BIRCH LEAFMINER: A SUCCESS

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ABSTRACT

Introduction

An account is provided of the classical biological control program directed against the birch leafminer, *Fenusa pusilla* (Lepeletier) (Hymenoptera: Tenthredinidae), in North America during the period 1974-2007. Emphasis is placed on the overseas exploration for importation, release, recovery, and evaluation of natural enemies in the northeastern United States.

First reported from Connecticut in 1923 (Friend 1933), *F. pusilla* dispersed throughout most of the northern U.S. and much of Canada, where it became an important defoliator of white barked birches (*Betula* spp.). This species has up to four generations per year and overwinters in a cocoon in the soil. The adults emerge and begin ovipositing in late April-early May, depending on the latitude. Damage is caused by the larvae, which mine through the palisade parenchyma of the leaves; trees were frequently attacked to the point at which the foliage of the entire crown turned brown, adversely affecting the trees normal development, aesthetic appearance, and resistance to other pests.

Though native parasitoids, primarily polyphagous chalcidoids, had been observed attacking the pest in Quebec (Cheng and Leroux 1969), Connecticut (Friend 1933), and the Middle Atlantic states (Fuester and Taylor, unpublished data), these studies indicated that the natural enemy complex consisted primarily of polyphagous chalcidoid wasps and that parasitism was very low, having little impact on populations of *F. pusilla.* Observations by Eichhorn and Pschorn-Walcher (1973) in Europe, where the pest originated, indicated that there was a rich complex of parasitoids (17 species) attacking the pest and that total annual parasitism was 38-47 percent.

Importation and Release of Natural Enemies

Because parasitism of *F. pusilla* was much higher in Europe, a classical biological control program was mounted against the pest in eastern North America during the 1970s. The initial releases of natural enemies were made in 1974 in eastern Canada (Raske and Jones 1975, Guèvremont and Quednau 1977), followed by others in the Middle Atlantic states (Fuester *et al.* 1984) and New England (Van Driesche et al. 1997). Brief notes on the four species of parasitoids imported and released in North America follow:

Lathrolestes nigricollis Thomson (Hymenoptera: Ichneumonidae) is the dominant parasitoid of *F. pusilla* in Europe. This multivoltine endoparasitoid attacks intermediate to late stage larvae and exhibits a high degree of host specificity. Although a high proportion of its eggs are melanized and encapsulated by the host, the larvae frequently overcome host defenses and complete their development, which is not completed until the host spins its cocoon. A total of 9,670 adults were released in the Middle Atlantic states during 1976-1982.

Grypocentrus albipes Ruthe (Hymenoptera: Ichneumonidae) is second in importance to *L. nigricollis* in Europe, but is similar in being highly host specific, having several generations per year, and attacking intermediate- to late-stage larvae. It differs, however, in

developing as an ectoparasitoid, the kidney-shaped egg being attached to the host by an anchor. The egg does not hatch until the host spins its cocoon. A total of 2,582 adults were released in the Middle Atlantic states during 1977-1982.

Phanomeris probably *catenator* Haliday (Hymenoptera: Braconidae) is a multivoltine ectoparasitoid of small and intermediate sized larvae. The host range of this species is poorly known and it has a somewhat restricted distribution in Europe. Multiparasitism with the aforementioned ichneumonids is infrequent, but *Phanomeris* usually wins, probably because it does not have to wait until the host spins its cocoon before completing its development. A single release of 47 adults was made in Pennsylvania during 1979.

Chrysocharis nitetis Walker (Hymenoptera: Eulophidae) is the most abundant chalcidoid parasitoid of birch leafminer in Europe. It develops endoparasitically within 1st and 2nd stage leafminer larvae. Parasitization by this species is sometimes high locally, approaching 100 percent. A total of 557 adults were released in Pennsylvania during 1981-1983.

Monitoring and Evaluation

Of the four parasitoids released, only one—the ichneumonid *L. nigricollis*—became established and spread widely. Studies of its preliminary impacts were made at several locations in the 1980s and 1990s, but full impact of the parasitoid on host density was not yet achieved in that period. Therefore, we conducted surveys in seven states (MA, CT, RI, NY, PA, NJ, DE) in 2007 documenting the current birch leaf miner levels (as percentage of leaves mined in spring) and parasitism. Birch leaf miner populations have come under complete biological control in all areas surveyed above 40° N latitude (central New Jersey). Mined leaves were extremely difficult to find in MA, CT, RI, PA, and NY (Long Island). In these areas, birch leafminer larvae could not be recovered in large enough numbers to estimate rates of parasitism. In New Jersey, the pest's density has been suppressed at most sites north of 40° N, but south of this latitude, pest densities remain high. Parasitism at New Jersey sites above 40° N averaged 58 percent, about twice the 28 percent rate found in southern New Jersey. Infestations of birch leafminer at Newark, DE, were highly variable, with the incidence of mined leaves ranging from 0 to 57 percent on different trees and averaging 10.4 percent, intermediate between New Jersey and the other states. Parasitism was low (1.2 percent), but samples were taken when most of the mines were small. Because *Lathrolestes nigricollis* females prefer to attack semi-mature and mature larvae (Eichhorn and Pschorn-Walcher 1973), sample timing may have caused parasitism to be underestimated.

In summary, results show that the pest has declined dramatically to barely detectable levels in five states (MA, CT, RI, NY, PA) but that in Delaware and southern New Jersey, the pest remains fairly abundant (up to 50 percent leaves mined) despite significant parasitism levels. Survey results, in context with previous evaluations made when populations were still declining, show that the project has been completely successful in much of the northeastern United States, but that there is a limit to efficacy along the pest's southern distribution. Possible reasons for lack of control in this area, in contrast to high levels of control elsewhere, include the following:

1. Population dynamics: In southern New England, birch leafminer is largely univoltine and about 75 percent of the first generation *L. nigricollis* diapause. In New Jersey and Delaware, birch leafminer has multiple generations which might present synchrony problems to the parasitoid.

2. Tree stress: Birches are primarily boreal trees, and most of the species preferred by birch leafminer do not occur naturally south of 40° N, except at high elevations in the Appalachians. Generally, they exist only as planted landscape trees which are often in stressed condition due to climate**.** Thus, they might be less resistant to leafminer infestations.

3. Difficulty in parasitoid adaptation: The birch leafminer and its parasitoids have a northern distribution in Europe, which characteristically has cool summers. The area in North America where biological control of birch leafminer is good corresponds with the Canadian and Transition Life Zones, whereas the area where biological control of birch leafminer is poor corresponds with the Upper Austral Life Zone, which is characterized by mean summer temperatures over 72 °F.

Conclusions

Classical biological control of birch leafminer by the introduced parasitoid *L. nigricollis* has been highly successful throughout all but a small part of the pest's range in North America. The results of our surveys illustrate the importance of continued monitoring of a classical biological control project for an extended period, in this case 34 years since the first releases. Although this case might be a bit extreme, Pschorn-Walcher (1977) has pointed out that monitoring in some classical biological control projects on forest pests has been discontinued too early. We concur with this idea, because evaluations on short time scales (3-6 years), typical of many research projects, may be premature and underestimate ultimate impacts of new biocontrol agents, especially when monitoring is done over very wide geographic areas.

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