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WIREWORM RESEARCH UPDATE - 2016-17

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Canada

Difference between wireworms and Millipedes

Wireworms



Millipedes



Whiteworm

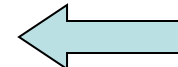
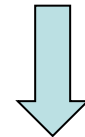
Lifecycle of Wireworms



They pupate in the soil and emerge as adults in the spring.



Spring-early summer
Adults lay 100-200
eggs in the soil



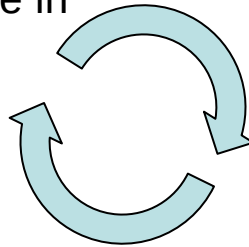
Spring – damage seeds
and seedling roots



Fall damage root crops



Later Fall- hibernate in the
soil. Return to the surface in
the spring.



**Span of life cycle can be 4-5
years**

Where do they prefer to lay their eggs

Undisturbed fields with green plant material are preferred

Sod fields



Under-seeded Fields



Pasture fields



Adults will also lay eggs in bare soil,
egg survival may be compromised



RESEARCH 2016-17 PEI

- Insecticide Trials
- Intercropping with Mustard
- Results from a Buckwheat trial
- Results from NELT Trials
- Click beetle biology (Suqi)
- Click Beetle Survey (Afternoon)

EFFICACY OF NEW AND REGISTERED INSECTICIDES



Figure 1. Mean number of blemishes (holes + scars) per tuber following an in-furrow or seed-piece insecticide treatment at planting in Russet Burbank potatoes 2016.

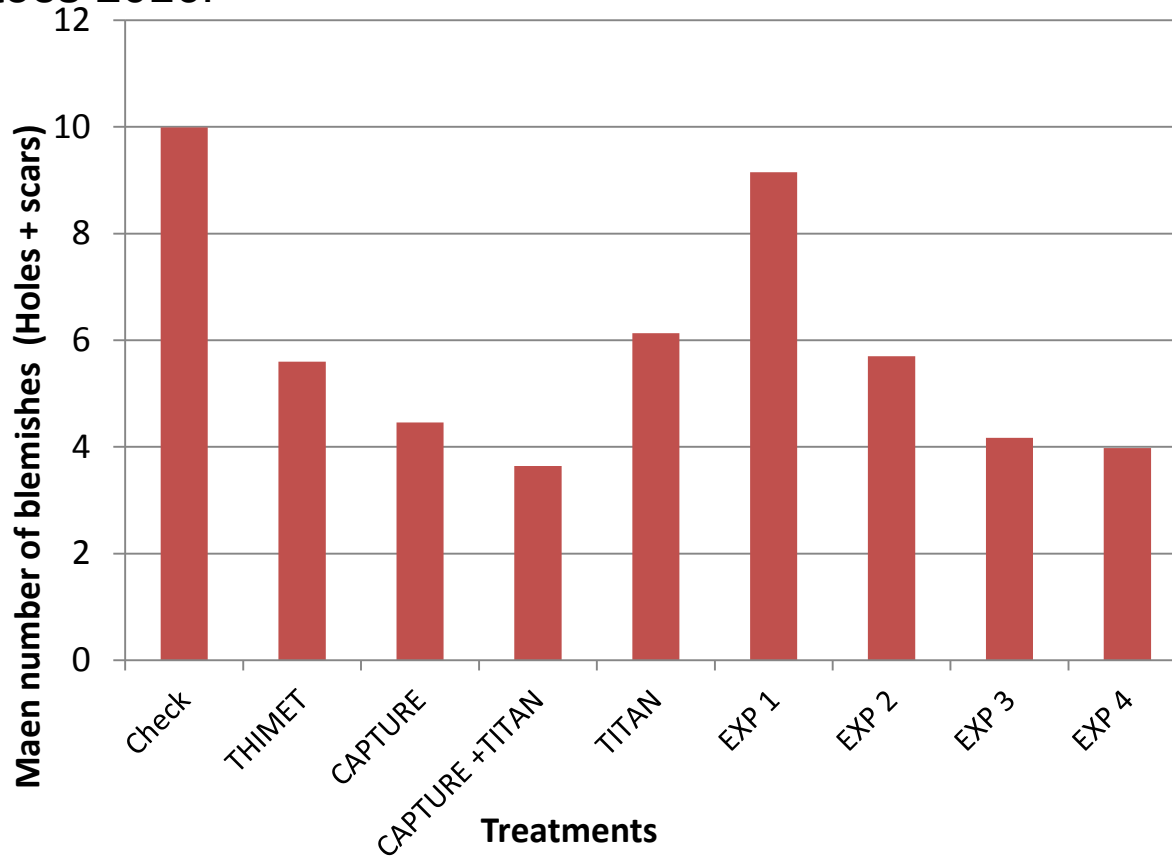
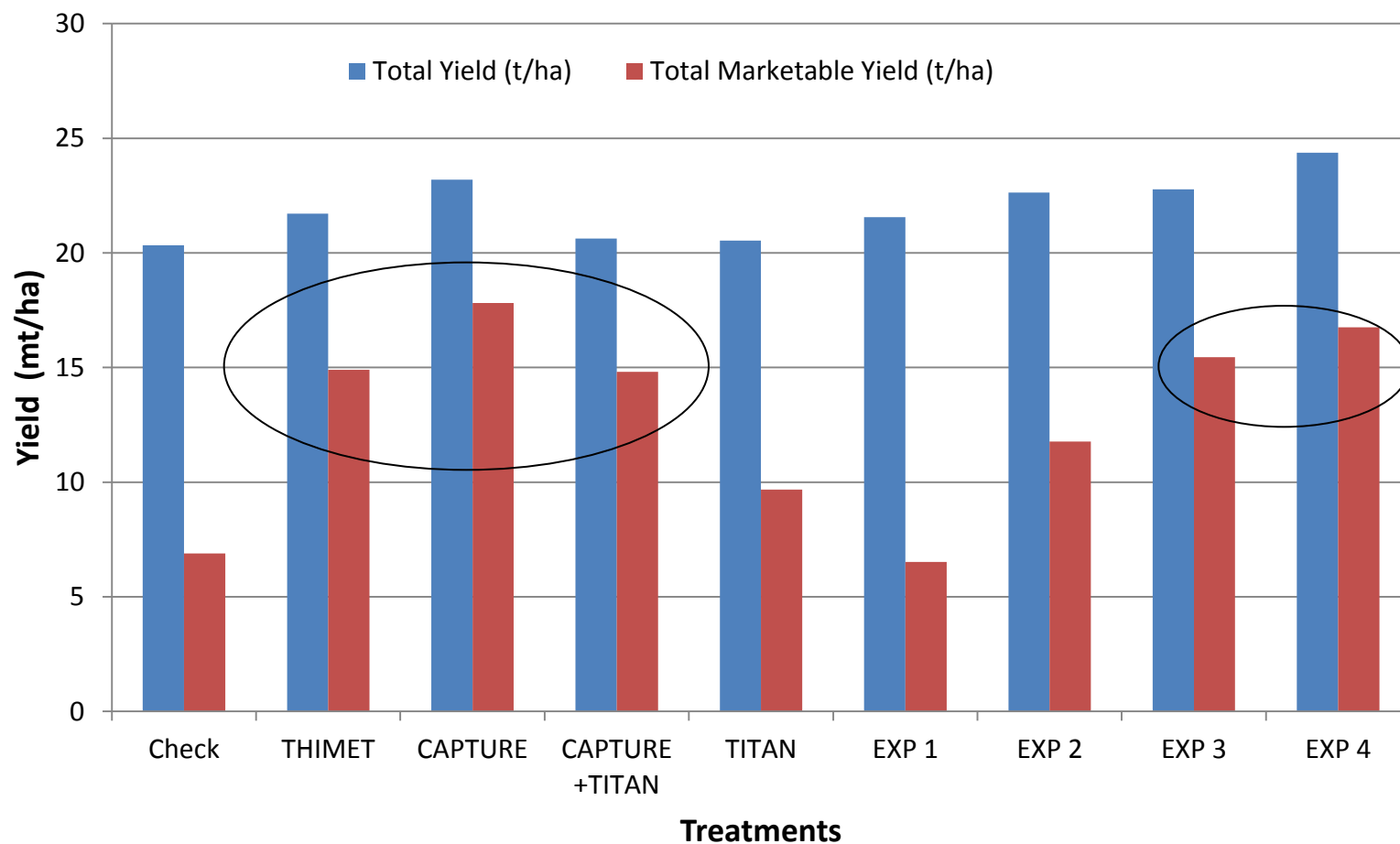
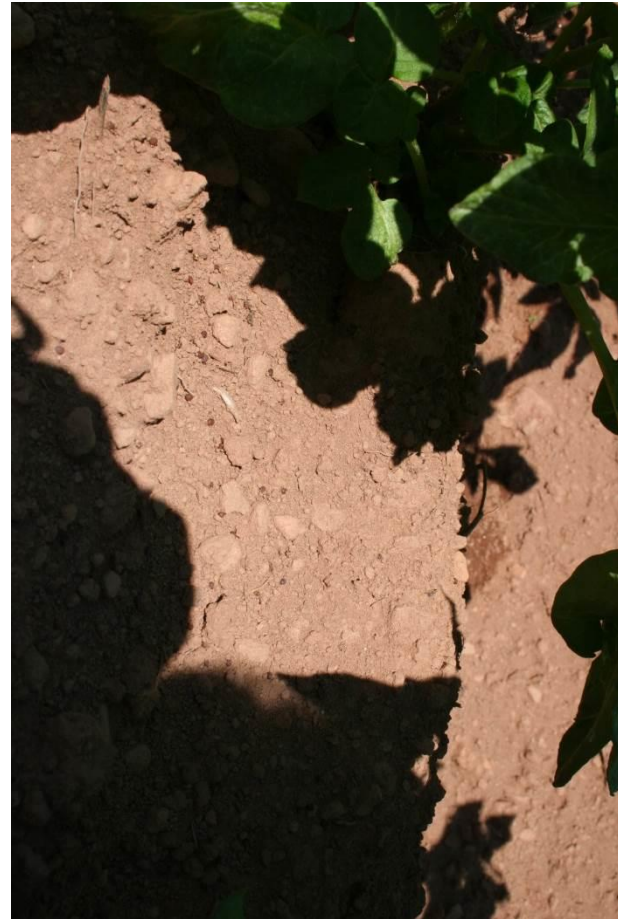


Figure 2. Efficacy of in-furrow and seed-piece insecticides treatments on **total and marketable yield for the processing market** in Russet Burbank potatoes, 2016



Using brown mustard as a nurse crop

Brown Mustard was planted in the potato rows at 5 (2015) and 8 (2016) different dates throughout over the Summer.



Growth of Brown mustard planted in the potato row on September 2015

Seeding date July 14



Seeding date July 30



Seeding date Aug 13



Seeding date Aug 20



Seeding date Aug 28



Mustard seeding date

July 14



July 21



July 28



Aug. 4



Aug. 11



Aug. 18



Aug. 25



Sept. 1



Check



Mustard roots within potato zone



July 14



July 28



August 4



August 18



Figure 1. Number of blemishes caused by wireworm feeding in plots planted with brown mustard as a nurse crop on 5 different dates during the growing season 2014

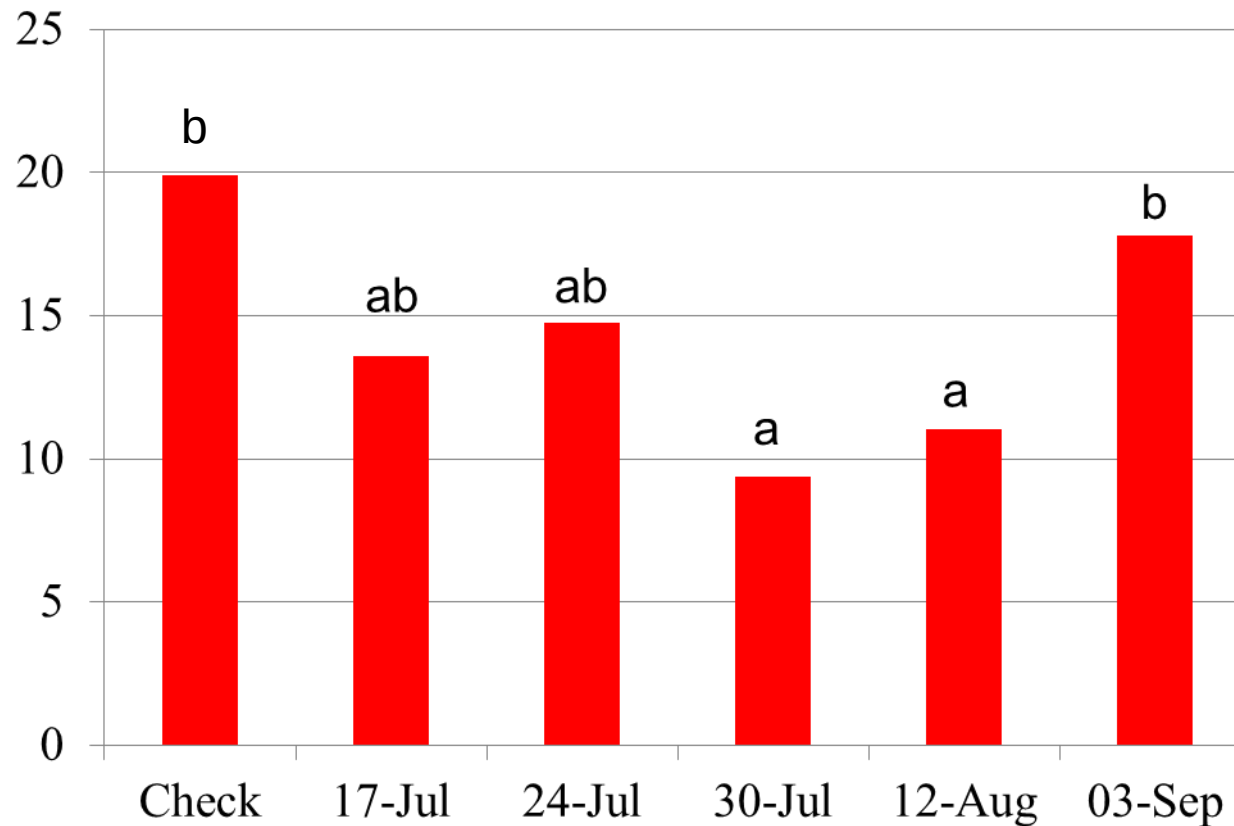
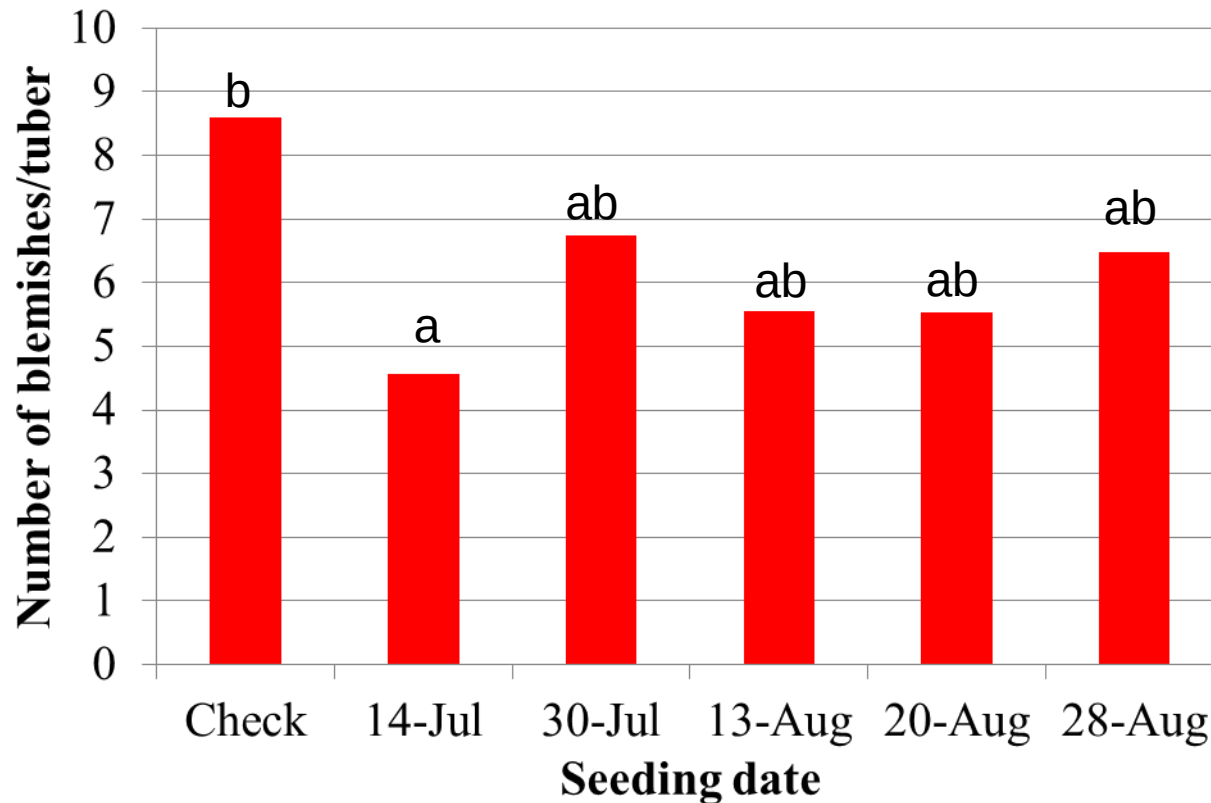


Figure 2. Number of blemishes caused by wireworm feeding in plots planted with brown mustard as a nurse crop on 5 different dates during the growing season 2015





Using Buckwheat to reduce wireworm populations.



BARLEY/CLOVER

BARLEY DISKED

BARLEY MOWED

BUCKWHEAT DISKED

BUCKWHEAT MOWED

Barley (August 4)



Buckwheat (August 4)



Mowing and Disking (August 8)



Buckwheat Mowed or Disked



Barley Disked or Mowed



Dicked Buckwheat









Buckwheat Regrowth (September 25)



Figure. Mean number of wireworms per bait in Buckwheat and Barley treatments

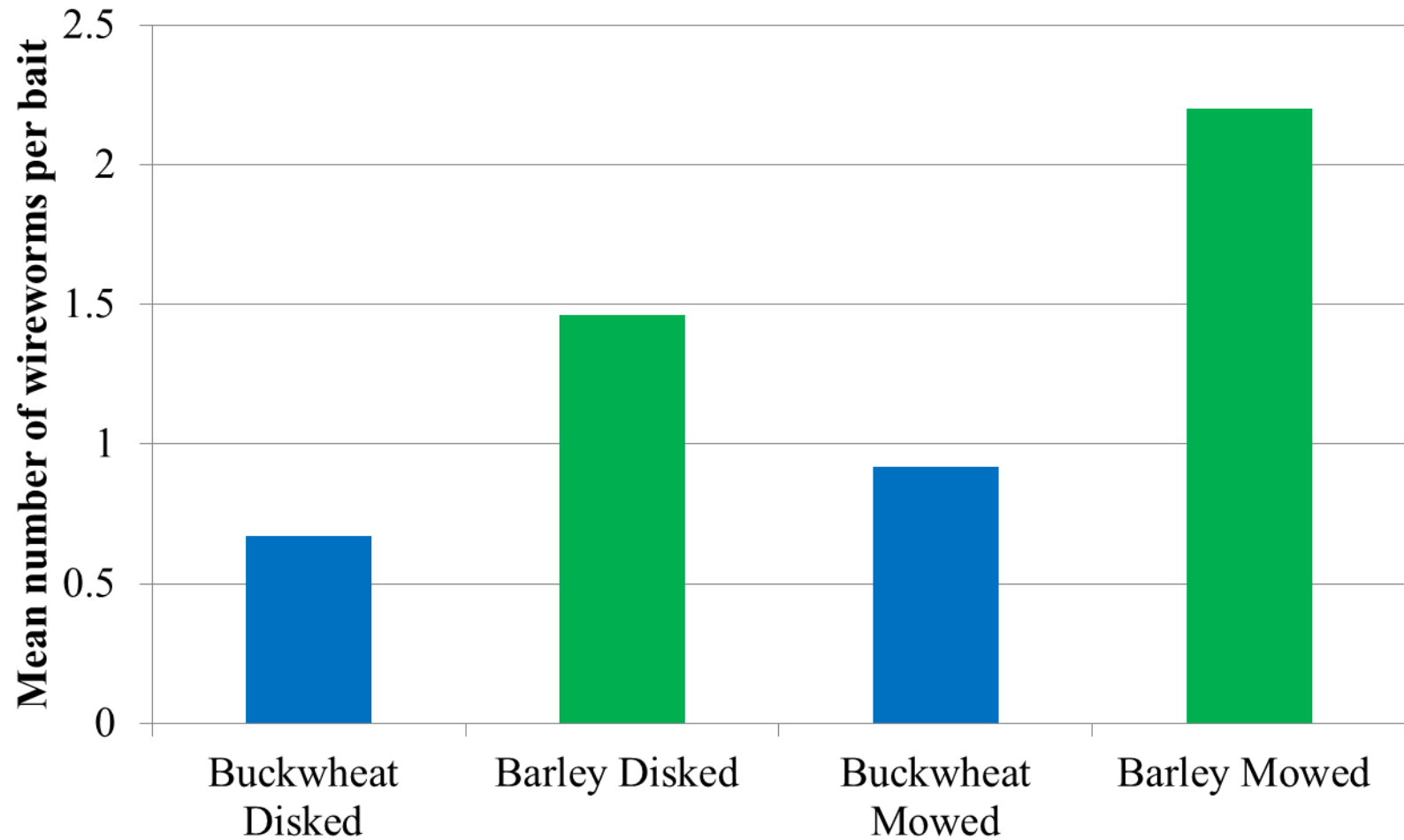


Figure1: Mean number of wireworms found attacking cabbage transplants planted in a field following two years of either barley, buckwheat or clover treatments.

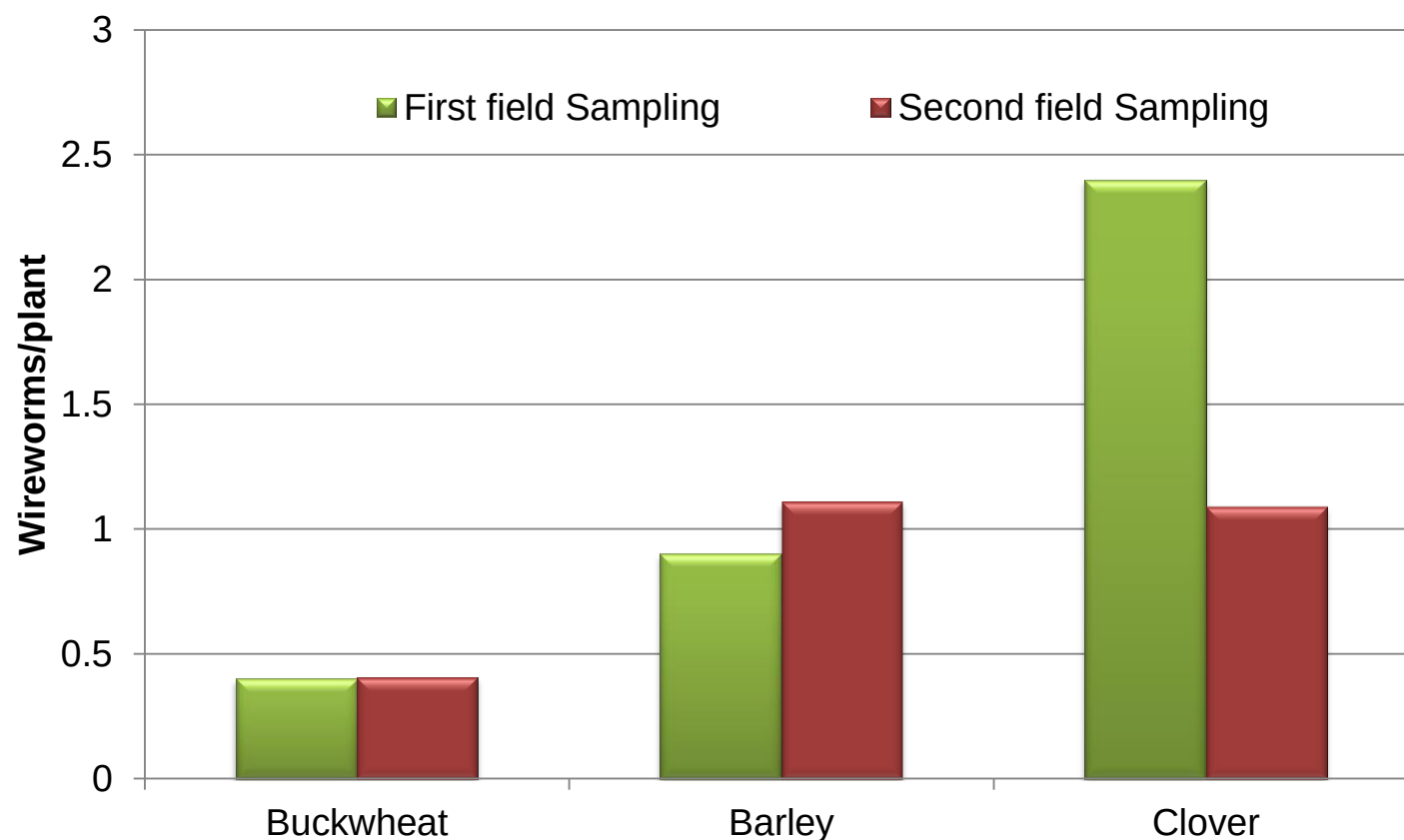
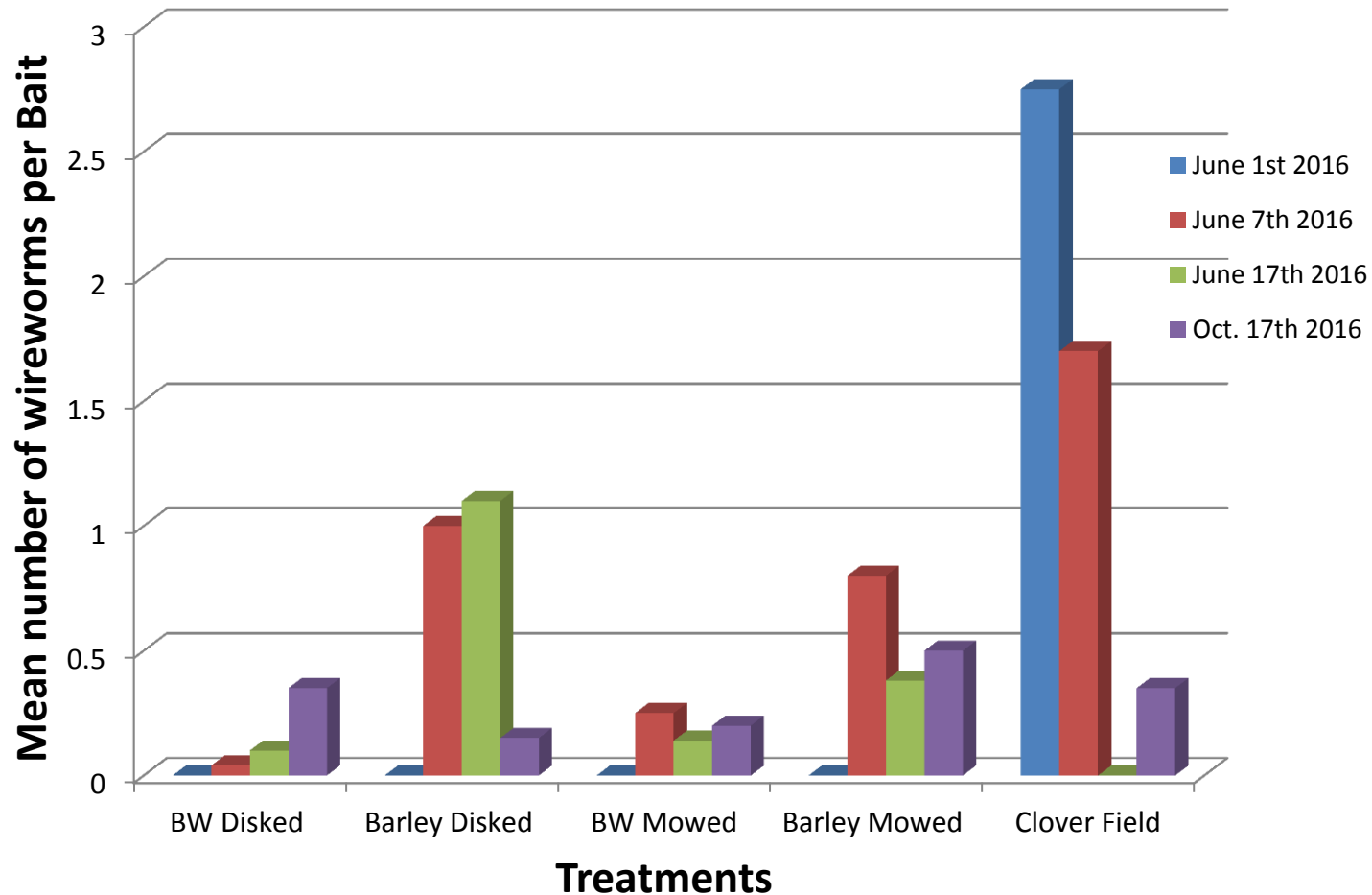


Figure 2: Mean number of wireworms per bait in cabbage after two years of Buckwheat and Barley treatments



The NELT™

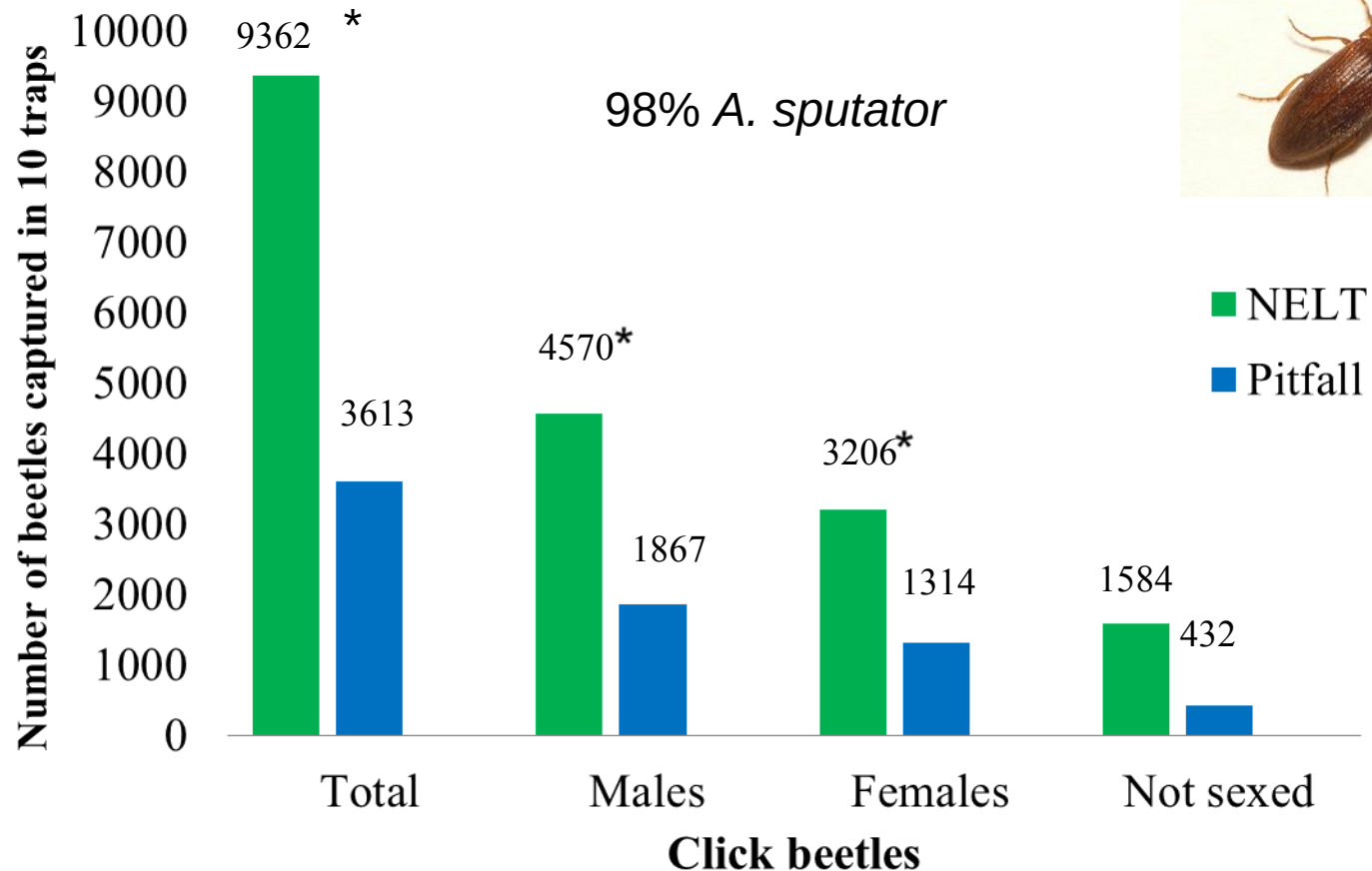


Not species specific and attracts both male and female beetles

A new trap to remove egg laying females for a field

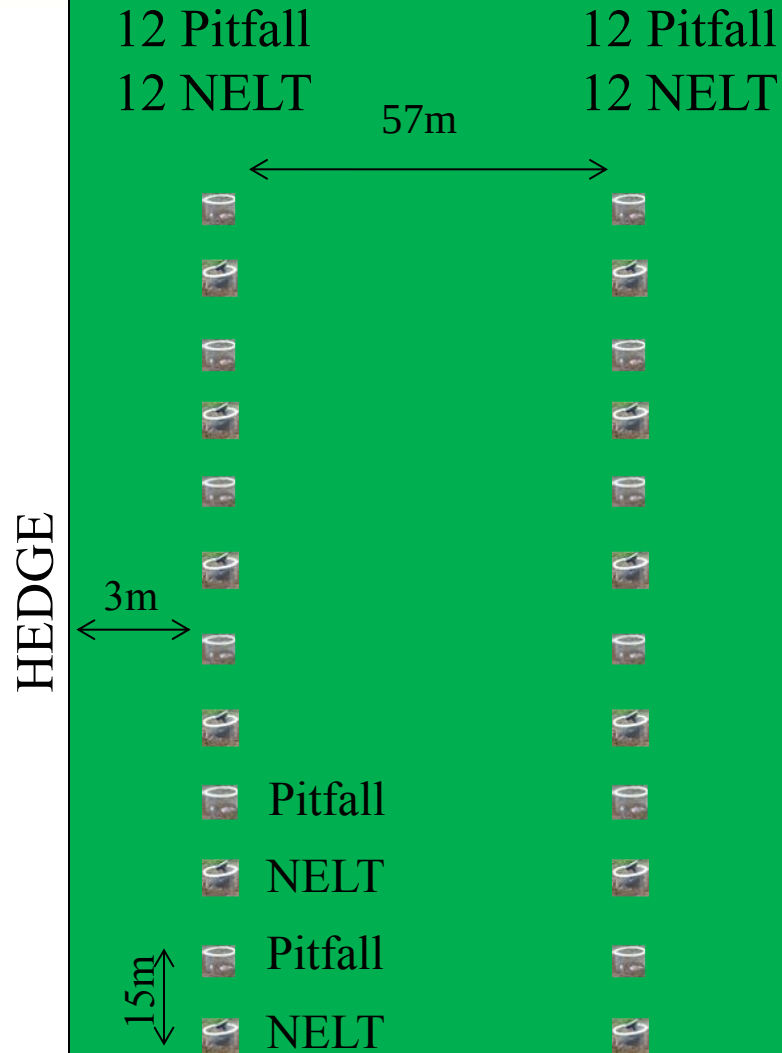


Figure 1. Comparison of the total number of click beetles captured in ten NELT™ and ten pitfalls over their activity period (May 19-Aug. 25) (Field 1, 4ha) (2015)



Other species
Hypnoidus abbreviatus

Field 1, 2016 50ac



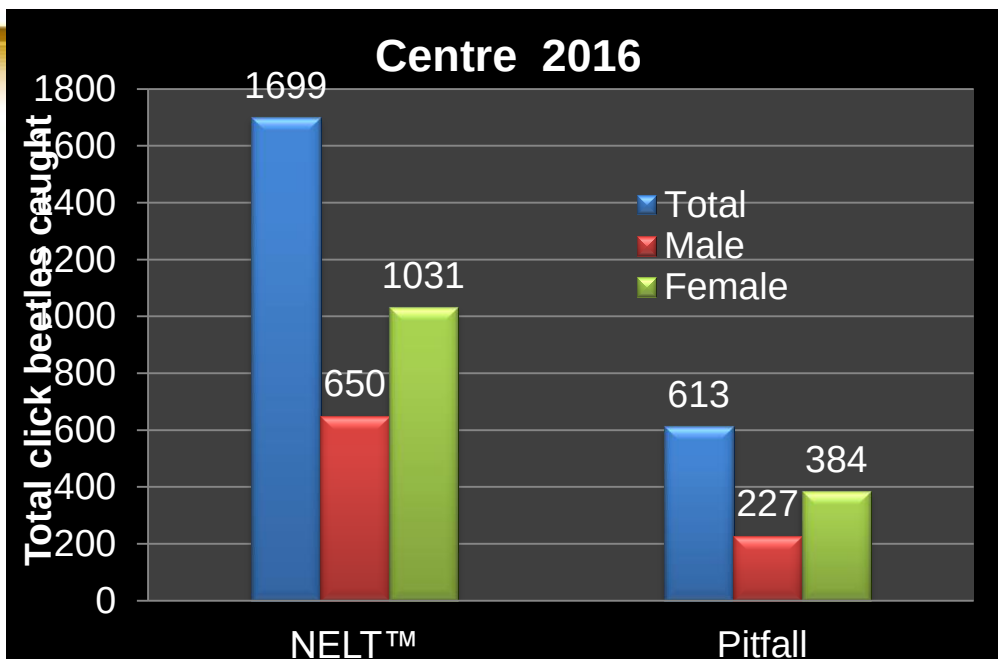


Figure 2. Total number of beetles caught in the NELT and Pitfall traps in the centre and edge of the field

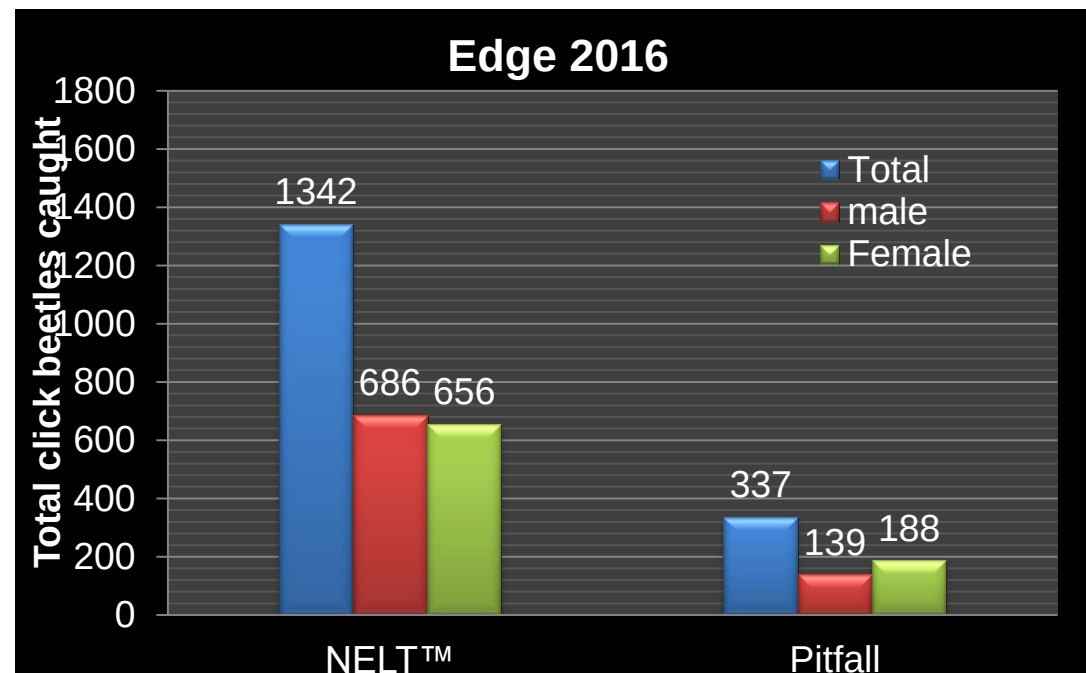


Figure 3: Mean number of click beetles found in the NELT and the pitfall traps placed either along the edge or centre of the field.
 $P < 0.001$ (Total beetle collected 4055)

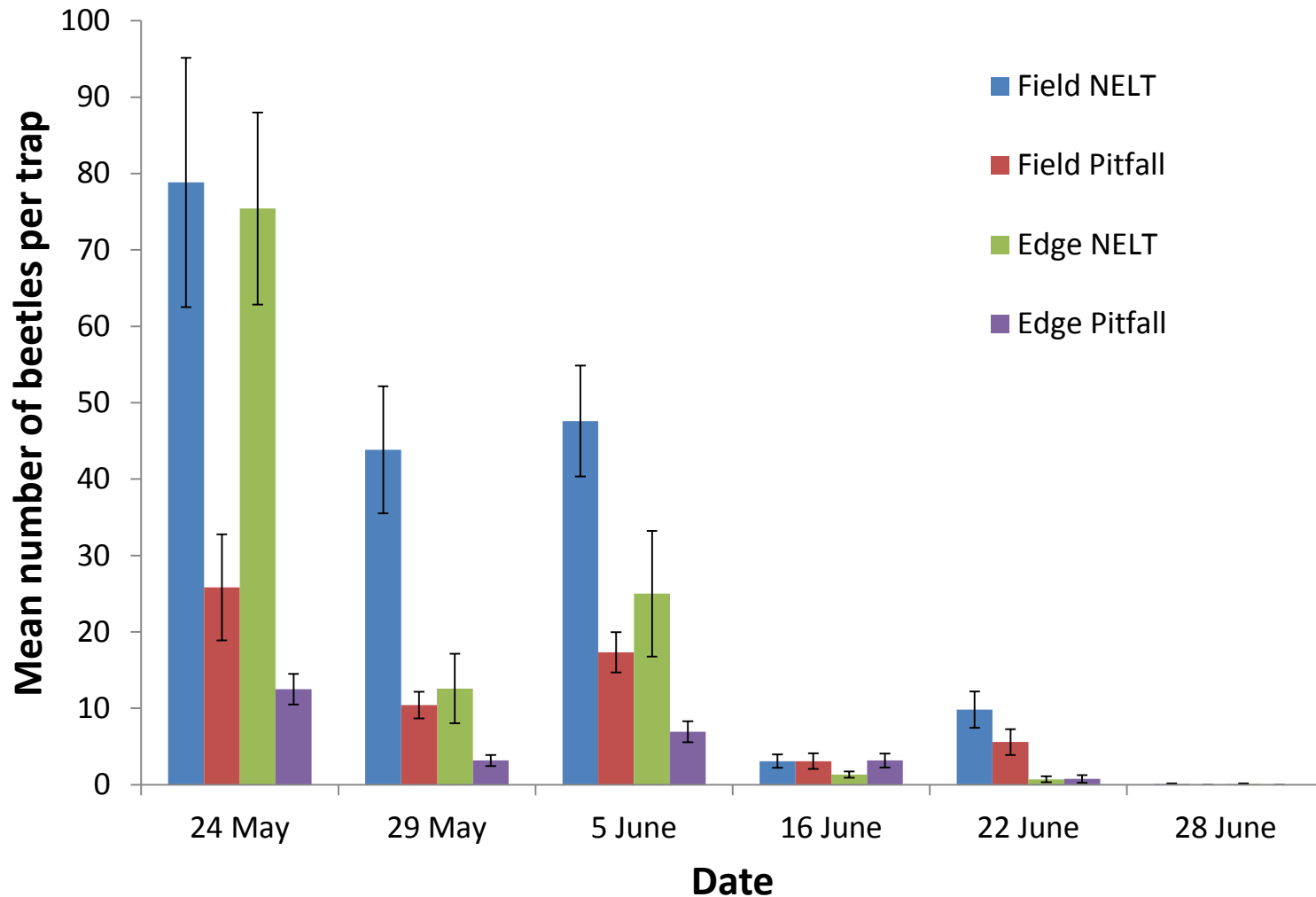


Figure 4: Mean number of male and female click beetles found in the NELT and the pitfall traps placed either along the edge or centre of the field. $P < 0.001$

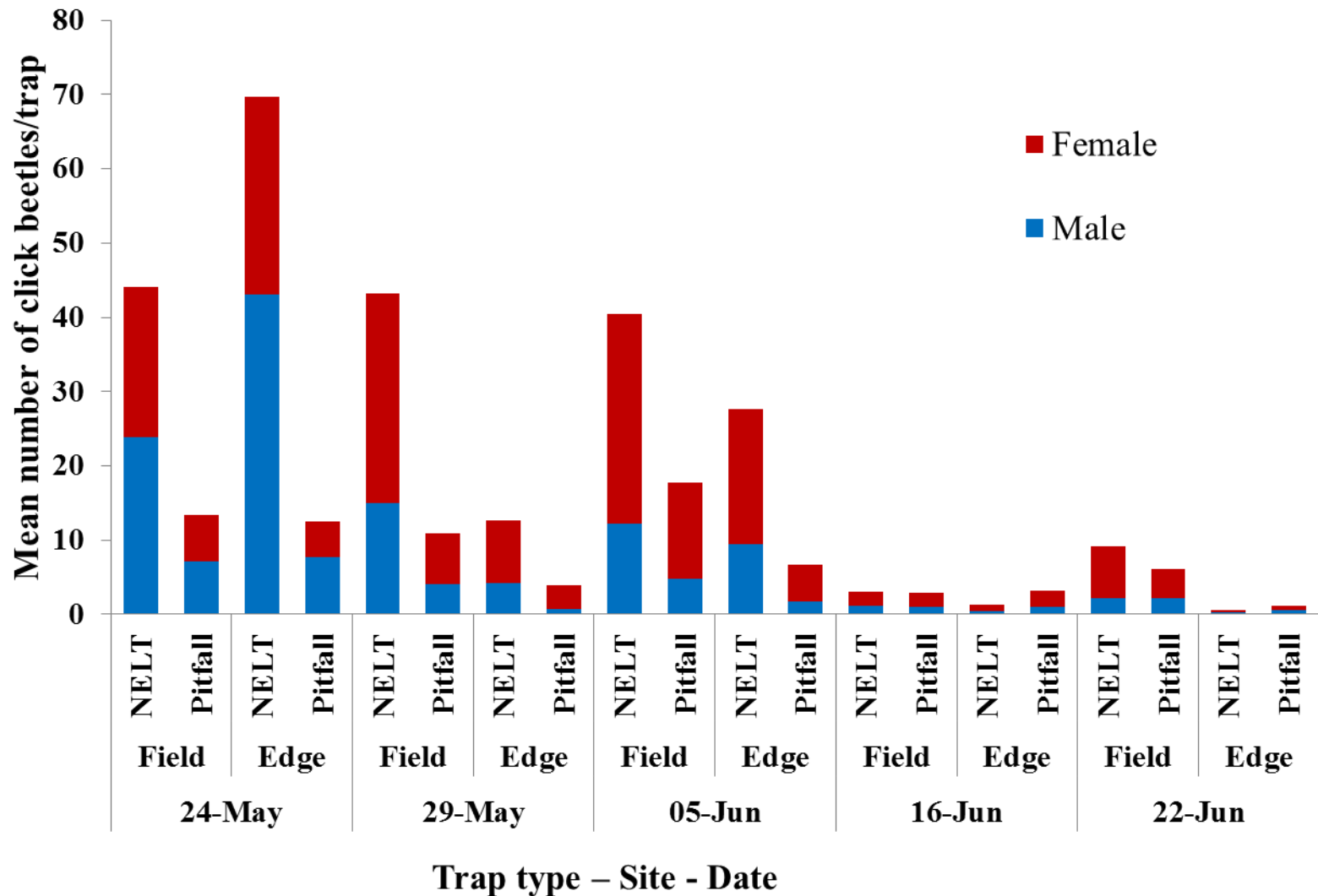


Figure 4: Total number of male and female *Agriotes sputator* adults found in the NELT and the pitfall traps placed in the centre of the field. $P < 0.001$

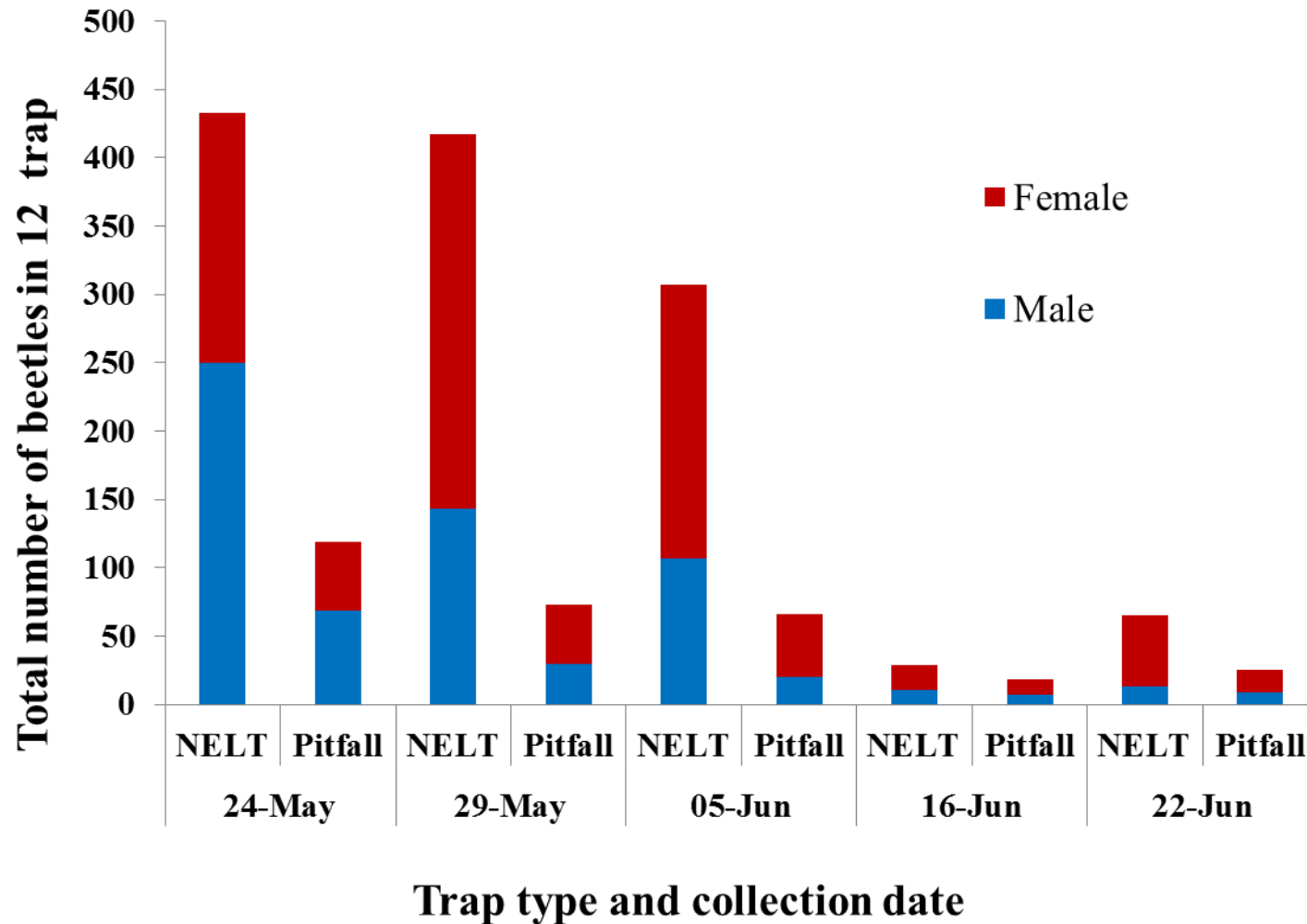
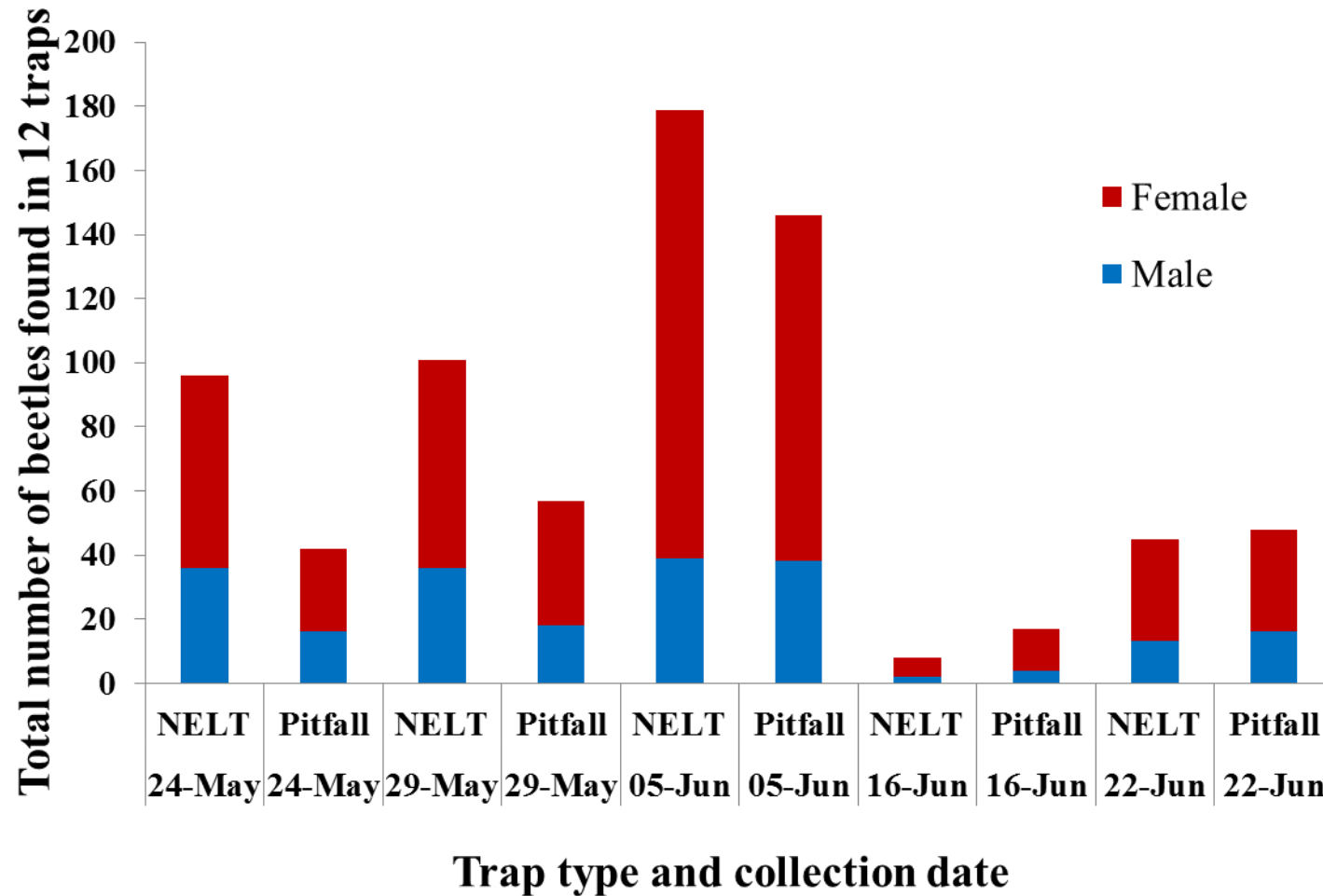


Figure 5: Total number of male and female *Hypnoidus abbreviatus* adults found in the NELT and the pitfall traps placed in the centre of the field. $P < 0.001$



Field 1, 2016 5ac

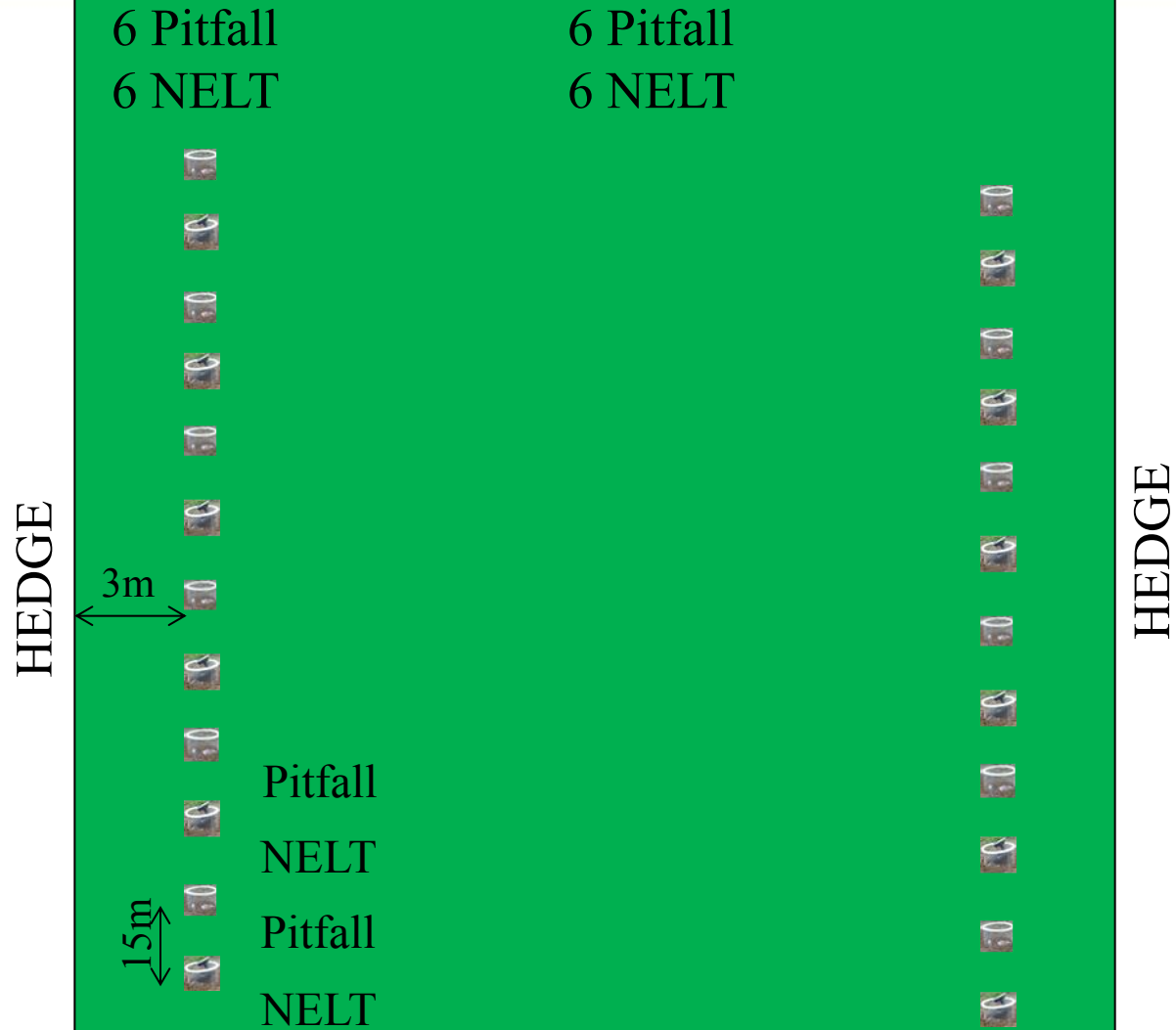


Figure 6: Mean number of click beetles found in the NELT and the pitfall traps placed along the edge of the field. $P < 0.001$

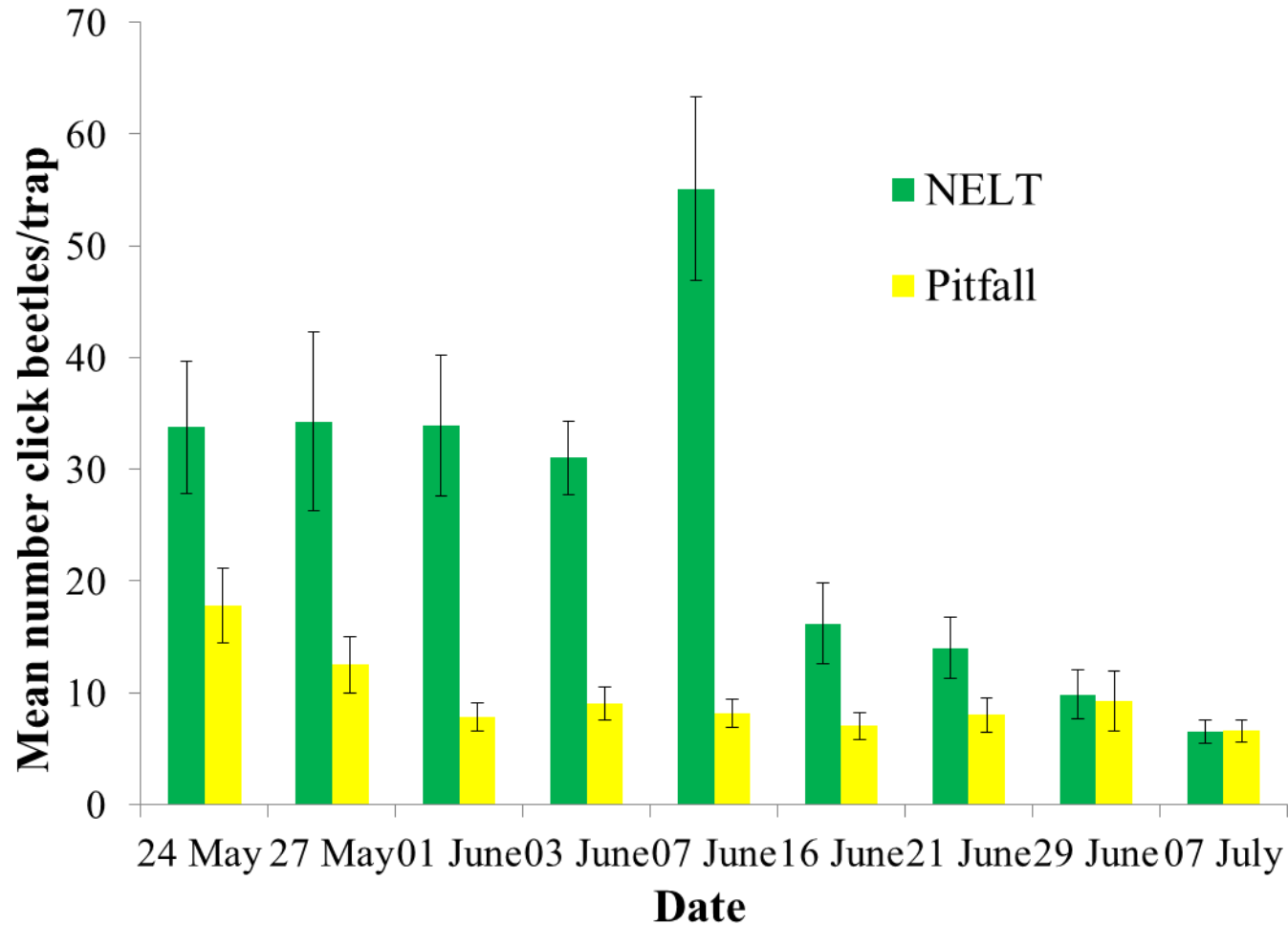


Figure 7: Total number of male and female click beetles found in the NELT and the pitfall traps placed along the edge of the field. $P < 0.001$

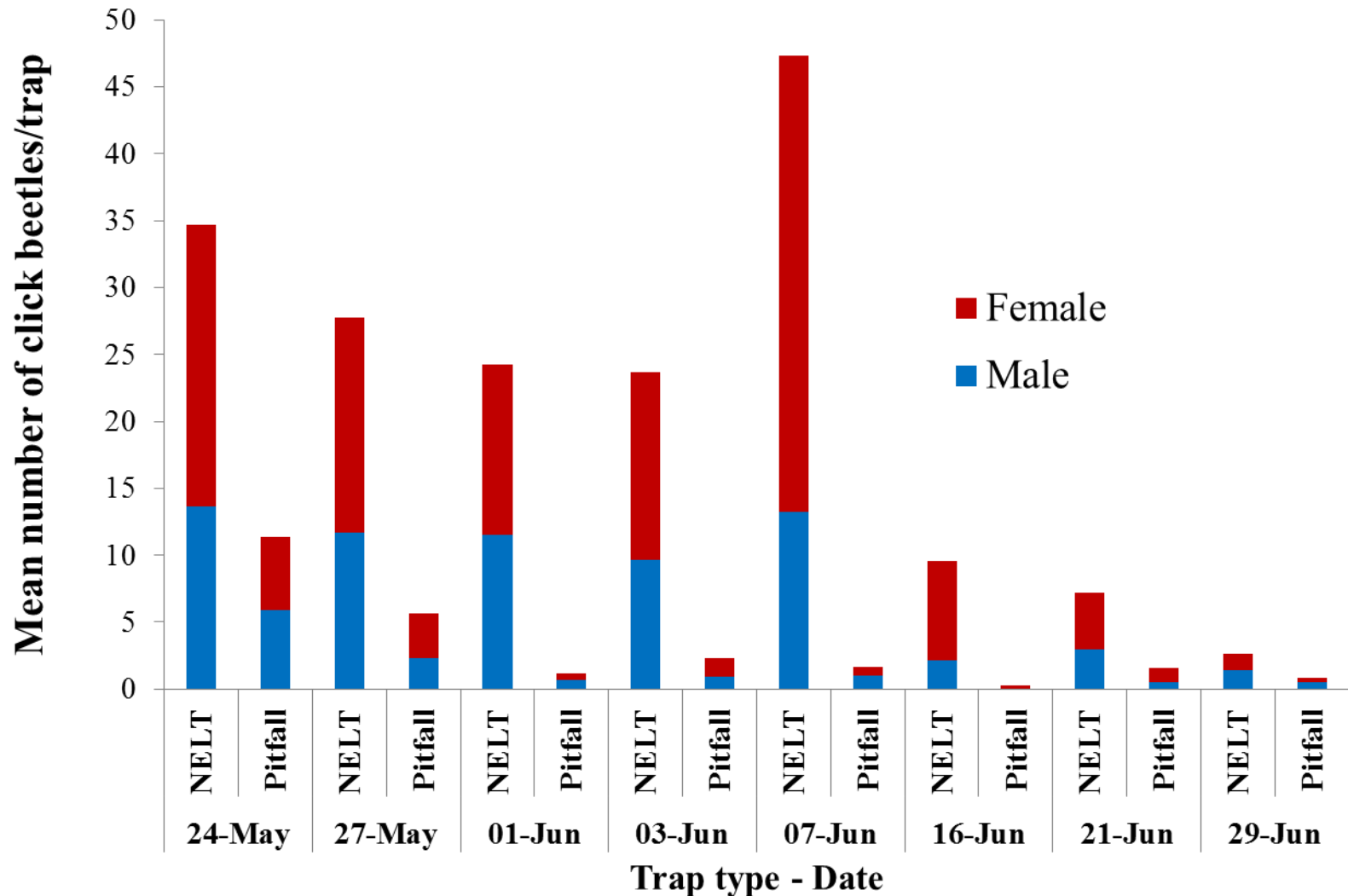


Table 1: Numbers number of click beetles found in the NELT and the pitfall traps and the percentage of the different species collected.

Field	Number of traps	Total	NELT	Pitfall	% <i>Agriotes sputator</i>	% <i>Hypnoidus abbreviatus</i>	% <i>Agriotes obscurus</i>	% <i>other</i>
Field 1	24	4055	3060	995	71.5%	27%	-	1.5%
Field 2	12	2537	2221	316	96%	3.8%	-	0.2%
Field 3	12	1273	885	388	64%	13%	23%	-
Field 4	15	2144	1216	412	76%	24%	-	-
Field 5	15	1731	1580	217	91%	8.5%	-	0.5%
Field 6	12	1388	1388		1.3%	98%	-	0.7
Field 7	265	27022	27022		61.75%	37%	0.25%	1%

Testing attraction distance of NELT

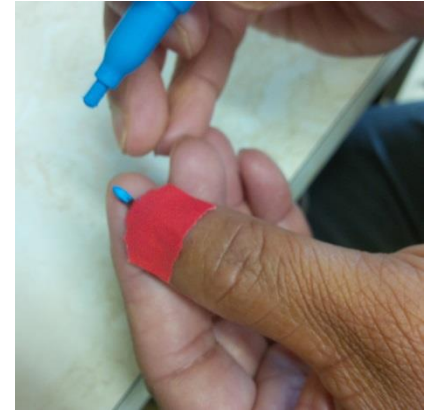
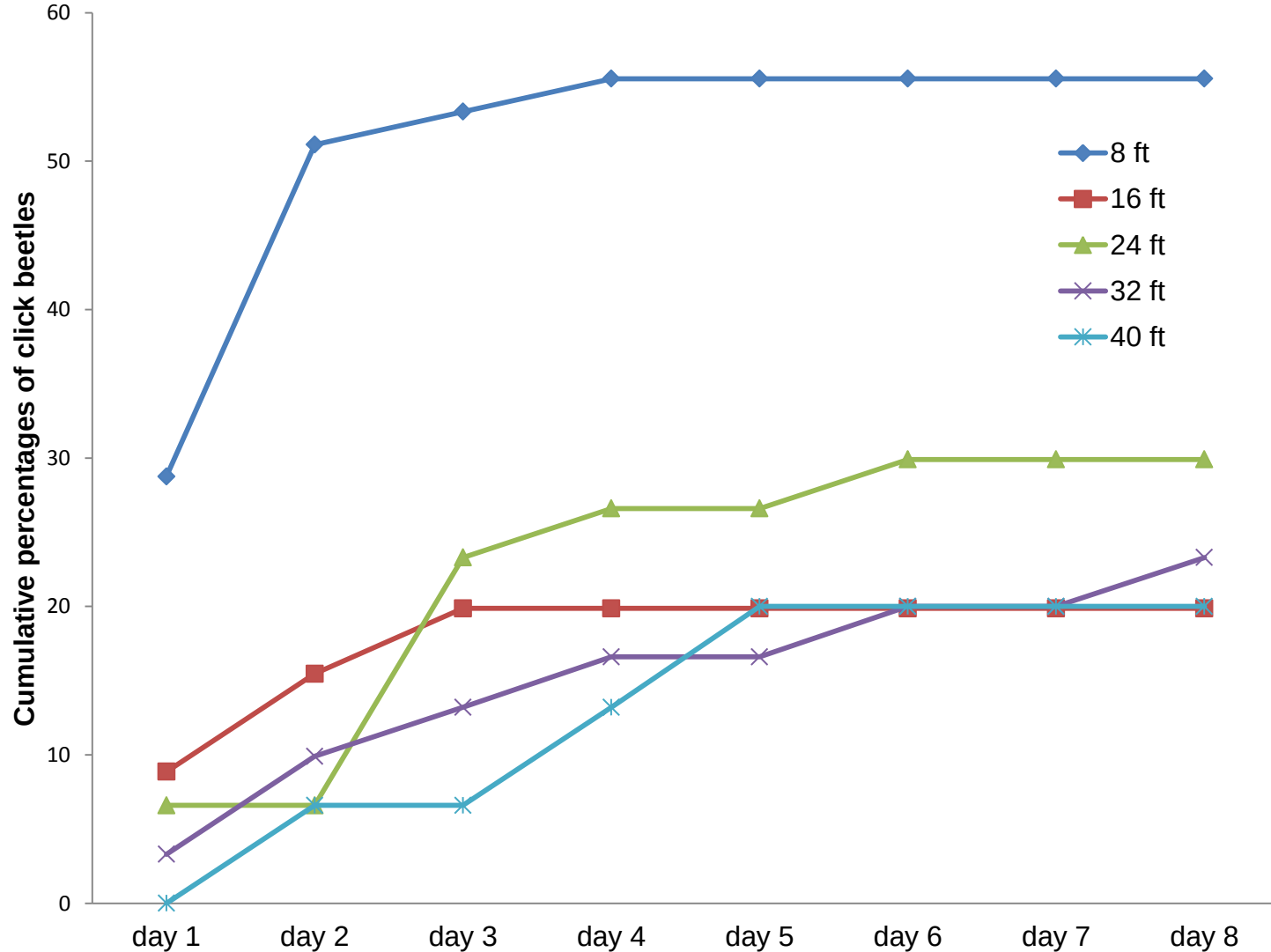


Figure 4: Cumulative percentage of click beetles attracted to the NELT from varying distances over 1 week.



Placement of the NELT in a sod field



Clear an area,
20cm radius,
around the NELT
so that the plants
do not grow into
the trap

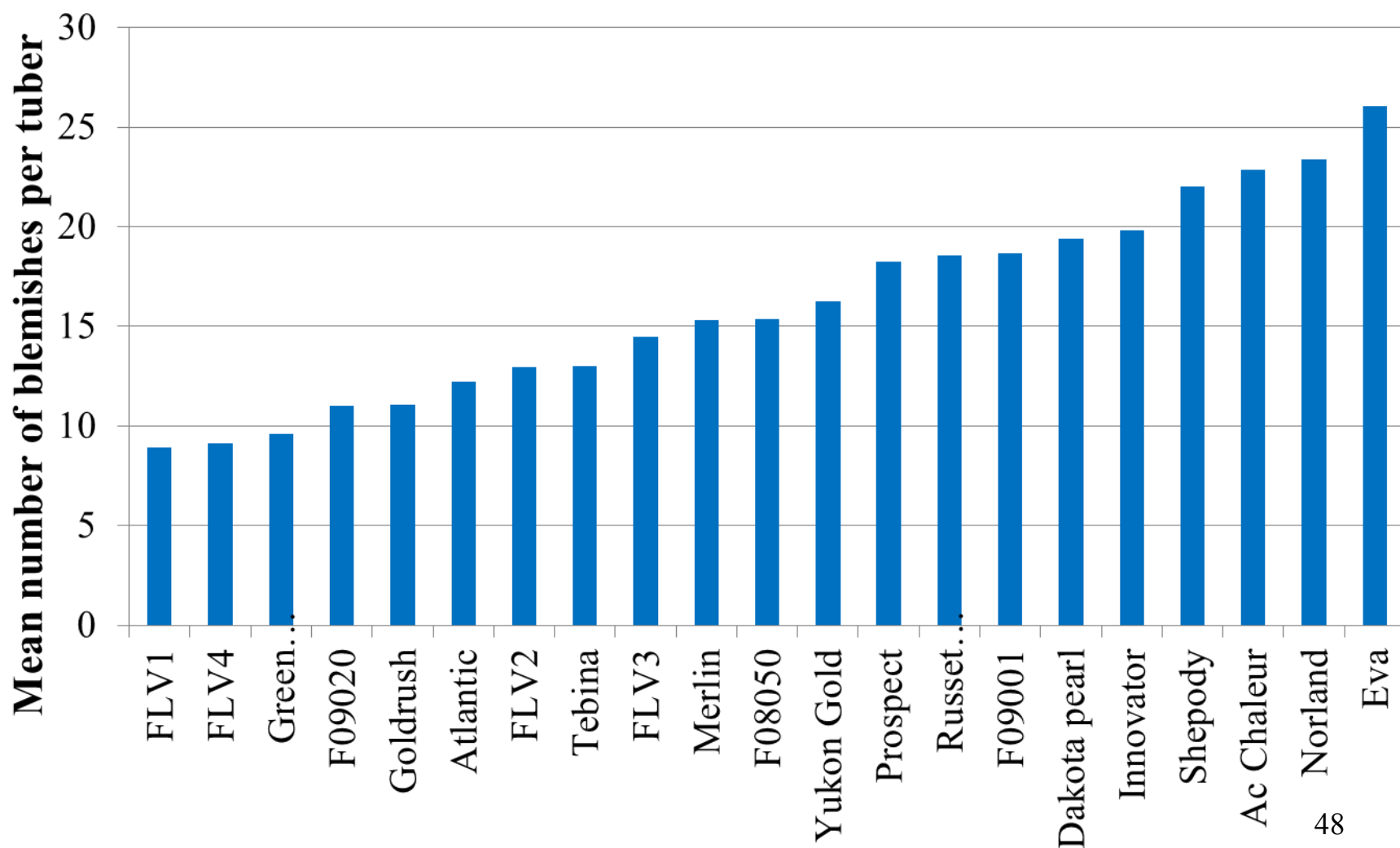


RESISTANT VARIETIES

Twenty varieties and six replicates per variety

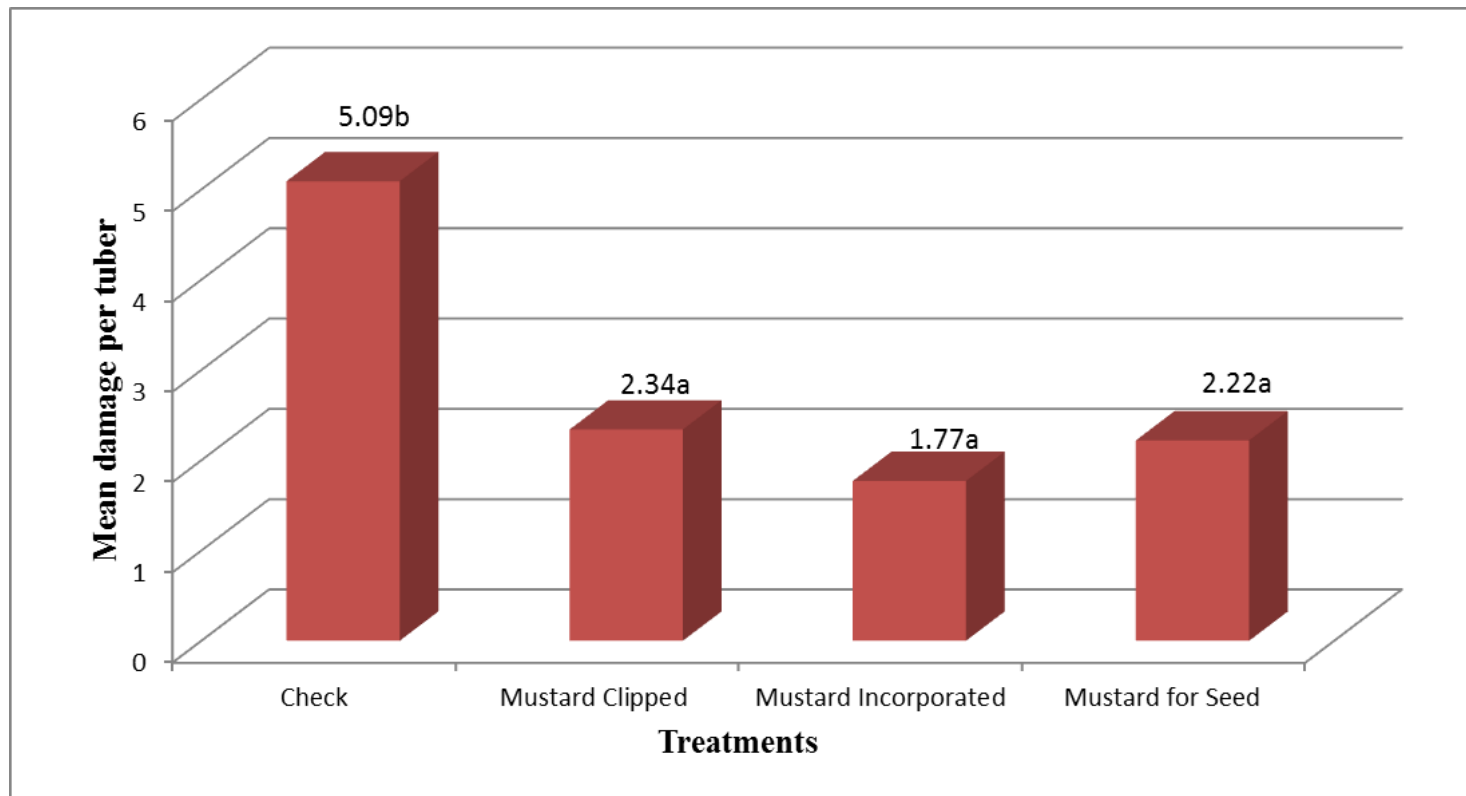


Figure 2. Mean number of blemishes (holes+scars) in different potato varieties grown without an insecticide application to protect against wireworm damage



Does Growing Brown Mustard for one year work

Figure. Mean damage per tuber following one year of Brown Mustard managed under 3 different regimes



ACKNOWLEDGEMENTS

The Entomology Team



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The Entomology Team
Natasha Boyle, Suqi Liu, Dave
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Local Support

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PEI Potato Board
PEI Horticultural Association

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Canadian Horticultural Council
Agriculture and Agri-Food Canada
Industry partners

All the growers I have the pleasure of working with in PEI



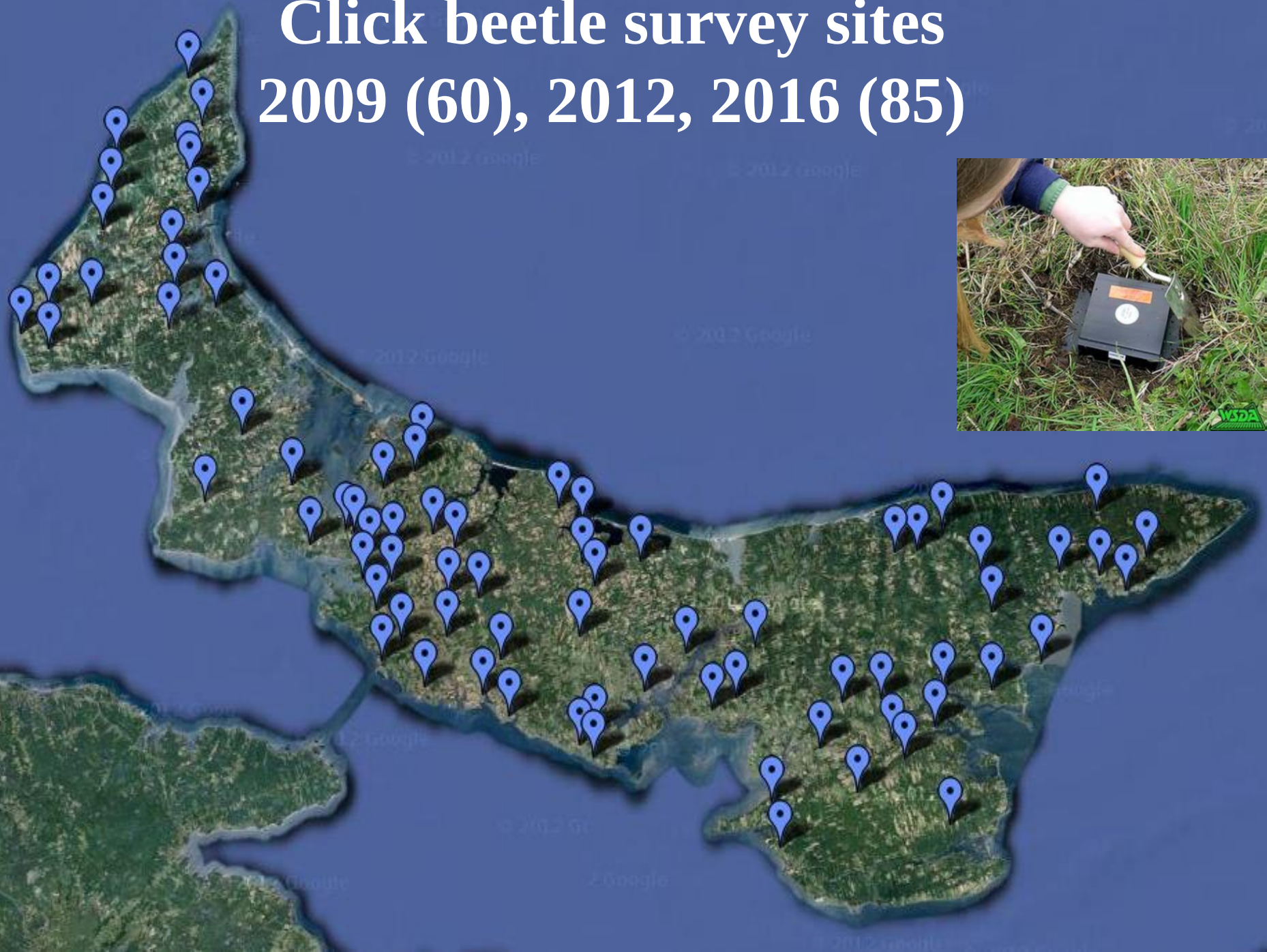
Contact information

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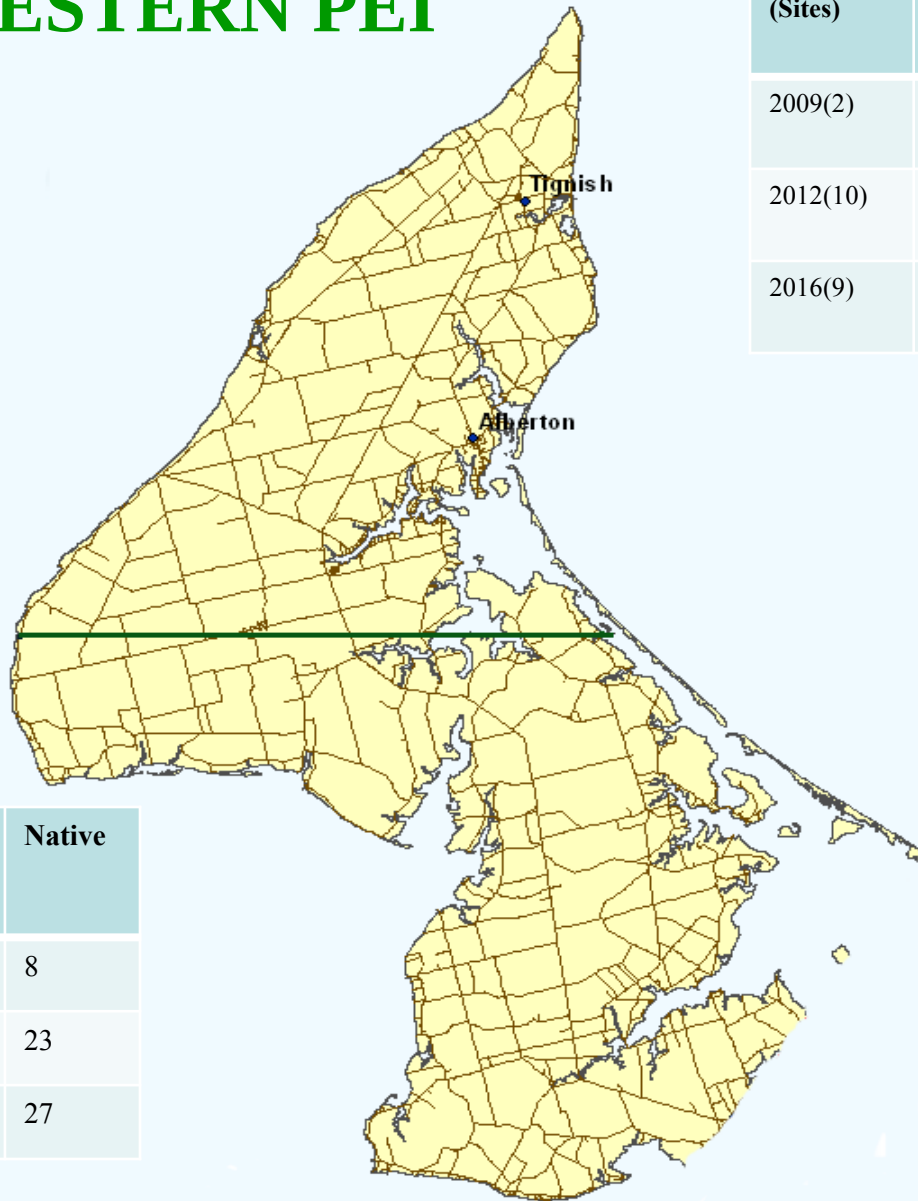


Canada

Click beetle survey sites 2009 (60), 2012, 2016 (85)



WESTERN PEI



Year (Sites)	AS	AL	AO	Native
2009(2)	0	0	0	0
2012(10)	1	0	2	18
2016(9)	10	0	6	17

Year (Sites)	AS	AL	AO	Native
2009(6)	0	0	3	8
2012(9)	7	0	1	23
2016(9)	387	0	1	27

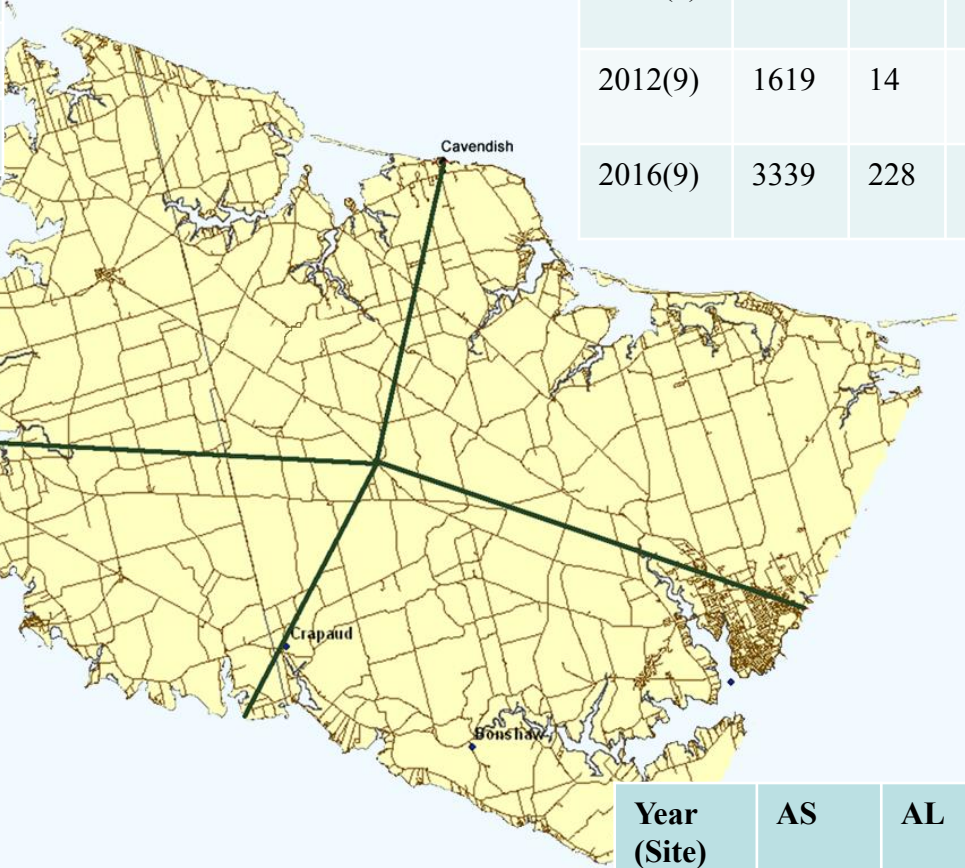
Projection: PEI Double Stereos
Datum: NAD63

Year (Sites)	AS	AL	AO	Native
2009(11)	89	5	9	47
2012(15)	1254	3	51	88
2016(15)	3537	1	12	31

CENTRAL PEI

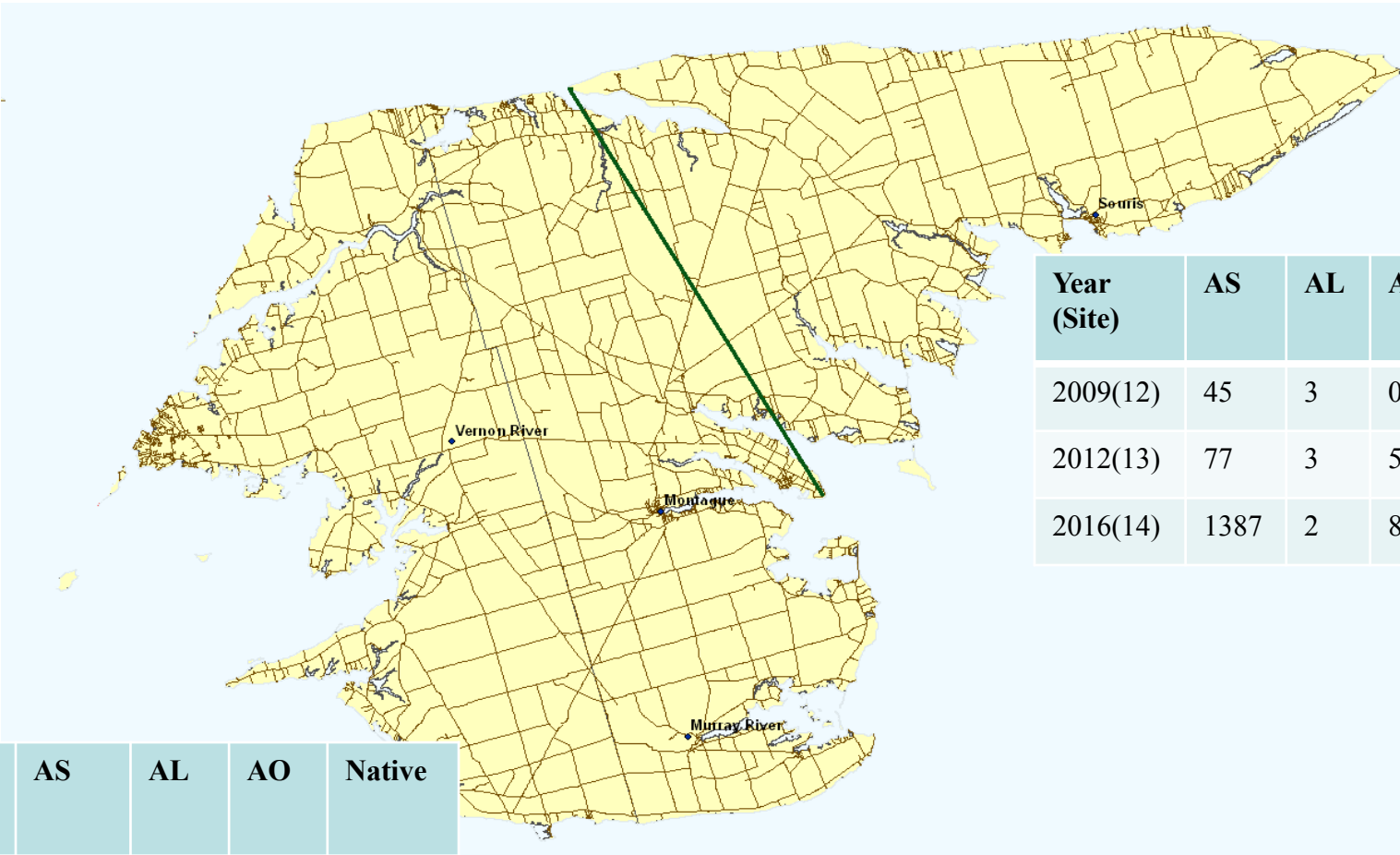
Year (Site)	AS	AL	AO	Native
2009(7)	32	17	18	20
2012(9)	1619	14	551	15
2016(9)	3339	228	1695	61

Year (Sites)	AS	AL	AO	Native
2009(8)	30	2	0	22
2012(5)	138	2	1	70
2016(7)	2051	1	4	13



Year (Site)	AS	AL	AO	Native
2009(4)	124	1	0	23
2012(8)	3891	0	1	39
2016(8)	14411	11	5	6

EASTERN PEI



Year (Site)	AS	AL	AO	Native
2009(12)	45	3	0	20
2012(13)	77	3	5	66
2016(14)	1387	2	8	65

Year (Site)	AS	AL	AO	Native
2009(10)	1072	4	4	1
2012(16)	4546	47	34	37
2016(16)	19351	195	134	128

Survey of click beetles species across PEI

Table 1. Comparisons of the number of farms with beetles numbers ranging for 0 - >1000 in 2009 and 2012, and 2016 for each county in Prince Edward

Island. Range of beetle numbers	Prince County No. of Farms			Queen County No. of Farms			Kings county No. of Farms		
	2009	2012	2016	2009	2012	2016	2009	2012	2016
0	4	4	2	0	0	0	2	1	0
1-10	16	25	16	8	6	0	10	12	2
11-50	7	5	7	7	4	4	3	7	5
51-100	0	2	5	1	3	3	0	0	5
101-500	0	2	5	2	5	6	0	0	5
501-1000	0	0	3	0	5	5	0	0	2
>1000	0	1	2	0	3	8	0	0	2
Total # of beetles	214	1969	6945	1308	10,438	30362	76	197	9817
Total per trap	7.9	50	173.63	72	401.46	1,167.77	5.4	9.8	467.48

YEAR 1

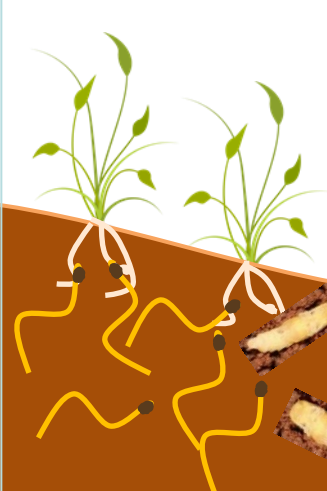
YEAR 2

YEAR 3

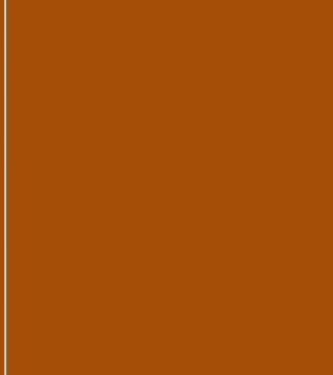
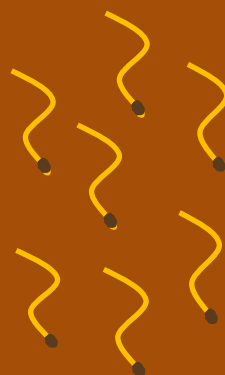
YEAR 4

YEAR 5

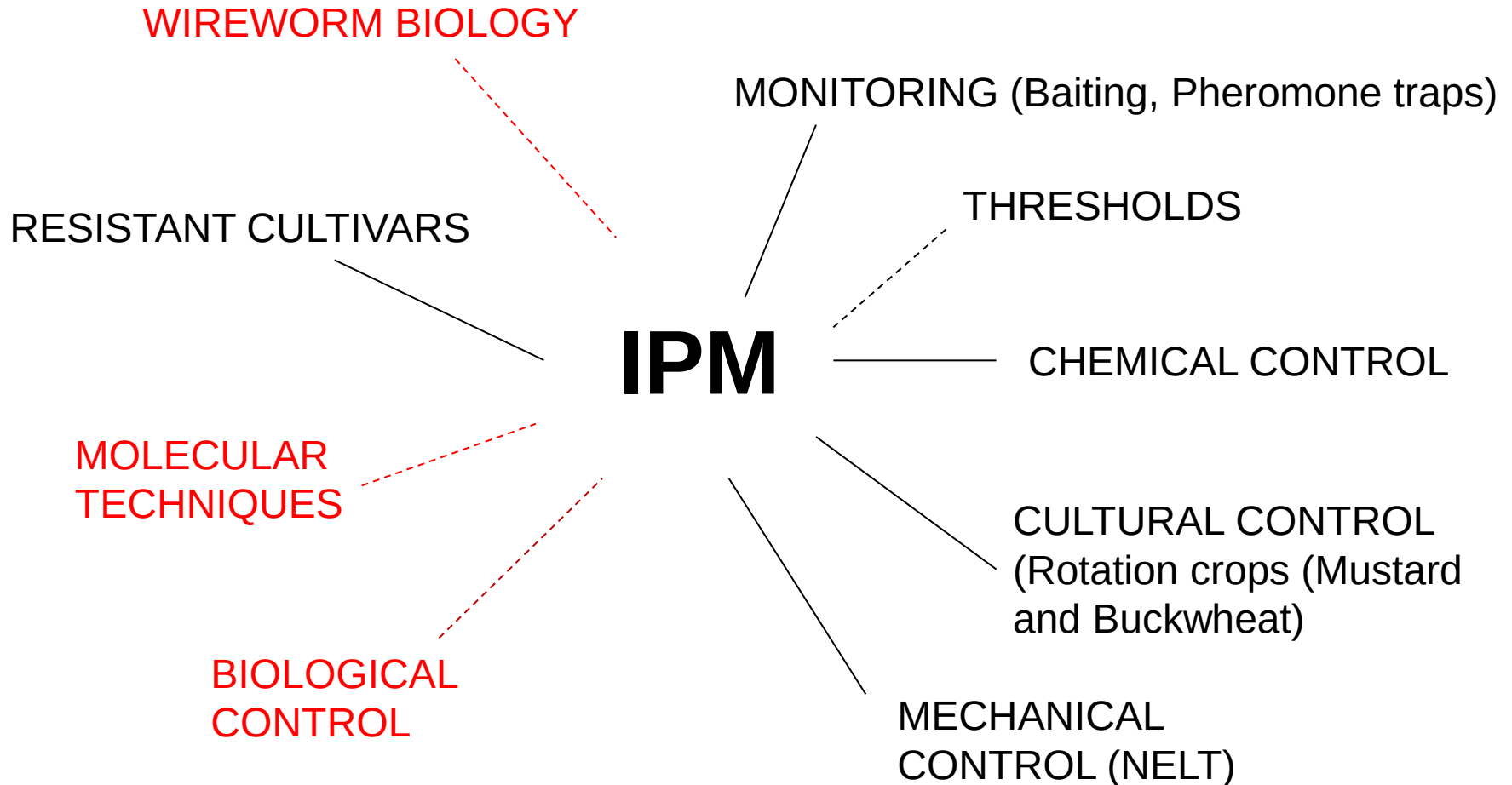
SPRING



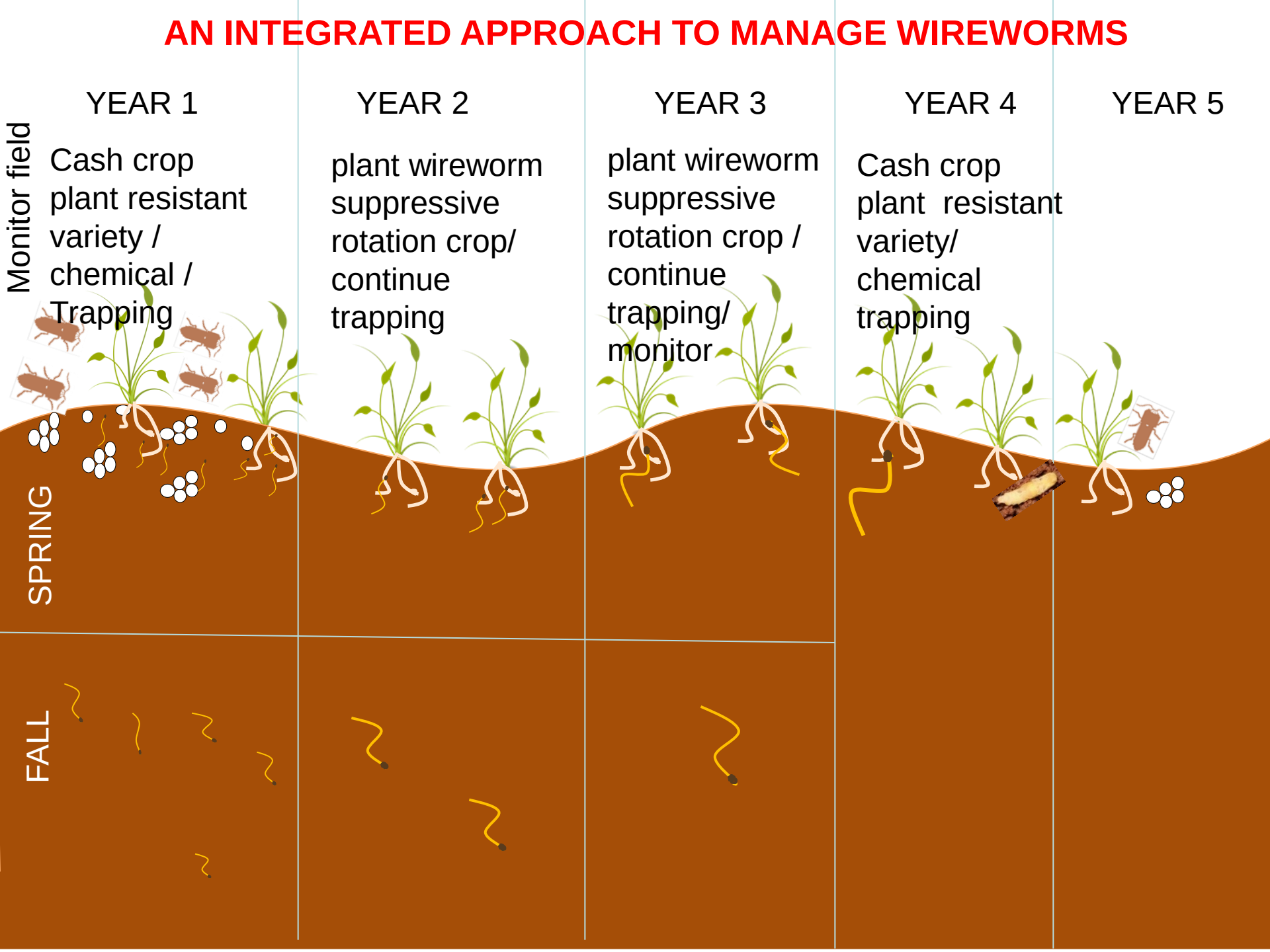
FALL



AN INTEGRATED PEST MANAGEMENT APPROACH TO CONTROL WIREWORMS



AN INTEGRATED APPROACH TO MANAGE WIREWORMS





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