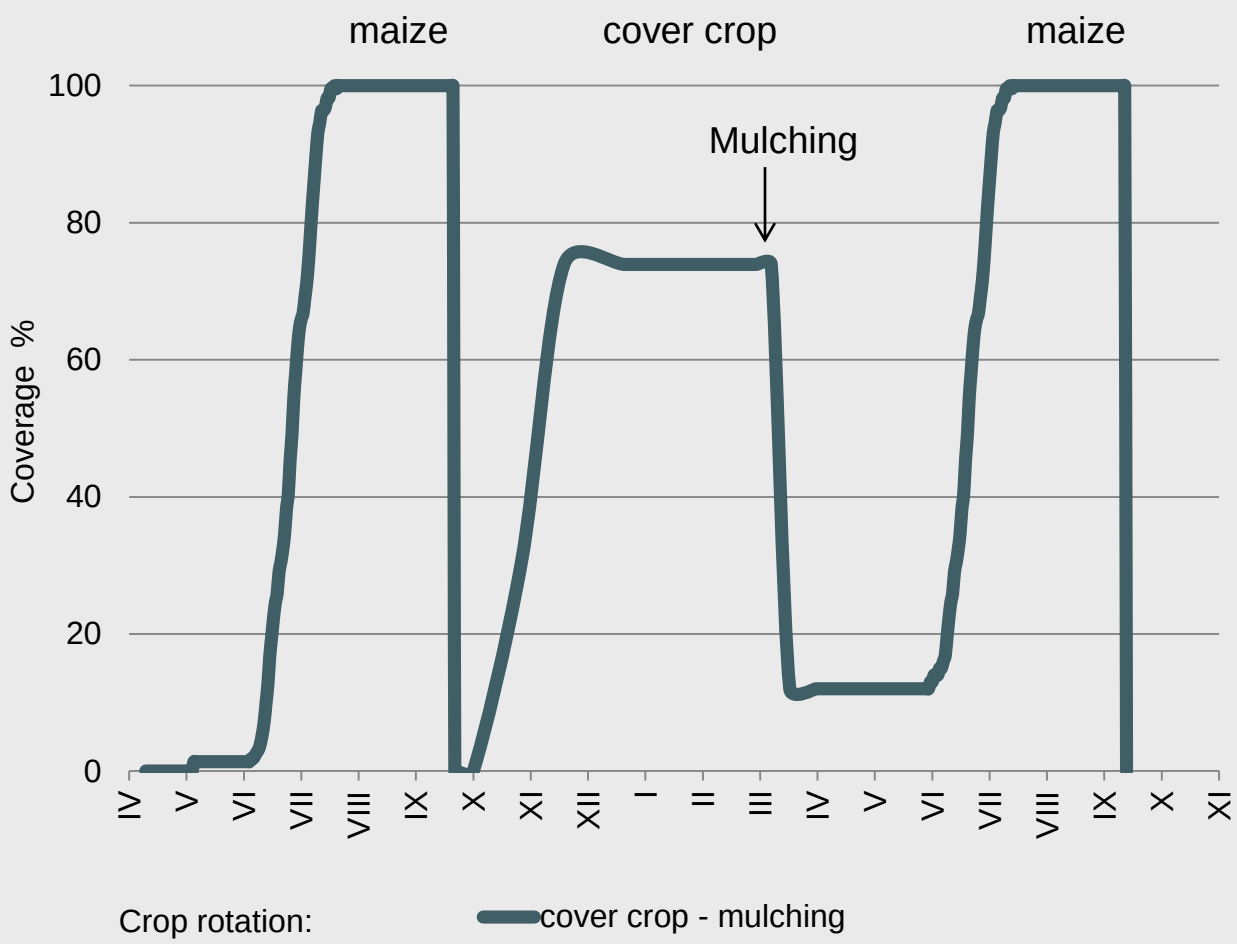

Winter cover crop between maize - mulching

Cover crops protect soil against erosion

During winter no increase in soil cover (slight decrease)

Reduction of erosion by 60% per year

Soil cover during the year
Winter cover crops

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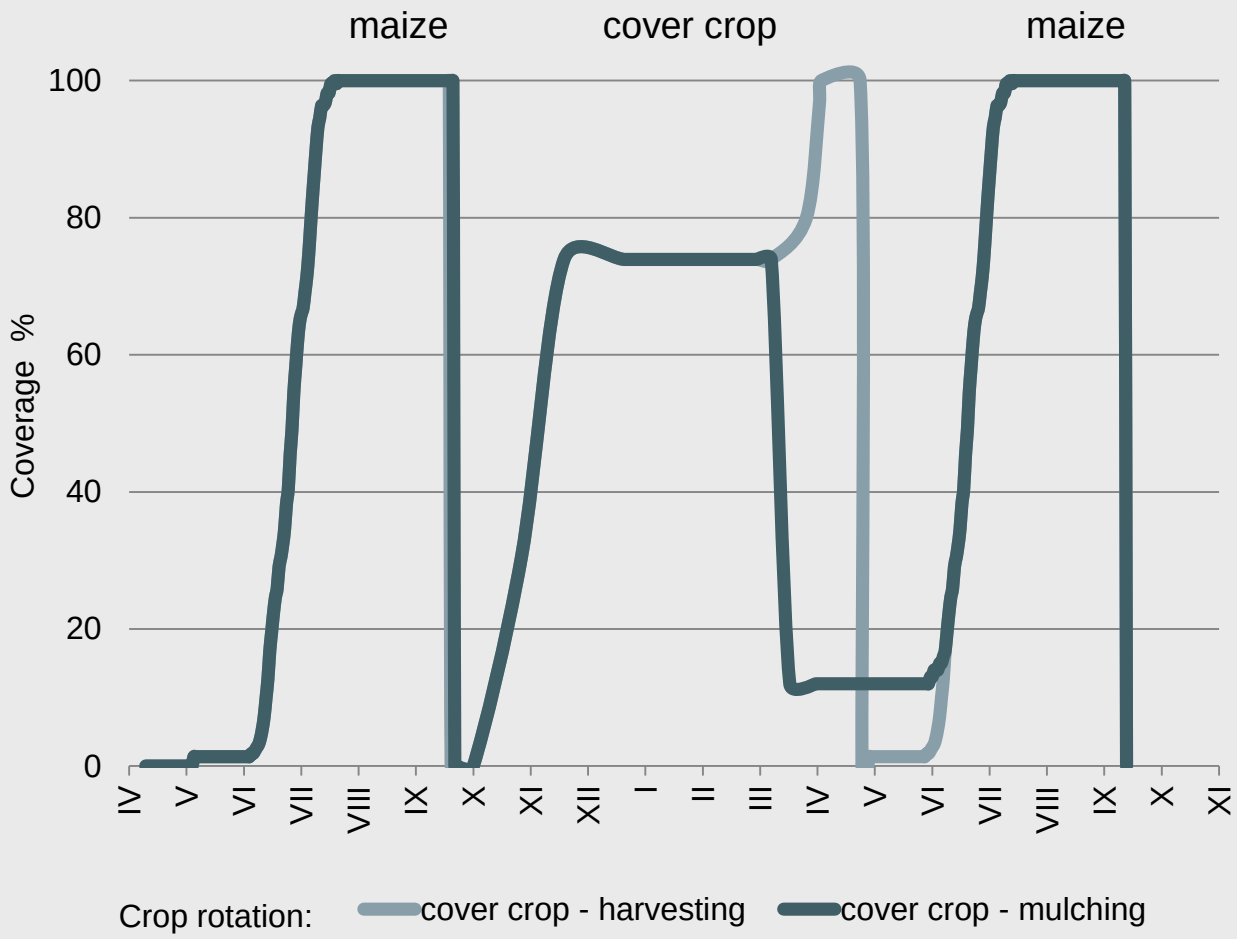

Winter cover crop between maize – harvesting

Higher biomass because of longer period with cover crops

High increase of coverage in spring shortly before harvest

Biomass >4,5 t DM/ha: protection similar to mulching

Soil cover during the year no summer cover crops

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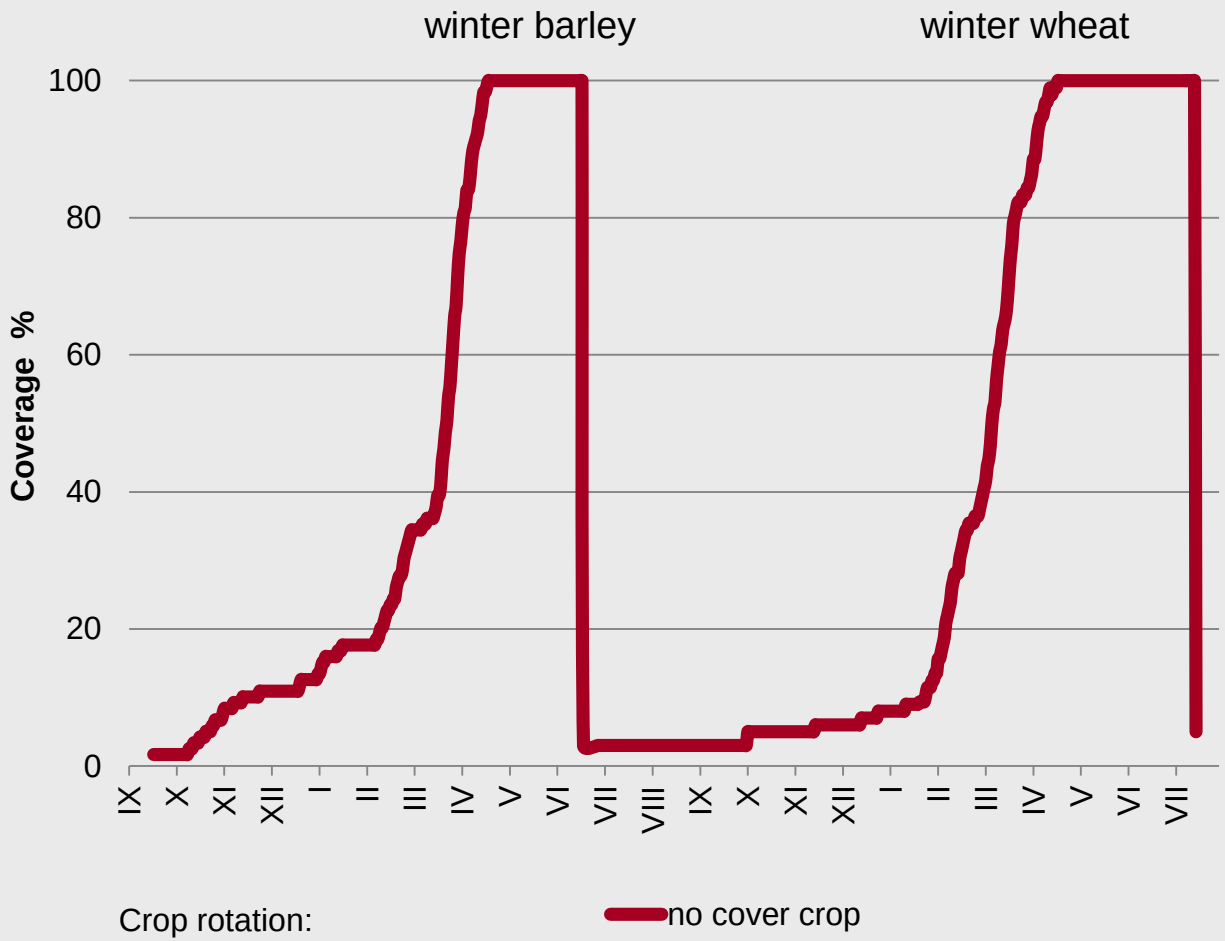

Summer cover crop between barley and winter wheat

shorter period between the main crops

Soil cover during the year
Summer cover crops

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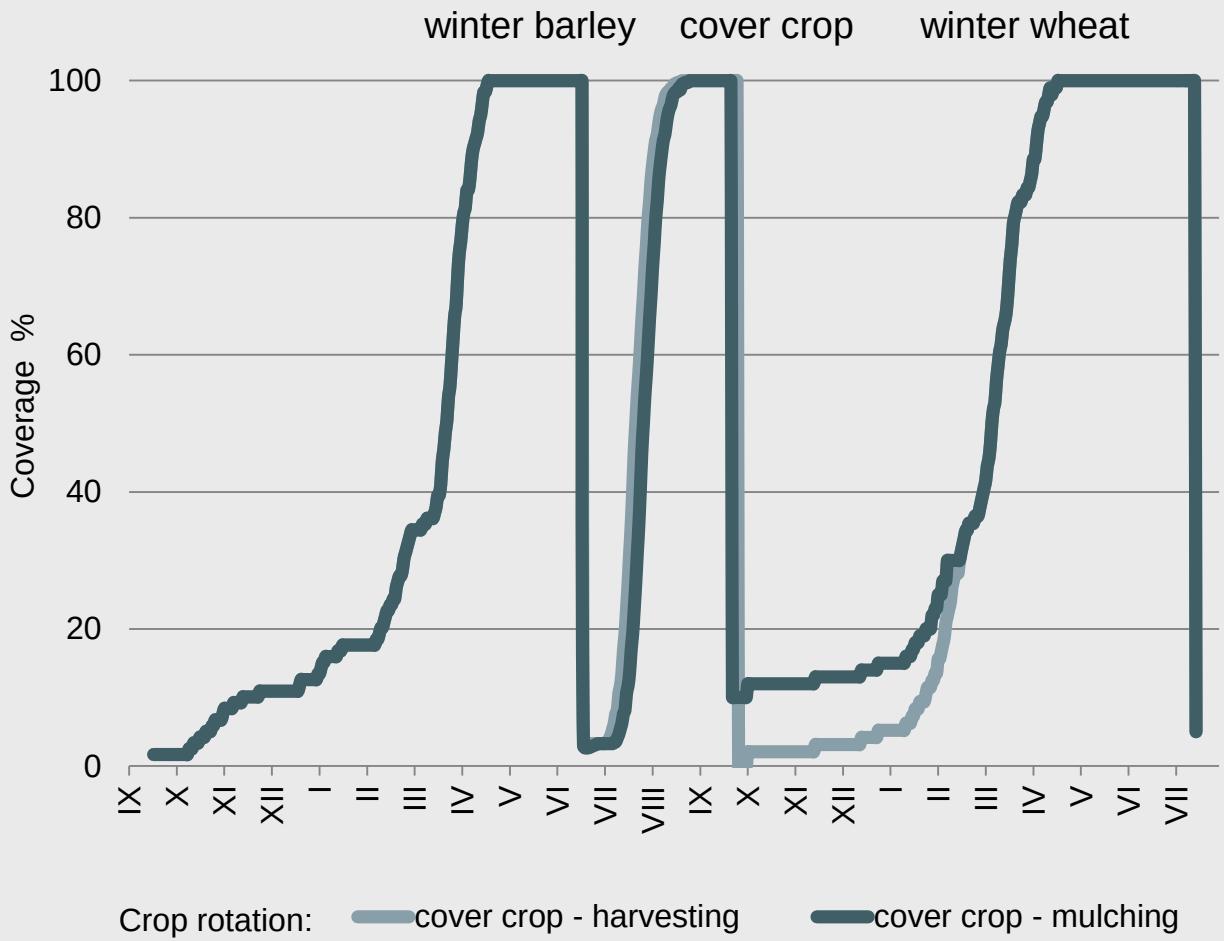

Summer cover crop between barley and winter wheat

Mulching:
reduces erosion by 25% per year

Harvesting:
longer period and higher biomass production, but no additional appreciable impact on the erosion

Energy yields

Achievable biomass from cover crops

- depends on date of cultivation
- varies between 3 - 7 t/ha
- average dry matter yield of 4.5 t/ha

Energy yields from 4.5 t/ha

- gross yield of 1300 m³ CH4
- net yield of 1000 m³ CH4

Cover crops on 15% of the agricultural land provides sufficient fuel for the total food and cover crop production

Do the positive effects of mulched cover crops remain?

Erosion

- **Protection is similar to mulching**
- **Reduction in erosion by 25% to 60% per year compared to bare fallow**

Water Quality

- **Fertilizer (amount adapted to the soil) to winter cover crops do not have negative effects on nitrate leaching, but not in dry regions**
- **Harvesting summer cover crops always reduces nitrate leaching**

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Biogas production from cover crops – assessing effects on water quality in five field experiments