

GENERAL ASPECTS OF INFLUENCE OF METEOROLOGICAL FACTORS ON THE DEVELOPMENT OF THE COLORADO BEETLE, IN CONDITIONS OF SUCEAVA COUNTRY

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Abstract

The study of Colorado potato beetle biology is conducted in close correlation with the meteorological factors from the hibernal period development. The research was conducted in a potato crop in Suceava over four years. For the study on the evolution and hibernation pest were conducted 15 surveys on soil depth of 0-90 cm the autumn and harmful samoles were collected from 5 to 5 cm. The adults density was recorded by executing a ten polls in monoculture determining the load of adults per m². Following the application the 15 ground polls in potato crop to a decreased biological reserve, in the layer of 30-40 cm more severe winter in 2009-2010 and in milder winters 2010-2011 and 2011-2012 the depth of 25-30 cm. Hibernal adult mortality is dependent on both the amount of freezing soil temperatures during and the amount of rainfall recorded in winter.

Key words: potato culture, hibernation, beetle biology

The potato crop is most importance in Suceava county agriculture, providing about 15-20% of the cultivated area of the county. One of the basic requirements to increase the production of tubers per hectare is the protection of plants against pests and disease complex, and of pests, the most important is *Leptinotarsa decemlineata* Say.

MATERIAL AND METHOD

Purpose of research for this paper was to bring some contributions to the study of biology Colorado potato beetle, due to the impact of meteorological factors on the evolution of insects hibernating period. Researches have been conducted over four years 2010-2013. The average annual air temperature has gone sinuous with increases or decreases in repetitive, and its evolutionary meaning in the range 1961 - 2013 shows a significant increase of about 1.2 °C compared to 1960, but the winter (Figure 1) and this caused a new approach sequences of Colorado potato beetle biology from the period of its appearance to Suceava concerning insect hibernation period.

Determination of the depth of hibernation was achieved through implementation of 15 surveys each fall to the ground after the insects were installed permanently to hibernation on 0-90 cm depth, collecting the specimens from 5 to 5 cm. Adult density was observed in the execution of the ten surveys in monoculture potato soil of two, three and four years,

determining the load of adult m². Using 5 cages (90x50x50 cm), which contain many 30 adults/cage established hibernating insect mortality. Due cage height of 90 cm, adults could migrate to the desired depth. In spring was determined percentage of adults living and those who died over the winter. The emergence of hibernal adult was pursued both in test plots where planting was done very early sprouting tubers and wild flora and noted the date of their occurrence.

RESULTS AND DISCUSSION

The 15 surveys at depths specified in Table 1, suggest that the number of adults hibernal variation was due to the intensity equally both factors - year and depth. From the point of frequencies, however, the depth at which adults were positioned hibernal adults influenced more "circumstances" population density.

Interdependencies between thermal regime of the soil and the depth to which recorded the most significant tolerance hypothermia is illustrated by data given in Table 1. Thus, in 2010 after a more severe winter, hibernal adults most numerous were recorded in the layer 31-40 cm, while in other years at a depth of 26-30 cm (figure 2).

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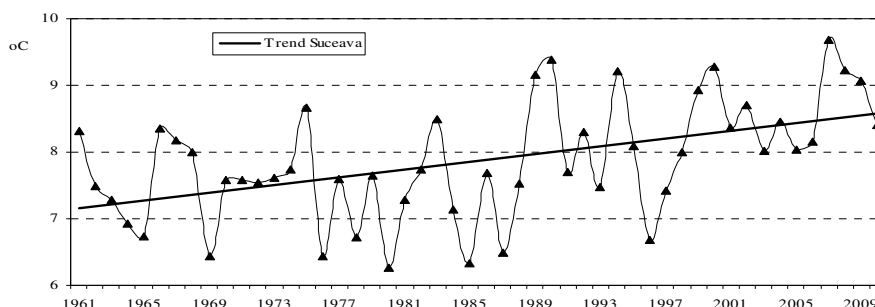


Figure 1 Evolution and variability of annual mean air temperatures (1961-2013) in Suceava

Table 1

Variation the number of hibernal adults at different depths in 2010-2013

Depth (cm/mp)	Year				Differences due to the years		
	2010	2011	2012	2013	2011	2012	2013
0 - 10	0,07	0,20	0,13	0,13	0,13	0,06	0,06
11 - 15	0,27	0,27	0,07	0,27	0,00	-0,20 ^o	0,00
16 - 20	0,07	0,13	0,20	0,27	0,06	0,13	0,20 ^x
21 - 25	0,20	0,40	0,20	0,47	0,20 ^x	0,00	0,27 ^{xx}
26 - 30	0,53	0,80	0,47	0,72	0,27 ^{xx}	-0,06	0,19
31 - 40	0,93	0,40	0,33	0,33	-0,53 ^{ooo}	-0,60 ^{ooo}	-0,60 ^{ooo}
40 - 50	0,26	0,26	0,07	0,20	0,00	-0,19	-0,06
Differences due to the depth					DI 5% - 0,19 DI 1% - 0,26 DI 0,1% - 0,36		
11 - 15	0,20 ^x	0,07	-0,06	0,14			
16 - 20	0,00	-0,07	0,07	0,14			
21 - 25	0,13	0,20 ^x	0,07	0,34 ^{xx}			
26 - 30	0,46 ^{xxx}	0,60 ^{xxx}	0,34 ^{xx}	0,59 ^{xxx}			
31 - 40	0,86 ^{xxx}	0,20 ^x	0,20 ^x	0,20 ^x			
40 - 50	0,19	0,06	-0,06	0,07			

Under and above these depths the hibernal adult population has less frequent in terms of 2011-2013. This process is due to hypothermia in the surface layers of soil and the deepest (under 30-40 cm) to sensitize adults due to increased consumption of carbohydrates and fats during diapause and crossing a thick layer of soil

Since between the percentage of hibernal adult mortality and minimum average amount (negative) occurring during ground frost, resulted in a significant dependence ($r = 0,95x$) can admit that without data on the development of soil temperatures may be used on the thermal regime of the soil surface. Negative thermal values unit amounts ranged from minus 369°C in winter 2010-2011 and winter 2009-2010 in minus 1173°C.

In the given circumstances it was estimated that the percentage of hibernal adult mortality (by 30 individuals per cage) was at least apparently dependent on the amount of rainfall recorded in the months of November to March, statistical expression of this interrelationship with the value of $r = 0,96x$. The values of the two types of interrelations are very close, although not express the proportional relationships, suggests, however, given the impact on the viability of the two weather features hibernal adults.

Data contained in Table 2 reveals that most

adverse weather conditions, in terms of hibernation was recorded in winter 2009-2010 when adult mortality was 70% and most well tolerated conditions were recorded in winter 2010 2011 and 2011-2012, the death rate was significantly reduced by 28 and 21%.

In Suceava County, especially of mountain areas, small farmers lack to surfaces for a proper rotation to achieve a potato monoculture practice. In a study by the SCDA Suceava, in some experimental areas could cause average load adults/mp to a monoculture of 2, 3 and 4 years (figure 3).

In addition with the agrophytotechnical, phytosanitary and economic effects, if we refer only to Colorado beetle showed that after carrying out 15 surveys at 0-90 cm soil depth, load adult average, adults is 0.8 mp in monoculture two-year increase to 1.2 adults in the three-year and four-year monoculture reach a value of 1.6 adults / mp. In a simple calculation we will hectare an estimated 16,000 adults (after Daniela Donescu et al., (2006), "20,000 adults / mp cause damage by 50%"), we have a loss of production of 40 % only this aspect. Since the missing data on the thermal regime of the soil in Table 3 are registered values of temperatures of air, which help to emphasize some aspects regarding their influence on the emergence of hibernal adults.. Based on data

during 30 years hibernal adult emergence was between April 11 and May 7, the average date is April 25, ie after 55 days from 1 March. As a result of global warming, the frequency of hibernal adults

in the third decade of April almost doubled compared to the eight and nine decade of the past twentieth century (figure 4).

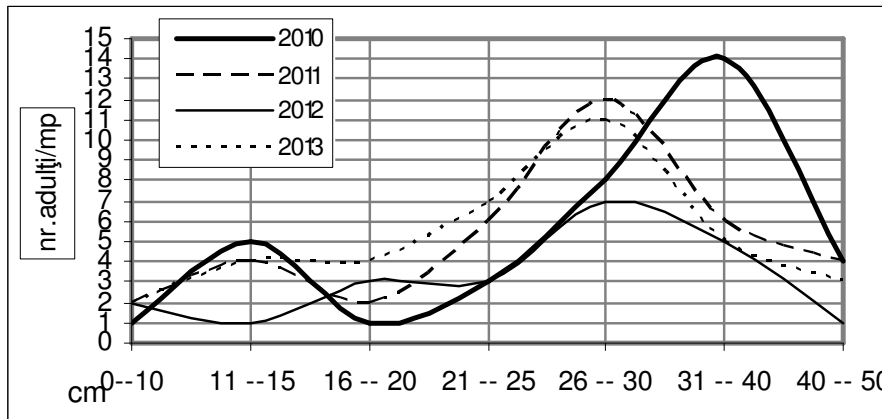


Figure 2. Graphic expression wintering depth of adults

Table 2

Procente ale mortalității din perioada hibernării

Year	2010	2011	2012	2013
% mortality	70	42	49	59
diference	mt	-28 ⁰⁰⁰	-21 ⁰⁰	-11
	DI 5% - 11%	DI 1% - 16%	DI 0,1% - 22%	

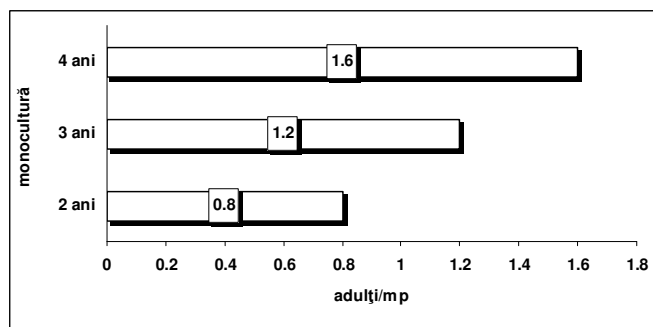


Figure 3. Density of the hibernal adults in monoculture

Great amplitude of hibernal adults date of emergence is presented as the variable coefficient (s%) very high (33-42%, table 3) and the very low value (- 0.07 and 0.12, table 4) coefficients the correlation between adult occurrence data hibernal and days with average temperatures of 5° or 8°C higher ratio to the first of March. Between the "moments" appearance the suite 2-3 days with 50 and 80°C that there has been no significant temporal relationship, the correlation index is very low (04.05). In great part this was helped by the fact that in the period between the occurrence of average temperatures 5° or 8° C and the hibernal adults have intervened temporal sequences with temperatures below the two thresholds mentioned. Thus 23% of the 34 days had average temperatures

below 5 ° C and 48% of those 29 days were below the threshold of 8 °C. The correlation of coefficients (0.658 xx and 0.655 xx) suggests that the mentioned frequencies cold days have significantly extended temperature range of reference and the emergence of hibernal adult emergence. Analyzing the data listed in Table 3 is remarkable that active temperature environments, with 5° and 8°C minimum thresholds, their occurrence and hibernal adults until the emergence presents the smallest variability (8-12%). Also that the amounts the heat units accumulated in the first five months show a greater variability with minimum thermal threshold and (5° and 8°C) is higher. Estimated using correlation coefficients (r) dependence of duration (days) of the occurrence

the suite 2-3 days to 5° or 8°C until the emergence of hibernal adults (Table 4), suggest the significant role of amounts thermal units (°C) compared with in diurnal mean of the air. It may also show that average temperatures role (active and effective) was higher if they were above the threshold of 8°C,

compared with the highest 5°C.

The survey results reveal that winters analyzed, only 29% of cases were hibernal adults significant losses they have recorded only parcel cultivated potato. Numeric significant losses hibernal adults represents 0.53 to 0.54 mp.

Table 3

Aspects of the air thermal regime - 20 years (1976-2007)

Specification	Statistic elements	Average temperatures				The emergence of hibernating adults
		≥ 5°C	≥ 8°C	< 5°C	< 8°C	
Number of days (until 5 ° and 8 ° C temperatures and hibernate adults)	average	21	26	-	-	55
	± s	8	9	-	-	9
	s %	40	33	-	-	15
	data	22.03	27.03	-	-	25.04
Number of days from the occurrence of average temperatures until the emergence of a hibernate dults	average	34	29	8	14	-
	± s	12	12	6	9	-
	s %	36	42	72	65	-
Temperatures assets from their appearance until the emergence of hibernate adults	average	8,9	10,4	-	-	-
	± s	1,1	0,9	-	-	-
	s %	12	8	-	-	-
	Σ	238	166	-	-	-
	± s	105	107	-	-	-
	s %	44	64	-	-	-
Effective temperature of their occurrence, until the emergence of adults hibernate	average	4,3	2,4	-	-	-
	± s	1,6	0,9	-	-	-
	s %	38	37	-	-	-
	Σ	106	43	-	-	-
	± s	59	39	-	-	-
	s %	55	90	-	-	-

¹⁾ from the time of 1.03

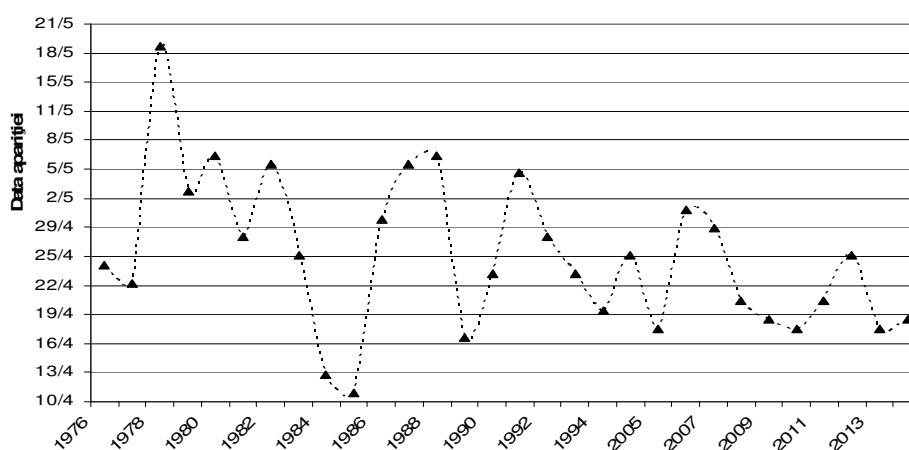


Figure 4. The emergence of hibernal adults in Suceava

Table 4

Dependence duration until the appearance of two hibernal adults of the thresholds thermal of the air

Specification		Correlation coefficient (r)
Average temperatures ≥ 5°C	active	-0,076
	effective	0,120
Σ average temperatures ≥ 5°C	active	0,791 ^{xxx}
	effective	0,648 ^{xx}
Average temperatures ≥ 8°C	active	0,343
	effective	0,389
Σ average temperatures ≥ 8°C	active	0,699 ^{xx}
	effective	0,687 ^{xx}

Table 5

Hibernal adult population decreases						
Culture	Adults frequency / mp.			Loos		
	autum	number	spring	number	no./mp.	%
2010 - 2011						
Corn	24.X.2010	0,40	28.III.2011	0,40	0,0	-
Barley		0,60		0,26	-0,34	56
Autumn wheat		0,27		0,27	0,0	-
Potato		1,20		0,67	-0,53^{oo}	44
DI 5% =0,37 DI 1% =0,50 DI 0,1% =0,66						
2011 - 2012						
Corn	28.X.2011	0,20	18.III.2012	0,13	-0,07	35
Barley		0,20		0,20	0,0	-
Autumn wheat		0,33		0,20	-0,13	39
Borceag de spring		0,20		0,20	0,0	
Potato		1,07		0,53	-0,54^{ooo}	
DI 5% =0,28 DI 1% =0,38 DI 0,1% =0,50						
2012- 2013						
Corn	23.X.2012	0,33	2.04.2013	0,13	-0,20	60
Barley		0,20		0,20	0,0	-
Autumn wheat		0,33		0,20	-0,13	40
Potato		1,07		0,53	-0,54^{ooo}	50
DI 5% =0,29 DI 1% =0,40 DI 0,1% =0,53						

Uniformity values might suggest that less cold winters biological reserves could decline by about half of hibernal adults met in potato growing land (Table 5). In the plots planted with corn, barley, winter wheat and borceag spring, hibernal adults from the perimeters planted with potatoes, although it had a chance of nutrition available (at least in the surface layer of soil), while lowering the frequency where there were losses is 39%. To this is added 23% of cases with biological reserve decreases of between 35 and 40%. Even if the numeric extent of losses is not significant, given that in 39% of cases there has been no diminution of biological reserve, this trend could be due to a more pronounced vitality adults.

CONCLUSIONS

Some meteorological factors, through their continuous action, single or complex, the Colorado potato beetle populations can produce changes that lead to delay or accelerate the development stage, reducing or increasing the number density of populations, and finally to loss.

The most insignificant biological reserve reductions of adults were recorded in the 30-40 cm layer in more severe winter (2009-2010), and at a depth of 25-30 cm in moderate winters from 2010 to 2011 and 2011 2012.

Compared with the load 0.8 mp the hibernation adults the case the two years of monoculture, their number has doubled (1.6/square meter) plot for potato cultivation in four years.

Based on the information accumulated during 30 years (1976-1995 and 2005-2013) average date of occurrence of hibernal adults is April 25. If it takes into account the average error - nine days - that probably hibernal adult emergence was between April 16 and May 5. The amplitude of its occurrence has been more extensive namely 11.04-19.05.

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