

Biology of *Metadelphax propinqua* (Fieber) (Homoptera, Delphacidae)

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The biology of the Turkish *Metadelphax propinqua* population was investigated in Finland. The egg closely resembles that of other delphacids, and the five nymphal instars are distinguished by the characteristics of the legs. The adults were macropters, brachypters or intermediary form. At 22°C the duration of the egg stage was 12 d, that of the nymphal stage 19 d, and that of the female stage 51 d. The average number of eggs was 1112 per female. In the trials the planthoppers oviposited 3.3–3.5 eggs per group in the sheath or blade of the leaf.

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The biology of *Metadelphax propinqua* has been investigated very little. Most notes refer to its distribution and habitats (Metcalf 1943). Its food plants have been studied, however, by Cheo (1935) and Ballou (1936).

According to Metcalf (1943) its injuriousness has been investigated by Shiraki (1910), Willcocks (1922) and Matsumura (1932). We have found that the *M. propinqua* planthoppers collected from Turkey caused considerable injury to barley if transferred to seedling barley plants. We have also tested it on oat, barley and wheat plants, but have never found it to transmit viruses to these plants (Bremer & Raatikainen 1975, Raatikainen, Raatikainen & Vasarainen 1991). The cereal yield losses caused by the toxicity of the saliva have been very small because *M. propinqua* planthoppers very seldom migrated to cereals (Bremer & Raatikainen 1975).

As the species is known to be a pest, we have investigated its ecology in connection with studies on its injuriousness.

Area of investigation and methods

The *M. propinqua* planthoppers were collected from Bornova, Turkey. The investigations were carried out in the years 1969–1970 at Ege University, Izmir-Bornova and in the years 1970–1972 at the Agricultural Research Centre, Tikkurila, Finland. The tests were made in glasshouses.

Planthoppers were reared in PVC cylinders while studies were being made on their host plants, the size of the eggs and egg groups, number of eggs, etc. Usually, one plant was sown or planted in a 6" flower pot, and a cylinder was put around it, 9 cm in diameter and 30 cm tall. The upper end

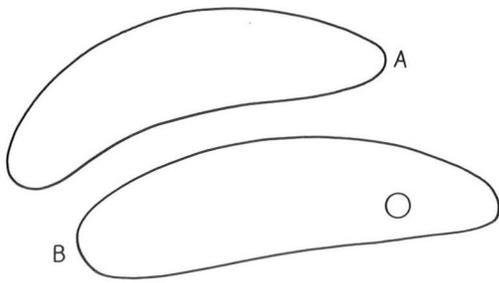


Fig. 1. Eggs one day (A) and seven days (B) old.

of the cylinder, and the two ventilation openings near the bottom were covered with gauze. Planthoppers were moved with an aspirator.

Egg and nymph

The eggs are at first greyish-white and later develop two visible reddish spots at their anterior end (Fig. 1). They have the typical shape of delphacid eggs, oval and slightly curved. Both the length and the breadth of the eggs are smallest when the eggs are young (Table 1). In form they resemble the eggs of *Stiroma bicarinata* (Herrich-Schäffer).

Among the characters distinguishing the nymphal instars from each other, are the length of the femur and tibia of the hind leg and the number of spines on the spur (Table 2).

Dimorphism

Metadelphax propinqua is a trimorphous species. Macropterous adults were more common than brachypterous ones. When *M. propinqua* planthoppers were reared in glasshouses at Tikkurila during the winter and summer seasons, it was found that of the about 5000 adults that were examined, only 5 females were brachypters and one male was a rare third intermediary form. Thus only 0.1% of the nymphs reared in short-day conditions became brachypters.

In the following winter the nymphs were taken for rearing during their second or third nymphal stage. The reared nymphs were given additional illumination from 11 p.m. to 6 p.m., and spending only five hours a day in darkness. In those conditions a total of 399 planthoppers matured and most of them were macropters. Eighteen females and one male were brachypters, however, and one female and one male were intermediary forms. Of this material 4.8% were brachypters and, including the intermediary forms, their proportion was 5.3%.

The results obtained from these rearing experiments suggest that the proportion of bra-

Table 1. Size of eggs (μ) of *Metadelphax propinqua* reared at 22°C. Mean and range.

Age of egg	N	Length		Breadth	
1 day	20	657	576-728	159	144-176
9-10 days	20	805	728-864	194	176-208

Table 2. Length (mm) of femur and tibia of hind leg and number of spines on spur of nymphs and adults of *M. propinqua*. Mean \pm SE, range.

	N	Femur		Tibia		Spines on spur	
1st instar	20	0.14 \pm 0.002	0.12-0.16	0.18 \pm 0.003	0.15-0.20	1	1-1
2nd instar	14	0.19 \pm 0.002	0.17-0.20	0.24 \pm 0.003	0.22-0.25	1	1-1
3rd instar	25	0.26 \pm 0.004	0.23-0.30	0.32 \pm 0.005	0.28-0.37	2.7 \pm 0.16	2-5
4th instar	32	0.36 \pm 0.005	0.31-0.43	0.44 \pm 0.005	0.39-0.50	9.9 \pm 0.28	7-13
5th instar	19	0.49 \pm 0.007	0.43-0.53	0.60 \pm 0.008	0.54-0.65	16.7 \pm 0.37	15-21
Male	10	0.62 \pm 0.009	0.59-0.68	0.78 \pm 0.010	0.73-0.84	23.0 \pm 0.47	21-26
Female	10	0.68 \pm 0.013	0.63-0.73	0.83 \pm 0.015	0.73-0.90	23.6 \pm 0.64	21-26

chapters is greater among adults of *M. propinqua* planthoppers reared in long-day conditions than among those developing in short-day conditions. This finding should, however, be experimentally confirmed.

Life cycle

In order to determine the duration of the egg stage, planthoppers were allowed to oviposit for 24 hours in barley leaves in the glasshouse. Observations on hatching were made every morning between 8 and 9 a.m. The time elapsing between the deposition of egg groups and the hatching of the first egg was the minimum incubation period. At 22°C it was about 1.5 days less than the average incubation period, as seen from the following data on the daily number of nymphs hatched during the days after hatching of the first egg in the egg group:

Days	0	1	2	3	4	5
Hatched	154	71	18	3	3	1

At 22°C in the glasshouse, the average duration of the egg stage was nearly 12 days. The duration of the egg stage in trials carried out at constant temperatures is presented in Fig. 2. For *M. propinqua* eggs, the equation was

$$d = 106.6 / (t - 11.9),$$

in which *d* = egg period in days, *t* = temperature during the egg period, 11.9 temperature of no development, and 106.6 a calculated constant.

At 22°C in the glasshouse, the average duration of the nymphal stage was about 19 days. The number of hatched adults at day intervals following emergence of the first adult was as follows:

Days	0	1	2	3	4	5
Hatched	8	4	20	2	1	—
Days	6	7	8	9	10	11
Hatched	—	2	—	—	1	5

The nymphal period was about the same length for males and females.

At a temperature of about 22°C, in the glasshouse the mean life span of 8 *M. propinqua* females was 51 (32–61) days. The pre-oviposition period was 4 (1–5) days, the oviposition period 44 (27–54) days, and the postoviposition period 3

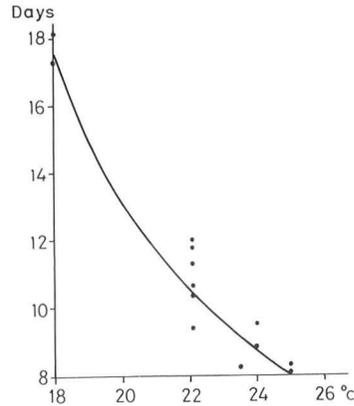


Fig. 2. Incubation period of eggs of *M. propinqua* at different temperatures.

(0–11) days. The average life span of the male was shorter than that of the female.

At about 22°C, the total duration of the developmental period of the immature stages + the pre-oviposition period averaged 35 days and that of the immature stages + the pre-oviposition period + the oviposition period averaged 79 days. *M. propinqua* is thus multivoltine and it is possible that the number of generations/year is 3–10.

Host plants

M. propinqua adults have been reared in the glasshouse for more than 10 days on *Triticum aestivum* L., *Hordeum vulgare* L., *Avena sativa* L., and *Lagurus ovatus* L. They also live on *Digitaria sanguinalis* (L.) Scop., *Zea mays* L., *Bromus* sp., *Lolium multiflorum* Lam., *Elymus farctus* (Viv.) Runemark ex Melderis, and *Agropyron cristatum* (L.) Gaertner. All the adults died in 10 days on *Spergula arvensis* L., *Trifolium pratense* L., *Lamium hybridum* Vill., *Capsicum annum* L., *Sonchus arvensis* L., *Taraxacum* sp. and *Chrysanthemum* × *morifolium*. It thus appears that *M. propinqua* is able to live on numerous different grasses.

On the young barley plants, the nymphs (*n* = 121) were mainly (83%) on sheaths and fairly rare (17%) on blades. On the young oats, they

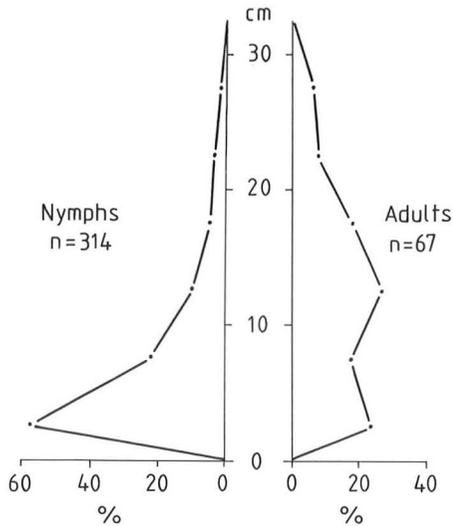


Fig. 3. Height above the ground of *M. propinqua* nymphs and adults on spring cereals.

($n = 110$) were fairly frequent on both sheaths (52%) and blades (48%). When they were found on the blades, they were usually on the basal part.

The adults ($n = 53$) on the young barley plants were very frequent (83%) on sheaths and fairly rare (17%) on blades.

On barley and oats the nymphs of *M. propinqua* were situated in the lower part of the plants (Fig. 3). According to a test, more than half of the nymphs remain at a height of less than 5 cm. The adults were higher in the plants than the nymphs.

Oviposition

The adults taken three days after emergence from the barley congregated in groups, and most of the planthoppers were in groups. The groups contained 2 to 5 planthoppers each (mean 3.3), and most of the groups consisted of both sexes. At this stage the leafhoppers copulated.

The oviposition of eight females was studied in the glasshouse at average temperature of 22°C (19–31°C) on barley plants (Fig. 4). At first the number of eggs laid daily was 24, but it rose to a maximum, which averaged 39 eggs per day, and thereafter slowly declined.

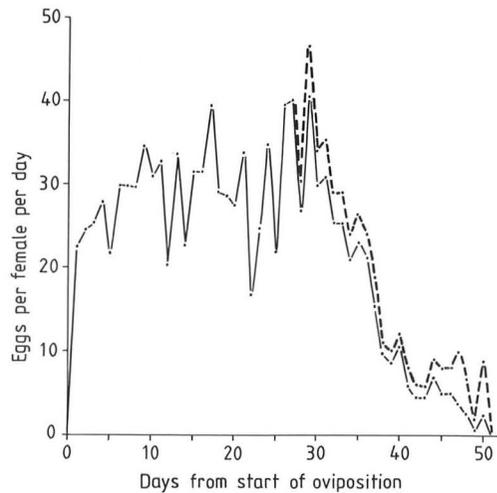


Fig. 4. Oviposition of eight *M. propinqua* females in the glasshouse on 10 May – 30 June, 1970. Broken line = average fecundity per surviving female. Continuous line = average fecundity per female.

It has been demonstrated that females are capable of reproducing on *Lagurus ovatus*, *Triticum aestivum*, *Hordeum vulgare* and *Avena sativa*.

The number of eggs per female in the barley was studied by means of PVC cylinders. The average number of eggs laid by 8 females was 1112 (746–1516). There were positive correlations between the life-span and the oviposition period ($r = 0.856$, $P = 0.007$) and between the oviposition period and the total number of eggs laid by the female ($r = 0.844$, $P = 0.008$).

In the trials the planthoppers oviposited in the sheath or blade of the leaf. The size of *M. propinqua* egg groups on barley and oats was determined in experiments carried out in the glasshouse. On the average, there were 3.3 eggs per group in barley sheaths and 3.5 eggs in the barley blades (Fig. 5). In the oat sheaths there were on the average 3.1 eggs per group (341 eggs and 111 egg groups) and in the oat blades the average was also 3.1 (963 eggs and 309 egg groups).

Discussion

Many researchers have investigated the dimorphism of delphacids. Kisimoto (1956a, 1956b)

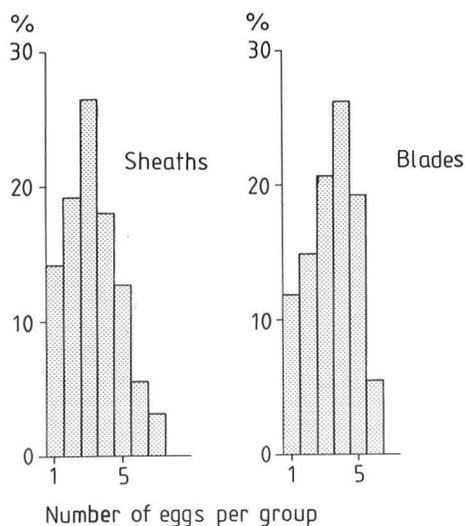


Fig. 5. The size of egg groups in the sheaths and blades of barley. A total of 1889 eggs and 572 egg groups were examined in the sheaths and 704 eggs and 202 egg groups in the blades.

found, that in the case of males of *Nilaparvata lugens* (Stål), the proportion of brachypters rose as the density increased to five per test-tube and subsequently diminished when the density increased still further. Raatikainen (1967) found in the field, that the proportion of brachypterous *Javesella pellucida* (Fabricius) decreased as the population density of *Javesella* increased.

Sahlberg (1871), Kontkanen (1947) and Raatikainen (1967) reported that in Finland the proportion of brachypterous planthoppers increased towards the north. Johno (1963) demonstrated that the temperature and daylength affect the proportion of brachypterous specimens of *Nilaparvata lugens*. The abundance of brachypters among the *Metadelphax propinqua* species may be caused by the same factors.

M. propinqua has a long life span and a long oviposition period. As the daily number of eggs is also great, the total number of eggs is greater than in any other planthopper studied (DeLong 1971). This is evidently favourable characteristic for a

species which in the summer lives in or near areas that can be classified as arid.

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