CONTARINIA MALI N. SP. THE APPLE BLOSSOM MIDGE, WITH NOTES ON THE MORE COMMON GALL MIDGES ATTACKING APPLE AND PEAR.

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1. The Apple Blossom Midge.

Through the courtesy of Dr. HIROHARU YUASA of the Imperial Agricultural Experiment Station, Nisigahara, Tôkyô, the writer has been able to examine specimens of the *Contarinia* species which Mr. C. TANABE has recently studied (J. Plant. Prot., 23, 1936, 509~18 and 596~604).

The conclusion is reached that the Apple Blossom Midge is new to science and it is described below as *Contarinia mali* n. sp. The colours are from balsam mounts.

C. mali n. sp.

Male. Length 2~2¼ mm. Antennae: typical *Contarinia* structure, 2+12, slightly longer than the body; 1st and 2nd flagellar segments fused; stem of 3rd flagellar segment about twice as long as broad, neck slightly longer, about the same width; stem of 10th flagellar segment slightly narrower than that of 3rd but the same length, about two and a half times as long as broad, neck slightly longer, about the same width; 12th flagellar segment with small distal prolongation. Palpi: proximal segment nearly twice as long as broad; second slightly longer and distinctly broader; third about twice the length of the proximal; distal slightly longer than the third, nearly three times the length of the first; distal three segments about the same width. Thorax dark brown. Wings clear, 3rd vein reaching margin just beyond apex of the wing. Legs paler, claws simple, empodium nearly as long as claws. Abdomen medium brown. Genitalia: basal clasp segment about twice as long as broad, medium brown; distal clasp segment paler; dorsal lamella small, deeply emarginated, each lobe about as wide as long, with a few setae distally, not so blunt-ended as in *pyrivora* RILEY; ventral lamella nearly twice as long as dorsal, each lobe narrow, about four times as long as wide, distinctly narrower than in *pyrivora* RILEY, widely separated; style narrow and pointed, about as long as ventral lamella.

Cotypes, Cecid. 3251~3 and 3392~8 inclusive.

Female. Length 2½~3 mm. Antennae: 2+12, first and second flagellar segments fused, 1st flagellar segment is three to four times as long as wide, 2nd about two to two and a half times as long as wide, (in *pyrivora* RILEY the 1st is about five times as long as wide, the 2nd about 3 times as long as wide), 3rd flagellar segment shorter, about twice as long as wide; neck on basal segments very transverse and short, on distal segments longer, about as long as wide; distal prolongation of 12th flagellar segment not so distinct as in *pyrivora* RILEY. Palpi: about as in male. Thorax dark brown. Abdomen paler. Ovipositor very extensile, aciculate. Otherwise about as in male.

Cotypes, Cecid. 3254~6 and 3399~3406 inclusive.

Note. Cotypes Cecid. 3253, 3393, 3399, and 3404 have been returned to Dr. YUASA for deposition in the collection of the Division of Entomology, Imperial Agricultural Experiment Station, Nisigahara, Tôkyô. The remaining cotypes are in the BARNES Collection.

The species is a large *Contarinia*, very similar to *Contarinia pyrivora* RILEY, the Pear Midge. It has been compared in detail with specimens of the latter midge from Norfolk, England (males, Cecid. 2735~42, 3072~3: females, Cecid. 2743~9, 3074~5) and from Caernarvonshire, Wales (males, Cecid. 3592~3: females, Cecid. 3594~5). The main points of difference are as follows:—The Apple Blossom Midges are slightly smaller in general size; their wings are slightly narrower; in the male, and to a lesser degree in the female, the distal prolongation of the terminal flagellar segment of the antennae is not nearly so pronounced as in the Pear Midge; in the female the necks of the basal flagellar segments of the antennae are more transverse and much shorter than in the equivalent segments of the Pear Midge; and in the latter species the first flagellar segment in the female is longer than in the Apple Blossom Midge. Differences in the male genitalia can be seen by reference to the technical description.

This midge was first discovered in 1926 in the Nagano Prefecture. It has one generation a year, the adults emerging in late March or early April. The males live 3~10 days and the females 4~27, the latter beginning oviposition 3~10 days after emergence. The eggs are laid in the flower buds of apple and the larvae hatch in 12~15 days. About 45 larvae are found in each flower bud and are fully fed in about 15 days. The infested buds which are swollen remain closed, the petals becoming thick and spotted with a dark pink. The larvae leave the buds for the top inch or so of the soil towards the end of May. The prepupal stage lasts about 140 days, while pupation takes place in late September and lasts about 190 days. Handpicking the infested buds has been recommended as a control. Alternatively or additionally intensive cultivation for several weeks at the end of May and in June and again in the spring might be suggested, as might also allowing poultry free range under infested trees at the same periods of the year.

2. Notes on some other gall midges attacking Apple and Pear.

The more common gall midges attacking Apple and Pear can be conveniently grouped according to the part of the plant the larvae damage.

A. Bud usually on terminal twigs.
  Woody plurilocular rounded gall.
    I. Pear .....1. *Apiomyia bergenstammi* (WACHTL).

B. Terminal Leaves.
  Rolled margins.
    I. Apple.....2. *Dasyneura mali* KIEFFER.
    II. Pear .....3. *Dasyneura pyri* (BOUCHÉ).

C. Flower Buds.
  Remaining closed.
    I. Apple.....4. *Contarinia mali* BARNES.
    II. Pear .....5. *Contarinia pyri* TAVARES.

D. Fruit.
  Young fruitlets swollen.
    I. Pear .....6. *Contarinia pyrivora* (RILEY).

E. Grafts.
  Between scion and stock.
    I. Apple.....7. *Thomasiniana oculiperda* RÜBSAAMEN.
    II. Pear .....7. *Thomasiniana oculiperda* RÜBSAAMEN.

1. *Apiomyia bergenstammi* (WACHTL) (1882). The distribution of this species is apparently limited to the countries adjoining the north eastern part of the Mediterranean, there being records of its occurrence in Italy, Corfu, Greece and Syria. The adult midges emerge between the middle of March and mid-April and the females lay about 60 eggs. The galls, in which the larvae subsequently overwinter, first appear in August. They are distinctly woody and several larvae live in separate cells in each gall (Fig. 1). Besides attacking *Pyrus communis*, this species is recorded from *P. salicifolia*.

2. *Dasyneura mali* KIEFFER (1904), the Leaf Curling Apple Midge. This species is on record from France, Germany, Italy and England in Europe and recently (1928) it has been found as a pest in north-eastern Massachusetts and south-eastern New Hampshire, U. S. A. Little definite information is available regarding its biology in Europe where it has attracted small attention as a pest. In America it has four generations a year, the larvae of the first being found between May 20th and June 25th, those of the second from June 30th to August 1st, those of the third from August 15th to September 1st and those of the fourth from September 20th to October 5th. The eggs are laid in the unfolded leaves which remain rolled up. These rolls become reddish and finally blacken when the larvae are full grown and are about to leave them for the soil where they pupate. Usually

Fig. 1. Galls of *Apiomyia bergenstammi*.

about 17 larvae are found in a leaf but as many as 131 larvae have been recorded by W. D. WHITCOMB who has studied the midge in the U. S. A. Stunted growth results from the curled leaves which occur on the terminal shoots and watersprouts and, as attacks are usually confined to young vigorously growing trees, the damage can be severe. Summer pruning, cultivation and soil insecticides can be used to supplement the work of its natural enemies.

3. *Dasyneura pyri* (BOUCHÉ) (1847), the Leaf Curling Pear Midge. This species, which is closely allied to the preceding species, is generally distributed throughout Central, Northern and Western Europe. It has also been a serious pest in New Zealand since about 1920 and more recently, 1929 onwards, it has appeared in Connecticut and New York State, U. S. A. In England this midge has three to four generations a year, in Italy six and occasionally seven and in New Zealand there are at least six. The eggs are laid in the folds of the young leaves as soon as they burst from the bud. The larvae, which usually number 35 per leaf, but 88 have on occasion been found, hatch in a few days and owing to their feeding activities and the lateral growth of the leaves the latter never uncurl (Fg. 2) and so a tube is produced on each side of the mid vein. These become red and finally blacken when the larvae have completed their growth. Some larvae pupate in the leaves while others descend to the soil. The overwintering larvae all pupate in the soil. The flights of the midges take place as follows in England, the first between April 11th and June 24th, the second June 4th to July 28th, the third July 8th to September 13th, the fourth August 15th to October 15th and the fifth September 29th to October 13th. There is considerable overlapping. Considerable damage to nursery stock and

grafts often results from infestations. Soil insecticides, such as calcium cyanide, spraying with nicotine and naphthalene and nicotine and soft soap against the adult midges and dusting with lime-sulphur against the eggs have all been tried with a certain amount of success. In addition, fairly successful attempts at biological control by introducing *Misocyclops marchali* into New Zealand have been made but this parasite did not exert the degree of control which had been hoped.

Fig. 2. Galls of *Dasyneura pyri*.

4. *Contarinia mali* BARNES (1939), the Apple Blossom Midge. This species is apparently confined to certain limited areas in Nippon. The only information available has been provided by TANABE whose papers have been abstracted earlier in this paper. The damage is serious as it prevents the fruit from setting.

5. *Contarinia pyri* TAVARES (1922), the Pear Blossom Midge. This white species, which was described from Spain is much smaller than the previous one, being only 1.3 mm. in the male and 1.6 mm. in the female. The larvae live gregariously in the blossom of *Pyrus communis* (PIRASTER). They pupate in the soil and the adults appear in early March the following year. There are as yet no records of *C. pyri* being a pest.

6. *Contarinia pyrivora* (RILEY) (1886), the Pear Midge. This is the most serious pest. Its range extends throughout Europe and it is well known in the fruit areas in the U. S. A., notably New Jersey and the Hudson valley. There is only one generation a year although some authorities have recorded a partial second flight of midges in the late summer. The adult midges in England emerge from the soil in late March and early April. The females lay their eggs in the young blossom buds as soon as the sepals swell and separate leaving small crevices between them. The ovipositor is inserted in these crevices and the eggs are laid inside the blossom without actually puncturing the petals. Twenty to thirty eggs are deposited inside each blossom. By time the blossom opens the larvae have worked their way into the young fruit. These swell more rapidly than unattacked ones, sometimes becoming

round, at others irregular in shape. The larvae eat out the centre of the fruitlets which blacken internally and finally become hollowed out. They crack and fall to the ground. The larvae leave the fruitlets for the ground where they aestivate and pass the winter. This movement to the soil is completed from the end of May to the end of June. The damage to the crop is often very considerable. The removal and burning of attacked fruitlets to be effective must be done before the larvae have left them. Intensive cultivation for several weeks, after the larvae have reached the soil has been practised on occasion with success particularly in dry summers, in England. Allowing poultry free range in infested orchards has also helped in keeping the numbers of midges down. Spraying with nicotine when the flowers are in full bloom has also been successful. Soil insecticides, such as calcium cyanide, have been used but are more successful when only isolated trees are infested. Besides attacking *Pyrus communis* this species is also recorded from *P. salicifolia*.

7. *Thomasiniana oculiperda* (RÜBSAAMEN) (1893), the Red Bud Borer. This species is recorded from Germany and England. Usually it occurs as a pest of grafted roses but it also attacks other Rosaceous plants and has been known to destroy grafted pears in Germany and grafted apples in England. The larvae live between the grafted bud and the stock and prevent the two from fusing. In England three generations have been known to occur in some years on roses, the first flight being on the wing during the latter part of May and nearly all June, the second in July and early August and the third in late August and September. Oviposition will not take place on healthy shoots of roses but only in artificial or natural cracks and slits in the stems such as occur when grafting has taken place or when thorns have scarred the stems. Considerable loss owing to the failure of grafts has frequently occurred. To control this midge it is necessary to prevent the females ovipositing in the grafts and this can be done successfully by covering them with vaseline (petroleum jelly) or tying them up with woollen thread soaked in turpentine and naphthalene and dried before use. In the case of low growing rose trees it is adequate to earth up over the grafts.

In addition, there are several midges from pear on record from Nippon which have not yet been identified. Mr. TADAO OKADA (Ins. World, 2, 1918, 14) recorded a midge attacking pear in Honsyû (on the Mainland), while later M. YAGO (J. Plant. Prot., 16, 1929, 21) also reported another midge doing similar damage at the same place. OKADA's midge is separable from YAGO's midge in that the former has patched wings.

Recently, T. AOYAMA (Rep. Jap. Ass. Adv. Sci., 13, 1938, 473～6) has reported a *Diplosis* species attacking pear in Korea. This species has two generations a year, the adults emerging in early May and again in August. It overwinters in the soil. The spring females lay 5～13 eggs in the young

pears in May, causing them to fall. Pupation takes place in the soil in mid-July. The summer females oviposit in the leaf stalks and the larvae bore in the fruit buds near the stalks and they become fully fed in late September. Three to twelve larvae occur in a bud. It is very much hoped that the opportunity of examining some specimens of this midge will be given to the writer of the present article. This species may turn out to be *Contarinia pyrivora* RILEY.

I am deeply indebted to Dr. HIROHARU YUASA for giving me particulars concerning the midges which have been recorded from Nippon.

訂　　正

卷　號　頁　行	誤	正
第13卷第2號　77頁第24行	*Aleyrodes taiheisanus*	*Aleyrodes taiheisana*
〃　〃　80頁第20行	*Taiwanaleyrodes montanus*	*Taiwanaleyrodes montana*