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AGONOPTERIX ALSTROEMERIANA (OECOPHORIDAE) AND OTHER LEPIDOPTERAN ASSOCIATES OF POISON HEMLOCK (*CONIUM MACULATUM*) IN EAST CENTRAL ILLINOIS

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ABSTRACT

Poison hemlock (*Conium maculatum*) (Apiaceae), a noxious Eurasian weed extensively naturalized throughout North America, is characteristically attacked by few insects. Over the past two decades, an introduced oecophorid caterpillar, *Agonopterix alstroemeriana*, has been reported infesting poison hemlock, its sole host in its area of indigeneity, in parts of the northeastern and western United States. We report for the first time evidence of established midwestern populations of this species. We also report poison hemlock as a host plant for the polyphagous lepidopterans *Eupithecia miserulata*, *Trichoplusia ni*, and *Spilosoma virginica*.

Poison hemlock, *Conium maculatum* (Apiaceae), is a herbaceous Eurasian weed that is extensively naturalized in temperate North America, as well as in other parts of the world, including Australia, New Zealand, and South America (Parsons 1976, Holm et al. 1979). Commonly found in waste places along roads, ditches, and cultivated fields, it also occasionally invades riparian forests and flood plains (Goeden and Ricker 1982). The weed is generally regarded as noxious; all aerial parts are poisonous to livestock and to humans (Sperry et al. 1964, Panter and Keeler 1989). Due to its toxicity, as well as to its rank odor and profuse growth, poison hemlock is frequently a target of eradication programs in populated areas.

The toxicity of *C. maculatum* to vertebrates is largely attributable to its production of relatively high concentrations of coniine and related piperidine alkaloids, including methylconiine, coniceine, and conhydrine. *Conium maculatum* is one of the few apiaceous species that produce alkaloids (Fairbairn 1971). The major alkaloids, coniine and g-coniceine, are found in all parts of the plant, with the highest amounts (over 1% of the dry weight) in reproductive tissues (Cromwell 1956, Khodzhimatov and Bobokhodzhaeva 1976). These alkaloids have long been known to be neurotoxic and have been implicated in many livestock poisonings (Bowman and Sanghvi 1963, Sperry et al. 1964, Panter and Keeler 1989). Although when administered in artificial diet coniine was not toxic to *Heliothis (=Helicoverpa) zea* in laboratory bioassays (Nitao 1984, 1987), it does display toxic or deterrent properties to other insects (Mody et al. 1976, Bernays and Chapman 1977). In addition to alkaloids, poison hemlock foliage and flowering parts contain small quantities of furanocoumarins, phototoxic compounds that are toxic or deterrent to both

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vertebrate and invertebrate herbivores (Berenbaum 1981, Murray et al. 1982, E. McCloud and M. Berenbaum, unpublished data), as well as polyacetylenes (Bohlmann 1971), which have been implicated in livestock poisoning in other apiaceous plants (Panter et al. 1988).

Relative to other introduced weed species, poison hemlock is attacked by few insect herbivores. In an extensive survey of poison hemlock in southern California, Goeden and Ricker (1982) reported "amazingly few insect species or individuals thereof. A clear majority, 16 (70%) of the 20 phytophagous insect species found on this weed were rare and were only encountered as a few individuals at one or two sites." Of the relatively few native insect species that have colonized the plant extensively throughout its range, the majority are species that feed generally on native and introduced plants in the Apiaceae; these species include *Papilio zelicaon* Lucas (Goeden and Ricker 1982), *P. polyxenes asterius* Stoll (Feeny et al. 1985; personal observations) (Lepidoptera: Papilionidae), and *Euleia fratria* (Loew) (Diptera: Tephritidae) (Berenbaum 1981; personal observations). The most abundant insect associate of the plant in California is an aphid, *Hyadaphis foeniculi* (Passerini), introduced from Europe, where it also feeds on poison hemlock (Goeden and Ricker 1982).

Recently, another European specialist on poison hemlock has been found in the United States. *Agonopterix alstroemeriana* (Clerck), a leaf-rolling oecophorid caterpillar that feeds exclusively on poison hemlock in its native Europe, was first found on flowers and foliage of poison hemlock in Tompkins County, New York in 1973 (Berenbaum and Passoa 1983); it was subsequently reported in 1983 in northern California, Oregon, and Utah and by 1987 was established in mesic areas of Washington, Idaho, and Colorado (Powell and Passoa 1991). An adult *A. alstroemeriana* collected in 1990 near Columbus, Ohio, marks the first appearance of this species in the Midwest (Powell and Passoa 1991).

In this paper, we report for the first time the presence of established populations of *A. alstroemeriana* in Illinois, and we confirm the use of *C. maculatum* as a host plant by several other lepidopteran species. These findings are of interest not only in the context of understanding patterns of colonization of alien weeds in general, but also in the context of evaluating the prospects of successful biological control of this noxious plant.

MATERIALS AND METHODS

Despite annual inspection of *C. maculatum* in east central Illinois from 1981 to 1990 (M. Berenbaum, J. Nitao, and S. Passoa, personal observations), no evidence of the presence of *A. alstroemeriana* could be found before 1993. On 18 June 1993, however, inspection of foliage in two locations (Urbana Yard Waste reclamation site; railroad right-of-way, Route 150, 6 km northeast of Urbana) in Champaign County, IL, revealed the characteristic leaf rolls of *A. alstroemeriana* on *C. maculatum*. At both sites, leaf rolls could be found on virtually every plant. Leaf rolls were collected intact and brought to the laboratory for examination. Although most of the leaf rolls were empty, a single ultimate instar *A. alstroemeriana* larva was found. This caterpillar was moribund (possibly parasitized), died shortly after collection, and was preserved in 70% ethanol for identification. Further inspection over the next two weeks at these two sites, as well as at two other Champaign County sites (Boneyard Creek, Campustown, Champaign, IL; Urbana-Champaign Sanitary District sewage lagoon, northeast Urbana, IL), failed to reveal any other larvae of this species, although leaf rolls were found in abundance at the sewage lagoon site. On 5 August 1993, an adult female *A. alstroemeriana*, confirmed by genitalia,

was collected inside a house northeast of Urbana, IL approximately midway between the sewage lagoon and railroad poison hemlock populations.

At all sites, all lepidopteran larvae that were found on *C. maculatum* were collected and reared. Larvae were fed foliage collected at or near the collection sites; foliage was replaced as needed. With the exception of the single *A. alstroemeriana* larva, all larvae that were collected were reared to adulthood; in cases where identification could not be made on the basis of external morphological features, genitalic dissections were prepared and examined.

RESULTS AND DISCUSSION

This report marks the first record of established populations of *A. alstroemeriana*, as evidenced by both larval and adult collections, in the midwestern region. The absence of prior records of its occurrence in east central Illinois, despite regular inspection of its host plant, suggests that it has only recently become established in this part of the country. This colonization likely represents overland expansion of the range of this species from the northeastern United States, inasmuch as there are very few waterways of any significance within a 100-mile radius of Champaign County to allow for direct introduction via inadvertent human transport from Europe or from the other established western North American populations. The recent discovery of this moth in Ohio (Powell and Passoa 1991) is consistent with overland expansion from the Northeast. As pointed out by Powell and Passoa (1991), *A. alstroemeriana* appears to be capable of extremely rapid colonization; the tremendous abundance of leaf rolls in several different sites in east central Illinois that lacked any sign of infestation as recently as three years ago is consistent with either multiple independent colonization events or with high reproductive potential and local dispersal.

Three other species of Lepidoptera were collected as larvae and reared on poison hemlock. Two individuals of *Eupithecia miserulata* Grote (Geometridae), collected at the Urbana yard waste collection site on 21 June 1993, subsequently pupated and emerged on 9 and 13 July 1993; one specimen of *Trichoplusia ni* (Hübner) (Noctuidae), collected at Urbana-Champaign Sanitary District sewage lagoon on 13 June, emerged on 27 July 1993; and two *Spilosoma virginica* (F.) (Arctiidae) were collected at the Urbana yard waste reclamation site on 21 June 1993, and emerged in the laboratory on 11 and 12 July 1993. Of these three species, *E. miserulata* and *T. ni* have been reported previously on poison hemlock in California (Goeden and Rickers 1982). Although poison hemlock appears to be a newly recorded host for *Spilosoma virginica*, this insect is a broadly polyphagous feeder associated with many other toxic plants (Tietz 1972) and thus might be expected to feed on poison hemlock as well.

Poison hemlock has been established in Illinois for over 100 years (Vasey 1861, Patterson 1876, Jones and Fuller 1955). In east central Illinois, records of poison hemlock date back at least 80 years; specimens from "waste places" in Peoria (Brendel 1882) were acquired by the University of Illinois Herbarium in 1906. Despite the fact that the plant is locally extremely abundant, intermittent inspection over the last decade has consistently revealed few insect associates of this plant and little leaf damage by herbivores. This same pattern has been documented in other parts of the United States – by Berenbaum (1981) in central New York and by Goeden and Rickers (1982) in southern California. The failure of lepidopteran larvae to colonize this plant in large numbers may be attributable to its broad array of chemical defenses. Evidently, however, populations of poison hemlock in several localities in the

United States are now experiencing unprecedented levels of herbivory due to colonization by and population growth of *A. alstroemeriana*. It would be of great ecological and evolutionary interest to monitor changes in plant secondary compounds that may accompany this colonization. The patchy distribution of *A. alstroemeriana* populations in east central Illinois, and presumably other localities in the midwestern states where this insect has invaded, may provide an opportunity to quantify the selective impact of a newly resumed association of this plant with an abundant herbivore. Baseline information on the chemistry of poison hemlock populations free from *A. alstroemeriana* can be obtained and compared with populations in which *A. alstroemeriana* is newly established in order to determine definitively under field conditions whether herbivores can reduce plant fitness and at the same time select for chemically based resistance factors (Berenbaum et al. 1986).

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