Weed Technology. 2005. Volume 19:1071–1077

Intriguing World of Weeds

Mile-a-Minute (*Polygonum perfoliatum*): An Increasingly Problematic Invasive Species[1]

VIRENDER KUMAR and ANTONIO DiTOMMASO[2]

INTRODUCTION

Mile-a-minute (*Polygonum perfoliatum* L., POLPF) is an introduced annual vine from eastern Asia that has become a serious weed in the eastern United States (Jianquing et al. 2000; McCormick and Hartwig 1995; McCormick and Johnson 1997; Oliver 1996). This plant is considered an invasive noxious weed because its aggressive growth allows it to outcompete and displace native plants in many habitats (Okay 1997; Oliver and Coile 1994). It is feared that mile-a-minute could spread all the way to Florida where under warm, moist climatic conditions it may attain the status of a perennial weed (Stevens 1994). The possibility of this weed spreading from coast to coast has also been raised (Hartwig 1991; Oliver 1996). The objective of this paper is to review key aspects of the etymology, history, biology, impact, and management of mile-a-minute in natural and seminatural plant communities with the ultimate goal of increasing awareness of the threat posed by this species, and of stimulating research into the development of effective and economical management strategies.

ETYMOLOGY

Mile-a-minute is a member of the Polygonaceae Family (smartweed) (Gleason and Cronquist 1991), subfamily Polygonoideae (Vánky and Oberwinkler 1994), tribe Polygoneae (Steward 1930), subtribe Polygoninae (Vánky and Oberwinkler 1994), genus *Polygonum* (Steward 1930), and section *Echinocaulon* (Steward 1930). In the United States and Canada, about 40 genera and 800 species of Polygonaceae are known (Bailey and Bailey 1976). They include 14 economically important species including buckwheat (*Fagopyrum* spp.) and rhubarb (*Rheum* spp.) grown for human and animal consumption, and pigeon-plum/tie tongue (*Coccoloba diversifolia* Jacq.), seagrape [*C. uvifera* (L.) L.], saffron buckwheat/conejo buckwheat (*Eriogonum crocatum* Davidson), Eastern Mojave buckwheat (*Eriogonum fasciculatum* Benth.), alpine mountain sorrel [*Oxyria digyna* (L.) Hill], and water smartweed (*Polygonum amphibium* L.) grown as ornamental plants (Wu et al. 2002). The remaining species can be classified as weeds and are a potential source of contamination in crop seed (Germplasm Resource Information Network 2004). There are 150 species of *Polygonum* in the United States and Canada (Bailey and Bailey 1976) including annual and perennial herbs, shrubs, and vines of mainly moist disturbed habitats (Park 1986). Arrow-leaved tearthumb (*P. sagittatum* L.) and halberd-leaved tearthumb (*P. arifolium* L.) are closely related native species of mile-a-minute (Park 1986). Other native species in the genus *Polygonum* include Pennsylvania smartweed (*P. pensylvanicum* L.), water smartweed (*P. amphibium* L.), pale smartweed (*P. lapathifolium* L.), dotted smartweed (*P. punctatum* Elliot), mild smartweed (*P. hydropiperoides* Michx.), Carey's smartweed (*P. careyi* Olney), hairy smartweed (*P. hirsutum* Walt.), oriental ladysthumb (*P. caespitosum* Blume), and erect knotweed (*P. erectum* L.) (Bailey and Bailey 1976; Wu et al. 2002). Other introduced weedy species in the Polygonaceae Family include: ladysthumb (*P. persicaria* L.), wild buckwheat (*P. convolvulus* L.), marshpepper smartweed (*P. hydopiper* L.), prince's feather/kiss me over the garden gate (*P. orientale* L.), prostrate knotweed (*P. aviculare* L.), *P. coccineum* Muhl. ex Willd., Japanese knotweed/Japanese or Mexican bamboo (*P. cuspidatum* Sieb. and Zucc.), sachaline/giant knotweed (*P. sachalinense* F. Schmidt ex Maxim.), doorweed/knotgrass (*P. arenastrum* Boreau), knotgrass (*P. neglectum* Besser), red sorrel (*Rumex acetosella* L.), and curly dock (*R. crispus* L.) (Bailey and Bailey 1976; Mitchell and Dean 1978).

Polygonum is derived from the Greek words *poly* meaning ''many'' and *gonu*, meaning ''knee or joint'', hence ''many joints'' referring to the thickened joints on stems of these plants, and also the origin of the common name ''knotweed'', like a knotted rope. The epithet *per-*

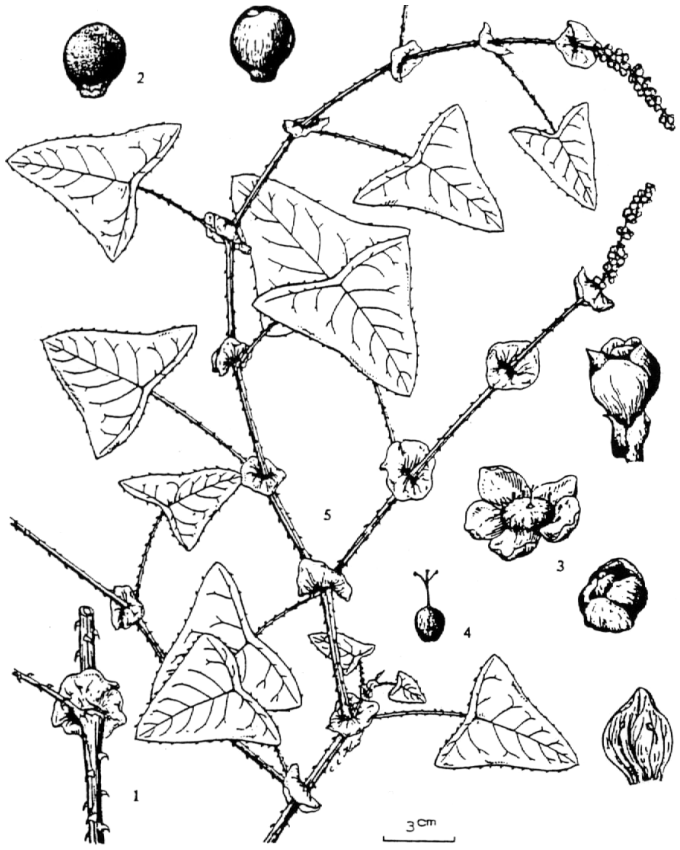
[1] Received for publication April 28, 2004, and in revised form December 13, 2004.

[2] Graduate student, Department of Horticulture; Associate Professor, Department of Crop and Soil Sciences, Cornell University, Ithaca, NY 14853. Corresponding author's E-mail: ad97@cornell.edu.

Table 1. Key distinguishing characteristics of the prickly *Polygonum* species except *P. convolvulus* in the eastern United States (adapted from Hill et al. [1981] and Oliver and Coile [1994]).

1. Leaves peltate; ocreae flare into saucer-like structures; perianth surrounding mature achenes metallic blue . . . . . *P. perfoliatum*
1. Petiole joining leaf blades at the margin; ocreae tubular; perianth surrounding mature achenes not metallic-blue.
2. Leaves sessile . . . . . *P. meisnerianum*
2. Leaves petiolate.
3. Stems not prickly . . . . . *P. convolvulus*
3. Stems prickly
4. Leaves hastate, without prickles below, pubescent on both surfaces . . . . . *P. arifolium*
4. Leaves sagittate, prickly on mid rib below, with pubescent margins . . . . . *P. sagittatum*

foliatum is derived from Latin meaning ''through the leaf'', which refers to the piercing appearance of the stem through the leaves but in mile-a-minute, the stem actually goes through the ocreae. Common names of this weed species include mile-a-minute, Asiatic tearthumb, devil's tearthumb, giant climbing tearthumb (Walker 1976), speedweed (Sun et al. 2000), and devil's-tail tearthumb (Hartwig 1995). Because of the presence of silicious prickles on stems, petioles, and leaves that can lacerate unprotected skin, this species is commonly referred to as tearthumb (Mountain 1989; Oliver and Coile 1994). Stems can grow 15 cm per day, hence, the common name mile-a-minute. Synonyms of *P. perfoliatum* include *Fagoparum perfoliatum* (L.) Rafine., *Chylocalyx perfoliatus* (L.) Hassk., *Echinocaulos perfoliatus* (L.) Meisn., *Echinocaulon perfoliatum* (L.) Hassk., *Tracaulon perfoliatum* (L.) Greene, *Persicaria perfoliata* (L.) H. Gross, *Amplelygonum perfoliatum* (L.) Roberty and Vautier, and *Truellum perfoliatum* (L.) Sojak (Cusick and Ortt 1987; Park 1986; Reed 1979a, 1979b; Steward 1930).



Mile-a-minute, *Polygonum perfoliatum* L. (1) ocrea, (2) nut, (3) flower, (4) pistil, and (5) habit. Reprinted with permission from Castanea 61:244–251.

DESCRIPTION

The following species description is based on information from Hickman and Hickman (1977), Hill et al. (1981), Mountain (1989), Oliver (1996), Oliver and Coile (1994), Riefner (1982), and Wu et al. (2002). Mile-a-minute is a prickly annual scrambling vine that can climb to a height of 6 m or more over shrubs and understory trees. Roots are fibrous and shallow. Stems are elongated, branched, and green when young, but becoming woody and red toward the base with age. Retrorse (i.e., backward pointing) prickles are 1–2 mm long; and are found on stems, petioles, and primary and secondary veins of leaves. The leaves are alternate, perfectly triangular shaped (deltoid) with long petioles, thin blades, membranous, glaucous, pale to bright green, and 2.5 to 7.5 cm long and wide. The leaf base is truncate but with a peltate attachment to the petiole (i.e., the petiole is attached from near the center of lower surface and not at the margin), and the apex is acute to subacute. Petioles are generally the same length as leaf blades. The diagnostic feature of *Polygonum* species, the ocrea (the nodal sheath made from the fusion of stipules), is saucer-shaped and appears leaflike rather than the usual tubular and papery form. The ocrea completely encircles the stem, hence the specific epithet, *perfoliatum*. The inflorescences are spikelike racemes up to 2 cm long with clusters of 10 to 15 tiny flowers either terminal or in the axils of upper leaves. Flowers and fruits are 1.5 cm across and subtended by a leaflike bract. Seeds are spherical, shiny black achenes about 3 mm in diameter and surrounded by a white or pink perianth (3–4 mm long). At maturity, the perianth thickens and becomes blue and fleshy, forming blueberrylike fruits arranged in clusters

5 mm in diameter. The fruits can remain on plants long after the vine senesces.

The main diagnostic characteristics of mile-a-minute are the vinelike stem; triangular leaves; sharp downward curving spines on stems, petioles, and main leaf veins; a saucer-shaped sheath encircling the stem at the nodes; and spherical, iridescent blue fruit borne in terminal clusters (McCormick and Hartwig 1995). Mile-a-minute may be confused with *P. arifolium* L., *P. sagittatum* L., *P. convolvulus* L., and branched tearthumb/mexicam tearthumb [*P. meisnerianum* Cham. & Schlecht var. *beyrichianum* (Cham. & Schlecht.) Meisn. in Mart] (Hill et al. 1981; Oliver and Coile 1994). These five species can be distinguished using the key (Table 1) that has been adapted from Hill et al. (1981) and Oliver and Coile (1994).

DISTRIBUTION AND HABITAT

Mile-a-minute is indigenous to Asia and is present in Japan, China, Taiwan, Korea, India, Indonesia, Bangladesh, India, Bhutan, Nepal, Siberia, the Philippines, Malaysia, Thailand, and Vietnam (Germplasm Resources Information Network 2004; Jianqing et al. 2000; Oliver 1996; Price et al. 2003). It has also been reported to occur in Turkey (Guener 1984). In the United States, mile-a-minute is found in Pennsylvania, Maryland, Delaware, West Virginia, Virginia, Oregon, New York, New Jersey, Ohio, and Washington, DC; and, most recently, Connecticut has been added to the list (Okay 1999; Price et al. 2003; USDA NRCS 2003; Wu et al. 2002). Fifteen additional states in plant hardiness zones 6 and 7 have also favorable climates to support mile-a-minute populations (Okay 1997). Scoggan (1979) reported its occurrence in British Columbia, Canada; however, this species does not seem to have established (Douglas et al. 1999).

Mile-a-minute is commonly found growing along roadsides, edges of woods and thickets, railroads, nurseries, recently harvested forest sites, forest edges, utility rights-of-way, low meadows and stream banks, wetlands, and uncultivated open fields (Mountain 1989; Okay 1997; Wu et al. 2002). This species poses a major threat to forest regeneration (McCormick and Hartwig 1995; Stanosz and Jackson 1991) and is an increasing problem in orchards and nurseries (Hill et al. 1981). In Mineral County, WV it has spread along power line rights-of-way and climbed over adjacent vegetation because of frequent use of herbicides that create open spaces and ideal conditions for establishment (Wu et al. 2002). Plants grow best in sunny locations at forest/field edges, preferring moist well-drained soils high in organic matter (McCormick and Johnson 1997; Okay 1997; Oliver and Coile 1994). However, it can also tolerate light shade and dry or extremely wet soil conditions. In its native range of Japan and eastern Asia, this species is commonly found growing along rivers and moist thickets (Ohwi 1965; Steward 1958).

HISTORY

The first record of mile-a-minute in the United States was a specimen collected from the ballast of a boat near Portland, OR in 1890 (Hickman and Hickman 1977). In Canada, the species was first reported in British Columbia in 1954 (Hill et al. 1981; Park 1986). However, plants did not establish following these initial introductions in North America. The discovery of plants from the Gable Nursery in Stewartstown, PA in 1946 is considered the first establishment site in the United States (Hill et al. 1981; Moul 1948). Seeds of mile-a-minute were likely unintentionally transported to this location in rhododendron nursery stock imported from eastern Asia in the1930s (Okay 1999; Riefner 1982). The species was also observed growing in an area of the Glenn Dale Introduction Garden in Beltsville, MD that had been planted in 1937 with Meliosa seed imported from China (Riefner 1982). Reed (1979a) speculated that the plant was spread with rhododendron stocks to the Gable Nursery in Stewartstown, PA from the Glenn Dale Introduction Garden. Hickman and Hickman (1977) also reported its establishment on the campus of Swarthmore College in southern Pennsylvania, and believed that it was spread primarily by attachment to rhododendron plants purchased from the Gable Nursery. Before 1980, mile-a-minute was limited to only five counties of Pennsylvania and parts of Maryland (Mountain 1995; Price et al. 2003) and by 1989 had spread to additional counties in Pennsylvania and Maryland, as well as to West Virginia. By 1994, it was found in a total of eight states (Pennsylvania, Ohio, Maryland, West Virginia, Virginia, Delaware, New Jersey, and New York) and the District of Columbia (Lehtonen 1994; Moutain 1995). In 1997, plants were also found in Connecticut (Lamont and Fitzgerald 2001; Okay 1999).

BIOLOGY AND ECOLOGY

Primarily a self-pollinated species with occasional outcrossing, mile-a-minute does not require pollinators for seed development (Okay 1997). Fruits ripen during mid-September to November in most regions of eastern North America (Hill et al. 1981; Lehtonen 1994), but

according to Okay (1997), fruits ripen from late June to early November in Virginia. In the northeastern United States, mile-a-minute plants senesce after the first frost in late October or early November, with germination occurring in early to mid-March the following year and continuing through April (McCormick and Johnson 1997; Wu et al. 2002). Under favorable conditions, plants can commonly reach a height of 6 m or more (McCormick and Johnson 1997). The prickly stem and leaves allow it to easily climb over neighboring vegetation and to form dense, tangled mats that cover small trees and shrubs in open areas and trees in forests to a height of 8 m along forest edges. Several workers have indicated that mile-a-minute is a prolific seed producer, but few data have actually been published to support this claim. In one report, McCormick and Johnson (1997) stated that a single plant could produce at least 50 to 100 seeds. Van Clef (2001) found that one seed was produced per fruit.

Seed dispersal in this species is largely carried out by migratory birds and mammals (chipmunks, squirrel, and deer) that consume the fruit, as well as by water transport and by human activities (Mountain 1989; Okay 1997, 1999). Birds are the primary natural vector for long-distance dispersal. Achenes retain viability even after passage through avian digestive tracts although the germinability of seeds is not affected (Okay 1997). Native ants also play a role in short-distance dispersal of mile-a-minute seeds because they are attracted to a small structure at the top of the seed known as the elaiosome that is a food source (Okay 1999). Long-distance dispersal of mile-a-minute seeds by water is also important because achenes can remain buoyant in water for about 7–9 d (Mountain 1989; Okay 1997, 1999). The self-compatibility of this species also contributes to its successful dispersal because single plants once established in a new habitat can produce new populations without the need for cross-pollination from neighboring conspecies (Cruden 1968; Okay 1997).

Information on seed dormancy and germination of mile-a-minute is essential for predicting its potential range in North America (McCormick and Johnson 1997). Okay (1997) determined that a stratification period of at least 8 wk at 5 C was required for breaking dormancy of achenes. At pH 3.5, however, stratification was not required, although germination levels were significantly lower (16.7%) than at pH 7.5 with cold treatment (46.7%). Johnson (1996) reported that seeds of mile-a-minute germinate over a wide range of temperature from 5 to 20 C and require at least 6 wk of moist stratification (2 C) for nonscarified seeds to germinate. Okay (1997) suggests that this stratification requirement for germination makes mile-a-minute an unlikely candidate as a serious problem in Florida. However, germination can occur under acidic soil conditions (i.e., pH = 3.5) without the need for a prolonged stratification period and thus this species has the potential to establish in cypress swamps of Florida where the pH can range from 2.8 to 3.9. Freshly collected seed in July did not germinate from July through October, but germinated in early spring (April) the following year (Okay 1997). Johnson (1996) showed that scarification could reduce the stratification period required for germination of achenes. Johnson (1996) found that more than 95% of seeds buried at depths of 0 to 10 cm in a forest soil in Pennsylvania remained viable after 2 yr of burial and that seeds retrieved in the spring were able to germinate, but seeds retrieved in autumn after 1 and 2 yr of burial did not germinate. The ability of mile-a-minute seed to germinate at relatively cold temperatures provides it a competitive advantage over other annual and perennial weeds that germinate at higher soil temperatures later in the spring. These findings suggest that preemergence cultivation or herbicide applications may be effective in reducing mile-a-minute populations in early spring.

Van Clef and Stiles (2001) evaluated possible differences in the seed bank dynamics of mile-a-minute and one of its native congeners, *P. sagittatum*, in New Jersey. Seeds of mile-a-minute are much heavier (mean weight = 27.4 mg) than seeds of *P. sagittatum* (mean weight = 6.4 mg) (Van Clef 2001). Although both species demonstrated a persistent seed bank with high germination (>75%) after 1 yr of burial in soil and lower levels (25%) for seeds buried for 2 yr, seed germination levels for mile-a-minute were significantly greater (32.6%) than for *P. sagittatum* (0.7%) for seeds buried in soil for 3 yr. Thus, although mile-a-minute exhibits high germination levels in the first year of burial, it also has a high proportion of seeds that remain dormant and serve to prevent local extinction of this species after poor years of seed production (Van Clef 2001).

Research by Van Clef (2001) comparing emergence and survival of mile-a-minute and *P. sagittatum* in an old-field, ecotone, and forest habitat of New Jersey demonstrated that mile-a-minute seedlings had significantly greater emergence (61.3 vs. 15.4%) and survival (4.3 vs. 0%) across all three habitats compared with *P. sagittatum*. Survival percentages of mile-a-minute plants were highest in the old-field (11.3%), followed by the ecotone (1.7%) and forest interior (0%) sites. Mile-a-minute

plants also had significantly greater total biomass, lower root-to-shoot ratio, and lower leaf weight ratio than *P. sagittatum* plants. Van Clef (2001) concluded that the three factors that contribute most to increased invasiveness of mile-a-minute in North America are likely seed longevity, seedling growth advantages provided by larger seeds, and bird dispersal.

CURRENT AND POTENTIAL USES

In its native eastern Asia, mile-a-minute is considered beneficial and has been used as an herbal medicine for over 300 yr (He et al. 1984; Hoque et al. 1989; Sook and Myung 1992; Yang and Kim 1993; Zhu 1989), or as an edible wild fruit (Bajracharya 1980). The plant also serves as a suitable food source for a diverse group of mammals, birds, and insects. Two protein kinase C inhibitors (PKC), vanicosides A and B; five diferuloyl esters of sucrose; and feruloylsucroses have been isolated from mile-a-minute plants (Sun 1999; Sun et al. 2000). PKC are involved in cell signal transduction and cell proliferation and are believed to be tumor promoters; thus PKC inhibitors could be used as potential anticancer agents (Sun 1999). Two well-known natural products, quercetin and beta-sitosterol, have also been isolated from mile-a-minute (Sun 1999). Beta-sitosterol is also reported to have anticarcinogenic properties (Park et al. 2003). The bioflavonoid quercetin has antioxidant (Boadi et al. 2003; Kumar et al. 2003; Pietruck et al. 2003), antiproliferative, and anti-inflammatory properties (Pietruck et al. 2003).

WEEDINESS

Mile-a-minute is an invasive weed that outcompetes and displaces native vegetation (including herbaceous perennials) and reduces the growth of nursery tree saplings (Okay 1997). Early germination of seeds at relatively low temperatures and rapid growth contribute to its competitive advantage in many invaded habitats (Okay 1997). Mile-a-minute is a major threat to forest regeneration and commercial forest areas. In forest revegetation sites of south-central Pennsylvania, it has formed dense, almost pure stands because of the removal of overstory vegetation and site preparation disturbances (McCormick and Hartwig 1995; McCormick and Johnson 1997). In revegetation areas of Virginia, additional costs for site preparation, weed management, and labor to replant tree saplings overtopped by this weed have been estimated to range from $60–500 per ha (Stanosz and Jackson 1991). At harvested forest sites in Pennsylvania, McCormick and Hartwig (1995) observed mortality of regenerating tree saplings including planted loblolly pine (*Pinus taeda* L.) because of the dense canopy formed by this weed.

Mile-a-minute has the potential to invade valuable apple orchards (Moul 1948) and Christmas tree plantations throughout the northeastern United States (Lehtonen 1994) and is also considered a potential threat to natural and restored ecosystems (Stevens 1994). The Virginia Department of Conservation and Recreation (DCR) has listed mile-a-minute on the state list of ‘‘100 nonindigenous most troublesome to control species’’ (Virginia DCR 2003). It is listed as a ‘‘Class A noxious weed’’ in North Carolina, a ‘‘prohibited noxious weed’’, in Ohio, and a ‘‘noxious weed’’ in Pennsylvania and Alabama (Germplasm Resource Information Network 2004; USDA NRCS 2003). Okay (1997) recommended adding this species to the Federal Noxious Weed List in the hope that it would bring greater attention to the threat posed by this plant as well as facilitate the development of effective and economical management programs.

Mile-a-minute has also infested recreational and residential areas in Washington, DC (Fleming and Kanal 1992), Pittsburgh, PA (Wu et al. 2002), and Valley Forge, PA (Hartwig 1995) regions. In the eastern United States, its rapid growth allows the species to outcompete native understory species such as elderberry (*Sambucus canadensis* L.) and *Rubus* spp. (blackberries and other brambles) (Hill et al. 1981; Moul 1948; Oliver 1994). The species has been reported to grow in areas where other invasive plants such as kudzu (*Pueraria montana* [LOUR.] Merr. var. *lobata* [Willd.] Masen and Almeida) have been killed by herbicides (Wu et al. 2002). Okay (1997) observed decreases in native plant species diversity in areas colonized by mile-a-minute. Displacement of native plants by this introduced species will likely have deleterious effects on wildlife in these areas because of reductions or elimination of food plants and habitat (Oliver 1994). Moreover, spines on stems, petioles, and leaf veins can restrict the movement of wildlife and humans in natural areas (Okay 1997).

Although mile-a-minute is considered an important agrestal weed especially in less intensively managed agricultural lands in eastern Asia (Anonymous 1978; Barbora 1972; Kasahara 1954), this plant is not considered troublesome in agricultural production in North America likely because of continuous tillage and herbicide use.

MANAGEMENT OPTIONS

Cultural and Mechanical Control. Control efforts on mile-a-minute should focus on eliminating or reducing

seed output (Oliver and Coile 1994) and limiting the creation of gaps or openings in existing vegetation (Okay 1999). Mechanical control of mile-a-minute by mowing, or cutting with scythe or weed whacker before excessive vine growth and seed set, is effective (Mountain 1989). Hoeing and tillage at the seedling stage are also effective (Mountain 1989). The clearing of dead and decaying plant material from infested or susceptible areas is also important for reducing the number of favorable germination sites (Mountain 1989). Hence, brush and old woodpiles should be removed or, where appropriate, eliminated using fire (Oliver 1996). Maintenance of broad vegetative buffers along streams and forest edges helps prevent establishment of this weed by shading (Okay 1999). The growth of mile-a-minute was suppressed when in the presence of the parasitic plant *Cuscuta gronovii* (Okay 1997). Further research is needed, however, to determine whether use of this parasitic species is an effective and economically viable option for managing this weed.

Biological Control. No biological agents are currently available for the control of mile-a-minute in North America. In a 3-yr survey of natural enemies in the eastern United States, Wheeler and Mengel (1984) found 34 insect species capable of developing on mile-a-minute, with 12 of the species feeding on plants as adults. None of these insects, however, provided effective suppression of growth. In China, about 80 insect species from 6 orders and 20 families were collected on mile-a-minute plants, with several of these having the potential for use as biological control agents (Jianqing et al. 2000). The most promising agents include the geometrid moth (*Timanndra griseata* Peterson), a bug (*Cletus schmidti* Kiritschulsko) (Price et al. 2003), and a weevil (*Rhinoncomimus latipes* Korotyaev) (Colpetzer et al. 2004).

ACKNOWLEDGMENTS

We thank Robin R. Bellinder, Daniel C. Brainard, and Stephen J. Darbyshire for valuable comments on an earlier draft of the manuscript. We are grateful to the editor of the journal *Castanea* for permission to use the line drawing.

LITERATURE CITED

Anonymous. 1978. Annual scientific report 1977, Tocklai Experimental Station. Tea Research Association, Jorhat, Assam, India.

Bailey, L. H. and E. Z. Bailey. 1976. Hortus Third, a Concise Dictionary of Plants Cultivated in the United States and Canada. New York: Macmillan. 1290 p.

Bajracharya, D. 1980. Nutritive values of Nepalese edible fruits. Z. Lebensm. Unters. For. 171:363–366.

Barbora, B. C. 1972. Chemical control of weeds in drains, drain sides and other non-tea pockets. Two Bud. 19:25–28.

Boadi, W. Y., P. A. Iyere, and S. E. Adunyah. 2003. Effect of quercetin and genistein on copper and iron-induced lipid peroxidation in methyl linolenate. J. Appl. Toxicol. 23:363–369.

Colpetzer, K., J. Hough-Goldstein, K. R. Harkins, and M. T. Smith. 2004. Feeding and oviposition behavior of *Rhinoncomimus latipes* Korotyaev (Coleoptera: Curculionidae) and its predicted effectiveness as a biological control agent for *Polygonum perfoliatum* L. (Polygonales: Polygonaceae). Environ. Entomol. 33:990–996.

Cruden, R. W. 1968. Birds as agents of long distance dispersal for disjunct plant groups of the temperate Western Hemisphere. Evolution 20:517–532.

Cusick, A. W. and M. Ortt. 1987. *Polygonum perfoliatum* L. (Polygonaceae): a significant new weed in the Mississippi drainage. Sida Contrib. Bot. 12:246–248.

Douglas, G. W., D. Meidinger, and J. Pojar, eds. 1999. The Illustrated Vascular Plants of British Columbia. Volume 4. Dicotyledons (Orobanchaceae through Rubiaceae). Victoria, BC: British Columbia Ministry of the Environment, Lands and Parks and Ministry of Forests. 427 p.

Fleming, P. and R. Kanal. 1992. Newly documented species of vascular plants in the District of Columbia. Castanea 57:132–146.

Germplasm Resources Information Network. 2004. GRIN Taxonomy: Web page: http://www.ars-grin.gov/cgi-bin/npgs/html/tax_search.pl?polygonum+perfoliatum. Accessed: March 25, 2004.

Gleason, H. A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. 2nd ed. Bronx, NY: New York Botanical Garden. 910 p.

Guener, A. 1984. A new record for the flora of Turkey and a new sub species from Australia. Candollea 39:345–348.

Hartwig, N. L. 1991. Voracious vine poses threat to young trees. Wall Street Journal, Sept. 5, 1991.

Hartwig, N. L. 1995. History of mile-a-minute weed (devil's tail tearthumb) in Pennsylvania. *In* N. L. Hartwig, ed. Proceedings of Mile-a-Minute Weed (*Polygonum perfoliatum* L.) Conference; July 17–18, 1995; York, PA: Pennsylvania State University. Pp. 1–2.

He, S. Y, Q. H. Xing, Z. T. Yin, and X. P. Jiang. 1984. Flora of Bejing. Volume 1. Beijing, China: Beijing Press. 710p.

Hickman, J. C. and C. S. Hickman. 1977. *Polygonum perfoliatum*: a recent Asiatic adventive. Bartonia 45:18–23.

Hill, R. J., G. Springer, and L. B. Forer. 1981. Mile-a-minute weed, *Polygonum perfoliatum* L. (Polygonaceae), a new potential orchard and nursery weed. Regul. Hort. 7:25–28.

Hoque, M. M, M. A. Hassan, and M. R. Khan. 1989. Screening of plants available in Bangladesh for antibacterial activity: II. *Polygonum* L. Bangladesh J. Bot. 18:141–146.

Jianqing, D., F. Weidong, Y. Wu, and R. C. Reardon. 2000. Insects associated with mile-a-minute weed (*Polygonum perfoliatum* L.) in China: A three year survey report. *In* N. R. Spencer, ed. Proceedings of the X International Symposium on Biological Control of Weeds; July 4–14, 1999; Bozeman, MT: Montana State University. Pp. 225–231.

Johnson, C. F., Jr. 1996. Achene Germination Requirements, Temporal Viability and Germination When Stored Under Natural Conditions and Abundance in the Soil Seed Bank for the Exotic Invasive Mile-a-Minute (*Polygonum perfoliatum* L.). M.S. thesis. Pennsylvania State University, University Park, PA. 112 p.

Kasahara, Y. 1954. Studies on the weeds of arable land in Japan, with special reference to kinds of harmful weeds, their geographic distribution, abundance, life-length, origin and history. Beriehtd. Ohara Inst. 10:73–108.

Kumar, P., S. Sharma, M. Khanna, and H. Guru Raj. 2003. Effect of quercetin on lipid peroxidation and changes in lung morphology in experimental influenza virus infection. Int. J. Exp. Pathol. 84:127–133.

Lamont, E. E. and J. M. Fitzgerald. 2001. Noteworthy plants reported from the Torrey Range—2000. J. Torrey Bot. Soc. 128:409–414.

Lehtonen, P. 1994. Pest risk assessment for mile-a-minute weed (Draft). Hyattsville, MD: U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine.

McCormick, L. H. and N. L. Hartwig. 1995. Control of noxious weed mile-a-minute (*Polygonum perfoliatum* L.) in reforestation. Northern J. Appl. For. 12:127–132.

McCormick, L. H. and C. F. Johnson, Jr. 1997. Mile-a-minute weed in the northeast. *In* K. O. Britton, ed. Proceedings of Exotic Pests of Eastern Forests; April 8–10, 1997. Nashville, TN: Tennessee Exotic Pest Plant

Council and U.S. Department of Agriculture Forest Service. Pp. 151–154.
Mitchell, R. S. and J. K. Dean. 1978. Polygonaceae (Buckwheat Family) of New York State. Contributions to a flora of New York State I—Bulletin 431. Albany, NY: New York State Museum. 79 pp.
Moul, E. T. 1948. A dangerous weedy Polygonum in Pennsylvania. Rhodora 50:64–66.
Mountain, W. L. 1989. Mile-a-minute weed (*Polygonum perfoliatum* L.) update distribution, biology, and control suggestions. Pennsylvania Department of Agriculture, Bureau of Plant Industry, Regulatory Horticulture. Weed Circular 15:21–24.
Mountain, W. L. 1995. Mile-a-minute weed-history, distribution and habitat. *In* N. L. Hartwig, ed. Proceedings of Mile-a-Minute Weed (*Polygonum perfoliatum* L.) Conference; July 17–18, 1995. York, PA: Pennsylvania State University. Pp. 3–6.
Ohwi, J. 1965. Flora of Japan. Washington, DC: Smithsonian Institution. 408 p.
Okay, J.A.G. 1997. *Polygonum perfoliatum*: A Study of Biological and Ecological Features Leading to the Formation of a Management Policy. Ph.D. thesis. George Mason University, Fairfax, VA. 132 p.
Okay, J.A.G. 1999. Mile-a-minute, *Polygonum perfoliatum* L. Virginia Department of Forestry, Fairfax, VA. PCA Alien Plant Working: Web page: http://www.nps.gov/plants/alien/fact/pope1.htm. Accessed: April 15, 2004.
Oliver, J. D. 1994. Mile-a-minute and *Vossia caspidata*, potential invasives of U.S. natural and restoration sites. Bull. Ecol. Soc. Am. 75:169–170.
Oliver, J. D. 1996. Mile-a-minute weed (*Polygonum perfoliatum* L.), an invasive vine in natural and disturbed sites. Castanea 61:244–251.
Oliver, J. D. and N. C. Coile. 1994. *Polygonum perfoliatum* L. (Polygonaceae), the mile-a-minute weed. Botany Circular No. 29. Gainesville, FL: Fla. Dept. Agric. and Consumer Services, Division of Plant Industry (PI95T-08).
Park, C. W. 1986. Taxonomy of Polygonum Section Echinocaulon. Ph.D. thesis. Cornell University, Ithaca, NY. 233 p.
Park, K. Y., E. J. Cho, S. H. Rhee, K. O. Jung, S. J. Yi, and B. H. Jhun. 2003. Kimchi and an active component, β-sitosterol, reduce oncogenic H-Ras^{v12}-induced DNA synthesis. J. Med. Food 6:151–156.
Pietruck, F., M. K. Kuhlmann, B. Lange, et al. 2003. Effect of quercetin on hypoxic injury in freshly isolated rat proximal tubules. J. Lab. Clin. Med. 142:106–112.
Price, D. L., J. Hough-Goldstein, and M. T. Smith. 2003. Biology, rearing, and preliminary evaluation of host range of two potential biological control agents for mile-a-minute weed, *Polygonum perfoliatum* L. Environ. Entomol. 32:229–236.
Reed, C. F. 1979a. *Tracaulon perfoliatum* (L.) Greene in Maryland. Phytologia 43:219–221.
Reed, C. F. 1979b. Additional notes regarding *Tracaulon perfoliatum* (L.) Greene. Phytologia 43:293.
Riefner, R. E. 1982. Studies on the Maryland flora, VIII: Range extensions of *Polygonum perfoliatum* L. with notes on introduction and dispersal in North America. Phytologia 50:152–159.
Scoggan, H. J. 1979. Flora of Canada. Part 4. Dicotyledoneae (Loasaceae to Compositae). Ottawa, ON, Canada: National Museum of Natural Sciences. Pp. 1116–1711.
Sook, J. L. and W. K. Myung. 1992. Hypoglycemic effects of Korean wild vegetable. Korean J. Nutr. 25:511–517.
Stanosz, G. and W. Jackson. 1991. Mile-a-minute weed. Pest Alert NA-PR-04-91. Morgantown, WV: U.S. Department of Agriculture, Forest Service, Northeastern Area.
Stevens, W. K. 1994. The environment-invading weed makes a bid to become the new Kudzu. New York Times 16 August. Pp. C4.
Steward, A. N. 1930. The Polygoneae of eastern Asia. Contributions from the Herbarium of Harvard University. 88:1–129.
Steward, A. N. 1958. Vascular Plants of the Lower Yangtze Valley, China. Corvallis, OR: Oregon State College. xiv + 621 p.
Sun, X. 1999. Phenylpropenoid Glycosides and Neoflavonoids from *Polygonum perfoliatum*. Ph.D. thesis. Virginia Commonwealth University, Richmond, VA.
Sun, X., M. L. Zimmermann, J. M. Campagne, and A. T. Sneden. 2000. New sucrose phenylpropanoid esters from *Polygonum perfoliatum*. J. Nat. Prod. 63:1094–1097.
USDA, NRCS. 2003. U.S. Department of Agriculture, Natural Resources Conservation Service. PLANTS Database: Web page: http://plants.usda.gov. Accessed: April 15, 2004.
Van Clef, M. 2001. Early Life Stage Performance of Native and Non-native Congeners of *Polygonum*, *Celastrus*, and *Parthenocissus*: Assessing Methods of Screening New Plant Introductions for Invasive Potential. Ph.D. thesis. Rutgers University, New Brunswick, NJ. 166 p.
Van Clef, M. and E. W. Stiles. 2001. Seed longevity in three pairs of native and non-native congeners: assessing invasive potential. Northeast. Nat. 8:301–310.
Vánky, K. and F. Oberwinkler. 1994. Ustilaginales on Polygonaceae—a Taxonomic Revision. Nova Hedw. Beih. 107:1–96.
Virginia Department of Conservation and Recreation. 2003. Invasive alien plant species of Virginia. Richmond, VA: Virginia DCR. Web page: http://www.dcr.state.va.us/dnh/invlist.pdf. Accessed: April 15, 2004.
Walker, E. H. 1976. Flora of Okinawa and the Southern Ryukyu Islands. Washington, DC: Smithsonian Institution Press. 543 p.
Wheeler, A. G., Jr. and S. A. Mengel. 1984. Phytophagous insect fauna of *Polygonum perfoliatum*, an Asiatic weed recently introduced to Pennsylvania. Ann. Entomol. Soc. Am. 77:197–202.
Wu, Y., R. C. Reardon, and D. Jianqing. 2002. Mile-a-minute weed. *In* R. Van Driesche, B. Blossey, M. Hoddle, S. Lyon, and R. Reardon, eds. Biological Control of Invasive Plants in the Eastern United States. Morgantown, WV: USDA Forest Service Publication FHTET-2002–04. Pp. 331–342.
Yang, Y. J. and Y. S. Kim. 1993. Seed germination of Korean wild medicinal plants: *Capsella bursa-pastoris*, *Persicaria perfoliata* and *Commelina communis*. J. Korean Soc. Hort. Sci. 34:315–319.
Zhu, Y. C., ed. 1989. Herb Medical Plants in the Northeast. Harbin, China: Heilongjiang Science and Technology Press.