HRI's Mission:

To direct, fund, promote and communicate horticultural research, which increases the quality and value of ornamental plants, improves the productivity and profitability of the nursery and landscape industry, and protects and enhances the environment.

Management of Poplar Twiggall Fly on Nursery-grown Aspen[1]

Whitney Cranshaw[2] and Matthew Camper[3]
Department of Bioagricultural Sciences and Pest Management
Colorado State University, Ft. Collins, CO 80523

Abstract

The poplar twiggall fly (PTGF), *Hexomyza schineri* (Giraud) (Diptera: Agromyzidae), makes smoothly rounded galls on current season twigs of aspen that persist and continue to expand into large swellings years after insect emergence. Early season observations noted that adults make feeding puncture wounds in foliage with their ovipositor that are good indicators of early season activity. Oviposition in twigs results in an observable swelling of tissues within days. However, full development of galls does not occur until approximately two months following oviposition. Adults typically were active for a period of about two to three weeks subsequent to bud break and its primary parasitoid, the eurytomid *Eurytoma contractura* Bugbee, was trapped at the end of the PTGF flight period. Efforts to prevent adult emergence by painting galls two weeks prior to adult emergence with either sealants (shellac, polyurethane) or insecticides (imidacloprid, abamectin) did not reduce adult emergence. Soil drench treatments of imidacloprid prior to and immediately following bud break significantly reduced PTGF gall production. High rates of thiamethoxam also provided suppression of galling. Foliar applications tested were ineffective in control of gall production by this insect.

Index words: gall insects, Agromyzidae, *Hexomyza schineri*, imidacloprid.

Chemicals used in this study: imidacloprid (Merit, Marathon, Admire); thiamethoxam (Flagship); clothianidin (Celero); abamectin (Avid); bifenthrin (Talstar); acetamiprid (Tristar); flocanimid.

Significance to the Nursery Industry

The poplar twiggall fly is an unusual gall-making insect of aspen and some other *Populus* spp. It produces a smooth, rounded gall in current season twigs and these swellings continue to develop for many years after the insects emerge. This produces permanant distortions of twigs and branches that severely limit salability. Formerly an obscure insect, it began to greatly increase in incidence in the mid-1980s and damage has steadily spread over a wide area of the Rocky Mountain region of the western United States. Currently it is the key insect pest of nursery-grown aspen in the region and previous efforts to identify consistently effective controls have failed. However, 2004–2005 trials indicate that soil drenches of imidacloprid and thiamethoxam have good potential to control this insect. This report also documents the spring flight of the poplar twiggall fly and its primary parasitoid. Efforts to control the insect with paint-on insecticides and sealants were ineffective.

Introduction

The poplar twiggall fly (PTGF), *Hexomyza schineri* (Giraud) (Diptera: Agromyzidae), is an unusual gall making insect associated with aspen and, less commonly, other *Populus* spp. Formerly an obscure insect rarely observed and largely unstudied, it began to greatly increase in incidence in the Denver Metro area in the mid-1980s. Since that time, damage has steadily spread over a wide area within the Rocky Mountain region of the western United States as well as some areas further east. It is now commonly observed in native forest stands in Colorado and in recent years has emerged as a key insect pest of nursery grown aspen from Idaho to Minnesota.

[1]Received for publication May 3, 2006; in revised form November 17, 2006. This project was supported, in part, by Colorado Agricultural Experiment Station Project 0618.

[2]Professor and Extension Specialist, Email: whitney.cranshaw@colostate.edu

[3]Research Associate, Email: camperma@colostate.edu

The primary injury produced by PTGF is a smooth, nearly spherical swelling on current season twigs — a type of twig gall. However, what is unusual and greatly increases the effects of this insect is that the affected tissues continue to grow and swell for many years, long after the insect no longer is present. The original gall on a small twig becomes a swelling on a branch a few years later. Galls produced on the leaders ultimately become permanent knot-like swellings on trunks.

Original studies by Eckberg and Cranshaw (1) provided an outline of the biology of this insect. However, repeated efforts to control this insect with various foliar treatments have been largely unsuccessful. The objectives of this report are to expand on life history studies and to evaluate insecticides to identify control measures for PTGF.

Materials and Methods

Monitoring early season activity of poplar twiggall fly and its primary parasitoid. Early season activity of poplar twiggall fly and its associated parasitoid, the eurytomid *Eurytoma contractura* Bugbee, were studied in 2002 and 2005 in Ft. Collins, CO. The 2002 study site involved a grove of over 250 mature aspen that had been established over 25 years. The 2005 studies were conducted at a commercial nursery on field grown clumps established from transplanted container-grown seedlings in 2004.

Primary observations were made using colored sticky panels maintained in aspen plantings to monitor flight period. In 2002 traps used were Pherocon AM No-bait traps (Trécé Incorporated, 7569 Highway 28 West, P.O. Box 129, Adair, OK, 74330), previously found attractive to the adult flies (1). In 2005, two trap designs were included, the Pherocon trap along with the neon yellow-green MultiLure trap (Scentry Biologicals, 610 Central Ave., Billings, MT 59102). In both years four traps of each type were maintained and evaluated at approximately weekly intervals. In 2002, trapping was initiated April 23 and concluded June 4; in 2005 trapping was conducted from April 26 through May 31.

Direct gall treatments. Poplar twiggall fly normally pupates within the gall and the adults subsequently emerge through a small opening forced through the thin bark. Although galled tissues will continue to expand for years following exit of the insect, prevention of adult emergence can be useful as a means to reduce oviposition in the subsequent generation. This is sometimes done by pruning out galls before adults emerge, but an alternative technique was tested in 2002 using various direct applications to the gall.

Two treatment approaches were tested. The first examined use of sealants to prevent insect emergence. Two products were evaluated for this use, shellac (Zinsser Bulls Eye Shellac) and polyurethane (MINWAX Fast-Drying Polyurethane) painted directly on the gall. The second approach used concentrates of insecticide with systemic activity. Two insecticides were used, Avid 0.15EC (abamectin) and Admire (imidacloprid) both diluted 1:9 in water and painted directly on the gall. All treatments were applied April 15, approximately 2 weeks prior to initial adult emergence, and ten galls received each treatment. Galls selected to receive treatments were selected among trees throughout the planting in a randomized complete block design. Ten untreated galls served as the control. Evaluation was done by counting emergence holes after the end of the adult flight period in early June.

Insecticide management trials. A series of four insecticide evaluation trials were conducted during 2004–2005 in a drip-irrigated nursery planting of aspen. The site was also used for the 2005 adult monitoring study previously described. Plots involved aspen clumps (usually 3 trees) previously grown in one gallon containers and transplanted to the field in early spring 2004. At the outset of the experiment trees averaged 1.5 to 2 m (5.0 to 6.5 ft) in height, each with an average diameter of ca 2 cm (0.8 in). By the end of the trial in midsummer 2005 trees often exceeded 4 m (13 ft) and cumulative diameter at breast height of 5–7 cm (2–3 in) per clump. Trees were spaced 1.6 m (5 ft) within rows, 3.1 m (10 ft) between rows.

Trials in 2004 involved trees selected by presence of galls from the previous year. In 2005 trials, galling was widespread through the planting and no individual tree selection was made. Experimental design in all trials was completely randomized with six to seven replications.

A single trial was conducted in 2004. Soil applications (imidacloprid/Merit, thiamethoxam/Flagship) were made using a drench of 2 liters (68 fl oz) water per tree applied April 15. At this time bud break was just beginning on a few of the trees; most had not yet broken bud. Foliar applications (bifenthrin/Talstar, abamectin/Avid) were made on April 15, April 26, and May 4. Approximately 120 ml (4 fl oz) were applied to each tree, which provided thorough coverage. On the final application evidence of recently initiated galls was present. Evaluations were made July 15 by counting all the current season galls present on each tree.

In 2005 three trials were conducted. In the first, applications were made April 9 as soil drenches. On this date buds had not noticeably begun to swell; fully swollen buds and initial leaf emergence occurred approximately 3 weeks subsequent. Insecticides were poured around the base of trees in a volume of 3.2 liters (108 fl oz) per clump. Rates of both insecticides used (Marathon, Flagship) were based on amounts labeled for white grub control (1X) and at a 10X rate. A heavy snowfall followed within 6 hours of application.

The second trial examined foliar applications. Three neonicotinoids were included — acetamiprid (TriStar), imidacloprid (Merit), and thiamethoxam (Flagship). Flocanimid was an additional tested treatment. Applications were made on three dates. The first application (May 3) occurred just after bud break but before there was evidence of emergence of poplar twiggall fly. Subsequent applications were made May 14 and May 22. The volume applied was ca. 163 ml (5.5 fl oz)/plant on the first application; 475 ml (16 fl oz)/plant on the latter applications.

The third trial included clothianidin treatments. Foliar applications of clothianidin (Celero 16WSG) were made May 14 in a volume of ca. 475 ml (16 fl oz)/clump, which allowed thorough coverage approaching point of run-off. Soil drench applications of clothianidin (Celero 16WSG) and imidacloprid (Marathon 60WSB) were applied May 13 in a volume of 2010 ml (68 fl oz) water/clump. Evaluations of all 2005 trials were made August 11 by counting all current season galls.

Results and Discussion

Early season activity of poplar twiggall fly and its primary parasitoid. The flight period of poplar twiggall flight began shortly after bud break in both seasons, during the first week of May (Figs. 1 and 2). During both years the peak flight lasted about two weeks and all adults were captured

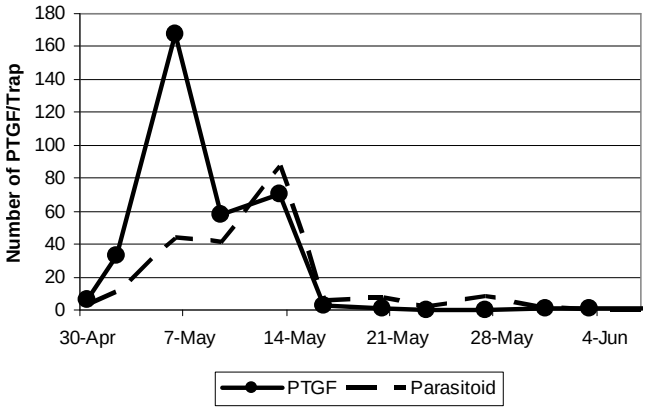

Fig. 1. Captures of poplar twiggall fly and its associated parasitoid, *Eurytoma contractura*, on colored sticky panels, Ft. Collins, CO, 2002.

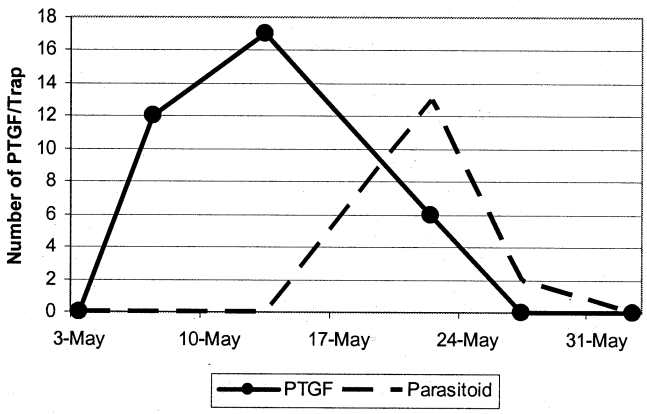

Fig. 2. Captures of poplar twiggall fly and its associated parasitoid, *Eurytoma contractura*, on colored sticky panels, Ft. Collins, CO, 2005.

Table 1. Poplar twiggall fly control study on aspen, Ft. Collins, CO, 2004.

Treatment	Rate	Application	Galls/tree[z]
Untreated check			25.7a
Flagship 25W	soil drench	2.8 gr/tree	1.5b
Merit 75W	soil drench	2.8 gr/tree	0.0b
Talstar L&T	3 foliar sprays	169 ml/100 l	13.8a
Avid 0.15EC	3 foliar sprays	47.6 ml/100 l	17.3a

[z]Numbers followed by the same letter are not significantly different (P = 0.05) by SNK.

Table 2. Poplar twiggall fly control study with soil applied systemic insecticides, Ft. Collins, CO, 2005.

Treatment	Rate	Galls/ aspen clump[z]
Marathon 60WSB	71.8 gr/1000 m^2 (0.15 gr/clump)	4.0b
Marathon 60WSB	717.6 gr/1000 m^2 (1.5 gr/clump)	4.1b
Flagship 25W	560.4 gr/1000 m^2 (1.2 gr/clump)	20.3b
Flagship 25W	56/1000 m^2 (0.122 gr/clump)	55.0a
Untreated check		56.3a

[z]Numbers not followed by the same letter are significantly different (P = 0.05) by SNK.

over a 3 week period. Numbers of PTGF caught per trap during 2002 were much higher than in 2005, apparently reflecting the high background populations present at the older site used during 2002.

Flights of the eurytomid parasitoid typically began one to two weeks after initiation of PTGF flights and peaked during as PTGF adult activity was concluding. This suggests that *E. contractura* oviposits in egg or early larval stages of its host. Pupal stages of this parasitoid were detected in winter, prior to PTGF pupation. An earlier study of this insect found it to be a major source of natural mortality in Colorado with parasitism percentages ranging from 3 to 94% (mean 21.5%) (1).

An additional behavioral observation of note made during the past season was sap feeding by ovipositor wounding prior to and concurrent with the egg laying period. Young leaves are repeatedly punctured by individual females, producing numerous small dimples and leaf tears. These injuries are easily seen shortly after initial emergence of the adult flies. Such sap feeding behavior following oviposition leaf wounding is widespread among many common leafmining agromyzid flies, such as *Phytomyza* spp. associated with hollies (2).

Female PTGF subsequently oviposit in developing twigs. An observable swelling of tissues is evident within days. However, full development of galls does not occur until approximately 2 months following oviposition, in early summer. Even at this time the galls may not be commonly observed because foliage obscures but are easily noted at leaf drop.

Table 3. Poplar twiggall fly foliar treatment trial, Ft. Collins, CO, 2005.

Treatment	Rate	Galls/aspen clump[z]
Tristar	12.7 gr/100 l	9.0a
Flagship 25G	10.6 gr/100 l	17.0a
Merit 75WP	3.7 gr/100 l	16.7a
Flocanimid 50WG	12.7 gr/100 l	26.2a
Untreated check		26.7a

[z]Numbers within a column not followed by the same letter are significantly different by SNK.

Table 4. Poplar twiggall fly control trial with clothianidin and imidacloprid, Ft. Collins, CO, 2005.

Treatment	Rate	Application method	Galls/ aspen clump[z]
Celero 16WSG	30 gr/100 l	foliar spray	19.3a
Celero 16WSG	162.8 gr/1000 m^2	soil drench	20.7a
Marathon 60WSB	1.5 gr/clump	soil drench	2.9b
Untreated check			25.2a

[z]Numbers not followed by the same letter are significantly different (P = 0.05) by SNK.

Direct gall treatments. There were no differences in number of emergence holes between the various treatments and the untreated control.

Insecticide management trials. The 2004 trial (Table 1) indicated a high degree of control with both soil drench treatments — imidacloprid (Merit 75W) and thiamethoxam (Flagship). This was the first time, following over a half dozen unpublished previous trials by the primary author, that any insecticide application had ever provided acceptable control. Foliar treatments did not perform acceptably, although they were repeatedly applied to provide plant coverage throughout the period of adult activity.

Lower rates of soil-applied insecticides were evaluated in the first 2005 trial (Table 2). In this trial imidacloprid (Marathon) again performed well at both tested rates. That the lower rate was effective indicated control can be achieved at rates currently labeled for other nursery production use. Thiamethoxam (Flagship) showed a rate response and only provided significant control at the 10X labeled rate tested.

Foliar applications evaluated in the second 2005 trial did not provide acceptable control (Table 3), consistent with the 2004 results. In the third 2005 trial neither clothianidin treatment was effective (Table 4). However, the imidacloprid soil drench did provide a high level of control of galling, despite being applied over a month later (May 13) than used in the 2005 soil drench trial (April 9). This suggests that there is a substantial period of time prior to and immediately following bud break during which soil drench applications of imidacloprid are effective.

This study has identified an effective control for gall production by the poplar twiggall fly on nursery grown aspen. Imidacloprid, applied as a soil drench either shortly before or after bud break, was repeatedly shown to be effective in prevention of these injuries. In addition to being more effective than foliar applications, use of soil applied systemic insecticides avoid surface residues of insecticides early in the growing season. These foliar treatments could be particularly damaging to the primary natural enemy affecting poplar twiggall fly species, the eurytomid wasp *Eurytoma contractura*, which is actively present on plants seeking hosts a couple of weeks after bud break.

Literature Cited

1. Eckberg, T.B. and W.S. Cranshaw. 1995. Notes on the biology and control of the poplar twiggall fly, *Hexomyza schineri* (Giraud) (Diptera: Agromyzidae), an emerging pest of aspen in Colorado. *J. Kansas Entomol Soc*. 68:127–132.

2. Potter, D.A. and C.T. Redmond. 1989. Early spring defoliation, secondary leaf flush, and leafminer outbreaks on American holly. Oecologia 81:192–197.