

# Research on the structure, dynamics, abundance and the role of the species of coleopters (Insect class, Ordinal *Coleoptera*) existing in the apple tree plantations

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**Abstract** This paper refers to the structure, dynamics, abundance and role of the beetle species found in an apple plantation in Suceava county. The place where the research is carried out has been structured in three experimental variants: V1 - existing vegetable carpet (control), V2 - vegetal carpet overlaid with a mixture of four vegetables species and V3 - black field. Also, by the adopted cultivation technology, the maintenance of the vegetal carpet is done by mowing it 2-3 times during a vegetative season, chopping the resulting material and using it as mulch, thus ensuring a contribution of organic matter for enriching the nutritional contribution of soil. In addition to this advantage, the vegetal carpet can influence the local ecosystem conditions, such as those concerning: the physical, chemical and microbiological properties of the soil; useful biodiversity of entomofauna; reducing the level of attack of the phytopathogenic agent and the specific pests etc., with multiple effects on the quantity and quality of the fruits and finally on the profitability of the apple crop. The collection of beetles was done periodically, from May to September, using the Barber soil trap method. Following the observations it was found that in 2017 the total number of copies collected was 1339, and the variant V 3 (black field) had the highest number of copies 571. In 2018, it is noted that the largest number of copies collected, recorded all the variant V 3 with 571 copies, V1 with 459 copies and V 2 with 414 copies.

## Key words

collection, variant, beetles, Harpalus, vegetable carpet

At the global level in 2011 there were 360,000 species described by beetles, and estimates indicate a number of 1.5 million species of beetles in the world [1]. Beetles make up about 25% (350,000-400,000 species) of all the described species (-1.5 million species), making it the richest known species on Earth [2]. Many species of beetles are considered major pests of agricultural plants, as well as of stored products. They attack all parts of plants, as well as processed fibers, grains and wood products. Beetles are insects useful as decomposers and recyclers of organic nutrients. Most are phytophagous, some are predators, others are consuming fragments, some are parasites, etc. Predatory species, such as coccinellids, are important biological agents for the control of aphids and mites, etc. They are considered predators species on other insects. The appetite of the lady bugs is to be noticed. An adult female of *Hippodamia convergens* can consume up to 75 aphids in one day, while the male can reach up to 40 aphids in one day, over 200 in a week. A larvae can consume up to 350 aphids during development [3].

## Material and Method

In the studied biotope were placed 10 traps, on two rows, installed from the edge to the inside, at a distance of 10 m between rows and at 6 m between traps per row.

The samples were collected in each of the 2 years of research (2017 and 2018) during the period May - September, at intervals of about 7-10 days.

The establishment of the experimental lot was implemented in one of the SCDP Fălticeni plots. Barber soil traps consisted in the introduction into the soil of plastic boxes in which the liquid is poured as the 4% formalin fixative solution, a solution of sodium chloride etc. (Figure 1).

Plastic boxes with a volume of 500 ml and a diameter of 10 cm were used, in which a solution of formol in conc. of 4%.



Figure 1. Barber soil traps (original)

In 2017, the experimental group with the following working variants was placed in the stationary Țarna Mare:

- V1 – existing plant carpet (control);
- V2 – vegetal carpet overlaid with a mixture of the four vegetables species;
- V3 – black field.

The collection of material from soil traps Barber-type was performed on the following dates: 23.05; 8.06; 21.06; 3.07; 17.07; 29.07; 11.08; 25.08; 5.09; 17.09, in total 10 collections.

The material thus collected was determined in variants, traps and on the harvest (Fig. 2).

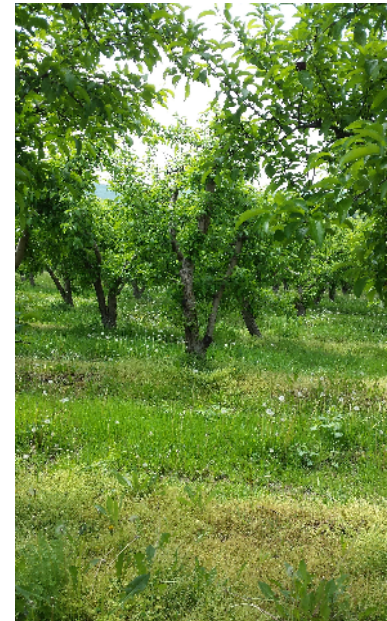


Figure 2. Aspects of the experimental field with working variants

## Results and Discussions

**In the first variant, existing vegetal carpet (control), in 2017,** regarding the species and the number of collected beetles, the situation is presented as follows:

A total of 21 species of beetles were collected, totaling 338 specimens (Table 1). The beetle species collected with the largest number of specimens were: *Harpalus calceatus*, *Anysodactylus binotatus*, *Harpalus tenebrosus* and *Harpalus pubescens*.

Table 1

The structure of the beetle species at variant 1 in 2017

No.	Species	Harvest										Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	
1.	<i>Acylophorus glaberrinus</i>					1						1
2.	<i>Agriotes ustulatus</i>								1			1
3.	<i>Anysodactylus binotatus</i>	7	21		4	15					1	48
4.	<i>Aphthona euforbiae</i>				1				2			3
5.	<i>Cianirys ciana</i>						1					1
6.	<i>Dermestes lanarius</i>					2						2
7.	<i>Harpalus aeneus</i>							1				1
8.	<i>Harpalus calceatus</i>	10	54		5	13	9	21	4		5	121
9.	<i>Harpalus distinguendus</i>	9		4	5	10			2		4	34
10.	<i>Harpalus griseus</i>	2	21	1				2			3	29
11.	<i>Harpalus pubescens</i>	9		1	2	1	24	3				40
12.	<i>Harpalus tardus</i>		1	1							2	4
13.	<i>Harpalus tenebrosus</i>			3		20		18				41
14.	<i>Longitarsus tabidus</i>							2				2
15.	<i>Malachius bipustulatus</i>		1									1
16.	<i>Metabletus truncatulus</i>				1			1				2
17.	<i>Mordela aculeata</i>										1	1
18.	<i>Otiorrhynchus porcatus</i>	1										1
19.	<i>Pteryngium crenatum</i>						2					2
20.	<i>Rinomias forticornis</i>							2				2
21.	<i>Tachyporus hypnorum</i>					1						1
<b>TOTAL 338 specimens</b>		38	98	10	18	63	36	50	9	0	16	338

**In experimental version 2, vegetal carpet covered with a mixture of four vegetables species:**

- A number of 19 species of beetles were collected, totaling 430 copies (Table 2).

- The most commonly collected beetle species were: *Harpalus calceatus*, *Anysodactylus binotatus*, *Harpalus pubescens*, *Harpalus distinguendus* and *Harpalus pubescens*.

Table 2

The structure of the beetle species at variant 2 in 2017

No.	Species	Harvest										Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	
1.	<i>Anysodactylus binotatus</i>	13	27	1	12	22				5	3	83
2.	<i>Bembidion ruficolle</i>				1							1
3.	<i>Coccinella 7 punctata</i>								2			2
4.	<i>Harpalus aeneus</i>							2				2
5.	<i>Harpalus calceatus</i>	15	6	15	21	9	18	12		4	2	102
6.	<i>Harpalus distinguendus</i>	3	3	9	12	6			3	3		39
7.	<i>Harpalus griseus</i>		17	12		3					4	36
8.	<i>Harpalus pubescens</i>	3		3	24		13	15		1		59
9.	<i>Harpalus tardus</i>			11							2	13
10.	<i>Harpalus tenebrosus</i>					9		9	42		7	67
11.	<i>Hister purpurascens</i>			1								1
12.	<i>Meligetes subrugosus</i>		1									1
13.	<i>Metabletus truncatulus</i>					1						1
14.	<i>Otiorrhynchus pinastri</i>					4	3					7
15.	<i>Otiorrhynchus porcatus</i>	1										1
16.	<i>Oxypora vittata</i>										6	6
17.	<i>Pentodom idiota</i>					1						1
18.	<i>Rinomias forticornis</i>							3				3
19.	<i>Scymnus auritus</i>		2								2	5
<b>TOTAL 430 specimens</b>		35	56	52	70	55	34	42	47	13	26	430

**In variant 3, black field** as for the species and the number of collected beetles, the situation is as follows:  
 - 22 varieties of beetles were collected in this variant, totaling 571 copies (Table 3).

- The beetle species most commonly collected in this experimental variant were: *Harpalus distinguendus*, *Harpalus calceatus*, *Harpalus pubescens*, *Harpalus tenebrosus* and *Anysodactylus binotatus*,

Table 3

**The structure of the beetle species at variant 3 in 2017**

No.	Species	Harvest										Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	
1.	<i>Agriotes ustulatus</i>								1			1
2.	<i>Amara aenea</i>					1						1
3.	<i>Anysodactylus binotatus</i>	1	42	36	10	12						101
4.	<i>Apion apricans</i>								1			1
5.	<i>Ceuthorynchus troglodytes</i>					1						1
6.	<i>Chysomela marginata</i>								1			1
7.	<i>Coccinella 7 punctata</i>									1		1
8.	<i>Harpalus aeneus</i>	24										24
9.	<i>Harpalus calceatus</i>	6	48		24	18		12	3	15		118
10.	<i>Harpalus distinguendus</i>	18	9	27	6	15			1	9		85
11.	<i>Harpalus griseus</i>	2			5			3				10
12.	<i>Harpalus pubescens</i>	15	9		3		3	6	12	1		49
13.	<i>Harpalus tardus</i>		6							12		18
14.	<i>Harpalus tenebrosus</i>			11		33	27	9	15	24		119
15.	<i>Hister purpurascens</i>	8		4								12
16.	<i>Longitarsus tabidus</i>							1				1
17.	<i>Malachius bipustulatus</i>		1									1
18.	<i>Meligetes maurus</i>			1								1
19.	<i>Metabletus truncatellus</i>				1			5				6
20.	<i>Otiorrhynchus pinastri</i>					6		4	1			11
21.	<i>Pentodom idiota</i>					1						1
22.	<i>Tachyporus hypnorum</i>					1						1
<b>TOTAL 571 specimens</b>		74	115	79	49	88	30	40	34	62	0	571

**Summary of the results obtained in 2017**

In 2017, following the ten harvests, a number of 1339 beetle specimens resulted, in the three experimental variants (Table 4, Figure 3):

V1 – existing plant carpet (control), totaled 338 beetle specimens;

V2 – vegetable carpet, sown with a mixture of four vegetables species, totaled 430 beetle specimens;

V3 – black field, totaled 571 beetle specimens.

It is noted that the total number of copies collected in 2017 was 1339, the variant V 3 having the largest number of 571 specimens.

Table 4

**Number of copies of beetles collected in 2017 from the 3 experimental variants**

Date of harvest	V 1	V2	V3	TOTAL
<b>Harvest I 23.05.2017</b>	38	35	74	147
<b>Harvest II 08.06.2017</b>	98	56	115	269
<b>Harvest III 21.06.2017</b>	10	52	79	141
<b>Harvest IV 03.07.2017</b>	18	70	49	137
<b>Harvest V 17.07.2017</b>	63	55	88	206
<b>Harvest VI 29.07.2017</b>	36	34	30	100
<b>Harvest VII 11.08.2017</b>	50	42	40	132
<b>Harvest VIII 25.08.2017</b>	9	47	34	90
<b>Harvest IX 05.09.2017</b>	0	13	62	75
<b>Harvest X 17.09.2017</b>	16	26	0	42
<b>TOTAL</b>	338	430	571	<b>1339</b>

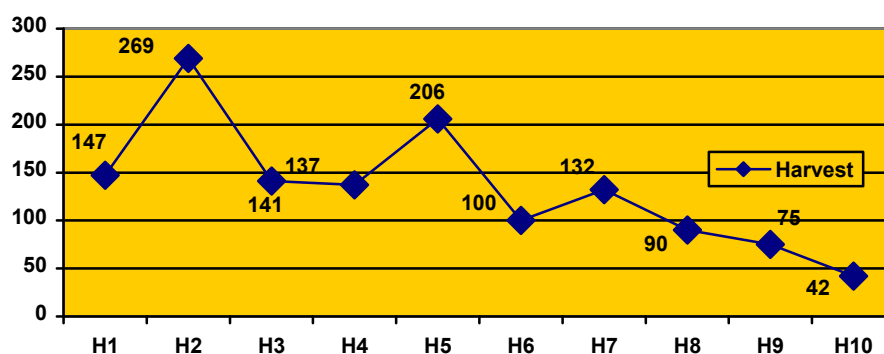


Figure 3. Graphical representation of the number of beetle specimens collected after the 10 harvests

### Structure, dynamics and abundance of beetle species collected in apple plantations in 2018.

In 2018, the collection of material from soil traps type-Barber was made on the following dates: 25.05; 7.06; 20.06; 4.07; 16.07; 31.07; 12.08; 23.08; 12.09; 26.09.

In this experimental variant, a number of 60 species of beetles were collected, totaling 459 specimens (Table 5). Of the beetle species collected with the most specimens collected: *Anysodactilus binotatus*, *Harpalus distinguendus* and *Dermestes lanarius*.

Table 5

The structure of the beetle species at variant 1 in 2018

No.	Species	Harvest										Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	
1.	<i>Acrulia inflata</i>		1									1
2.	<i>Aleocara moerens</i>							2				2
3.	<i>Amara aenea</i>					3			1			4
4.	<i>Amara crenata</i>		4		1	1	2					8
5.	<i>Anisodactilus binotatus</i>				7		12	6	10			87
6.	<i>Anthichus floralis</i>						2					2
7.	<i>Anthichus humeralis</i>						1		2			3
8.	<i>Aphthona euforbiae</i>				1		1		1			3
9.	<i>Apion pomone</i>							1				1
10.	<i>Argoptochus bisignatus</i>						1					1
11.	<i>Brachynus explodens</i>						1					1
12.	<i>Calathus fuscipes</i>			1								1
13.	<i>Cantharis fusca</i>			1								1
14.	<i>Ceuthorrychus sulcicolis</i>			1								1
15.	<i>Ceutorrhynchus pyrrhorhynchus</i>						1					1
16.	<i>Chaetocnema angustula</i>		1									1
17.	<i>Chantaris fusca</i>				1							1
18.	<i>Coccinella 7 punctata</i>			1			1					3
19.	<i>Colodera aethiops</i>							4	10			14
20.	<i>Cryptichus quisquilius</i>						1					1
21.	<i>Cryptophagus scanicus</i>			1								1
22.	<i>Dermestes lanarius</i>		6	6	17	3	13	5	10			55
23.	<i>Dorcadion pedestre</i>		2	1								3
24.	<i>Epicometis hirta</i>		2	2	1							5
25.	<i>Epurea obsoleta</i>		3									3
26.	<i>Harpalus azureus</i>									3	3	6
27.	<i>Harpalus calceatus</i>		30		3			1	6			40
28.	<i>Harpalus distinguendus</i>		41	15	4	1	5	2	16	1	1	86
29.	<i>Harpalus griseus</i>		2					4	3			9
30.	<i>Harpalus pubescens</i>				2		2					4
31.	<i>Harpalus rufipes</i>		4									4
32.	<i>Harpalus tardus</i>		1			1		3	1			6
33.	<i>Harpalus tenebrosus</i>		16		3	2		3	5			29

Continued table 5												
34.	Hister purpurascens			1				1	1		8	11
35.	Idichroma dorsalis								1			1
36.	Melighetes subrugosus					1						1
37.	Metabletus truncatulus		1	1		3						5
38.	Microlestes maurus								5			5
39.	Monotoma picipes			4	1							5
40.	Onthophagus semicornis								13			13
41.	Opatrum sabulosum		1									1
42.	Ophonus obscurus			1								1
43.	Ophonus sabulicola						2					2
44.	Otiorrhynchus pinastri		5	2	6	6	3	2				24
45.	Oxypora vittata			1				6	3			10
46.	Paramalus paralelipedus		6				2	3	1			12
47.	Phalacrus caricis						1					1
48.	Phylotretta atra				1		4					5
49.	Pseudocleonus cinereus							1				1
50.	Pseudophonus pubescens				1							1
51.	Pterostichus cupreus						1					1
52.	Pterostichus niger						1			1		2
53.	Quedius alpestris			2								2
54.	Sipalia circellaris		3									3
55.	Staphylynus caesareus								3			3
56.	Stomodes girasicolis					1						1
57.	Stricticalis tabias		1									1
58.	Tachyporus abdominalis						1					1
59.	Tachyusa coarctata								3			3
60.	Valgus hemipterus			3								3
<b>TOTAL 459 specimens</b>		0	130	44	49	22	58	44	95	5	12	459

**The structure, dynamics, abundance and ecological indices of the beetle species in variant V2, vegetal carpet overlaid with a mixture of four vegetables species.**

In variant 2, a number of 64 species of beetles were

collected, totaling 414 specimens (Table 6). Of the beetle species collected in this experimental variant we mention: *Anysodactylus binotatus*, *Dermestes lanarius*, *Harpalus distinguendus* and *Harpalus tenebrosus*.

Table 6

**The structure of the beetle species at variant 2 in 2018**

No	Species	Harvest										Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	
1.	Acylophorus glaberrimus		1									1
2.	Aleocara laevigata							8				8
3.	Aleocara moerens							5				5
4.	Aleocara rufficornis							6				6
5.	Amara aenea			1								1
6.	Amara crenata		1				6					7
7.	Amara similata	1										1
8.	Anthichus floralis		1				1					2
9.	Anthichus humeralis			1				2				3
10.	Anysodactylus binotatus	1	25	35	3			3				67
11.	Anysodactylus sigatus	8										8
12.	Aphodius granarius		2									2
13.	Aphthona euforbiae						1	1				2
14.	Apion apicans							1				1
15.	Apion pomonee					1						1
16.	Apion violaceum			1								1
17.	Argoptochus bisignatus			1								1
18.	Atomaria ornata				1							1

Continued table 6

19.	<i>Attogetus smirnovi</i>				1							1
20.	<i>Boris analis</i>				1							1
21.	<i>Brachynus explodens</i>			1			1					2
22.	<i>Carpophilus bipustulatus</i>				1							1
23.	<i>Cetonia aurata</i>			1	1		1	1				4
24.	<i>Ceuthorrychus sulcicolis</i>	1		1								2
25.	<i>Chaetocnema angustula</i>			1								1
26.	<i>Chantaris fusca</i>			1	1							2
27.	<i>Coccinella 7 punctata</i>							3		1	1	5
28.	<i>Coenorrhinus aequatus</i>				1							1
29.	<i>Conosoma bipunctatum</i>						2					2
30.	<i>Cyanis cinerea</i>		1									1
31.	<i>Dermestes lanarius</i>		7	14	11		15	5				52
32.	<i>Dorcadion pedestre</i>		3									3
33.	<i>Epicometis hirta</i>	1	2	1								4
34.	<i>Epurea neglecta</i>						1					1
35.	<i>Epurea obsoleta</i>				1							1
36.	<i>Halyzia 14 punctata</i>							1				1
37.	<i>Harpalus calceatus</i>	1	2		1							4
38.	<i>Harpalus distinguendus</i>	9	13	17	7		1	3		1	1	52
39.	<i>Harpalus griseus</i>		2		4		1					7
40.	<i>Harpalus pubescens</i>				3							3
41.	<i>Harpalus tardus</i>		1		1			1				3
42.	<i>Harpalus tenebrosus</i>		10					2			27	39
43.	<i>Heterostomus villiger</i>				1							1
44.	<i>Hister purpurascens</i>	1		1			1	1				4
45.	<i>Larinus jocae</i>				1							1
46.	<i>Longitarsus tabidus</i>							1				1
47.	<i>Metabletus truncatulus</i>	3		2			7	1				13
48.	<i>Microglossa pulla</i>						3					3
49.	<i>Monotoma picipes</i>	1	1	2			1					5
50.	<i>Mordella fasciatta</i>									1		1
51.	<i>Ophonus obscurus</i>			1								1
52.	<i>Otiorrhynchus pinastri</i>		2	5	13		13	1				34
53.	<i>Oxypora vittata</i>				2		5					7
54.	<i>Paramalus parallelipipedus</i>						3					3
55.	<i>Phylotretta atra</i>						5					5
56.	<i>Platynaspis luteorubra</i>							1				1
57.	<i>Pseudocleonus cinereus</i>				1							1
58.	<i>Scymnus auritus</i>						1	1				2
59.	<i>Sitona lineatus</i>		1									1
60.	<i>Tachyporus abdominalis</i>				1							1
61.	<i>Tachyporus hypnorum</i>						1					1
62.	<i>Tachyusa coarctata</i>	1	1				4					6
63.	<i>Tanymechus paliatus</i>			9								9
64.	<i>Valgus hemipterus</i>			1	1							2
<b>TOTAL 414 specimens</b>		28	76	97	58	0	75	48	0	3	29	414

**The structure, dynamics, abundance and ecological indices of the beetle species in the V3 variant, black field.**

In experimental version 3, a number of 22 species of

beetles were collected, totaling 571 copies (Table 7). The beetle species collected in this experimental variant are: *Harpalus calceatus*, *Harpalus tenebrosus*, *Anysodactylus binotatus* and *Harpalus pubescens*.

Table 7

The structure of the beetle species at variant 7 in 2017

No.	Specia	Harvest										Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	
1.	Agriotes ustulatus								1			1
2.	Amara aenea					1						1
3.	Anysodactylus binotatus	1	42	36	10	12						101
4.	Apion apricans								1			1
5.	Ceuthorynchus troglodytes					1						1
6.	Chysomela marginata								1			1
7.	Coccinella 7 punctata									1		1
8.	Harpalus aenusus	24										24
9.	Harpalus calceatus	6	48		24	18		12	3	15		126
10.	Harpalus distinguendus	18	9	27	6	15			1	9		85
11.	Harpalus griseus	2			5			3				10
12.	Harpalus pubescens	15	9		3		3	6	12	1		49
13.	Harpalus tardus		6							12		18
14.	Harpalus tenebrosus			11		33	27	9	15	24		119
15.	Hister purpurascens	8		4								12
16.	Longitarsus tabidus							1				1
17.	Malachius bipustulatus		1									1
18.	Meligetes maurus			1								1
19.	Metabletus truncatulus				1			5				6
20.	Otiorrhynchus pinastri					6		4	1			11
21.	Pentodom idiota					1						1
22.	Tachyporus hypnorum					1						1
<b>Total exemplare 571</b>		<b>74</b>	<b>115</b>	<b>79</b>	<b>49</b>	<b>88</b>	<b>30</b>	<b>40</b>	<b>34</b>	<b>62</b>	<b>0</b>	<b>572</b>

**Summary of the results obtained in 2018**

In the year 2018, following the ten harvests, a number of 1444 beetle specimens resulted in the three experimental variants (Table 8, Figure 4):

V1 - existing plant carpet (control), totaled 459 beetle specimens;

V2 - vegetal carpet overlaid with a mixture of the four vegetables species, totaled a number of 414 beetle specimens;

V3 - black field, totaled 571 beetle specimens.

It is noted that the largest number of copies collected in 2018, registered their variants V 3 with 571 copies, V1 with 459 copies and V 2 with 414 copies (Table 8).

Table 8

Number of copies of beetles collected in 2018 from the 3 experimental variants

Date of harvest	V 1	V2	V3	TOTAL
<b>Harvest I 25.05.2018</b>	0	28	74	102
<b>Harvest II 07.06.2018</b>	130	76	115	321
<b>Harvest III 20.06.2018</b>	44	97	79	220
<b>Harvest IV 04.07.2018</b>	49	58	49	156
<b>Harvest V 16.07.2018</b>	22	0	88	110
<b>Harvest VI 31.07.2018</b>	58	75	30	163
<b>Harvest VII 12.08.2018</b>	44	48	40	132
<b>Harvest VIII 23.08.2018</b>	95	0	34	129
<b>Harvest IX 12.09.2018</b>	5	3	62	70
<b>Harvest X 26.09.2018</b>	12	29	0	41
<b>TOTAL</b>	<b>459</b>	<b>414</b>	<b>571</b>	<b>1444</b>

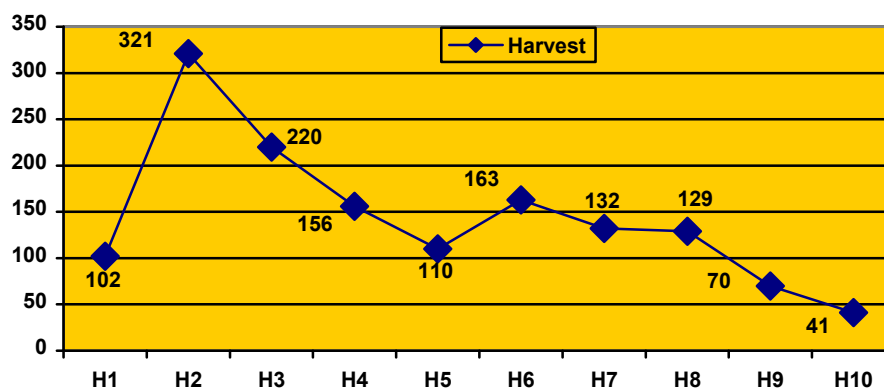


Figure 4. Graphical representation of the number of beetle specimens collected after the 10 harvests in 2018

## Conclusions

1. In 2017, a total number of 1339 beetle specimens were collected, variant V 3 (black field), with the highest number of specimens (571), and the smallest number of coleopterans was recorded at variant V1 (control).
2. In 2018, variant V 3 (black field) recorded the largest number of collected specimens (571), while variant V2 recorded the smallest number (414 copies of beetles) with a total of 1444 copies.
3. It follows from these observations that the vegetal carpet can influence the local ecosystem conditions, such as those regarding: the physical, chemical and microbiological properties of the soil; useful biodiversity of entomofauna; reducing the level of attack of the phytopathogenic agent and the specific pests etc., with multiple effects on the quantity and quality of the fruits and finally on the profitability of the apple crop.

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