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Rearing and Releasing Galerucella Beetles to Control Purple Loosestrife

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Rearing and Releasing Galerucella Beetles to Control Purple Loosestrife

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Purple loosestrife is a noxious weed quickly invading Nebraska's wetlands. This publication describes the rearing and releasing of insects for biological control of the weed, as one part of an integrated management program.

Purple loosestrife (*Lythrum salicoria*, *Figure 1*) is a noxious perennial weed invading thousands of acres of wetlands and waterways in the Midwest. In Nebraska an estimated 18,000 acres are already infested by this plant, mostly along the main rivers and waterways. Purple loosestrife is a strong competitor suppressing the growth of native vegetation. Once a wetland is taken over by loosestrife, the balance of natural habitat *(Figure 2)* is lost and the productivity of native plant and animal communities is severely reduced. Loosestrife has very limited food value for most wildlife species. Some song birds may feed on the seeds and deer may graze the young plants; however, once the loosestrife plants are about a foot high the leaves and stem harden and become unpalatable. Wildlife species are forced to feed on the surrounding plants, creating more space for purple loosestrife to expand. By feeding on other species, wildlife "eats itself out of house and home." Loss of habitat and wildlife interferes with various levels of the ecosystem and influences many recreational activities, creating a negative effect on the social and economic well-being of local communities. With the loss of recreational land for fishing, boating and hunting , the local communities also lose tourism revenues.

Purple loosestrife is of Eurasian origin and was introduced to North America in the early 1800s. It has no natural enemies in North America, therefore it is very hard to prevent it from spreading. For years people have tried to eradicate it, especially in the Great Lakes region and northeastern United States. Now it is clear that this is impossible and we must find ways to live with this plant. The challenge in our state is to contain the weed and stop its spread. A single method does not provide long-term, sustainable, control. An integrated approach, which includes the use of a variety of mechanical, cultural, chemical and biological control methods is necessary. For example, mechanical control methods may include plant clipping and flower head removal as well as mowing and disking repeated at least several times during the season. Herbicides such as Rodeo, 2,4-D and Garlon 3A also have been promising tools for weed control. Another option would be to integrate biological control methods. This NebGuide describes a practical, inexpensive method for rearing and releasing insects for biological control of purple loosestrife.

Figure 1. Purple loosestrife

Figure 2. Wetland habitat infestations

Biological weed control or biocontrol is the use of natural enemies to reduce weed populations to economically acceptable levels. In general, the effectiveness of biocontrol has been limited primarily to perennial weeds on low value land (rangeland, pastures, forests, roadsides and recreation lands) and aquatic sites. Perennial weeds growing in these relatively undisturbed areas are ideal targets because biocontrol agents have a chance to build up their population over an extended time. Biocontrol agents are chosen specifically for their selectivity, so they cannot be expected to control a complex of weeds effectively. Their greatest value is in situations where a single aggressive weed is the major problem.

Bio-control agents can be an important component of an

integrated approach to stop the expansion of purple loosestrife in Nebraska. They are especially valuable for those sites that are not easily accessible for other methods of control. Examples of such sites are evident along the main waterways in Nebraska. At some sites loosestrife covers 95 percent of the wetland while growing under large trees, which prevents the use of other control methods, especially aerial application of selective herbicides. Control of such sites is limited to biocontrol agents and would benefit from the establishment of local insectariums for rearing and releasing biocontrol insects.

Several insect species were introduced from Europe, where loosestrife originated. They include: root weevil (*Hylobius* sp.), two beetles (*Galerucella pusilla* and *G. calmariensis*), and two flower-feeding weevils (*Nanophyes* sp.). Based on the quarantine studies conducted by USDA, these insects are highly host specific to purple loosestrife, defoliating the plant as both adults and larvae. These insects, in combination with other plant species, act as natural competitors to keep loosestrife under control in Europe.

Raising Galerucella Beetles

Raising *Galerucella* beetles is a relatively easy and inexpensive procedure which does not require special skills. The first step is to acquire the necessary materials *(Table I)* and select a location for the rearing pit. Most of the materials can be easily found at the local garden center. The pit *(Figure 3)* should be located in a secluded sunny location away from wind and other forms of disturbance.

Establishing the Rearing Pit

Depending on how long you plan to use it, several types of rearing pits can be built. Short-term pits can be built by simply scraping the soil surface from the center to the edges of the pit, creating a berm. A plastic wading pool is also an alternative. Long-term pits are usually constructed of concrete, concrete blocks, impregnated wood or PVC pipes. An average pit is about 1 foot deep and 10 ft x 10 ft *(Figure 3)*. A plastic liner or a thick plastic sheet is laid on the bottom of the pit to hold the water. A minimum of 3 inches of water is important to simulate the weed's natural habitat. Overflow holes or pipes should be installed to the side of the pit at about five inches from the bottom to prevent bucket tip-overs when heavy rains occur.

Collecting Purple Loosestrife Rootcrowns

The rootcrown is the underground portion of the plant that consists of woody storage roots and stem buds which will produce new shoots. In spring, preferably during May, collect mature rootcrowns from a local wetland infestation of loosestrife. Dig the "clump" of rootcrown from the soil using a shovel or tile spade. Live and healthy rootcrowns have a tan to brown color. They are pink to whitish on the inside and somewhat flexible. Do not collect rootcrowns that are charcoal-black and brittle because they likely are dead. Collect rootcrowns about 12 weeks before you plan to release new beetles. Collect enough rootcrowns for all buckets, an average of one healthy rootcrown per bucket.

Table I. Materials needed, cost and quantities.

Material	*Cost/unit*	*Quantity*[1]
Heavy duty plastic liner	$20	1
Wading pool (alternative)	$10	1
Five gallon buckets	$ 1	50
Soil mix (planting mix)	$ 2	25 bags
Fertilizer, 14-14-14 NPK	$15	5 lbs
Metal fence posts (T-posts)	$ 4	6
Heavy duty nylon string	$ 3	1
Sleeve mesh cage[2]	$ 4	25 yards
Wire tomato cage (alternative)	$ 3	—
Aspirator (alternative)	$ 8	1
PVC pipe and elbows (alternative)	$ 0.5/ft	50 ft
Large cable ties (>36 inches)	$ 0.5	50
Clothes pins	$ 0.03	50
Plastic cable ties	$ 0.03	50

[1]Actual quantity will depend on the size of the pit.
[2]Sold per yard, cost of cutting and sawing not included.

Figure 3. Rearing pit

Potting the Rootcrowns

Rootcrowns should be potted immediately to avoid drying. First, drill several 1/2-inch holes on the bottom of the bucket to allow water uptake. Fill the five-gallon bucket halfway with potting mix and add a tablespoon of any slow release fertilizer. Place one large or several smaller rootstocks inside the center of each bucket and fill the remainder with potting mix. Sprinkle sufficient water to moisten the potting mix. Orient the rootcrowns in the same direction they were growing in the wetland, shoot buds pointed upward. Add more potting mix and water. Do not press or pack the potting mix into the bucket because the beetle larvae need a porous soil to aid movement into the top inch to pupate. Put the potted plants inside the rearing pit.

Maintaining the Plants

Make sure that plants have adequate water at all times, maintaining a water depth of about three inches in the pit. Too much water will make the buckets unstable and they may tip over. When plants are about one foot tall, cut off the tip of each stem to stimulate branch development. Pruning will produce bushier plants for larval feeding. Ten to 20 days later the plants should be ready to receive the *Galerucella* beetles. Place the fence poles into the ground along the edge of the pit and spread the nylon string between them, over the pit and potted plants *(Figure 4)*. Use the mesh sleeve bags to cover the whole plant. The mesh sleeve bags can be made from a mosquito-type mesh obtained at a local hardware store. Tie the top of the mesh sleeve with cable ties and then clip it to the nylon string using clothes pins. Attach the bottom end of the mesh sleeve to the upper edge of the bucket using a long plastic tie or rubber-band. Most buckets have a groove along the upper edge which works well to hold the mesh sleeve bag *(Figure 5)*.

Infesting Loosestrife Plants with Beetles

Beetles can be obtained from several sources *(page 4)*. Make sure they are not exposed to temperature extremes during

Figure 4. Pots, mesh sleeves and plants

Figure 5. Pots and large cable ties

Figure 6. *Galerucella* adult (Courtesy of Don Hamilton, University of Guelph)

Figure 7. Feeding damage by *Galerucella* adults

Figure 8. *Galerucella* eggs mass (Courtesy of Don Hamilton, University of Guelph)

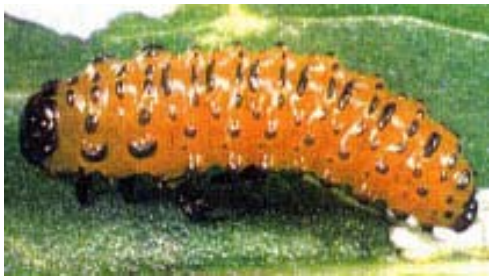

Figure 9. *Galerucella* larva (Courtesy of Don Hamilton, University of Guelph)

shipping. Place 20-25 beetles from the bulk shipping container in each bucket. Untie the top of the mesh sleeve cage you want to infest with beetles and place them into the cage. Make sure to securely close both the top and the bottom of the mesh sleeve and periodically check to prevent beetle escape.

Gallerucella Development

The time needed for *Gallerucella* development will depend on the temperature and food quality. About six to eight weeks are needed for new beetles to develop from the time the initial adults are placed into the mesh cage. Approximate development times for each life stage are: adult (eight weeks), egg (two weeks), larva (three weeks), and pupa (two weeks). The initial 20-25 adult beetles can produce about 400-600 new adult beetles.

Beetles *(Figure 6)* will begin feeding on the foliage soon after placing them in the mesh sleeve cages. Signs of their feeding will be evident in the form of "shot-holes" on the loosestrife leaves *(Figure 7)*. Adult mating will begin soon after feeding. About two weeks later females begin laying eggs. The eggs are laid in small groups *(Figure 8)* attached to the stem and leaves over a period of several weeks. Yellow-colored larvae hatch two weeks after eggs are laid and will have black stripes across the width of the body. The larva has three growth stages (instars). The first two instars are very small and probably not noticeable through the mesh. Third instar larvae *(Figure 9)* are about 1/4 inch long and more easily seen. Larval feeding is indicated by white stripes on the leaves. Larvae eat the upper layer of the leaf, leaving the lower layer behind. Black, dust-like excrements collecting on the leaf or the mesh sleeve are another indicator of feeding activity. Last instar larvae crawl to the soil, just under the surface, to change into pupae. During pupation — the transitional stage from larvae to adults which lasts for about two weeks — they do not feed or move. New adults emerge from the pupae and begin feeding right away. They usually congregate at or near the top of the sleeve. They are lighter color than the older beetles. The combination of extensive defoliation and the appearance of many new beetles near the top of the mesh sleeve is an indication beetles are ready for release into the wetland.

Do not wait for all adults to emerge. There is not enough food for all adults since the plants are heavily defoliated by larvae. If plants are completely defoliated and many larvae (>50) are still found on the plant, it is necessary to supplement feeding with fresh shoots from another bucket or collected from a wetland. It may be handy to keep a few extra buckets of non-infested loosestrife plants available. Place the freshly cut stems in a bottle of water and place in contact with the defoliated loosestrife plants. Larvae and adults will move to the new shoots to feed.

Releasing the Beetles

Releasing adult beetles is the final stage in the process. Different release methods can be used. We suggest taking the whole cage (bucket, mesh sleeve, plant) and placing it next to purple loosestrife already growing in the release site. Space the 10 plants within an area of 10 square yards (one plant per square yard). Remove the mesh sleeve, allowing insects to move freely. Place remaining larvae onto purple loosestrife plants. Leave the buckets, plants and soil intact for a few weeks, allowing enough time for all adults to emerge. Empty soil, collect buckets and destroy remaining rootcrowns later. Rootcrowns can be destroyed by leaving them where they can dry out completely or burn them.

Select a release site that is an easily accessible, sunny location, not highly visible to vandals and others who may

disturb the release area. The corners of the release site should be marked with fence poles or PVC pipes with colored flags to facilitate returning to them if needed. If possible, the release site should be spatially referenced. It can be done by providing coordinates using Global Positioning System (GPS). GPS coordinates are especially valuable for those sites along main rivers. For example, the Missouri River in northeast Nebraska often changes its channel, resulting in eroded river bank. GPS coordinates would help locate these sites. GPS data also can be used for making a state map of all release sites. Such information would be valuable to University of Nebraska scientists for monitoring insect spread. In addition, record the exact location of the site with a diagram of measurements and permanent reference points using landmarks such as trees, rocks, docks, etc.

Monitoring Insect Survival and Spread

Rearing and releasing insects is just one step in the process of biocontrol. Monitoring insect survival and spread is also crucial for the success of the control. We suggest monitoring the sites for several years after the release. Observe and record insect survival, movement, feeding damage and possible off-target feeding. Results from other parts of the United States and Canada suggest that it takes five to seven years to observe effects of feeding. Most estimates suggest a range of 5 to 15 years depending on insect survival. Survival will depend not only on the food quality, but also on weather-related mortality and predation. For example, about 30 percent of recently released insects have been predated by local birds at one site in northeastern Nebraska, requiring additional insect releases. Some sites may require a continuous release program for three to five years until a sufficient insect population size is achieved. Therefore, monitoring release sites and scouting for insect damage for several years after the release day can provide information on the effectiveness of the control program.

Monitoring Non-target Feeding

Even though *Galerucella* beetles have been tested and approved for release by the U.S. Department of Agriculture, there might be a risk of their feeding on non-target species. Host specificity testing showed that in the absence of purple loosestrife, the *Galerucella* beetles could feed on several related native North American species. The species of concern are winged loosestrife (*Lythrum alatum*), California loosestrife (*L. californicum*), and swamp loosestrife (*Decodon verticillatus* (L). To argue in favor of *Galerucella*, the review panel of USDA scientists concluded that the benefits of controlling purple loosestrife outweighed the potential risk to non-target species. They believe that non-target species were unlikely to be threatened by the *Galerucella* species in the field because the beetles strongly prefer purple loosestrife; however, since there are so many purple loosestrife control programs in the United States solely based on *Galerucella* and which release thousands of beetles annually, it is important to practitioners and critics alike to be aware of the potential risk. This also brings the rationale or need for developing comprehensive monitoring programs.

Places to Obtain the Beetles

Adult beetles can be obtained from several sources. In some cases, the sources of beetles might be right next door in your county. Check with the nearest Extension Office or the County Noxious Weed Superintendent. If there is a bioc ontrol project in the county, you may be able to collect beetles locally to begin a breeding stock. Additional information is available from the Nebraska Department of Agriculture or the Federal Plant Protection Quarantine office in Lincoln (USDA-APHIS-PPQ).

It's the Law

The Noxious Weed Control Act defines and places specific responsibilities for noxious weed control on landowners, individual counties, and the State of Nebraska. The Act is known as Title 25, Chapter 10, Nebraska Administrative Code - Noxious Weed Regulations. Under these regulations, purple loosestrife became a noxious weed as of January 2001.

Noxious Weed Law, Biocontrol methods (002.02D): To be deemed acceptable, the use of livestock, predators, pathogens and parasites as a method of controlling noxious weeds shall be as effective as the use of herbicides, as set in the 002.02C, and shall be approved by the control authority.

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