JOURNAL OF PLANT PROTECTION RESEARCH Vol. 50, No. 4 (2010)
DOI: 10.2478/v10045-010-0082-5

SHORT-TERM FORECASTING AND MONITORING OF LEAF MINERS (AGROMYZIDAE) AND LEAF BEETLES (*OULEMA* SPP.) ON WINTER WHEAT

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Received: August 20, 2010
Accepted: October 26, 2010

Abstract: One of common cereal pests in Poland are flies of the Agromyzidae family. The larvae of these flies is the stage which is harmful. Leaf miner larvae feeding on the leaf parenchyma cause characteristic damage (mines). Their widespread occurrence contributes to a reduction in leaf assimilation surface. Leaf miner larvae mostly damage first-flag and second leaves. Their damage has a negative effect on the yield parameters. Locally they cause losses of economic significance. The flight of leaf miner imagines coincides with the development of leaf beetles (*Oulema* spp.), another dangerous cereal crop pest.

The aim of the conducted research was to determine the optimum time for chemical treatment of leaf mining flies and leaf beetles as part of integrated cereal protection. To achieve that aim, field experiments were conducted in the years 2008–2009 at the Research Station for Variety Testing in Słupia Wielka (the county of Środa Wielkopolska) using winter wheat of the Bogatka variety. Values monitored included the dynamics of flight for leaf mining flies along with the speed of leaf beetle development. The accuracy of the suggested dates was measured by the quantity of the yield obtained. Additionally, the species composition of Agromyzidae damaging winter wheat was also analyzed.

During the years of the research, the biggest yields were obtained when both pest species were chemically treated during the period when the leaf mining flies were abundant and when the oldest leaf beetle larvae reached the size of about 2 mm (in the year 2008) and about 4 mm (in the year 2009). It was also determined that the species composition of Agromyzidae damaging winter wheat changes between particular years.

Key words: leaf miners, Agromyzidae, cereals, warning system, winter wheat

INTRODUCTION

In Poland about a dozen species of leaf miners occur on cereal and locally they might occur in high abundance (Walczak 1995). Those leaf miners include flies belonging to the Agromyzidae family. The species are very similar to each other and identification is sometimes possible only based on the male genital structure (Beiger 1989, 2004). Damage done by the miner larvae reduce the quality and quantity of yields. Research regarding chemical treatment of these pests has shown that one good practical method of short-term forecasting might be monitoring the flight dynamics of adult leaf miners caught on yellow sticky traps (Walczak *et al*. 2009), while at the same time making observations regarding the development of leaf beetles (Walczak 1998).

The first aim of the research was short-term forecasting of chemical treatments against leaf miners and leaf beetles. The next aim was to evaluate the accuracy of the suggested treatments based on the quantity of the yield obtained. The final aim was to determine the most abundant species of leaf miners.

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MATERIALS AND METHODS

In the years 2008–2009 field experiments were conducted at the Research Station for Variety Testing Słupia Wielka (the county of Środa Wielkopolska) using spring wheat of the Bogatka variety on 1x15 m plots. The experiments were repeated four times for four combinations – three dates for chemical treatments against leaf miners and leaf beetles, as well as a control one. To determine the dates of the treatments, it was necessary to catch adult flies. The researchers used yellow 25x40 cm sticky traps placed on three control plots to catch the adults. The traps were attached to stakes so that they were right above the crops. All traps were replaced once a week. The average number of flies caught in the three traps was calculated. At the same time, a visual inspection of the development of leaf beetles was also conducted and stages of development of leaf beetles at particular times were recorded.
The dates were determined using the following criteria:

– the first treatment: based on a visible increase of the abundance of flies caught on the yellow traps and after the occurrence of beetles, and eggs of leaf beetles was recorded,

– the second treatment: during the period of further abundant flights of leaf miners, with the oldest leaf beetle larvae reaching the size of about 2 mm (Walczak 1998),
– the third treatment: during the period when the flights of leaf miners were still abundant, with the oldest leaf beetle larvae reaching the size of about 4 mm.

The efficiency of treatments conducted on dates determined according to the above criteria was evaluated based on the quantity of the yield obtained within each combination.

The treatments were conducted using the Dimezyl 400 EC (2008) and the Bi 58 Nowy 400 EC (2009) with a dose of 0.5l/ha.

To determine the abundance of leaf miners on experimental plots, and selected wheat plantations located in the proximity of the experiments in May, leaves with visible larvae or pupa inside were collected for breeding. The collection enabled the researchers to obtain imagines. Mines on the winter wheat leaves which were typical for particular species were identified using a key (Beiger 2004). In addition, the species identification was conducted based on the male genitalia (Beiger 1989).

RESULTS AND DISCUSSION

Catching of leaf mining flies in the year 2008 was conducted between April 14th and June 16th, and in the year 2009 between April 20th and June 22nd. In 2008, the maximum number of flights was observed on May 10th, while in 2009, on May 25th (Fig. 1).

Based on the number of caught flies and observations regarding the development of leaf beetles, it was possible to determine the dates of treatments against both pests

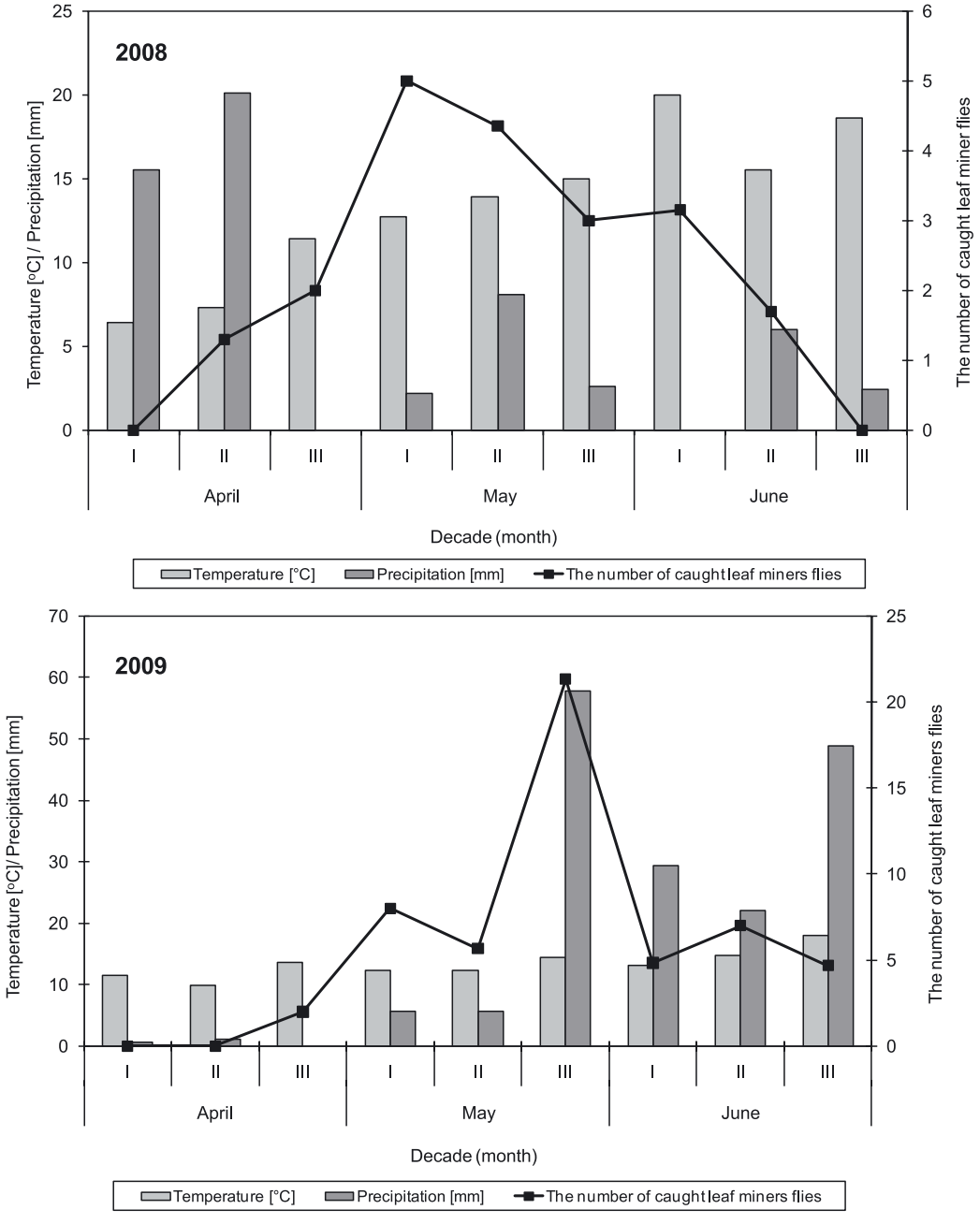

Fig. 1. Leaf miners flies in Słupia Wielka in local meteorological conditions in 2008 and 2009

(Table 1), as well as assess the quantity of the yield obtained from particular combinations (Table 2).

In 2008 the optimum date for the treatment fell during the period of abundant flights of flies, when the oldest leaf beetle larvae reaching the size of about 2 mm. In 2009 the optimum date for the treatment fell during the maximum flights, of flies when the leaf beetle larvae reaching the size of about 4 mm. The dates of treatments differed only by one day and in both years the biggest yields were obtained. The weather was the factor contributing to the difference in the leaf beetle development during the optimum dates of treatments. In 2009, due to low air and soil humidity, the flights of the flies were delayed, while such conditions were favorable to the development of leaf beetles.

In 2008, a total of 27 winter wheat leaves, with larvae or pupas inside the mines to be bred in a laboratory, were collected. There were 24 specimens bred to the pupa stage, while 21 specimens reached the imago stage. Additionally, from among the miner leaf larvae and pupa collected for breeding, one parasitic Hymenoptera also reached the imago stage (Table 3).

In 2009, a total of 20 winter wheat leaves, with larvae or pupas inside the mines to be bred in a laboratory, were collected. There were 15 specimens which were bred to the pupa stage, while 13 specimens reached the imago stage. Additionally, from among the miner leaf larvae and pupa collected for breeding, one parasitic Hymenoptera also reached the imago stage (Table 3).

In total, 34 specimens of imagines were bred in laboratory conditions. The *Chromatomyia nigra* (Ztt.) species was identified based on the structure of the male genitalia (Fig. 2, 3), while two other species, *Chromatomyia fuscula* (Ztt.) (Fig. 4) and *Poemyza superciliosa* (Ztt.) (Fig. 5), were identified based on morphological features. Those were the dominant species during the years of the research.

It was also discovered that the species composition of Agromyzidae damaging the winter wheat, changes in particular years. The results differ from the results of the previous research (Walczak 1998), where the dominant species were *Phytomyza nigra* (Mg.) and *Agromyza ambiqua* (Fll.).

Table 1. The dates of chemical control of leaf miner flies in 2008 and 2009

Treatments	Dates of chemical treatments 2008	Dates of chemical treatments 2009
Treatment I, when a visible increase in the abundance of caught leaf mining flies occurred and after the occurrence of beetles and eggs of leaf beetles was recorded	May 7	May 5
Treatment II, during the period of further abundant flights of leaf miners, when the oldest leaf beetle larvae reached about 2 mm	May 26	May 20
Treatment III, during the period of abundant flights of leaf miners, when the oldest leaf beetle larvae reached 4 mm	June 6	May 27

Table 2. Yields from particular combinations in the years 2008–2009 expressed in dt/ha

Combination	Yield	
	2008	2009
Control	58.0	77.30
1st date of treatment	58.3	80.33
2nd date of treatment	60.8	83.67
3rd date of treatment	59.2	85.33

Table 3. The number of puparium, imagines and parasites bred in laboratory conditions in the years 2008– 2009

Year	Number of leaves collected	Bred to the grub stage	Bred to the fly stage	The number of parasitic *Hymenoptera*
2008	27	24	21	1
2009	20	15	13	1
Total	47	39	34	2

Fig. 2. Male genitalia structure *C. nigra* (Ztt.)

Fig. 4. Winter wheat leaves damaged by larval stage of *C. fuscula*

Fig. 3. Imago of *Chromatomyia nigra* (Ztt.)

Fig. 5. Winter wheat leaf damaged by larval stage of *P. superciliosa*

CONCLUSIONS

1. In the year 2008, the optimum date of the treatment fell during the period of abundant flights of flies, while at the same time the oldest leaf beetle larvae reached the size of about 2 mm. In the year 2009, in turn, the optimum date of the treatment fell during the period of very abundant flights of flies, with the oldest leaf beetle larvae reaching the size of about 4 mm.
2. In 2009, the maximum flights of flies as compared to the development of leaf beetles was a little delayed, possibly due to low soil and air humidity.
3. The dynamics of leaf mining fly flights on the winter wheat plantations typically changes quite a bit, which is why for the purposes of short-term forecasting of treatments against leaf miners and leaf beetles it is necessary to monitor particular plantations.
4. The results of the research enrich our knowledge regarding reducing the abundance and harmfulness of leaf miners and leaf beetles on cereal plantations within the frame of integrated cereal protection.
5. The leaf mining species occurring on winter wheat plantations during the years of the research were *C. fuscula*, *C. nigra* and less abundantly *P. superciliosa*.
6. Based on the research and literature data, the species composition of Agromyzidae damaging winter wheat in particular years varies.

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POLISH SUMMARY

MONITORING MINIAREK (*AGROMYZIDAE*) I SKRZYPIONEK (*OULEMA* SPP.) NA PSZENICY OZIMEJ DLA POTRZEB PROGNOZOWANIA KRÓTKOTERMINOWEGO

W Polsce obserwowane jest powszechne występowanie na zbożach muchówek z rodziny miniarkowatych (*Agromyzidae*), których stadium szkodliwym są larwy. Larwy miniarek, żerując w tkance miękiszowej liści zbóż, powodują charakterystyczne uszkodzenia (miny). Ich liczne wystąpienie przyczynia się do znacznego ograniczenia powierzchni asymilacyjnej liści. Larwy miniarek uszkadzają głównie liście flagowe i podflagowe, co wpływa na pogorszenie się parametrów plonu. Lokalnie powodują straty o znaczeniu gospodarczym. Lot form dorosłych miniarek zbiega się z rozwojem skrzypionek (*Oulema* spp.) także szkodników roślin zbożowych.

Prowadzone badania zmierzały do określenia optymalnego terminu chemicznego zwalczania muchówek z rodziny miniarkowatych i skrzypionek, będącego elementem integrowanej ochrony zbóż. W tym celu w latach 2008–2009 w miejscowości Słupia Wielka (powiat średzki) założono doświadczenia ścisłe z pszenicą ozimą odmiany Bogatka. Monitorowano dynamikę lotu muchówek miniarek i jednocześnie obserwowano tempo rozwoju skrzypionek. Miarą oceny trafności wyznaczonych terminów była wielkość uzyskanego plonu. Ponadto analizowano skład gatunkowy *Agromyzidae* uszkadzających pszenicę ozimą.

W latach badań najwyższe plony uzyskano w przypadku zwalczania obu gatunków szkodników w okresie, trwania licznego lotu muchówek miniarek i jednocześnie osiągnięcia przez najstarsze larwy skrzypionek wielkości około 2 mm (w roku 2008) lub około 4 mm (w roku 2009). Stwierdzono także, że skład gatunkowy *Agromyzidae*, uszkadzających pszenicę ozimą, zmienia się w poszczególnych latach.