# POLLEN AS A SPRING FOOD FOR ADALIA BIPUNCTATA

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## Introduction

In Belgium, A. bipunctata (L.) begins to leave the dormancy sites in March well before there are large numbers of aphids. In this period of the year, the ladybirds are principally going towards bushy vegetation and trees. It seems that important quantities of A. bipunctata are staying in the Rosaceae orchards up to the end of blooming. Then, the main part of the ladybirds will migrate towards herbaceous plants where they will find important aphid populations and where they will breed (Hemptinne, unpublished work). Several experiments have been realized in order to know better the feeding possibilities of A. bipunctata during the stay in the orchards.

## Observations made in the orchards

Feeding possibilities of A. bipunctata were studied in spring 1983 in three orchards and in one orchard in spring 1984. The observations were recorded once a week from 11.5.83 to 1.6.83 and from 3.5.84 to 23.5.84. In each orchard, the lower branches of three trees have been shaken in order to collect ladybirds in a large cloth. A sample was taken to the laboratory and dissected.

The gut contents were prepared with gelatinous glycerin and observed under the microscope. Table 1 shows the main types of pollen found.

Table 1 Pollen found in the gut of A. bipunctata

| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| Nb of Adalia dissected | 24 | 18 | 26 | 24 | 9 | 21 | 17 | 17 |
| Nb of pollen grains | 78 | 102 | 24 | 7 | 455. | 230 | 25 | 307 |
| % of pollens | | | | | | | | |
| Aceraceae | | 1 | 4 | | | | | |
| Amaryllidaceae | 24 | | | | | | | |
| Berberidaceae | | 3 | | | | | | |
| Betulaceae (Betula sp.) | | | 4 | | | | | 1 |
| Betulaceae(Corylus sp.) | 3 | | | | 4 | | 16 | |
| Brassicaceae | 4 | | | | | | | |
| Fagaceae | | 1 | | | | | | |
| Grossulariaceae | | 3 | | | | | | |
| Liliaceae | 5 | 1 | | | | | | |
| Pinaceae | | 1 | 13 | 85 | | | | |
| Poaceae | 4 | | | | | | | |
| Rosaceae | 4 | 69 | 54 | | 94 | 96,5 | 36 | 63,5 |
| Salicaceae | 1 | | | | 1 | | 40 | |
| Miscellaneous | 55 | 21 | 25 | 15 | 1 | 3,5 | 8 | 35,5 |

a ) 11.5.83; b ) 18.5.83; c ) 25.5.83; d ) 1.6.83
e ) 3.5.84; f ) 9.5.84; g ) 16.5.84; h ) 23.5.84

In 1983, pollen was found in large quantities in the stomachs until May 25. The remains of aphids were found only after May 18. The Rosaceae pollen found in the samples of May 18 and 25 during the period of blooming was the most important. In 1984, the main part of the gut contents of A. bipunctata consisted of Rosaceae pollen. As we can see from the sample made on May 16, the ladybirds consumed also some pollen of Salix sp and Corylus avellana. The remains of aphids appear sporadically from May 3. They were found more frequently later in May.

## Food suitability of Rosaceae pollen

During the first week of March 1984, A. bipunctata was sampled at dormancy sites and brought to the laboratory (25 $\pm$ 1°C, 16 hours light and 80 % relative humidity) for the study of the suitability of Rosaceae pollen. The ladybirds were sorted out in two lots to make two experiments.

First experiment (40 pairs on four diets):

$D_1$ : honey sweetened agar (control)

$D_2$ : pollen of Rosaceae

$D_3$ : pollen during ten days followed by pollen and aphids ( Acyrthosiphon pisum(Harris))

$D_4$ : aphids

For each treatment, we measured the preoviposition delay, the number of eggs laid and the length of larval and pupal development (Table 2; Fig. 1). Although the experiment begun with ten pairs for each treatment, the number of pairs decreased to 7 for $D_4$, to 8 for $D_3$ and to 4 for $D_2$. No egg laying has been observed in the control. The preoviposition delay was the shortest on diet $D_4$ and the longest on $D_2$. In spite of a longer preoviposition delay, the number of eggs laid for $D_3$ was nearly the same as for $D_4$. The duration of larval and pupal development did not show a significant difference between the treatment of $D_3$ and $D_4$; The oviposition was low with the diet $D_2$ and the larval and pupal development were significantly longer than with $D_3$ and $D_4$.

Diets of the former experiment were used to follow the impact of pollen on the ovarian development of A. bipunctata. The second part of the samples of ladybirds was divided into 8 Erlenmeyers with about 50 insects per flask. Each diet was tested in

Table 2 Reproduction of A. bipunctata on four different diets

| | $D_1$ | $D_2$ | $D_3$ | $D_4$ |
|---|---|---|---|---|
| | control | pollen | mixed | aphids |
| Nb of effective pairs | 10 | 4 | 8 | 7 |
| Preoviposition delay° | - | 46,0±25,6(a)" | 16,5±2,0(b) | 9,4±2,5(c) |
| Nb of eggs/female | - | 49,0±53,1(a) | 548,8±414,2(b) | 657,0±399,5(b) |
| Larval development | - | 16,6±0,7(a) | 12,5±0,1(b) | 12,7±0,2(b) |
| Pupal development | - | 6,0±0,6(a) | 3,9±0,4(b) | 4,5±1,5(b) |

" : Nb followed by same letters in each line do not differ significantly ( = 0,001)

° : in days (results are given as mean ± SD)

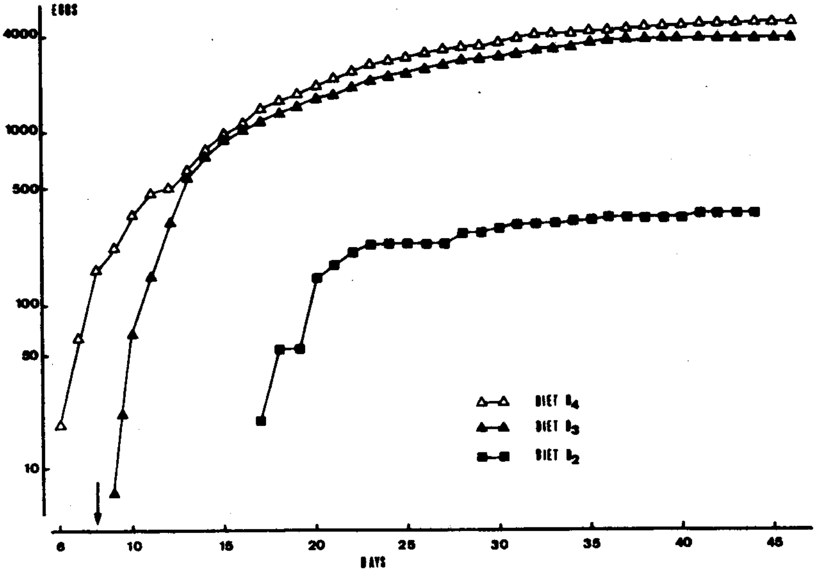


Fig. 1 Cumulative number of eggs laid by A. bipunctata fed on aphids ($D_4$), aphids and pollen ($D_3$) and pollen ($D_2$) The number of eggs is given by 2 $\log_e$ (cumulative number of eggs + 1) and corresponds to the sum of 7 females. Arrow show the introduction of aphids in $D_3$

two flasks. Every two days, we took 5 ladybirds from each treatment, dissected three of them in Ringer's solution and measured the length of the first oocyte on ten ovarioles per ladybird. For each treatment, the maturity of the ovaries is shown by the number of matured first oocytes, which means the one having a dimension equal to or longer than 0,650 nm

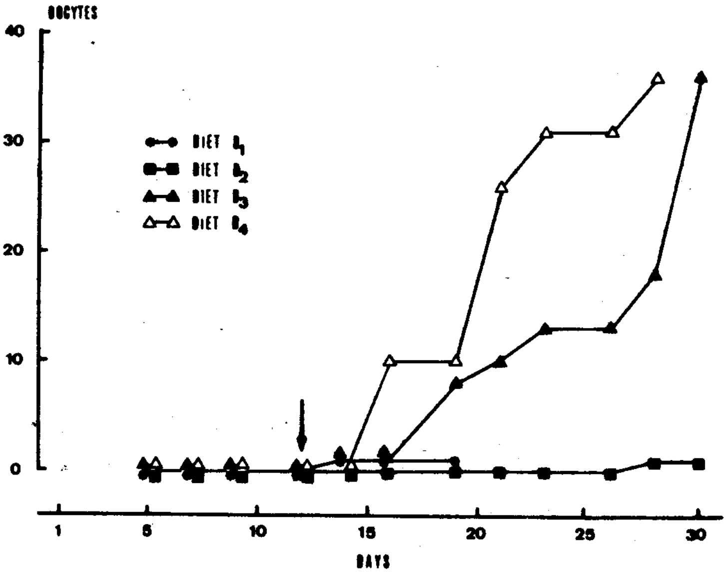


Fig. 2 Cumulative number of mature oocytes of A. bipunctata fed on aphids ($D_4$), aphids and pollen ($D_3$), pollen ($D_2$) and agar with honey ($D_1$)
Arrow shows the introduction of aphids in $D_3$

There is no difference between the number of matured first oocytes for the diets $D_3$ and $D_4$. The cumulative curves of the two experiments are similar and the difference shown is evidently due to the introduction of aphids in $D_3$ ten days later. The treatments $D_1$ and $D_2$ show only one mature first oocyte and differ significantly from the treatments $D_3$ and $D_4$. The food suitability of $D_2$ appears to be more effective than that of $D_1$ for two reasons. Firstly, there was lower mortality in the treatment $D_2$ than in $D_1$ where the last individual died by the 18th day of the experiment. Secondly, we have observed one laying in the flask $D_2$.

## Discussion and Conclusions

Numerous ladybirds are able to eat pollen during some periods of their life-cycle. The adults of Anatis ocellata subsist on pollen of pine, on larvae of Choristoneura pinus or on aphids (Allen et al. 1970). In the same way, Hawkes(1920)concluded that A. bipunctata feeds on pollen. In California, Coccinella trifasciata juliana, Hippodamia parenthesis, Hippodamia convergens, H. quinquesignata pustulata and H. sinuata subsist on pollen and other foods of plant origin at the end of hibernation when aphids are rare. Feeding on this food enables them to build-up reserves but does not permit the ovogenesis. In the same way, some Californian species of ladybirds feed on pollen at the end of the season in order to develop their reserves for dormancy (Hagen 1962). For Hodek (1973), the pollen allows the ladybirds to survive with a reduced mortality when the insect-food is scarce for a while. It allows a rapid resumption of oviposition as soon as the prey re-appears. Coleomegilla maculata is considered as an exception because it can normally develop on pollen (Smith 1968). In the corn fields of Ontario, the typical habitat of this ladybird coincides with strata where the pollen is accumulated on the leaves (Ewert & Chiang 1966). This possibility to develop on pollen allows a large number of C. maculata to support low densities of corn aphids (Wright & Laing 1980).

In Belgium, A. bipunctata feeds on pollen from the end of hibernation up to early June. From the results of some experiments, pollen appears to be an alternative food which allows the ladybirds to lay eggs as soon as aphids appear. In spite of the delay in preoviposition due to a pollinic diet for ten days, the ladybirds from $D_3$ reach the same level of egg laying as the pairs from $D_4$. In the same way, the number of mature first oocytes is similar to the pairs of $D_3$ and $D_4$. But the Rosaceae pollen also allows an ovarian development resulting in the oviposition which is still much lower than the one observed with the ladybirds fed with aphids. Nevertheless, pollen can be considered as a more suitable diet than honey sweetened agar.

During the spring the Rosaceae pollen is the main diet for A. bipunctata. In view of the use of A. bipunctata in the control of cereal aphids, pollen could be a main diet to feed ladybirds in order to synchronize their ovogenesis with the development of aphid populations.

## References

Allen D C, Knight F B & Foltz J L 1970 Invertebrate predators of the Jack-Pine Budworm, Choristoneura pinus, in Michigan. Ann Entomol Soc Am 63: 59-67

Ewert M A & Chiang H C 1966 Effects of some environmental factors on the distribution of three species of Coccinellidae in their microhabitat. In: Ecology of Aphidophagous Insects. Hodek I (ed), Academia, Prague, p 195-219

Hagen K S 1962 Biology and ecology of predaceous Coccinellidae. Annu Rev Entomol 7: 289-326

Hawkes O A M 1920 Observations on life-history, biology and genetics of the ladybird beetle, Adalia bipunctata (Mulsant). Proc Zool Soc London 1920: 475-490

Hodek I 1973 Biology of Coccinellidae. Academia, Prague, 260 p

Smith B C 1960 A technique for rearing coccinellid beetle on dry foods, and influence of various pollens on the development of Coleomegilla maculata lengi Timb. (Coleoptera: Coccinellidae). Can J Zool 38: 1047-1049

Wright E J & Laing J E 1980 Numerical response of Coccinellids to aphids in corn in Southern Ontario. Can Entomol 112: 977-981