Kansas Department of Agriculture—Plant Protection & Weed Control

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Entomological News

SURVEY & MANAGEMENT

Spotted knapweed (*Centaurea stoebe micranthos*, aka *C. maculosa*) biocontrol

Figures 1–2. SKW. (1) State Weed Specialist, Scott Marsh and author in a field of SKW in north-central KS. (2) Feeding damage on SKW seed heads showing characteristically black-tipped bracts giving them a "spotted" appearance. Fig. 1 photo courtesy, Amy Jordan.

Robust establishment of SKW has the negative impact of: (1) reduced forage quality; (2) increased water runoff (as much as +56%) and soil sedimentation (as much as +192%); (3) decrease in overall surrounding plant diversity. Allelopathy, chemical (cnisin) inhibition of growth in competitors is known, but there is disagreement on extent and significance on native plants (Sheley *et al*. 1998; Story *et al*. 2006; Tyser & Key 1988).

For many years, spotted knapweed (*Centaurea stoebe micranthos*) has been on the radar as a problematic invasive weed in Kansas with Kansas Department of Agriculture-Plant Protection & Weed Control (KDA-PPWC) (https://agriculture.ks.gov/docs/default-source/pp-2013-weed-reports/noxious-and-invasive-weed-update---spring-2013.pdf?sfvrsn=e681a7c1_0). A non-native forb native to a wide range of Eurasia, spotted knapweed (SKW) is a problematic perennial that has routinely taken over rangeland (Figs. 1–2).

SKW was first detected in Victoria, British Columbia, Canada in 1893. It is believed that material was brought in through contaminated alfalfa and discarded soil ballasts[1]. SKW, along with the notorious diffuse knapweed (*Centaurea diffusa*) was historically soon recognized as a problematic adventive weed and control measures were installed. As one of North America's first biological control initiatives, over the course of decades, 13 species of knapweed (*Centaurea* spp.) feeding insects from their native

[1]Interestingly, many adventive ground-dwelling beetles (Coleoptera) are thought to originate from discarded soil ballasts in Northeastern U.S. Although most of these beetles have no direct impact on human activity, they indirectly do so by outcompeting native fauna. In many areas of New England, much of the soil beetle fauna primarily constitutes of adventive European fauna. Contextually: during colonial times, British ships would arrive in the U.S. with soil ballasts for the sole purpose of exporting American goods. The European born soil ballasts were indiscriminately discarded on American soil, likely being the main contributor to the introduction of Western European ground-dwelling insect fauna that are now widely established in the U.S. (Lindroth 1957).

Agent	Common name	Weed attacked	Type of agent	States established
Agapeta zoegana	Sulphur knapweed moth or yellow-winged knapweed root moth	CENMA, CENDI[a]	Root-boring moth	MT, OR, WA
Banganstemus fausti	Broad-nosed seedhead weevil	CENMA, CENDI	Seedhead weevil	MT, OR, UT
Chaetorellia acrolophi	Knapweed peacock fly	CENMA	Seedhead weevil	MT, OR
Cyphocleonus achates	Knapweed root weevil	CENMA	Root-boring/gall weevil	CO, MT, OR, WA
Larinus minutus	Lesser knapweed flower weevil	CENMA, CENDI	Seedhead weevil	MT, OR, WA
Larinus obtusus	Blunt knapweed flower weevil	CENMA	Seedhead weevil	WA
Metzneria paucipunctella	Spotted knapweed seedhead moth	CENMA	Seedhead moth	ID, MT, OR, WA
Pelochrista medullana	Brown-winged root moth	CENMA, CENDI	Root-boring moth	Not established in United States
Pterolonche inspersa	Gray-winged root moth	CENDI	Root-boring moth	MT
Sptenoptera jugoslavica	Bronze knapweed root borer	CENDI	Root-boring/gall beetle	CA, ID, MT, OR, WA
Terellia virens	Green clearwing fly	CENMA	Seedhead fly	MT, OR
Urophora affinis	Banded gall fly	CENMA, CENDI	Seedhead fly	CA, ID, MT, OR, UT, WA
Urophora quadrifasciata	UV knapweed seedhead fly	CENMA, CENDI	Seedhead fly	ID, MT, OR, UT, WA

[a] WSSA-Bayer Code: CENMA—spotted knapweed, CENDI—diffuse knapweed.

Table 1. Biological control agents released for DKW and SKW. Source: Sheley *et al*. 1998.

range were introduced in an effort to quell their spread (Sheley *et al*. 1998) (Table 1). Despite several ecological characteristics that seemingly suggest diffuse knapweed (DKW) as a more problematic species, studies and monitoring efforts have repeatedly shown success of biocontrol insect releases on controlling DKW populations. Contrastingly, efficacy of biocontrol on SKW is somewhat inconclusive (Knochel *et al*. 2010; Seastedt *et al*. 2007). Unlike SKW, DKW will readily break at the base and spread seed via a tumble-weed like manner. On the other hand, SKW, while having a thin, light seed, potentially capable of wind dispersal, will typically extend their range through peripheral enlargement of existing stands (Sheley *et al*. 1998).

When biocontrol works, it is elegant. The appeal is that it does not rely on chemicals and the biocontrol agents self-multiply, spreading and persisting in the environment, lowering pest populations below a threshold level with economic impact. The theory behind classic biocontrol is based on the "enemy release hypothesis". The idea that when non-native organisms establish in new areas, they are released from natural enemies that keep their populations in check in their native environment. Therefore, identifying and releasing these natural enemies alongside non-native populations will restore this check and balance relationship.

Biocontrol of invasive plants is considered to be successful initiatives overall (Clewley *et al*. 2012), and studies on SKW biocontrol sheds some light on how our efforts may fare in Kansas. Ideally a biocontrol agent is host-specific and has a strong negative effect on hosts (e.g. kills the host). In this regard, all 13 species of bioconotrol insects released to tackle knapweeds in the US have proven to be host specific (Table 1). While *Urophora* spp. (a seed head-feeding fruit fly [Tephritidae]) appear to have very little direct effect on SKW seed production, *Larinus* spp. (a seed head-feeding weevil [Curculionidae]) are dominant control agents for DKW and for SKW in British Columbia and Minnesota (Seastedt *et al*. 2007). *Cyphocleonus achates* (weevil, family Curculionidae) with its root-feeding larvae have a proven ability to cause plant mortality. An 11 year-long study of *C. achates* effect on SKW densities at two sites in Montana have shown significant decrease in SKW populations (77% and 99% each). Although six other biocontrol agents were released during the study, only the two sites containing *C. achates* showed significant decline in SKW (Story *et al.* 2006). With increasing reports of successful biocontrol of SKW, following those with DKW, "the multiple releases of biological control agents against these two *Centaurea* species [SKW and DKW] may represent a less-than perfect but successful biological control effort…The combination of flower head insects and root-feeders appear to provide results consistent with a 'cumulative stress' effect on target species,…and the comparison of results reported here with the Montana findings by Story et al. (2006) suggest that this effect can be generated with different combinations of insects." (Seastedt *et al.* 2007). With high enough insect density, biocontrol attenuates the ability of SKW to exploit favorable habitats, and SKW densities can be reduced in most habitats (Maines *et al*. 2013). Furthermore, biological control can intensify the efficacy of other control methods (Maines *et al*. 2013), such as the use of herbicides like picloram (e.g. an active ingredient in

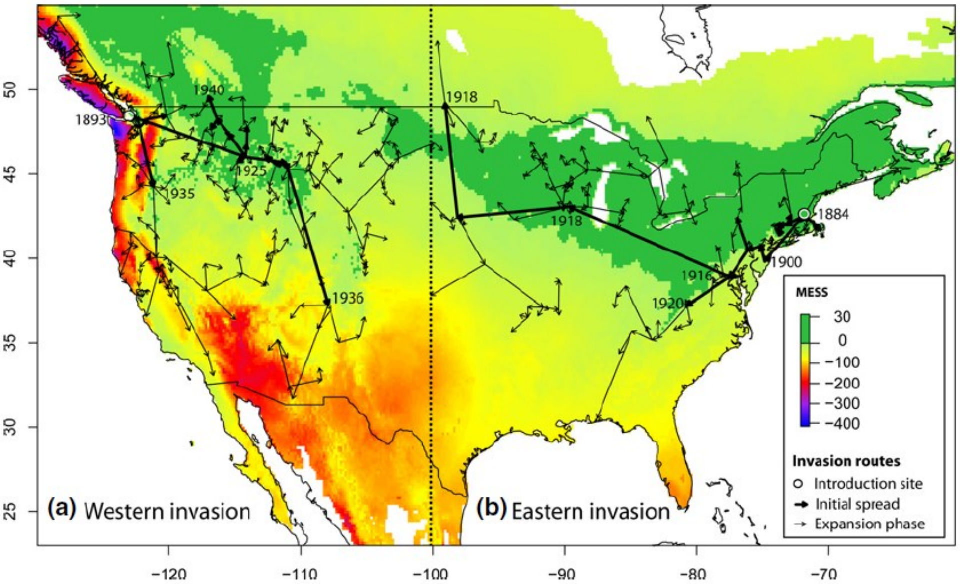

Figure 3. Pattern of SKW spread from (a) western and (b) eastern introduction sites. Arrows and dates indicate introduction sites with think and thin arrows corresponding to initial spread and expansion phases, respectively. Dark green = most, blue = least suitable environments. Source: Broennimann *et al*. 2014.

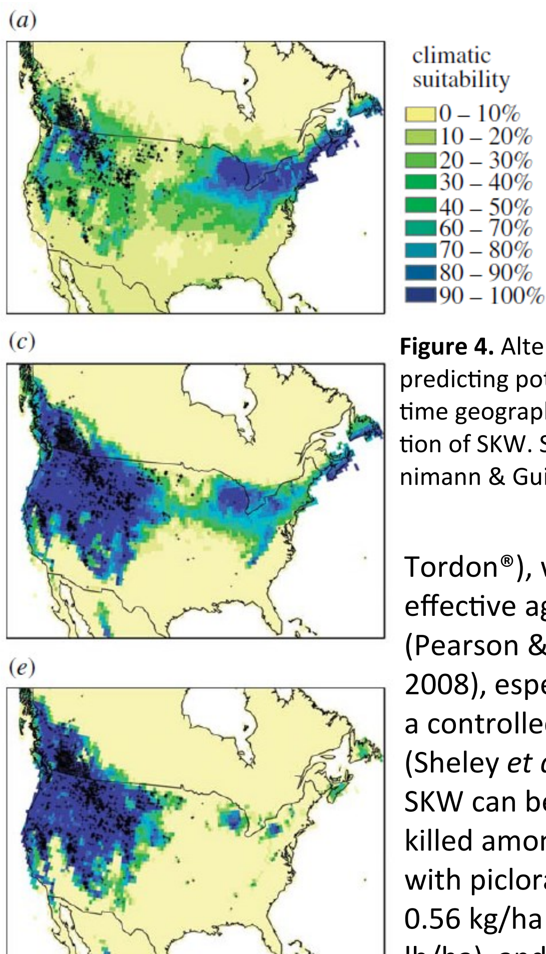

Figure 4. Alternative models predicting potential present time geographical distribution of SKW. Source: Broennimann & Guisan 2008.

Tordon®), which is effective against SKW (Pearson & Fletcher 2008), especially after a controlled burn (Sheley *et al*. 1998). SKW can be selectively killed among grasses with picloram at 0.42–0.56 kg/ha (0.93–1.23 lb/ha), and gross return from hay four years after treatment should be over $100/ha compared to $14/ha in an untreated field (figures based on Western Canada in the 1970s) (Harris & Cranston 1979).

Through a previous survey initiative by KDA-PPWC, SKW populations were mapped out for the northeastern portion of the state. Although populations are not yet dense nor extensive, due to SKWs highly invasive history in other regions of the US and Kansas being a relatively suitable environment for SKW establishment (Broennimann & Guisan 2008, Broennimann *et al*. 2014) (Figs. 3–4), KDA-PPWC released biocontrol agents from Colorado as a control measure. This year, KDA-PPWC had another opportunity to re-release biocontrol agents to target SKW. Similar to the previous release, two or three species of weevils were released: (1) a root-feeding *Cyphocleonus achates*; (2) a seed head feeding *Larinus* spp. (there are two very similar species, *L. minutus* and *L. obtusus*, and our source did not clarify the species being provided). At the release site, we observed establishment of *Larinus* from the previous release (later determined to be *L. minutus*), but no signs *of Cyphocleonus achates*. 200 specimens each were released onto SKW plants. The goal is to establish a healthy population of the insects at the release site to utilize in additional releases at other sites in Kansas. Breeding and subsequent new releases of biocontrol agents to other sites in Kansas will be conducted in conjunction with careful monitoring of SKW populations to ensure it is not spread during our control efforts using insects.

Interestingly, several seed heads were brought back and a seed head-feeding fly, *Urophora quadrifaciata* was reared out from one of the seed heads. Two species of *Urophora*, *affinis* and *quadrifaciata* were first introduced into North America in the 1970s and have rapidly spread. Therefore, it is unsurprising that *U. quadrifaciata* has found its way into Kansas. It is likely that small patches of SKW have acted as islands for progressive spread of the fly. Nearby, the flies are known from Arkansas and may have been a source of spread into Kansas.

Figures 5–6. Releasing SKW biocontrol agents in northcentral Kansas. Beetles were mailed overnight in tubes with some plant material (pictured). Each tube contained 50 adults. (1) *Cyphocleonnus achates*. (2) *Larinus* sp./ spp. Photo courtesy, Amy Jordan.

into Kansas.

KDA-PPWC will continue to monitor SKW populations in conjunction with the biocontrol agents that have been released. According to previous research, *C. achates* is an important component of SKW biocontrol (Story *et al*. 2006). Accordingly, we will continue to re-release *C. achates* if they do not establish from this year's release. KDA-PPWC believes that cumulative stress due to multiple seed and root-feeding insects will be the most promising approach to controlling SKW with biologicals in Kansas.

A lot of information about SKW and their identification are available online (see Further Reading below). If you believe there is a strong population of SKW in your area in Kansas, please contact KDA-PPWC (see last page for contact info). Help KDA-PPWC and Kansas by making sure not to move spotted knapweed in hey bails. You can request for a Weed Free Forage Inspection here (https://agriculture.ks.gov/kda-services/weed-free-forage-inspection).

NOTE: Above management practices were aggregated from available literature and are not official recommendations by the Kansas Department of Agriculture. As with all herbicide applications, it is extremely important to read and follow label instructions and state regulations. The importation and release of non-native biocontrol agent(s) requires proper permitting and clearance with the state of Kansas. Questions concerning weed management should be directed to your local Weed Director(s).

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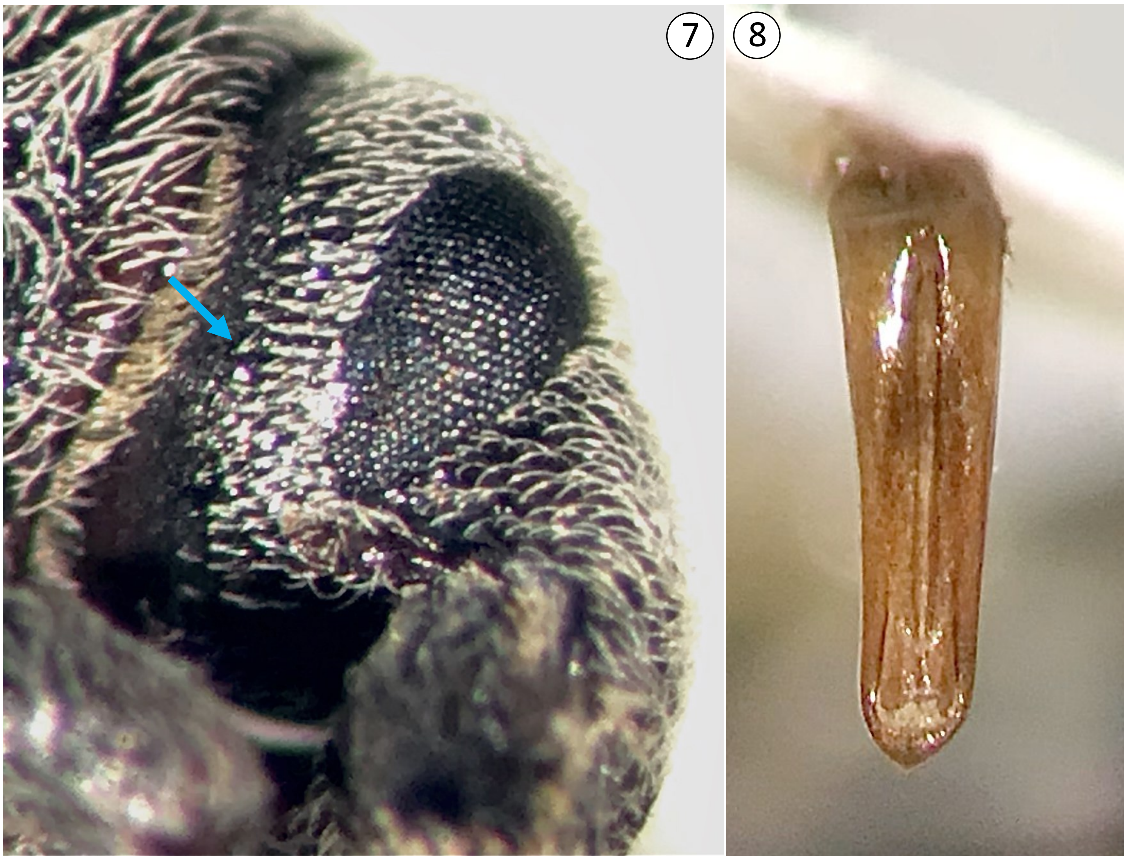
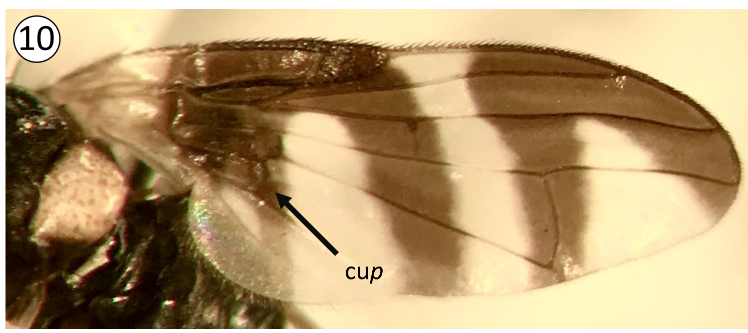


Figures 7–8. Specimens of *Larinus minutus* established in KS from previous release showing diagnostic characters according to Gültekin & Anderson 2017. (7) Gena with bi– and trifurcate scales. (8) Aedeagus gradually narrowing apically with apex of ventral plate strongly triangularly narrowed.



Figures 9–10. *Urophora quadrifaciata* reared from a seed head collected at biocontrol release site. (9) Head and prothorax showing diagnostic setation for the genus. (10) Fore wing with diagnostic venation and patterning for the species.

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Further Reading

KDA-PPWC Noxious and Invasive Weed Update (https://agriculture.ks.gov/docs/default-source/pp-2013-weed-reports/noxious-and-invasive-weed-update---spring-2013.pdf?sfvrsn=e681a7c1_0 • https://agriculture.ks.gov/docs/default-source/pp-weed-reports-2017/noxious-and-invasive-weed-update---fall-2017.pdf?sfvrsn=d81683c1_0 https://agriculture.ks.gov/docs/default-source/pp-weed-reports-2017/noxious-and-invasive-weed-update---fall-2017.pdf?sfvrsn=d81683c1_0 • https://agriculture.ks.gov/docs/default-source/pp-weed-reports-2017/noxious-and-invasive-weed-update---spring-2017.pdf?sfvrsn=f789bcc1_0).

University of Nebraska-Lincoln Extension, EC 173, *Noxious Weeds of Nebraska: Spotted and Diffuse Knapweed* (http://extensionpublications.unl.edu/assets/pdf/ec173.pdf).

Washington State Noxious Weed Control Board, Information and Identification, *Selected Knapweeds of Washington* (https://www.nwcb.wa.gov/pdfs/Knapweed-2010.pdf).

- USDA-APHIS, Program Aid Number 1529, *Biological Control of Spotted and Diffuse Knapweeds* (https://www.invasive.org/publications/aphis/knapwpub.pdf).

YEAR-END RECAP—2019

CAPS—Cooperative Agricultural Pest Survey

The Cooperative Agricultural Pest Survey (CAPS) is a program that coordinates and funds states to survey for exotic pests with the aim to detect introductions and establishments early for rapid response. This year, KDA-PPWC continued our efforts in monitoring for pests of agricultural small grains (i.e. wheat and sorghum).

Small grains pest survey

This year, we continued surveying for exotic insects that are known to be serious pests of small grains outside of the U.S. Four pests were targeted: (1) sunn pest (Hemiptera: Scutelleridae: *Eurygaster integriceps*); (2) small brown planthopper (Hemiptera: Delphacidae: *Laodelphax striatellus*); (3) Egyptian cottonworm (Lepidoptera: Noctuidae: *Spodoptera littoralis*); (4) Old World bollworm (Lepidoptera: Noctuidae: *Helicoverpa armigera*). Two pheromone baited bucket traps targeting each moth species, yellow sticky card trap for the planthopper, and fields were swept with a net for the sunn pest. 110 sites for wheat (Fig. 11) and 28 sites for sorghum (Fig. 12) were sampled across 29 counties (Table 2): Barton, Cheyenne, Clay, Cloud, Decatur, Dickinson, Ellsworth, Greeley, Jewell, Lane, Logan, Marion, McPherson, Mitchell, Ness, Norton, Ottawa, Phillips, Rawlins, Republic, Rice, Rooks, Russell, Saline, Scott, Sherman, Smith, Wallace, Wichita.

(1) Sunn pest: no positive detections.

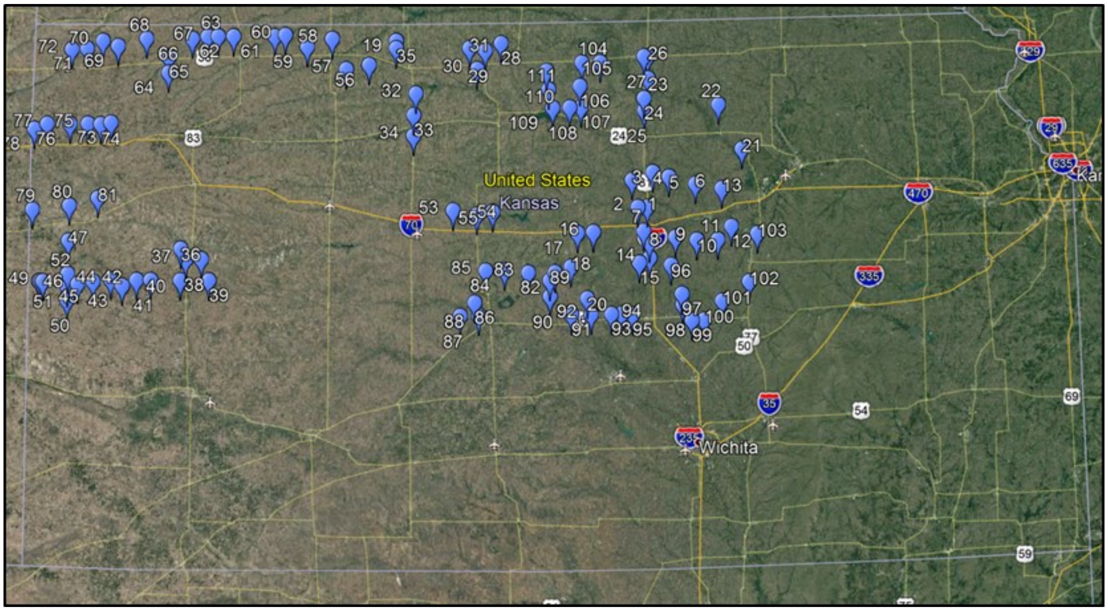


Figure 11. CAPS, small grains pest survey, wheat sites. Map courtesy, Laurinda Ramonda.

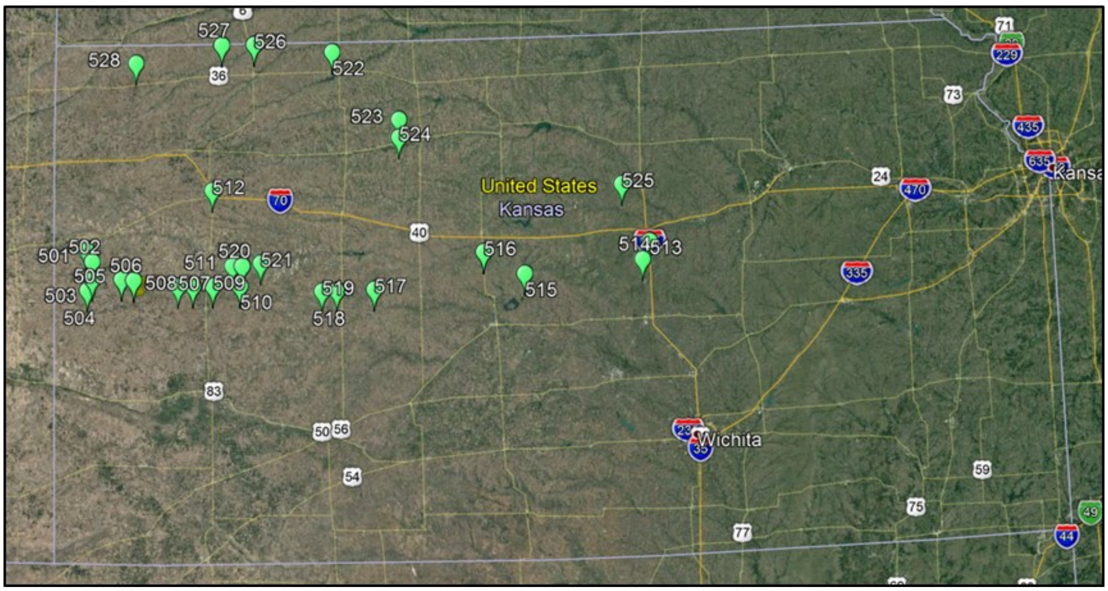


Figure 12. CAPS, small grains pest survey, sorghum sites. Map courtesy, Laurinda Ramonda.

(2) Small brown planthopper: 11 planthopper (Delphacidae) specimens were sent off for identification, but none were positive for small brown planthopper. All identified planthoppers are native of limited to no economic importance (https://sites.udel.edu/planthoppers/) and are not known to be vectors of plant diseases (Table 3).

(3) Egyptian cottonworm: 1,022 moth specimens were recovered and sent off for identification.

(4) Old World bollworm: 43,689 moth specimens were recovered and sent off for identification.

A total of 45,534 moth specimens were sent off for identification. 11,006 specimens (~24%) were identified. A list of identified moths and their counts are presented in Table 4.

KDA-PPWC plans to continue the small grains pest survey in 2020, focusing on southern Kansas.

Table 2. Summary of CAPS, small grains pest survey site and traps counts across 29 counties. Data courtesy, Laurinda Ramonda.

Commodity	Sites	Traps
Wheat	110	330
Sorghum	28	84

Table 3. Planthoppers collected during CAPS, small grains pest survey.

Identification	Count
Kosswigianella sp.	1
Muirodelphax avensis OR *parvulus*	9
Muirodelphax sp.	1

Table 4. Moths collected during CAPS, small grains pest survey.

Family	Identification	Count
Blastobasidae	*Hypatopa*	21
	Pigritia fidella	3
Crambidae	*Achyra rantalis* (garden webworm)	3
	Hahncappsia pergilvalis	94
	Loxostege	6
	Nomophila nearctica (lucerne moth)	6
	Ostrinia nubilalis	1
	Udea rubigalis	1
	Udea	1
Erebidae	*Caenurgina*	9
	Hypena scabra (green cloverworm)	6
Gelechiidae	*Chionodes mediofuscella* (black-smudged Chionodes moth)	1
Gelechioidea	Undet.	1
Geometridae	Undet.	1
	Anavitrinella pampinaria	1
	Digrammia colorata (creosote moth)	1
	Orthonama obstipata (the gem)	1
Noctuidae	Undet.	6
	Autographa californica (alfalfa looper)	2
	Caradrina montana	3
	Condica videns (white-dotted groundling moth)	8
	Dargida diffusa (wheat head armyworm)	3
	Dypterygia rozmani (American bird's-wing moth)	2
	Euxoa auxiliaris (army cutworm)	4
	Helicoverpa zea (corn earworm)	1,0180
	Heliothis	365
	Leucania	6
	Leucania stolata	1
	Megalographa biloba (bilobed looper)	1
	Mythimna unipuncta (true army worm moth)	3
	Peridroma saucia (variegated cutworm)	38
	Psychomorpha epimenis (grapevine epimenis)	1
	Resapamea passer (dock rustic moth)	1
	Resapamea	63
	Schinia	1
	Spodoptera	2
	Spodoptera ornithogalli (yellow striped army worm)	4
Pterophoridae	Undet.	6
Pyralidae	*Tlascala reductella* (Tlascala moth)	1
Pyraloidea	Undet.	2
Tortricidae	*Celypha cespitana* (celypha moth)	1
	Clepsis consimilana (privet tortrix)	6
Microlepidoptera	Undet.	65
Macrolepidoptera	Undet.	232
Total		1,1006

Plant Protection Act Survey

The Plant Protection Act 7721 (formerly called Farm Bill) financially supports surveys, research and management of pests and other topics related to the agricultural interested of the United States. This year we are continuing our survey for the walnut twig beetle (*Pityophthorus juglandis*).

Walnut twig beetle (*Pityophthorus juglandis*)

The walnut twig beetle (WTB) survey began on June 13th and concluded on August 13th, 2019. 44 Lindgren funnel traps were deployed in 15 counties with 1 trap/site (Butler, Chase, Chautauqua, Cowley, Elk, Greenwood, Harvey, Lyon, Marion, McPherson, Morris, Reno, Rice, Sedgewick, Sumner) (Fig. 13). In addition, 22 walnut bolts were set up alongside Lindgren funnel traps as an alternative method for detecting WTB, but also to monitor the coexistence of wood boring insects and the fungal pathogen *Geosmithia morbida*, the causal agent of thousand cankers disease.

This year, we similarly implemented a dry-trap regiment as in previous years. However, due to the unseasonably wet field season, many of the traps were found to contain a significant amount of rain water. Consequently, many of the traps demonstrated significant specimen decay, which subsequently attracted carrion beetles. Many traps were overflowing with carrion beetles (especially Histeridae [clown beetles]: *Saprinus* spp.; Silphidae [carrion beetles]: *Nicrophorus* spp. & *Silpha* spp.; Staphylinidae [rove beetles]: *Aleochara* spp.). Possibly due to the wet field season and the overwhelming odor of decay, no traps recovered bark beetles (Scolytinae) and wood boring beetle bycatch was overall noticeably depauperate.

Insects are currently being reared out of the walnut bolts that were set out, and results are pending. However, due to the size of holes and amount of frass, it appears that no scolytines are in the bolts but are instead occupied by larger wood borers like longhorn beetles (Cerambycidae). Beetles recovered will contribute to pending survey for *G. morbida* in the environment in Kansas.

KDA-PPWC plans to continue surveying for WTB in 2020. Additionally, there are tentative plans to survey for *G. morbida* in the environment in Kansas. The work plan is currently being prepared, but we plan to survey for the fungus by focusing on other wood boring beetles feeding on walnuts (*Juglans* spp.). The motivation is to: (1) detect the coexistence of *G. morbida* and non-WTB wood boring beetles in the presence of walnut; (2) demonstrate widespread prevalence of *G. morbida* in the environment in Kansas; (3) demonstrate the lack of thousand cankers disease in Kansas despite the presence of *G. morbida* (minimal canker development can and is expect, just not “thousand(s) of cankers”). Depending on our findings, KDA-PPWC will reevaluate the quarantine involving the thousand canker disease complex.

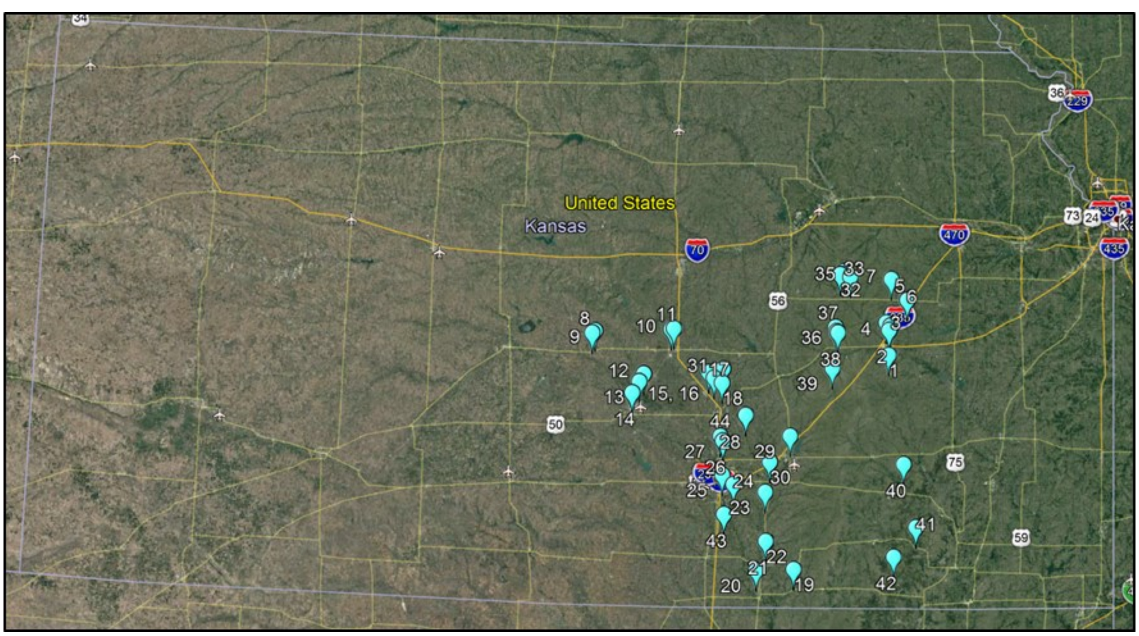


Figure 13. PPA, walnut twig beetle survey sites. Map courtesy, Laurinda Ramonda.

Emerald ash borer (*Agrilus planipennis*)

This year, KDA focused emerald ash borer (EAB) monitoring efforts to counties surrounding the front line of their distribution in eastern Kansas. Additionally, areas with high traffic farther west of their front line was monitored, including Hays, Wichita and Wilson Lake (Fig. 14).

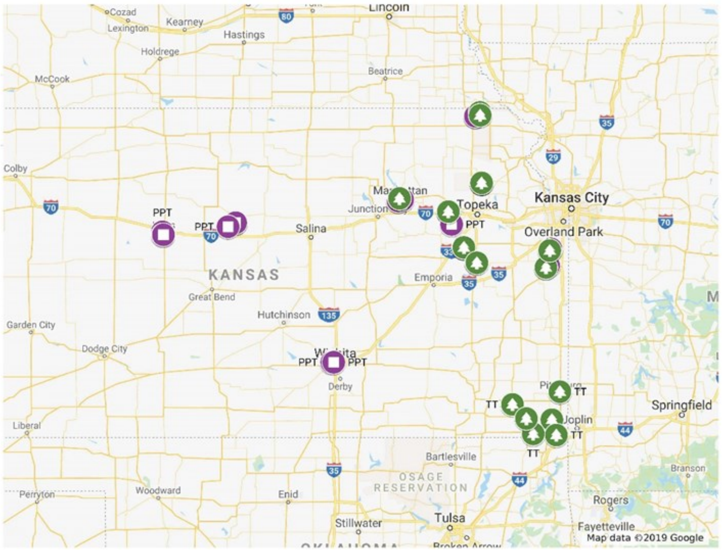


Figure 14. EAB survey sites. Purple square = purple prism traps; green trees = girdled trap trees.

- Purple prism traps: KDA set up 30 purple prism traps across 9 counties (Brown, Ellis, Jackson, Miami, Osage, Riley, Russell, Sedgwick, Wabaunsee). There were no positive detections.

- Girdled Trap Trees: Working with Kansas Forestry Service (KFS), Kansas State University Extension, and local cooperators, KDA set up 16 traps trees (Figs. 15–16). One trap tree near Hiawatha was not accessible due to delayed harvest in the adjacent field and will be left for a two-year girdle, along with a tree in southeastern Kansas.

  EAB adults and larvae were recovered from three trap trees in two counties: Paola and Spring Hill in Miami Co., and just south of Denison in Jackson Co (Figs. 17–18). These detections represent new county records for EAB in Kansas, and KDA is working on expanding the quarantine (Fig. 19). Trees from Spring Hill and Denison were notable for their extremely high density of EAB, and likely represented multiple years of colonization and damage (Fig. 20).

- Public Reports: Staff continue to follow up on public reports of possible EAB infestations. This year, KDA-PPWC joined KFS to survey poor ash trees at Osawatomie Golf Course, Osowatomie, Miami Co. While we noted many secondary wood boring insect damage, including cerambycids and scolytines, EAB was not found.

KDA-PPWC will continue to monitor the spread of EAB, and together with KFS and KSU Extension will work to inform the public as this adventive invasive wood boring beetle extends its western range through Kansas.

Figures 15–16. EAB survey work. (15) Trap tree peeling in Spring Hill in cooperation with KFS. (16) Dropping an ash tree near Denison in cooperation with KFS.

In addition to EAB, other non-target insects were recovered during surveys. Non-target metallic wood boring beetles (Buprestidae) that were recovered from traps are listed in Table 5. Notably, a silken parasitoid wasp cocoon was recovered from an EAB gallery during a tree peel. It is thought to be a species of Braconidae, and likely *Atanycolus* sp., a native genus known to readily parasitize EAB in North America. According to the literature (Duan & Schmude 1999), late season *Atanycolus* require a period of diapause (cold spell) for development. The specimen is currently trying to be reared out for identification and understanding the role of native parasitoids on EAB in Kansas.

Figures 17–18. EAB recovered during survey work. (17) EAB adult recovered from a trap tree near Denison. (18) EAB larva recovered from a trap tree in Spring Hill.

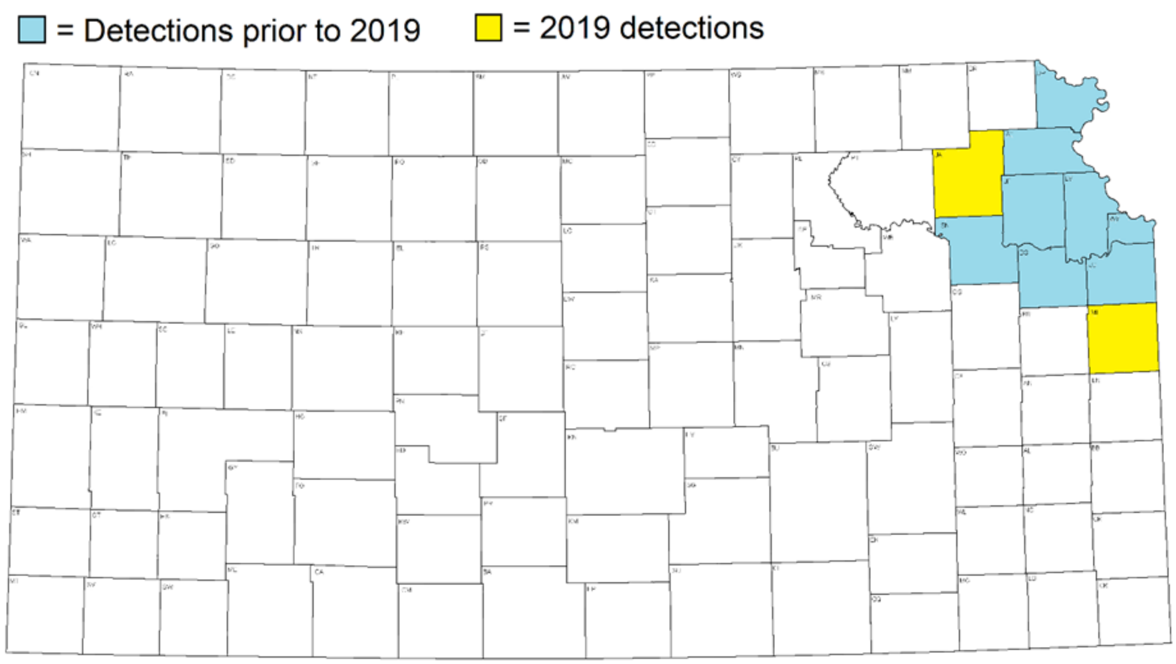


Figure 19. Current distribution of EAB in Kansas, 2019.

Figure 20. A severely stressed trap tree from near Denison, demonstrating such heavy infestation that EAB larvae are no longer forming the characteristically serpentine larval galleries—sign of a compromised host immune system.

Table 5. Metallic wood boring beetles collected during EAB survey trapping.

Species	Count
Agrilus ferrisi	1
Agrilus leconti	12
Anthaxia fisheri	1
Chrysobothris harrisi	2
Chrysobothris sexignata	8

Brown marmorated stink bug (*Halyamorpha halys*)

Brown marmorated stink bug (BMSB) was first detected in Douglas Co. in 2011 and later reported in the Journal of the Kansas Entomological Society . Subsequently, BMSB came to the attention of KDA-PPWC through reported sightings in Johnson Co., follow-up trapping efforts by KDA and a sighting in Douglas Co.

This year we continued our survey efforts using pheromone baited traps. 18 traps were placed across four counties (Douglas, Leavenworth, Johnson, Shawnee). Three from Johnson and one trap from Shawnee Co. recovered BMSB, the latter representing a new county record for Kansas. Although specimens were not abundant in Johnson Co. traps, due to specimens being recovered consecutively over the years, BMSB is likely wide spread and well established in the area. Six specimens were recovered from a single trap at Washburn University in Shawnee Co. The high abundance may illustrate that BMSB is already established in parts of Shawnee Co., and presence on a university campus may be due to unintended movement by students (Fig. 21).

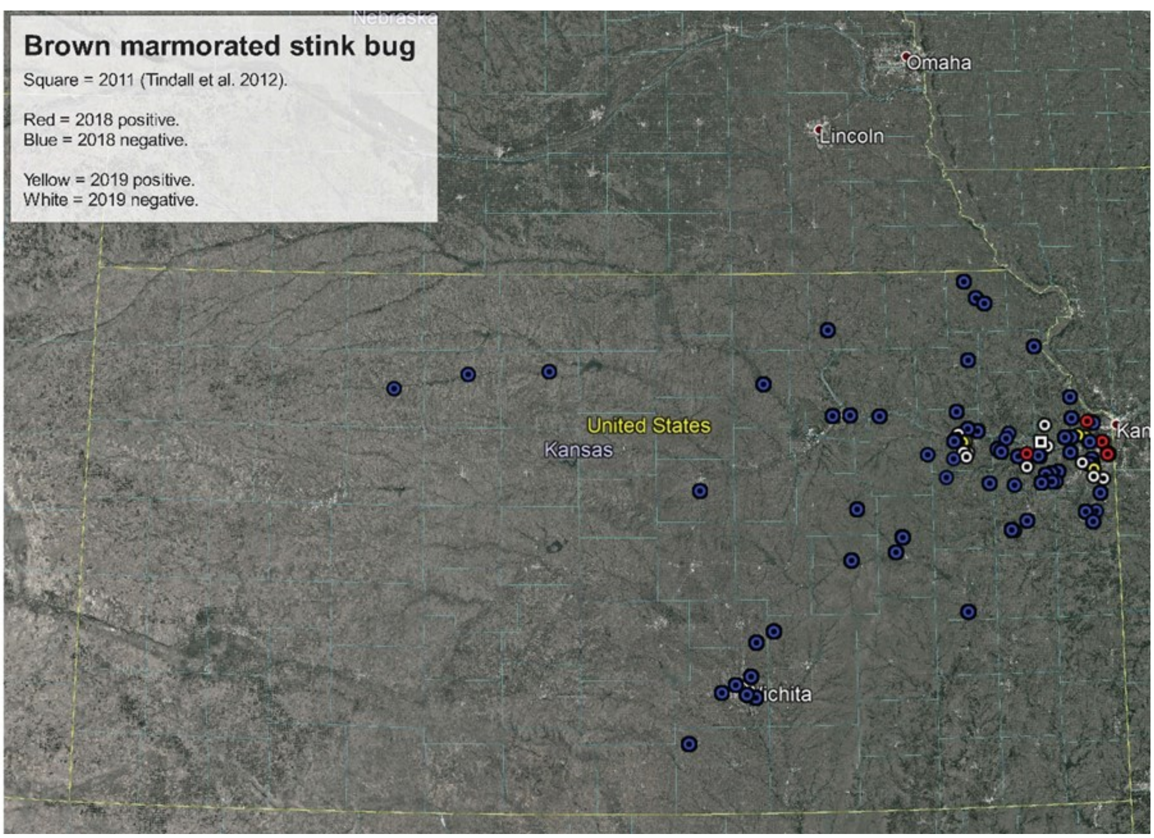
Although not yet known to cause noticeable damage, due to their highly polyphagous nature and economic importance, KDA-PPWC will continue to monitor and survey for BMSB in 2020.

At this juncture, it is becoming apparent that BMSB is making a movement westward through Kansas and will be a matter of time before they become

Species	Count
Chinavia hilaris	4
Euschistus tristigmus	1
Euschistus variolarius	11
Thyanta calceata	2

Table 6. Stink bugs collected during BMSB survey trapping.

Figure 21. BMSB survey and summary of known



widely established with the state.

Other non-target stink bugs were recovered from BMSB traps (Table 6). All are commonly collected species from Kansas, likely attracted to BMSB pheromones due to similar and/or shared chemistry.

Gypsy moth (*Lymantria* spp.)

KDA-PPWC had no positive finds in traps set in 2019. KDA set 52 traps across 33 counties throughout the state (Fig. X): Allen, Anderson, Barber, Bourbon, Butler, Comanche, Douglas, Edwards, Franklin, Geary, Gove, Graham, Harper, Johnson, Kingman, Kiowa, Lane, Leavenworth, Logan, Lyon, Montgomery, Morton, Ness, Norton, Pratt, Riley, Scott, Shawnee, Stafford, Stevens, Trego, Wichita, Wyandotte.

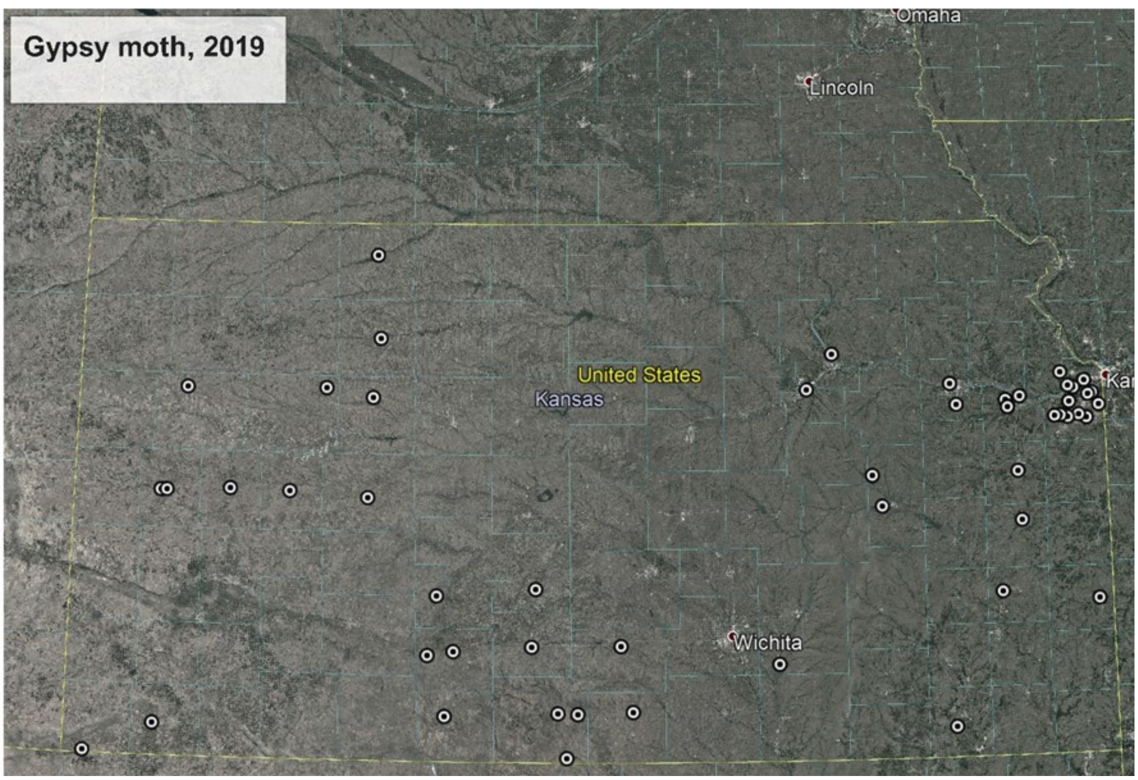


Figure 22. Gypsy moth survey sites, 2019.

European pepper moth (*Duponchelia foveolate*)

For the second year in a row, KDA-PPWC trapped for European pepper moth (EPM). This exotic moth is originally from Southern Europe and Northern Africa. Larvae, the destructive life stage, are high-

Figure 23. EPM caught in sticky trap. Arrow indicating diagnostic finger-like wing pattern of fore wing.

ly polyphagous and are recorded to feed on over 70 different plants. Larvae prefer very moist soils and because EPM are unable to overwinter in Kansas, known instances of EPM in Kansas are likely being brought in with greenhouse stock imported from southern states. This year, EPM was detected from three different greenhouses (Fig. X). In two of these operations, only one or two specimens were recovered and are not believed to be a serious problem in Kansas. The third house had over 50 specimens recovered from it, and the very wet soils from overwatering is thought to be a contributing factor there. However, due to the EPM's inability to overwinter in Kansas and little evidence to suggest they are a major issue in Kansas greenhouses, KDA-PPWC will be concluding EPM survey work in 2019.

Japanese beetle (*Popillia japonica*)

In order to comply with the Japanese Beetle Harmonization Plan, KDA-PPWC has continued efforts to survey for Japanese beetle in 2019. This year, there were two new county records: Pratt and Sumner counties. Of the two, the detection in Sumner county only included a single specimen, and under the Harmonization Plan does not fulfill the necessary requirements to be considered "infested" as of the present.

KDA-PPWC is currently in the midst of reevaluating its stance on the state of JB in Kansas. Part of this process involves reviewing historical records on JB distribution through time in Kansas and formulating a risk assessment for Kansas concerning JB.

KDA-PPWC will continue to monitor for JB in 2020 and is additionally looking into the possibility of cooperating with out of state agencies to explore the release of biocontrol insects to control JB in Kansas.

Our mission:

- Exclude or control harmful insects, plant diseases and weeds.
- Ensure Kansas plants and plant products entering commerce are free from quarantined pests.
- Provide customers with inspection and certification services.

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