NCERA 220 Meeting Minutes

Wednesday, June 3, 2015, 8am to 12pm (Fliint Hills + Kings Room)
Manhattan, KS
Authors: Brian McCornack, Debbie Finke

1. Attendance:
    a. Luis Canas
    b. Julie Peterson
    c. Debbie Finke
    d. Ben Puttler
    e. Jen White,
    f. Matt Grieshop
    g. Matt O'Neal
    h. Brian McCornack
    i. John Ruberson
    j. Jim Nechols
    k. Jean Haley (North Central IPM Center)
2. Agenda:
    a. Call to business.
    b. State reports were briefly discussed. All state reports were submitted to the midwestbiocontrol.org website prior to the meeting. Given the short amount of time to discuss the rewrite, we decided it was best to focus most of our agenda on the upcoming proposal.
    c. Discussion of project renewal (see notes below).
    d. George Heimpel was elected the new vice-chair.
    e. Adjourn

Renewal Discussion:

Statement of Issues and Justification – Debbie Finke and John Ruberson agreed to lead the rewrite of this section. Other group members would contribute text as well. Specifically, each person writing an objective will provide 1-2 sentences of justification to be included in the revised justification section. The four objectives now represent the three main tiers of the Land Grant system (Education, Research and Extension), but further extends to include ways of influencing policy and those making funding decisions. The group then thought it best to delegate the revision of existing sections, which included:

Objective 1 – Brian McCornack and Jim Nechols agreed to lead the rewrite. Discussed the addition of an "education menu" item to the group site to consolidate educational materials such as lectures and webinars. Participants would upload shared lectures and webinars related to biological control. It was clear from all those present that the group needed to shift away from a focus on short courses. Considering the small number of biocontrol expertise and course offerings within the region, participants felt it best that we focus on consolidating materials and making them more accessible. We would then reconsider the short courses at a later date. This is now the "Education" objective.

Objective 2 – Matt O'Neal agreed to lead this section. The primary shift for this objective was to not focus so much on target systems. Instead, the group thought it best to include text that promotes

collaborative projects in general across regionally-important systems. By only including specific examples, the group was concerned that we would not be able to address biological control of invasive species that have yet to establish. In other words, this provide more flexibility for members to develop projects as needs arise. We also decided to define how biological control contributes to topics of interest, including but not limited to: 1) How biocontrol fits into larger IPM programs, and 2) Translation of fundamental research. We also talked about more effective ways to disseminate research findings. For example, a symposium could be used to interact with stakeholders – host a symposium, invite stakeholders to contribute as a follow-up, summarize discussion in a broader format (submit to a journal, or NC IPM newsletter, or IOBC-NRC newsletter). This is now the "Research" objective.

Objective 3 – Matt Grieshop and Julie Peterson agreed to modify this objective to fit the group's Extension activities related to biological control across the Midwest. In particular, the proposal should include key way in which adoption of biological control will be documented, both basic and applied research. For example, identifying metrics that showcase number of people implementing biocontrol.

Objective 4 – Debbie Finke and George Heimpel will rework this objective. Specifically, participants felt that it was important that this section broaden in scope, beyond classical biocontrol and regulatory issues. For example, comments were made that our group needs to find ways of working with our IPM regional center on federal requests for info.

NCERA220 State Report List

- #:
  79
  State:
  Ohio
  Project title:
  Vacant land conversion to community gardens and the effect on biocontrol services
  view report
  Keywords:
  urban
  Key personnel:
  Mary Gardiner, Scott Prajzner, Caitlin Burkman, Casey Hoy, S. Albro, Parwinder Grewal
  Objective(s) addressed:
  Objective 2
  Abstract:
  Due to economic decline and the recent rise in home foreclosure, many U.S. cities are faced with managing large acreages of vacant land. Interest in local food production on this land has the potential to dramatically reshape the composition of greenspace found within urban landscapes. This study examined how the conversion of vacant land to urban gardens and farms influenced arthropod generalist predator populations and their ability to support biocontrol services. We found that the abundance of Coccinellidae and Syrphidae, and the activity density of Carabidae, Formicidae, and Lycosidae were equivalent among vacant lot and urban garden sites. Dolichopodidae abundance and the activity density of Linyphiidae and Opiliones were reduced in urban gardens whereas Anthocoridae abundance and the activity density of Staphylinidae were greater within urban gardens relative to vacant lots. The biocontrol service supplied by generalist predators was measured using sentinel eggs (Helicoverpa zea (Noctuiidae)) and pupae (Sarcophaga bullata (Sarcophagidae) and Musca domestica (Muscidae)). We found no difference in the biocontrol of H. zea eggs or M. domestica pupae among the focal greenspaces. We found no difference in the removal of S. bullata pupae by predators in June 2010, whereas in August 2010 a greater proportion of pupae were removed in urban garden sites relative to vacant lots. Based on these findings, we discuss the potential of the urban landscape to support generalist predators and sustainable urban gardening and farming.

Gardiner, Mary M.; Prajzner, Scott P.; Burkman, Caitlin E.; Abro, S.; Grewal, Parwinder. 2014. Vacant land conversion to community gardens: influences on generalist arthropod predators and biocontrol services in urban greenspaces. Urban Ecosystems 17:101-122.

- #:
  78
  State:
  Ohio
  Project title:
  Effect of soil management on entomopathogenic nematodes
  view report
  Keywords:
  Heterorhabditis bacteriophora
  Key personnel:
  Harit Bal, Parwinder Grewal, Nuris Acosta, Casey Hoy, Zhiqiang Cheng, Hannah Whitehead
  Objective(s) addressed:
  Objective 2
  Abstract:
  Soil habitat conditions that promote abundance and persistence of entomopathogenic nematodes (EPNs) might be encouraged by reduced tillage and compost amendments. We hypothesized that altered soil management with reduced tillage, cover crops (clover and barley), and compost (100 kg of N/ha), would increase survival and biocontrol services of EPNs, compared with conventional management. Field trials were conducted at the Ohio Agricultural Research and Development Center Muck Crops Research Station, Huron County, OH in 2010 and 2011. Plots were planted with carrots. EPNs, Heterorhabditis bacteriophora GPSI I, were released and their survival was compared between the two soil management regimes by sampling over a period of 8 weeks using in situ bait traps containing Galleria mellonella. Repeated measures analysis of variance did not show significant differences between the two soil management regimes in the pattern of H. bacteriophora survival over time or during any evaluation in either year, except 2 weeks after cadaver application in 2010 when the EPN population was significantly greater in the conventional than in the alternative soil management regime. Although treatment effects were generally not significant, statistically significant increase in nematode population densities between the 2 years of the study, despite generally poor weather conditions following EPN release in the second year, provide encouraging evidence that populations of these biological control agents could increase in vegetable production fields. However, longer periods may be required for clearly distinguishable increase in EPN population density, persistence, and biological control services in the alternative soil management treatments. (C) 2014 Elsevier Inc. All rights reserved.

  Bal HK, Acosta N, Cheng, Z, Grewal PS. 2014. Effect of soil management on Heterorhabditis bacteriophora GPS11 persistence and biological control in a vegetable production system. Biological Control 79:75-83.

Bal, H., Nuris Acosta, Zhiqiang Cheng, Hannah Whitehead, Parwinder S. Grewal, Casey W. Hoy. 2014. Effect of soil management on Heterorhabditis bacteriophora GPS11 persistence and biological control in a vegetable production system, Biological Control. 79: 75-83. http://dx.doi.org/10.1016/j.biocontrol.2014.08.008.

Bal HK, Taylor RAJ, Grewal PS. 2014. Ambush foraging entomopathogenic nematodes employ sprinters for long-distance dispersal in absence of hosts. Journal of Parisitology 100:422-432

Bal HK.; Michel AP, Grewal PS. 2014. Genetic selection of the ambush foraging entomopathogenic nematode, Steinernema carpocapsae for enhanced dispersal and its associated trade-offs . Evolutionary Ecology 28:923-939.

- #:
  77
  State:
  Ohio
  Project title:
  Evaluation of the effect of different insecticides on the most common biological control agents used to control pests in greenhouses
  view report
  Keywords:
  Encarsia formosa
  Key personnel:
  Luis Canas, Renato Zardo
  Objective(s) addressed:
  Objective 2
  Abstract:
  Recently in Ohio producers have started to rely in the use of biological control agents, but the effects of the most common insecticides on them is not well known. Authors working on peppers have shown that it is possible to combine insecticides and biological control. Preliminary tests done in my laboratory on *Encarsia formosa*, a biological control agent of whiteflies, showed that some insecticides seems to be more compatible with these agents than others. We are evaluating the effect of different chemistries on the most common biological control agents used to control pests in greenhouses, some of them recently introduced into the market.

- #:
  76
  State:
  Ohio

Project title:
Delphastus catalinae and the silverleaf whitefly, Bemisia tabaci biotype B, on tomato: modeling predation across spatial scales
view report
Keywords:
model
Key personnel:
Diego Rincon, Casey Hoy, Luis Canas
Objective(s) addressed:
Objective 2
Abstract:
The silverleaf whitefly, Bemisia tabaci biotype B (Gennadius) (Hemiptera: Aleyrodidae), is a significant pest of tomato crops worldwide that exhibits highly aggregated populations at several spatial scales, including within the plant. As part of an analytical framework to understand predator–silverleaf whitefly interactions, the objective of this research was to develop an algorithm to generate explicit spatial counts of silverleaf whitefly nymphs within tomato plants. The model developed provides the number of silverleaf whitefly individuals for each leaf and leaflet on one or more plants. Validation revealed a substantial agreement between algorithm outputs and independent data that included the distribution of counts of both eggs and nymphs. This algorithm can be used in simulation models that explore the effect of local heterogeneity on whitefly–predator dynamics.

We described the spatial interaction between the SWF and *D. catalinae* at the within-plant scale and examined its effects on *D. catalinae* predation rates and functional response. I found that prey and predator prefer different regions within plants and that predation rates and the functional response at the scale of a leaflet are comparable to what have been observed in the laboratory. In contrast, I observed that predation rates are lower and that the functional response changes qualitatively when the scale of observation is increased from the leaflet to the plant

Rincon, D. F., C. W. Hoy, and L. A. Cañas. 2015. Generating within-plant spatial distributions of an insect herbivore based on aggregation patterns and per-node infestation probabilities. Environmental Entomology 44: 194-209.

- #:
  75
  State:
  Ohio
  Project title:
  Automated release and dispersion of predatory mites in greenhouses
  view report

Keywords:
predatory mites
Key personnel:
Luis Canas, Renato Zardo
Objective(s) addressed:
Objective 2
Abstract:
We are evaluating a machine that is used to release predatory mites in greenhouses. The machine consists of a fan with a tumbler that releases predatory mites. We will test how far mites are dispersed using the machine and will try to use dispersion models to document how well the mites are being distributed on greenhouse benches.

- #:
  74
  State:
  Kansas
  Project title:
  Environmental regulation of diapause in the green lacewing, Chrysoperla rufilabris
  view report
  Keywords:
  diapause, photoperiod, temperature, lacewings, phenology
  Key personnel:
  Kewei Chen, James R. Nechols, John R. Ruberson
  Objective(s) addressed:
  Objective 2
  Abstract:
  Chrysoperla rufilabris is a widely-distributed species of green lacewing in North America, but very little is known about its phenology, including environmental factors that regulate reproductive diapause. Therefore, we examined and compared the effect of photoperiod under lower and higher temperature on diapause induction at three geographic locations in the U.S. Fixed photoperiods ranging from short to long had little effect on diapause, but subjecting lacewings to a long-to-short photoperiod during larval development caused a significantly greater incidence of diapause. Lacewings that experienced a combination of decreasing day length and decreasing temperature had the highest percentage of diapause. Results will improve predictions of seasonal activity, population growth, and potential for biological control.

- #:
  73
  State:
  South Dakota

Project title:
Impact of neonicotinoid insecticides applied as seed treatments and foliar sprays on beneficial arthropods associated with soybean
view report
Keywords:
neonicotinoids, natural enemies, spider mites, soybean aphid, predatory mites
Key personnel:
Adrianna Szczepaniec
Objective(s) addressed:
Objective 3
Abstract:
We tested the impact of neonicotinoid insecticides on communities of natural enemies in a soybean system. The experiments were conducted over a two-year period in two locations in eastern South Dakota. In replicated plots we examined how seed treatments and foliar sprays of neonicotinoid insecticdes affected target and non-target herbivores and their natural enemies. We used biplots to visually represent the impact of treatments on natural enemy populations and we found that insect and mite predators were significantly more prevalent in untreated plots than in plots exposed to either type of neonicotinoid treatment. With the exception of predatory mites in the family Stigmaeidae none of the individual predator taxa were collected in sufficient numbers to perform statistical analyses. Predatory mites did not differ significantly among treatments at either location in 2013 (Volga: $F = 1.18$; df = 2, 9; $P = 0.35$; South Shore: $X2 = 2.65$; df = 3; $P = 0.448$), but there was a trend for a lower predatory mite abundance with increasing amount of neonicotinoid insecticide in 2014 at Volga ($F = 2.13$; df = 3, 12; $P = 0.1$; Table 1.2) and at South Shore ($F = 2.1$; df = 3, 20; $P = 0.132$). Populations of thrips, which can be facultative predators were correlated with abundance of spider mites and tended to be greater in neonicotinoid-treated plots which also harbored higher numbers of spider mites.

Overall, it appears that neonicotinoid insecticides had an indirect, herbivore-driven effect on communities of natural enemies in soybeans. Neonicotinoid insecticides had a negative impact on insect predators of soybean aphids, which were effectively suppressed in plots exposed to foliar sprays of neonicotinoid insecticides. Predators of spider mites responded more variably to the treatments and were suppressed (predatory mites) or increased (thrips) in numbers after exposure to the insecticides.

Because populations of arthropods were extremely low in 2013 the inferences that can be drawn from this project are somewhat limited. Nonetheless, this experiment highlights the complexity of neonicotinoid-driven changes in abundance of herbivores that affect natural enemies. This indirect effect of neonicotinoid insecticides on predators seem to be especially relevant in cropping systems, where neonicotinoid seed treatments rather than foliar sprays are more prevalent.

- #:
  72
  State:
  Nebraska
  Project title:
  Conservation practices on Nebraska farms and their impact on beneficial arthropods and arthropod-mediated ecosystem services
  view report
  Keywords:
  carabidae, Araneae, Cover Crops, biodiversity, wildlife conservation
  Key personnel:
  Kayla A. Mollet, Michael J. Eskelson, Charles Burr, Julie A. Peterson
  Objective(s) addressed:
  Objective 1, Objective 3
  Abstract:
  There are 3 sub-projects that address how within-field and adjacent to cropfield conservation practices affect arthropods and the ecosystem services they provide:

1. Impact of cover cropping on the epigeal arthropod community in dryland Nebraska cornfields.
2. Effects of cover crops and pollinator habitat on beneficial arthropods in West Central Nebraska wheat.
3. Enhancing Biodiversity at Pivot Corners to Maximize Ecosystem Services.

Large-scale commercial agriculture can often lead to low diversity landscapes with few resources for wildlife and beneficial insects, such as pollinators and natural enemies of crop pests. However, enhancing plant diversity has been shown in some cases to augment important ecosystem services, such as pollination, biological control of crop pests, and provisioning of wildlife habitat. In Nebraska, a unique program called Corners for Wildlife (CFW) sponsored by Pheasants Forever and other partners (http://nebraskapf.com/habitat-programs/corners-for-wildlife/) allows farmers to receive cost-share assistance and rental income by planting a high diversity of trees, shrubs, and perennial plants (grasses, wildflowers, and legumes) on center-pivot irrigation corners. This project seeks to understand whether pivot corners with higher plant diversity (those enrolled in CFW) compared to conventional lower-diversity corners (planted to corn or winter wheat) will provide greater ecosystems services by: 1) Providing biological control of crop pests in the adjacent crop fields by supporting beneficial insects that are natural enemies (predators and parasitoids) of these pests; 2) Enhancing pollination services and native pollinator abundance and diversity by providing floral resources, nesting and overwintering sites; and 3) Increasing recreational land value by providing habitat for desirable wildlife populations

(such as pheasant and quail). Outcomes will increase farmers' and CFW partners' knowledge of how these ecosystems services are impacted by plant diversity and how these services are of value to farmers. Increased enrollment in CFW or similar programs will increase landscape diversity at the regional scale leading to higher biodiversity and sustainability within the region.

- #:
  71
  State:
  Nebraska
  Project title:
  Characterization of the natural enemy community, with emphasis on entomopathogens, in pest management of western corn rootworm (Diabrotica virgifera virgifera) in West Central Nebraska
  view report
  Keywords:
  corn rootworm, fungi, nematodes, entomopathogen, IPM
  Key personnel:
  Camila Oliveira-Hofman, Anthony O. Adesemoye, Lance J. Meinke, Julie A. Peterson
  Objective(s) addressed:
  Objective 3
  Abstract:
  Diabrotica virgifera virgifera LeConte (Coleoptera: Chrysomelidae), the western corn rootworm (WCRW), is a major pest of maize (*Zea mays* L.) in the United States and Europe. WCRW management options comprise mainly of transgenic hybrids, insecticide applications and crop rotation. WCRW has proved to be highly adaptable to management practices and several cases of resistance to transgenic corn, insecticides and rotation in the United States Corn Belt have been reported. WCRW's high adaptability to control tactics motivated this project to look into alternative options for pest control. In the U.S., little research has been done to investigate the roles of natural enemies of the WCRW in commercial fields. Nebraska is currently the third largest maize grower in the country and WCRW is one of the state's biggest pests. In West Central Nebraska, the weather is dry and because of that, continuous corn is primarily grown under central-pivot irrigation systems. Research will focus on examining the feasibility of incorporating biological control agents into the array of WCRW pest management techniques. This will be achieved by isolating endogenous entomopathogens, as well as potential predators, from commercial fields in which WCRW is a problem pest, and by screening these promising isolates for their pathogenicity to WCRW larvae. For the entomopathogens that are effective against the WCRW, behavioral studies will be performed to determine if they modify WCRW behavior. Lastly, the role of entomopathogens in WCRW mortality in the field will be investigated and also how corn-

soybean rotations influence the persistence and movement of entomopathogens will be considered.

- #:
  70
  State:
  Nebraska
  Project title:
  The effect of agricultural practices on sugar beet root aphid and beneficial epigeal arthropods
  view report
  Keywords:
  root aphid, carabidae, weed granivory, High Plains, tillage, seed treatment
  Key personnel:
  Jeff Bradshaw, R. Johan Pretorius, Erin Blankenship, Gary Hein
  Objective(s) addressed:
  Objective 3
  Abstract:
  Over a 4-yr period, studies were conducted to determine the effect of agricultural practices on pests and soil-born (epigeal) beneficial arthropods in sugar beet cropping systems in western Nebraska. Initial field studies were conducted to gather data regarding the existing soil-born arthropod populations. No impact was measured of 8 sugarbeet varieties on one dominant, soil-born arthropod group, Carabidae, of which 79 species were collected. Field experiments evaluating the impact of seed-applied neonicotinoid insecticides on root aphids and beneficial arthropods found significant (but not economically valuable) reductions in root aphids and very limited impact on epigeal arthropods. One ground beetle species, *Bembidion quadrimaculatum oppositum*, had higher activity in untreated plots. Finally, the impact of two, common (regionally) soil-management practices in sugar beets (spring plow, 5-8.2% corn residue, and zone-tillage, 70-81.2% corn residue) were evaluated for impact on diversity and ecosystem function of beneficial, epigeal arthropods. High activity-density was measured for many dominant epigeal arthropod groups. Carabid density was not impacted by tillage practice. However, carabid species richness, diversity, and evenness were increased significantly by using zone-tillage soil management. Additionally, while predation of *Galleria mellonella* larvae was not affected by tillage (in either day or night predation evaluations), the seed consumption of four important weed species (*Setaria lutescens*, *Echinochloa crusgalli*,*Kochia scoparia*, and *Chenopodium album*) significantly increased in zone-tillage systems.

- #:
  69
  State:
  North Dakota

Project title:
Integrated management of Canada thistle
view report
Keywords:
Hadroplontus litura, stem-mining weevil, Urophora cardui, Canada thistle
Key personnel:
Deirdre A. Prischmann-Voldseth, Greta G. Gramig, Erin Burns
Objective(s) addressed:
Objective 3
Abstract:
Canada thistle is a noxious weed that impacts rangeland, cropland, and urban landscapes. Biological control is one potential management option; however, the literature indicates that using an IPM approach may be most successful. This project explores the effects of multiple control tactics and/or biocontrol agents on weed performance within an environmental context.

- #:
  68
  State:
  Michigan
  Project title:
  Evaluating Natrural Biological Control Potential for Brown Marmorated Stink Bug in Michigan and New Jersey
  view report
  Keywords:
  brown marmorated stink bug, Conservation Biological Control
  Key personnel:
  Kristin Deroshia, Matthew Grieshop, Anne Nielsen, John Pote
  Objective(s) addressed:
  Objective 1, Objective 2, Objective 3
  Abstract:
  We have continued a study using video surveillance of sentinel egg masses to determine the initial incidence of brown marmorated stink bug egg parasitism and predation in organic apples and vegetable crops. We deployed sentinel eggs in tomatoes and apples and used video surveillance on a subset to capture predation and parasitism events. Overall rates of predation and parasitism were again higher in New Jersey compared to Michigan. In Michigan, parasitoids were collected at one of two sites and predation was slightly higher in apples than tomatoes —although overall predation/parasitism rates were under 10% in 2013, however in 2014 no parasitoids were collected. Six species of parasitoids collected and Orthoptera, Neurotptera, Dermaptera, Aranae identified as egg predators. We are completing analysis of video footage and expect to publish this study in the next year.

- #:
  67
  State:
  Michigan
  Project title:
  Susceptibility of Dalotia coriaria (Kraatz) (Coleoptera: Staphylinidae) to entomopathogenic nematodes (Rhabditida: Heterorhabditidae and Steinernematidae).
  view report
  Keywords:
  entomopathogenic nematodes, Dalotia coriaria, greenhouse
  Key personnel:
  Joseph Tourtois, Matthew Grieshop
  Objective(s) addressed:
  Objective 2, Objective 3
  Abstract:
  Dalotia coriaria (Kraatz) (Coleoptera: Staphylinidae) and entomopathogenic nematodes (Rhabditida: Heterorhabditidae and Steinernematidae) are two soil-dwelling biological control agents used to manage western flower thrips, *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae) and fungus gnats *Bradysis spp*. (Diptera: Sciaridae) in glasshouses. Growers often use multiple natural enemies to achieve economic control, but knowledge of interactions among natural enemies is lacking. We conducted a laboratory bioassay to test the pathogencity of four commercially available nematode species – *Heterorhabditis bacteriophora* Poinar (Rhabditida: Heterorhbditidae), *Steinernema carpocapsae* (Weiser) (Rhabditida: Steinernematidae), *S. feltiae* (Filipjev), and *S. riobrave* Cabanillas et al. – to third instar and adult *D. coriaria*. Third instars were three times more susceptible than the adults to the entomopathogenic nematodes. Mortality for *D. coriaria* adults and third instars treated with *S. feltiae* and *H. bacteriophora* was lower than the mortality for *D. coriaria* adults and third instars treated with *S. carpocapsae* and *S. riobrave*. Neither infective juvenile foraging behavior nor size correlates with *D. coriaria* mortality. *Dalotia coriaria* appears to be most likely compatible with applications of *S. feltiae* and
  H. bacteriophora.

- #:
  66
  State:
  Michigan
  Project title:
  Exploring the use of black soldier fly, Hermetia illucens (L.) (Diptera: Stratiomyidae) as an in vivo entomopathogenic nematode host
  view report

Keywords:
entomopathogenic nematodes, alternative hosts, black soldier fly
Key personnel:
Joseph Tourtois, Matthew Grieshop
Objective(s) addressed:
Objective 2, Objective 3
Abstract:
We completed a reasearch project evaluating the use of black soldier fly as an alternative in vivo rearing host for four commonly used species of entomopathogenic nematodes (EPN): Steinernema carpocapsae, S. feltiae, S. riobrave and *Heterorhabitis bacteriophora*. Initial experiments indicated that EPN were not efficient colonizers of black solider fly larvae but that 5th instar were the most susceptible. Follow up research showed that injuring larvae increased the infection rate of S. carpocapsae, S. feltiae and S. riobroave but not H. bacteriophora. A final study compared the number of EPN produced per gram of black soldier fly larvae and compared it to production from the traditional host: waxworms (Galleria mellonella). Injury increased production in all cases and H. bacteriophora was the most successful of the species tested. However, production was at least 100 fold less per gram compared to the standard host. Our research suggests that black solider fly is not a good substitute host for rearing EPN.

- #:
  65
  State:
  Michigan
  Project title:
  Onsite Rearing of Dalotia coriaria
  view report
  Keywords:
  Dalotia coriaria, greenhouse, vegetables, thrips, fungus gnats
  Key personnel:
  Joseph Tourtois, Matthew Grieshop
  Objective(s) addressed:
  Objective 1, Objective 4
  Abstract:
  Dalotia coriaria is an important augmentative biological control agent for thrips, fungus gnats and other soil dwelling greenhouse pests. In 2014 we continued exploring alternative rearing systems that would allow growers to produce this predatory beetle on-site. In 2013 we conducted a rearing experiment comparing rearing containers and concluded that an open pile system of vermiculite, coir and chicken feed provided an optimal rearing environment. In 2014 we evaluated rearing media including, dairy compost, sterilized dairy compost and vermiculite and coir. We also evaluated the importance of providing

supplementary chicken feed (15 g/l). We concluded that supplmentary feed was absolutely necessary. Unsterilized dairy compost was as productive as vermiculite and coir but sterilized compost was not. Our results suggest that growers could use compost as a rearing media but that supplementary feed should always be added.

- #:
  64
  State:
  Michigan
  Project title:
  Habitat management for beneficial insects in cucurbits
  view report
  Keywords:
  vegetables, squash, cucubitacae, Conservation Biological Control
  Key personnel:
  Nicole Quinn, Zsofia Sendrei
  Objective(s) addressed:
  Objective 1, Objective 2, Objective 3
  Abstract:
  Promoting beneficial insect services requires habitat and resources to increase the abundance and efficacy of natural enemies and pollinators, which are often lacking in conventional agroecosystems. Our research seeks to increase beneficial insect abundance and diversity in cucurbit systems through habitat management. In one experiment, the effects of strip or full tillage and mulch or no mulch treatment combinations on the natural enemy community and weed seed removal in an acorn squash field are measured. In another experiment, flowering windbreaks are integrated within a cucumber field in order to increase beneficial insect abundance and diversity while decreasing pest insect abundance and diversity. The data will reveal which flowering species enhance beneficial insect abundance and cucumber yield the most and at which distances from the flowering areas these responses can be observed. Ultimately, this work could lead to an increased understanding of conditions favorable to beneficial insect activity on growers' farms, thus reducing pesticide inputs and increasing cucurbit yield and profitability.

- #:
  63
  State:
  Michigan
  Project title:
  Classical biological control of the emerald ash borer.
  view report
  Keywords:

emerald ash borer, forestry, classical biological control
Key personnel:
Leah Bauer
Objective(s) addressed:
Objective 1, Objective 2, Objective 3, Objective 4
Abstract:
The emerald ash borer is an invasive phloem-feeding beetle from Asia that attacks and kills ash and fringe trees in North America and was discovered near Detroit, Michigan and Windsor, Ontario in 2002. Early studies of EAB natural enemies in southeast Michigan revealed few diseases and parasitoids attacking EAB. In 2003, we began foreign exploration for EAB natural enemies in northeastern China, and within two years, discovered three species of parasitic wasp, and in 2007 received release permits for their environmental release at field sites in Michigan. Over the next few years, USDA initiated an Interagency EAB Classical Biological Control Program, and APHIS built and staffed a parasitoid mass-rearing laboratory in Brighton, Michigan. Parasitoid production has steadily improved at the Brighton laboratory, and field releases have been done in 19 of the 25 states with known EAB infestations, and in Ontario and Quebec, Canada. In collaboration with several other researchers including Drs. Jian Duan (USDA Agricultural Research Service, Newark, Delaware) and Roy van Driesche (University of Massachusetts, Amherst), we are studying the establishment, prevalence, spread, and impacts of these biocontrol agents and other natural enemies on the population dynamics of EAB using life table analyses at long-term study sites in southern Michigan. In addition, we are studying the impacts of EAB biocontrol on the health, survival, and regeneration of ash trees in collaboration with Dr. Dan Kashian (Wayne State University, Detroit). We have learned that both the egg parasitoid, O. agrili, and the larval endoparasitoid, T. planipennisi, are established and spreading in EAB populations in Michigan and other northern states, whereas the larval ectoparasitoid, S. agrili, is apparently not, perhaps due to host asynchrony or low cold tolerance. As a result, releases of S. agrili are now restricted to regions below the 40th parallel. This year, APHIS issued release permits for a similar larval ectoparasitoid, Spathius galinae, from the Russian Far East with higher cold tolerance, and releases are expected to start this summer in Michigan.

- #:
  62
  State:
  Michigan
  Project title:
  Spotted Knapweed Biological Control
  view report
  Keywords:
  spotted knapweed, alternative nectar sources

Key personnel:
Julia Perrone, Doug Landis
Objective(s) addressed:
Objective 3, Objective 4
Abstract:
We are researching the establishment, dispersal, and impacts of three biocontrol insects that target the invasive plant spotted knapweed (Centaurea stoebe). Because spotted knapweed is viewed by beekeepers in Michigan as a valuable nectar plant, we are also investigating ways of establishing native nectar plants in knapweed dominated fields.

- #:
  61
  State:
  Michigan
  Project title:
  Herbivore induced plant volatiles of asparagus (Asparagus officinalis L.) and their attraction of predators of asparagus miner (Ophiomyia simplex Loew) (Diptera: Agromyzidae) and common asparagus beetle (Crioceris asparagi L.) (Coleoptera: Chrysomelidae)
  view report
  Keywords:
  asparagus miner, asparagus beetle, chemical ecology, asparagus, vegetables
  Key personnel:
  Adam Ingrao, Zsofia Sendrei
  Objective(s) addressed:
  Objective 1, Objective 2, Objective 3
  Abstract:
  Asparagus growers in Michigan have indicated interest in developing conservation biocontrol programs to aid in the control of some of the crops most important obligate pests. However, knowledge gaps exist that are preventing development of these programs. Our 2014, research sought to address these gaps by identifying the endemic predators of asparagus miner (Ophiomyia simplex) and common asparagus beetle (Crioceris asparagi) through molecular gut content analysis. This research represents the first time explicit predatory linkages have been established for either pest and will serve as the foundation for our future research which seeks to manipulate habitat and volatile plant signals to enhance conservation biological control.

- #:
  60
  State:
  Michigan
  Project title:

Classical biological control of the brown marmorated stink bug
view report
Keywords:
brown marmorated stink bug, classical biological control
Key personnel:
Ernest Delfosse
Objective(s) addressed:
Objective 2, Objective 3
Abstract:
2014 research continued on classical biological control of the brown marmorated stink bug, Halyomorpha halys (Stål) (Hemiptera: Pentatomoidea; BMSB) with an egg-attacking endoparasitic wasp from China, Trissolcus japonicus Yang (Hymenoptera: Platygastridae). BMSB is potentially a billion dollar pest that attacks over 300 species of crops and native plants, and is a serious home invader. To be successful and sustainable, IPM of BMSB on a landscape basis must be biologically based. This year we nearly completed host-specificity testing of T. japonicus, and are also conducting large-cage and olfactometry experiments in quarantine, and habitat complexity field experiments. T. japonicus can complete development on several genera of stink bugs, so the data are being examined in a risk analysis context to determine if a release permit should be requested. (Extremely valuable chemical, cultural and mechanical tactics are being developed elsewhere as crop protection options.)

- #:
  59
  State:
  Iowa
  Project title:
  Science-Based Trials of Rowcrops Interagrated with prairie Strips (STRIPS)
  view report
  Keywords:
  soybean, prairies, Conservation Biological Control
  Key personnel:
  Matt O'Neal
  Objective(s) addressed:
  Objective 3
  Abstract:
  STRIPS stands for Science-based Trials of Rowcrops Integrated with Prairie Strips. The project is composed of a team of scientists, educators, farmers, and extension specialists determining the value of prairie strips as an affordable option for farmers and farm landowners seeking to garner multiple conservation benefits. By converting just 10% of a crop-field to native perennials, the amount of soil leaving corn and soybean fields can be

reduced by 90% and the amount of nitrogen leaving their fields through surface runoff by up to 85%. Prairie strips also provide potential habitat for biodiversity, including pollinators and natural enemies of insect pests, like the soybean aphid. For more information, visithttp://www.nrem.iastate.edu/research/STRIPs/. Efforts to determine the value of prairie strips for improving the biological control of pests are summarized in the following articles:

Cox, R., M.E. O'Neal, R. Hessel, L.A. Schulte, and M. Helmers. 2014. The impact of prairie strips on aphidophagous predator abundance and soybean aphid predation in agricultural catchments. Environmental Entomology. 43:1185-1197. *http://dx.doi.org/10.1603/EN13129*

Gill, K.A., R. Cox, and M.E. O'Neal. 2014. Quality over quantity: buffer strips can be improved with select native plant species. Environmental Entomology 43:298-311.*http://dx.doi.org/10.1603/EN13027*

- #:
  58
  State:
  Kentucky
  Project title:
  Endosymbiotic candidates for parasitoid defense in weevils
  view report
  Keywords:
  bacterial endosymbionts, defensive symbioses, parasitoid, weevils
  Key personnel:
  Jennifer A. White
  Objective(s) addressed:
  Objective 2
  Abstract:
  An exploratory project to characterize bacterial associates of weevils, and identify candidate bacteria that might be providing defense against parasitoids

- #:
  57
  State:
  Kentucky
  Project title:
  characterizing predator prey interactions in biological control using molecular methodology
  view report
  Keywords:
  generalist predators, molecular methods, gut contents, trophic interactions

Key personnel:
James D. Harwood
Objective(s) addressed:
Objective 2
Abstract:
A variety of studies that use molecular gut content analysis to disentangle trophic interactions between generalist predators and pest insects, within the context of biological control

- #:
  56
  State:
  Kentucky
  Project title:
  Population genetics of the predatory lady beetle Hippodamia convergens
  view report
  Keywords:
  ladybeetle population genetics
  Key personnel:
  Arun Sethuraman, Fredric J. Janzen, John J. Obrycki
  Objective(s) addressed:
  Objective 2, Objective 4
  Abstract:
  Characterizing the population genetics of a ladybeetle species that is redistributed for augmentative biological control

- #:
  55
  State:
  Kansas
  Project title:
  Effect of drought stress on tropic interactions in cotton
  view report
  Keywords:
  abiotic plant stress, trophic interactions, biological control, spider mites, thrips, cotton
  Key personnel:
  James R. Nechols, John R. Ruberson, Sarah Zukoff, David Margolies, Mary Beth Kirkham,Anandhi Swamy, Megha Parajulee, Glen Ritchie
  Objective(s) addressed:
  Objective 2, Objective 3
  Abstract:

This newly-funded USDA-AFRI project will focus on the cotton agroecosystem. The goal is to investigate direct and indirect effects of drought stress on the crop plant, and on two herbivores (twospotted spider mite, *Tetranychus urticae*; western flower thrips, *Frankliniella occidentalis*) the latter of which is also an omnivore and therefore functions as a spider mite predator. Data collected will be useful for making predictions about biological control, overall pest management, and crop productivity and quality.

- #:
  54
  State:
  Kansas
  Project title:
  Larger tamarisk beetle population dynamics and environmental impact in Kansas
  view report
  Keywords:
  Diorhabda carinata Larger, tamarisk beetle, Salt cedar beetle, Kansas
  Key personnel:
  Sarah Zukoff, Anthony Zukoff, James R. Nechols
  Objective(s) addressed:
  Objective 2, Objective 3
  Abstract:
  Tamarisk beetle populations have recently been discovered in Kansas in late 2013 and determining the extent of this beetle's establishment was initiated in 2014. Significant questions brought up by rangeland managers sparked the formation of this project which are currently underway in conjunction with county weed control officers and local USDA NRCS personal. Statewide sampling and data collection started in Feb 2014 and continue currently. Mapping and distribution work is in partnership with the Tamarisk Coalition, and morphological/molecular work is in partnership with the Colorado Palisade Insectary and Texas A&M.

  Primary objectives are to:

1. Examine if "beetle refuges" are useful/needed in rangeland areas where tamarisk stands are managed by chemical means or burning
2. Understand tamarisk tree hybrids & larger tamarisk beetle hybrid dynamics
3. Sample central and western counties for presence of beetles.
4. Quantify predator impact on local beetle populations and presence of other arthropod species using Tamarisk
5. Determine local impact of beetle infestations on tamarisk trees and quality of rangeland habitat.

6. Genotyping and morphological characterization of the Larger- Mediterranean Tamarisk beetle hybrid that occurs in Kansas

- #:
  52
  State:
  Missouri
  Project title:
  Building parasitoid-host interaction webs
  view report
  Keywords:
  aphid, non-consumptive, behavior, parasitoid
  Key personnel:
  Kathryn Ingerslew, Deborah Finke
  Objective(s) addressed:
  Objective 2
  Abstract:
  We are using interaction webs to understand how non-enemy parasitoids can contribute to biological control by inducing changes in herbivore behavior. We have found that parasitoids can reduce the abundance of non-host aphids through behavioral interactions. However, these non-enemy effects may interfere with suppression by biological control agents.

- #:
  51
  State:
  Missouri
  Project title:
  Stinkbug (Pentatomidae) Parasites
  view report
  Keywords:
  Stink bug, Trisolcus brochymenae, Trisolcus euschisti, Chinavia hilaris, Euschistus servus,Euschistus variolarius
  Key personnel:
  Ben Puttler
  Objective(s) addressed:
  Objective 2, Objective 3
  Abstract:
  Two species of stinkbug parasites were reared from a small woodland and prairie habitat located on the University of Missouri, Columbia campus. One species was reared in 2010 from an unidentified egg mass collected from a leaf on a buckthorn tree. It was identified as*Trissolcus brochymenae* (Ashmead). In 2013 an attempt was made to resurrect this species using egg masses obtained from three species of adult stinkbugs (*Chinavia hilaris,*

Euschistus servus, E. variolarius) collected from soybeans. Two sentinel egg masses of each species were attached to foliage of buckthorn and prairie sun flower. After 48 hours they were returned to the lab and held in plastic vials to determine parasitism. Adult parasites emerged from all three species and were subsequently identified as *T. euschisti* (Ashmead).

Adult females emerging from the field parasitized egg masses were exposed to egg masses of the same three species in addition to *Podisus maculiventris* (obtained from a laboratory colony maintained at the USDA Biological Control Laboratory, Columbia) were accepted for oviposition and successful development (N.F. Johnson, Ohio State University, identified the parasites).

In the spring and summer of 2014 success was again achieved by utilizing sentinel stinkbug eggs to obtain parasitism of the following species: *Chinavia hilaris* (green stinkbug);*Euschistus variolarius, E. serves* (brown stinkbug); *Podisus maculiventris* (spined soldier bug); and *Thyanta custator accerra* (red shouldered stinkbug) when exposed (attached) to different plant species in the small prairie and woodland habitat on the University of Missouri campus.*Trissolucus euschisti* was reared from all the afore mentioned stinkbugs. *Telenomus podosi* only occurred once and it was reared from E. variolarius. Except for the latter, these observations duplicate those obtained in the fall of 2013.

The observation and rearing data reported in both years was obtained under the following conditions: temperatures ranged from 21-240 C with a 4-6 hour daily light exposure during the week and total darkness during the weekends and about 40-50% RH. Under these conditions adult parasites did not always emerge (+/- 20 days) and died in that stage. They may have been induced into diapause which could not be terminated under the rearing conditions except for an occasional late emerging adult. No adult parasites emerged from a field collected egg mas of*C. hilaris* reared under the above conditions.

- #:
  50
  State:
  Missouri
  Project title:
  Biological Control of Spotted Knapweed (Centaurea stoebe)
  view report
  Keywords:
  spotted knapweed, Larinus minutus, Cyphocleonus achates
  Key personnel:
  Ben Puttler
  Objective(s) addressed:
  Objective 3

Abstract:
We now have some established sites for the introduced seed (*Larinus minutus*) and root (*Cyphocleonus achates*) weevils for the biological control of spotted knapweed. As of 2014 the seed weevil was widely distributed in south-central Missouri mainly from south of Richland to interstate I-44 and Highway 133 (MM145), east on I-44 to about Rolla and west to Lebanon. It was also found along Highway 63 from five miles north of Edgar Springs to ten miles south of Licking. In the southwest the weevil was found along Highway 65 at the 18.2 mile marker north of Branson and at I-44 Northview exit. There were other releases but their status is unknown. The root weevil has a limited distribution. It primarily established at the I-44 and Highway 133 exit.

- #:
  47
  State:
  Kansas
  Project title:
  Biological control of sugarcane aphid, Melanaphis sacchari
  view report
  Keywords:
  Melanaphis sacchari, Schizaphis graminum, Hippodamia convergens, Aphelinus spp., Orius insidiosus, Syrphidae, Coccinellidae, Allograpta obliqua, Chamaemyiidae, Hemerobiidae,Chrysopidae
  Key personnel:
  Felipe Colares, J. P. Michaud
  Objective(s) addressed:
  Objective 2, Objective 3
  Abstract:
  Colares, F., J.P. Michaud, Clint Bain & Jorge B. Torres. Recruitment of aphidophagous arthropods to sorghum plants infested with Melanaphis sacchari and Schizaphis graminum (Hemiptera: Aphididae). Biological Control (accepted).

- #:
  46
  State:
  Kansas
  Project title:
  Non-target effects of sunflower seed treatments on beneficial insects
  view report
  Keywords:
  thiamethoxam, chlorantraniliprole, Hippodamia convergens, Coleomegilla maculata,Chrysoperla carnea, Orius insidiosus, Lysiphlebus testaceipes

Key personnel:
Valeria Moscardini, Pablo Gontijo, J. P. Michaud
Objective(s) addressed:
Objective 2, Objective 3
Abstract:
See articles for more information.

- #:
  45
  State:
  Missouri
  Project title:
  Monitoring overwintering soybean aphid (Aphis glycines) populations
  view report
  Keywords:
  soybean aphid, Aphis glycines
  Key personnel:
  Ben Puttler
  Objective(s) addressed:
  Objective 2, Objective 3
  Abstract:
  No overwintering soybean aphids were observed during the spring of 2014 on buckthorn on the University of Missouri (Columbia) campus. As in the past three years, Aphids were not detected in soybeans in central Missouri until mid-August and no economic populations were reported throughout the state. The aphid did return to the buckthorn in early October. Aphids were common by mid-October and were readily fed upon by syrphid larvae. Cool, damp weather during this period contributed to the initiation of a fungal disease that decimated the aphid population to the extent that no living aphids could be detected by the end of October. The latter no doubt contributed to the absence of aphids on the buckthorn during the spring of 2015.

- #:
  41
  State:
  Missouri
  Project title:
  Fungal pathogens of termites
  view report
  Keywords:
  Beauveria, Metarhizium
  Key personnel:

Tamra Reall, Richard Houseman
Objective(s) addressed:
Objective 2
Abstract:
Comparing the relative frequency and virulence of the entomopathogenic fungi (Beauveria and Metarhizium) in forested and developed/urban soils.