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STUDY OF THE IMPACT OF POLLUTED AGROECOSYSTEM BY SULPHUR COMPOUNDS ON COLORADO POTATO BEETLE (*LEPTINOTARSA DECEMLINEATA* SAY) AND THE OCCURRENCE OF CANNIBALISM AMONG BEETLES OF THIS SPECIES

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Abstract. The research was conducted to evaluate the impact of sulphur compounds on the sex of Colorado potato beetle in the region of sulphur factory in Chmielów near Tarnobrzeg in 1995. The control plantations were situated in the village of Zarębki, about 30km from Chmielów. The object of the study was the average body mass of female and male specimen of the insect after full spring beetle appearance in potato plantations as well as the average body female and male mass after pupation of the larvae of the first generation and emerging from the soil. After six and twelve days of starvation, the average female and male body mass was determined. After twelve days of starvation the incident of cannibalism was noticed among the beetles of the first zone polluted by sulphur compounds.

Key words: sulphur compounds, agroecosystem, Colorado beetle, cannibalism

I. INTRODUCTION

Pollution of natural environment by industrial emissions has become the main cause disrupting the highly delicate balance that exists in agroecosystems. This phenomenon concerns both the surface and the soil flora and fauna, resulting in systematically worsening life conditions. Sulphur compounds have had the leading role among many substances polluting the environment for many years. The recent report presented by Swedish – Polish Environment Protection Society confirmed this in 1989. In spite of decreasing tendency of sulphur compounds emissions in Poland noted from 1992, the SO_2 emission level per one inhabitant is still higher than in other European countries (report of The National Environment Protection Inspectorate, 1998). The continuous impact of sulphur compounds on natural environment often causes irreversible changes in agroecosystems. This is well presented by the results of the research on the occurrence of fauna of insects in crops carried out in the region of sulphur factory near Tarnobrzeg since 1965 (Przybylski 1967; 1974;1996). The degree of environmental pollution by industrial emissions containing sulphur has the negative impact on the appearance and development of many insect species, although the cases of significant appearance of some pests of cultivated plants, e.g. aphids, should not be excluded (Przybylski 1990).

II. MATERIAL AND METHODS

Potato beetle was selected for the purpose of the study on the negative effect of polluted atmosphere by sulphur compounds on the fauna of insects. The extreme resistance of this insect to industrial emissions and the fact that the certain development stage takes place in

soil justify this selection. The study was conducted in the region of sulphur factory in Chmielów near Tarnobrzeg where two pollution zones were laid out, i.e. the first zone in the distance from 0.5 to 1.5 km and the second zone from 1.5 to 3.0 km from the chemical factory. The stated zones were established, among other things, on the basis of the obtained results of chemical analysis of the soil samples on $S\text{-}SO_4$ and S content. The analysis was conducted in the Regional Chemical – Agricultural Station in Rzeszów (Przybylski 1994). The control plantations were set up in the village of Zarębki in the distance of about 30-km from sulphur factory. In spring, after full occurrence of potato beetle cockchafers, 50 insects were collected from four plantations of each zone. They were transported to the Institute laboratory and then weighed regardless of the sex and also female and male insects separately. The average beetle body masses both for all the beetles and the specified sex was calculated. At the stage of the full occurrence of larva at stage L_4, groups of 50 larvae were collected and placed in vases with soil collected from plantations from the experimental zones. After pupation, the beetles and females, and males separately were weighted and again they were placed in the vases without the source of food. After six and twelve days of starvation, the average body mass was established. The important task of this study were the observations on the behavior of the beetles during starvation, mainly because of the stress they experienced during development in heavily polluted environment by sulphur compounds. The obtained results were worked out statistically and presented in tables and photographs.

III. RESULTS AND DISCUSSION

The average potato beetle mass after full occurrence in the potato plantations after emerging from soil in spring is presented in Table 1. The insects collected in the first zone of pollution had the lowest mass and it varied significantly from the average beetle mass occurring in the control plantations. The interesting results were obtained after establishing the average female and male mass from the first zone of pollution and from the control plantations. The average female mass was statistically higher to a considerable degree than the average male mass both in the first zone of pollution and in the control plantations. The attention should be drawn to the fact that in the first pollution zone in Chmielów the average female body mass significantly varied from the beetle body mass established regardless of the sex (Tabs. 2, 3).

Table 1

The average body mass of the beetle after emerging from the soil in spring after hibernation in 1995

Test location	Mass in grams
Chmielów (1st zone)	0.135*
Jadachy (2nd zone)	0.149
Zarębki (control)	0.146
LSD at P=0.05	0.0045

Table 2

The average female and male body mass of potato beetle after hibernation in the control plantation in relation to the beetle body mass from the whole population

Beetle sex	Mass in grams
Female	0.154
Male	0.140*
Regardless of sex	0.146
*LSD at P=0.05	0.0103

The subsequent studies concerned the average body mass of the first beetle generation including female and male potato beetle and the decrease in their body mass after six and twelve days of starvation. For this reason during the period of full occurrence of larvae at the stage L_4, groups of 50 larvae were collected from each potato plantations, both the control and the experimental ones. After transporting them to the laboratory, they were placed in vases filled with soil collected from the potato plantations from the 1st and 2nd pollution zones, and from the control plantation. The average beetle body mass after emerging from the soil from each plantation was presented in Table 4. It was significantly lower for the plantations from both pollution zones the 1st and 2nd in relation to the control plantations. The beetles were placed again in vases without the source of food. The average body mass of the starving beetles including female and male specimens was established after six and twelve days of starvation. The obtained results were presented in Tables 5, 6, 7, 8. In the control plantation, after six days of starvation, the average male body mass was significantly lower than the average female mass and the beetle mass regardless of sex. In the plantation from the 1st pollution zone the significant difference in the average body mass in relation to the beetle regardless of sex concerned both male and female specimens. After twelve days of starvation in the control plantation the average male body mass and the beetle regardless of sex was significantly lower than the female body mass. In the 1st pollution zone in the same period of starvation the decrease in body mass did not considerably differ between male, female and

Table 3

The average female and male body mass of potato beetle after hibernation in the 1st pollution zone in relation to the beetle body mass from the whole population

Beetle sex	Mass in grams
Female	0.142
Male	0.128*
Regardless of sex	0.135*
* LSD at P=0.05	0.0064

Table 4

The average body mass of potato beetle after pupation

Test location	Mass in grams
Chmielów (1st zone)	0.153*
Jadachy (2nd zone)	0.155*
Zarębki (control)	0.164
* LSD at P=0.05	0.0052

Table 5

The average female and male body mass of potato beetle in the control plantation in the 6th day of starvation in relation to the beetle body mass from the whole population

Beetle sex	Mass in grams
Female	0.111
Male	0.087*
Regardless of sex	0.112
* LSD at P=0.05	0.003

Table 6

The average female and male body mass of potato beetle in the 1st pollution zone in the 6th day of starvation in relation to the beetle body mass regardless of sex

Beetle sex	Mass in grams
Female	0.074*
Male	0.072*
Regardless of sex	0.087
* LSD at P=0.05	0.0088

Table 7

The average female and male body mass of potato beetle in the control plantation in the 12th day of starvation in relation to the beetle body mass regardless of sex

Beetle sex	Mass in grams
Female	0.098
Male	0.073*
Regardless of sex	0.082*
*LSD at P=0.05	0.0084

Table 8

The average female and male body mass of potato beetle in the 1st pollution zone in the 12th day of starvation in relation to the beetle body mass regardless of sex

Beetle sex	Mass in grams
Female	0.072
Male	0.067
Regardless of sex	0.072
LSD at P=0.05	0.0067

beetle regardless of sex. It was also the lowest average potato beetle body mass both for the control plantation and the control one where there was an increase in mortality of this insect due to the lack of food. That was the line between life and death of potato beetle. It was also the period of cannibalism among the starving beetles in the 1st pollution zone, not noted in the conducted studies till then. The beetle usually attacked another beetle on the back of the body damaging its integument (Fig. 1). The defending beetle managed to escape very often, however that was not possible when other beetles joined the attack (Figs. 2, 3). Consequently, the beetles were devoid of heads, integument and their abdomens were bitten off (Figs. 4, 5).

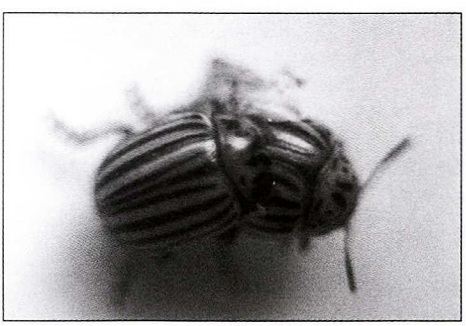

Fig. 1.

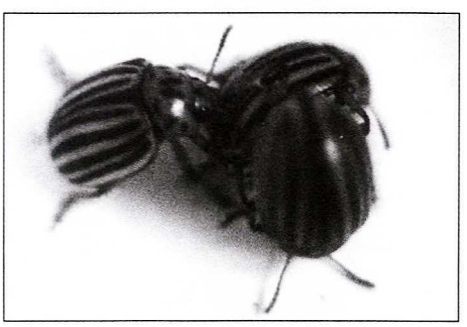

Fig. 2.

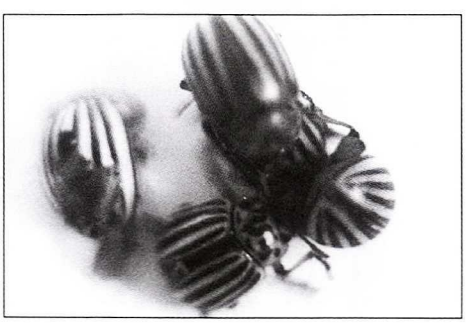

Fig. 3.

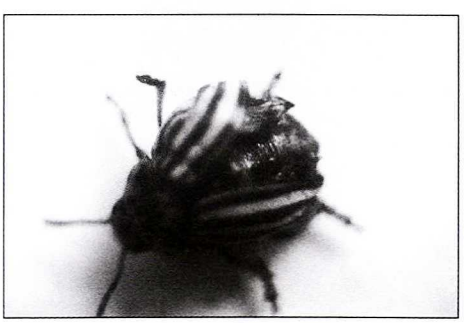

Fig. 4.

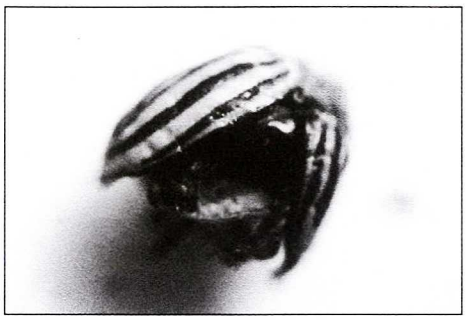

Fig. 5.

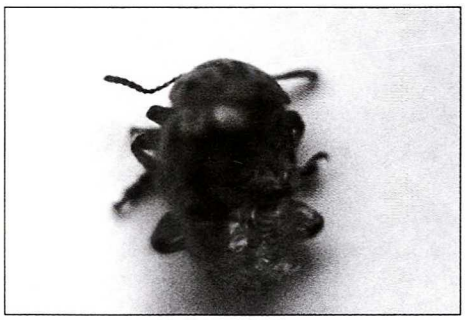

Fig. 6.

There was a case noted when a beetle with its abdomen bitten off was moving for few minutes on the surface of the soil (Fig. 6).

The general view of the devastation among beetles caused by cannibalism in the environment polluted by sulphur compounds is presented in Fig. 7.

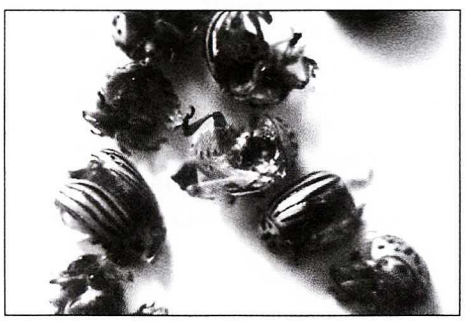

Fig. 7.

The results of the research on the development of potato beetle in agroecosystem polluted by sulphur compounds univocally prove that even the insect species with such extreme vitality and high ecological flexibility, the industrial contamination is not indifferent to the development and life of this insect. It should be also taken into consideration that the main cause of the cannibalism in the 1st pollution zone is not only a famine but also mainly stress caused by the environment polluted by sulphur compounds where potato beetle spent all its life.

IV. REFERENCES

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Zdzisław Przybylski

BADANIA NAD ROZWOJEM I ZACHOWANIEM SIĘ STONKI ZIEMNIACZANEJ (*LEPTINOTARSA DECEMLINEATA* SAY) W AGROCENOZIE ZANIECZYSZCZONEJ ZWIĄZKAMI SIARKI

STRESZCZENIE

Prowadzone od szeregu lat badania nad wpływem zanieczyszczonej związkami siarki agrocenozy na stonkę ziemniaczaną wykazały wyraźny negatywny wpływ zmniejszając masę ciała chrząszczy i larw w stadium L_4. Kolejne przeprowadzone w 1995 roku badania dotyczyły stopnia obniżenia średniej masy ciała chrząszcza bez względu na płeć, tak samca jak i samicy tego szkodnika.

Otrzymane wyniki wykazały statystycznie istotny spadek średniej masy ciała w 1. strefie zanieczyszczenia agrocenozy, zarówno samca jak i średniej masy ciała chrząszcza bez względu na płeć w stosunku do masy ciała samicy. Na obiekcie kontrolnym zjawisko to dotyczyło jedynie średniej masy ciała samca. Identyczne badania prowadzono po sześciu i dwunastu dniach głodowania stonki ziemniaczanej.

Nienotowanym dotąd zachowaniem się głodujących chrząszczy było zjawisko kanibalizmu, które miało miejsce w obiekcie silnie zanieczyszczonym związkami siarki.