KOMITET EKOLOGICZNY - POLSKA AKADEMIA NAUK

EKOLOGIA POLSKA - SERIA A

Tom XVII Warszawa 1969 Nr 8

DEPARTMENT OF AGROECOLOGY, TUREW

Head: Docent Dr. Przemysław Trojan

Jerzy KARG

THE EFFECT OF SHELTERBELTS ON DENSITY AND REDUCTION OF NUMBERS OF THE COLORADO BEETLE (*LEPTINOTARSA DECEMLINEATA* SAY)

The number of overwintering adults grew with the distance from the shelterbelts. Shelterbelt did not affect the numbers of the summer generation of beetles or of any of the instars. With the growing distance from the shelterbelt the eggs laid by the Colorado beetle increased in number. The reduction rate of younger instars increased with a decrease in the distance from the shelterbelt and with time. No such relations could be seen in the case of eggs or instars L_4.

The purpose of the present study was to demonstrate the effect of shelterbelts on the numbers and on the natural reduction of the Colorado beetle populating the potato fields situated nearby. In the few papers concerned with the effect of tree plantations on the abundance dynamics of insects (Melničenko 1949, Bilewicz-Pawińska 1961) the effect of afforested areas on population size and reduction of numbers of the Colorado beetle has not been taken into consideration. The present study was carried out in continuation of the research on variations in numbers and natural reduction of the Colorado beetle, started in 1965 (Karg, Trojan 1968).

The decision to investigate the effect of shelterbelts on the abundance dynamics and natural reduction of numbers of the Colorado beetle seemed to be justified particularly on account of the large-scale afforestation programme being now carried out in Poland.

STUDY AREA, MATERIAL, METHODS

The research was carried out in 1966 in a field 4ha in surface. The eastern side of the field bordered on a shelterbelt of the direction N–S. In the same field studies on population dynamics and natural reduction of numbers of the Colorado beetle had been carried out also in 1965.

Material for study was collected between the time of emergence of the first beetles of the overwintering generation (11.V.1966) and the time of emigration from the field of the adults of the summer generation (7.IX.1966).

In the potato field four rectangular areas of equal size, each about one are in surface, 10-, 50-, 100- and 200-metres far from the shelterbelt, were marked out. The longer sides of the rectangular areas were parallel to the shelterbelt. In surveying the areas a permanent plan was followed to avoid examining the same potato plants twice. Samples were collected at 3-day intervals. Each time samples from 10 plants in each area were taken. Larvae of all the instars were counted in the field immediately after being collected; eggs and adults were taken to the laboratory where the percentage of damaged eggs was calculated and the adults were segregated according to sex and with regard to wintering and summer generations. In order to estimate the emergence dynamics in the same areas isolating boxes were installed prior to the sprouting of the potatoes and emergence of the first overwintering adults. The isolating boxes, 0.5 m^2 in surface, were made of boards and had at their tops metal nets with a mesh-diameter of 3 mm. The boxes, five in each area, installed at equal distances in all the areas, were checked every two days.

SPRING EMERGENCE OF ADULTS

The spring emergence of beetles began about the same time in the four areas. The first individuals were recorded on 11.V.1966; their numbers were still small, the average for the four fields being 0.75 individuals per one m^2. Maximum emergence was recorded on 16.V.1966, amounting to 7.03 ind./m^2 on the average. During the second half of May the number of beetles emerging from the earth decreased steadily with only slight variations observable. The last individuals were seen on 8.VI.1966, their average number then being 0.40 ind./m^2.

Although the spring was comparatively warm (the air temperature being much above the physiological zero), the emergence period was long: in the area 100 m from the shelterbelt it lasted 31 days and was only two days shorter in the remaining areas. This is in agreement with the data published by W ę-gorek (1959). The emergence was not uniform or continuous, and it clearly dependent on the temperature of the soil and air. The emergence time con-

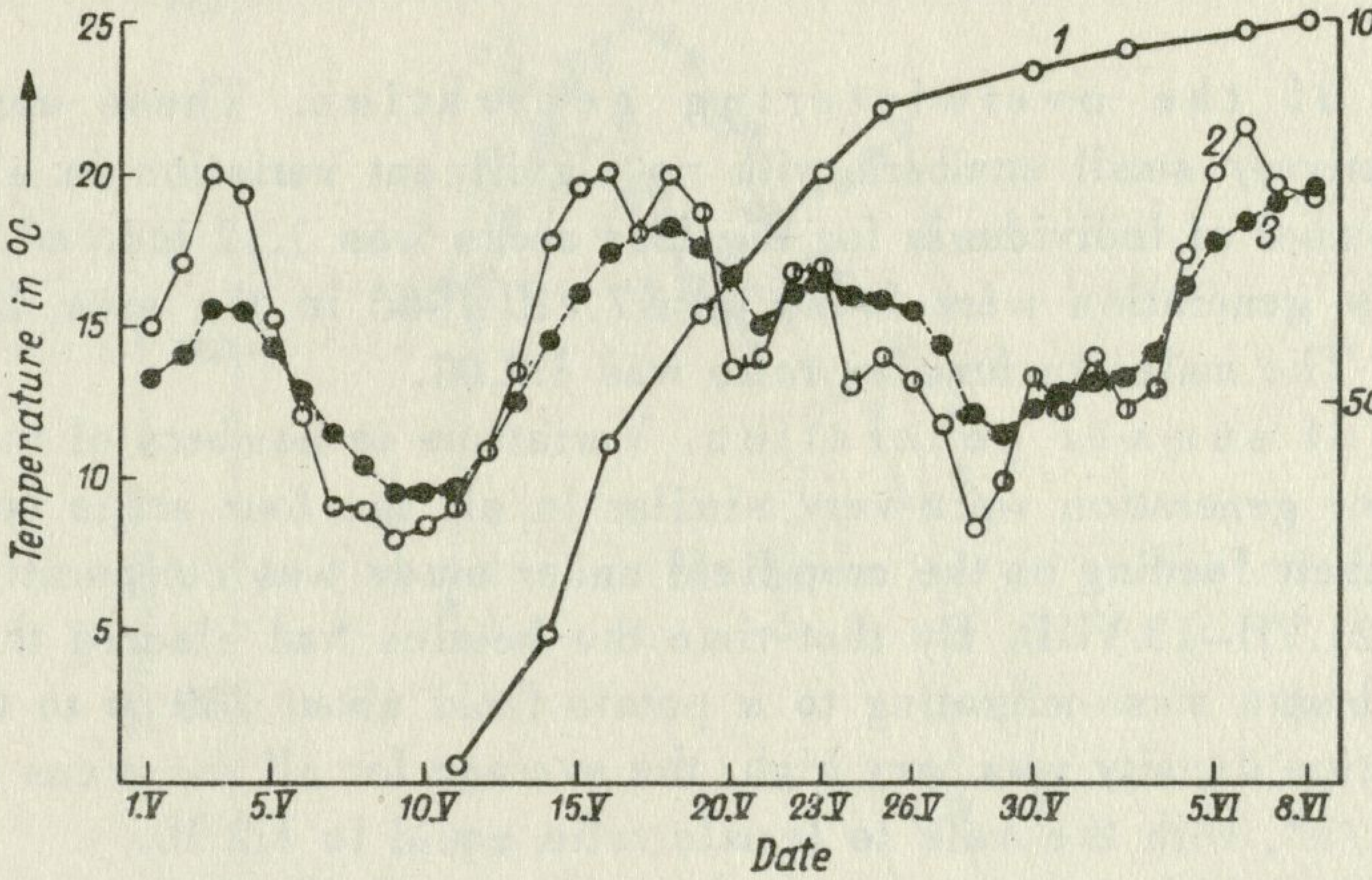

Fig. 1. Emergence dynamics of overwintering adults of *Leptinotarsa decemlineata* in relation to soil and air temperatures

1 – per cent of individuals, 2 – air temperature, 3 – soil temperature

sisted of two periods: the first period – from 11.V.1966 to 23.V.1966 was characterized by a rapid increase in the number of emerging beetles (at that time 80% of beetles came to the surface), the second period lasted until 8.VI.1966 (emergence of the remaining 20%) (Fig. 1).

The number of beetles emerging from the earth increased with the distance from the shelterbelt. An exception was the area 200 m from it where a slight decrease in the number of emerging adults, as compared with the preceding area (Fig. 2), could be seen. This agreed with the findings reported by K a c z m a r e k (1955), indicating that areas close to an afforested land are to a lesser extent populated by the overwintering adults.

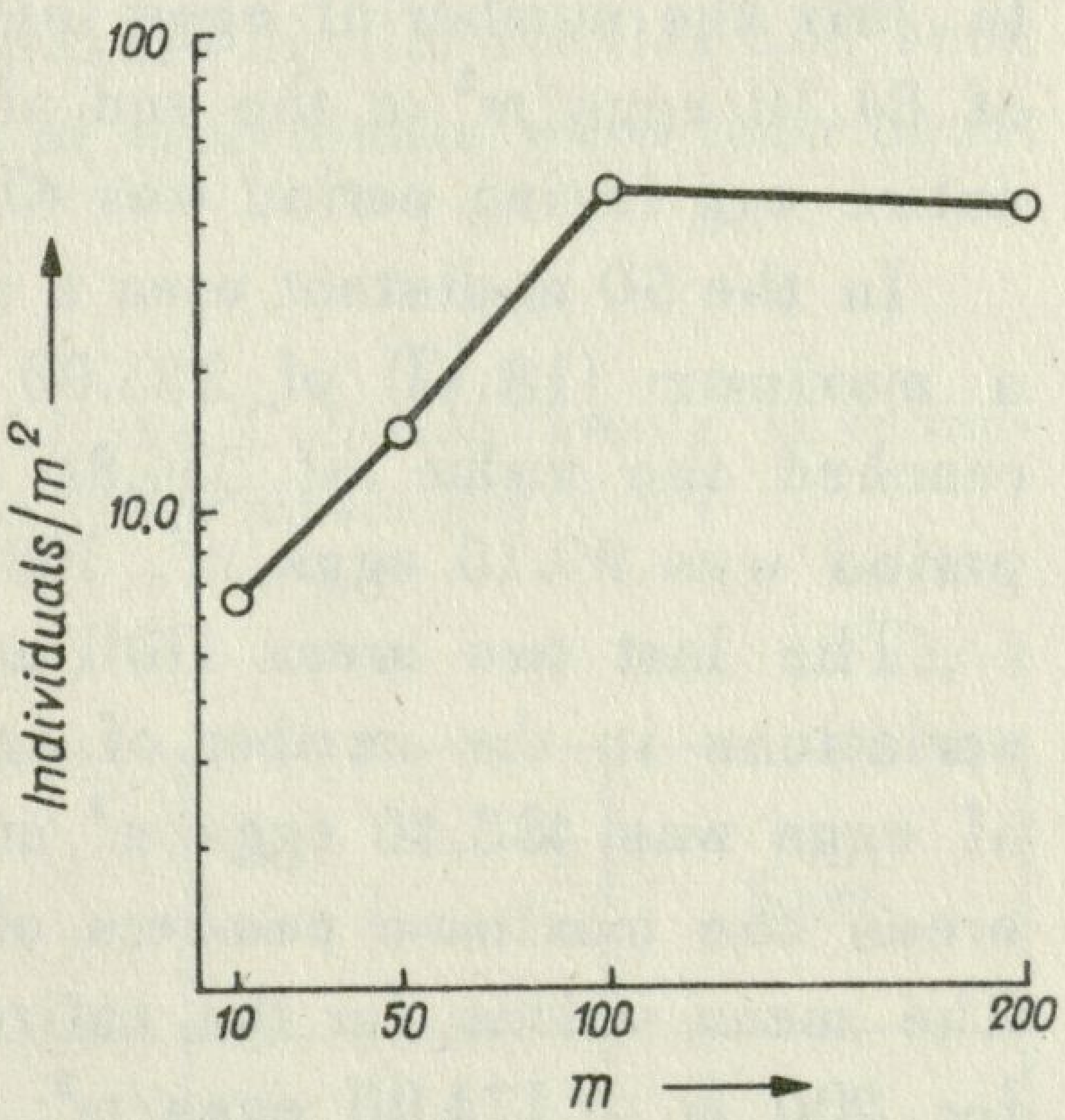

Fig. 2. Emergence of overwintering adults of *Leptinotarsa decemlineata* in four areas (the distance from the shelterbelt 10,50,100 and 200 m)

The total numbers of overwintering adults emerging from the earth in the areas under observation were as follows: 10 m from the shelterbelt – 6.67 ind./m², 50 m –

14.80 ind./m², 100 m – 45.60 ind./m² and 200 m – 42.00 ind./m². The males to females ratio was 1:2.15.

VARIATION IN THE NUMBERS

Adults of the overwintering generation. These appeared to occur in relatively small numbers with no significant variation in abundance. The mean number of individuals for the four areas was 1.12 ind./m².The last adults of this generation were found on 17.VIII.1966 in the area 50 m from the tree belt. The males to females ratio was 1:2.08.

Adults of summer generation. Variations in numbers of the beetles of the summer generation were very similar in all the four areas considered. The time of their feeding on the crop-field under study was comparatively short – 23 days (21.VII–13.VIII). By that time the beetles had cleared the field of foliage and begun mass-migrating to a potato field about 300 m to the north. Their population density was very high, the average for all the areas amounting to 36.73 ind./m², with the male to female ratio equal to 1:2.90.

Eggs. The time of egg laying was similar in all the four areas except in the one 10 m off the shelterbelt, where eggs were seen two days earlier than in the other areas. The number of eggs varied from area to area, growing proportionally to the distance from the shelterbelt. In the two areas nearest to the shelterbelt (10 m and 50 m) two numerical peaks were recorded, and only one in the remaining two areas. In the 10 m-distant area the average number of eggs, between 6.VI–12.VI, was 3.60 eggs/m²; after that time it increased rapidly to reach its maximum as early as 15.VI (244.4 eggs/m²). Another peak, a lower one, was seen on 30.VI, amounting to 141.00 eggs/m². In July the number of eggs laid decreased gradually down to an average value of 34.10 eggs/m² at the end of the month. In that area the mean value for the entire egg laying period was 61.31 eggs/m², 958 eggs per a female.

In the 50 m-distant area a somewhat higher number of eggs was noted, with a maximum (18.VI) of 335.00 eggs/m². The second numerical peak (15.VII) reached the value of 234.80 eggs/m². The mean for the entire egg laying period was 99.18 eggs/m², 1088 eggs per a female.

The last two areas (100 and 200 m-distant) were characterized by similar variations in the number of eggs. In the former (100 m) the maximum number of eggs was 488.40 eggs/m² and in the latter (200 m) 864.80 eggs/m². In both areas the maximum numbers of eggs were recorded on the same day (18.VI). The mean values for the entire period were: for 100 m – 113.81 eggs/m² and for 200 m – 174.00 eggs/m²; calculated per a female – 1276 and 890 eggs, respectively. The average per a female for all the four areas for the entire period of egg laying was 1060 eggs.

Larvae. Variations in numbers of all the instars appeared to be similar in the four areas studied. With a growing distance from the shelterbelt slight variations in numbers and shifts of the dates of emergence and abundance peaks were noted. The aggregate data for all the four areas (Fig. 3) showed

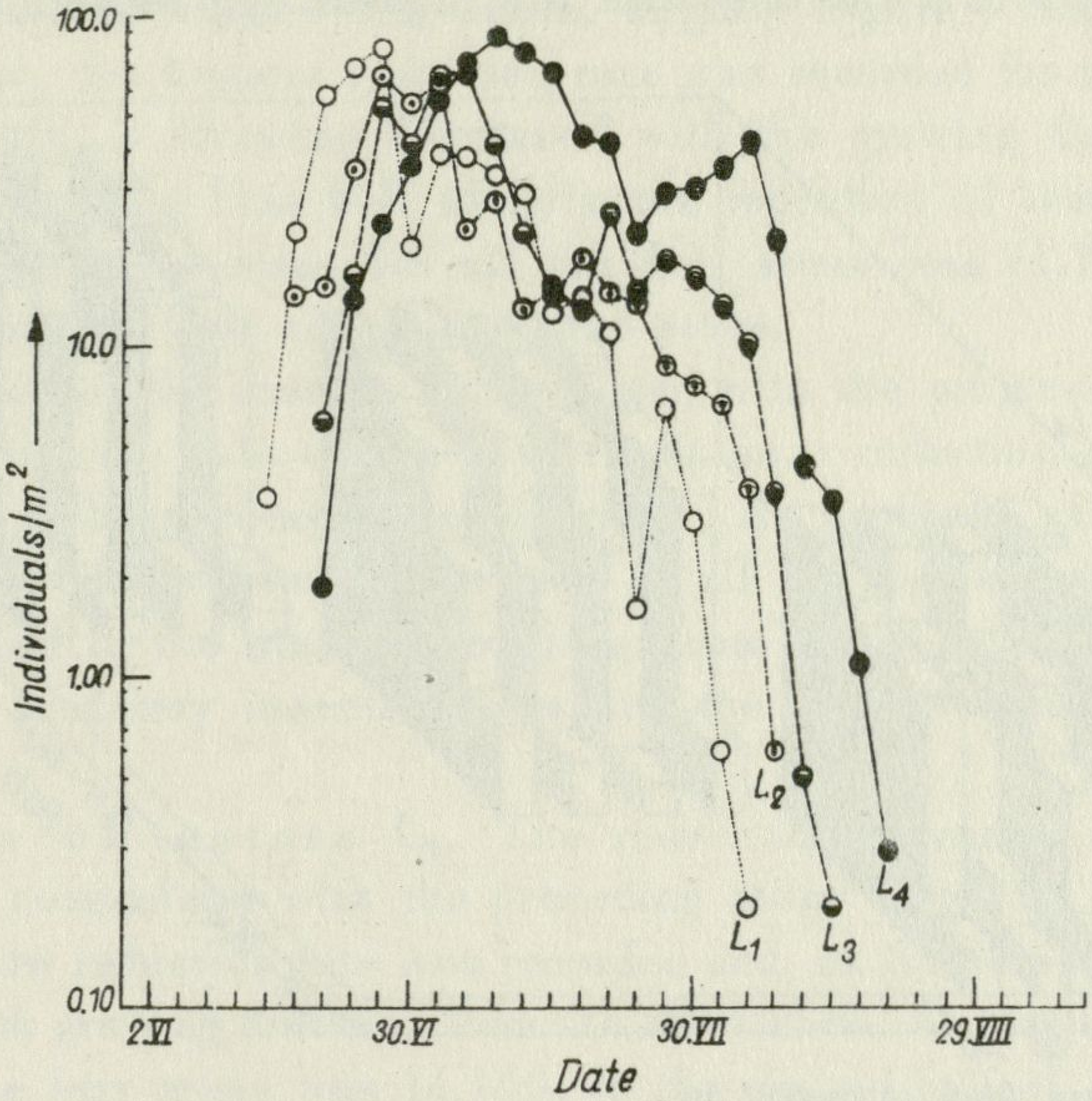

Fig. 3. Abundance dynamics of larvae of *Leptinotarsa decemlineata*
Total number of individuals in four areas per 1 m^2

clear shifts of the dates of emergence of the particular instars, and also an increase (apparent) in the number of the older stages. Similar results had been obtained in that area in 1965, but the numbers of individuals were then about ten times smaller (Tab. I).

Maximum density of individual instars and eggs of the Colorado beetle (*Leptinotarsa decemlineata* Say) in 1965 and 1966 (individuals per 1 m^2)

Tab. I

Instar / Year	L_1	L_2	L_3	L_4	Eggs
1965	4.96	4.86	8.23	13.97	49.85
1966	56.80	61.80	58.20	192.50	291.10

REDUCTION

The reduction of eggs (Fig. 4). In the first half of June (6.VI–18.VI) a relatively low level of egg reduction was seen, its average value for the four areas being 9.05%. At that time the highest egg reduction rate was re-

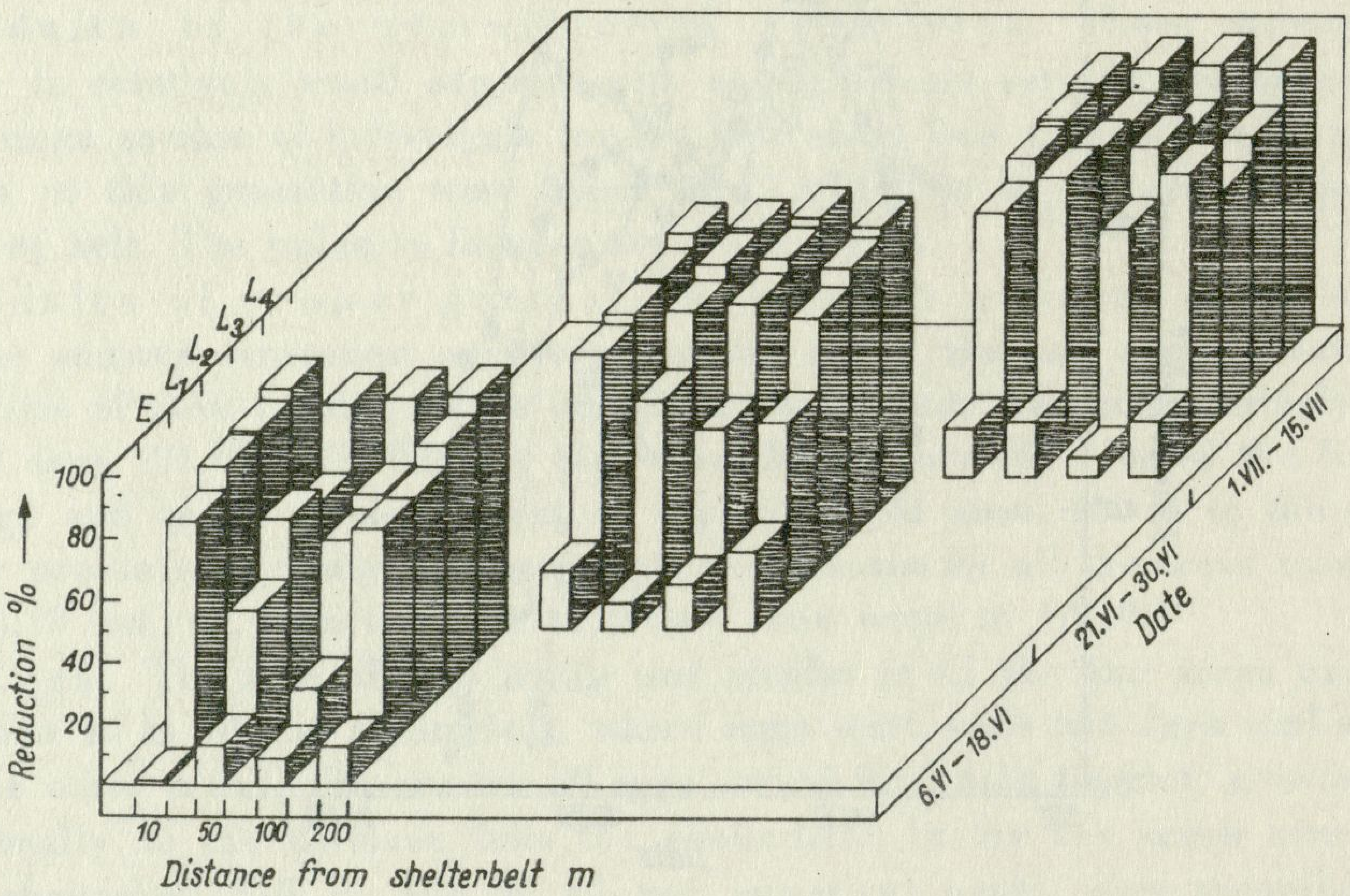

Fig. 4. Natural reduction of eggs (E) and instars (L_1, L_2, L_3, L_4) of *Leptinotarsa decemlineata*

corded for the areas 50- and 200 m-distant from the shelterbelt. During the second half of June (21.VI–30.VI) the reduction increased in intensity, attaining an average value of 16.89% for all the areas; the highest values recorded were those for the areas 10- and 200 m-distant from the shelterbelt. A slight decrease in the rate of reduction was seen in the first half of July (4.VII–15.VII). The average value for the four areas was 15.31% while the rates of reduction in individual areas appeared to be much more even. Generally, the egg reduction rate increased steadily with the progress of the season. With the time passing egg reduction tended towards an equal level of intensity, which was attained by the end of the vegetation season (first half of July).

Reduction of instars L_1 (Fig. 4). Throughout the season and in all the sample areas under observation the 1st instars showed the highest reduction rate, usually several times higher than that of other instars. This confirms the findings from 1965 (Karg, Trojan 1968). During the first half of June the reduction on instars L_1 was at ist lowest (the mean for the four areas was 52.39%); the highest reduction rate values, 73.89% individuals, were reached in the area nearest to the shelterbelt (10 m). With the growing distance from the shelterbelt the reduction rate decreased, but it rapidly increased again in the last area (200 m), where it reached a value almost equal to that recorded for the first area (10 m). In the second half of June the mean value of the rate of reduction was, for all the four areas, slightly higher – 55.59%. As in the preceding period, the highest reduction rate was recorded for the area nearest to the shelterbelt. It likewise decreased with the growing distance from the shelterbelt. During the first half of July the reduction of instars L_1 reached its maximum value, the mean for all the four areas was 71.17%. The rate of reduction was at that time equal in all the areas.

The reduction of the instars L_1 increased with the progress of the vegetation season. Also the role of the shelterbelt as a reduction modifying factor appeared to have been reduced considerably. As a result, at the end of the season an even reduction level was seen in all the four areas. This situation may be attributed to the steady spreading, from the shelterbelt into the crop-field, of some predatory insects feeding on the early stages of the Colorado beetle.

Reduction of instars L_2. The reduction of instars L_2 was several times lower in comparison with the preceding stage (Fig. 4). During the first half of June a low reduction rate was recorded and, as in the case of instars L_1, it decreased with growing distance from the shelterbelt. At that time the average reduction for the four areas was 14.16%. In the second half of June an intensified reduction was seen (on the average 18.65% for all four areas). Simultaneously, the reduction intensity appeared to be equal in all the areas considered. During the first half of July an average reduction rate of 6.39% was recorded, being almost equal in all areas (except in area 200 m off the shelterbelt).

Reduction of instars L_3. The course of reduction of instars L_3 was similar to that of instars L_2 (Fig. 4), except for a slight further decrease. The average reduction rate for the four areas was in the first half of June 3.43%, in the second half of June – 4.17% and in the first half of July – 2.53%. The tendency towards an equal reduction rate in all the areas was even more marked than in the case of instars L_2. An almost equal level of reduction in all four areas was attained as early as the first half of June. The similarity of the course of reduction of instars L_2 and L_3 was probably due to the action of the same group of reducing insects.

Reduction of instars L_4. The course of reduction of instars L_4 was a very characteristic one (Fig. 4). Being generally the lowest of all, in some periods this reduction attained values higher than the values recorded for instars L_3 and even those for instars L_2. The equal reduction intensity in all the four areas was noticeable. The effect of the shelterbelt, so obvious in the case of reduction of instar L_1, was not noted at all. During the first half of June the level of reduction in the four areas was high, amounting to 13.16%. It was at its lowest (3.17%) during the second half of June and again at a rather high level (8.56%) during the first half of July. As indicated by the stomach content analysis, responsible for the rate of reduction of this instar are amphibians (Mazur 1966).

CONCLUSIONS

1. The rate of reduction of the younger instars (L_1–L_2) of the Colorado beetle larvae is inversely proportional to the distance from a shelterbelt, and it increases with the progress of the vegetation season.

2. Shelterbelts do not affect the reduction rate of the eggs or instars L_4.

3. Directly proportional to an increase in the distance from a shelterbelt is an increase in the number of eggs laid.

4. The growth in numbers of the adults of the overwintering generation is directly proportional to the growth of the distance from a shelterbelt.

5. The dynamics of emergence of the overwintering generation beetles depends on the temperature of the soil and air.

REFERENCES

1. Bilewicz-Pawińska, T. 1961 – Wpływ zadrzewień na dynamikę ilościową pluskwiaków różnoskrzydłych (*Heteroptera*) – Ekol. Pol. A, 4:61–77.
2. Kaczmarek, W. 1955 – W sprawie czynników kształtujących lokalne migracje stonki ziemniaczanej *Leptinotarsa decemlineata* Say – Ekol. Pol. B, 3: 65–83.
3. Karg, J., Trojan, P. 1968 – Fluctuations in numbers and reduction of the Colorado beetle (*Leptinotarsa decemlineata* Say) in natural conditions – Ekol. Pol. A, 16: 147–169.
4. Mazur, T. 1966 – Preliminary studies on the composition of amphibians' food – Ekol. Pol. A, 14: 309–319.
5. Melničenko, A.N. 1949 – Polezaščytnye polosy i rozmnoženie životnych poleznych i vrednych dla selskogo chozjajstva – Moskva.
6. Trojan, P. 1968 – Egg reduction in Colorado-beetle (*Leptinotarsa decemlineata* Say) as hunger-dependent reaction – Ekol. Pol. A, 16: 171–183.
7. Węgorek, W. 1959 – Stonka ziemniaczana (*Leptinotarsa decemlineata* Say) – Prace nauk. Inst. Ochr. Roślin 1, 2: 7–167.

WPŁYW ZADRZEWIEŃ ŚRÓDPOLNYCH NA LICZEBNOŚĆ I REDUKCJĘ NATURALNĄ STONKI ZIEMNIACZANEJ (*LEPTINOTARSA DECEMLINEATA* SAY)

Streszczenie

W sezonie 1966 prowadzono w Zakładzie Agroekologii PAN w Turwi pow. Kościan badania nad wpływem zadrzewień śródpolnych na kształtowanie się dynamiki liczebności i redukcję stonki ziemniaczanej. Pod uwagę wzięto uprawę ziemniaka o powierzchni 1 ha, na której nie stosowano ochrony chemicznej.

Badane pole położone było po zachodniej stronie pasa zadrzewień o przebiegu N–S. Badaniami objęto dynamikę wylotu chrząszczy zimujących, dynamikę liczebności chrząszczy obu pokoleń, jaj oraz larw z uwzględnieniem wszystkich stadiów rozwojowych, a także redukcję naturalną jaj i larw.

Stwierdzono ujemny wpływ pasa zadrzewień na liczebność zimujących chrząszczy. Nie zauważono wyraźnego wpływu zadrzewienia na liczebność chrząszczy obu pokoleń i liczebność larw. W przypadku jaj zaobserwowano wzrost liczebności, proporcjonalny do wzrostu odległości od zadrzewienia.

Redukcja larw młodszych stadiów rozwojowych jest zależna wyraźnie od wpływu zadrzewienia i wzrasta odwrotnie proporcjonalnie do odległości od pasa zadrzewień, a wprost proporcjonalnie do upływu czasu. Redukcja jaj i larw stadium L_4 nie wykazuje tych zależności i charakteryzuje się największym natężeniem na początku i w końcu sezonu wegetacyjnego.

AUTHORS' ADDRESS:
Mgr. Jerzy Karg,
Zakład Agroekologii PAN,
Turew, pow. Kościan, woj. poznańskie,
Poland.