Title:

Effect of banker fields (oat and Indian cress) on aphids population recorded on potato crop under field conditions with respect to plant and soil biodiversity

IPM Trial Code:

THRITA22-02A Zeeland

Date study report:

23rd of February 2023

Investigator:

IPM Impact
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Sponsor:

Statement of confidentiality: confidentiality contract signed
Contract number: N/A

Guidelines:

The tests were done based on the EPPO Guidelines for efficacy evaluation of insecticides against aphids on outdoor crops.
These methods were adapted for this specific trial.

1. Guideline for the efficacy evaluation of plant protection products. Conduct and reporting of efficacy evaluation trials. (1993) Bulletin OEPP/EPPO Bulletin 23: 353-364.
2. EPPO Guidelines for efficacy evaluation of plant protection products. 1989. Bulletin OEPP/EPPO Bulletin 19: 183-247.
3. EPPO Guidelines PP 1/230(1) Aphids on potato

GLP: No

GEP: No

Principal investigator's report submission:

Name of principal investigator	*Date*	*Signature*
Guido Sterk	23rd of February 2023	
Paraskevi Kolokytha	23rd of February 2023	

Sponsor's report approval

Name of study monitor	*Date*	*Signature*

1. **OBJECTIVES OF THE TRIAL**

Effect of two banker fields (oat and Indian cress) on aphids population recorded on potato crop under field conditions with respect to plant and soil biodiversity

a. Introduction

Aphid damage is among the most serious of agricultural and horticultural problems. A pest aphid species may affect only a specific crop, a group of related crop hosts (e.g., crucifers), or be quite polyphagous within and between plant families. Many notoriously polyphagous aphid pests represent sibling species complexes that are morphologically identical but differ in karyotype. Generally, such aphid pests comprise anholocyclic clones, or biotypes, that differ in host preferences, the ability to transmit diseases, or resistance to pesticides.

About 450 species occur on crops, but only about 100 species pose significant economic problems. In detail, 14 aphids as the most serious agricultural pests: *Aphis craccivora*, *Aphis fabae*, *Aphis gossypii*, *Aphis spiraecola*, *Rhopalosiphum maidis*, *Rhopalosiphum padi*, *Schizaphis graminum*, *Acyrthosiphon pisum*, *Diuraphis noxia*, *Lipaphis pseudobrassicae*, *Macrosiphum euphorbiae*, *Myzus persicae*, *Sitobion avena*e and, *Therioaphis trifolii*.

Aphids cause damage and lower agricultural yields in several ways. They can build to high population densities, removing plant nutrients, and may damage plants by removing enough sap to cause withering and death. If not washed off, aphid honeydew excrement can build enough on plants to be a growth medium for sooty molds that impair photosynthesis and promote other fungal diseases. Salivary secretions of some aphids are phytotoxic, causing stunting, leaf deformation, and gall formation, which is of particular concern to horticulture. Even if otherwise asymptomatic, aphid-feeding effects may affect plant hormone balances changing host metabolism to their advantage and essentially hijacking the plant's physiological functions.

The most serious problem posed by aphids is the vectoring of plant viruses. Virus-infected plants often show an aphid-attractive yellowing and have increased free amino acids, so aphids benefit by virus transmission. Stylet-borne viruses, occurring on the aphid's epidermis, are not aphid specific. They are acquired quickly and transmitted during rostral probing of the plant's epidermis. These are nonpersistent viruses whose infectiousness is lost when the aphid molts. Circulative viruses, in contrast, live in the aphid's gut and require an incubation period before successful transmission. They are persistent viruses and an aphid, once infected, remains a vector for life. Circulative viruses have fairly specific virus–aphid–plant linkages and any given virus is transmitted by only one or few aphid species.

The two most common aphids on potatoes are the green peach aphid and the potato aphid. Both species occur statewide. The green peach aphid is usually the most common and abundant species; infestations typically begin on the bottom most leaves of the plant. Potato aphid infestations are generally scattered over the plant.

Aphids damage potatoes primarily by spreading plant diseases. Occasionally, aphids become so abundant that their feeding weakens the plants. Potato leafroll virus is spread by both aphids, but green peach aphid is by far the more effective vector. Early season leafroll infection stunts the plant. Plants grown from infected seed potatoes will not produce marketable potatoes.

b. Biology of the pest

Description: Aphids are small, from 1 to 7 mm long. They are soft-bodied and vary in shape and color. Their body shape may be pear-like, globular, oval, spindle-like, or elongated, and they may appear black, gray, red, orange, yellow, green, brown, blue-green, white-marked, or wax-covered. Adult aphids may be winged (alate) or wingless (apterous). Environmental changes usually trigger winged forms (e.g., decreasing photoperiod or temperature, deterioration of the host plant, or overcrowding). On the back of the fifth abdominal segment, a pair of tube-like structures called 'siphunculi' or 'cornicles (on Oleander Aphid) are present on most aphid species. These structures secrete a defensive fluid.

Life cycle: Simple metamorphosis; parthenogenic. Most aphids reproduce sexually and develop through gradual metamorphosis (overwintering diapause egg, nymphs and winged or wingless adults) but also through a process called 'parthenogenesis' in which the production of offspring occurs without mating. These aphids may even bear live young, instead of laying eggs. The average lifespan of an adult is approximately one month with sexual maturity reached in four to ten days. Under suitable environmental conditions, aphids' reproductive period is approximately three weeks. Aphids can be quite prolific and can reproduce faster than any other insect.

Type of feeding: Piercing and sucking. Aphids draw sap from plant tissues using mouthparts adapted for piercing and sucking. .

Habitat and food source(s):
They feed on all plant parts. Foliage, twigs, limbs, branches, fruits, flowers or roots may be affected, and after some time, cast whitish skins from the aphids' developmental stages will accumulate on infested plant parts.

Damage: Aphids injure plants by: 1) causing plant stress by directly removing plant juices (sap from phloem tissues); 2) reducing the aesthetic quality of infested plants by secreting a sugary liquid (excess plant sap called "honeydew") on which a black-colored fungus called "sooty mold" grows, discoloring the foliage and further stressing the plant from preventing sunlight from reaching plant cells for photosynthesis; and 3) possibly transmitting plant diseases, particularly viruses.

c. Liability of the used test method

The test method was adapted to the OEPP/EPPO guidelines for the efficacy evaluation of plant protection products (1989, 1993). The present study was designed to investigate the effect of two different banker fields (oat and Indian cress) on aphid population under field conditions concerning the plant and soil biodiversity. The role of oat and Indian cress banker fields on beneficial organisms, aphids control, and biodiversity enhancement was also studied.

Potatoes + banker fields

2. Material and methods

a. Treatment description

i. Pesticides Treatment list

INSECTICIDES APPLICATION

Experimental plot: Zeeland

Date	*Product*	*Active ingredient*	*Dose rate % prep.*	*Form.*	*Amount (liter/ha)*	*Application*	*Applic.Vol. (liter)*
27-6-22	**Coragen**	**chlorantranilipole**	**0.12**	**200 SC**	**0.012 kg/ha**	**spraying**	**0.133**

ii. Application description

Experimental field **:**

Date **:** 27th of June 2022
Product : Coragen
Application technique : spraying
Volume : 0.133 lt
Application placement : on potato plants
Spraying equipment :
Spraying technique :
Spraying pressure :

b. Trial description

The trial took place in a potato in Zeeland, the Netherlands. The trial is a field trial.

c. Plot description

Site type : Field
Surface : 2.21 ha
Plotsize : all field

d. Trial plan:

The experimental field consisted of a potato field (AARD) together with oat and Indian cress as banker fields.

e. Crop description

Crop : Potatoes
Variety : Hansa
Planting date : 29th of April 2022
Number of plants/ha : 1925
Substrate : sand
Trial's code name : AARD
Samples taken in the middle of the patato field: AARD+
Samples taken at the margins of the potato fields neighboring to banker fields: AARD-

Crop stage at application
BBCH stage :
Height of the plant :

f. Banker fields description

Banker plant A : Oat (*Avena sativa*, Poaceae)
Banker plant's code name : HAVER
Variety : Japanese oat
Planting date : 29th of April 2022
Number of plants/ha : 62.5
Substrate : sand

Banker plant B **:** Indian cress (*Tropaeolum majus*, Tropaeolaceae)
Banker plant's code name : OIK
Variety :
Planting date : 29th of April 2022
Number of plants/ha : 6.67
Substrate : soil

g. Target description

Scientific name : Homoptera: Aphididae
English name : aphids
Strain : N/A
Source : natural population
Way of release : existing infestation
Stage(s) of the beneficial
Introduction : Mixed population
Treatment : Mixed population

Alternative food source(s) : N/A
Additional food source(s) : N/A

h. Climatic conditions during the trial

Mean Temperature : 13-28 °C
Mean Relative Humidity : 40-80% RH

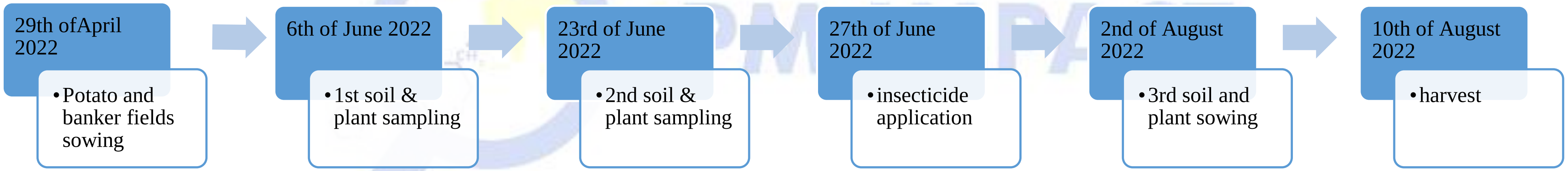
3. TIME LINE

a. Introduction

The trials were carried out in the summer of 2022.

b. Clear time line of the trial with date of application, introduction, assessment

Crop: Potatoes



4. ASSESSMENTS

a. Assessments description

- On potato plants

Method
Counting on : the extractions of the potato plants through Tullgren (Berlese) funnels methods
Parameters : larvae, pupae, and adults of thrips
: All stages of living organisms
Dates of assessment for potatoes : 6th of June 2022
25th of June 2022
2nd of August 2022
Stage of the pest : mixed population

- On banker plants

Method
Counting on : the extractions of banker field plants through Tullgren (Berlese) funnels method
Parameters : larvae, pupae, and adults of thrips
: All stages of living organisms
Dates of assessment : 6th of June 2022
25th of June 2022
2nd of August 2022
Stage of the pest : mixed population

- Soil samples

Method
Counting on **:** the extractions of 2 L soil through Tullgren (Berlese) funnels method
Parameters : all living organisms
Dates of assessment for potatoes : 6th of June 2022
25th of June 2022
2nd of August 2022
Stage of the pest : nymphs (and adults)

b. RESULTS

Potatoes and banker plants

- Thrips

Nb.	Fields 06-06-22	Thrips adults	Thrips pupae	Thrips larvae	Mean number of thrips adults & larvae
3	AARD+	1	0	2	
4	AARD-	16	5	35	
5	HAVER+	4	0	7	

Nb.	Fields 23-06-22	Thrips adults	Thrips pupae	Thrips larvae	Mean number of thrips adults & larvae
3	AARD+	15	7	16	
4	AARD-	0	1	2	
5	HAVER+	2	0	43	
Nb.	Fields 02-08-22	Thrips adults	Thrips pupae	Thrips larvae	Mean number of thrips adults & larvae
2	OIK+	5	7	84	9.60
3	AARD+	3	3	26	3.20
4	AARD-	1	1	2	0.40
5	HAVER+	31	6	40	7.70

- Aphids

Nb.	Fields 06-06-22	aphids
3	AARD+	3
4	AARD-	13
5	HAVER+	21

Nb.	Fields 23-06-22	aphids
3	AARD+	5
5	HAVER+	14
6	HAVER-	3
9	PH	0
10	KLAVER	0
Nb.	Fields 02-08-22	aphids
2	OIK+	1
3	AARD+	1
4	AARD-	0
5	HAVER+	29

- **Beneficial and other arthropods**

Nb.	Fields 06-06-22	Neuroptera eggs	Neuroptera Larvae	Miridae nymphs	Anthocoridae adults	Anthocoridae nymphs	Mites	predatory mites
3	AARD+	0	0	0	0	0	21	5
4	AARD-	0	0	0	0	0	131	7
5	HAVER+	0	0	0	0	0	1414	19

Nb.	Fields 23-06-22	Neuroptera eggs	Neuroptera Larvae	Miridae nymphs	Anthocoridae adults	Anthocoridae nymphs	Mites	predatory mites
3	AARD+	0	1	3	13	16	4	11
4	AARD-	0	0	0	4	0	8	8
5	HAVER+	0	0	5	0	0	58	5
Nb.	**Fields 02-08-22**	**Neuroptera eggs**	**Neuroptera Larvae**	**Miridae nymphs**	**Anthocoridae adults**	**Anthocoridae nymphs**	**Mites**	**predatory mites**
2	OIK+	0		9	0	2	16	1
3	AARD+	0		3	0	1	123	2
4	AARD-	0		0	0	1	148	1
5	HAVER+	0		2	0	1	83	2

Nb.	Fields 06-06-22	midge flies adults	midge flies larvae	maggot flies adults	maggot flies larvae	Diptera adults	Diptera larvae
3	AARD+	0	0	2	0	0	145
4	AARD-	0	0	3	0	0	60
5	HAVER+	11	0	2	3	2	1

Nb.	Fields 23-06-22	midge flies adults	midge flies larvae	maggot flies adults	maggot flies larvae	Diptera adults	Diptera larvae
3	AARD+	3	0	2	0	1	2
4	AARD-	6	0	2	0	1	1
5	HAVER+	7	0	0	4	2	3
Nb.	**Fields 02-08-22**	**midge flies adults**	**midge flies larvae**	**maggot flies adults**	**maggot flies larvae**	**Diptera adults**	**Diptera larvae**
2	OIK+	48	0	0	0	0	1
3	AARD+	21	0	0	0	0	0
4	AARD-	0	1	1	0	0	4
5	HAVER+	3	0	1	0	0	0

Nb.	Fields 06-06-22	Staphylinidae adults	Staphylinidae larvae	Carabidae adults	Coleoptera larvae	Chrysomelidae adults
3	AARD+	1 *Proteinus* sp.	0	0	0	0
4	AARD-		12	0	1	0
5	HAVER+	1	11	0	5	0

Nb.	Fields 23-06-22	Staphylinidae adults	Staphylinidae larvae	Carabidae adults	Coleoptera larvae	Chrysomelidae adults
3	AARD+	0	0	0	1	0
4	AARD-	0	0	0	0	0
5	HAVER+	0	0	0	5	1 *Epitrix* sp.

Nb.	Fields 02-08-22	Staphylinidae adults	Staphylinidae larvae	Carabidae adults	Coleoptera larvae	Chrysomelidae adults
2	OIK+	0	2	1	3	0
3	AARD+	0	0	0	1	0
4	AARD-	0	0	0	0	3 *Leptinotarsa 10lineata*
5	HAVER+	1	1	0	5	0

Nb.	Fields 06-06-22	Collembola	spiders	Hymenoptera (parasitoids)	Psocoptera	Cicadelidae Nymphs	Corolophydae Aults
3	AARD+	0	1	1	2	0	0
4	AARD-	1	1	1	1	0	1
5	HAVER+	10	0	1	2	0	2

Nb.	Fields 23-06-22	Collembola	spiders	Hymenoptera (parasitoids)	Psocoptera	Cicadelidae Nymphs	Corolophydae Aults
3	AARD+	1		2	0	0	0
4	AARD-	1		0	1	0	0
5	HAVER+	9	1	1	0	0	0

Nb.	Fields 02-08-22	Collembola	spiders	Hymenoptera (parasitoids)	Psocoptera	Cicadelidae Nymphs
2	OIK+	1	1	0	2	0
3	AARD+	1	0	0	4	2
4	AARD-	0	0	0	1	0
5	HAVER+	1	0	0	0	6

Nb.	Fields 06-06-22	Corolophydae Aults	Lepidoptera larvae
3	AARD+	0	0
4	AARD-	1	3
5	HAVER+	2	0

Nb.	Fields 23-06-22	Corolophydae Aults	Lepidoptera larvae
3	AARD+	0	0
4	AARD-	0	0
5	HAVER+	0	0

Soil

- Soil Mesofauna

Nb.	Fields 06-06-22	Midge fly adults	Midge fly larvae	Maggor flies larvae	Diptera Larvae
3	AARD+	1	0	0	0
4	AARD-	0	0	0	0
5	HAVER+	0	0	4	2

Nb.	Fields 23-06-22	Midge fly adults	Midge fly larvae	Maggor flies larvae	Diptera Larvae
3	AARD+	0	4	0	0
6	AARD-	1	0	0	0
5	HAVER+	0	2	0	0
9	PH	0	0	0	0
10	KLAVER	0	0	0	0

Nb.	Fields 02-08-22	Midge fly adults	Midge fly larvae	Maggor flies larvae	Diptera Larvae
3	AARD+	4	0	0	0
4	AARD-	0	0	0	0
1	OIK+	0	0	0	0
5	HAVER+	0	0	0	0

Nb	Fields 06-06-22	mites	Predatory mites	Collembola	nematodes	Staphylinidae adults	Staphylinidae/ Coleoptera larvae
3	AARD+	118	17	1	4	0	0
4	AARD-	201	9	0	0	0	5
5	HAVER+	17	1	5	0	4	2

Nb.	Fields 23-06-22	- mites	Predatory mites	Collembola	nematodes	Staphylinidae adults	Staphylinidae/ Coleoptera larvae
3	AARD+	223	1	6	3	0	0
6	AARD-	497	2	8	2	0	0
5	HAVER+	70	2	2	11	0	0
9	PH	23	0	0	0	0	0
10	KLAVER	10	1	1	0	0	0

Nb.	Fields 02-08-22	- mites	Predatory mites	Collembola	nematodes	Staphylinidae adults	Staphylinidae/ Coleoptera larvae
3	AARD+	63	4	5	4	0	0
4	AARD-	15	5	0	0	0	1
1	OIK+	747	2	52	0	0	0
5	HAVER+	23	0	0	0	0	0

Nb.	Fields 06-06-22	Psocoptera	thrips larvae	aphids	Nitidulidae Adults	Hymenoptera (parasitoids)	Carabidae adults
3	AARD+	1	1	0	0	0	0
4	AARD-	1	0	1	0	0	0
5	HAVER+	1	4	0	0	0	1 *Bembidion* sp.

Nb.	Fields 23-06-22	Psocoptera	thrips larvae	aphids	Nitidulidae Adults	Hymenoptera (parasitoids)
3	AARD+	0	0	0	0	0
6	AARD-	0	0	0	0	0
5	HAVER+	0	0	0	0	1
9	PH	0	0	0	0	0
10	KLAVER	0	0	0	0	0

Nb.	Fields 02-08-22	Psocoptera	thrips larvae	aphids	Nitidulidae Adults
3	AARD+	1	0	0	0
4	AARD-	0	0	0	0
1	OIK+	1	2	0	1 *Cryptarcha* sp.
5	HAVER+	0	0	0	0

c. Discussion

i. Thrips on plants

Larva, pupae and adult thrips were detected in the two first samplings (6th, and 23rd of June) in the potato and banker fields, but in low numbers (Fig. 1). In the third sampling (2nd of August), no pupae were collected. The highest numbers of the sampling period were recorded at the banker fields (OIK+ and HAVER+) at the end of August. Concerning the thrips infestation in the potato field, the potato plot next to the oat (AARD-) was hosting a high number of thrips, early in the sampling period, but later on, thrips infestation at this point was less than in the middle of the potato field (AARD+).

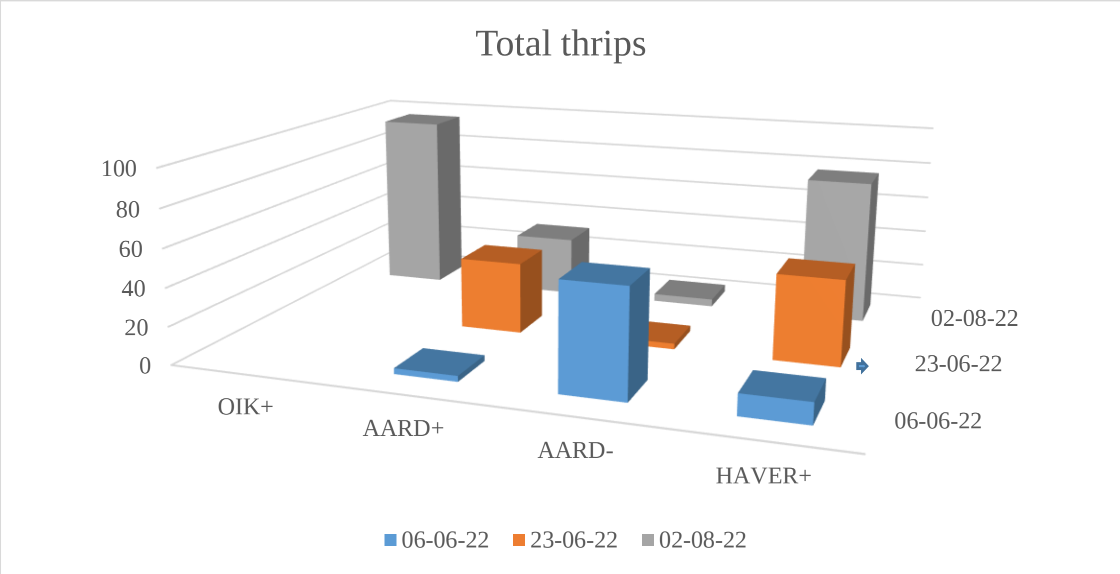


Figure 1 Total thrips' number per plot and sampling date

ii. Aphids

A limited amount of aphids was also recorded on potato plants throughout the sampling season (Fig. 2). The highest number of aphids was found on the potato plot next to the oat (AARD-) (13 individuals) at the beginning of June. Nevertheless, potato plants' aphids were fewer than those collected from oats. The highest number of aphids (29 individuals) was found in the oat plot at the beginning of August.

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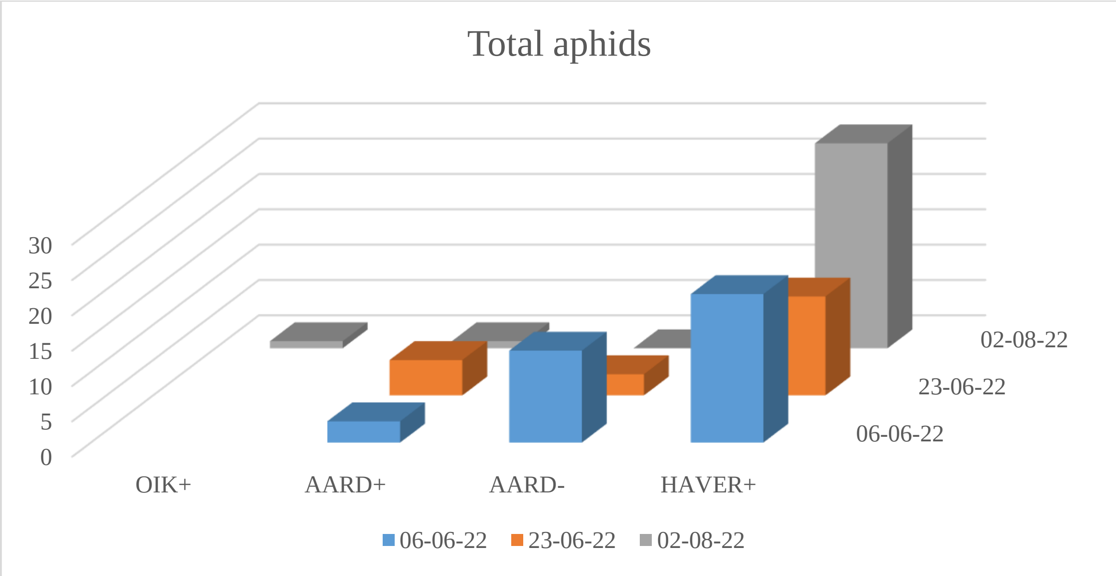

Figure 2. Total aphids number per plot and sampling date.

iii. Plant mesofauna and beneficial organisms

In Figure 3, the plant mesofauna, thrips excluded, is presented. Our findings showed that plant mesofauna was poorer this year than in previous years (authors' observations). Exceptionally, oat hosted many mesofauna organisms (1505 individuals), mainly consisting of mites. The mesofauna that was collected in the potato fields was also higher during this sampling (AARD+: 181 and AARD-: 235 individuals). By the end of June, the number decreased in the potato and oat fields (AARD+: 65, AARD-: 38 and HAVER+: 160 individuals). At the beginning of August, the mesofauna's numbers followed an increase, especially in the potato fields, with similar recorded numbers throughout the sampling fields.

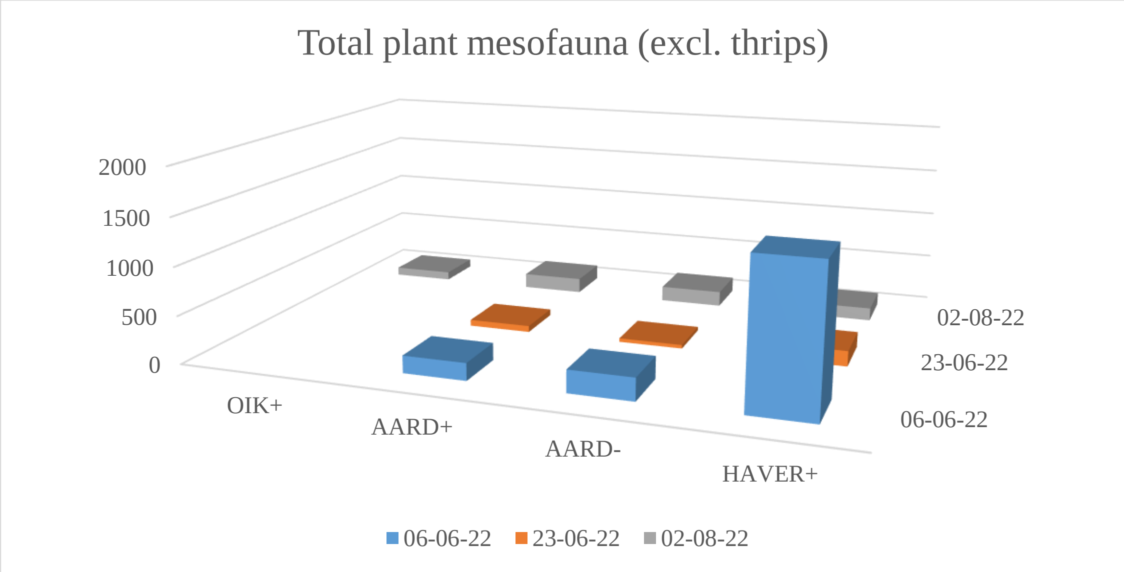

Figure 3 Total plant mesofauna (thrips excluded) per plot and sampling date

Among the recorded mesofauna, many beneficial organisms were collected. The essential beneficials belonged to Chrysopidae, Miridae and Anthocoridae, Staphylinidae and Carabidae, predatory mites, parasitoids, and spiders.

At the beginning of June sampling, oat plants presented the highest records of beneficials (37 individuals) (Fig 4). At the end of this month, the main potato field (AARD+) was hosting many beneficials (36 individuals). At the beginning of August sampling, the beneficials collected from the banker fields were more than the ones collected from the potato plants.

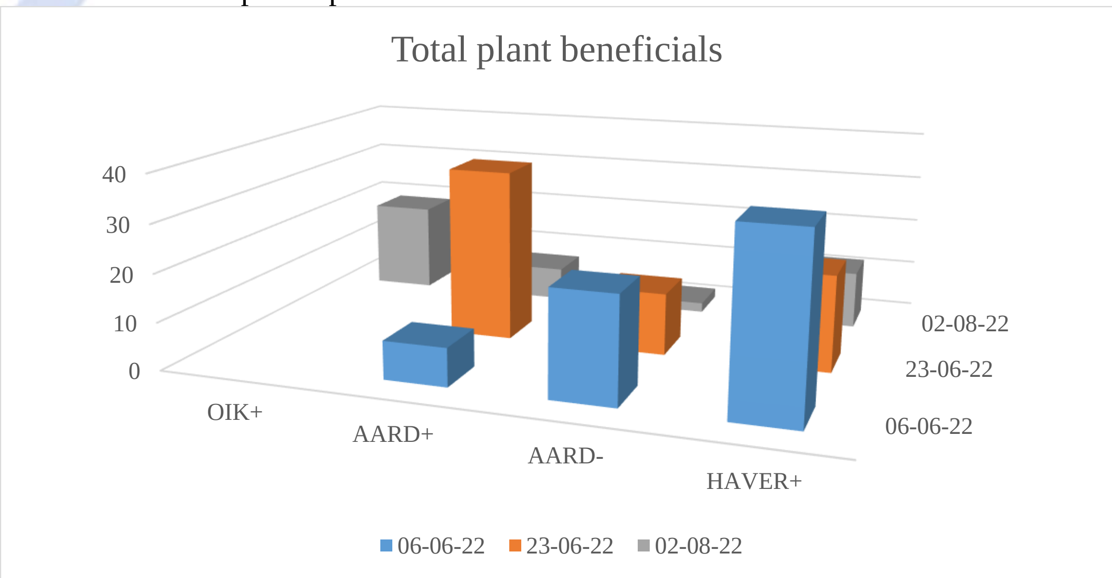

Figure 4 Total number of beneficial organisms per plot and sampling date

Specifically, just two larvae of lacewings were collected throughout the sampling period.

The predatory and minute pirate bugs, which belong to Miridae and Anthocoridae families, had highly inhabited the main potato field at the end of June (33 individuals (Fig. 5). On the same sampling date, four and five individuals were recorded at the potato next to the oat plot and oat field, respectively. Indian cress was hosting 11 individuals by the last sampling, while the potato plants had fewer (4 and 1 individuals). No predatory Hemitera were recorded at the beginning of June.

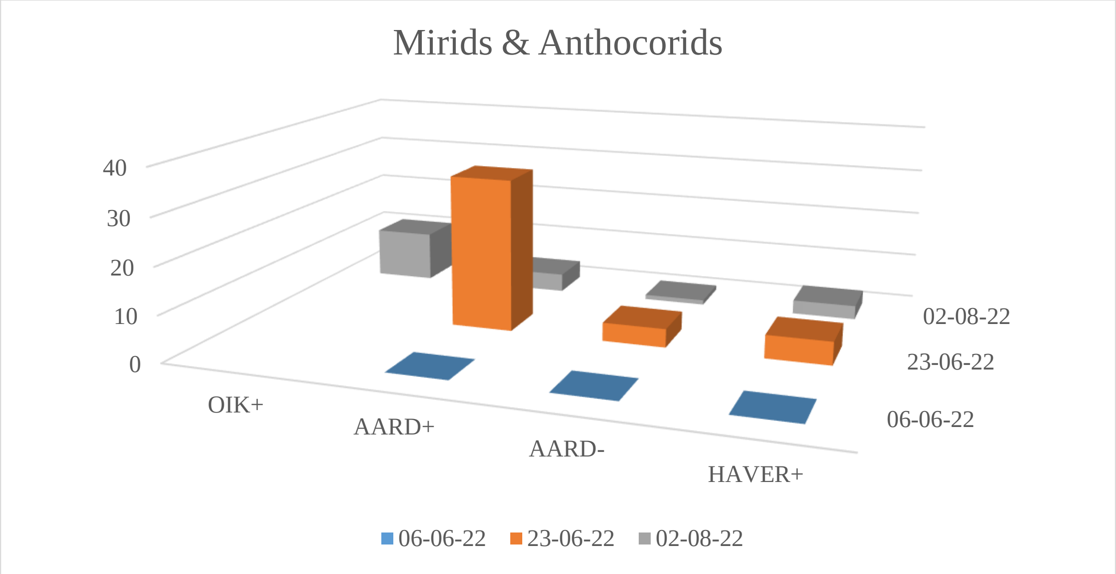

Figure 5 Total number of predatory and minute pirate bugs per plot and sampling date

Twelve rove beetles were collected from the oat field and the potato field next to the oat (AARD-) at the beginning of June (Fig. 6). These were the highest recorded numbers for rove beetles throughout the sampling period. None rove beetle larvae nor adults were found in all sampled plots on the 23rd of June. Similarly, no rove beetles were found on potato plants at the beginning of August. On this same date, two rove beetles were collected from the oat and Indian cress samples, respectively.

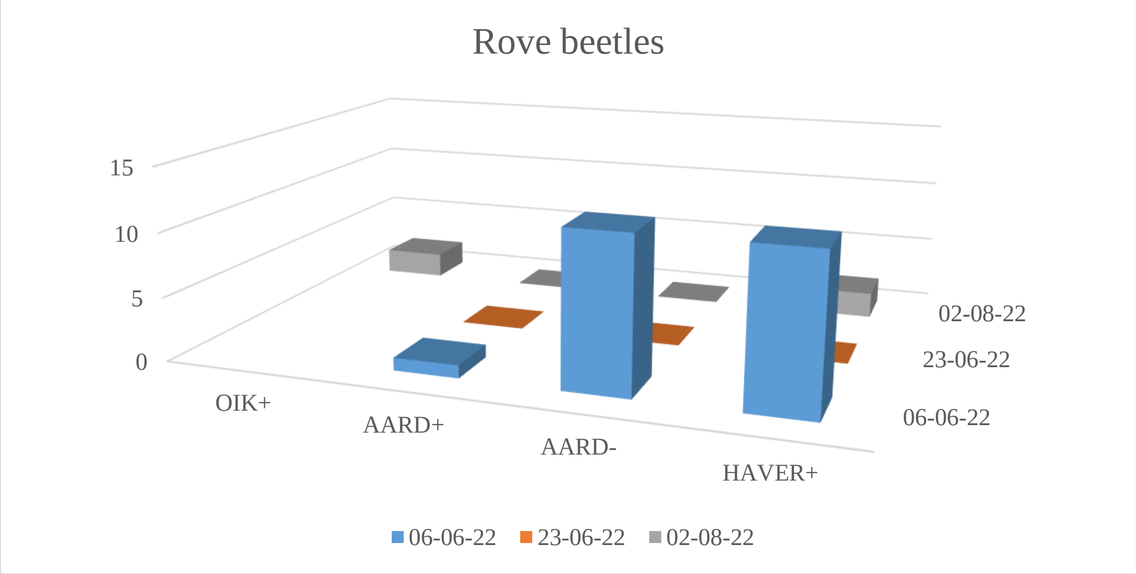

Figure 6 Total number of rove beetles per plot and sampling date

An equal number of five ground beetles were detected in the oat plot along the three sampling dates (Fig. 7). Apart from these recordings, carabids were found at the Indian cress field (4 individuals), as well as in potato plots (AARD+ and AARD-) but with lower numbers (one individual).

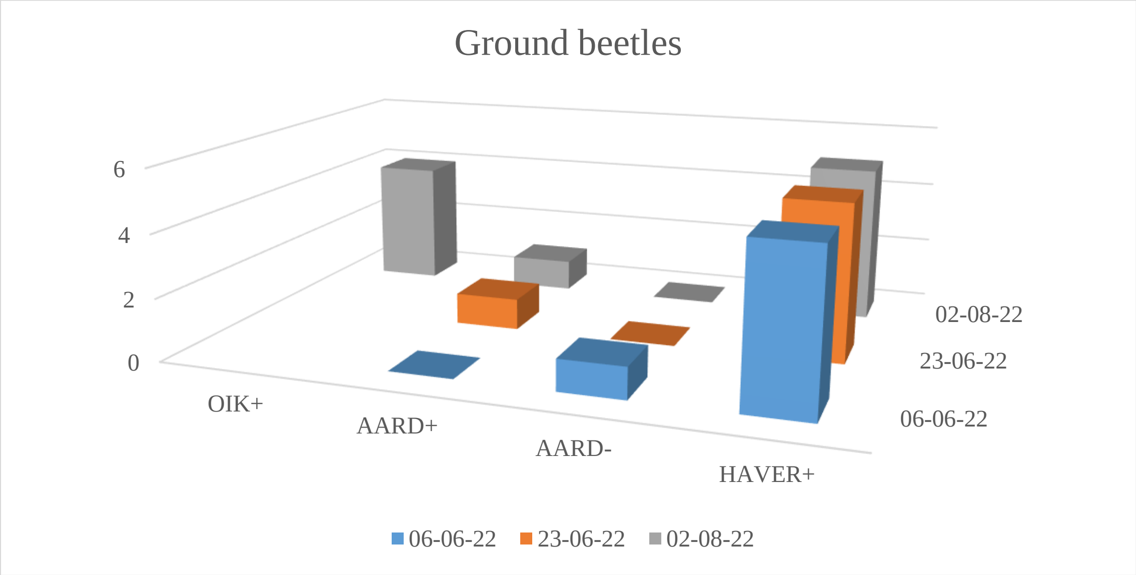

Figure 7 Total number of ground beetles per plot and sampling date

Finally, several predatory mites were collected from all plots at all three sampling dates (Fig. 8). Predatory mites were mainly recorded in the oat plot (19 individuals) and the potato plots. The highest numbers were found at the beginning and

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end of June. At the beginning of August, low numbers of one to two predatory mites were collected at all sampled plots (potatoes and banker fields).

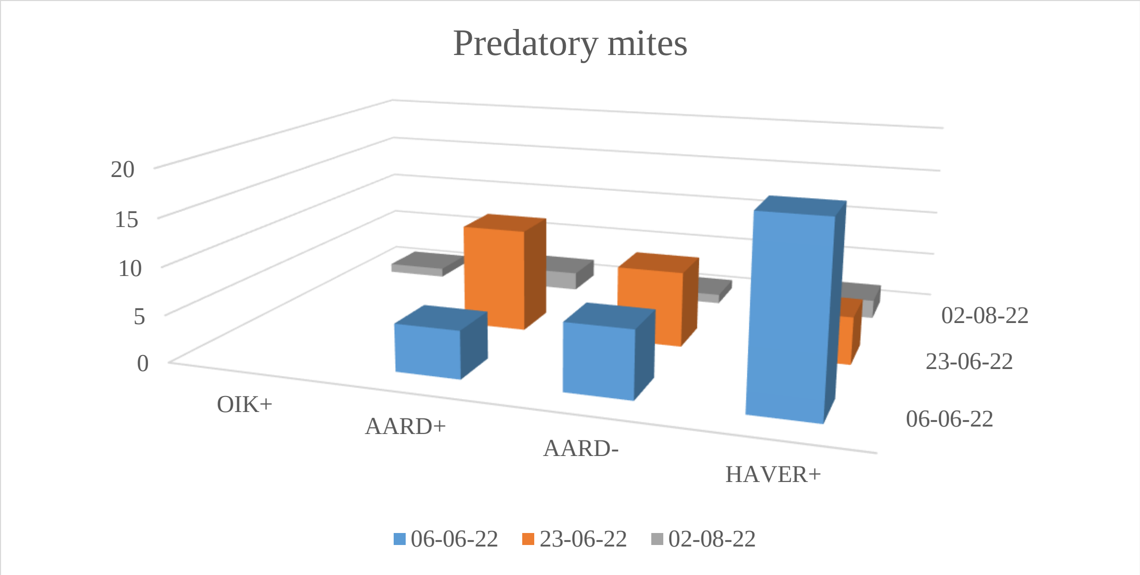


Figure 8 Total number of predatory mites per plot and sampling date

Hymenopteran parasitoids are considered one of the essential beneficials for aphid control. However, their numbers were also low, detected only at the first and second samplings (Fig. 9). Their low number may be derived from the low host number and the mesofauna's extracting method.

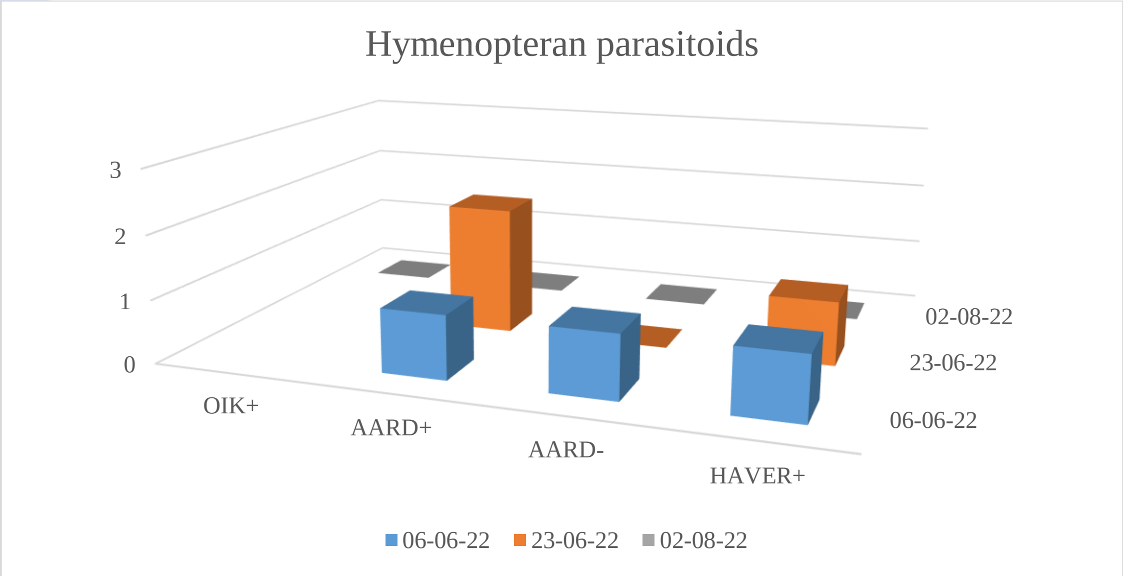


Figure 9 Total number of Hymenopteran parasitoids per plot and sampling date

iv. Soil mesofauna

In general, the soil mesofauna was relatively limited, according to Figure 10, compared with other experimental locations of the same year (authors' observations). The mesofauna that was collected at the Indian cress on the 2nd of August was the highest record from this year's plot (805 individuals). The second high record was the potato soil mesofauna next to the oat plot (510 individuals). In general, oat soil mesofauna was relatively poor throughout this year's samples, as the highest value was 88 individuals on the 23rd of June. Moreover, soil from the potato plot next to the oat (AARD-) presented approximately double the number of mesofauna organisms compared to the main potato field (AARD+). In August, the mesofauna numbers were low in potato and oat fields, ranging from 21 (AARD+) to 81 individuals (AARD+).

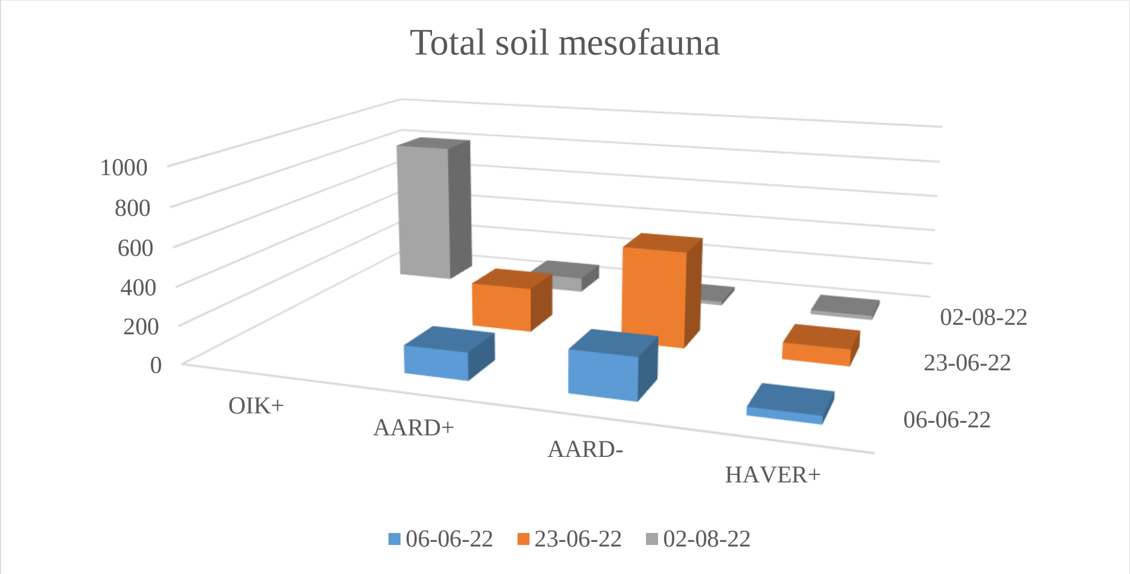


Figure 10 Total soil mesofauna per plot and sampling date

The beneficial soil mesofauna mainly consisted of predatory mites and rove beetles. Inadequate numbers of beneficial soil organisms and sampling dates were recorded in most of the tested plots. The highest soil-dwelling beneficial number was recorded in the main potato field at the beginning of June (17 individuals). The majority of soil beneficials were recorded in the potato and oat fields on the same date (Fig. 11). In the second sampling date low numbers were recorded in all plots (6 beneficials in total). The number of beneficials increased at the last sampling but remained low-level compared to other experimental plots of this year (authors' observations).

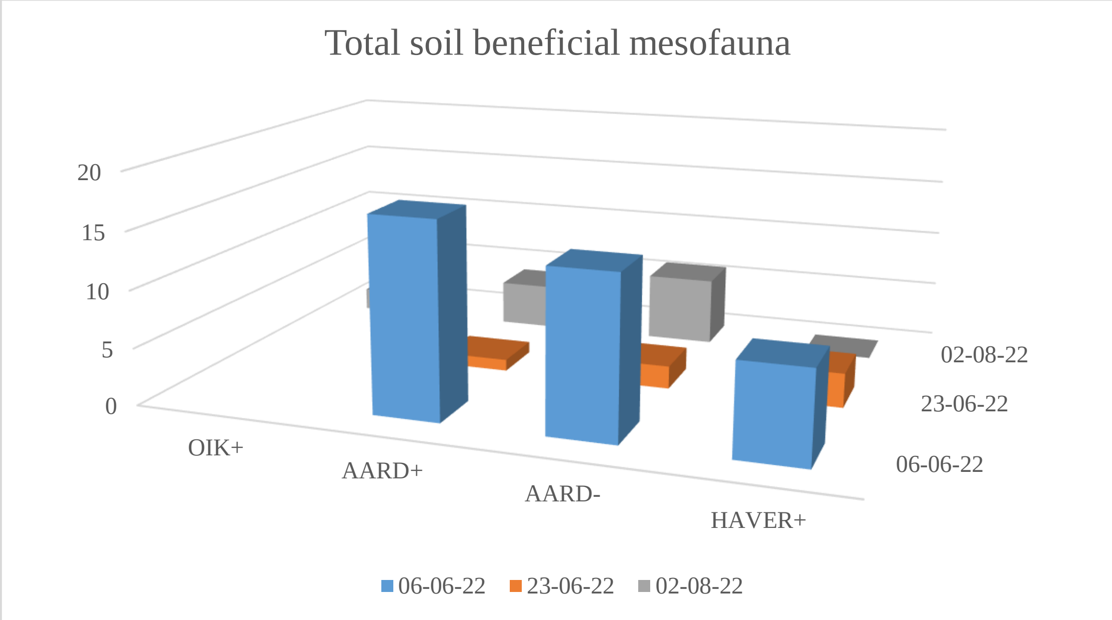


Figure 11 Total soil beneficial mesofauna per plot and sampling date

The highest number of soil-dwelling predatory mites was recorded in the main potato (AARD+) and potato next to oat (AARD-) plots (17 and 9 individuals, respectively) at the first sampling (Fig. 12). On the other hand, low numbers of soil-dwelling predatory mites were recorded in all plots on the 2nd and 3rd samplings, Oat field hosted scarcely any soil-dwelling predatory mite at all samplings throughout this year's trial.

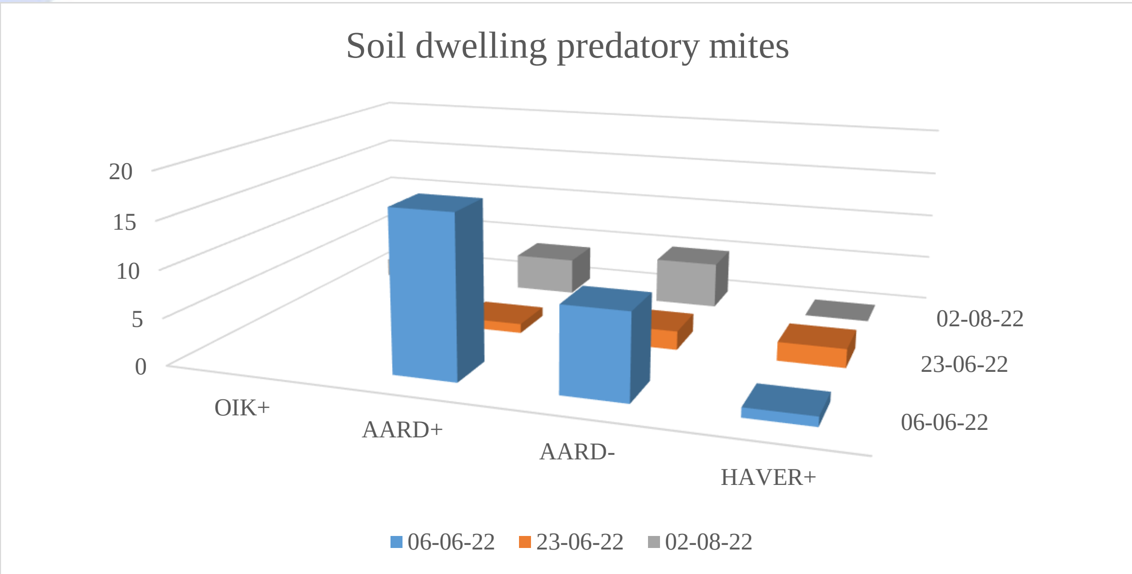


Figure 12 Total soil-dwelling predatory mites per plot and sampling date

Rove beetles that were collected from the soil samples (Fig. 13) were similarly distributed to those collected on plants (Fig. 6). On plants and soil, a high number of rove beetles was collected on the potato plot next to oat, and oat plots (5 and 6 individuals, respectively) on the begin of June. Further on, their numbers were eliminated in almost all plots.

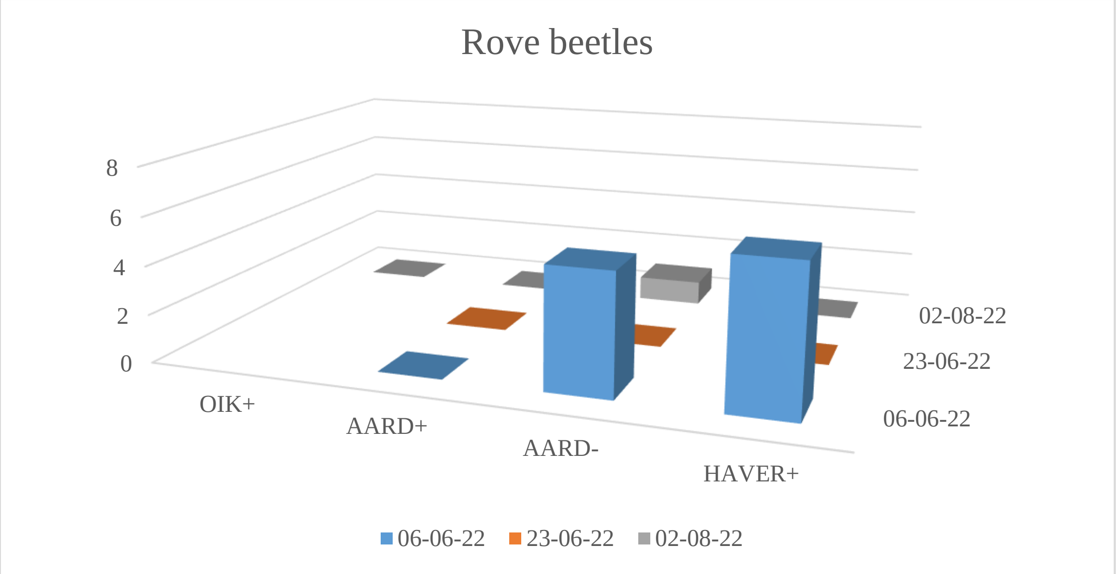


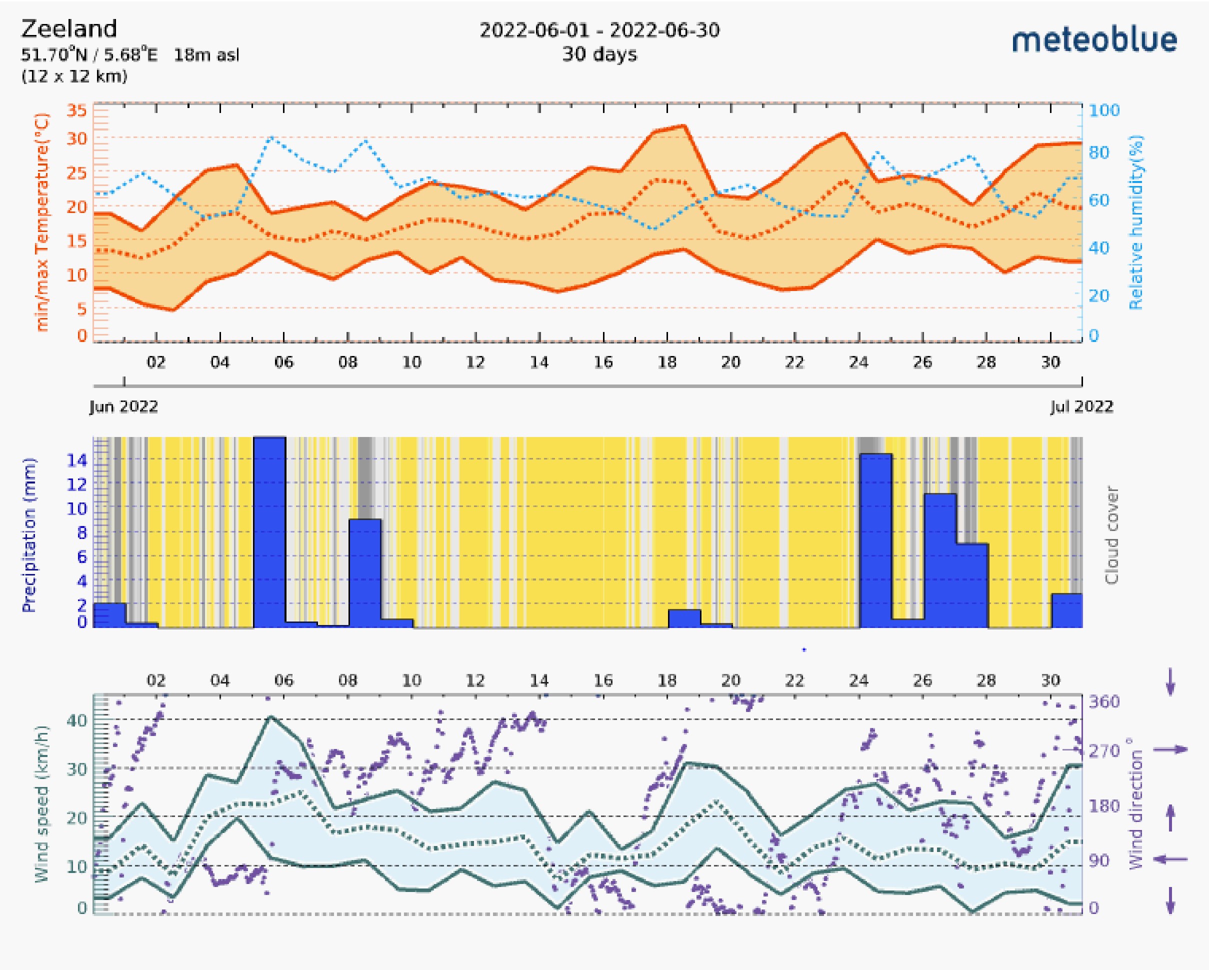
Figure 13 Total number of rove beetles in soil per plot and sampling date

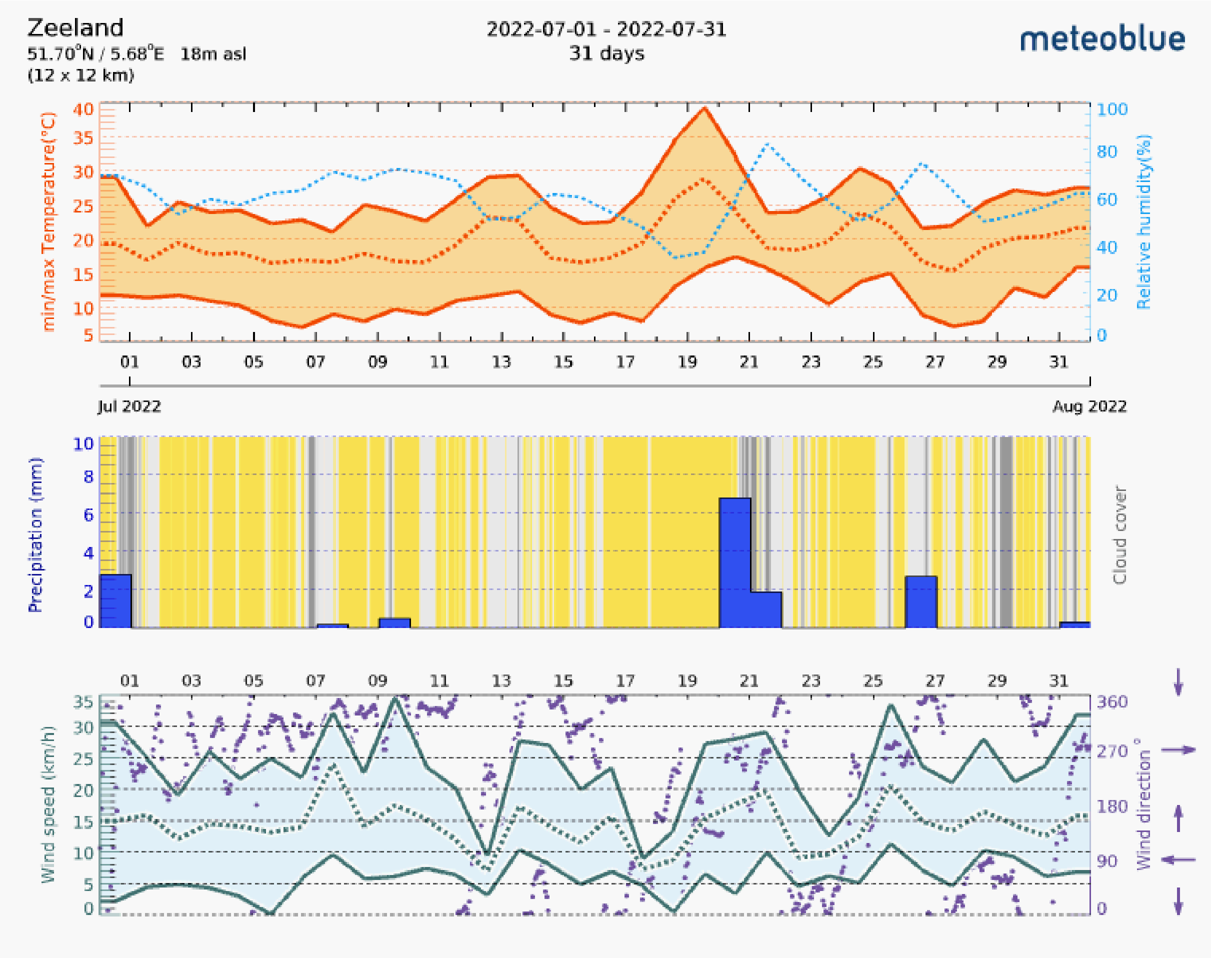
Notably, no earthworms were collected during this year's sampling in all plots. Moreover, ground beetles were so inadequate that can not lead us to a safe conclusion.

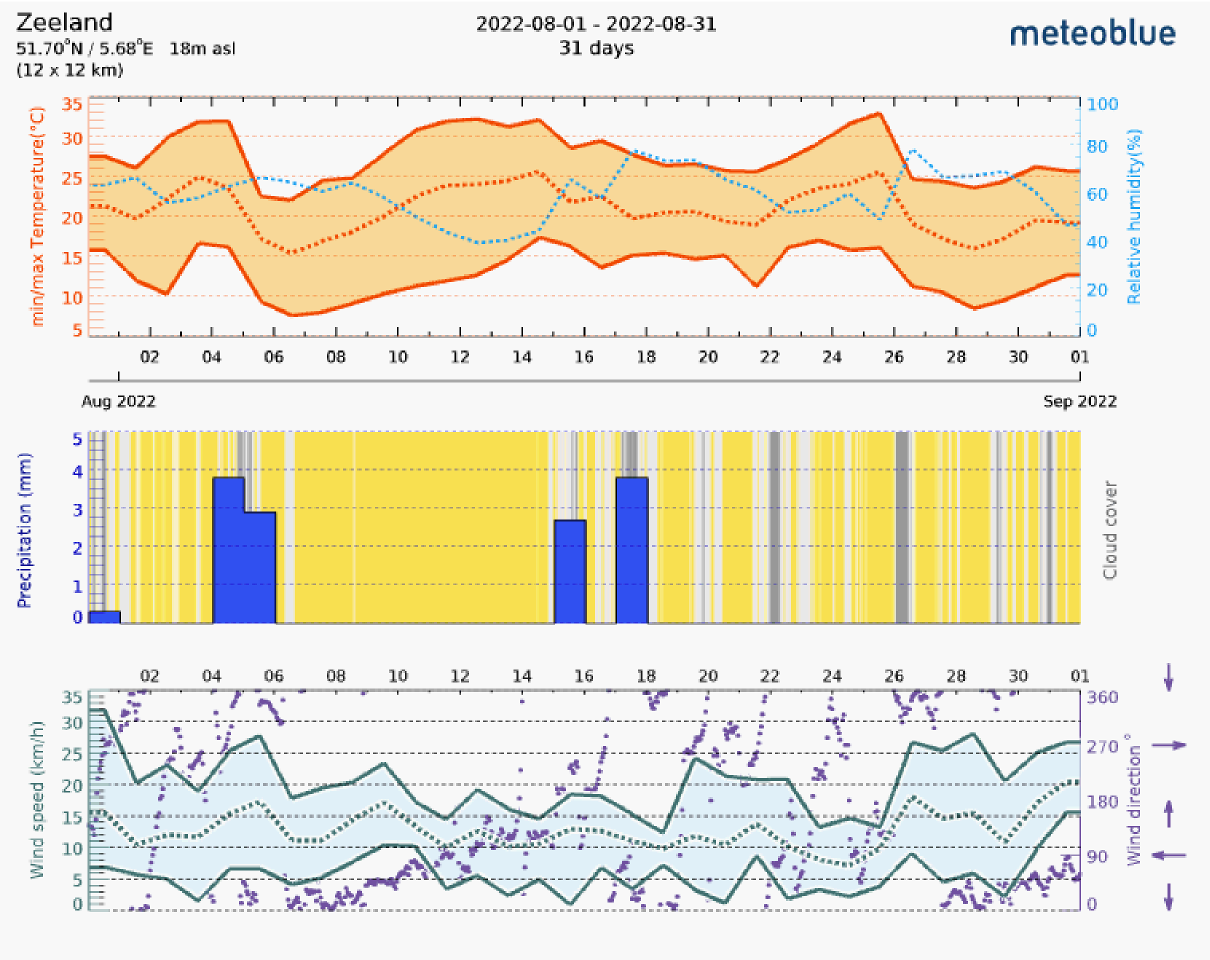
CONCLUSIONS

- Low numbers of thrips were found in the potato and banker fields throughout the sampling period. The highest number of thrips found on the potato plants was 56 individuals at the beginning of June sampling.
- Low numbers of aphids were also recorded throughout the plots in this year's samplings. The highest aphid's number that was noted on potato samples was 13 individuals.
- Quite high numbers of beneficials that could act against aphids (and thrips) were collected during the trial, certainly beside the bankerfields. They might be the reason that the control of both aphids and thrips was succesfull during the season.
- The number of thrips decreased by the beginning of August. Specifically, before harvesting, the number of thrips has been almost eradicated in the potato plot next to the oat.
- Extremely high plant mesofauna was recorded in oat at the beginning of June. Potato plants also hosted an adequate number of plant mesofauna. The highest number of soil mesofauna was found in the Indian cress plot at the beginning of August.
- The majority of the beneficial organisms were collected from the plant samples. Fewer beneficials were recorded in soil samples.
- Plant-beneficial organisms were found in all potato and banker plots throughout the sampling period. The majority of the beneficials were predatory bugs and mites, rove and ground beetles.
- A few hymenopteran parasitoids were collected throughout the sampling period in all plots. The few parasitoids might follow the low aphid number on the potato and banker plots.
- The wealthiest soil beneficial mesofauna, mainly consisting of predatory mites and rove beetles, was extracted from potato fields at the beginning of June.
- It looks that the bankerfields, together with a selective spraying scheme, was very succesfull in controlling both aphids and thrips in potatoes.

APPENDIX A: CLIMATIC CONDITIONS: TEMPERATURE + RH




Zeeland
51.70°N / 5.68°E 18m asl
(12 x 12 km)
2022-07-01 - 2022-07-31
31 days
meteoblue
min/max Temperature(°C)
Relative humidity(%)
Jul 2022
Aug 2022
Precipitation (mm)
Cloud cover
Wind speed (km/h)
Wind direction °


Zeeland
51.70°N / 5.68°E 18m asl
(12 x 12 km)
2022-08-01 - 2022-08-31
31 days
meteoblue
min/max Temperature(°C)
Relative humidity(%)
Aug 2022
Sep 2022
Precipitation (mm)
Cloud cover
Wind speed (km/h)
Wind direction °

APPENDIX C: LITERATURE

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