APHID SPECIFIC PREDATORS IN POTATO IN BELGIUM

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ABSTRACT

In summer 2003, aphid specific predators populations were sampled in four potato fields located in Wallonia. Ladybirds, hoverflies and lacewings were the most abundant predators collected. A total of 6 ladybird, 8 syrphid and 2 lacewing species was found. Predator species composition and abundance greatly differed from field to field, while aphids populations were more or less similar with a peak of 3 to 5 aphid/potato leaf in mid-July.
All chrysopidae sampled belong to the *Chrysoperla kolthoffi* (NAVAS) species except 2 specimens of *Chrysopa perla* L. *Episyrphus balteatus* DEGEER was the dominant syrphid species. *Sphaerophoria scripta* L. and *Syrphus vitripiennis* MEIGEN were subdominant species and 1 or 2 specimens of *Melanostoma scalare* F., *Melanostoma mellinum* (L.), *Melliscaeva cinctella* (ZETTERSTED), *Metasyrphus corollae* (F.) and *Platycheirus albimanus* F. were also collected. *Coccinella septempunctata* (L.) and *Propylea quatuordecimpunctata* (L.) were the dominant ladybird species. *P. 14-punctata* was proportionally more abundant in beating samples than with visual inspection samples, indicating that this ladybird is probably more discrete than *C. septempunctata* and that their populations can be underestimated with only visual inspection. *Adalia bipunctata* (L.) was also present in nearly all samples, but with lower levels of populations. *Coccinella quinquepunctata* (L.) and *Adalia tenpunctata* (L.) were found in small numbers at one occasion. Larvae and adults of *Harmonia axyridis* PALLAS, the multicoloured Asian beetle introduced in glasshouse for aphid control, were found in 3 fields out of 4, with 1.5 to 6 % of ladybirds sampled. This is the first record of *H. axyridis* in open field in Belgium. As this beetle has been found in numbers at different locations and with different growth stages including larvae and pupae, it is supposed that *H. axyridis* is adapted to ware potato aphid and able to complete a full life cycle in this crop. As this species is very competitive for exploitation of food resources and aggressive for other predators, they are several questions about the evolution in the future of aphid specific predator biodiversity in ware potato.

Key-words: Ware potato, aphid predator, ladybird, hoverfly, lacewing, Harmonia axyridis

INTRODUCTION

Aphids are considered as a major pest in ware potato in Western Europe (Carden, 1962, Harrewijn, 1989, Dubois et Duvauchelle, 1998). However, populations levels greatly differs from year to year and from field to field. On basis of field survey monitoring performed since 1994 in the Walloon part of Belgium, insecticide treatments were only required in only a few case (Jansen, 2002). One of the main reason of this low occurrence follows from biological aphid control by natural enemies (Jansen, 2000a, 2002). Among these, aphid specific predators as syrphids, coccinellids and chrysopids are considered as of particular importance. Analysis of 1994-2001 aphid and aphid natural enemies field observation data's in Belgium were indicating that a density of 2 predator larvae for 100 aphids were most of the time sufficient to avoid aphid outbreak and insecticide use. However, if the importance of aphid predator is well documented in potato, little is known about species specifically encountered in Belgium. In the context of development of IPM program, with the possibility of habitat management measures to improve natural enemies activities, this lack of information is a limiting factor. The objective of this research was to sample and identify aphid specific predator species found in ware potatoes in Belgium during aphid infestation period.

MATERIAL AND METHODS

Aphids specific predators were sampled in June and July in four potato fields located in the Belgian Walloon area, with the help of visual and beating sampling. All fields were commercial potato fields of 2-8ha conducted according to normal agricultural practices, with regular fungicides applications and no insecticide treatments.

For visual sampling, 200 leaves were weekly selected randomly in the field and inspected for aphids and aphids natural enemies from mid-June to end of July. These counts were assessed in the context of aphid survey for farmer's advertising system. At several occasions, supplementary plants were inspected for aphid predators to increase sample size. All predator eggs and pupae were brought back to the laboratory and left to hatch for identification. Larvae and adults were directly identified or, in case of doubt, brought to the laboratory. Lacewings larvae and several hoverflies larvae collected into the field were reared in the laboratory with aphids till pupation and adults identified. For lacewing identification, several adult characteristics were used to distinguish *Chrysoperla carnea* (STEPHENS) sensus stricto and *C. kolthoffi* (Çaldumbide *et al.*, 2001).

For beating samplings, 30 potato plants were randomly selected at three occasions in each fields and shaken just above a plastic tray. Insects that were collected were immediately placed in plastic vials and brought back to the laboratory for counts and identifications, as describe before.

RESULTS

Results of visual inspections of the four potato fields are given in Table 1. Eggs and pupae that did not hatched or were parasitised and larvae that died during laboratory rearing were not taken into account. Parasitism rates were comprised between 2.5 % (lacewings) and 23.6% (hoverflies).

Results of beating samplings with ladybirds are given in Table 2. Hoverflies gave very poor results with this method and all lacewings collected belong to *C. kolthoffi* species. As no ladybirds larvae or adults were collected in Beauvechain, results are only presented for three of the four potato fields.

Comparison of species relative abundance obtained with the two sampling methods are given in table 2, not taking into account Beauvechain results with visual inspection. Percentages were compared with the help of a Student t-test at p=0.05 level, after arcsin percentage transformation.

Table 1. Relative abundance of aphid specific predators sampled by visual inspection in four potato field in summer 2003 in Belgium.

	Nivelles	St-Gérard	Hanret	Beauve-chain	%	Total
Aphid/leaf (max)	5.5	3.2	2.9	3.6		
LADYBIRDS (n=)	595	65	186	2	-	848
C. 7-punctata	88.9%	70.8%	73.7%	100.0%	83.3%	714
P. 14-punctata	4.0%	23.1%	19.4%	0.0%	11.6%	75
H. axyridis	3.2%	1;5%	6.5%	0.0%	2.8%	32
A. bipunctata	3.2%	4;6%	0.5%	0.0%	2.1%	23
C. 11-punctata	0.5%	0.0%	0.0%	0.0%	0.1%	3
A. 10-punctata	0.2%	0.0%	0.0%	0.0%	0.0%	1
HOVERFLIES (n=)	8	12	51	10	-	81
E. balteatus	50.0%	8.3%	80.4%	70.0%	52.2%	53
S. scripta	37.5%	50.0%	5.9%	20.0%	28.3%	14
S. vitripiennis	0.0%	16.7%	9.8%	0.0%	6.6%	7
M. cinctella	12.5%	8.3%	0.0%	0.0%	5.2%	2
M. scalare	0.0%	16.7%	0.0%	0.0%	4.2%	2
M. corollae	0.0%	0.0%	2.0%	0.0%	0.5%	1
P. albimanus	0.0%	0.0%	2.0%	0.0%	0.5%	1
M. mellinum	0.0%	0.0%	0.0%	10.0%	2.5%	1
LACEWINGS (n=)	49	14	52	44		159
C. kolthoffi	100.0%	85.7%	100.0%	100.0%	96.4%	157
C. perla	0.0%	14.3%	0.0%	0.0%	3.6%	2

Table 2. Abundance of ladybirds sampled by beating in 3 potato field in Belgium and relative abundance compared to visual inspection

	Nivelles	St-Gérard	Hanret	Total	Beating sampling	Visual inspection*
C. 7-punctata	28	15	1	44	58.6% a	84.2% b
P. 14-punctata	12	14	1	27	36.0% a	8.8% b
H. axyridis	3	0	0	3	4.0% a	3.8% a
A. bipunctata	1	0	0	1	1.3% a	2.7% a
Total	44	29	2	75		

Statistical analysis, Student-t test (arc sin), a=no differences, b= differences at p=0.05 level

* results from Nivelles, St-Gerard and Hanret only, from table 1

A total of 16 aphid specific predators (6 ladybirds, 8 hoveflies and 2 lacewings) was found. Dominant species were *C. 7-punctata* and *P. 14-punctata* for ladybirds, *E. balteatus* and *S. scripta* for hoverflies and *C. kolthoffi* for lacewings. With ladybirds, relative abundance was different according to sampling methods, *P. 14-punctata* being more abundant when sampled by beating than with visual inspections and counting.

In term of predators abundance, a great variability between fields was observed while aphid infestation levels were comparable. If lacewings were found more or less in similar numbers in all fields, ladybirds were nearly absent in Beauvechain with only two specimens collected while there were very abundant in Nivelles, with up to 600 specimens. Hoverflies were scarcer than the other aphid predators. They were more numerous at Hanret than in the other fields.

If they were great differences between fields in terms of abundance of the different groups, the same species were found in a relative similar proportion inside each group, at least for the most important species. *C. septempunc-*

tata, *P. 14-punctata*, *E. balteatus* and *C. kolthoffi* were clearly the dominant and the most regular aphids predators species found in ware potato in 2003.

DISCUSSION AND CONCLUSIONS

Sampling and identification of aphid predators have revealed a relative great diversity of these natural enemies, with a total of 16 species found with only one year of sampling and four field investigated. There were great differences between fields in term of relative abundance of the different groups, with ladybirds nearly absent in one field and very abundant in another one. These differences are unexplained and did not seemed to be relzated to aphid density. Field natural environment could play a rule but the four potato fields sampled were more or less similar in this point of view. They were all located in intensive production areas with cereal, sugar beet, oilseed rape and maize as surrounding fields. Landscape was also quite similar, with trees groups and gardens also present at maximum 500m far from field edges. Fields borders (mix of grass and wild flowers) were also present near each fields.
Comparison of visual inspection and beating sampling results with ladybirds showed that if the same species were found, relative abundance was quite different according to sampling method. *P. 14-punctata* was more abundant with beating than with visual inspection. It is possible that this species is more discrete and preferentially active of the lower part of plants while the seven-spotted ladybird prefers the upper part and is thus more easily seen than the other species. Thus, visual sampling can overestimated relative importance of several species, especially *C. 7-punctata*, and therefore underestimate other ones. If visual inspections seems to be the simplest methods to use, beating systems are more adapted in the context of quantitative studies.
If there were great differences between fields in term of abundance, the commonest species were more or less the same inside each group, regardless of field situation. Dominant species were *C. kolthoffi* for lacewings, which belongs to *C. carnea* sensus lato group and probably cited under this name in most of the publications (Canard *et al.*, 2002), *E. balteatus* for syrphids and *C. 7-punctata* and *P. 14-punctata* for ladybirds. All these species are commonly found in others herbaceous crops and clearly adapted to agricultural habitat. There is especially a strong connection with aphid predators species found in cereals in Belgium (Jansen, 2000b), both in terms of species and phenology. Aphids predators are found in potato 3-4 week later than in cereals and could therefore probably being originating from this crop. This hypothesis must be confirmed but it is verified, that will say that cereal aphid control and insecticide use in cereals could exert an influence on potato aphid control by decreasing aphid predators densities originating from this crop and emigrating later in potato.
In both visual and beating samplings the multicoloured Asian ladybeetle *H. axyridis* was found in three of the four fields investigated. In the last one, Beauvechain, there were nearly no ladybirds, thus in all fields sampled were there was ladybirds *H. axyridis* was found. This ladybeetle is originating from middle-east Asia. According to its efficacy and adaptability for aphid control, it was introduced in the past in USA and Canada where it has rapidly became invasive and supplanted indigenous species in several habitats.

In Belgium, this species was mass released in glasshouses for aphid control since 1997. In 2001, first records of this species were noted outdoors in the North of Belgium, where glasshouses productions are particularly developed. Since these first records, *H. axyridis* populations rapidly increased and the beetle was found in large numbers during winter 2003 at different hibernation sites in the north of Belgium and in spring and summer 2003 on *Acer* sp and *Tilia* sp trees, not only in the north part of Belgium but also in the south, where glasshouse production is very limited (Adriaens *et al.*, 2003). This is the first record of this ladybird species in potato and, in a more general way, in arable crop. *H. axyridis* summed about 4% (1.5-6.5%) of total ladybirds captures. They were found as larvae, pupae and adults and catches were not localised in patches but were distributed in all the field. As they were found in three fields distant each other from 30-60km, with nearly no glasshouses production in these areas, the hypothesis of accidental contamination's by ladybirds escaped from glasshouses can be rejected. And as they were found as larvae, pupae and adults, this species seems to be adapted to aphid potato and able to feed and reproduced in this crop.
Several authors have emphasised on the danger of introducing exotic species for indigenous biodiversity. In this context, *H. axyridis* seems to be a big threat for indigenous aphid predator species. Several studies have shown that the Asian ladybeetle is very aggressive and able to dominate *C. septempunctata* and *A. bipunctata*, both by competition for exploitation of food resources and by direct predation (Yasuda *et al.*, 2001, Kajita *et al.*, 2000, Hokkanen *et al.*, 2003), while predation of *H. axyridis* by other ladybirds species seems to be limited (Yasuda et Katsuhiro, 1997, Hautier, 2003). That can explain why this ladybird species has became the dominant one in several habitats when it has been introduced in the USA and has led to major changes in aphidophagous ladybirds biodiversity in natural and agricultural ecosystems. This probably will happen in Belgium and can also be possible for other insect groups in the future if regulation requirements for the autorisation of use of exotic biological control agents are not adapted to take into account possible risks for indigenous species.

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