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OBSERVATIONS ON THE STRUCTURE AND DYNAMICS OF CARBID SPECIES IN SOME APPLE TREE ORCHARDS ACCORDING TO THE GROWING AREA AND IN THE CONTEXT OF CLIMATE CHANGE

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Abstract

Investigations into the entomofauna of carabides study in apple tree orchards were carried out using the soil traps type Barber. The collection of the material was done in both sampling during May-August, at intervals of 7 to 15 days, for each of the two stages 2010-2011 and 2018 to 2019. At each harvest, the biological material has been taken from traps and at the same time, the salt solution 25 % concentration has been completed or replaced. It would be ideal for certain species (predators and deleterious) to be in balance so that harmful species do not cause damage. In this paper it was initiate a comparative study of the carabids found in apple tree plantations in Iasi and Vaslui counties who was carried out in the context of the evolution of the climatic conditions. From the collected biological material, only carabids species were selected, which were then determined to the species level. Of these most commonly collected carabid species were: Pseudophonus rufipes Mull., Harpalus distinguendus Duft., Ophonus azureus F., Harpalus aeneus F., etc

Key words*: soil traps, Barber type, climatic values.*

INTRODUCTION

Carabidae is an exceedingly diverse family, to telong the Coleopera order of class Insecta. They are distributed worldwide and are adapted for every possible habitat on our planet (except marine and polar regions) (Talmaciu M. et al., 1998).

Habitat and food specificity make them ecologically and economically significant as indicator species and pests respectively. The World record of identified species is the most species have been reported from Europa.

The beetle diversity is enormous; they display a great deal of ecological importance. Some of them are specialized feeder of animal and plant debris, while some are not. (Varvara M. et al., 1995). Many of species are destructive; by feeding on vital plant parts like flowers, fruits and seeds, which ultimately damage our economy. (Varvara M. et al., 1996)

The numbers of the predatory species are biological control agents of agricultural pests beetles of the family Carabidae (ground bugs) feeds on insect pest like aphids and another larvae stage that damages crops. (Paulian F., 1974).

The present study helps in understanding the seasonal variation in the diversity of beetles from Iasi and Vaslui country which have been identified using the determinant books (Du Chatenet G., 1990; Grozea I., 2006; Panin I., 1951; Reitter E., 1908; Rogojanu V., 1979).

MATERIALS AND METHODS

The soil traps type Barber by which we collected the carabids from the fruit orchards ecosystems, it they consisted of the introduction into the soil of plastic pots of 500 ml volume into which 25% sodium chloride solution is poured as a fixative liquid (Herea M. et al., 2011; Talmaciu M. et al., 2017)

Six traps, on two rows, placed from the edge inward, were placed in the studied biotope, at 10 m row spacing and 6 m for the traps on row spacing.

Samples were collected every 3 years of observation (2011 and 2018-2019) between May and September at approximately 10-15 day intervals.

The setting up of the experimental stationary was implemented in one of the plots of the apple tree plantation at the Didactic Station of

the Faculty of Horticulture from Iasi, and in one of the plots belonging to the SC Lot Service SRL Farm, Vaslui County.

RESULTS AND DISCUSSIONS

Environmental or ecological factors exercise complex and continuous action on the population of the species and all organisms in the biocenosis. Ecological factors influence the number of insect populations due to their organic or inorganic nature and the consistency of their actions over time and space. Due to these nature factors, imbalances occur which lead to acceleration or delay in the development of certain organisms, to the reduction or numerical increase of the population of species and even the change in the structure and dynamic change of ecosystems.

Some of the most important anorganic factors influencing geographical distribution, growth and activity of insects are climatic factors.

The monthly temperatures recorded between 2011 and 2018-2019 in the Iasi area are presented in Table 1.

Table 1. The thermal regime in, 2011 and 2018-2019 (source: www.tutiempo.net)

Iasi Monthly average temperature (°C)			
Month / Year	2011	2018	2019
January	1,1	3,2	2
February	3,8	5,7	2,6
March	4,9	9,2	7
April	12,4	12,6	10,9
May	17,2	16	16,8
June	19,9	20	20,5
July	22,2	21,6	24,2
August	23,4	21	24,5
September	15,1	17,5	20
October	13	12,4	6,5
November	8,7	8	2,6
December	1,3	3,6	-1,5

In 2011, the average annual temperature was 12°C and the average maximum and minimum temperatures were 17.7°C and 6.4°C, respectively.

In 2018, the annual average temperature was 12.6°C and the average maximum and minimum temperatures were 18.4°C and 7.3°C respectively.

The year 2019 was until September a year with high summer temperatures and a small amount of precipitation.

The monthly temperatures recorded between 2011 and 2018-2019 in Vaslui County are shown in Table 2.

In 2011 the annual average temperature was 11.1°C and the maximum and minimum average temperatures were 18.2°C, 5.8°C, respectively.

In 2018 the average annual temperature was 11.7°C and the average maximum and minimum temperatures were 18°C and 6.4°C, respectively.

As in Iasi county, in 2019, during the entire growing plants season of climate regime it was characterized that one year with high summer temperatures and a small amount of rainfall.

Table 2. The thermal regime in 2011 and 2018-2019 (source: www.tutiempo.net)

Vaslui Monthly average temperature (°C)			
Month / Year	2011	2018	2019
January	-0,4	1,7	0,3
February	3,6	5,1	1,3
March	4,9	9	6,5
April	12,1	11,9	10,1
May	17,3	15,1	16,5
June	19,2	18,4	19,3
July	21	20,4	23,2
August	22,3	20,7	22,9
September	14,1	16,7	16,6
October	11,2	11,5	8,8
November	7,9	6,3	3,2
December	-1,1	2,5	-0,1

As climatic conditions influence very much the entire activity in agrobiocenosis, data on the rainfall regime of the two areas considered in the study were also recorded.

The monthly rainfall between 2011 and 2018-2019 in Iasi County is shown in Table 3 and the relative humidity in Table 4

In 2011 the total rainfall was 676.58 mm and the average humidity for the 365 days was 70.5%.

In 2018 the total rainfall was 314.6 mm and the average humidity for the 365 days was 72.8%.

The year 2019 was until the end of the research on September was shown as a year with a small amount of rainfall, which was not a great advantage for plant cultivation.

Monthly rainfall between 2011 and 2018-2019 in the Vaslui area is shown in Table 5 and relative air humidity in Table 6.

Table 3. The fainfall regime in 2011 and 2018-2019 (source: www.tutiempo.net)

Iasi Monthly average rainfall (mm)			
Month / Year	2011	2018	2019
January	56,38	29,8	38,61
February	19,4	16,4	31,24
March	28,6	11,4	22,36
April	24,8	19,9	26,41
May	30,2	19,2	70,62
June	83,6	62,1	27,18
July	26,2	38,7	61,22
August	100,6	38,6	30,47
September	30,73	16,4	13,3
October	43,17	18,1	44,25
November	42,16	30,3	43,1
December	36,0	13,7	31,9

Table 4. Relative humidity in Iasi, 2011 and, 2018-2019 (source: www.tutiempo.net)

Iasi Average monthly of relative humidity%			
Month / Year	2011	2018	2019
January	93	81,2	86,9
February	88,9	79,0	49,8
March	84,3	72,1	65,2
April	73	77,53	64,9
May	74,7	62,9	74,2
June	80,6	73,2	78,3
July	63	69,5	65,9
August	58,1	65,5	69,2
September	77,4	56,1	17,6
October	81,1	73,0	34,6
November	89	78,0	87,4
December	90,5	82,12	80,1

Table 5. The fainfall regime in, 2011 and 2018-2019 (source: www.tutiempo.net)

Vaslui Monthly average rainfall (mm)			
Month / Year	2011	2018	2019
January	24,88	18,8	32,78
February	17,53	19,05	19,82
March	74,92	13,47	9,14
April	47,24	46,74	42,67
May	65,53	70,09	31,51
June	142,76	38,34	51,82
July	35,81	57,4	4,83
August	40,38	34,29	21,84
September	61,95	34,78	26,6
October	90,17	50,29	64,2
November	28,43	34,54	37,0
December	2,28	63,47	47,2

Table 6. Relative humidity in, 2011and 2018-2019 (source: www.tutiempo.net)

Vaslui Average monthly of relative humidity %			
Month / Year	2011	2018	2019
January	83,4	88,7	83,6
February	75,2	73,4	73,7
March	70,2	61,2	62,8
April	64,1	69,5	56,7
May	63,1	72,2	68,2
June	76,8	69,5	68,7
July	64,1	74,5	57,1
August	63	68,6	58,9
September	76,6	70,8	62,3
October	79,1	76	68,5
November	83,4	82,1	83
December	87,4	87,5	82,9

In Vaslui County, in 2011 the total rainfall was 631.88 mm and the average humidity over the 365 days was 73.8%.

In 2018 the total rainfall was 481.26 mm and the average humidity for the 365 days was 74,5%.

Just like in Iasi County, and in Vaslui County in 2019 until September there was a small amount of precipitation.

Moisture and precipitation also play an important role in the life and dynamics of the insect population, as water is indispensable for the vital processes of the organism, thus the moisture of the food substrate acting as a limiting factor in the dynamics of the beetle population.

Results on the status of the collections in the two stages (2011 and 2018-2019) in the two experimental stationary

We have achieved the following results following biological material collections during the research period at the Iasi stationary.

The *Carabidae* family has totaled the highest number of specimens collected with genus, determined/identified by means of determiners (Du Chatenet G., 1990 ; Grozea I., 2006; Panin I., 1951; Reitter E., 1908; Rogojanu V., 1979): *Amara, Bembidion, Brachinus, Calathus, Carabus, Cicindela, Cymindis, Harpalus, Microroles, Notiophilus, Pseudophonus, Ophonus* and *Pterostichus* totalized 1103 specimens collected (Table 7).

In 2011, were collected 224 specimens from biological material collections and the species with the highest abundance were represended by: *Harpalus distinguendus*, *Amara eurynota, Calathus fuscipes*, *Anisodactylus signatus*, *Brachinus crepitans*, *Pterostichus niger* and *Notiophilus palustris.*

In 2018, the number of insect species collected totaled 416 and the species with the the most abundant of specimens collected was collected: *Harpalus distinguendus, Pseudophonus rufipes Amara eurynota*, *Amara familiaris*, *Pseudophonus griseus*, *Brachinus crepitans* and *Carabus coriaceus.*

In 2019, the number of insects collected totaled 463 and the species were found to have the the most abundant of specimens collected: *Calathus fuscipes*, *Pseudophonus rufipes, Carabus coriaceus, Harpalus distinguendus* and *Pterostichus cylindrichus.*

Table 7. The family, genera and species belonging to *Carabidae* collected from apple orchards to stationary from Iasi

Family	Genus	Name of species	Year			Total
			2011	2018	2019	
Carabidae	Abax	Abax carinatus Duft	-	**3**	**4**	**7**
	Amara	Amara eurynota Panz.	21	60	0	81
		Amara aenea Dejean	1	0	8	9
		Amara crenata Dejean	3	2	1	5
		Amara familiaris Duft.	12	35	7	54
		Amara similata Gyll	3	-	-	3
	Anisodactylus	Anisodactylus signatus Paz	15	17	15	47
	Attagemus	Attagemus unicolor	5	-	-	5
	Brachinus	Brachinus crepitans L.	11	25	18	54
		Brachysomus hirtus	19	-	-	19
	Calathus	Calathus ambiguus Payk	-	2	13	15
		Calathus fuscipes Goeze	45	1	96	142
	Carabus	Carabus besseri Fischer	2	7	1	10
		Carabus coriaceus L	5	20	48	73
		Carabus cancellatus Illyg	3	4	-	7
		Carabus scabrisculus Ol	-	-	21	21
	Harpalus	Harpalus distinguendus Duft.	53	110	35	198
		Harpalus tardus Panz.	2	3	2	7
		Harpalus calceatus Duft	-	-	2	2
	Leistus	Leistus ferrugineus L	-	-	1	1
	Microlestes	Microlestes maurus Strm.	3	-	-	3
	Nebria	Nebria picicornis F	-	9	2	11
	Notiophilus	Notiophilus palustris Duft.	10	-	-	10
	Pterostichus	Pterostichus niger Schaller	11	2	11	24
		Pterostichus cylindrichus Hr.	-	5	20	25
	Pseudophonus	Pseudophonus griseus Panz.	-	35	66	101
		Pseudophonus rufipes Müll	-	72	83	155
	Poecilus	Poecilus cupreus		2	3	5
	Zabrus	Zabrus tenebrioides Goeze.		2	6	8
16 genus		**29 species**	**224**	**416**	**463**	**1103**

From biological material collections during research periods at Vaslui stationary we achieved the following results.

The Carabidae family whose representatives we selected from the total number of species collected totaled the highest number of specimens collected 293 are represented by the genres: *Brachysomus, Amara, Carabus, Calathus, Harpalus, Licinus, Leystus and Pterostichus* (Table 8).

In 2011, 89 specimens were collected from biological material collections and the species with the highest abundance were: *Amara aenea , Amara crenata, Attagemus unicolor, Calathus fuscipes, Harpalus calceatus, Harpalus tardus, Leistus ferrugineus, Licinus cassideus and Pterostichus vulgaris*

In 2018, the number of insect species collected totaled 104specimens and the species with the highest number of specimens collected were: *Amara aenea, Attagemus unicolor, Brachysomus hirtus, Harpalus aeneus, Harpalus tardus, Licinus cassideus* and *Pterostichus vulgaris* .

In 2019, the species of insects collected totaled 10 specimens , and the species were the highest collected were: *Attagemus unicolor, Calathus fuscipes, Carabus violaceus, Harpalus aeneus, Harpalus calceatus, Harpalus tardus, Leistus ferrugineus, Licinus cassideus* and *Pterostichus vulgaris.*

Table 8. The family, genera and species belonging to *Carabidae* collected from apple orchards to stationary from Vaslui

	Genus	Name of species	Year			Total
			2011	2018	2019	
Carabidae	Amara	Amara aenea Dejean	10	24	1	35
		Amara crenata Dejean	4	2	1	7
		Amara eurynota Panz.	2	1	-	3
	Attagemus	Attagemus unicolor	12	26	15	53
	Brachysomus	Brachysomus hirtus	2	9	-	11
	Calathus	Calathus fuscipes Goeze	21	0	18	39
	Carabus	Carabus violaceus L.	2	4	22	28
	Harpalus	Harpalus aeneus F.	-	12	7	19
		Harpalus calceatus Duft.	3	2	5	10
		Harpalus distinguendus Duft.	2	1	12	15
		Harpalus pubescens	1	-	1	2
		Harpalus tardus Panz.	12	13	11	36
	Leistus	Leistus ferrugineus	4	2	-	6
	Licinus	Licinus cassideus L.	5	3	3	11
	Pterostichus	Pterostichus vulgaris L.	9	5	4	18
10 genus		**20 species**	**89**	**104**	**100**	**293**

Following the centralization of the data obtained in the three years of research from the two areas located in the counties of Iasi and Vaslui in two apple tree plantations, we recorded (Table 9) a total of 34 species of carabidae with a total of 1395 specimens, of which 329 specimens were collected in 2011, in 2018 we recorded 520 specimens and 2019 recorded the highest number of carabids equal to 563.

Table 9. The family, genera and species belonging to *Carabidae* collected from apple orchards

Family	Genus	Name of species	Total Iasi	Total Vaslui	Total samples
Carabidae -	Abax	Abax carinatus Duft	7	-	7
	Amara	Amara eurynota Panz.	81	3	84
		Amara aenea Dejean	9	35	44
		Amara crenata Dejean	5	7	12
		Amara familiaris Duft.	54	-	54
		Amara similata Gyll	3	-	3
	Anisodactylus	Anisodactylus signatus Paz	47	-	47
	Attagemus	Attagemus unicolor	5	53	58
	Brachinus	Brachinus crepitans L.	54	-	54
		Brachysomus hirtus	19	11	30
	Calathus	Calathus ambiguus Payk	15	-	15
		Calathus fuscipes Goeze	142	39	181

	Carabus	Carabus besseri Fischer	10	-	10
		Carabus coriaceus L	73	-	73
		Carabus cancellatus Illyg	7	-	7
		Carabus scabrisculus Ol	21	-	21
		Carabus violaceus L	-	28	28
	Harpalus	Harpalus distinguendus Duft.	198	15	213
		Harpalus aeneus F.	-	19	19
		Harpalus tardus Panz.	7	36	43
		Harpalus calceatus Duft	2	10	12
		Harpalus pubescensL.	-	2	2
	Leistus	Leistus ferrugineus L	1	6	7
	Licinus	Licinus cassideus L.	-	11	11
	Microlestes	Microlestes maurus Strm.	3	-	3
	Nebria	Nebria picicornis F	11	-	11
	Notiophilus	Notiophilus palustris Duft.	10	-	10
	Pterostichus	Pterostichus niger Schaller	24	-	24
		Pterostichus cylindrichus Hr.	25	-	25
		Pterostichus vulgaris H.	-	18	18
	Pseudophonus	Pseudophonus griseus Panz.	101	-	101
		Pseudophonus rufipes Müll	155	-	155
	Poecilus	Poecilus cupreus L	5	-	5
	Zabrus	Zabrus tenebrioides Goeze.	8	-	8
16 genus		**29 species**	**1102**	**293**	**1395**

CONCLUSIONS

In 2011 and 2018-2019, in the apple fruit-growing plantations belonging to the Iasi and Vaslui stationary, Barber-type traps were installed for collecting species of epigeous carabids. These traps functioned from May until August.

The collected saples of carabids (1395 specimens) belong to 17 genus and 34 species.

The species with the highest number of collected samples were: *Harpalus distinguendus* (213 specimens), *Calathus fuscipes* (181 specimens), *Pseudophonus rufipes* (155 specimens), Pseudophonus griseus (101 specimens), *Amara eurynota* (84 specimens), *Carabus oriaceus* (73 specimens), *Attagemus unicolor* (58 specimens), *Amara familiaris* (54 specimens), *Brachinus crepitans* (54 specimens), *Anisodactylus signatus* (47 specimens), *Amara aenea* (44 specimens), *Harpalus tardus* (43 specimens), *Carabus violaceus* (28 specimens), *Pterostichus cylindrichus* (25 specimens), *Pterostichus niger* (24 specimens) and *Carabus scabrisculus* (21 specimens).

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