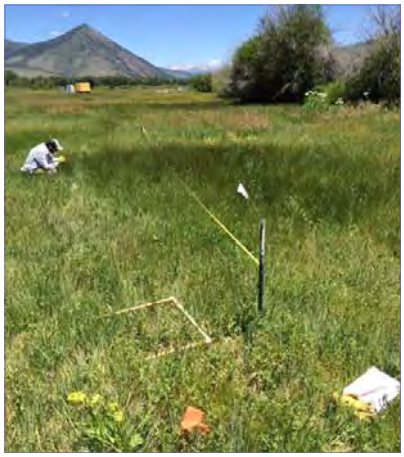
Colorado Department of Agriculture 2016
Palisade Insectary

BIOCONTROL

Biological control is the use of natural enemies to suppress weed and pest populations in a safe, effective and economical way. The Palisade Insectary implements biological control which means that we perform the last step in the process of biological control; putting the agents out and into action. Besides agent release the modern practice of biological control implementation also includes post-release monitoring and evaluation of the agents in action. Monitoring is a component of any pest or weed management program, and is a cornerstone of integrated pest management (IPM). Through monitoring we learn how the agent is doing in the field and then can use that information to guide the program. In this issue of Biocontrol we report success in controlling Dalmatian toadflax which was quantified through long term monitoring and we present information on the impact of tamarisk beetles on tamarisk flowering which had been reported as anecdotal information, but has now been quantified through our monitoring program which has been ongoing since 2005. We also update the Canada thistle biological control project where the Canada thistle rust fungus is now showing an impact on densities of Canada thistle in the field.

All of our projects are collaborative efforts between the Insectary and end users of biological control but we also depend on collaborators to provide us with the agents and information about them at the start of our projects. Collaboration includes the delivery of safe effective biological control agents through the long pipeline that begins overseas with our international partners and goes through the research branch of the USDA ARS (Agricultural Research Service) and then through the regulatory

Inside This Issue



Jon Golson monitors Canada thistle following rust treatment.

branch of the USDA APHIS (Animal and Plant Health Inspection Service), before agents can be used in the US. Even after they are approved for use here we keep in close contact with other biocontrol end users around the west, sharing experiences and tips on how to best use the agents. Every year all of these groups, from international organizations to universities and state agriculture departments come together at the western regional biological control meetings known as the W3185 meetings. This year the Colorado Department of Agriculture sponsored the meetings which attracted biocontrol scientists and practitioners from around the west and around the world, as described in this newsletter.

Our annual biocontrol release records are listed below for 2016. Overall it was a successful year with most requests fulfilled and most areas of the state covered by releases. *Aulacidea acroptilonica* and *Mecinus janthinus* are both new agents in short supply for Colorado and will be the focus of collection and propagation efforts in 2017.

Agent	Target	# of Releases	Total Agents
Aceria malherbae	Field bindweed	585	585,000
Tyta luctuosa	Field bindweed	12	2,530
Aphthona spp.	Leafy spurge	70	70,000
Oberea erythrocephala	Leafy spurge	5	250
Larinus minutus	Diffuse or Spotted Knapweed	120	24,050
Cyphocleonus achates	Spotted Knapweed	10	525
Jaapiella ivannikovi	Russian Knapweed	87	2,168
Aulacidea acroptilonica	Russian Knapweed	2	97
Mecinus janthinus	Yellow toadflax	16	3,253
Mecinus janthiniformis	Dalmatian toadflax	107	21,475
Trichosirocalus horridus	Musk thistle	88	8,800
Puccinia punctiformis	Canada thistle	117	5,425 grams
Macrocentrus ancylivorus	Oriental fruit moth	1,556	1,556,000
Hylobius transversovittatus	Purple loosestrife	3	900
Microlarinus spp	Puncturevine	147	14,780
Diorhabda carinulata	Tamarisk	24	180,500

"# of Releases" may represent more than one release site. The number in the column "Total Agents" is the number of adults, galls, mites or inoculations depending on the agent.

Before (left, 2013) and after (right, 2016) Dalmatian toadflax biological control at the Hewlett Fire site. Steve Ryder, CDA noxious weeds, releasing adults weevils in 2013 (left). Note the lack of yellow flowers in the photo on the right.

DALMATIAN TOADFLAX

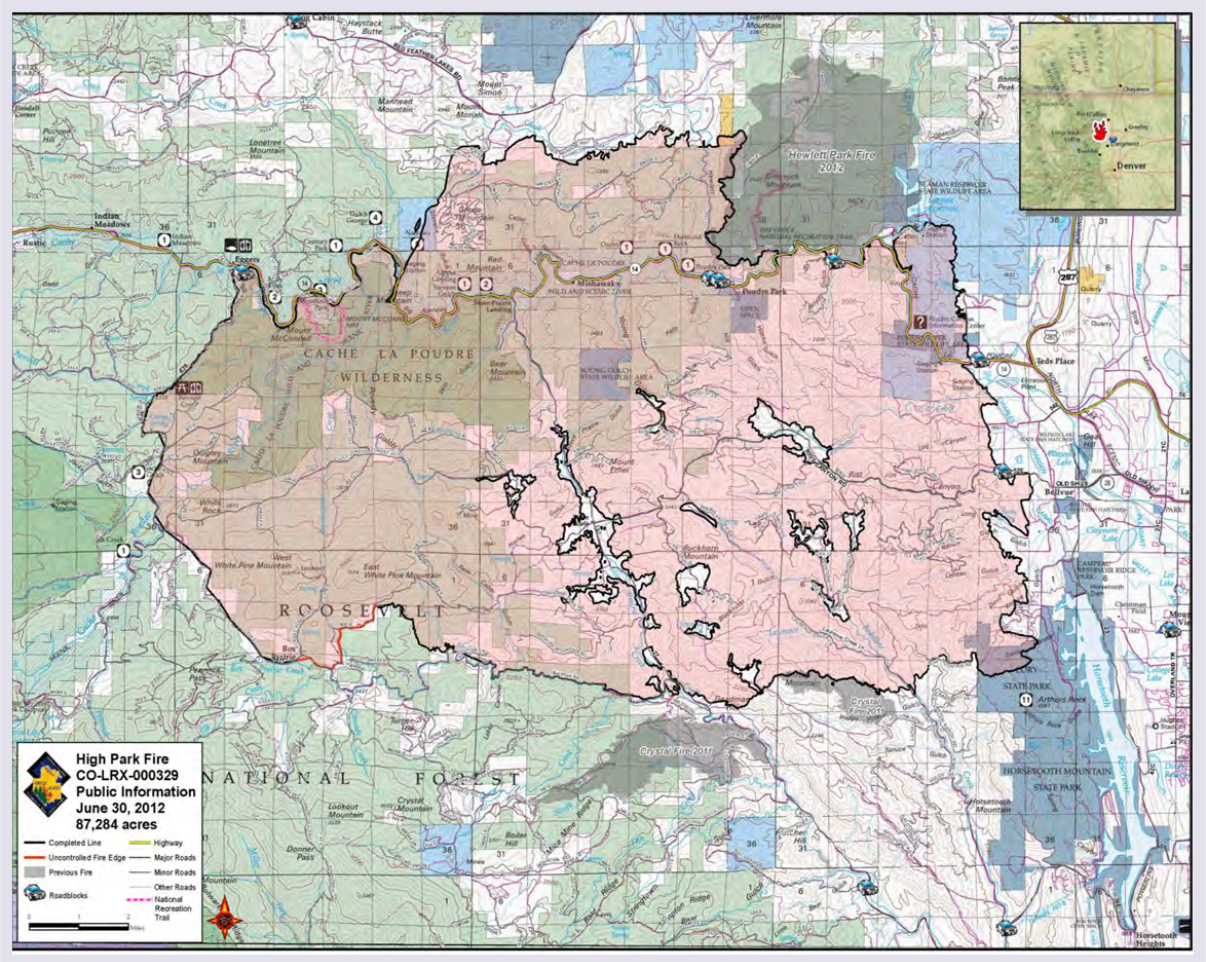
In 2012 the Hewlett and High Park fires northwest of Fort Collins, CO, burned approximately 95,000 acres of land that included the Gateway Natural Area near Seaman Reservoir. After the fires, the steep, blackened hillsides were quickly invaded by several species of noxious weeds. By far the most dramatic invasion was from the showy perennial weed, Dalmatian toadflax (*Linaria dalmatica*). This plant crowds out native grasses and forbs, is shunned by livestock and wildlife and reproduces by both seed and creeping rhizomes. In the late spring and early summer flowering Dalmatian toadflax can light up a hillside with bright yellow blossoms and this is especially conspicuous in burned areas. To help battle the eruption of noxious weeds after the fires, Steve Ryder of the Colorado Dept. of Agriculture (CDA) helped formed the Poudre Invasive Species Partnership (PISP), a cooperative project including the CDA, Larimer County, USDA-APHIS, City of Greeley, City of Fort Collins, CO State Land Board, CDOT, CO Parks & Wildlife, USDA-Forest Service and 2 private landowners. The Insectary's role in PISP was to develop a biocontrol program for Dalmatian toadflax within the burned areas.

Releases of the stem boring weevil, *Mecinus janthiniformis* in 2013 (6450 weevils) and 2014 (2077 weevils) at 27 different sites in the Hewlett burn have led to overwintering and establishment in the burned area above Seaman Reservoir. The weevils overwinter within stems as adults that emerge in spring, feed on leaves, mate and lay eggs in new stems. Larvae tunnel

within the stem as they feed and then pupate in them stem and the cycle is repeated. There is one generation per year.

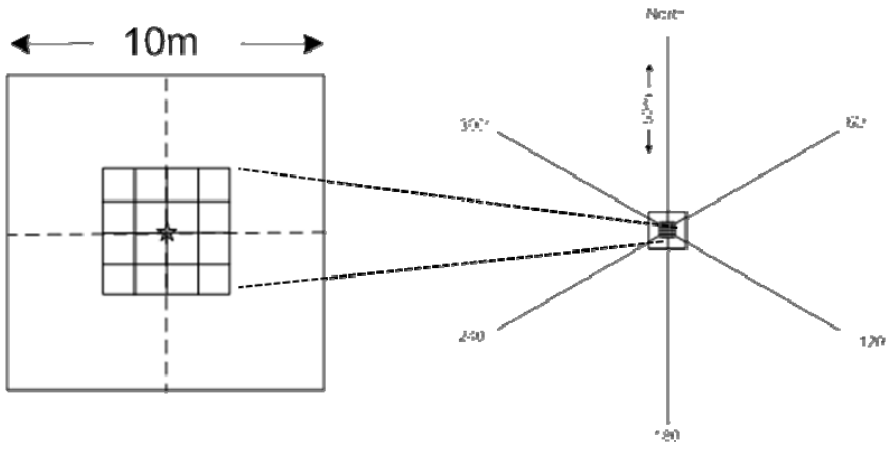
Dalmatian toadflax weevil.

Insectary staff set up monitoring plots at four of the release sites in this area in order to observe the changes in Dalmatian toadflax density, weevil quantities and other changes in vegetation composition. Monitoring plots consist of a central area measuring 4 x 4 meters within which all toadflax stems are counted annually. The weevil release point is right in the middle of this central high intensity monitoring zone. Beyond the release point there are 6 monitoring transects, 50 meters long, running out in a symmetrical star pattern, each offset by 60° from the nearest neighbors. Along each transect we measure vegetation and other ground cover at 2 meter intervals (See Plot Diagram next page). The intensely monitored inner plot gives us a census of toadflax within a 16 m^2 area, and sampling along the six transects gives us a measure of changes on a larger scale (the area within the 6 monitoring transects is a little more than 2 acres). Weevil densities were also monitored and correlated with overall condition of the toadflax population.



Map of burned area with the relative location of Ft. Collins shown on the right

This year Dalmatian toadflax had declined dramatically over the entire burn area. At most of our weevil release sites the blooming yellow toadflax had declined from being a dominant feature to being almost non-existent. This could be seen in a series of before and after photos. The change showed up most dramatically in our intensive 16 m^2 monitoring plots where toadflax stem densities declined to almost zero. Along our monitoring transects we could easily see the more large scale changes occurring as Dalmatian toadflax declined. First, we saw a steadier decline in toadflax stem densities than we saw in the intensive small plots. We also noted an increase in forbs and woody vegetation which could have been due to a post fire recovery of some native plant species. Finally, weevil populations had steadily increased since 2013 and in 2016 nearly every toadflax plant in the area had weevil presence and/or damage. We will continue to monitor our sites to see if Dalmatian toadflax makes a comeback as weevil populations decline due to a lack of food (green Dalmatian toadflax plants) or if the impact on toadflax populations is a long term one.



Plot diagram for protocol used to monitor Dalmatian toadflax . The left square shows the weevil release point (as a star) and the 16 m^2 surrounding it where all toadflax stems are counted. The right diagram shows the entire plot including the 6 monitoring transects.

Hillside near Seaman Reservoir covered in Dalmatian toadflax 1 year after the 2012 fire.

Dalmatian toadflax weevil inside of toadflax stems

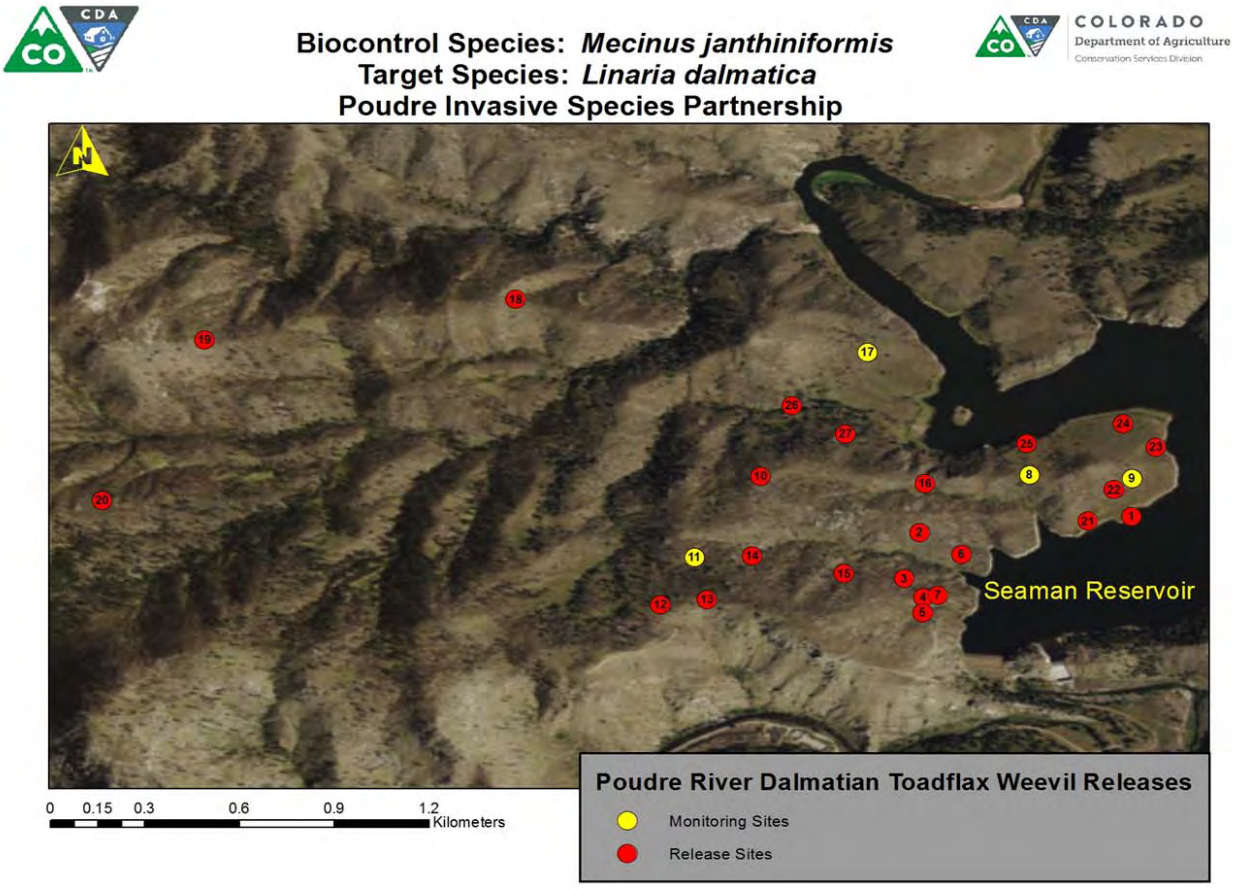
Timeline for the Dalmatian toadflax biocontrol project

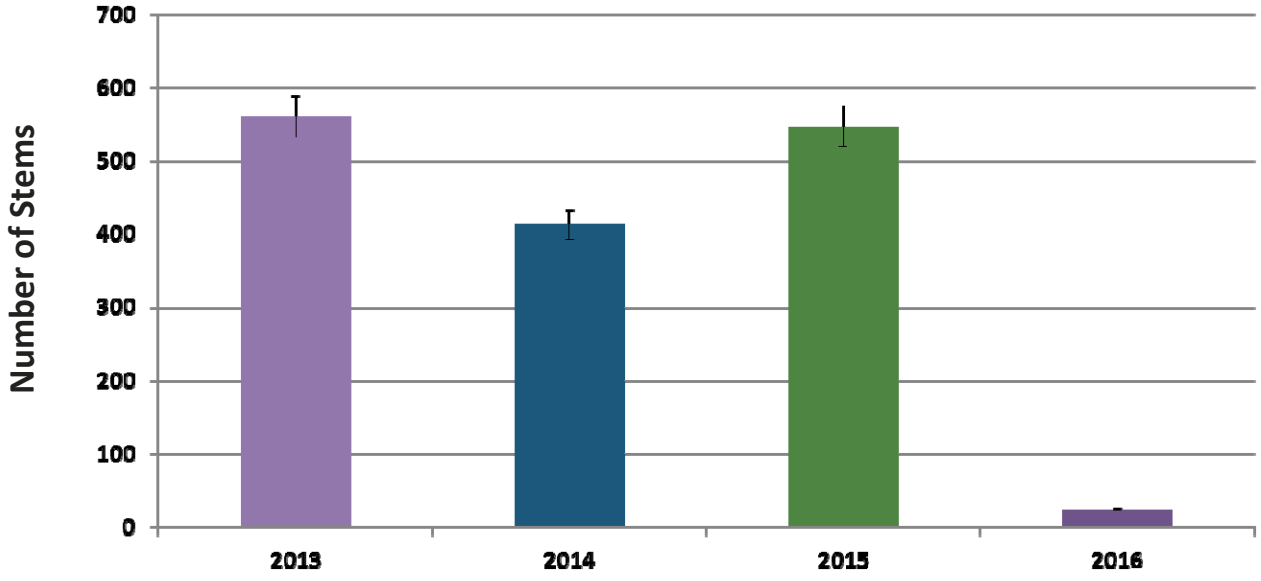
2013 Pre-release sweep samples. No *M. janthiniformis* found in four monitoring plots before release of 1050 weevils

2014 Fall stem dissections in monitoring plots. Found weevils in 77% of sampled stems.

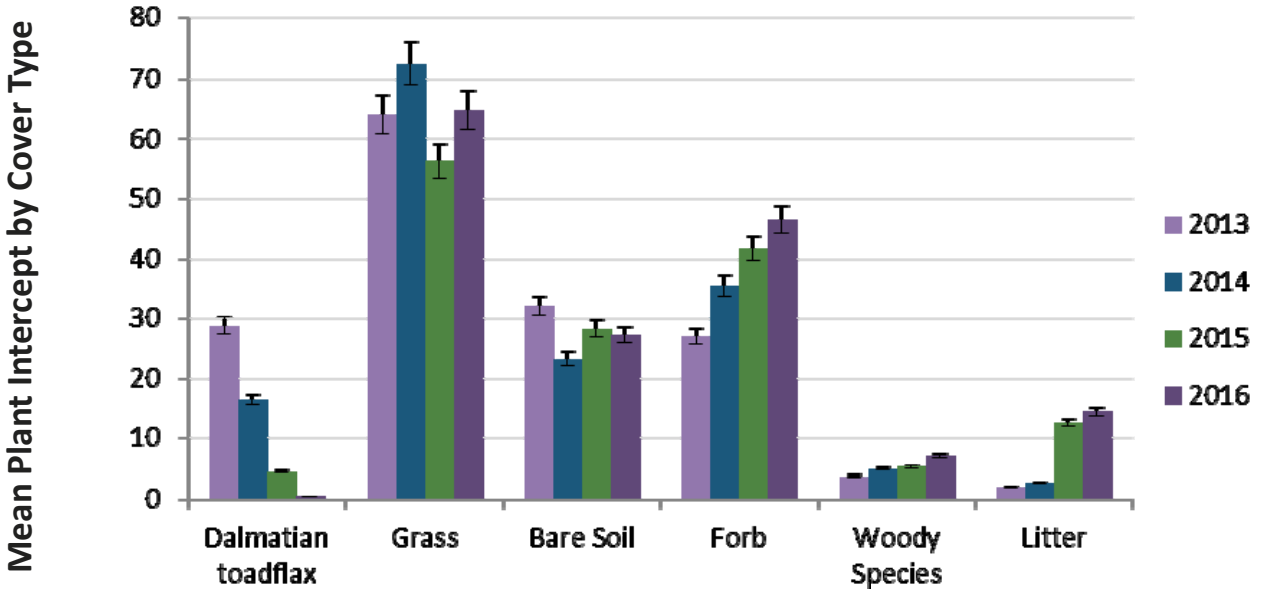
2015 Sweep samples in monitoring plots. 243 weevils collected from the 24, 50m transects. Weevils were found on 88% of transects.

2016 Few toadflax plants remain. Sweep samples and visual counts across all plots. 100% had weevils and/or feeding damage. Fall stem dissections – 67% had wee vils.





Average toadflax stem number in the four 16 m^2 monitoring plots



Vegetation Composition Over Time. Point Intercept Data taken along the 50 meter transects

TAMARISK / SALT CEDAR

When a tamarisk tree flowers, you might admire their small pink to white delicate appearance. They might smell fragrant and seem harmless; however, these seemingly innocent blossoms can produce over half a million seeds per plant, leading to thousands of invasive tamarisk seedlings under the right conditions.

The right conditions for seedling establishment include moist barren soil, such as that found when rivers recede from the high waters of spring runoff. If tamarisk seeds end up on moist barren soil they quickly germinate to form a green carpet of seedlings. During unusually wet years high rivers, streams and lakes can flood and produce ideal conditions for seed germination and establishment of tamarisk seedlings across thousands of acres of floodplains and lakeshores. Seedlings can thrive, growing half a meter per year while putting down a deep tap root to enable survival even during dry years (Fig xxx). In this way tamarisk has come to infest many of our prized riparian areas. The results of the tamarisk invasion include high water use, increased fire risks, alteration of channel flow, and even significant changes in river geomorphology. These and other negative impacts have made tamarisk a target for control and have earned this invasive weed designation as one of our List B noxious species. Control is difficult and expensive but it would be easier if we had a way to decrease flowering and lower invasion potential. Fortunately, our long term monitoring program has revealed that we already have a method for decreasing flowering in tamarisk, which is the use of the northern tamarisk beetle as a biocontrol agent!

Blooming tamarisk before

The tamarisk biocontrol implementation program started in 2005 with a few releases of the northern tamarisk beetle across Colorado and as beetle populations grew at the initial release sites collection and redistribution efforts by the Palisade Insectary were intensified, spreading beetles statewide. Now most river systems within Colorado have populations of the northern tamarisk beetle. Starting with the initial releases, the Insectary has been monitoring the spread of the beetles and damage to tamarisk. Currently we have 20 monitoring sites across Colorado. Each site includes 25

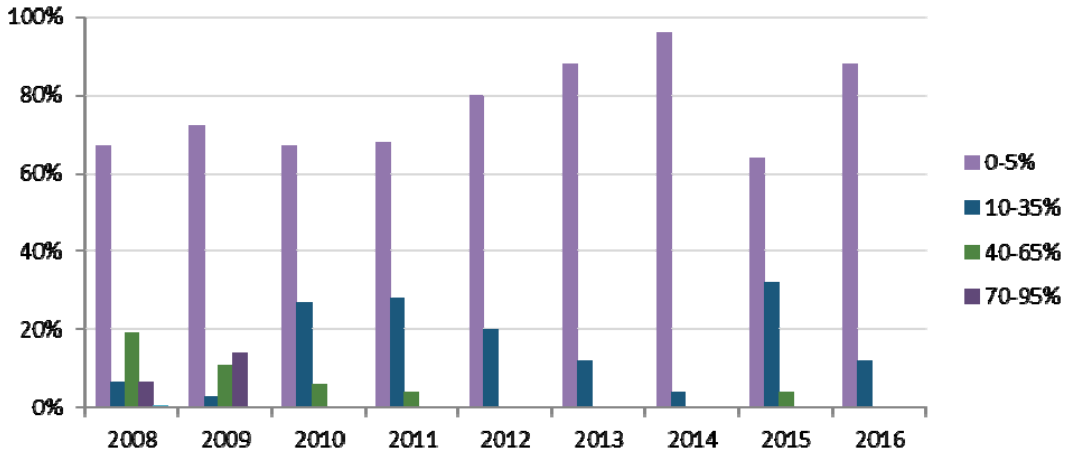
permanently marked tamarisk trees and at most sites the marked trees have been defoliated once or more as beetles have moved through Colorado's river corridors. Our monitoring protocol includes an estimation of flower density for each marked tree. Trees with no or very few flowers fall into the 0-5% category, while trees that are covered with flowers fall into the high density category of 70-90% flowering. Intermediate levels are typical of trees in areas that have not been defoliated. These are broken into 10-35% and 40-65% flowering. At sites where trees have been completely defoliated multiple times we have seen a dramatic decline in trees that fall within the high and intermediate density categories for flowering. At such sites far more trees fall into the low flowering category with few or no flowers. A prime example of this pattern is seen at the Gateway Site on the Dolores River where defoliation was first seen late in 2007 and widespread defoliation occurred in 2008. Prior to defoliation (the 2007 measurements) all trees were in the intermediate flowering categories while after defoliation (2008 and on) the majority of trees fell into the category that includes no flowers or very few flowers. This is in contrast to a site on the Gunnison River known as the Rattlesnake Gulch Site where beetles have been released but where we have yet to see widespread defoliation. Although it isn't a perfect control site, it does function as a site where beetle impact is minimal. At Rattlesnake Gulch flowering has been variable over the years but often the dominant categories are the intermediate ones. This means that the potential for seed production is much greater at a site with low beetle impact (Rattlesnake Gulch on the Gunnison) than one with high beetle impact (Gateway on the Dolores). This pattern is further illustrated by averaging data over 6 sites that have experienced multiple defoliations and comparing with data from the Rattlesnake Gulch site. Within the 6 sites that have experience multiple defoliations there are very few trees that ever show flowering densities in the high categories compared with the Rattlesnake Gulch site that continues to have trees in the high density flowering cat-

beetles have defoliated it.

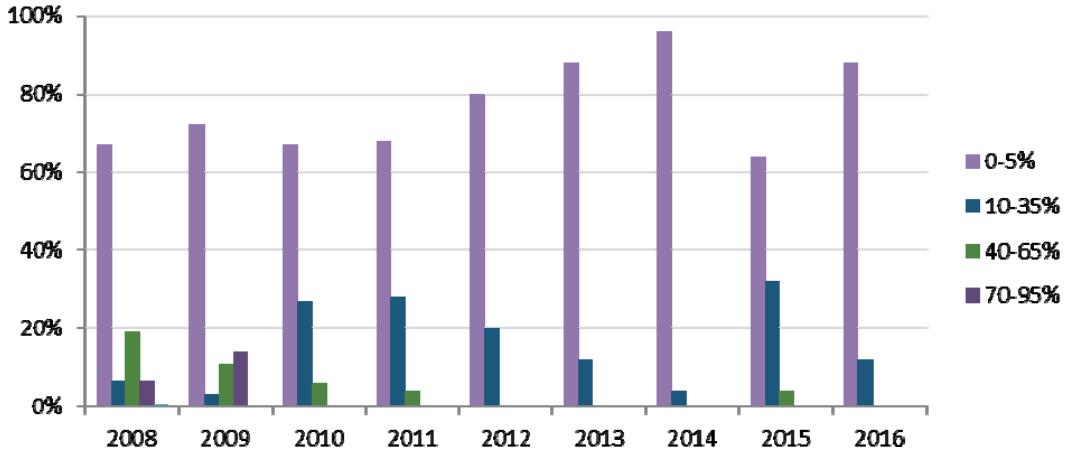
egory (see figure below). This pattern shows that beetles can diminish the ability of tamarisk to spread and we should see an overall long term decline in tamarisk statewide as flowering is suppressed by biocontrol.

Following the low beetle years of 2014 and 2015, we observed a large increase in beetle numbers on the Dolores and West Salt Creek drainages in western Colorado in 2016. We collected enough beetles to make distributions around Colorado and indications are good for even better numbers in 2017. At our eastern sites in the Arkansas Basin beetles have not recovered to levels seen in 2014. We will continue to distribute beetles in the Ark Basin as it seems that establishment is much more difficult to achieve there. Although the successful control of tamarisk has been accomplished at sites where significant decreases in flower production, canopy volume and large scale dieback have occurred, tamarisk beetles have plenty more to take a bite out of.

For more information please contact Nina Louden (nina.louden@state.co.us)



Percentage of trees in five classes of flowering density at the Gateway site. This site first experienced complete beetle-induced defoliation in 2007

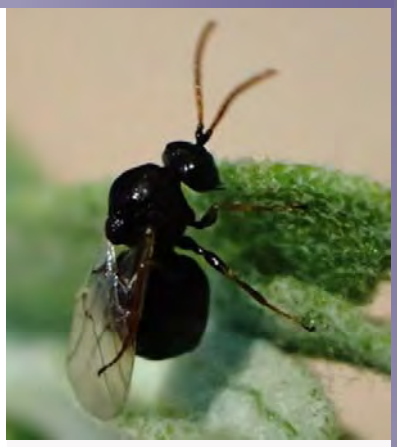


Percentage of trees in five classes of flowering density at the Rattlesnake Gulch site. This site has never experienced complete beetle-induced defoliation.

RUSSIAN KNAPWEED

The Russian knapweed gall wasp, *Aulacidea acroptilonica*, is a host specific biocontrol agent in the gall wasp family Cynipidae. Adult female wasps oviposit inside stems and branches of Russian knapweed (*Rhaponticum repens*) and the resultant larvae induce gall formation on the host plant. Galls appear as swellings on the stems of Russian knapweed and act as a nutrient diversion from flower/seed production and above-ground growth. The goal of releasing the wasp is to stress Russian knapweed plants into reduced competition with native plants and to reduce seed production. As the gall wasps spread throughout Colorado they will either overlap in range with the gall midge *Jaapiella ivannikovi* providing an additional source of stress, or they may be better suited for areas where the gall midge is difficult to establish. In either case, having both the gall wasp and the gall midge will increase the likelihood of controlling Russian knapweed.

Gall wasps were originally imported from Turkey and Uzbekistan to the U.S. in 2008. The Palisade Insectary acquired them in 2013 from Rich Hansen of the USDA APHIS in Fort Collins, and started a release program centered in Mesa County as a first step to build up gall wasp populations for general distribution throughout Colorado. We have released wasps at four separate locations in Mesa and Delta Counties and we have seen establishment of wasp populations at three of those sites, while at the fourth site establishment is yet to be deter-



Russian knapweed gall wasp, *Aulacidea acroptilonica*

Russian knapweed wasp galls.

Two wasps crawl on the side of the carton (Bottom).

Russian knapweed gall.

mined. This is a very promising result but it has taken 2-3 years for populations to grow enough to make certain of establishment. It looks like *A. acroptilonica* will be slow to build large populations. This could be due to the fact that the wasps are univoltine, that is they only have one generation per year. They may not show the explosive population growth of some of our other agents but we do have a number of successful univoltine agents, such as the leafy spurge flea beetles (*Aphthona* spp.) and the lesser knapweed flower weevil *Larinus minutus* so being univoltine isn't necessarily bad.

Our goals for 2017 are as follows: To receive additional wasp shipments from out-of-state collaborators for supplementing our newly established field colonies, to release wasps in other knapweed hotbeds around the state (Montezuma and Crowley Co.), and expand study locations where the Russian knapweed midge and wasp occur together. Our hope is that expansion of our wasp program will give us additional options for releasing in more arid environments. Wasp galls are woodier, providing more protection than midge galls, and will possibly be more resilient to extreme temperatures and low humidity.

We have a collaborative project with Dr. Paul Ode of CSU, Ft. Collins, to monitor and better understand the interactions between the gall wasp and the Russian knapweed gall midge since both are now being used to control Russian knapweed. The collaboration has allowed us to better reach landowners in eastern Colorado, and has let us benefit from the scientific expertise of the Ode lab.

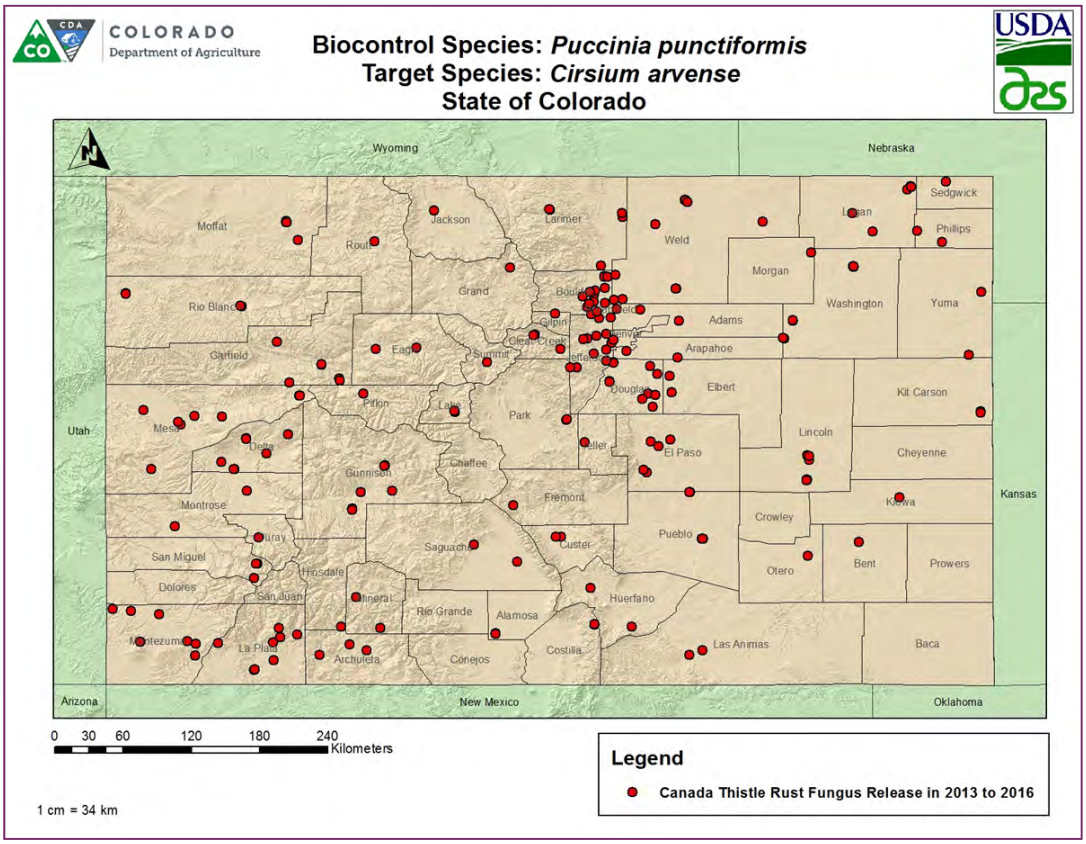
CANADA THISTLE

In the fall of 2013 the Palisade insectary initiated a program to control Canada thistle (*Cirsium arvense*) using a highly host-specific rust fungus *Puccinia punctiformis*. The program was supported by the USDA ARS Foreign Disease Weed Science Research labs in Ft. Detrick, Maryland, with the goal of getting out the rust fungus to landowners across Colorado. By the end of 2016 the rust fungus had been released at over 200 sites in Colorado which cover a wide range of environmental conditions and land use patterns (see map). At many of these locations we set up permanent monitoring sites consisting of 12 meter transects between two metal posts. We measure Canada thistle density by counting stems within 0.37 m^2 frames placed at six evenly spaced locations along the transect and we also search the area for evidence of systemic infection. Systemically infected plants are those in which the rust fungus has invaded the root system and these can be detected when the root system sends up spore-bearing systemically infected shoots (see photo). Once a Canada thistle plant becomes systemically infected it is doomed and only a matter of time before it is gone. That's the beauty of this biocontrol agent; it attacks the roots which are the strength of the plant. Canada thistle is a long lived perennial and the root system is the primary means by which a patch expands, kill the roots and you'll kill the patch. For a more detailed explanation of the fungus life cycle and how the fungus enters the root system see the Biocontrol Newsletter, 2014.

We knew from the outset of this project that the rust was slow to kill Canada thistle. The first hurdle is to achieve systemic infections within thistle patches. To do this we target fall rosettes with spores along either side of the monitoring transect. The spores have to germinate and enter the plant with the mycelia moving into the roots. We've documented this at about 40% of our inoculation sites. After initial infection the fungus has to spread within the patch which often means moving through an extensive root system. Our 2014 inoculations either failed to produce systemically diseased plants in 2015, or systemically infected plants appeared and were either

Canada thistle leaves with rust.

Mike Racette and Jon Golson monitor a dense patch of Canada thistle



within or outside of the monitoring transect. For those sites that had systemically infected plants within the monitoring transect we saw a significant decline in Canada thistle density by 2016. Our goals are to continue monitoring sites around Colorado and also to work with landowners to develop more effective inoculation procedures. It is clear though that the rust fungus is capable of decreasing Canada thistle densities and time will tell what level of control we can expect. Previous work by our collaborator Dr. Dana Berner showed an average 80% decrease in Canada thistle density three years after infection, with some patches disappearing entirely. A similar result in Colorado would indicate a major success in controlling one of our most widespread invasive weeds.

Monitoring a transect through dense blooming Canada thistle

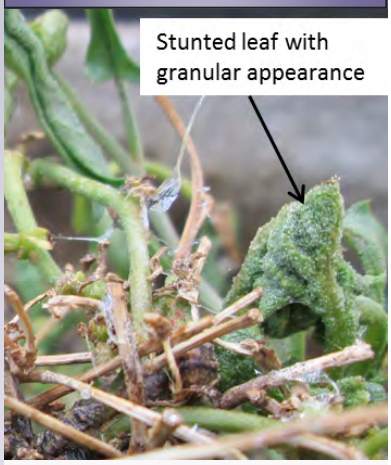
For more information please contact Karen Rosen (karen.rosen@state.co.us) or Joel Price (joel.price@state.co.us)

FIELD BINDWEED

Arriving in the United States in the early 1700's, field bindweed, *Convolvulus arvensis,* is a perennial, invasive herb that has spread across most of the temperate regions of the country to become one of the most problematic weeds for agriculture. This noxious weed is recognizable by the funnel shaped pink or white flowers and prostrate stems often climbing up fences or other structures. Crops or other desirable plant life are also susceptible to this twining activity often times leaving tangled mats. Crop yield may decrease up to 60% and prohibit the use of farm equipment. It is particularly destructive in Colorado where herbicide treatments can be costly and often ineffective. With the massive root system, cultural and mechanical means of control provide little benefit. Both the roots and the seeds of the plant are reproductive adding to the difficulty of control. In the absence of natural enemies, it will invade pastures, roadsides, wasteland, gardens and more. In Colorado, we have two biocontrol agents available for control of field bindweed, a mite and a moth.

Aceria malherbae is a microscopic mite that forms a gall along the midrib of the leaf, and to a lesser extent along the stem and petiole. This leaf gall is likened to a "taco" or "canoe" shape as the leaf folds in half along the midrib and forms a protective "nursery" for the eggs and nymphs inside. On the developing gall, a noticeable rough texture forms on the back side of the leaf along the mid rib and auxiliary veins. These small pustules look and feel as if the leaf was dipped in sugar. Older infested leaves may reveal a more twisted gall and ultimately form dense clusters of stunted stem buds. As each new leaf forms, mites are carried to the next leaf

Bindweed mites inside of a gall.



Bindweed mite damage near the root crowns.

to continue this process until the stem is stunted from this feeding behavior. Flowering is also greatly reduced. Once mature, mites are highly mobile as the wind carries along broken pieces of dying bindweed and distributes them to uninfected locations. Animals also can carry the mites to new locations. Prairie dog villages have been great collection sites due to this. The feeding and gall formation tax the plants root reserves and if infected with mites over several years the plants can become completely stunted and unable to grow. The mites are very effective in dry, non-irrigated sites.

For the collection and redistribution of the field bindweed mite, *Aceria malherbae,* 2016 proved to be a solid year. The majority of collections were made at locations that have been utilized in previous years, fields along the I-70 corridor near Loma, CO. Roadways traveling east and west have great value in that the wind can help distribute the mites for long distances. With the field bindweed nourished by the rain runoff and the added heat from the pavement, the plant was abundant and the site was ideal for *A. malherbae* to thrive. Over 500,000 galls were sent out to customers from the Palisade insectary, fulfilling some requests dating back to 2014. The 2015 and 2016 request lists were filled through by the first of August. Most counties in Colorado were included in the mite distributions and mites were also shipped to other states, North Dakota, Nevada, Nebraska and Montana. Two new collection sites were discovered in Delta County that will be ready for fulfilling 2017 requests. Sites that were originally infested in 2015 were not ready for harvest in 2016, but will be evaluated in 2017.

In 2016 we started to evaluate the conditions at nursery sites to help us find the optimal locations for creating large numbers of agents. This includes monitoring an overhead sprinkling trial alongside a flooded trail. By the end of 2016, both had gall formation and showed no preferences in watering technique. We will continue this work in 2017.

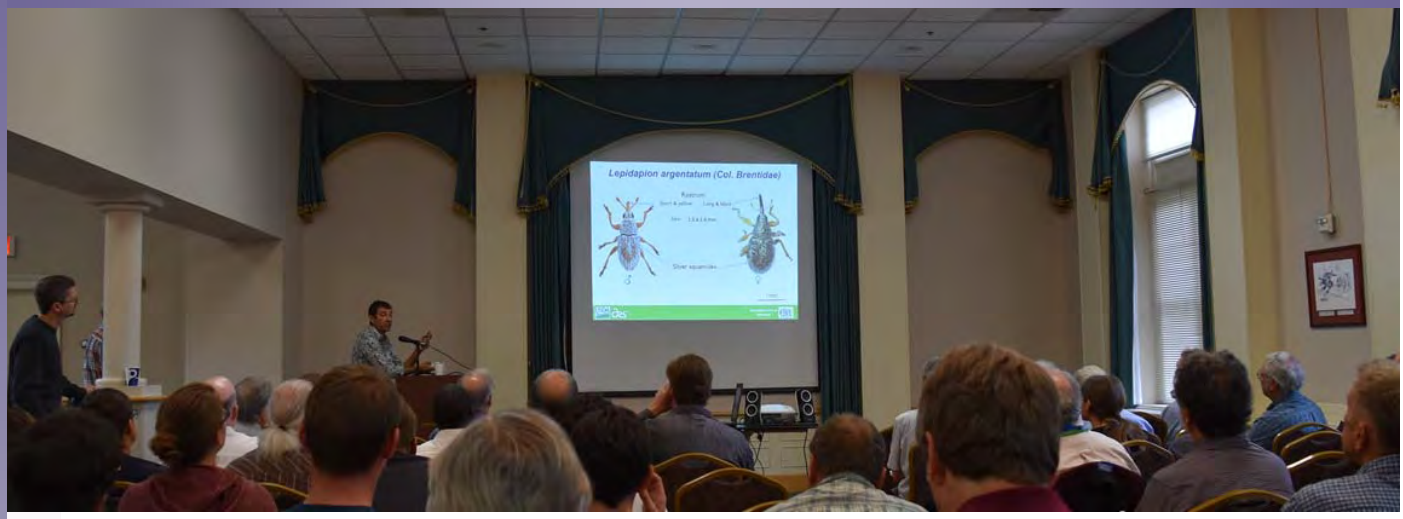
We have not found collection sites for mites along the Front Range since 2013. We speculate that the heavy rains in the fall of 2013 saturated the ground and killed the mites back. In the summer of 2016 we found several sites with mites that should have collectible populations in 2017. In addition to the heavy moisture, we are curious as to potentially mite-resistant field bindweed along the Front Range. To

address this, we have collected bindweed seeds from Larimer and El Paso counties and germinated them in the Palisade Insectary greenhouse. These plants will be infected with the gall mites to evaluate if those strains of bindweed are resistant to the mites.

Our other agent, the bindweed moth *Tyta luctuosa,* made a great come back in 2016 with moths being collected at various sites in Mesa and Montrose counties. By the end of June, we successfully captured newly emerged moths to begin egg lay. This enabled us to release over 2,000 larvae and restock our overwintering population. A Plexiglas bucket with a tightly woven mesh lid has replaced our older Berkley Boxes as the rearing cage. This will decrease the chances of a parasitoid wasp invading the cage and destroying the growing larvae. If this does not seem suitable, we will continue to experiment with our equipment to produce the best means for rearing production.

For more information on bindweed moths, bindweed mites, or if you would like to order agents please contact Terri Locke at terri.locke@state.co.us or call at (970-) 464-7916

Caterpillar of the field bindweed moth, Tyta luctuosa



René Sforza presents update on weed biocontrol programs at the European Biological Control Laboratory

BIOCONTROL MEETING

Every year biocontrol researchers and practitioners get together in a western regional meeting known as the W 3185 conference. This year the Colorado Department of Agriculture, Palisade Insectary, hosted the conference at the historic Hotel Colorado in Glenwood Springs. Approximately 60 scientists and other biocontrol practitioners met for three days to cover topics ranging from overseas discovery of new biocontrol agents to the latest news on funding sources for biological control. When the meetings were over several scientists toured the Palisade Insectary. It was an excellent opportunity to show off the Insectary and to develop collaborations that will help us in our projects.

Paul Brusven, director of the Nez Perce Biocontrol Center in Idaho presented an update on weed biocontrol projects at the Nez Perce Center, and then toured the Insectary. Paul directs one of the few biocontrol facilities in the US aside from ours and so it was exciting to compare notes and plan collaborations. Our facilities have swapped agents and expertise over the past decade and plan to do more of that.

Scientists from abroad presented information on the development of weed control projects critical for Colorado, including control of toadflaxes and Russian olive. Two of the foreign scientists, Massimo Cristofaro from Italy and René Sforza from France, are working in collaboration with the Palisade Insectary and Colorado Mesa University to determine the origin of the accidentally introduced *Coniatus splendidulous*, our latest and most colorful tamarisk biocontrol agent (see the 2015 newsletter for the full story). They are also working on the discovery and development of many new agents for use against weeds and pests found in Colorado.

Their work takes them to exotic and dangerous places where they practice entomology, botany, plant pathology and other scientific disciplines under field conditions that aren't always hospitable, so we really appreciate what they've done and continue to do. Massimo and René received a Grand Junction welcome and thank you following the meetings (see photo).

We also gave a tour of the Insectary to scientists from California. Right now California is battling several new invasive species including what could be the most devastating one, known as the Asian citrus psyllid. One of our guests, David Morgan, is leading California's efforts to develop and distribute biological controls for the psyllid so we compared notes on facilities and the challenges of large scale insect rearing and distribution of biological controls.

We got to hear from a long list of biocontrol practitioners from throughout the west but we also got the chance to have Insectary projects on display. John Kaltenbach reported on the Emerald Ash borer biocontrol project, Mike Racette summarized work on Dalmatian toadflax control following wildfire (reported in this Newsletter), and Karen Rosen summarized work on the Canada thistle rust. The Russian knapweed biocontrol project was the focus of three talks at the meetings including a talk describing our biocontrol project given by our project lead, Joel Price. Tamarisk biocontrol was also a topic for several talks including one by Nina Louden updating Colorado's tamarisk biocontrol program. The high-tech topic of DNA sequencing technology, bioinformatics and biocontrol was covered by a graduate student working at the University of Idaho. Amanda Stahlke also happens to be a former seasonal staff member with the Insectary and a graduate of Colorado Mesa University. This is a short summary of the meetings and if anyone would like more detailed information please contact Dan Bean (dan.bean@state.co.us).

Paul Brusven from the Nez Perce Biocontrol Center, Idaho

John Kaltenbach (CDA) and *David Thompson (NMSU) discuss weed biocontrol.*

Massimo Cristofaro (left, director of BBCA, Rome, Italy), Zeynep Özsoy (Colorado Mesa University) and René Sforza (European Biological Control Laboratory, Montpellier, France) post conference.

SUBSCRIPTION SERVICE

BIOCONTROL SUBSCRIPTION SERVICE

The Palisade Insectary offers a voluntary subscription program which allows counties and municipalities to work more closely with us and support our programs. Several counties and municipalities participate every year which has helped us fulfill the seasonal demand for biocontrol agents. Money from subscription fees is spent primarily on hiring seasonal help to increase our ability to collect and distribute agents. Money is also spent on supplies, shipping and compiling monitoring data on releases, and efficacy of the agents. Contact the Insectary to enroll in subscription service today.

Subscription Service Tiers:

Bronze Tier—$250 annual fee

- An assessment of biocontrol needs for the weed manager,
- 5 releases of biocontrol agents for one to two weed species accompanied by brochures/information for distribution to landowners that will be receiving the releases,
- An easily performed monitoring protocol.

Silver Tier—$500 annual fee

- An assessment of biocontrol needs for the weed manager,
- 10 releases of biocontrol agents for one to three weed species accompanied by brochures/information for distribution to landowners that will be receiving the releases,
- An easily performed monitoring protocol.

Gold Tier—$750 annual fee

- An assessment of biocontrol needs for the weed manager,
- 15 releases of biocontrol agents for one to four weed species accompanied by brochures/information for distribution to landowners that will be receiving the releases,
- An easily performed monitoring protocol.

Platinum Tier—$1000 annual fee

- An assessment of biocontrol needs for the weed manager,
- 15 releases of biocontrol agents for one to five weed species accompanied by brochures/information for distribution to landowners that will be receiving the releases,
- An easily performed monitoring protocol.
- At this level you will also receive new agents as they first become available for introduction in Colorado, such as the yellow toadflax stem borer, the Russian knapweed gall fly or the Canada thistle rust.

Insectary
70 37.8 Road
Palisade, CO 81526

P: (970) 464-7916
Toll Free: 1 (866) 324-2963
F: (970) 464-5791

www.colorado.gov/ag/biocontrol