

**Federal Interagency Committee  
for the  
Management of Noxious and Exotic Weeds**

**Issue Paper on Invasive Plant Management Using Integrated Pest Management**

Invasive species are defined as organisms that are non-native to an ecosystem, and whose introduction causes economic, social, or environmental harm. Nearly every terrestrial, wetland, and aquatic ecosystem in the United States has been invaded by nonindigenous species (Lee and Chapman 2001), with economic losses estimated at \$137 billion per year (Pimentel et al. 2000). Invasive plants constitute one of the most serious economic, social, and environmental threats of the 21<sup>st</sup> century, and now infest over 100 million acres in the United State alone.

In addition to their negative impacts on endangered species and biodiversity, invasive plants cause billions of dollars in lost revenue and control costs each year. Terrestrial invasive plants typically crowd out more desirable and nutritious plant species, cause soil erosion, and are toxic to some livestock and wildlife species. They reduce habitat for native and endangered species, degrade riparian areas, create fire hazards, and interfere with recreational activities. Aquatic invasive plants clog lakes and waterways and adversely affect fisheries, public water supplies, irrigation, water treatment systems, recreational activities, and shipping.

Section 15 of the Federal Noxious Weed Act of 1974, and Executive Order 13112 direct federal agencies to use an integrated pest management (IPM) approach for the management of undesirable plants on federal lands using all available tools, including: education; preventative measures; cultural, mechanical, physical, biological, and chemical control; and general land management practices such as revegetation, manipulation of livestock or wildlife grazing, and improvement of livestock and wildlife habitat.

Integrated Pest Management provides a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. The adoption and utilization of IPM is also being encouraged through other legislative authorities within departments. For example US Code (Title 7, Chapter 6, Subchapter II, Sec. 136r-1. Integrated Pest Management) states that "The Secretary of Agriculture, in cooperation with the Administrator, shall implement research, demonstration, and education programs to support adoption of Integrated Pest Management." It further states that "Federal agencies shall use Integrated Pest Management Techniques in carrying out pest management activities and shall promote Integrated Pest Management through procurement and regulatory policies, and other activities. IPM is also being encouraged across federal agencies within the Department of Interior.

Because of the complexity of economic, social, and environmental issues associated with invasive plant management, and the biological and ecological attributes associated with the invasive plant species, programs that are based on a combination of technologies tend to be most successful and sustainable. As indicated in the Management Plan, National Invasive Species Council (2001), the IPM approach considers the best available scientific information, updated

target population monitoring data, and the environmental effects of control methods in selecting a range of complementary technologies and methods to implement to achieve a desired objective. Some of the factors to consider in selecting control methodologies include environmental compatibility, efficacy, cost-effectiveness, inter-compatibility of different types of control measures, practicality, and safety.

An operational IPM program is comprised of a number of basic elements including 1) biological and environmental monitoring (e.g., obtaining life history information on the target plant and natural enemies; monitoring weed and natural enemy densities; obtaining temperature and moisture data, etc.); 2) decision-support systems (e.g., economic/environmental thresholds and injury levels; phenology models; predictive models, etc.); 3) decisions; 4) procedure implementation; and 5) outcome evaluation (Barker and Koenning 1998, Kennedy and Sutton 2000, CAST 2003). Regarding invasive plant management, additional elements of an IPM program necessarily include prevention, early detection and rapid response, restoration, education and public awareness. Knowledge and information about plant growth and reproduction can help identify weak links in the life cycle of the invasive species which can be targeted for the appropriate management strategies. Decision support tools such as economic/environmental thresholds and injury levels can help the invasive plant manager determine the point in time that management activities need to be implemented to prevent an invasive plant population from reaching the economic and/or environmental injury levels. Phenology models of the target plant, based on degree days, can help the invasive plant manager carefully time the implementation of the appropriate management strategies (e.g., the release of a biological control agent; the application of an herbicide, etc.). Outcome evaluation can help the invasive plant managers develop an adaptive management plan (learning by doing, analyzing the results, and refining the process). Integrated weed management systems can result in more rapid, economical, and complete weed control than a single method used alone (Lym 2004).

It is important to point out that no single pest management strategy (be it chemical, biological, or cultural) is a panacea for all invasive plant management situations. In practice, several different pest management approaches typically have been used in some of the more successful invasive plant management programs. However, it is important to recognize that certain management strategies may play a more central role in the management of a particular invasive plant species, depending on the circumstances (e.g., environmental sensitivity, size of the infestation, accessibility, efficacy, etc.). For example, herbicides likely will continue to be emphasized in roadside weed management (where the weed manager is typically faced with a whole complex of different weed species), followed by mowing, burning, hand pulling, and biological control. Similarly, herbicides will continue to play the prominent role in the eradication of new, starting infestations of an invasive plant species, since biological control agents (under most circumstances) do not have the potential to totally eliminate their target host. In contrast, for some invasive plant species that have infested vast acreages of marginal rangeland, biological control strategies may be emphasized and integrated with controlled grazing and revegetation (to encourage inter-specific plant competition), and chemical management for containment and elimination of spot infestations of the target weed.

Integrated Weed Management Examples.

IPM of Leafy Spurge, *Euphorbia esula*. Leafy spurge is an invasive, deep-rooted perennial herb that is native to Eurasia. The plant spreads through explosive seed release and vigorous lateral root growth, forming large, coalescing patches that can dominate rangeland, pastures, prairies and other noncrop areas in the Great Plains region of North America. Management of leafy spurge has been successfully achieved at numerous sites in the U.S. now on public and private lands through a combination of management approaches.

In a number of locations in Montana, North Dakota, and Wyoming leafy spurge has been successfully managed through a combination of biological and chemical controls, supplemented where appropriate with controlled grazing, and reseeding with desirable plant species. In North Dakota, herbicides have been successfully integrated with biological control agents to control heavy infestations of leafy spurge. Herbicides are applied first to reduce plant densities and open up the plant canopy. *Aphthona* flea beetles (mostly *Aphthona lacertosa*) are then released and within a few years normally build up large populations, which then cause dramatic reductions in the spurge density. Herbicides incorporated with *Aphthona* flea beetle species have resulted in more rapid and complete control of leafy spurge than either the biological control agent or the herbicide used alone (Lym 2004). Controlled grazing by sheep and goats, and reseeding flea beetle impact areas with desirable plant species can also help contribute to the sustained management of this invasive species. In addition, herbicides have also been used to contain current spurge infestations and control starting infestations of the target weed.

On the N-Bar Cattle Ranch in central Montana, successful management of leafy spurge was achieved using systematic and repeated releases of flea beetles and controlled grazing by sheep. Sustained control of spurge was obtained over very large areas, some a mile or more in length.

It should be pointed out that in the early days of control and management of leafy spurge, effective natural enemies were not yet available and the effects of animal grazing on leafy spurge were not well documented. Hence, during that period, management of leafy spurge emphasized chemical and cultural control (although neither of these approaches provided consistent and effective spurge control).

IPM of Garlic Mustard, *Alliaria petiolata*. Garlic mustard is a cool season biennial herb in the mustard family that poses a severe threat to native plant and animals in forest communities in much of the eastern and midwestern United States. Once garlic mustard is introduced into a new area it outcompetes native plant species by aggressively monopolizing moisture, nutrients, light and space. Garlic mustard typically occurs in moist, shaded soil of river floodplains, forests, roadsides, edges of woods, trail edges, and forest openings. Current management practices for garlic mustard emphasize the following: 1) hand removal of plants to prevent seed production for light infestations of the weed; 2) cutting plants at ground level (again to prevent seed production) for larger infestations of the weed where hand pulling is not practical; and 3) use of systemic herbicides (where risks to desirable plant species are minimal), for heavy infestations of the target weed. Fire also has been used to control garlic mustard in some large natural areas, but because burning opens up the understory, it can encourage germination of stored seeds and promote growth of emerging garlic mustard seedlings. Hence, controlled burning needs to be conducted for three to five consecutive years. Biological control agents are currently undergoing host-specificity testing for release against garlic mustard. In time,

hopefully these biological control agents will be approved for release and available to integrate with other management approaches against garlic mustard in the future.

IPM of Yellow Starthistle, *Centaurea solstitialis*. Yellow starthistle is a winter annual weed native to Eurasia. The weed was introduced into California around 1850 from contaminated alfalfa seed from South America. Yellow starthistle commonly infests open areas along roadsides, rangeland, wildlands, hay fields, pastures, and waste areas. The weed currently infests between 10 and 15 million acres in California alone. Researchers in California have made significant progress on the control of yellow starthistle using an integrated approach.

Over a four-year period, Fort Hunter Liggett has implemented these new integrated management techniques in different habitats typical of California and other Western states in order to find the best integrated approach for managing yellow starthistle. The research and implementation plan focused on three habitats: grasslands disturbed annually; grasslands surrounded by oaks; and grasslands supporting rare plant populations.

Prescription burning was used to remove dead yellow starthistle vegetation, to sterilize the residual above-ground seed bank, to stimulate seedling germination, and to eliminate “bolting” yellow starthistle plants. Prescription burning was followed-up with application of Transline herbicide. Biological control agents were also established in these habitats. The primary species used were *Eustenopus villosus* (hairy weevil) and *Larinus curtus* (flower weevil). Revegetation was also an important component of the integrated management plan. Legumes and perennial grasses were used to control erosion and compete with yellow starthistle plants.

Preliminary implementation of the integrated approach significantly reduced yellow star thistle cover and increased overall species richness. On the annually disturbed grasslands, these techniques reduced yellow starthistle 99% and increased species richness 27%. On grasslands surrounded by oaks, the integrated methods reduced yellow starthistle 94% and increased species richness 13%. And in grasslands supporting rare plant populations, where herbicide treatments were not used due to concerns for threatened plant species, yellow starthistle was reduced 37% and species richness increased 13%.

## References

- Barker, K. R. and S. R. Koenning. 1998. Developing sustainable systems for nematode management. *Annu. Rev. Phytopathol.* 76: 165-205.
- CAST. 2003. Integrated Pest Management: Current and Future Strategies. Council for Agric. Sci. and Technol., Ames, Iowa. Task Force Report No. 140, 246 pp.
- Kennedy, G. G. and T. B. Sutton (eds.). 2000. Conference on Emerging Technologies for IPM: Concepts, Research and Implementation. APS Press, St. Paul, Minnesota.
- Lee, H and J. W. Chapman. 2001. Nonindigenous species – an emerging issue for EPA. Volume

2: A landscape in transition: Effects of invasive species on ecosystems, human health and EPA goals. 54 pp.

Lym, R. G. 2004. Integration of biological control agents with other weed management technologies: How can it be done best? Abstract. Science and Decision-Making in Biological Control of Weeds. January 27-29, 2004, Denver, CO.

Pimentel, D., L. Lach, R. Zuniga, and D. Morrison. 2000. Environmental and economic costs of nonindigenous species in the United States. *BioScience* 50: 53-65.

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Approved by FICMNEW on September 1, 2004