MANAGING MILKWEED CROP PESTS: A Native Seed Industry Guide

Monarch caterpillar causes a conservation challenge in milkweed seed production (left). Pest scouting (right) can help identify when pest management is actually needed and help reduce unnecessary harm to non-pest insects. (Photographs by Thelma Heidel-Baker (L) and Brianna Borders (R), The Xerces Society.)

Introduction

Project Milkweed is a collaboration with The Xerces Society, the native seed industry, and the USDA Natural Resources Conservation Service (NRCS) to increase commercial availability of milkweed seed. Since 2010 this partnership has worked to address some of the major production challenges faced by the native seed industry and has expanded commercially viable milkweed production to regions where seed was not previously available.

During Project Milkweed surveys of native seed producers, yield loss from insect pests was consistently the most significant challenge reported. Further complicating the situation is the abundance of monarch butterfly caterpillars, crop pollinators, and predatory insects, all of which are typically found in seed production plots and which are vulnerable to insecticides used for pest control.

To address this challenge, Xerces' ecologists partnered with seed industry partners to develop a model pest management system for milkweed. While there are still significant opportunities to improve and refine this model system, it is a first step toward helping maintain and improve profitable milkweed crop yields while minimizing nontarget risks to beneficial insects.

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Specialist Insects of Milkweed

Although milkweed contains toxic chemicals that help protect it from insect feeding, various specialist insects have evolved that are capable of feeding on these plants despite the toxins. Many of these specialist insects then store these chemicals in their bodies, providing a toxic defense against predators. These insects often have bright warning coloration to advertise their unpalatability.

While monarch butterfly caterpillars are the most well-known of these milkweed specialists, various beetles, true bugs, aphids, and moth caterpillars are also common and widespread milkweed herbivores. In monoculture situations where milkweed is mass planted for seed production, populations of these insects can increase substantially and crop damage can be extensive. In this fact sheet, we address the most common and detrimental groups of milkweed-feeding insects. Although these are diverse insects, their life cycles and damage are similar enough to merit grouping

Researchers estimate that between 1999 and 2010, milkweed density in the Midwest declined by 58%, resulting in a corresponding 81% decline in Midwest monarch reproduction. Current research estimates that 1.6 billion new milkweed stems would be needed in the monarch breeding grounds to safeguard monarchs from extinction.

Photo credit: John Anderson, Hedgerow Farms, Inc.

into these three simplified respective categories:

1. Large and small milkweed bugs (*Oncopeltus fasciatus* and *Lygaeus kalmii*, respectively), native true bugs that feed on milkweed seeds;
2. Red milkweed beetles (*Tetraopes* spp.) and the blue milkweed beetle (*Chrysochus cobaltinus*), native beetles that feed on milkweed roots (as larvae) and leaves and flowers (as adults);
3. Oleander aphid (*Aphis nerii*), a nonnative, invasive herbivore that has become a significant pest of wild and nursery milkweeds, and is suspected of vectoring plant diseases such as viruses and phytoplasmas.

Table 1 provides additional information on each of these milkweed pests. Note that while monarch caterpillar populations can sometimes be significant in milkweed seed production fields, we have not seen crop scouting data suggesting any yield loss for growers. Accordingly, we do not recommend any attempt to control monarch caterpillars. Moreover, when control actions are being considered for milkweed pests, we make note of specific strategies designed to protect monarchs.

Integrated Pest Management for Milkweeds

Integrated pest management (IPM) provides a framework for reducing pest damage while minimizing harm to the broader environment. This can be accomplished by incorporating pest prevention strategies, relying on scouting to monitor milkweed insect populations, and using pesticides only when absolutely necessary. The recommendations provided in this fact sheet are based on our research and development with the native seed industry as well as existing knowledge of milkweed herbivore ecology. We also considered management recommendations for similar pests in agronomic crops.

Figure 1. Many different lady beetle species, including the Asian lady beetle *Harmonia axyridis* shown here, will readily consume oleander aphids on milkweed. (Photograph by Thelma Heidel-Baker)

The general IPM principles underpinning our recommendations include:

1. Focusing on pest prevention strategies like cultural controls that create a less favorable environment for pest development or enhancing natural biological control of pests (e.g., inter-planting milkweed with other wildflowers and native grasses to enhance habitat for predatory insects);
2. Conducting regular crop scouting for pests and beneficial insects to monitor populations and know when and where pest outbreaks occur;
3. Establishing and using pre-determined damage thresholds as a basis for any pesticide treatment applications;
4. Precisely targeting all insecticide treatments to protect monarch caterpillars and other beneficial insects;
5. Reducing and eliminating all broad-spectrum insecticides, such as carbamates, organophosphates, and pyrethroids, that can harm beneficial insects and lead to secondary pest outbreaks, such as spider mites.

In the sections that follow, we detail each of these strategies, and provide real world options for effectively managing crop pests and sustaining profitable yields.

Pest Prevention

Creating conditions that prevent the development of pest outbreaks is a primary goal of IPM. Prevention achieves a more long-term and environmentally sustainable approach to pest management and can reduce the need for other costly measures like chemical use. Preventive practices can include both cultural and biological controls. For example, promoting plant diversity and providing additional floral resources in milkweed plots support those beneficial predatory insects responsible for natural pest control.

Oleander aphid (*Aphis nerii*) is preyed upon by many beneficial insects, including lady beetles (Figure 1), hoverflies, and parasitoid wasps. These and other predators readily feed on the oleander aphid despite toxic cardenolides aphids sequester from feeding on milkweed. Planting wildflowers within or near milkweed plots provides predators with critical alternative prey and food (pollen and nectar), egg-laying sites, and overwintering habitat. Plants with shallow nectaries (e.g., carrot and mint families) are particularly useful for supporting parasitoid wasps of aphids.

Red milkweed beetles (*Tetraopes* spp.) can be significant pests of milkweed in the Midwest and Eastern U.S. Practices

Table1 General Biology of Important Milkweed-Feeding Insects

MILKWEED PEST	SCIENTIFIC NAME	IDENTIFYING CHARACTERISTICS	ADULT SIZE	LOCATION ON PLANT	EGG-LAYING LOCATION	HOST PLANTS	US RANGE
A **COBALT BLUE BEETLE**	*Chrysochus cobaltinus*	Metallic cobalt-blue or blue-green colored leaf beetle	6–9 mm	• Adults feed on foliage, causing leaf defoliation • Larvae feed on roots	On milkweed or surrounding vegetation	Milkweed and dogbane (*Apocynum cannabinum*)	Western U.S. (High Plains west to California)
B **RED MILKWEED BEETLE**	*Tetraopes* spp.	Bright red to red-orange colored robust beetles with black spots and long black antennae	8–15 mm	• Adults feed on foliage, causing leaf defoliation • Larvae feed on roots	In dry hollow stems of milkweed or grasses and forbs near milkweed stems	Milkweed, with beetle species often associated with a distinct milkweed species	Eastern U.S. (from North Dakota to Texas and eastward)
C **LARGE MILKWEED BUG**	*Oncopeltus fasciatus*	• *Adults:* orange-red and black in coloration with black band across forewing • *Nymphs:* red-orange with black spots and black wingpads • Long piercing mouthpart characteristic of true bugs to suck up plant juices	10–18 mm	Adults and nymphs on stems, foliage, flowers, and pods, often forming small colonies	In or between developing milkweed pods	Primarily milkweed but may feed on seeds of *Apocynum*, *Cynanchum*, and *Nerium spp.*	Overwinters in southern U.S. (California to Florida) and moves northward during summer
D **SMALL MILKWEED BUG**	*Lygaeus kalmii*	• *Adults:* orange-red and black in coloration with a distinct orange X-shaped pattern on wings • *Nymphs:* red with black spots and wingpads • Long piercing mouthpart characteristic of true bugs to suck up plant juices	10–12 mm	Adults and nymphs form colonies on stems, foliage, flowers, and pods	• In hollow stems of nearby dried forbs • Between terminal leaves of milkweed OR • On surfaces of fallen leaves	Milkweed and other herbaceous plants	Entire U.S.
E **OLEANDER APHID**	*Aphis nerii*	• Bright yellow to yellow-orange colored aphid with prominent black cornicles (rear abdominal tubes), legs and antennae • May appear as winged or non-winged forms	1.5–2.6 mm	Adults and nymphs on stems, foliage, flowers, and pods	Do not lay eggs but rather give birth to live young	Milkweeds, dogbane (*Apocynum* spp.), oleander (*Nerium oleander*), periwinkle (*Vinca* spp.), wax plant (*Hoya carnosa*)	Entire U.S.

Figure 2. Several milkweed-feeding insects can cause significant damage in milkweed seed production. These include the cobalt blue milkweed beetle (*Chrysochus cobaltinus*) (A), red milkweed beetle (*Tetraopes* spp.) (B), large milkweed bug (*Oncopeltus fasciatus*) (C), small milkweed bug (*Lygaeus kalmii*) (D), and oleander aphid (*Aphis nerii*) (E). (Photographs by Thelma Heidel-Baker, The Xerces Society (A, C), David Cappaert, Bugwood.org (B, E), and Susan Ellis, Bugwood.org (D))

such as the following can help prevent red milkweed beetle damage:

- **Companion Plantings for Biological Control**: Interseeding a companion plant (e.g., short native grasses or legumes) into milkweed plots may help boost native populations of soil-borne nematodes that prey on beetle larvae. Companion plants benefit nematodes by hosting alternative prey and protecting soils from extreme heat. Companion plants may also reduce the foraging efficiency of underground beetle larvae.
- **Minimize Egg-Laying Sites:** Mow dead grass and milkweed stems as early as possible after harvest in and around milkweed plots to reduce the number of potential egg-laying sites. Red milkweed beetle primarily deposit their eggs in the hollow stems of dead grasses and possibly milkweeds and other flowers. The larvae emerge and move to the soil where they feed on milkweed roots.
- **Location of New Plots:** If possible, new milkweed plots should be located at least 350 feet away from established milkweed plantings (both wild and cultivated). Red milkweed beetles do not readily disperse. Spacing out plots can reduce the potential for colonization by these beetles.

Crop Scouting

Establishing a regular scouting routine for milkweed pests is one of the most critical components to successful milkweed pest management. Scouting and monitoring provides information on pest abundance and allows for early detection of pest problems and easier control. Scouting also provides information on beneficial insects such as predators and parasitoid wasps that suppress pests naturally.

Scouting should occur at least weekly in each milkweed field or plot from the early vegetative stage until harvest. In fields where a pest is detected, scouting frequency should be increased to track pest development. Each scouting event should include visual observation of at least 20 randomly selected plants per field. In locations where red milkweed beetles (*Tetraopes* spp.) occur, scouting should also include a plant "tug test" to detect larval feeding damage to milkweed root crowns (Fig. 3 and Table 2). Selecting plants randomly to scout can be accomplished by walking a Z- or W-shaped path in large milkweed plots or throwing a bright colored object and choosing the closest plant in long, narrow plots. Scouting details for each milkweed pest is found in Table 2. Information to be collected during scouting includes pests present, percent defoliation from insect feeding, and beneficial insects present (see example scouting form), and an example scouting form (Table 3) is provided to show the type of information to collect. This form should be adapted to fit a particular producer's pest pressures and needs.

Figure 3. Red milkweed beetle larval feeding damage on roots of swamp milkweed. Severe damage (middle and right root) may be detected when scouting using a "tug test" of plant stems to determine feeding damage severity. (Photograph by Keith Fredrick, Minnesota Native Landscapes)

Damage Thresholds: Deciding When to Take Action

Milkweed pest management should first focus on incorporating practices that prevent pest outbreaks. Only when regular scouting indicates an emerging pest problem should treatment measures be considered.

HOW THIS FACT SHEET WAS DEVELOPED

A 2015 written survey completed by U.S. milkweed producers as well as field monitoring surveys conducted by partner growers in California, Iowa, and Minnesota highlighted five economically significant pests of commercial milkweed production in the U.S. (Table 1). Other insects (whiteflies, thrips, leaf miners, and the milkweed tussock moth) and spider mites were identified as insects of lesser concern that did not demonstrate widespread, consistent milkweed damage as those listed in Table 1.

Damage thresholds provided in this fact sheet are novel for milkweed seed production. These thresholds were created using available scientific literature (Kris Braman and Latimer 2002; Matter 2001), as well as existing action thresholds developed for sunflower seed pests like the tarnished plant bug and the sunflower beetle (Knodel et al. 2015).

We have developed preliminary action thresholds to help guide growers in making pest treatment decisions. These thresholds were developed based on existing knowledge of these pests in milkweed or similar pests in other crops. These action thresholds are briefly overviewed here and restated in Table 2:

- **Milkweed Beetles:** Separate thresholds were developed for each damaging stage (larval or adult). Larval threshold is based on plant damage symptoms that can be detected by a tug test of plant stems (Fig. 3). When >20% of plants indicate root damage, control action may be warranted. Adult threshold is based on percent leaf defoliation, and action is recommended when average defoliation per plant exceeds 25%. Damage percentages are similar to thresholds used in sunflower IPM (Knodel et al. 2015).
- **Milkweed Bugs:** Milkweed bug damage is incurred when these bugs feed on seeds forming in pods. Action threshold occurs when >15% of developing pods have milkweed bugs present on them.
- **Oleander Aphid:** Plants can typically withstand a moderate amount of aphid feeding without seeing a seed yield impact. The action threshold reflects this and is based on the average number of aphids found on a milkweed plant's terminal growth points (Fig. 4). Only when the average number of aphids per terminal growth point exceeds 50 aphids should additional control measures be pursued (Braman and Latimer 2002).

Chemical Controls: The Last Resort

Incorporating insecticides is a balancing act between protecting monarchs and controlling pests. All insecticides can harm beneficial insects, and chemical pest control should only be used when all other options have been exhausted. A regular scouting routine and the use of our developed action thresholds for milkweed pests (Table 2) should always occur prior to any insecticide application.

Exercise caution when deciding to manage outbreaks with insecticides. Timing, application rates, and application method must all be considered. Strategies for minimizing harm to other milkweed organisms include spot treating localized infestations, applying pesticides when plants are not in bloom, and selecting products with low toxicity and short residual toxicity times.

Using targeted products with reduced risks to beneficial insects is recommended. Such options include horticultural oils, insecticidal soaps, and plant-derived oils. These are contact insecticides with demonstrated efficacy against some milkweed pests (oleander aphid and spider mites). Aria (active ingredient: flonicamid) is a relatively new selective insecticide compound targeted to control aphids, but it may also provide some suppression of true bugs like milkweed bugs. Aria should be used with caution since its broader impacts on nontarget organisms are not yet fully understood. Table 2 provides a compiled list of control options for managing particular milkweed pests.

Use of broad-spectrum (organophosphates, pyrethroids, carbamates) or systemic insecticides (neonicotinoids) are not recommended to reduce harmful impacts to monarchs and other beneficial insects. If spider mites are a potential issue, eliminate use of insecticides such as carbaryl that increase the rate of mite reproduction and may result in secondary mite outbreaks.

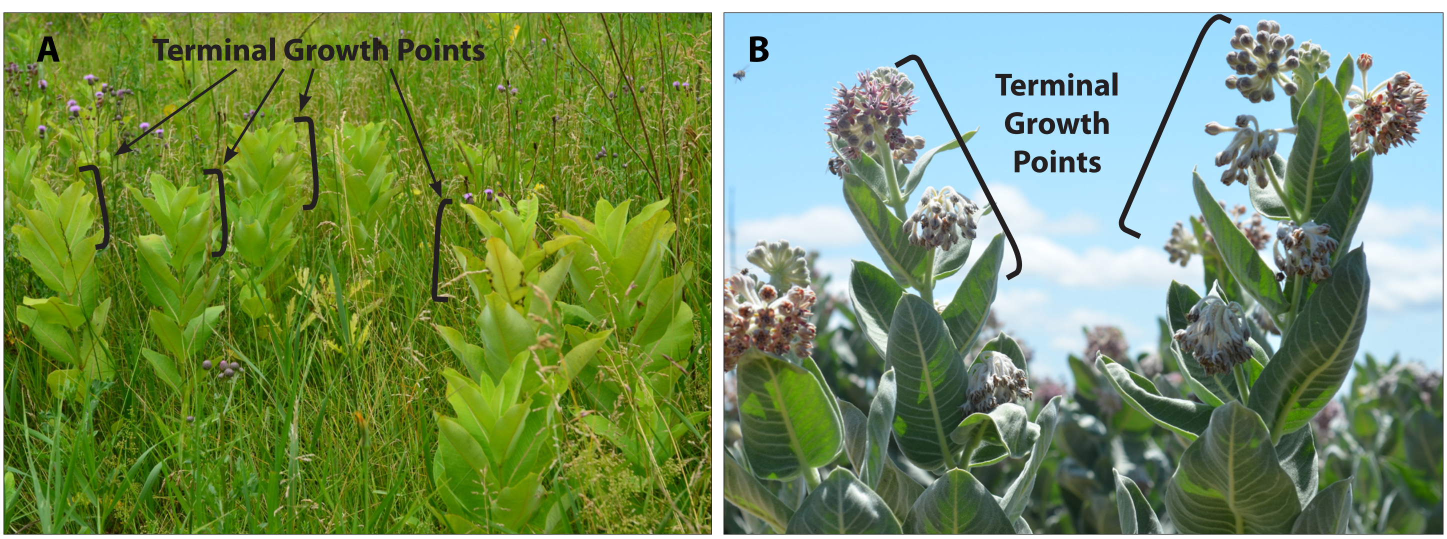

Figure 4. Counting insects on a plant's terminal growth point is one way to assess a pest's population and prevalence. The brackets shown in above photos exemplify these terminal growth points on non-flowering plants (A) and flowering milkweed (B). On larger and mature plants, this assessed area includes the top 6–8 inches of the plant, including flowers or pods. (Photographs by Thelma Heidel-Baker, The Xerces Society)

Table 2 Scouting and Management Strategies for Milkweed-Feeding Insect Pests

BEETLES	**MILKWEED BEETLE (COBALT/BLUE or RED)**	
	PEST SCOUTING	• Scout at least weekly for beetle presence and their damage beginning at plant emergence ADULT SCOUTING: • Observe plants for presence of beetles • If beetles are present, estimate % defoliation from leaf feeding LARVAL SCOUTING: • Below-ground larval damage can be detected by conducting a "tug test" on randomly selected plants • Conduct test by bundling a plant's stems and tugging firmly upward. Plants that are easily uprooted indicate significant larval feeding damage has occurred • Split the crown of uprooted plants and look for beetle galleries from larval feeding NOTE: Presence of numerous adult beetles is not necessarily an indication of a significant below-ground larval beetle problem.
	PEST PREVENTION MEASURES	• Interseed plots with companion plants (legumes or short native grasses) to help boost predatory soil nematodes and reduce below-ground foraging ability of beetle larvae • Interplant plots with summer and fall blooming floral resources that provide food and refuge for beneficial insects (e.g., goldenrod species) • Sanitation: Mow grass and weed stems down in and around plot after harvest to limit future egg-laying sites • *For Red Milkweed Beetle:* Space new milkweed plots at least 350 feet away from existing milkweed to slow new colonization by beetle
	ACTION THRESHOLD	ADULT THRESHOLD: • Consider taking further action only when adult beetles are observed and defoliation exceeds 25% on a majority of plants scouted LARVAL THRESHOLD: • Consider taking further action when >20% of plants exhibit root damage issues from the "tug test"
	NON-CHEMICAL CONTROL	• In small plots, physical removal and disposal of beetles from a few highly infested plants may be an option to reduce damage. Removal options may occur via suction through a bug-vac or by hand.
	CHEMICAL CONTROL	• As a last resort, apply short residual, reduced-risk contact insecticide like pyrethtrin • Avoid use of systemic insecticides like neonicotinoids • Avoid use of broad-spectrum insecticides that can impact beneficial insects • If spider mites are an issue, avoid insecticide groups that may flare spider mite outbreaks (organophosphates, pyrethroids, carbamates)
MILKWEED BUGS	**MILKWEED BUG (SMALL or LARGE)**	
	PEST SCOUTING	• Scout at least weekly for adult and nymph milkweed bugs beginning at reproductive stage • Randomly select plants and count the number of developing pods with milkweed bugs • At pod formation and fill stage, calculate % developing pods with milkweed bugs present
	PEST PREVENTION MEASURES	• Interplant plots with summer and fall blooming floral resources that provide food and refuge for beneficial insects
	ACTION THRESHOLD	• Consider taking further action based on the % of developing pods with milkweed bugs present during pod formation and filling stages • If >15% of developing pods have milkweed bugs present, consider further action. Prior to these growth stages (pod formation and fill), yield impacts from feeding are minimal
	NON-CHEMICAL CONTROL	In small plots, physical removal and disposal of bugs from a few highly infested plants may be an option to reduce damage. Removal options may occur via suction through a bug-vac or by hand.
	CHEMICAL CONTROL	• Avoid use of systemic insecticides like neonicotinoids • Avoid use of broad-spectrum insecticides that can impact beneficial insects • Use insecticides targeted for piercing-sucking insect control like flonicamid (Aria®) that may have limited impacts to beneficial insects

Table 2 Scouting and Management Strategies for Milkweed-Feeding Insect Pests

APHIDS		OLEANDER APHID
	PEST SCOUTING	• Begin scouting in early vegetative stage of plants and continue until early pod formation • Early infestations are easier to control • Scout 1–2 times weekly • Randomly select plants and estimate the number of aphids on two 8–inch terminal growth points per plant scouted • Scouting should include looking for aphids AND natural enemies (lacewings, aphid mummies formed by parasitoid wasps, lady beetles, syrphid fly larvae or fungal diseases)
	PEST PREVENTION MEASURES	• Remove non-milkweed alternate host plants from area (see Table 1) • Interplant plots with summer and fall blooming floral resources that support parasitoid wasps and other beneficial insects for aphid biological control • Establish cover crops or permanent ground covers to encourage beneficial insects (e.g., Phacelia in Western seed production plots, or partridge pea in Eastern and Midwestern seed production fields)
	ACTION THRESHOLD	• Large plants can typically tolerate up to moderate numbers of aphids without causing damage to the plant • Consider pursuing further action when the average number of aphids per terminal growth point exceeds 50 aphids
	NON-CHEMICAL CONTROL	• WATER STREAM: Physically dislodge with forceful water stream • MILK SPRAY: Apply a 10% milk solution directly onto aphids • Releasing lady beetles is NOT recommended for control
	CHEMICAL CONTROL	HORTICULTURAL OILS: Application of horticultural oils at early stages of outbreaks INSECTICIDAL SOAPS like M-Pede • Insecticidal soaps and oils (horticultural or plant-derived ones like neem) are effective and pose least risk to beneficial insects but must be applied thoroughly to plants (top and bottom of leaves) and require contact with pests to be effective • Avoid use on water-stressed plants or in temperatures above 90°F INSECTICIDES: Use insecticides targeted for piercing-sucking insect control like flonicamid (Aria or Carbine) that may have minimal impacts to beneficial insects • Avoid systemic insecticides like neonicotinoids • Avoid products like malathion, permethrin, and acephate that are effective against aphids but also very harmful to beneficial insects

Table 3 Example Milkweed Pest Scouting Form

Date: Location:										
Field ID: Milkweed Species: Time: AM/PM										
Plant Blooming State (circle one): Pre-Bloom Bloom Post-Bloom (pod formation)										
MILKWEED PEST	PLANT NUMBER*									
	1	2	3	4	5	6	7	8	9	10
Milkweed Beetles - Larvae Plant demonstrates damage from "tug test"?	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N
Milkweed Beetles - Adults Estimate the percentage of defoliation on the plant										
Milkweed Bugs Number of developing pods with bugs										
Total developing pods										
% Developing pods with bugs										
Aphids Aphid count from two 6–8" terminal growth points per plant										
Aphid mummies present?	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N
Additional observations (predatory insects, disease symptoms, etc.)										

* A single plant is defined as all stems originating from a single milkweed root crown.

Additional Resources

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Acknowledgements

Funding for this fact sheet was provided by the Monarch Joint Venture, the U.S. Department of Agriculture (USDA)- Natural Resources Conservation Service (NRCS) Plant Materials Program, and Xerces Society members. Special thanks to our partner nurseries (Tallgrass Prairie Center (IA), Minnesota Native Landscapes (MN), and Hedgerow Farms (CA) for participating in the 2015 scouting survey. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the U.S. Department of Agriculture.

This document was written by Thelma Heidel-Baker, James Eckberg, Eric Lee-Mäder, and Brianna Borders. Design by Sara Morris, The Xerces Society. Formatted by Thelma Heidel-Baker, The Xerces Society.