Tallgrass Prairie CENTER
UNIVERSITY OF NORTHERN IOWA

Assessing the milkweed (*Asclepias spp.*) seed marketplace in Iowa.

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"Loss of habitat in the summer breeding grounds is another factor that could be contributing to the decline in monarch numbers. We are losing 6,000 acres of potential monarch/pollinator habitat a day in the United Stated due to development (2.2 million acres per year). The losses of habitat due the adoption of glyphosate tolerant corn and soybeans in the last 10 years amount to at least 100 million acres. The conversion of 7 million acres of Conservation Reserve Program (CRP) land to crops for the production of biofuels adds to the total. In all, we estimate the loss of habitat to be 147 million acres since Monarch Watch was started in 1992 – an area 4 times the state of Illinois."
http://monarchwatch.org/bring-back-the-monarchs/campaign/the-details

Introduction

The recent and precipitous decline in the migratory monarch butterfly (Danaus plexippus) population in mid-continent North America has focused attention on loss of pollinator habitat, and more specifically on loss of larval milkweed host plants (*Asclepias* spp.) from the landscape. Evidence points specifically to the loss of common milkweed (*Asclepias syriaca*) from row crop agricultural fields with the advent and wide adoption of glyphosate (e.g. 'Roundup') resistant corn and soybeans (Pleasants and Oberhauser 2012). The obvious question being asked is how best to increase common milkweed abundance on the remaining landscape. Arguably, this may not be the right question, and the solutions may be far less obvious. Regardless, this has led to an exploration of the native seed industry around the country in an attempt to identify bottlenecks or other limitations to milkweed seed availability, the assumption being that if somehow seed can be made available, milkweeds can be restored to the landscape.

This report attempts to capture a sort of 'where we are now' perspective on availability of (and opportunities for) native seed production and marketing of *A. syriaca* relative to Iowa's native seed industry. To accomplish this, several native seed producers associated with Iowa source identified seed were informally surveyed fall of 2014.

Background on Source-Identified Seed

There are several small to moderate-sized commercial native seed producers and vendors in and around the state of Iowa. Commercial production of native seed in Iowa is predominantly source-identified seed, primarily for seeding state and county roadsides. Because plant materials of known genetic origin were in immediate demand for restoration on disturbed sites in the West, the need for third-party verification of source led to the development of the source-identified seed program. Standards for source-identified, or "Yellow Tag" seed, were developed by the Association of Official Seed Certifying Agencies (AOSCA). The program is administered by AOSCA's affiliate state crop improvement associations. AOSCA's source-identified seed standards were originally intended to provide a "fast-track" alternative release procedure when 1) there are inadequate existing commercial supplies for a species, 2) propagation material from specific ecotypes is needed for ecosystem restoration, 3) there is a high potential for immediate use, and 4) there is limited potential for commercial production beyond specific plant community sites (Young 1995). The program is now broadly applied to a host of native species intended for ecosystem restoration in several states around the nation. Iowa Crop Improvement Association adopted the source identified native seed program for Iowa sources in 1994 and currently certifies over 170 native species in the state (ICIA 2014).

Source-identified seed may be from either a single remnant source or from several sources pooled together as a regional source. No intentional selection or testing of traits occurs. Original collection sites are documented, and nursery and production fields established from original collections are inspected and certified annually. Commercially produced seed is marketed with an official AOSCA yellow certifica-

tion tag identifying the source and the producer of the material.

Several Midwest states have source-identified seed programs in place, administered by their respective crop improvement association per AOSCA guidelines. Individual states differ in their application of source-identified program guidelines regarding native species. Several states have reciprocal agreements regarding isolation distances and proprietary rights – among them Iowa, Minnesota, Wisconsin, and Missouri. The Tallgrass Prairie Center has been developing source identified seed beginning in1990 (Houseal and Smith 2000).

Current Levels of Production for Asclepias in Iowa

Eight producers/vendors in and around Iowa were queried on their experience producing and marketing common milkweed specifically, and other Asclepias species in general. Half of these producers had experience producing common milkweed, but none on a large scale. Six of the eight producers had experience producing other milkweeds, mostly Swamp (commonly called 'Rose' in the trade, *A. incarnata*), butterfly (*A. tuberosa*), and whorled (*A. verticillata*). Relative scale of production for each species in Iowa is as follows: Swamp milkweed, 7000-8000lbs/year (mostly from two growers); Butterfly milkweed, 400-500 lbs/year (mostly by 4 growers); Whorled milkweed, 100 lbs/year (two growers); and Common milkweed, less than 30 lbs/year (two growers) (Table 1). Primary markets for milkweed seed listed by growers included Department of Transportation (Iowa DOT), Integrated Roadside Vegetation Management (IRVM program at the Tallgrass Prairie Center, University of Northern Iowa), Departments of Natural Resources (Iowa and Minnesota DNR's), Pheasant's Forever (PF), 'pollinator mixes in Michigan', USDA Conservation Reserve Program (CRP), and 'public and private' sector markets. Most, but not all, of the sources produced are either Iowa or Minnesota 'ecotypes', much of it certified as source identified seed.

Roadside Use of Milkweed

Even when seed of milkweed species is available commercially, the price point often discourages purchase if cost is deemed to be prohibitive for private and agency use (Table 1). State and federal support subsidize the purchase and planting of native prairie species, including milkweed, in Iowa roadside plantings. According to Iowa DOT, 1,093 pounds of milkweed seed (primarily butterfly and swamp milkweed) have been seeded on 8,102 acres along Iowa's roadsides from 2011 to 2013 alone. Milkweed seed purchases for Iowa's Integrated Roadside Vegetation Management (IRVM) program (via the University of Northern Iowa's Native Seed Distribution Program at the Tallgrass Prairie Center) exceeded 440 lbs combined for 2011-2013 for two species, swamp milkweed and butterfly milkweed. This amount could be seeded over an estimated 4,310 acres of roadsides at a cost of $16.82/acre. While roadside plantings along state and county roads have incorporated milkweed species, more species of milkweed could be added to roadside mixes (i.e. whorled on drier backslopes and common and Sullivant's on lower slopes and ditch bottoms, for example).

Species	Habitat	CC(IA)	#seeds/oz	Low - High($/oz)	~Annual Prod (IA)
A. incarnata, Swamp	W-WM-M	4	4,800	$ 5.30 - $20.00	8,000 lbs
A. sullivantii, Prairie	WM-M	7	4,500	- $84.00	0 lbs
A. syriaca, Common	WM-M-DM-D	0	4,000	$ 6.25 - $21.10	30 lbs
A. tuberosa, Butterfly	M-DM-D	6	4,300	$18.75 - $36.00	500 lbs
A. verticillata, Whorled	M-DM-D	0	11,000	$25.00 - $50.00	100 lbs

Table 1. *Habitat, Coefficient of Conservatism (CC), seed count data, price range, and estimated annual production of five milkweed species in Iowa. Habitat key: W=Wet, WM=Wet-Mesic, M=Mesic, DM=Dry-Mesic, D=Dry soil types.*

Agency Seed Mix Specifications

Common milkweed is not specified in native seed mixes in Iowa for use on Federal USDA-NRCS Conservation Reserve Program acres. Obvious reasons for this include the economics of seed costs, a cultural bias against it as an agricultural weed, and a general lack of focus on milkweeds in mixes prior to the monarch decline. The monarch crisis could be a game-changer for seed specifications in future farm bill legislation. Estimates for 2010 Iowa CRP was over 1.6 million acres (663,000 hectares). CRP/WRP have slightly increased to 1.7 million acres in 2013 (4.7% of Iowa land area, Figure 1). This is still less than the approximately 2 million acres of CRP land in Iowa in the mid-1990s (Iowa Learning Farms 2015, Figure 2).

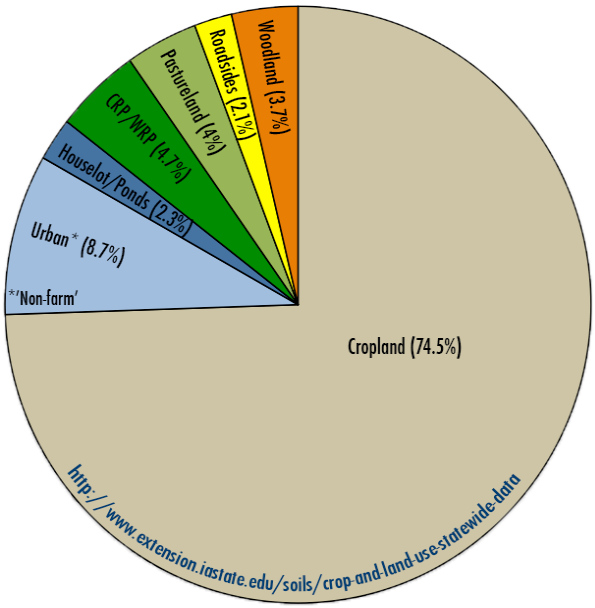

Figure 1. *Percentage of Landuse in Iowa in 2013. Source: Iowa State Extension 2013.*

Improving specifications for seed mixes in CRP/WRP programs at the federal level would be an effective way to favor native pollinators, in general, and monarchs in particular via planting of milkweeds and other nectar sources. The native seed market for milkweeds will respond. One grower put it very succinctly, " my customer isn't the farmer, my customer is the agency that sets the specifications for the program." Specification of any single species in a mix is probably inadvisable, and would likely create an immediate shortage in supply in the short term.

Any proposed fundamental changes in agency seed mix specifications should be communicated through dialogue with native seed growers and plant material

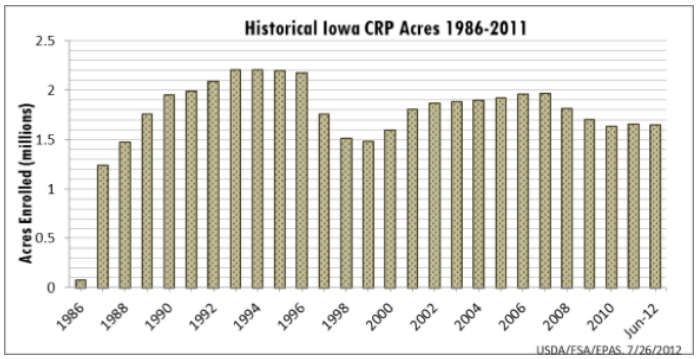

Figure 2. *Historical Iowa CRP Acres from 1986-2011. Source: Iowa Learning Farms 2012.*

providers along a carefully considered timeline. This would allow for producers to ramp up production while maintaining a fair and openly competitive marketplace, and ultimately facilitate implementation and success. Logically, more than one milkweed species could be included in a mix, if region and site appropriate, at a total combined minimum number of seeds per square foot for all milkweed species. This would allow for flexibility in species selection in the formulation of a seed mix in response to seed market prices and availability, and in turn allow the market to respond to increased demand. By way of illustration, a specification of 'a native Asclepias species appropriate to the region and planting site' at 0.2 seeds per square foot (approximately 8712 seeds/acre for common milkweed) would amount to just over 2.1 ounces of common milkweed seed (0.136 lbs/acre) at a cost of $16.32/acre just for one species ($120/lb for common milkweed, at 4000 seeds/oz; Prairie Moon Nursery 2015 catalog prices). Similiar approaches to NRCS specification standards already exist, for example annual and biannual species of forbs can not exceed 20% by seed count of the forb component (NRCS Conservation Practice Standards 327).

Opportunities for Restoring Habitat to Agricultural Lands

There is no dispute that common milkweed has declined on the landscape over the past 15 years. Estimated losses of milkweed range from a 31% decrease from 'non-agriculture' areas (CRP, pasture, roadsides) to 81% loss from agricultural row crop fields, and perhaps a 58% average decline overall (Pleasants and Oberhauser 2012). Common milkweed in row crops receives nearly 4 times more use by monarchs than when it occurs in a mixed species stand of vegetation,

presumably because it is easier for female monarchs to locate in a monoculture crop (Pleasants and Oberhauser 2012). While milkweeds may never return to row crop land as an agricultural weed, there may be opportunities to integrate them as part of a diverse prairie into 'working' landscape. One potential new market opportunity for milkweed and other native seed is the use of prairie strips, or prairie terraces within agricultural fields. Iowa State University's STRIPS (Science-based Trials of Rowcrops Integrated with Prairies) has demonstrated that putting as little as 10% of a row crop field into prairie vegetation in the form of strips can mitigate up to 60 % of the overland flow of water and up to 90% of nutrient transport from agricultural fields (STRIPS 2015). The Tallgrass Prairie Center has launched a similar effort called 'Prairies on Farms' which will include a diverse mix of appropriately adapted prairie species, including native pollinator host and nectar species. With education and awareness, it should be possible to overcome any agricultural bias against milkweeds in general, and common milkweed in particular. If these conservation practices make their way into farm bill legislation and are adopted on a large scale, it could add several hundred thousand acres of pollinator habitat in Iowa 'agricultural' lands alone.

Perceptions of Common Milkweed

Historically, common milkweed has earned a cultural stigma as a nuisance species in agricultural and developed land. However, most producers did not perceive barriers to using common milkweed in seed mixes, but also acknowledged there wasn't much demand for it. One estimated annual production/demand at less than 30 lbs and another at less than 2 lbs. Three growers reported establishing or attempting to establish a production field, and two acknowledged that it was difficult to establish from seed. The third grower destroyed his field/plot (including a Sullivant's milkweed plot!!) because of lack of demand. A fourth grower acknowledged he had spent 'thousands of dollars trying to eradicate it' from his farm, but occasionally collects seed from wild stands if someone request it. One producer observed "there are a thousand common milkweed plants per mile of gravel road", and that they readily seed into his adjacent row crop fields and establish as seedlings, but are killed with the first glyphosate application. He noted milkweeds being present in a field of conventional soybeans they planted to control glyphosate resistant water hemp (via conventional tillage), and in an adjoining neighbors field of hilum-free soybeans grown for the tofu market.

Common milkweed has long been considered an agricultural weed in Iowa, and posed an especially serious problem before the WWII industrial war-complex provided cheap and lethal herbicides. Cultivation of fields essentially propagated this species inadvertently via root cuttings. The abundant adventitious buds that occur on rhizomes meant that this species was not only prone to resprout from severed pieces of root but also increasingly distributed throughout the field by cultivation. Showy milkweed (*A. speciosa*) apparently caused similar difficulties where abundant, particularly in northwest Iowa, but now is a state-listed endangered species (Pammel and King 1926). Common milkweed is considered weedy or invasive in many parts of the country within its range of distribution. Prior to glyphosate-resistant crops, 'conventional' herbicides were less effective at killing common milkweed, often simply 'burning down' top growth with resprouting of new shoots and leaves later, which likely actually favored monarchs in their migration (Pleasants, pers comm 2014). It is listed as a weed in Iowa State Weed Identification Field Guide, Missouri Weed Guide, and Weeds of Nebraska and the Great Plains, Weeds of Kentucky and Adjacent States, Weeds of the Northeast, Weeds of the United States and Canada (www.plants.usda.gov).

The adoption and widespread use of glyphosate-ready crops circa1996 has virtually eliminated common milkweed from row crop fields, with something like 85% of annual row crop of soy and corn production now glyphosate resistant. Common milkweed is no longer a threat. In recognition of this, the agribusiness, weed extension, and natural resource communities are beginning to coalesce around an effort to restore monarchs and milkweeds through a new Iowa Monarch Conservation Consortium, established through the efforts of Iowa State University's College of Agriculture and Life Sciences, the Iowa Department of Agriculture and Land Stewardship and the Iowa Department of Natural Resources. Initial partners in the Iowa Monarch Conservation Consortium include farmer and conservation organizations, state agencies, companies and Iowa State (ISU News Service 2015).

Opportunities for Plant Materials Development of Milkweed

In general terms, if a suitable quantity and source of

foundation seed, and the necessary establishment and management technologies are available, establishing a larger production field (multiple acres) could ramp up seed production in a couple years, and may only be limited by the reproductive biology of the species. It typically requires two full growing seasons for native perennial species to flower and set seed, with optimal production often in year 2 or 3, and a gradual and to precipitous decline in subsequent years (Houseal 2008). A minimum of three to seven years or more are required for ramping up production if foundation seed sources have to be collected from wildland stands, and/or are difficult locate/collect, propagate, manage, harvest, clean, etc.

Growers indicated they had difficulties with establishing and/or growing common milkweed from direct seeding in multi-acre field-scale production (as compared to swamp milkweed, for example). Generally forb production plots are established from plugs, so it's not clear if they had success direct seeding other milkweed species, of if perceived low demand for common milkweed discouraged due diligence in pursuing successful establishment. Research on common milkweed prior to the 1990's mostly focused on control and eradication of it as a weed in agronomic production systems. Since that time more work has been done on milkweed as a crop for floss production, moisturizing oil from seeds, or as a possible soil additive to control nematodes (Phippen 2007). Research at Western Illinois University on commercial floss production from common milkweed used transplants to establish a 5 acre production field, at a rate of 28,000 transplants per acre (Phippen 2007).

Northern Iowa butterfly milkweed (A. tuberosa) foundation seed increase plots at the Tallgrass Prairie Center, in partnership with the Prairie Resource Center, IA-DNR and Monarch Joint Venture.

Common milkweed pods ripening in a remnant prairie in Chickasaw county, IA in late September 2014.

Common milkweed is the most common and widely distributed milkweed species in Iowa. It is arguably one of the most broadly adapted, as well, occurring in wet meadows, roadside ditches, old pastures, relatively pristine prairies, and until recently in row crop agricultural fields. It readily seeds into recently disturbed areas, including new prairie reconstructions, from adjacent fencerows, pastures, and roadsides. Disturbance favors recruitment of new individuals from seed (gopher mounds, tillage, mono-cultural stands, grazing, burning, etc.), or root pruning/division from conventional tillage. Monarch Watch states succinctly that common milkweed "is by far the best colonizer among our milkweeds, but tends to be out-competed and disappear as plant succession progresses." (Monarch Watch 2014).

Over 70 species of milkweed (Asclepias spp.) are native to the U.S. and Canada, with at least 17 species native to Iowa. As a genus, milkweeds are adapted to a range of conditions, from driest sand and gravel to wet marsh, and from the full sun of open prairie to semi-shade of savanna and open woodland. At least five species have been identified as 'Priority species for habitat restoration' in the Midwest region (Iowa, Missouri, Illinois, Indiana) by the Xerces Society (Borders and Lee-Mader 2014). These five species are swamp, prairie/Sullivant's (*A. sullivantii*), common, butterfly, and whorled milkweed. Sullivant's milkweed might be considered an appropriate analogue species to common milkweed. Being more conservative, it could potentially perform better (persist and increase in abundance over time) in mixed stands of native plant communities, at least in wet-mesic and mesic

Species		No. of Counties	Status
Sand	*A. amplexicaulis*	32	Uncommon
Eared	*A. engelmanniana*	2	***Endangered***
Poke	*A. exaltata*	15	Common NE
Tall Green	*A. hirtella*	40	Uncommon
Swamp/Rose	*A.incarnata*	84	Common
Wooly	*A. lanuginosa*	15	***Threatened***
Mead's	*A. meadii*	8	***Endangered***
Oval	*A. ovalifolia*	18	Uncommon
Purple	*A. purpurescens*	32	Uncommon
Fourleaf	*A. quadrifolia*	12	Very uncommon
Showy	*A. speciosa*	16	***Threatened***
Narrow-leaved	*A. stenophylla*	3	***Endangered***
Prairie/Sullivant's	*A. sullivantii*	51	Uncommon
Common	*A. syriaca*	99	Common
Butterfly	*A. tuberosa*	76	Uncommon
Whorled	*A. verticillata*	93	Common
Green	*A. viridiflora*	57	Common W

Table 2. *Native milkweed species and their historic distribution by county in Iowa. Source: Monarch Watch*

sites. Sullivant's milkweed occurs in 51 of Iowa's 99 counties, and was likely more abundant/ubiquitous in pre-Euro settlement (Table 2). It is similar in appearance, growth form and life history, and species distribution within Iowa to common milkweed (Figure 3). It remains a question whether it is equally suitable or preferred by monarchs. The Tallgrass Prairie Center's Natural Selections Program has been collecting, increasing, and releasing Iowa germplasm of 59 native prairie species from 142 regional Iowa sources over the past 25 years. To date, the Center has released 8 species of warm-season grasses (23 sources), 5 species of cool-season grasses (13 sources), 10 species of sedges

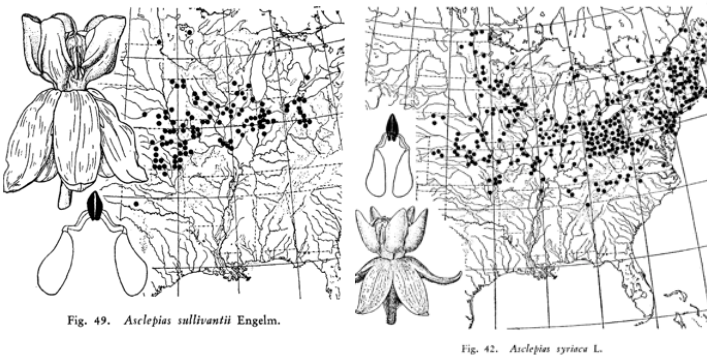

Figure 3. *Species distribution of Sullivant's (A. sullivantii) and common (A. syriaca) in the midwest.*

(13 sources), 6 species of legumes (18 sources), and 30 other forb species (74 sources) including two species of Asclepias (A. incarnata, A. tuberosa). Funding for this effort has largely been provided through an annual grant from Iowa's Living Roadway Trust Fund, administered by the Iowa DOT. Funding this past year has allowed the center to collect germplasm for common, swamp, whorled, and butterfly milkweeds from 51 additional remnant populations fall of 2014. Production fields are planned for a central Iowa source common milkweed, northern and central swamp milkweed, and a central whorled milkweed. A northern Iowa butterfly milkweed and Sullivant's milkweed seed increase plots have already been established in partnership with Iowa DNR through a small grant from Monarch Joint Venture. Plans are to re-establish a central Iowa butterfly milkweed plot spring of 2016 in cooperation with Iowa DNR if funds are available. This plant material would be available for release to producers in early 2017.

Conclusions and Summary

The source identified native seed industry is strong in Iowa, and several producers, from small to large, are producing seed of over 170 native species, including milkweeds, certified through Iowa Crop Improvement Association. Major markets for this material have historically been the Integrated Roadside Vegetation Management programs at both Iowa Department of Transportation and Tallgrass Prairie Center's Native Seed Distribution Program to Iowa IRVM counties. Additional markets include Pheasant's Forever, and NRCS Conservation Reserve Programs, county conservation boards, non-profits, and various local and private businesses. These programs have done a good job of including milkweeds and other nectar sources in diverse plantings around the state. More work is underway in developing plant materials of additional milkweed species suitable for diverse prairie plantings. Additional market opportunities exist through new initiatives to include prairie restoration on working agricultural land to mitigate water and nutrient transport (ISU STRIPs and TPC's Prairie on Farms). If adopted state-wide, practices like these would expand the market for native seed, transform the landscape, and provide critical pollinator habitat throughout the state. Otherwise, agricultural row crop land is likely out of the picture as monarch habitat in the future.

The challenge of the monarch decline is not the lack of milkweeds on the landscape, ***it's the lack of landscape where milkweeds can thrive***. To plant or not to plant more common milkweed in non-agricultural land (ergo increasing seed production) may be asking the wrong question. Native seed cost are already perceived to be high, and budgeting for a species that ultimately will colonize on it's own in a few short years could be

considered an unnecessary loss of the opportunity cost of purchasing another more conservative (and likely more persistent) species. With common milkweed essentially 4 times less favorable for monarchs in mixed species vegetation as compared to monoculture row-crops, the remaining 15% (pastures, roadsides, CRP/WRP, woodland) of the non-agricultural landscape becomes even more critical. A broad scale approach of using multiple milkweed species appropriate to the region and planting site, as previously discussed, will help insure that milkweeds are both present and persistent in high-diversity prairie reconstructions on non-agricultural lands in Iowa and the greater Midwestern landscape.

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Survey Questions:

What milkweed species are you currently producing?
Are you now, or have you ever produced common milkweed (*Asclepias syriaca*)?
Are you producing source identified (Yellow Tag) seed?
What is your estimated annual seed production of common milkweed?
What is your estimated annual seed production of other milkweed species?
What markets are there (predominantly) for milkweed seed?
What barriers do you perceive to common milkweed production?