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POPULATION DYNAMICS OF CEREAL LEAF BEETLES, *OULEMA MELANOPUS* L. AND *O. LICHENIS* VOET (*COLEOPTERA : CHRYSOMELIDAE*), ON WHEAT FIELDS IN SOUTHERN BELGIUM

by

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SUMMARY

In order to determine the pest status of cereal leaf beetles in Southern Belgium, the population densities of *Oulema melanopus* (L., 1758) and *O. lichenis* (Voet, 1806) were studied at Ciney and Louvain-la-Neuve during 1993 and 1994. During the two-year study period *Oulema* spp. populations had never reached the economic threshold of 2.5 larvae per tiller. The levels of the *Oulema* populations were significantly different between the 2 sites in 1994 ; Louvain-la-Neuve supporting greater densities than Ciney. Phenological differences between the two locations were postulated to be the result of two phenomena : (1) the early attainment of the physiological time of development, expressed in degree days, necessary for immature stage development, in Louvain-la-Neuve, the warmest location, and (2) the early attainment of the cold sum necessary to end the adult diapause in Ciney, the coldest site, however this second argument stays as a hypothesis that must be tested.

Keywords : Oulema melanopus, Oulema lichenis, population dynamics, winter wheat pests.

INTRODUCTION

Oulema melanopus (L., 1758) is distributed in the whole Palearctic region (BALACHOWSKY and MESNIL, 1935) and in 1962 it was accidentally introduced into Michigan. From there it spread rapidly from an area ranging from Pennsylvania to Winsconsin and from Kentucky to Michigan and Ontario (GALLUN *et al.*, 1966 ; TUMMALA *et al.*, 1975). *O. lichenis* (Voet, 1806) is more common in Europe. The color of the pronutum, red for the former and metal blue for the latter, makes it possible to distinguish them easily (BALACHOWSKY and MESNIL, 1935).

They both feed on small grains, with a preference for oat and barley *versus* wheat by *O. melanopus* and wheat *versus* barley by *O. lichenis*. However, only the

first species has the reputation of being an economic pest, mainly in continental-type climate areas, where a short spring is followed by a dry summer (BALACHOWSKY and MESNIL, 1935). In some years, estimated reductions of grain yield as high as 70 % were reported in Central Europe (KNECHTEL and MANOLACHE, in WILSON *et al.*, 1969) and in Michigan (GUYER, in GALLUN *et al.*, 1966). Little is known about their density and there is no mention if these species reach the economic threshold in Belgium. The economic threshold level is 2.5 larvae per tiller, in the Paris Basin (Anonymous, 1982), and 0.5 larvae per tiller, in Switzerland (HAUSAMMAN, personnal communication), at the wheat growth stage 50 to 59 on the Zadoks scale (ZADOKS *et al.*, 1974). The lower threshold in the second area is due to climatic conditions more favorable to the pest, in the more continental-type climate. Therefore the purpose of this work was to analyse the phenology and the abundance of these species in two different biogeographical areas in Southern Belgium.

MATERIAL AND METHODS

This study was conducted during 1993 and 1994, on two sites in the southern part of Belgium, Ciney, in the Condroz region, and Louvain-la-Neuve, in Brabant-Wallon. During the first year two fields of winter wheat, cultivar Estica (field C 1) and cultivar Torino (field C 2), at Ciney and one winter wheat field, cultivar Estica (field L 2), and one spring wheat (field L 1) at Louvain-la-Neuve, were sampled. In 1994, three winter wheat fields, with cultivars Sideral (field C 1), Clan (field C 2) and Estica (field C 3) at Ciney and Clan (fields L 1 and L 3) and Estica (field L 2) at Louvain-la-Neuve, were sampled.

The number of *Oulema* spp. adults, eggs, larvae and *O. lichenis* pupae were counted weekly, from the beginning of May till the end of July, *in situ*, on 100 tillers taken on two transects. The *O. melanopus* pupae formed in the ground were not sampled.

The means of the number of eggs, larvae and pupae were compared by using ANOVA2 — fixed model after a log (x+1) transformation.

RESULTS

During the two-year study, *Oulema spp.* populations never reached the economic threshold of 2.5 larvae per tiller at the stage 50 to 59 on the Zadoks scale (Anonymous, 1982). The maximum observed was 0.2 larvae per tiller per week in 1994 in the fields L 1, L 2 and C 3.

In 1993, the levels of the pest population were not significantly different between the two sites ($F_{(eggs)}(1,12) = 1,62$ NS ; $F_{(larvae)}(1,13) = 0,98$ NS). However,

in 1994, the incidence of *Oulema* populations was more important in Louvain-la-Neuve than in Ciney ($F_{(eggs)}(1,28) = 12,15^{***}$; $F_{(larvae)}(1,28) = 12,80^{***}$, $F_{(pupae)}(1,20) = 21,08^{***}$).

The major differences in the phenology of these species occurred between fields of winter wheat (Fig. 2) and spring wheat (Fig. 1), but these results must be considered with care as only one field of each kind was taken into account. On spring wheat the maximum oviposition was recorded, at growth stages 54-55, three weeks later than on winter wheat, at growth stage 39. Likewise, the maximum larval incidence on spring wheat occurred, at growth stage 55-65, one to two weeks later than on winter wheat, at growth stage 54-55.

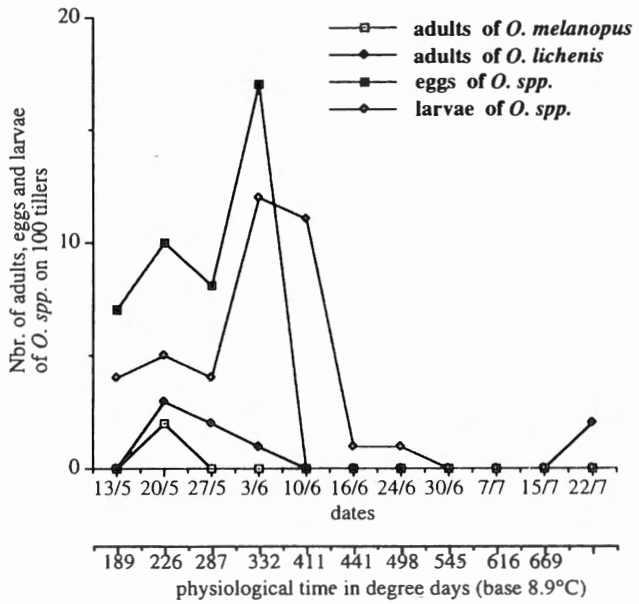

Fig. 1. — Phenology of *O. melanopus* and *O. lichenis* on spring wheat, Louvain-la-Neuve, 1993.

Small differences appeared between sites of winter wheat (Figs 2-3). In 1994, the peak of *Oulema* spp. oviposition occurred at Ciney, the colder area, one week before Louvain-la-Neuve. Nevertheless this delay is negligible for the larval peaks that were synchronized in both sites, and pupation began one week earlier at Louvain-la-Neuve. In both sites, the maximum number of eggs was observed one week after the peak of *O. lichenis*, except at Ciney in 1994 where both peaks were simultaneous.

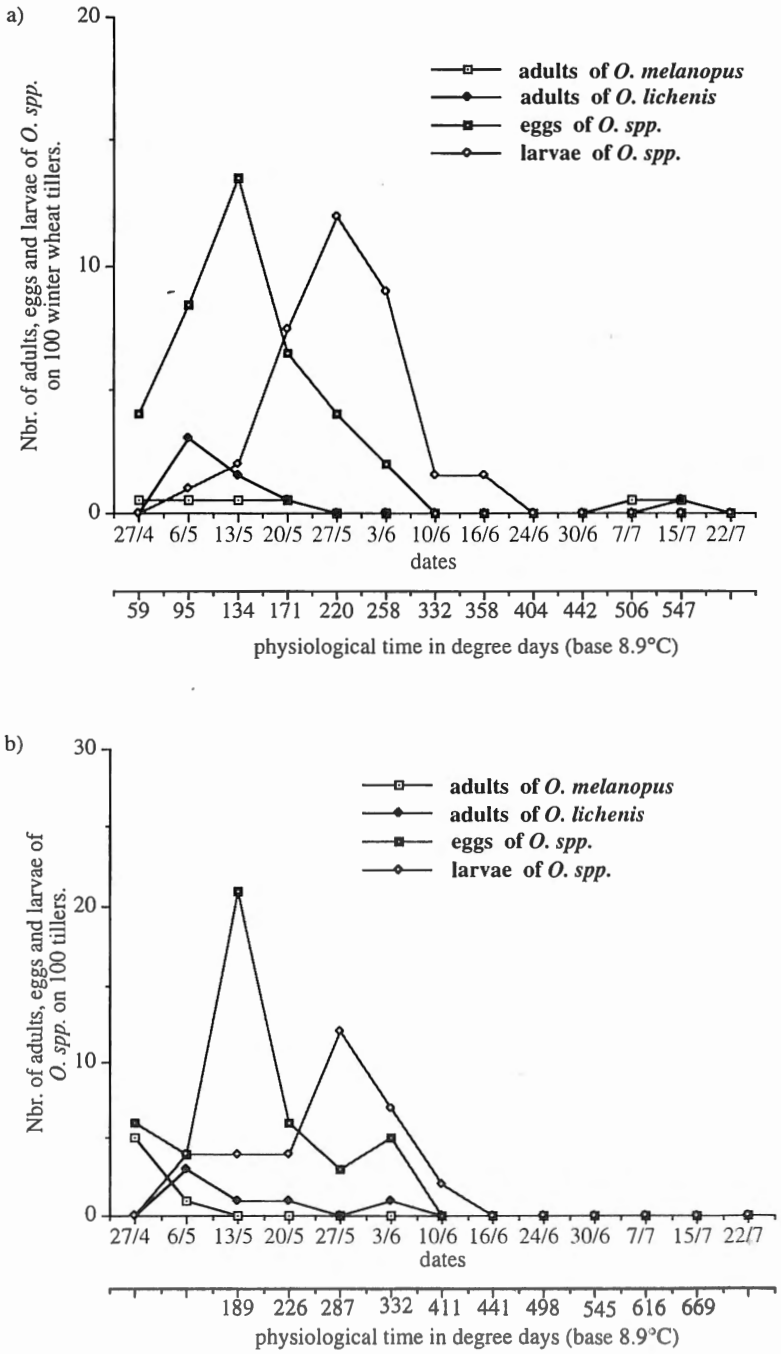

Fig. 2. — Phenology of *O. melanopus* and *O. lichenis*, on winter wheat in 1993. (a) Ciney (mean on 2 fields) (b) Louvain-la-Neuve.

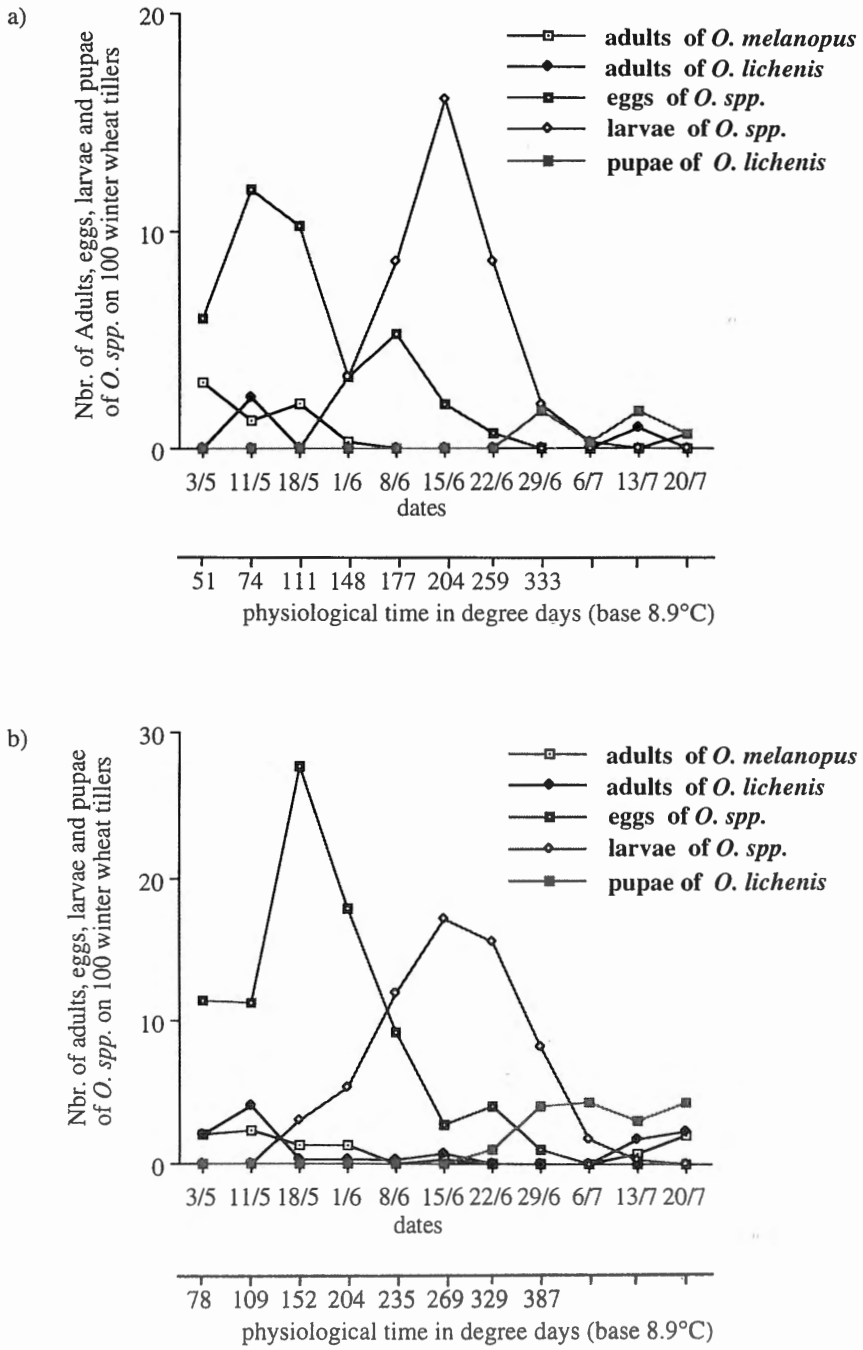

Fig. 3. — Phenology of *O. melanopus* and *O. lichenis*, on winter wheat in 1994. (a) Ciney (mean on 3 fields) (b) Louvain-la-Neuve (mean on 3 fields).

The timing of these events can be expressed in degree days (Table 1) based on the development threshold temperature that is estimated to be 8.9° C for all immature stages of *O. melanopus* (YUN, 1967, in TUMMALA *et al.*, 1975).

TABLE 1

Phenological timing expressed in degree days
(base 8.9° C)

	Peak of egg density	*Time between the two peaks*	*Peak of larvae*
Ciney 1993	133.8	86.6	220.4
Louvain-la-Neuve 1993	188.9	98.3	287.2
Ciney 1994	73.5	130.0	203.5
Louvain-la-Neuve 1994	151.8	117.2	269.0

DISCUSSION

In Belgium, Cereal Leaf Beetles remain marginal pests in winter wheat fields, as their densities are below the economic threshold. However, no data are available concerning other small grain cereal crops. Indeed, as *O. melanopus* prefers oat and barley, it would be interesting to know its density on these crops. According to WILSON *et al.* (1969), the loss of oat grain yield due to this pest ranges from 148 to 266 kg/ha at the density of one larva per tiller.

YUN (1967, in TUMMALA *et al.*, 1975) estimated that physiological time of development of the eggs, larvae and pupae of *O. melanopus* was 82, 116 and 216 degree days respectively. This explains why in 1994, at Louvain-la-Neuve, pupal formation was earlier than at Ciney, although the oviposition began later in the first site. Lengths of larval development were, in 1994, 1.4 to 1.6 times greater than expected. This may be due to the cooler spring of 1994 (see the degree days scales of the two seasons in the same site).

In 1994, the earliest oviposition at Ciney, the cooler area, may be explained by the early attainment of the cold sum, necessary to end the adult diapause. Adults emerged earlier and could oviposit. However this argument stays as a hypothesis that must be tested.

The low *Oulema* spp. density observed might be due to the climatic situation. It might also be due to a great activity of their different parasitoids or to the use of resistant varieties of winter wheat. An egg and three larval parasitoid species were recorded in Europe on this pest (STEHR, 1968). The character which plays a role in the varietal resistance is the length and the density of trichomes. These trichomes act by isolating the eggs in the air ; improving thereby their desiccation ;

and, because they can not be digested, they kill the young larvae by penetrating the midgut epithelium (GALLUN *et al.*, 1966 ; PAPP *et al.*, 1992).

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