

Influence of shelterbelts on distribution and mortality of colorado beetle (Leptinotarsa decemlineata Say)

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Studies on the shelterbelts impact on the abundance and biocenotic reduction of the Colorado beetle were carried out in the years 1965-1973. Initially investigations were concentrated on two crop-fields of 4 ha area each situated in the immediate proximity of a shelterbelt. Latter studies were extended to a regional scale (some 30 crop-fields different as regards their localization, area, timing of potato shootings etc.) At the time of detailed investigation, the two selected field-crops were not kept under chemical protection whereas the fields chosen for studies of a landscape character were subjected to the normal protective practice (DDT was applied mainly in doses of about 1 kg per ha). Extensive description of the area studied as well as the methods applied may be found in earlier elaborations (KARG and TROJAN, 1968 ; KARG, 1969).

The abundance of wintering Colorado beetles (and consequently their vernal appearance) is, because of autumnal micromigrations, only indirectly determined by the adjacent afforested area. The reduction rate of the vernal beetles during hatching out of soil shows a slight, nevertheless distinct decrease as a distance from the shelterbelt grows. The reduction intensity was evaluated on basis of a ratio of the number of beetles that abide in the soil and those leaving the soil to the number of beetles after the leave. The beetles spread over the whole area of the crop-field. The beetles of the summer generation after leaving the soil remain at the spot as long as food supplies are available in sufficient quantity, while in the case of its shortage they move to other parts of the field or, in extreme cases they emigrate into other crop-fields.

The total abundance in the season for eggs and larvae of every developmental stages of Colorado beetles was estimated according to the following formula :

$$N = \frac{\sum n \cdot t}{T}$$

where :

- N – the total abundance in the season
- n – the number of individuals in samples
- t – frequency of sampling (in days)
- T – ecological duration time of a given developmental stage (in days).

Distribution of Colorado beetle eggs and larvae in the crop-field is uneven and decidedly differentiated spatially. The total abundance of eggs and larvae stages increases with the distance from the shelterbelt ; this relationship being statistically significant (fig. 1).

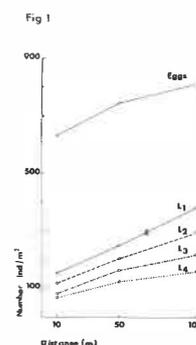


Figure 1 : TOTAL (IN THE SEASON) NUMBERS OF EGGS AND LARVAE OF THE COLORADO BEETLE AT VARIOUS DISTANCES FROM THE SHELTERBELT (MEAN OF YEARS 1966 - 1967).

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The distribution of abundance results from unequal intensity of reduction taking place at various distances from the shelterbelt. The reduction of eggs and larvae of all the stages is characterized by greater intensity in the areas neighbouring with the shelterbelt (fig. 2) and declines with the increase of distance from the shelterbelt. The above-presented regularities point to the existence of a relationship between the distance and the abundance of Colorado beetle in the adjacent field-crop.

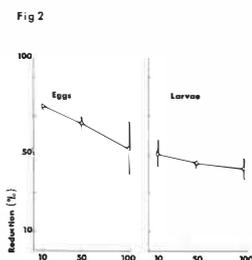


Figure 2 : NATURAL REDUCTION OF THE COLORADO BEETLE EGGS AND LARVAE AT VARIOUS DISTANCES FROM SHELTERBELTS (MEAN OF YEARS 1966 - 1968). Larvae : reduction in the whole period of larval development (from L₁ stage to L₄ stage).

During the vegetative season the abundance and reduction of Colorado beetle also undergo changes : the abundance decreases whereas reduction increases. The abundance decreases as a result of a gradual expansion of predatory species in the area of the field-crop. At the same time, at the end of vegetative season, aphid abundance in the field-crop drops and therefore Colorado beetle larvae become a main food source for many aphidophages (TROJAN, 1968).

It was shown in the landscape studies that the eggs reduction (a biocoenotic reduction due to the determined group of predators occurring on the crop-field) is almost twice as high in the field-crops situated in the vicinity of woodland or shelterbelts as in the open fields (8,5 per cent and 4,8 per cent, respectively (KARG, 1973) (Tab. 1). The differences found are statistically significant. Concerning the abundance and reduction of Colorado beetle larvae, differences of similar character were ascertained however not statistically significant. Probably, in the case of larvae, the modifying effects of pesticides are more significant and cover the changes that result from the activity of biocoenotic factors.

Table 1

THE ABUNDANCE OF EGGS OF COLORADO BEETLE IN THE FIELD-CROPS OF DIFFERENT LOCATION AND DATES OF POTATO SHOOTING (ind./m²)

Fields	Shielded	Open	Mean
early shootings	1046,8	1248,0	1147,4
late shootings	654,4	894,1	774,2
mean	850,6	1071,1	960,8

The assessed Colorado beetle reduction is due, to a large extent, to activities of some groups of predatory species which dwell in the potato field and prey on particular developmental stages of Colorado beetle. Spatial distribution of these species corresponds, in general, to spatial changes in the intensity of Colorado beetle reduction (fig. 3). A major part of these species is usually profoundly bound with the shelterbelt where they over-winter, for example bugs of the genus *Lygus*, species of the genus *Chrysopa* or predatory *Coccinellidae*. Many species of *Carabidae* living in the shelterbelt confine their penetration area to a narrow (several tens of meters) adjacent zone. Only few groups of predators which prey on Colorado beetle are excepted from this rule, occurring most abundantly far from the shelterbelts, in the open fields. For instance, some *Carabidae* like *Pterostichus lepidus* Leske (BONKOWSKA, 1970) and amphibians (KARG and MAZUR, 1969) avoid distinctly the shelterbelts. Data concerning the amphibians may be

referred to the particular year (1967) only since in the successive years their numbers in agrocenoses dropped almost down to zero as a result of rapidly proceeding processes of drying up of small water bodies.

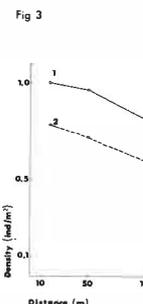


Figure 3 : DENSITY OF PREDATORY INSECTS AT VARIOUS DISTANCES FROM SHELTERBELT (1967). 1 - Total 2 - Coccinellidae

The selected most abundant species of predators in the potato field, which utilize Colorado beetle as a food source, were thoroughly analyzed as regards their share in the total reduction of particular developmental stages of Colorado beetle.

As to the eggs and younger larval stages of Colorado beetle the share of the known predatory groups of species in the total of observed reduction was estimated from 77 to 84 per cent. Thus, only a limited part of reduction is caused by the unknown factors. In the reducing of these stages a considerable contribution should be ascribed to the species connected strongly with the shelterbelt (*Lygus*, *Chrysopa*, *Coccinellidae*) and to an additional factor, i.e. to the cannibalism.

Larvae of the older developmental stages and the beetles as vernal ones (after leaving the soil) as the aestival, enter the activity ranges of other predatory groups of species. All the predatory species of *Carabidae* and three species of amphibians (*Bufo bufo* L., *Pelobates fuscus* Laur., *Rana arvalis* Nills.) relatively numerous in this period in agroecosystems were taken into consideration. The share of these species in reducing older larval stages and imagines of Colorado beetle amounts 14,4 per cent and 9,0 per cent, respectively.

Fluctuations of the reduction intensity of vernal individuals of *Carabidae* are similar to the spatial distribution of the predatory species numbers which are strongly bound to the shelterbelt (fig. 4). Distribution in

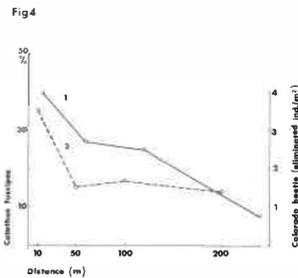


Figure 4 : REDUCTION OF IMAGOS OF COLORADO BEETLE BY *Carabidae* AND DISTRIBUTION OF *Calathus fuscipes* (Gz.) PLOTTED AGAINST GRADIENT OF DISTANCES FROM SHELTERBELT.

RÉSUMÉ

INFLUENCE DES HAIES SUR LA DISTRIBUTION ET LA MORTALITÉ DU DORYPHORE (*Leptinotarsa decemlineata* Say)

Des études de longue durée (1965-1973) consacrées au doryphore ont montré l'impact des haies sur l'importance des populations et la mortalité de cet

1 - *Calathus fuscipes* (Gz.) per cent of individuals (after BONKOWSKA, 1970).
2 - Adults of Colorado beetles (number of eliminated individuals per m²).

the field of the last larval stage (L₄) reduction and the reduction of Colorado beetle adults, which fall a prey, among others, to amphibians, appear differently. The reduction is accentuated most in the crop-field parts distant from the shelterbelt. This region of the cultivation is most abundantly inhabited by the amphibians (fig. 5).

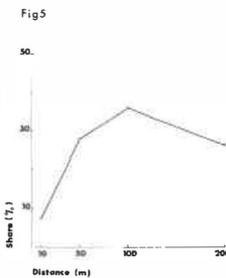


Figure 5 : THE SHARE OF AMPHIBIANS CAUGHT IN BARBER'S TRAPS AT DISTANCES FROM SHELTERBELT (1967).

At present, when Colorado beetle is no more a new element in our biocoenoses, many species which are components of the potato field biocoenosis as well as those not strictly confined to it (Starling) changed their diets in favour of Colorado beetle as a food supply. For instance in the Starling Colorado beetle constitutes about 15 per cent of the total diet (GROMADZKI, 1960), while in the toad it ranges up to 40 per cent (KARG and MAZUR, 1969). The list of organisms that destroy the Colorado beetle still increases and the adaptive processes are progressing. Despite the growing number and effectiveness of the Colorado beetle predators, and then the growing effectiveness of the biocoenotic regulation, the application of pesticides cannot be abandoned yet. A problem arises of how to work out the most efficient integrative methods which would optimize both the action of chemical protective agents as well as the biocoenotic regulation.

ennemi des cultures. La mortalité la plus élevée a été observée dans les zones voisines des haies ; elle est due à la grande abondance de différents prédateurs. Le taux de destruction des oeufs du doryphore dû à l'activité des prédateurs est presque deux fois plus élevé au voisinage des haies que dans les champs ouverts. Des résultats similaires ont été trouvés pour d'autres stades de développement du doryphore. L'efficacité des prédateurs les plus importants a été estimée.