Inventory & Starting document

EIP Focus Group 32 NCWM

Marleen Riemens, November 2018

Starting document: 2 timelines

1. Alternatives and bottlenecks *today*

Herbicides are easy to use and cost effective compared to existing alternatives.

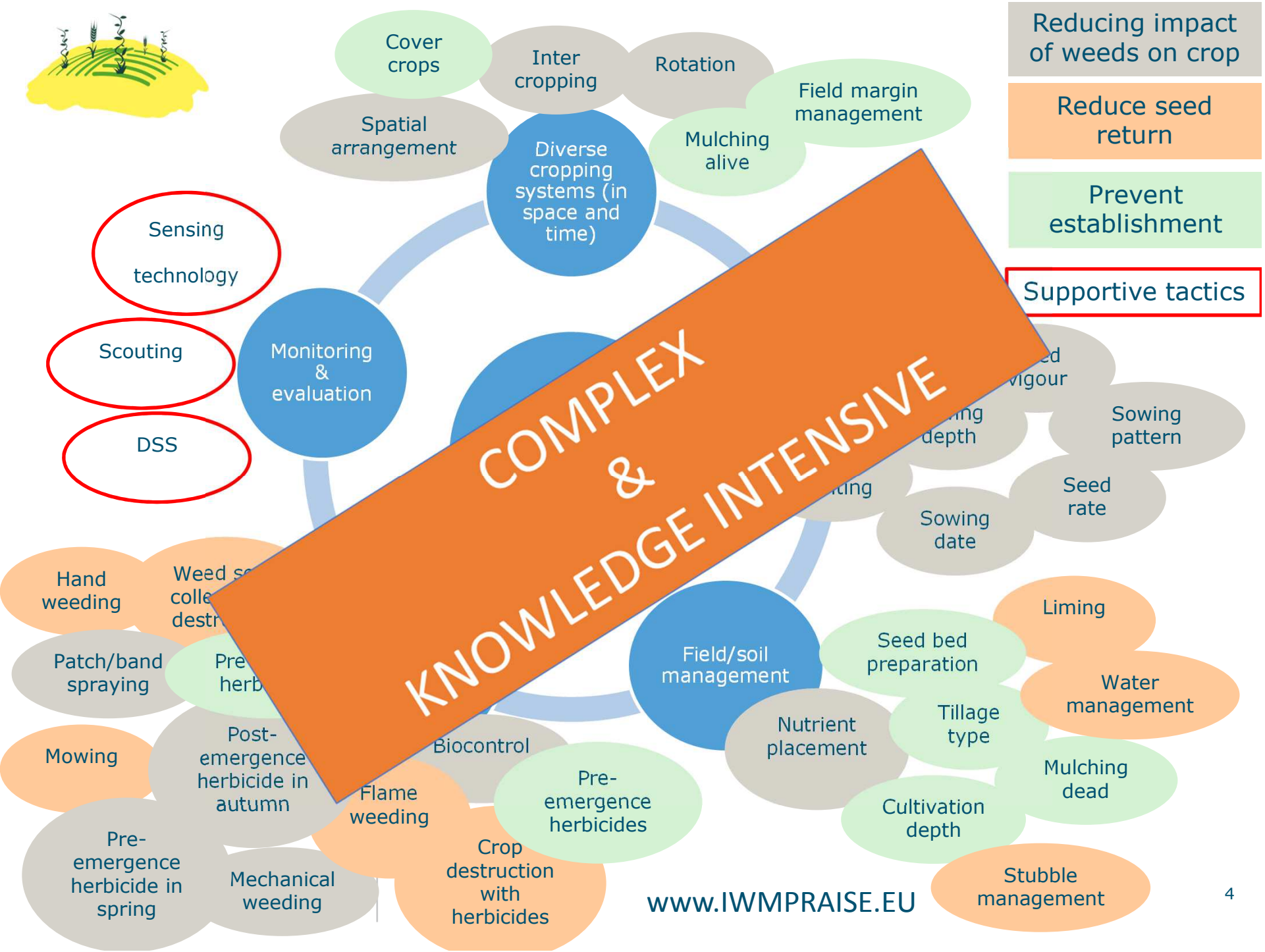Alternatives need to be combined to be just effective.

Combined use of methods is called
Integrated Weed Management (IWM).

2. Areas for development in *2050*

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100years
1918 — 2018

IWM uses tools and techniques that enable:

- the use of diversified cropping systems
- use of weed suppressive and competitive cultivars,
- adequate field and soil management,
- targeted control, and
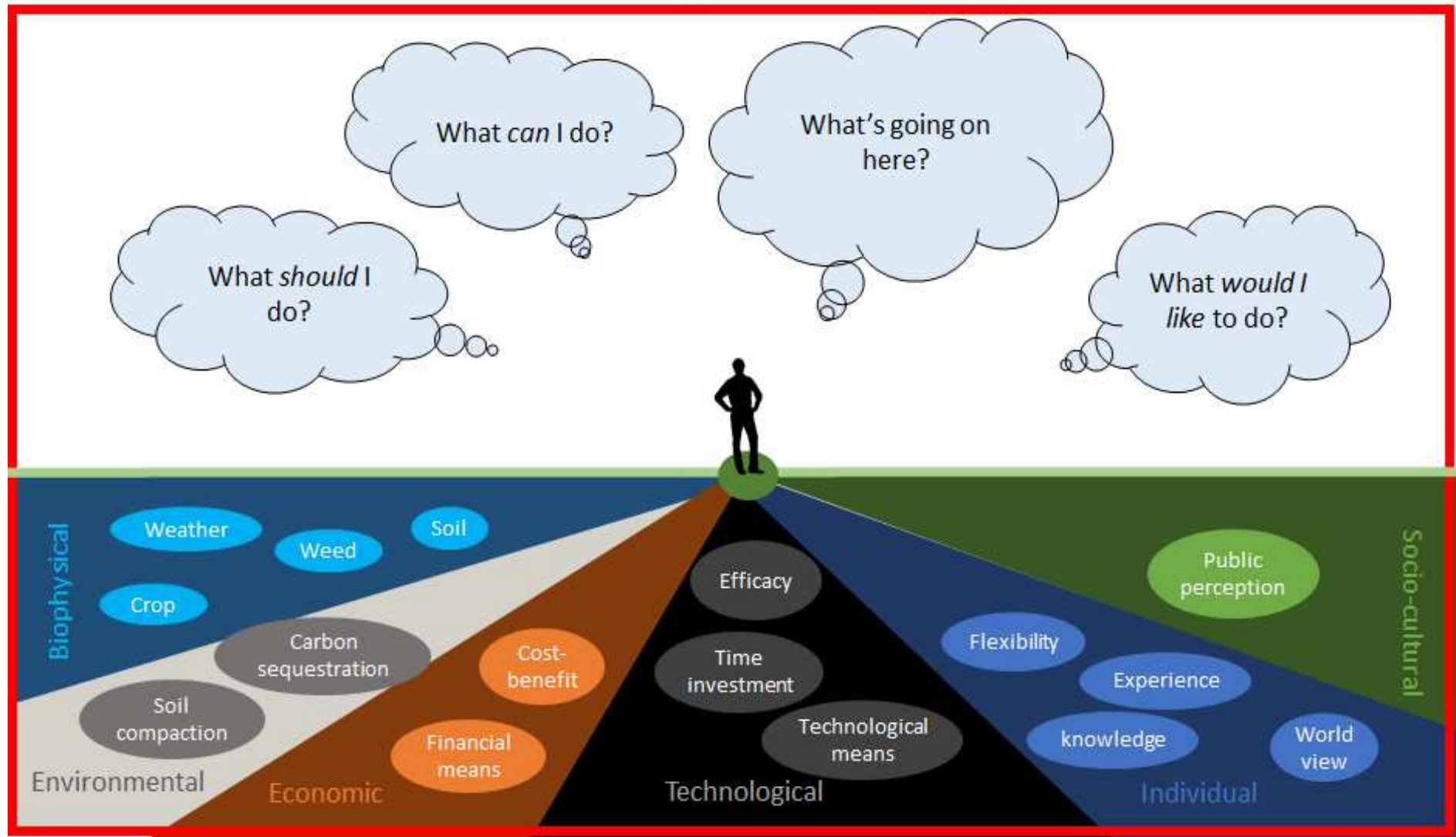- monitoring and evaluation.

Reducing impact of weeds on crop

Reduce seed return

Prevent establishment

Supportive tactics

Cover crops

Inter cropping

Rotation

Field margin management

Spatial arrangement

Diverse cropping systems (in space and time)

Mulching alive

Sensing technology

Scouting

DSS

Monitoring & evaluation

COMPLEX & KNOWLEDGE INTENSIVE

Seed vigour

Sowing pattern

Sowing depth

Seed rate

Sowing date

Hand weeding

Weed seed collection destr...

Patch/band spraying

Pre... herb...

Field/soil management

Seed bed preparation

Liming

Mowing

Post-emergence herbicide in autumn

Biocontrol

Nutrient placement

Tillage type

Water management

Flame weeding

Pre-emergence herbicides

Cultivation depth

Mulching dead

Pre-emergence herbicide in spring

Mechanical weeding

Crop destruction with herbicides

Stubble management

www.IWMPRAISE.EU

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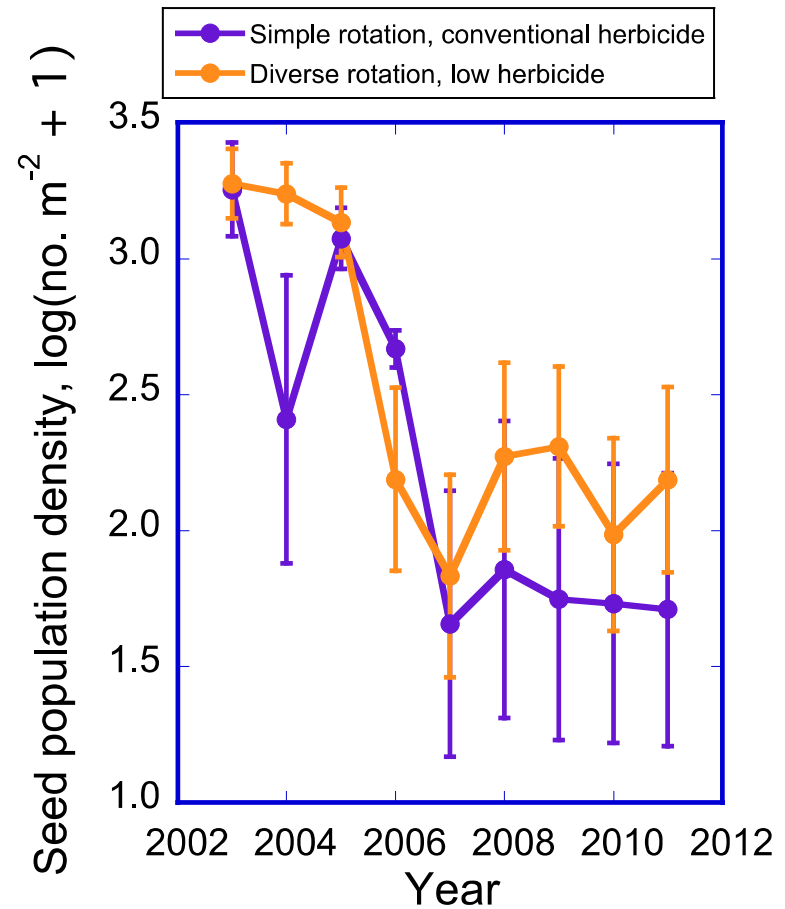# Barriers for adoption of IWM by farmers

Farmers are the key to system change

www.IWMPRAISE.EU

Example diversified systems

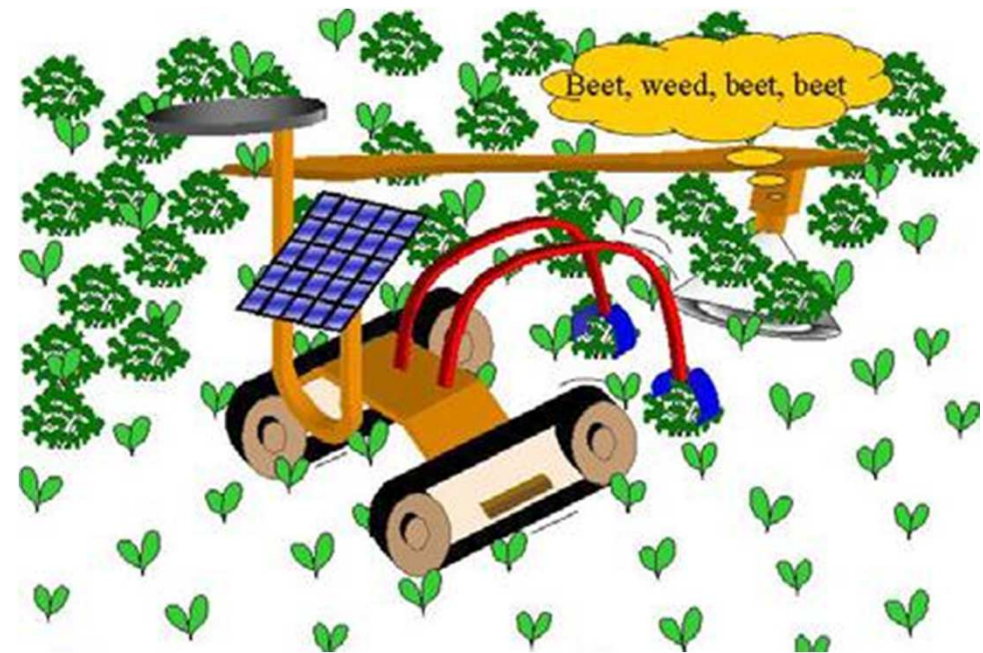Wider crop rotation leads to a strong reduction in herbicide use.

Seed population density, log(no. m^{-2} + 1)

Legend:
- Simple rotation, conventional herbicide
- Diverse rotation, low herbicide

X-axis: Year (2002, 2004, 2006, 2008, 2010, 2012)
Y-axis: 1.0, 1.5, 2.0, 2.5, 3.0, 3.5

(Liebman et al 2016.)

Alternative targeted management

Intrarow: Torsionweeders

Fingerweeders

Steketee IC weedmachine

Cameras view the crop from above

Camera is activated with a support wheel mounted to the machine
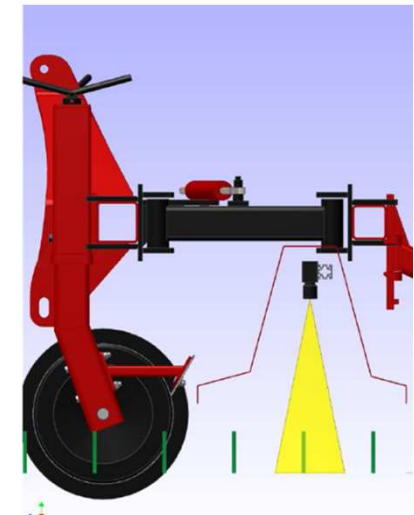
Special software "traces" the plants
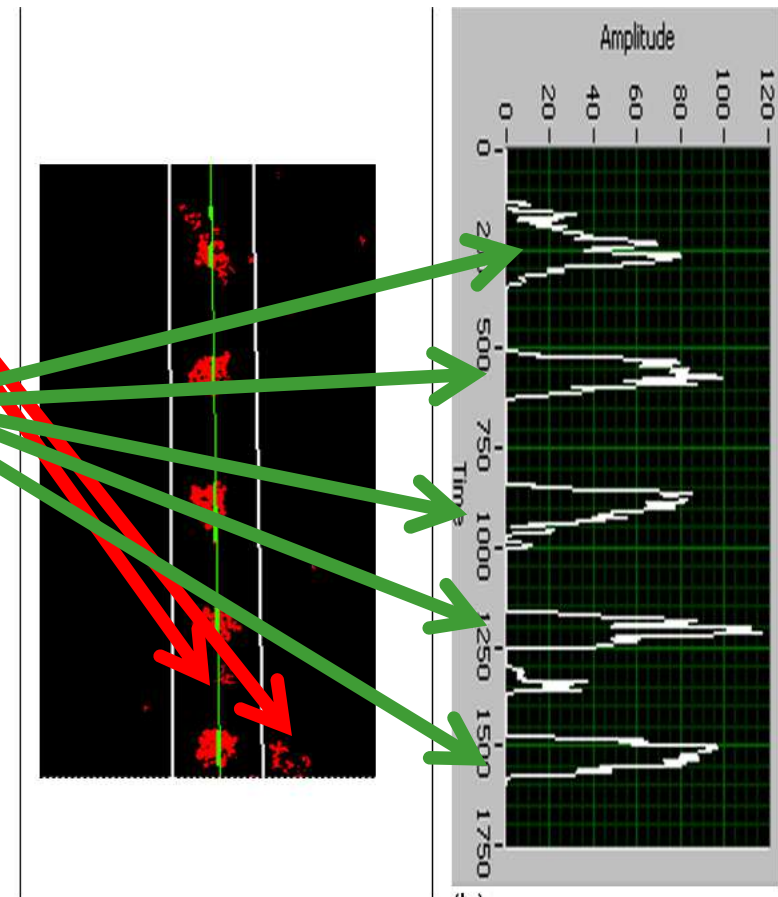- Colour algorithm (Excessive Green)
- Binar image
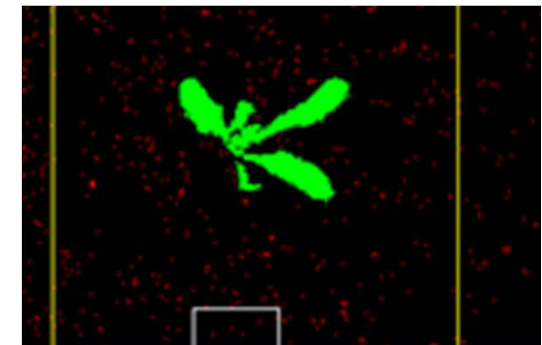
How does the software works?

Practical problem:
weeds are also "plant pixels"

However:
Location/pattern of weeds

deviates

Solution:
Detect the consistency of

the seed pattern

Method:
Fast-Fourier Transformation
(patent Wageningen UR)

Intelligent intra-row weeding

Sensing technologies example

- Robot Ruud: dock in grassland

Colour   Fourier transformed   Binary

www.ruud.wur.nl

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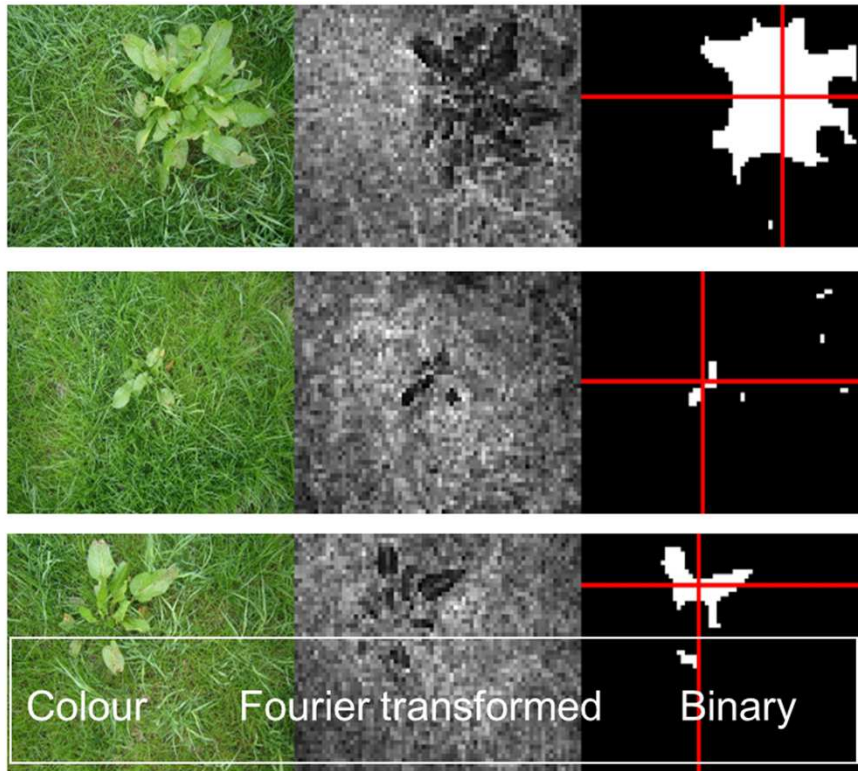
Precision spray
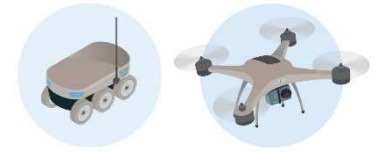
Digitilisation

Areas for development foreseen in 2050

1. **Diversified systems**: developing competitive mixed cropping and intercropping systems and appropriate mechanization

2. **Breeding for weed competitiveness and suppressiveness** through a focus on the molecular and physiological level

3. **Precision agriculture and robotics**: automated robots th recognise weeds based on hyperspectral imaging and machine learning techniques
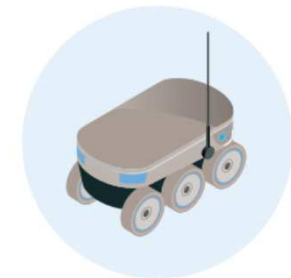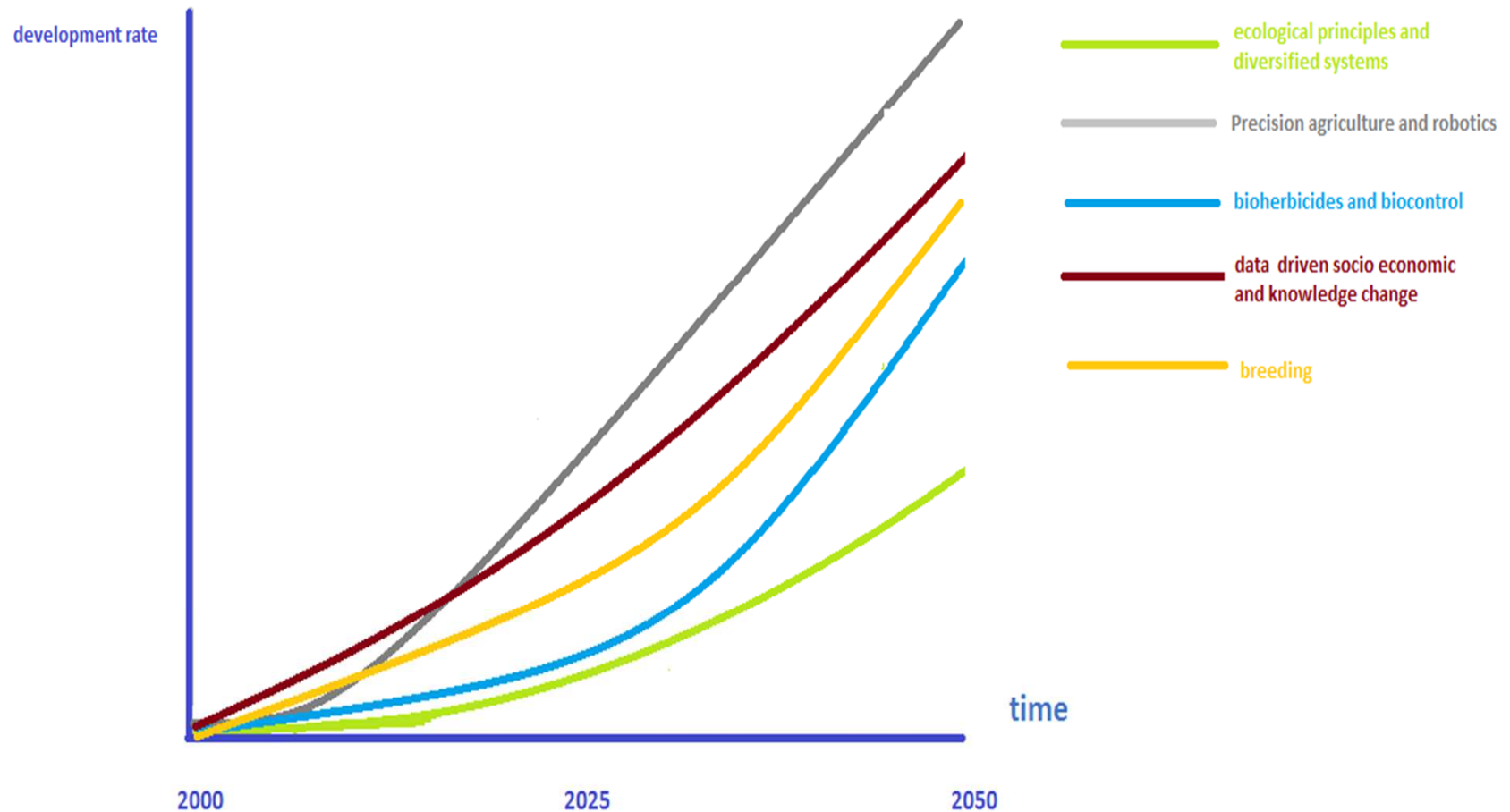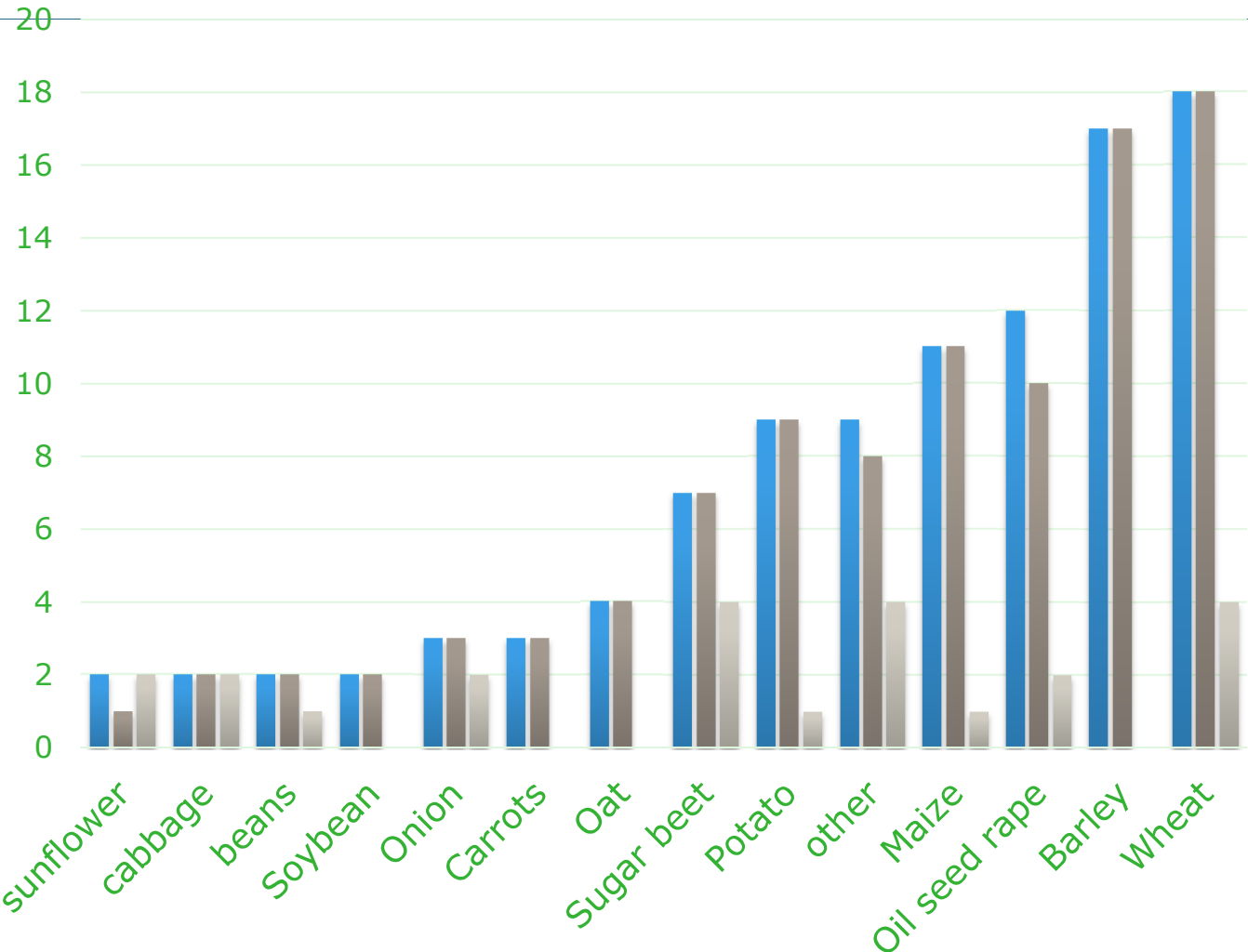

4. **Bioherbicides** based on plant extracts or microbes

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5. **Data driven socio economic and knowledge exchange**

Different speeds of development areas

development rate

- ecological principles and diversified systems
- Precision agriculture and robotics
- bioherbicides and biocontrol
- data driven socio economic and knowledge change
- breeding

time

2000   2025   2050

Inventory: crops

IWM

Diverse cropping systems (in space and time)
- Cover crops
- Inter cropping
- Rotation
  - Field margin management
  - Mulching alive

Cultivar choice & establishment
- Cultivar choice
- Seed vigour
- Sowing depth
- Sowing pattern
- Sowing date
- Seed rate
- Trans-planting

Field/soil management
- Seed bed preparation
- Water management
- Nutrient placement
- Tillage type
- Mulching dead

Targeted control
- Hand weeding
- Patch/band spraying
- Weed seed collection & destruction
- Mowing
- Mechanical weeding
- Contact herbicide
- Systemic herbicides
- Flame weeding

Monitoring & evaluation
- Sensing technology
- Scouting
- DSS

Legend:
- Reducing impact of weeds on crop
- Reduce seed return
- Prevent establishment
- Supportive tactics

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Length of rotation

nr of crops in the rotation

Difficult species

Grasses
Agropyron repens
annual meadow grass (Poa annua)
Avena fatua (wild oat)
Avena sterilis
Blackgrass (Alopecurus myosuroides)
Bromus spp.
couch grass (Elymus repens)

Cyperus esclulentus
Digitaria spp
Echinochloa cruss-galli (barnyard grass)
foxtail (alopecurus and setaria spp)
Lolium multiflorum (annual ryegrass)
Lolium rigidum (rigid ryegrass)
Panicum spp
Phalaris spp.
pigweed
Setaria spp
Setaria viridis
silky bentgrass (Apera spica-venti)
Sorghum halepense
sterile broom
stir, twitch, cane
Vulpia myuros

Broad leaf
 Abutilon theophrasti
 Atriplex patula
Amaranthus retroflexus
Amaranthus spp.
Ambrosia artemisiifolia
Anthemis- Matricaria
bindweed (convolvulus)

Chenopodium sp (fat hen, white goo
Cirsium arvense
Convolvulus vulgare
Datura spp
Datura stramonium (Jimsonweed)
Fallopia japonica
Field Pansy (Viola arvensis)
Fumariaceae (Fumitory)
galinsoga parviflora
Galium aparine (cleavers)
Helianthus tuberosus
horsetail, cornflower
knotgrass (Polygonum aviculare)
Lamium purpureum
Papaver rhoeas
redshank?
Rumex obtusifolius
senecio vulgaris (common groundse
Sinapis arvensis (Charlock)
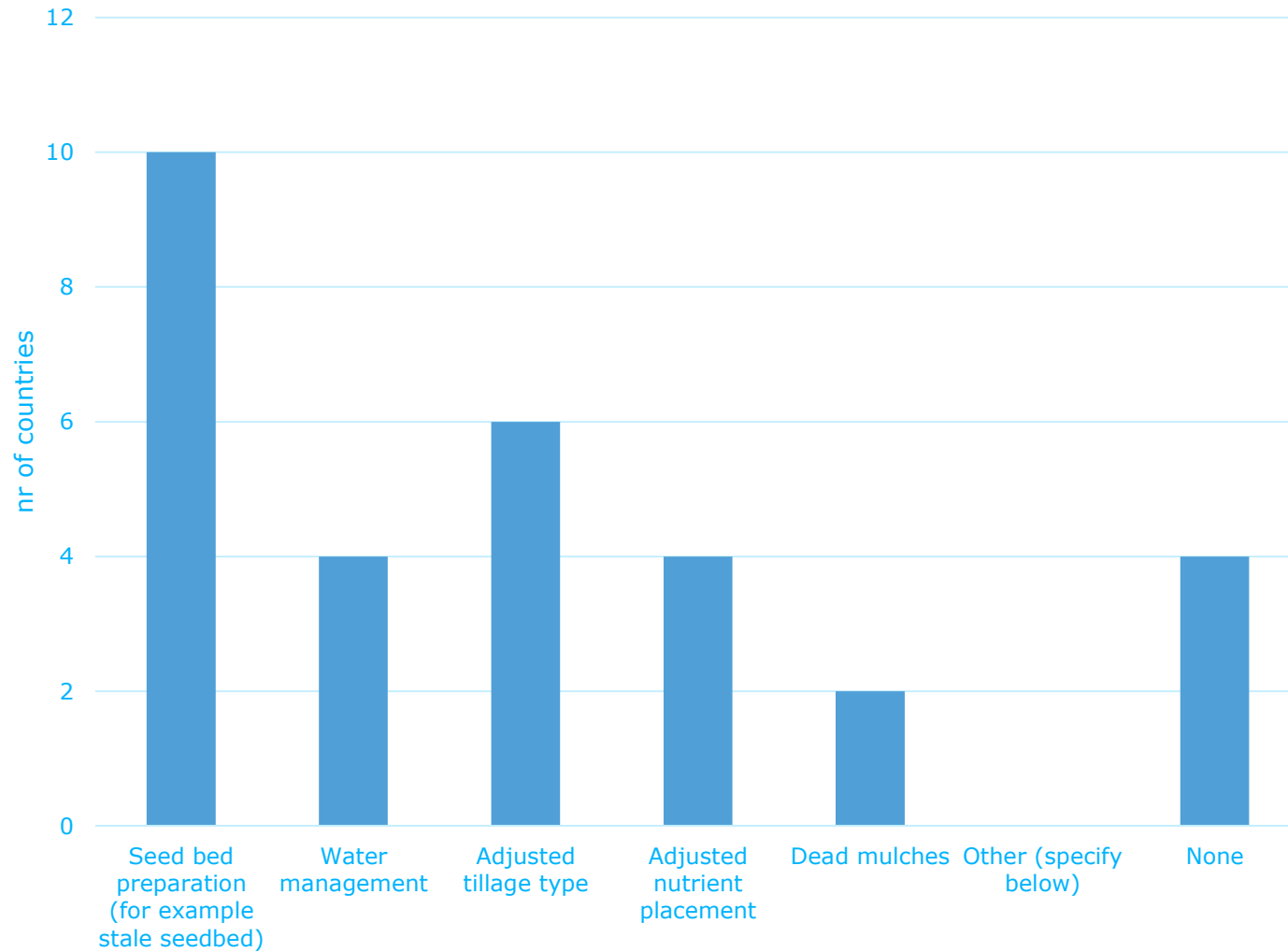Sinapis- Raphanus/ Ambrosia spp.
Solanum nigrum
stellaria media (chickweed)
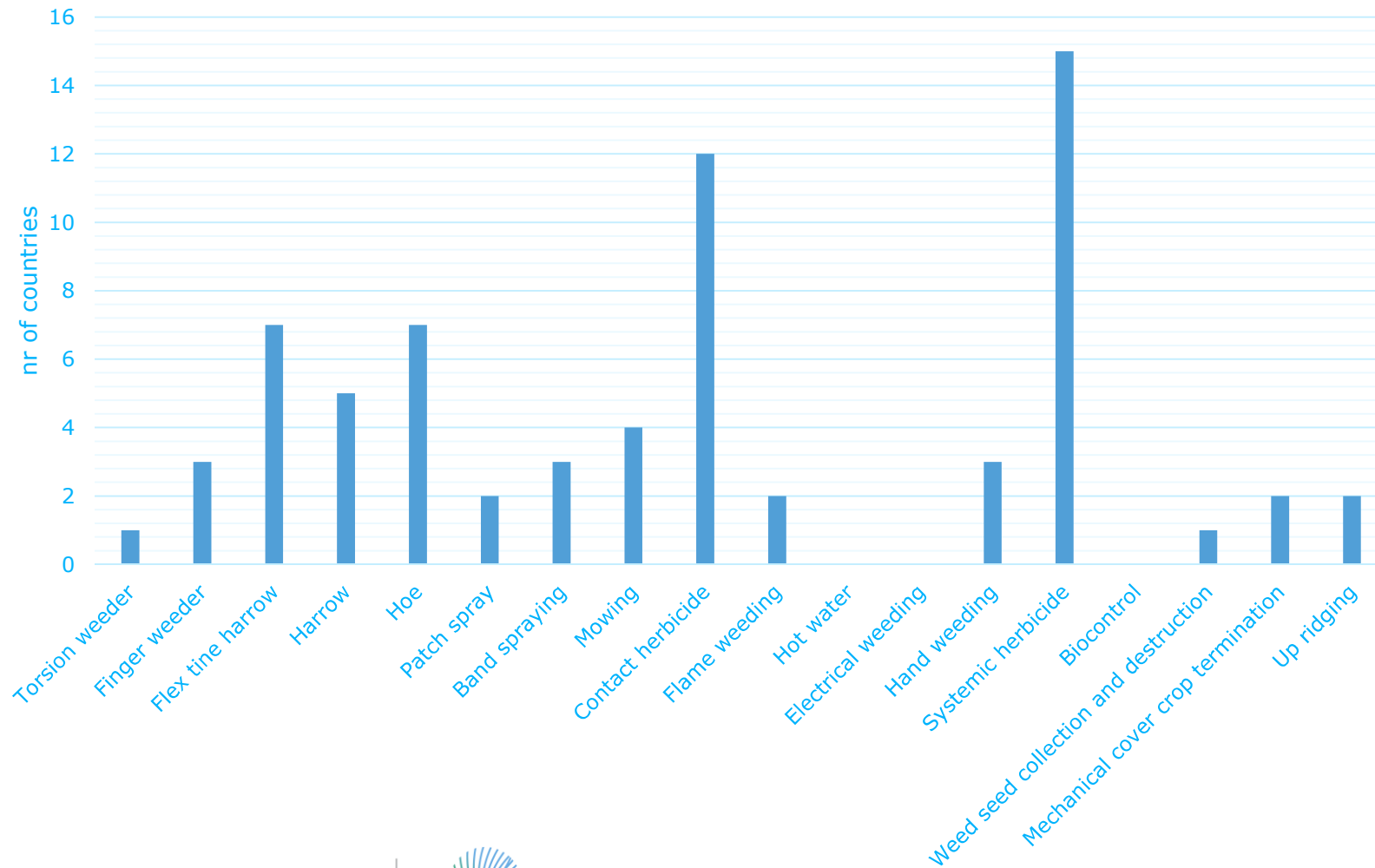
Diverse cropping system measures
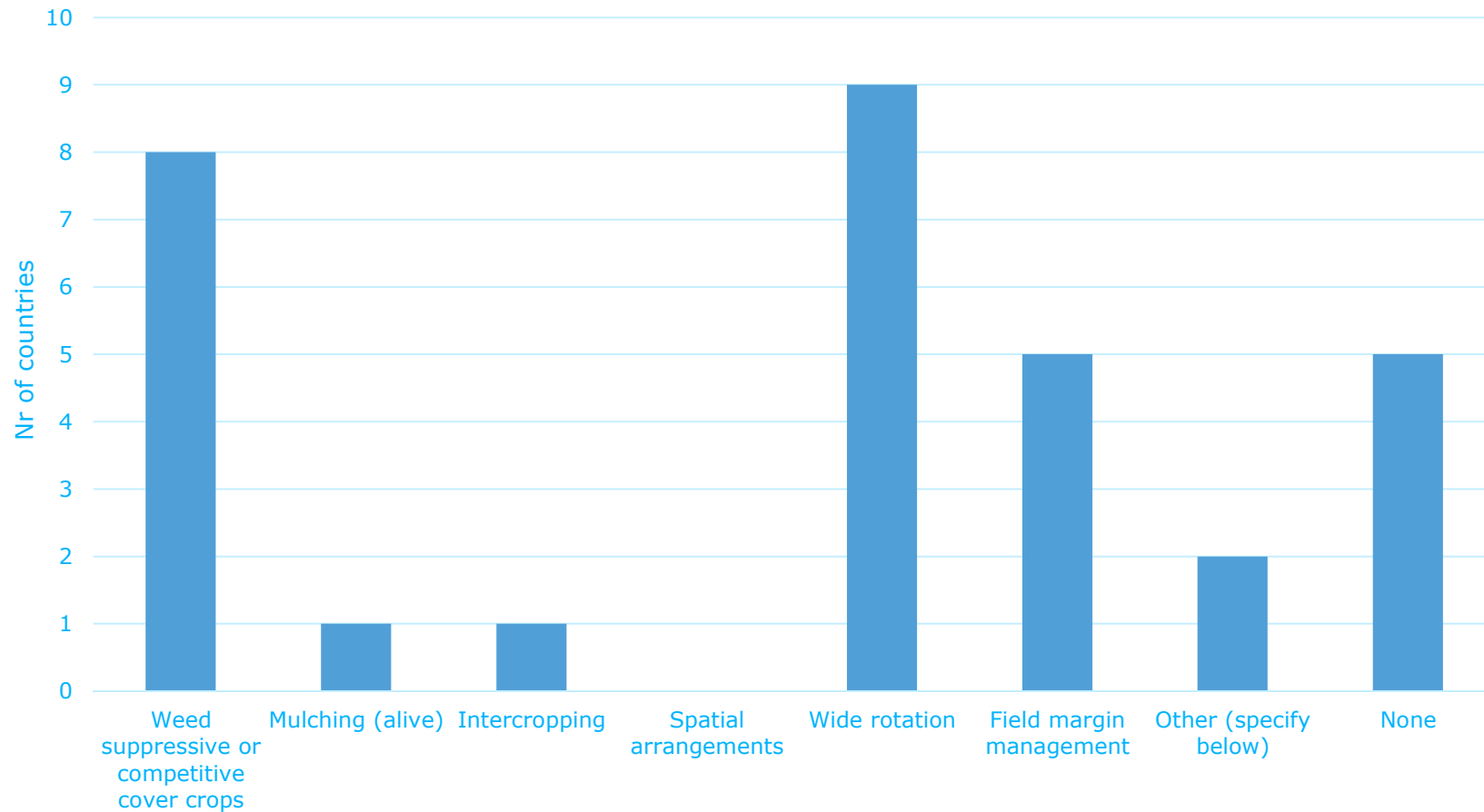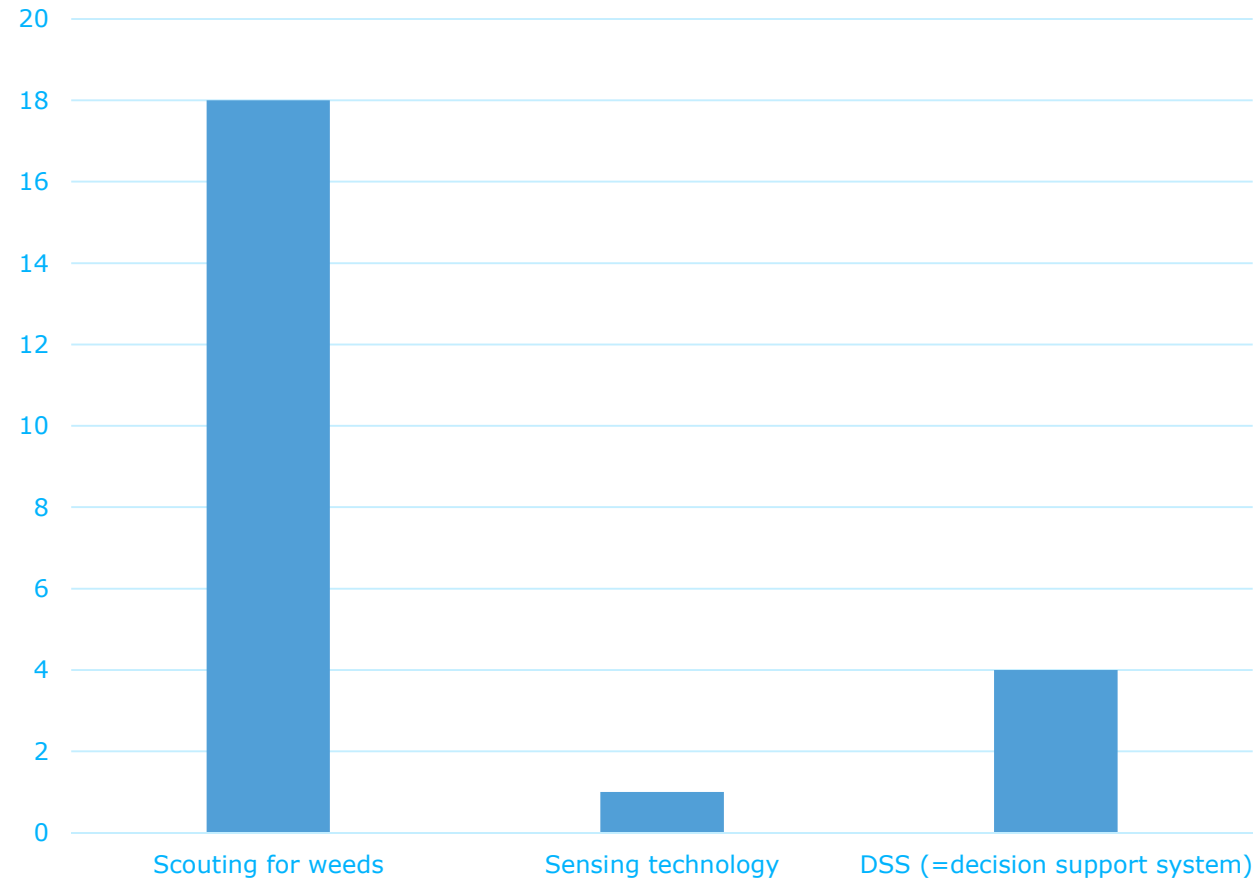
Cultivar choice and establishment
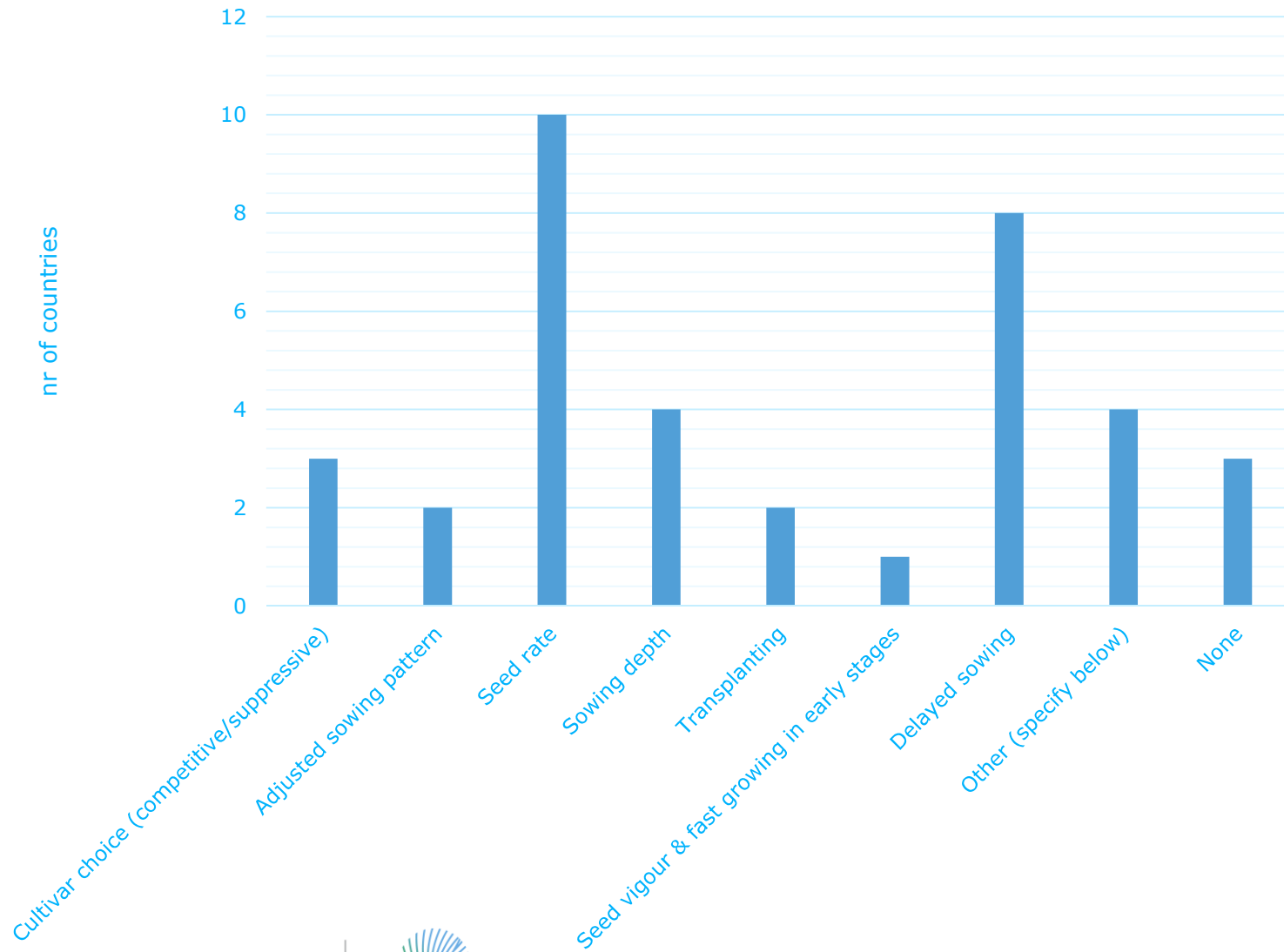
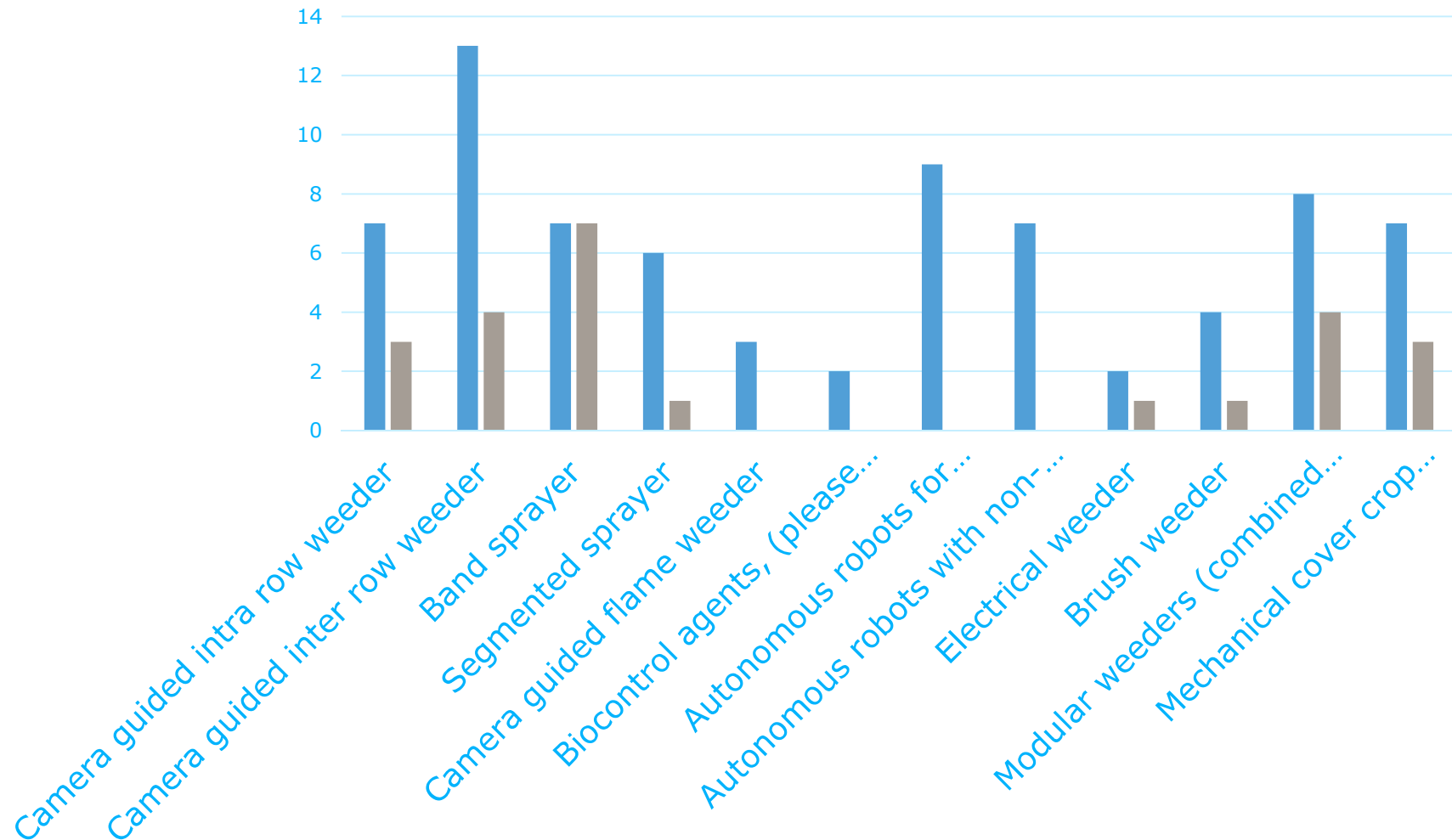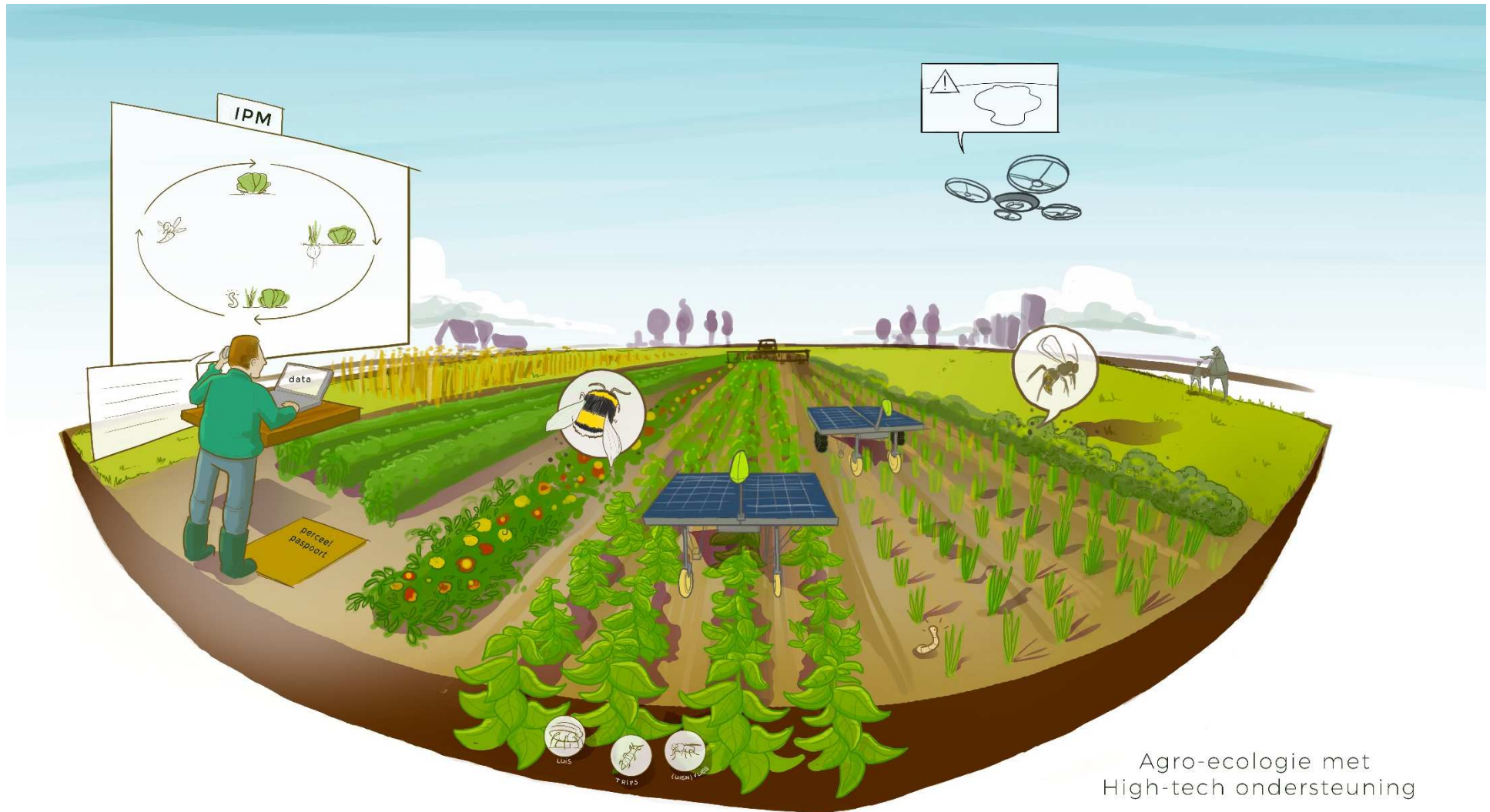# Field and Soil management

Targeted control

Monitoring and Evaluation

Direct control tools available & applied

Discussion!

Agro-ecologie met
High-tech ondersteuning