# From afterthought to added value – service crops for soil health in potato systems
# Trials and experience from the Netherlands

## Fra tanker til merværdi – Serviceafgrøder der styrker jordsundhed i kartoffelsædskifter

Potato Day BJ-Agro ~ Maria-Franca Dekkers ~ 16 December 2026

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# Why grow a cover crop?

## Cover crop

- Soil structure
- Erosion

## Green manure, Groenbemester, Gründüngung

- Soil organic matter
- Soil fertility

## Efterafgrøder, Zwischenfrucht

- As an afterthought or because of regulations

## Cover crops have many extra purposes

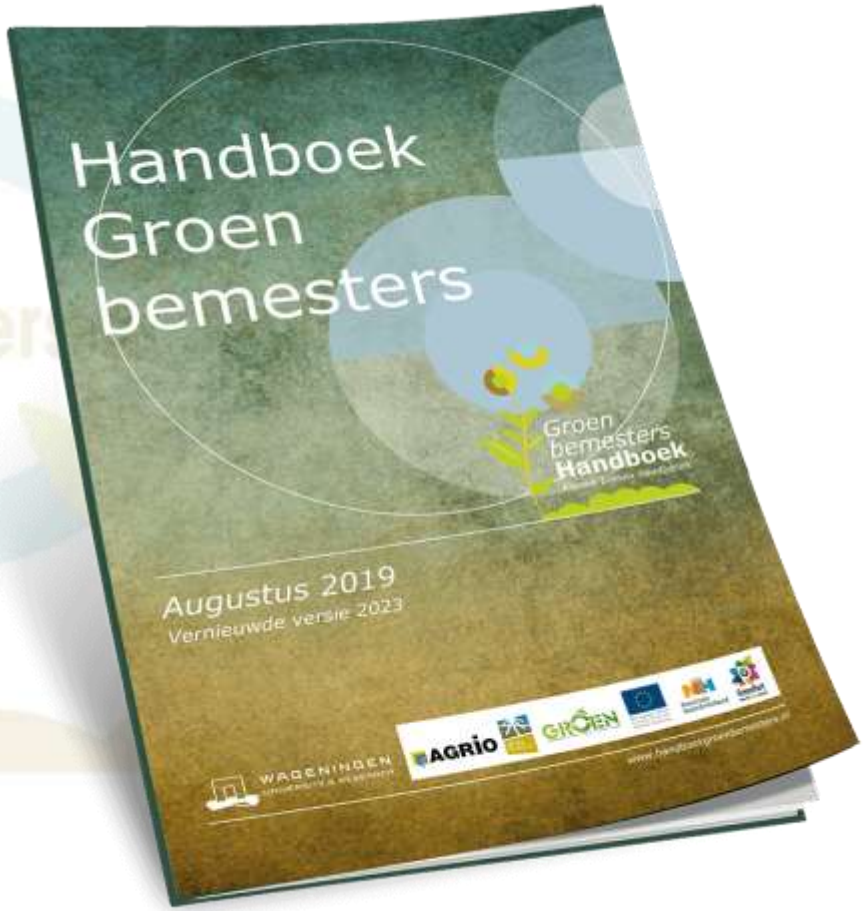
- Pest and diseases
- Weeds
- Biodiversity
- Water management
- Yield of main crops

## Service crops?

# Choosing a cover crop in a potato rotation

## Steps for choosing a cover crop

1. What is the context?
   - Crop rotation
   - Soil type
   - Tillage
2. What goals for improvement do you have?
   - Soil organic matter
   - Soil structure
   - Soil and crop health
   - Biodiversity
3. Other growing conditions
   - Fertilization
   - Weeds
   - Water management
   - Cover crop costs
4. Mixture or monoculture?



# Step 1: What is the context?

## Soil type

- Different challenges on different soil types
  - Weeds, nematodes, nitrogen leaching on sandy soil
  - Soil structure and water management on clay soils

# Step 1: What is the context?

## Crop rotation

- Cover crops are a long-term investment for the whole crop rotation, so take the whole rotation into account when choosing a cover crop
- The crop rotation gives the window of opportunity for sowing a cover crop
  - What are opportunities of sowing a cover crop before a potato
  - What are the opportunities of sowing a cover crop after the potato harvest.

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# What was the nitrogen uptake of this cover crop?

| | | | |
|---|---|---|---|
| Cover crop: | horse radish | | |
| Sowing date: | 15-09-2023 | Hight: | 18 cm |
| Pre crop: | wheat (straw incorporated) | | |
| Fertilization: | 30 kg N/ha | | |
| Date picture: | 23-10-2023 | Date of picture: | 07-12-2023 |




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# Step 1: What is the context?

## Tillage (incorporation of the cover crop)

- Timing of incorporation
  - Mineralization
  - Biomass production (organic matter)
  - Weed suppression
  - Water management
  - Biodiversity
  - Pests and diseases
  - Soil structure
- Method of incorporation
  - Ploughing (deep, un-deep), reduced tillage (sub soiling, disc harrowing), mowing, flailing, rolling, cultivator, chemical

# Step 2: What goals for improvement do you have?

## Increasing soil organic matter

- Soil organic matter is beneficial for many soil functions (soil life, nutrient availability, soil structure, water retention and drainage, etc.)
- Choose cover crops with high biomass production (black oats, crucifers like radish, marigold)
- Earlier sowing times give higher biomass production (effective organic matter)

| Cover crop | Sowing time | | | | | | |
|---|---|---|---|---|---|---|---|
| | *15 juli* | *1 aug* | *15 aug* | *1 sep* | *15 sep* | *1 okt* | *15 okt* |
| Winter cereal (rye) | 800 | | | | | 650 | 400 |
| Black oats | - | 1650 | 1000 | 550 | 400 | 350 | 300 |
| Vetch | 800 | 700 | 500 | 350 | 250 | - | - |
| Horse radish | 2050 | 1600 | 950 | 650 | 350 | 150 | - |
| Italian ryegrass | 1850 | 1600 | 1250 | 1000 | 750 | 450 | 200 |
| Phacelia | - | 1100 | 600 | 350 | 150 | 50 | - |
| Tall fescue | - | - | - | - | 1050 | | - |
| Yellow mustard | 1800 | 1250 | 750 | 500 | 350 | 250 | - |
| Winter cereal (barley) | - | - | - | 650 | | | 300 |
| Marigold | 2500 | 1350 | 1200 | - | - | - | - |

# Step 2: What goals for improvement do you have?

## Improving the soil structure

- Roots of cover crops, addition of organic matter and covering (protection the soil) improves the soil structure
- Soil structure is important for
  - Rooting of main crop
  - Soil tillage
  - Compaction
  - Prevention of wind and water erosion
  - Water management
  - Soil life

# Step 2: What goals for improvement do you have?

## Improving the soil structure

- Cover crops for improving soil structure
  - Ground cover and biomass (crucifers, grasses)
  - Frost tolerance (grasses, white or crimson clover)
  - Deep rooting (grasses, radish, mustard, red clover)
  - Dense rooting (grasses, clover, marigold, phacelia)
- Mixture of cover crops for a combination of the benefits




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# Step 2: What goals for improvement do you have?

## Increasing soil and crop health

- Biodiversity and functioning
- Disease suppressiveness

# Step 2: What goals for improvement do you have?

## Increasing soil and crop health

- Biodiversity and functioning
- Disease suppressiveness
- Nematode suppression

Select cover crops specific for the field, presence of pathogens, pre- and following crop

| Groenbemester | Aaltjes en tabaksratelvirus(TRV) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *G. rostochiensis* en *G. pallida* (aardappelcysteaaltjes) | *Heterodera schachtii* (wit bietencysteaaltje) | *Heterodera betae* (geel bietencysteaaltje) | *Meloidogyne chitwoodi* (maïswortelknobbelaaltje) | *Meloidogyne fallax* (bedrieglijk maïswortel-knobbelaaltje) | *Meloidogyne hapla* (Noordelijk wortelknobbelaaltje) | *Meloidogyne naasi* (graswortelknobbelaaltje) | *Pratylenchus penetrans* (wortellesieaaltje) | *Ditylenchus dipsaci* (stengelaaltje) | *Paratrichodorus pachydermus* | *Paratrichodorus teres* | *Trichodorus primitivus* | *Trichodorus similis* | tabaksratelvirus (TRV) |
| Bladrammenas | - | - - R[1] \| - R[2] | - R | - R | •• R | •• | - | ••• [1] \| •• [2] | ? | •• | • | ••• | •• | - |
| Gele mosterd | - | - - R[1] \| - R[2] | - R | •• | •• | • | - | ••• [1] \| •• [2] | ? | ••• | • | ••• | ••• | ••• |
| Bladkool | - | ? i | ••• | ? | ? | ? | ? | ••• | ? | ? | ? | ? | ? | ? i |
| Zwaardherik | ? i | ? i | ? i | • i | ? i | ? i | ? | ••• i | ? | ? | ? | ? | ? | ? |
| Ethiopische mosterd | ? | ? i | ? i | • i | ? | ? | ? | ••• i | ? | ? | ? | ? | ? | ? |
| Engels raaigras | - | - | - | • | ••• | - | ••• | •• [1] \| • [2] | • | ••• | ••• | ••• | ••• | •• |
| Italiaans raaigras | - | - | - | ••• | ••• | - | ••• | ••• | • | ••• | ••• | ••• | ••• | ••• S |
| Westerwolds raaigras | - | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
| Rietzwenkgras | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
| Winterrogge | - | - | - | ••• | •• | - | •• | ••• [1] \| •• [2] | •• | ••• | ••• | ? | ••• | •• |
| Japanse haver | - | - | - | ••• | ? i | ? | • | - | ? | ? | ? | ? | ? | ? |
| Soedangras | - | - | - | ? | • | ? | ? | ••• | ? | ? | ? | ? | ? | ? |
| Triticale | - | - | - | •• | • | - | ••• | •• | - | ? | ? | ? | ? | ? |
| Witte klaver | - | - | ? | •• R i | •• R i | •• R i | ? | ••• | ••• | ? | ••• | ? | ? | ••• S i |
| Rode klaver | - | - | ? | ? | ? | ? | ? | ? i | ••• | ? | ? | ? | ? | ? |
| Alexandrijnse klaver | - | ? | •• | ••• | ••• | ••• | ? | ? i | ? | ? | ? i | ? | ? | ••• |
| Perzische klaver | - | - | ••• | ••• | ••• | ••• | ? | ? i | ? | ? | • | ? | ? | ••• i |
| Voederwikke | - | - | •• | • R | ••• | ••• | ? | ? i | ? | ? | ? i | ••• | ? | - |
| Incarnaat klaver | | | | | | | | | | | | | | |
| Afrikaantje | - | - | - | - | - | - i | - | - - | ? | ? i | ? i | ? i | ? i | ••• S |
| Facelia | - | - | - | • | • | •• | - | ••• | ? | •• | ? | • | ? | ••• |
| Raketblad | - - i | ? | ? | •• | ? | ? | ? | • | ? | •• | •• | •• | •• | ••• |
| Spurrie | - | ? | ? | ? | ? | •• | ? | ? | ? | ? | ? | ? | ? | ? |

| Legenda schade | |
|---|---|
| | onbekend |
| | geen |
| | weinig (0-15%) |
| | matig (16-35%) |
| | zwaar (36-100%) |

| Legenda vermeerdering | |
|---|---|
| -- | actieve afname |
| ? | onbekend |
| - | geen |
| • | weinig |
| •• | matig |
| ••• | sterk |
| ■ | waard, geen kwantificering |
| R | resafhenkelijk |
| G | resistente onderstammen voor enten |
| A | overleving op gewasresten of verwelking |
| B | wortel- en knolinfectie of ruststructuren in de bodem |
| C | vaatinfectie |
| i | enige informatie |

# Step 2: What goals for improvement do you have?

## Increasing soil and crop health

- Biodiversity and functioning
- Disease suppressiveness
- Nematode suppression

Select cover crops specific for the field, presence of pathogens, pre- and following crop

## Example from the Netherlands: Long term effect of marigold in crop rotation

Potato + Rye & Phacelia

Sugar beet

- Rye and phacelia can be sown later.
- They benefits from leftover nitrogen after potato.
- Rye naturally decrease *Melodoigyne hapla.*
- Phacelia is a poor host for *Melodoigyne chitwoodi* and *falax*.
- Rye increases *Pratylenchus penetrans*. That is no problem for sugar beet and sugar beet will not increase it further.

# Step 2: What goals for improvement do you have?

## Increasing soil and crop health

- Biodiversity and functioning
- Disease suppressiveness
- Nematode suppression
- Pests

Select cover crops specific for the field, presence of pathogens, pre- and following crop

## Problems with wireworms in rotations with cereals and gras cover crops

Cover crops that reduce wireworm pressure:

- Yellow mustard (can be sown quite late)
- White clover
- Brassica rapa (can be sown quite late)

# Step 2: What goals for improvement do you have?

## Increasing soil and crop health

- Biodiversity and functioning
- Disease suppressiveness
- Nematode suppression

- Risk for pathogen build up

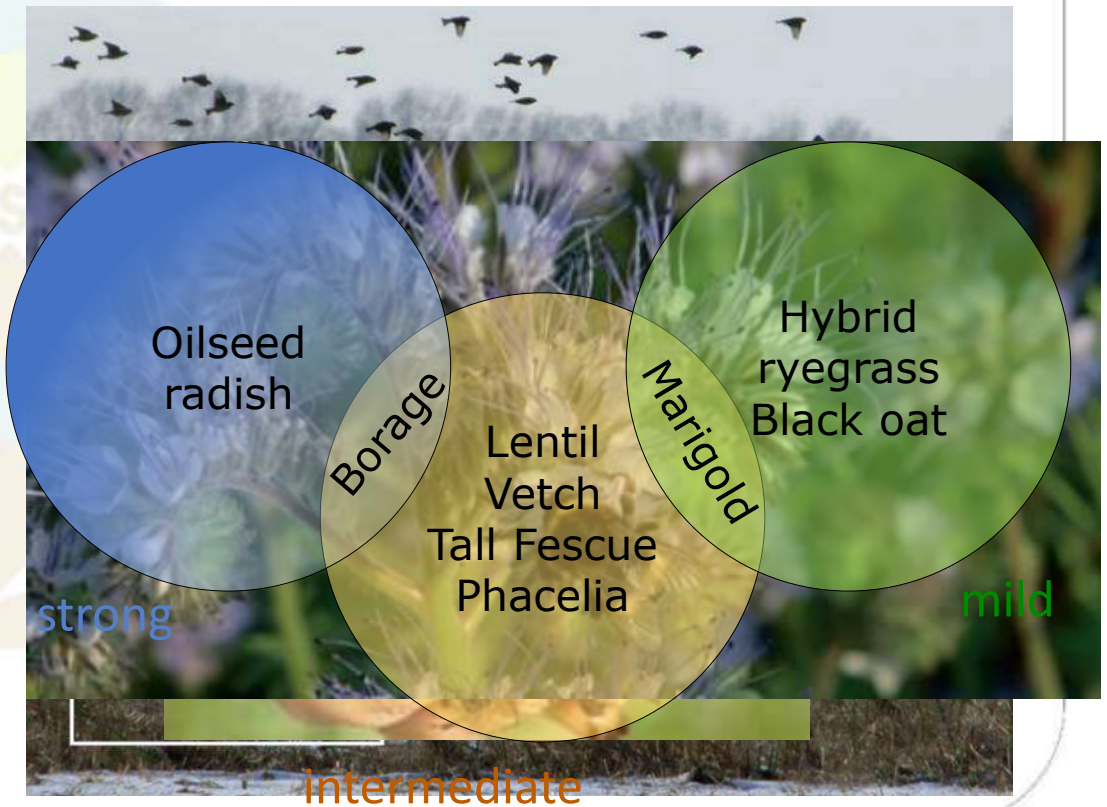
# Step 2: What goals for improvement do you have?

## Increasing biodiversity

- Food, rest place & reproduction in the wintertime
- Stimulating soil life

- Cover crops for biodiversity
  - Pollination (crucifers, clover, phacelia)
  - Seeds for birds (oats, sunflower, crucifers)
  - Leaving the cover crops until spring
  - Cover crops with deep and dense root systems (see soil structure)

  - Cover crops' legacy on the soil microbiome lasts for most cover crops until the planting of potatoes, while for radish it lasts until the potato harvest






Sara Cazzaniga, 2023, PhD thesis
https://edepot.wur.nl/640265

# Step 3: Other growing conditions

## Fertilization

1. Fertilizing the cover crop? It depends on
   - Pre crop
   - Sowing time
   - Cover crop type
   - Goal
   - Legislation

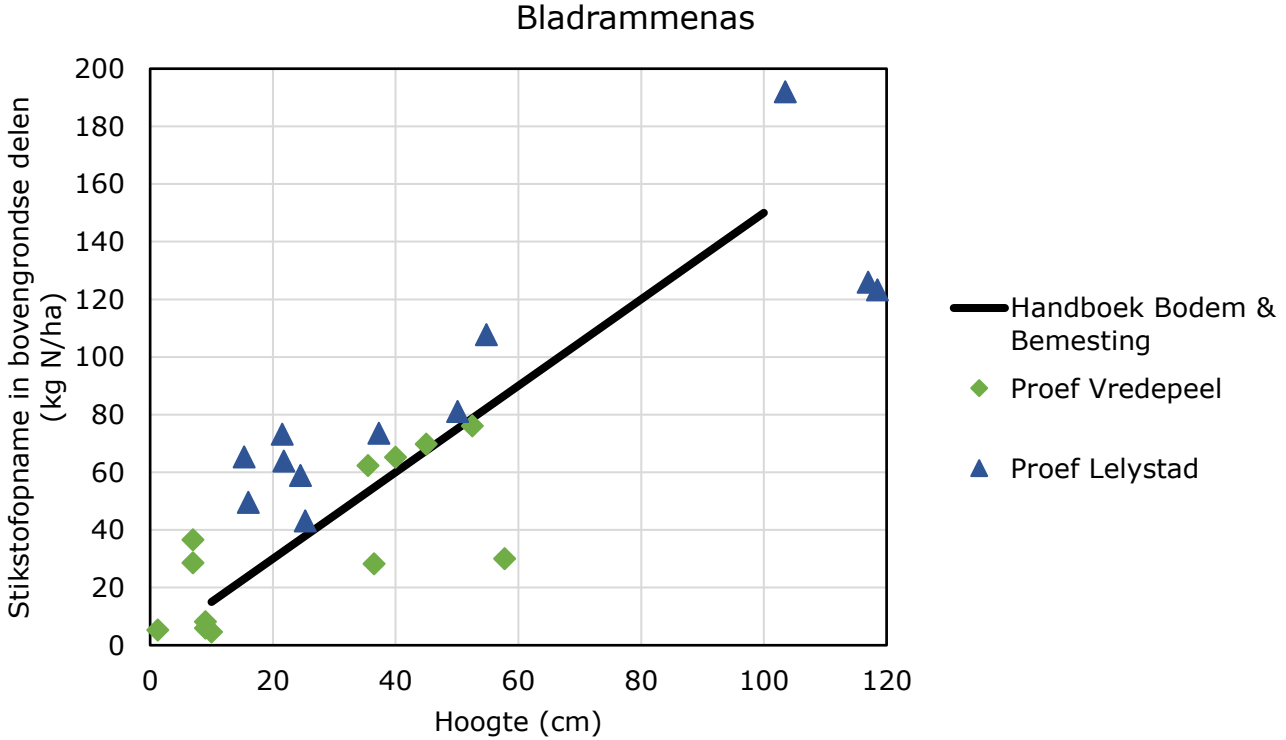
- ✓ No need after potato and onions
- ✓ After cereals may be needed
- ✓ Not needed for legumes or mixtures with legumes
- ✓ Goal: better structure or organic matter > more biomass
- ✓ Goal: Nitrogen leaching reduction > no extra fertilization

# Step 3: Other growing conditions

## Fertilization

2. Nitrogen uptake of the cover crop

- Prevent leaching & fix additional N with legumes
- It can be estimated based on
  - Sowing date
  - Height
  - Indicators
    - 80 kg/ha for well developed cover crop
    - 40 kg/ha for a small cover crop
  - Expert judgement

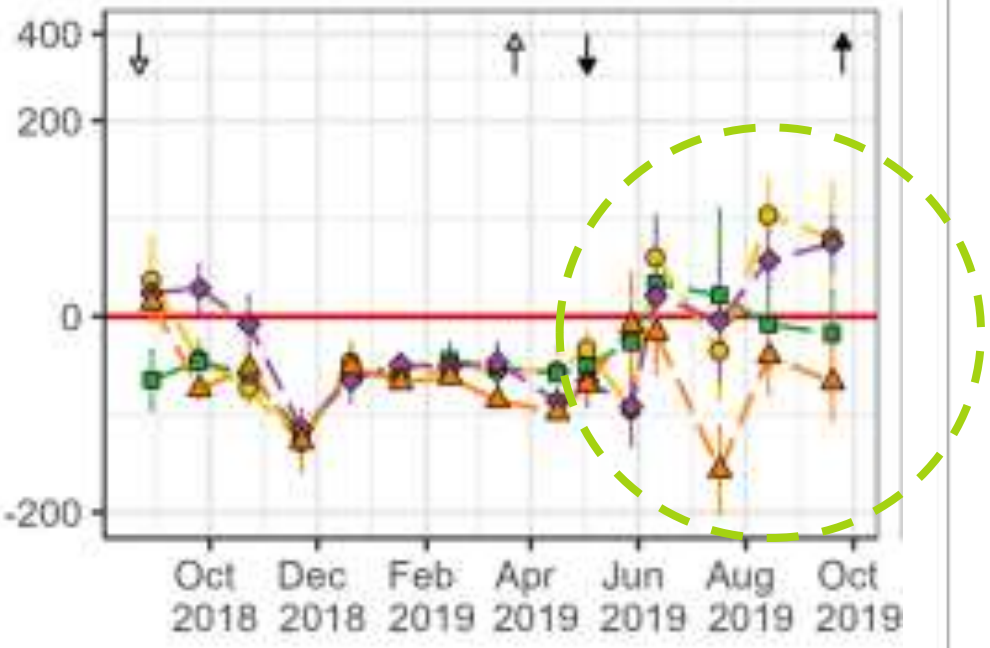



# Step 3: Other growing conditions

## Fertilization

3. Nitrogen mineralization for the next main crop

- Indicators
  - Non-legumes: 40% or 50% N uptake becomes available for the next main crop when incorporating in autumn or in spring
  - Legumes: 75% of N uptake becomes available for the next main crop when either incorporating in autumn or in spring.
- Moment of mineralization depends on
  - Moment and method of incorporation
  - Winterhardiness of the cover crop
  - C/N ratio
- Reduction of fertilization of main crop




*Kühling et al. (2023)*

- Lower Nmin in winter
- Higher Nmin in growing season
- Periods of N immobilization (mainly with winter rye)

# Step 3: Other growing conditions

## Weeds

- By covering the soil, weeds get less change to grow
- A cover crop mulch can also effectively cover the soil
- Risk of weeds, when the cover crop is not dense/big enough
- Risk of regrowth of cover crops in the following main crop

# Step 3: Other growing conditions

## Water management

- More evaporation in living cover crop
- Better water retention due to improved structure

# Step 3: Other growing conditions

## Cover crop costs

- Profit
  - Increase yield
  - Subsidies
  - Safe on fertilization
  - Long term soil health
- Costs
  - Decrease yield
  - Seed and management costs of cover crop

# Step 4: Mixture or monoculture?

## When multiple species are fitting in the crop rotation, it is an option to use a mixture of these species and combine the benefits

- Biomass production
- Higher chance of success
- Soil cover
- Root structure differentiation
- Add legumes for N-fixing
- Biodiversity

Be careful with hosts of pests and diseases

# From afterthought to added value – service crops for soil health in potato systems

## Cover crops provide many different services = Service crops?

## But prioritising is needed to select a cover crop

There is no single cover crop that does everything at once

- Can you use a broad rotation?
- Sample your soil to know what is there
- Cultivate with good soil conditions
- Set priorities

- Use the steps to select a cover crop
- Use the tools available
  - Best4Soil, Handbooks?

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# Thanks! Questions

maria-franca.dekkers@wur.nl