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ANTHECOLOGICAL RELATIONS BETWEEN REPUTEDLY ANEMOPHILOUS FLOWERS AND SYRPHID FLIES. II. PLANTAGO MEDIA L.

H. LEEREVELD, A. D. J. MEEUSE, and P. STELLEMAN

Hugo de Vries-laboratorium, Universiteit van Amsterdam

SUMMARY

After intensive field work in Upper Hessia (W. Germany) the authors have come to the conclusion that although *Plantago media* L. is most probably visited much more frequently and by a wider range of insects than *P. lanceolata* L., syrphid flies of the *Melanostoma-Platycheirus* group play a negligible role in the pollen transfer of *P. media*. The possible reason for this unexpected result is anything but clear and only a tentative possibility is suggested.

1. INTRODUCTION

After the relation between syrphid flies of the *Melanostoma-Platycheirus* (M–P) group and *Plantago lanceolata* had been studied in the Netherlands (Stelleman & Meeuse, part I of this series), the possible role of these syrphid flies as effective pollinators of other species of *Plantago* seemed a promising field of study. In particular the species *P. media*, which to our human senses appears to be more attractive than *P. lanceolata* both optically and olfactorally, seemed a suitable object, the more so since a great many insect visitors have been recorded on *P. media* (see KNUTH 1899 and KUGLER 1970).

The opportunity arose when Professor Neubauer and Professor Weberling of the botanical institute of the University of Giessen invited us to study the pollination ecology of this species in the Giessen area. We arrived in the area when the flowering period of *P. media* had not reached its peak and stayed until in some sites flowering was over or the grass had been mowed for hay-making and the flowering spikes were cut off.

It was decided to carry out a survey of the distribution and relative frequency of syrphid flies of the M-P group in Upper Hessia and to study populations of *Plantago media* more thoroughly in a few selected, favourable sites near Giessen.

2. DISTRIBUTION OF PLANTAGO MEDIA AND SYRPHID FLIES OF THE MELANOSTOMA-PLATYCHEIRUS GROUP IN UPPER HESSIA

The region of Upper Hessia was surveyed by car in a broad and more or less E.W.-oriented strip of country from the Westerwald in the W. through the Wetzlar and Giessen area and the Vogelsberg to Steinau in the E. It appears that in all suitable sites where the soil is loamy and sufficiently alkaline, the stands of

vegetation are not too dense and the terrain is not of hardly shaded, *P. media* can be found. These sites include roadsides, waste land, lawns, and hay fields.

The syrphids were surveyed by selective collection in suitable sites (partly by swishing with an insect net), and also by observations of specimens on inflorescences of Umbelliferae, grasses, *Plantago*, etc. Leaving all rare species out of consideration, it can be said that the species of *Melanostoma* and *Platycheirus* visiting *Plantago lanceolata* in the Netherlands, with the possible exception of *Platycheirus fulviventris* Macquart (which was not seen at all), occur in the area of Hessia surveyed. Some species which are rarer (or absent) in the low-lying parts of western Holland such as the Naardermeer area, were plentiful in some sites in Hessia: *Melanostoma scalare, Platycheirus scutatus*, and *P. manicatus*. We believe that all species, *Platycheirus scutatus* perhaps excepted, have a similar pattern of anthophilous behaviour.

A survey of the distribution, habitat etc. of the principal species, as recorded by the present authors, is shown in *table 1*.

Both our field records and observations and our collected material indicate that *Melanostoma mellinum* is the most common and most frequently occurring species in the whole area; all other species were always found in appreciably lower numbers.

It can be concluded from our observations that most of the species of the M-P group behave rather similarly and frequently ingest the pollen of grasses such as

Species	Wide spread	Local	Habitat	Remarks
Melanostoma mellinum (Linnaeus)	+	-	meadows, road sides, forest edges	especially found on anemophiles, but also on entomophiles
<i>M. scalare</i> (Fabricius)	÷	_	as above, but mostly near low scrub vegeta- tion and forest edges	as above
Platycheirus clypeatus (Meigen)	_	+	open places near water	on anemophilous flowers
P. angustatus Zetterstedt	_	+	as above	predominantly on anemophiles
P. scutatus (Meigen)		+	along forest edges	found on, e.g., Umbelliferae; sucks nectar
P. manicatus (Meigen)	+	_	open sites	relatively rare, occasionally found on entomophilous flowers

Table 1.

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Alopecurus pratensis, Arrhenaterum elatius, Dactylis glomerata, Festuca rubra, Glyceria spec., and Helictotrichon pubescens, of Plantago lanceolata, of some Umbelliferae such as Aegopodium podagraria, Anthriscus sylvestris, Chaerophyllum hirsutum, C. temulum and Heracleum sphondylium, and occasionally also of other species (species of Epilobium, Ranunculus, and Rubus; Sanguisorba minor). It is very probable that the species visiting Umbelliferae sometimes also ingest nectar. This was repeatedly ascertained in the case of Platycheirus scutatus visiting Chaerophyllum temulum. This syrphid sucks up the nectar exuded by the floral disk, the anthers remaining untouched. It has been established in a study of digestive tract contents in the Netherlands, however, that this species also consumes the pollen of a wide variety of entomophilous flowers (VAN DER GOOT & GRABANDT 1970).

This species of syrphid has been recorded as preferring woodland as a habitat and we could confirm this in Hessia. Its different ecology renders it highly improbable that it could ever be an important pollinator of plants whose flowers only offer pollen as food and no nectar at all (such as most grasses, *Plantago*, etc.).

From our survey it could be concluded that in most, if not in all, sites where *Plantago media* occurs a sufficient quantity of syrphids of the M-P group is present. For the more detailed studies two sites near Giessen were selected, one near Rodheim Bieber and the other one near Klein Linden, where both *P. media* and syrphids of the M-P group were sufficiently plentiful. In both localities also *P. lanceolata* appeared to occur in sufficient quantities to permit a comparison with *P. media* on the one hand, and with some comparable sites in the Netherlands on the other.

3. OBSERVATIONS IN THE FIELD

Apart from many observations in the two selected sites several incidental observations were made elsewhere. The male phase of anthesis of the protogynous *Plantago media* began, under favourable weather conditions, between about 5.00 and 7.00 a.m. As in the case of *P. lanceolata* (see STELLEMAN & MEEUSE, in the press), the temperature seems to be a major external master factor inducing anthesis, the lower critical range being $12^{\circ}C-14^{\circ}C$. The spikes flower in an acropetalous direction, successive "whorls" being produced daily. Between the first appearance of the anthers and the complete anthesis of such a "whorl" lies a period of between about 2 to about 4 hrs. Spikes with a well-developed zone of emerged stamens are, accordingly, already encountered from about 07.00 hrs. In the late morning, dependent on the strength of the wind and of the frequency of insect visits, most of the pollen has been removed from the anthers which assume a shrivelled appearance. The female phase of anthesis precedes the male one by several days but continues basipetally for some time after the male phase of anthesis has begun.

It soon appeared that the flies of the M-P group do not frequently visit *Plantago* media, although they were active on *P. lanceolata* and grasses in close proximity of specimens of *P. media* in anthesis with dehisced anthers. In the course of six mornings, under favourable weather conditions, several groups were continuously kept under close observation by two of us. One of us noted a total of 12 visits by M-P syrphids, but the other one did not record a single visit! The visitors included *Melanostoma mellinum*, *M. scalare*, and *Platycheirus clypeatus*, apart from some unindentified specimens which were not (or could not be) caught. *Plantago media* was frequently visited by numerous other insects including other species of Syrphidae. The accompanying *table 2* gives the recorded visitors of *P*, *media*.

It was striking that *P. media* is not very attractive to syrphids of the M-P group, especially in view of the large number of other insect visitors, some of which were very often noted, such as the muscid *Thricops semicinerea* and the small moth *Micropteryx* spec. The muscid proved to be very numerous in some sites and is one of the first insects to become active in the very early morning, even moving about and feeding before any M-P syrphids are observed. The muscid in question was not recorded in the Naardermeer area in the Netherlands, but in Hessia it was seen actively ingesting pollen of several grasses, such as *Dactylis*, *Helictotrichon. Alopecurus* etc., of *Plantago lanceolata*, and of *P. media* from sunrise to not later than about 10.00 hrs, after which they disappear from the site. There can be very little doubt that *Thricops semicinerea* is an effective pol-

Table 2. Insect visitors recorded on *Plantago* in Hessia.

HYMENOPTERA

Apidae: Apis mellifica, Bombus spec. div., small solitary bees of Andrena, Halictus, and Osmia type.

DIPTERA

Syrphidae: Melanostoma mellinum, M. scalare, several species of Platycheirus (see table 1), Eristalis spec. div., Syrphus spec. div., Sphaerophoria spec., Chrysotoxum spec., Volucella pellucens, Xylotomima lenta, Myiatropa spec. (list probably not exhaustive).

Muscidae: Thricops semicinerea (very early morning only!), Lucilia caesar and various other taxa.

Empidae: (not identified specifically). Scatophagidae: *Scatophaga* spec.

COLEOPTERA

Cantharidae: Malachius aeneus, Rhachonycha spec. Mordellidae: Meligethes spec. Nitidulidae: (not identified specifically). Cerambycidae: Strangalia spec. div., Leptura spec., and several other small species. Oedemeridae: Asclera cyanea. Dasytidae: Dasytes plumbeus.

LEPIDOPTERA Micropterygidae: *Micropteryx* spec.

NEUROPTERA Chrysopidae: Chrysopa spec.

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linator of *P. media* and of a number of grasses. Further observations are clearly indicated.

Several specimens were collected and studied by means of electroscan observations. On various parts of their bodies both pollen of *P. media* and pollen of (unidentified) grasses were observed (in addition to pollen grains of other species such as *Sanguisorba minor*), and in their digestive tracts large quantities of grass pollen were present. *Micropteryx* was seen so frequently on *P. media* and remained ingesting its pollen during the morning for such long periods that it almost certainly also plays a role as a vector of *P. media* pollen. These moths are not very mobile, however, and often remain on the same inflorescence for a long time, so that their possible role in cross-pollination cannot be very important (we did not find any reports on self-incompatibility in *P. media*). Electroscan studies of this species of *Micropteryx* are in progress.

Visits by other kinds of insects (including those recorded by KNUTH 1899, p. 335, and by KUGLER 1970, p. 58) will presumably less often result in an effective cross-pollination for two reasons: in the first place anthesis has progressed long before these (sun-loving) insects become active and an appreciable amount of pollen has been removed from the anthers by earlier visitors and by the action of wind (some of which has already been deposited on stigmas of *P. media* flowers), and, secondly, the visits by such insects often have an incidental character and are not necessarily followed by an immediate visit to another flowering specimen of *P. media*. As regards the Coleoptera among these visitors, they are often not very mobile and remain on the same flowering spike for an appreciable lenth of time (sometimes even spending the night there to start ingesting the same inflorescence the next day). There is, however, a certain overlap between the visiting period of M-P syrphids and of *Thricops* and of that of the more heliophilous insects, so that the effectiveness of the latter as pollen vectors is not necessarily negligible.

Finally, some space will be devoted here to the relative frequencies of the visits to the different pollen producers. The inflorescences of *P. lanceolata* are clearly much more frequently visited by syrphids of the M-P group than those of *P. media*. Nevertheless appreciable differences in the number of visits to *P. lanceolata* were noticed even if the weather remained favourable for several consecutive days. Since potential sources of pollen for feeding are numerous at the sites (particularly grasses), the fluctuations may conceivably be attributable to the degree of correlation between the commencement of the anthesis of the various pollen-producing species and the time when the flies start moving about, apart from differences in wind velocity (lesser or greater loss of pollen by wind action in grasses, etc.). The first two phenomena are in their turn affected by the prevailing weather conditions, but not always in the same way (when the sky is overcast or when it rains, grass flowers often do not even open at all, whereas M-P syrphids are active nonetheless).

4. TRANSLOCATION OF PLANTAGO MEDIA TO THE NAARDERMEER AREA IN HOLLAND

After having returned to the Netherlands, a number of spikes of specimens of P. media taken with us from Hessia were used for some experiments in the Naardermeer area where *P. media* does not occur (it is absent in by far the largest part of the western Netherlands, for that matter). In the Naardermeer nature conservancy relatively rich populations of some M-P syrphids occur which predominantly ingest P. lanceolata pollen (STELLEMAN & MEEUSE, in the press). The purpose of the experiments was to ascertain whether in an area with a relatively great population density of these flies fresh inflorescences of P. media are visited by these flies and, if so, to what degree. To this end a small number of P. media spikes in anthesis were placed between two well-visited groups of P. lanceolata inflorescences in a suitable stage of male anthesis. From previous observations it had become known that these flies during ingesting usually fly from one group of inflorescences to another, and as a rule in the upwind direction. This was accounted for in the experimental set-up, so that after a visit to a downwind group of P. lanceolata inflorescences they would necessarily encounter spikes of P. media in their upwind flight.

During two consecutive mornings and during the period of ingesting activity of the M-P syrphids such experiments were made. Disrogarding any details, the results were as follows:

1 st day – about 70 individuals passed 9 introduced spikes of P. media; in 13 cases a short flight towards such a spike was observed, but the fly continued its flight almost immediately.

2nd day -2 spikes of *P. media*, one of which at a distance of about 5 cm from an inflorescence of *P. lanceolata*, drew the attention of 4 flies (out of 55 that passed along) as against 11 that took interest in *P. lanceolata* of which 6 times resulted in a landing.

The obvious conclusion is that *P. media* is not of any importance as a source of pollen for M-P-syrphids in the given situation, and that the inflorescence hardly functions as a signal. Some other Syrphidae (*Helophilus pendulus*, *Sphaerophoria scripta*, and *Syrphus balteatus*) visited spikes of *P. media* during the experiments to consume pollen for a short time.

5. CONCLUSIONS

The results of our observations revealed, contrary to expectation, that the role of syrphid flies of the MP-group as pollinators of *Plantago media* is insignificant. The number of visits is so low as compared with those to *P. lanceolata* and certain grasses that it was not deemed useful to attempt a demonstration of a pollen transfer (STELLEMAN & MEEUSE, in the press). Even after a visit of such a fly to a spike of *P. media* it is most unlikely that the next visit will be to another spike of the same species.

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The reason why the inflorescences of *P. media* appear to be unattractive to syrphid flies of the MP-group can be ascribed to an inadequacy of the optical appearance or the scent of these inflorescences, but in view of the frequent visits by other insects including several syrphids this does not seem to be so acceptable. Experiments in which inflorescences of *P. media* were placed in close proximity of those of *P. lanceolata* show that the M-P syrphids may become more interested in the former, but after a brief visit to a *P. media* spike soon abandon it and move away again. One can only assume that it is not attractive to these flies for some rather trivial reason, but not because the inflorescence is unattractive or the pollen uneatable. Our observations suggest that it is perhaps the greater length and lesser stiffness of the filaments of *P. media* (as compared to those of *P. lanceolata*) which prevents the syrphids from getting a proper foothold on the androecial members of the inflorescence, so that they do not instinctively feel at home and cannot manipulate the anthers so easily to ingest the pollen.

We do not wish to suggest in the least that this is indeed the solution of the problem. More observations and additional experiments to test the correctness of this assumption or to detect a possible different cause are clearly indicated. A drawback is that the inflorescences of *P. media* appear to be so rarely visited by M-P syrphids that sufficient observations and experiments cannot so easily be compiled.

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