

STORAGE AND TRANSPORTATION

BEFORE YOU BEGIN

The manner in which biocontrol agents are handled from the moment you collect or obtain them, during transportation to the release site, until the moment they are released will affect whether they will survive and multiply at the new site. **To reduce mortality or injury, it's ideal to release biocontrol agents the same day they are collected.**

SORTING

Regardless of the method you use to field collect weed biocontrol agents, extraneous debris (such as other insects, weed seeds, etc.) must be sorted and removed to avoid spreading potential problems to the areas of release. This can be accomplished in different ways, such as using sorting trays and an aspirator (Fig. 1a), picking out the target biocontrol agent by hand, or using a passive sorter. A relatively simple passive sorting option is to take a large PVC pipe, or even a large mailing tube, and either drill holes or saw slits that are just larger than the size of your target biocontrol agent (Fig. 1b). Cap off both ends after you put your sweep contents inside, and place the sorter in a mesh bag or even a lightweight white pillowcase. Insects will crawl towards the sun, so after the sorter is placed in the sun for up to 30 minutes, many of the desired biocontrol agents will come out of the holes and into the bag (Fig. 1c) while larger insects, less mobile insects, and debris all stay inside and can be dumped out after.



Figure 1. (a) aspirating biocontrol agents out of a sorting tray; (b) passive sorter made from a capped mailing tube with holes drilled just larger than the target biocontrol agent; (c) biocontrol agents emerging from the holes of a passive sorter and being contained by a large mesh bag (a-c: Travis McMahon, MIA Consulting)

Many biocontrol agents will try to crawl or fly away immediately when collected, especially at high temperatures. Cooling the collected sample for 10–15 minutes reduces insect activity and can make sorting easier. Any cooling should be done in a refrigerator, not a freezer. If sorting is done in the field, keep the sorting trays or containers in the shade.

COUNTING

If you are collecting a large number of insects from a productive insectary site, counting a set number of beetles, repeating the process 2–5 times, and marking the average of their volume on a collection vial will provide an accurate method of collecting large numbers without the added task of counting each individual beetle (e.g., 100–200 *Mecinus* spp. beetles for toadflax; Fig. 2). Remember that adults of the various biocontrol species are different in size, so different fill levels should be used for each biocontrol agent species.



Figure 2. Collection vial with average fill levels for 500, 1000, and 1500 *Mecinus* beetles (Sharlene E. Sing, USDA FS RMRS)

STORAGE CONTAINERS

Biocontrol agents should be maintained in containers intended to protect them and to keep them from escaping en route to the release site. Containers should be rigid to resist crushing and ventilated to provide adequate air flow and prevent condensation. Unwaxed paperboard cartons (Fig. 3a) are ideal for most species. Alternatively, you can use light-colored, lined containers (such as ice cream cartons) or plastic containers, as long as they're ventilated. Cut or poke holes in the container or its lid, and cover the holes with a fine mesh screen. Do not use glass or metal release containers; they are breakable and make it difficult to regulate temperature, airflow, and humidity.

BIOLOGICAL CONTROL OF WEEDS



Figure 3. (a) unwaxed cardboard release container with label; (b) container filled with tissue paper for biocontrol agents to rest on and hide in and for regulating humidity (a: Jennifer Andreas, Washington State University Extension; b: Travis McMahon, MIA Consulting)

For insects, fill containers with crumpled tissue paper (Fig. 3b) to provide a substrate for insects to rest on and hide in, and to help regulate humidity. Include several fresh sprigs of the target weed foliage. Sprigs should be free of roots, seeds, flowers, dirt, spiders, and other insects. Do not place sprigs in water-filled containers; they may crush the biocontrol agents or drown them upon leaking. Seal the container lids either with masking tape or rubber bands. Be sure to label each container with (at least) the name and number of biocontrol agent(s), the collection date and site, and the name of the person(s) who did the collecting (Fig. 3a). When infested stems or foliage are used for redistribution, the plant material should be stored in sealable but breathable bags made of paper or gauze. Plastic bags may cause moist plant material to rot or drown the biocontrol agents. Infested plant material should be kept cool at all times to avoid deterioration during hot summer months.

DO'S

- Use rigid but ventilated containers
- Add crumpled tissue paper and sprigs of target weed
- Seal and label each container
- Keep containers in a refrigerator no lower than 40°F/4°C until release
- Release as soon as possible

DON'TS

- Use glass or metal containers
- Allow roots, seeds, flowers, spiders, other insects in the containers
- Keep containers in a hot vehicle or the dash of even a cool vehicle
- Store insects in containers for more than two days

STORAGE

If you sort and package your agents indoors, keep them in a refrigerator (no lower than 40°F or 4°C) until you transport or ship them (which should occur as soon as possible but no longer than 48 hours). For biocontrol species that hibernate within target weed material over winter (e.g., some beetle species), infested plant material can be kept in cold storage overwinter and then transferred the following spring. Plant material must be retained under consistently cold, moist conditions (ideally 40–46°F, 4–8°C) at ~60% humidity) to keep biocontrol agents alive and discourage them from leaving the stems until host plants begin growing on release sites the following spring.

TRANSPORTATION (SHORT)

Once you collect and package the biocontrol agents, maintain them at temperatures between 50 and 65°F (10–18°C). If possible, place the release containers in large coolers equipped with frozen ice packs (Fig. 4). Don't use ice cubes unless they are contained in a separate, closed, and leak-proof container. Wrap the ice packs in crumpled newspaper to prevent direct contact with release containers and to absorb any condensation that forms. Then place extra packing material in the coolers to prevent ice packs from moving around and damaging the biocontrol agent containers. As an alternative to coolers with ice packs, electric car-charged coolers may be utilized, provided they are checked regularly for the proper settings and for vent blockages to ensure temperatures are adequate. Always keep coolers out of direct sun, and only open them when you are ready to release the biocontrol agents. If you can't release them immediately, place them in



Figure 4. Cooler with release containers and wrapped frozen ice packs that has been filled with crumpled newspaper and other packing material to prevent the ice packs from crushing the release containers during transit (Travis McMahon, MIA Consulting)

a refrigerator (no lower than 40°F or 4°C) for short-term storage until you transport or ship them (which should occur as soon as possible and preferably not longer than 48 hours).

SHIPPING LONG DISTANCES

If you will be shipping your biocontrol agents to their final destination, use a bonded carrier service with guaranteed overnight delivery. Some carriers do not ship live insect material. Check with your local carrier ahead of time, and also make sure they will not treat the packages in ways that could harm the biocontrol agents. Plan collection and packaging schedules so that overnight shipments can be made early in the week. Avoid late-week shipments that may result in delivery on Friday through Sunday, potentially delaying release of the biocontrol agents for several days. Send the recipient the tracking number for the package, verify that someone will be there to accept the shipment, and instruct them to open the package and place the release containers directly into a refrigerator until the biocontrol agents can be released (as soon after receipt as possible).

The release containers should be placed in insulated shipping containers with one or more ice packs. Some specially designed foam shippers have pre-cut slots to hold small biocontrol agent containers and ice packs. This construction allows cool air to circulate but prevents direct contact between the ice and the release containers. Laboratory and medical suppliers sell foam “bioshippers” that are used to transport medical specimens, or insulated boxes used by meal delivery services could be recycled to use for shipping biocontrol agents. If neither foam product is available, you can use a heavy-duty plastic cooler which also may be better suited to large weed stems infected or infested with biocontrol agents. For additional security and protection, it is recommended you place the sealed shipping containers or coolers inside cardboard boxes. Clearly label the shipping containers and specify that they contain perishable material.

Careful packaging is very important regardless of the shipping container you use. Ice packs need to be wrapped in crumpled newspaper, wrapping paper, or bubble wrap, and should be firmly taped to the inside walls of the shipping container to prevent them from bumping against and possibly crushing the release containers during shipping. Empty spaces in the shipping container should be loosely filled with crumbled or shredded paper, bubble wrap, packing “peanuts,” or other soft, insulating material. Use enough insulation to prevent release containers and ice packs from shifting during shipment, but not so much that air movement is restricted.

For safety reasons, dry ice cannot be used for transporting biocontrol agents.

In the USA, transporting many biocontrol agents across state lines requires a [special permit](#), and for other species (such as galling insects), the transport of galled material across state lines is illegal. If your biocontrol agent is approved for transfer across state lines and your shipment is going interstate, enclose all paperwork accompanying the biocontrol agents (including copies of permits and release forms) before sealing the shipping container.