

T. C. Davis, 2014



Tavia Cathcart Brown

Kentucky Pollinator Protection Plan



Kentucky
Department of
Agriculture

2017

Stakeholders

AgriBusiness Association of Kentucky
Bayer Corporation
Central Kentucky Audubon Society
Columbia Gas of Kentucky
Dadant Bee Supply
The Garden Club of Kentucky
Governor's Office of Agricultural Policy
Kelley Beekeeping Company
Kentucky Conservation Committee
Kentucky Corn Growers/Small Grain Growers Association
Kentucky Department of Agriculture
Kentucky Department of Fish and Wildlife
Kentucky Environmental Foundation
Kentucky Farm Bureau
Kentucky Horticulture Society
Kentucky Soybean Association
Kentucky State Beekeepers Association
Kentucky State Nature Preserves Commission
Kentucky State University
Kentucky Transportation Cabinet
Kentucky Women in Agriculture
National Garden Club
Roundstone Native Seeds
United States Department of Agriculture -
Farm Service Agency
United States Department of Agriculture -
Natural Resources Conservation Service
United States Fish & Wildlife Service
University of Kentucky Arboretum
University of Kentucky
Wild Ones Native Landscaping, Inc.



Summary

Since 2015, stakeholders have met in an effort to reduce pollinator loss in the Commonwealth by making available best management plans to beekeepers, chemical applicators, and landowners; increasing pollinator habitat; supporting education, extension and outreach, and facilitating communication among landowners, chemical applicators and pollinator advocates. These goals are designed to be inclusive of all pollinators.

Introduction

Managed bees and native pollinators are necessary to U. S. agriculture. Over 90 crops in the U. S., including almonds, tree fruits, cotton, berries, and many vegetables, are dependent on insect pollinators such as the honey bee for reproduction (USDA 2013).

Bee-pollinated crops account for 15-30 percent of the food we eat (USDA 2013). Beekeepers have suffered significant colony losses over the past decade, raising questions about the sustainability of managed colonies in the U. S. This issue has gained national attention, and in response, the U. S. Department of Agriculture (USDA) has focused more resources to pollinator issues. A steering committee was formed in 2007 to look at factors contributing to bee decline. The National Honey Bee Health Stakeholder Conference was held in October 2012 to discuss multiple factors influencing honey bee health.

These factors include pests, parasites, diseases, low genetic diversity, and poor nutrition. Currently, the consensus is there is no one factor that can be blamed for the declines. Additional research is needed to determine to what extent multiple factors contribute to declines. In addition, the rusty-patched bumble bee has now been added to the federal endangered list, and monarch butterflies continue to struggle to replenish their populations.



With its diverse flora and centralized location, Kentucky has had a mixed role in U. S. apiculture. Prior to the 20th century, Kentucky used to be a major honey production state since clover planted for the cattle/dairy industries did very well. However, as tobacco became a dominant agricultural industry in the 1930s through the 1950s and the western states began to offer more alfalfas and specialized fruits/orchards, Kentucky apiculture gradually regressed to a cottage industry.

Along with the rest of the nation, Kentucky is experiencing an agricultural shift with the need to protect pollinator-dependent “truck farms” while also acknowledging the challenges of large-scale cereals, equine, or manufacturing, and urban concerns that currently define the state’s land uses.

Much of Kentucky’s forest-based beekeeping potential has never been realized.

Even with significant losses by some beekeepers and historic rainfalls in recent years, Kentucky produced approximately 100,000 pounds of honey in 2014 and 130,000 pounds in 2015, two years that all beekeepers agree were low in honey production because of excessive rains. The demand for Kentucky honey remains strong, as does the demand for honey bees raised in the state.

Two major bee supply companies are located in this state, and they supply the Heartland region with bees, equipment, and other necessary supplies to the industry. Each spring, well over 10,000 packages are shipped or transferred out of the state to the region, and approximately 3,000 nucs (small colonies of honey bees) are sold.



With its diverse patchwork of family farms, gardens, orchards, and cereal crops, Kentucky is well positioned to reclaim a leadership role in apiculture if the goals of this plan are implemented. This plan acknowledges unmanaged pollinators are equally sensitive to land use changes, and for this reason we have broadened its scope beyond the managed pollinators.

The Plan

The major goal of this plan is to bring awareness to the issues faced by all parties and find ways for everyone to be part of solutions. The best management practices were developed with this goal in mind. This plan does not seek to eliminate chemical use, but rather urges responsible use, and creates new and easily accessed lines of communication.

Increasing pollinator habitat works in conjunction with federal goals of reducing chemical spray drift, providing more nutrition, and reducing mowing. Including more pollinator awareness education in various outreach agencies and points-of-sale companies can educate general audiences as well as schools. Finally, communication in various formats and education will be needed to make these goals happen for years to come in order to make updates and reassess the success of the plan's goals.

A commitment to the following four goals should ensure increased cooperation among beekeepers, landowners, and pesticide applicators, as well as continuing compliance with state chemical use requirements.

Goal One: Best Management Practices

The best management practices (BMPs) listed below have been developed to reduce the exposure of honey bees and other pollinators to pesticides. These BMPs are intended to be voluntary, as this issue should be addressed through education and communication.



Beekeepers

- **Document honey bee colony health during all seasons,** with photographic evidence as well as business receipts from current and previous years.
- **Establish and maintain contact with local USDA Farm Service Agency offices regarding the ELAP program** (fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/2016/2016_elap_for_honeybee.pdf).
- **Consider reporting colony numbers and locations to the Kentucky Department of Agriculture State Apiarist** (kyagr.com/statevet/honeybees.html).
- **Use a Bee Flag to communicate approximate hive location with area farmers or urban neighbors to help create much-needed communication between applicator/beekeeper.** (blogs.msucare.com/honeybees/files/2015/01/BeeWare-Flag-Pole-Flyer-2014.pdf)

- **Maintain strong healthy colonies using recommended management practices.**
- **Plant diverse flowers for pollinator forage.** Every hive on average needs 252 million flowers to make it through a full calendar year.
- **Stay informed about honey bee issues through beekeeping associations, cooperative extension, beekeeping journals, and the USDA FSA.** The Kentucky State Beekeeping Association website is a good place to look for local associations, meeting times, and other events: ksabeekeeping.org.
- **Avoid placing honey bee colonies in direct proximity to agricultural fields in such a way that they are vulnerable to spray drift.** Many pesticide labels have language that addresses spraying of buffer areas. Placing colonies within or behind buffer areas could help avoid slight drift issues. Beekeepers must always have permission from landowners before placing colonies on private property.
- **Have full-length screens or hive nets “at the ready” to drape over hives and keep bees inside for a brief and limited time.** These can be bought at bee supply stores listed at the end of this document in “Other Resources”.
- **Send honey to be tested on a regular basis** to determine the plant species that are actually being represented in the honey varietals.
- **Understand how to recognize colony loss due to pesticides and properly report to KDA/ USDA FSA.** Do not disturb the site, and contact KDA inspectors immediately. Other than video or photos, do not take bee tissue or honey samples prior to an on-site inspection with KDA inspectors. Consult the following website for standard operating procedures: kyagr.com/statevet/honeybees.html.
- **Establish good relations and communication with neighboring farmers, and notify them of your colony locations.**
- **Post beekeeper contact information in a prominent location at each apiary.**

Pesticide Applicators

Not all pesticide applications pose a risk to honey bees and other pollinators. The greatest risk occurs during the following conditions:

1. Broad-spectrum insecticides are applied to crops or weeds in bloom,
2. Pollinators are foraging in the area during daylight hours, and/or
3. Chemical spray drifts onto colonies.

Tank mixes of certain pesticides can also increase the risk to pollinators.

- **Be aware of honey bee colonies or habitat for other pollinators near fields to be treated with pesticides.** Know how to contact owners of these colonies if required by product label.

- **Use Integrated Pest Management (IPM) and economic thresholds to determine if insecticides are required to manage pests.** When insecticides are required, consider using insecticides with low toxicity to bees, short residual toxicity, or repellent properties toward bees.
- **Avoid dusts and wettable powder insecticide formulations if possible.** Granular and liquid formulations are safer for pollinators since granules are not typically picked up by bees, and liquids dry onto plant surfaces.
- **Crop consultants, agronomists, points of sale contacts, and others making pesticide recommendations should consider impacts on pollinators.** This should include product choices and timing of application to minimize potential impact to pollinators.
- **Always use registered pesticides according to the label.** Failure to comply with the label not only puts humans and the environment at risk, it is also illegal. Many pesticides, especially insecticides, have use restrictions prohibiting applications when pollinators are foraging in the treatment area. Some labels prohibit applications to blooming plants (crops or weeds) and require the applicator notify beekeepers in the area prior to application. Applicators are bound to follow all directions, precautions, and restrictions on pesticide labels, even when following other BMPs. Contact the KDA or your local cooperative extension office with any questions on pesticide label language.
- **Pesticides toxic to pollinators should be applied when bees are less active.** Pollinators are most active during daylight hours between 9 a.m. and 3 p.m. and when the temperature is over 55 degrees Fahrenheit.
 - Be aware of temperature inversions when choosing the best time for applications, as temperature inversions increase the risk of off-site movement.
 - Avoid applying when low temperatures will allow dew formation. Dew may re-wet pesticides and increase pollinator exposure.
- **Minimize pesticide drift.** Pesticide drift involves the off-site movement of pesticides through the air from the treatment site to other areas, either in the form of mist, particles, or vapor. Drift reduces the effectiveness of the chemical applied since only part of the applied amount remains on site and unnecessarily increases cost to the applicator. Drifting chemicals also pose a risk to pollinators that come in contact with off-target residues. Contact the Cooperative Extension Service for more information on how to prevent pesticide drift.
 - Insecticide applications should be made only in calm weather when winds are blowing away from hive locations adjacent to or near fields to be treated.
 - Consider alternatives to talc/graphite in seed planters. The talc and graphite can erode the insecticide treatment off of the seeds, creating insecticide containing dust that can drift onto flowering plants and into hives.

- **Identify and notify beekeepers in the area prior to applying pesticides if required by label directives.** To facilitate this, applicators are encouraged to use an interactive map. The Kentucky Department of Agriculture has settled on an electronic communications tool that assures anonymity while also quickly alerting beekeepers about products requiring notification that will be sprayed, and the date. Notification should be done at least 48 hours prior to application or as soon as possible but no less than 24 hours. Timely notification provides ample time for the beekeeper and applicator to develop a mutually acceptable strategy to manage pests while mitigating risk to pollinators. These strategies may include covering hives, moving hives, or choosing the time of day to apply.

** Notifying beekeepers does not exempt applicators from complying with pesticide label restrictions. Some insecticide labels prohibit use while pollinators (bees) are foraging in the treatment area.*

- **Document your efforts** (*via* emails or phone calls) **to contact beekeepers** when applying pesticides that require beekeeper notification.
- **Minimize spraying non-crop areas and buffer zones with insecticides or other pesticides highly toxic to pollinators.** Buffer areas, hedge rows and other natural areas provide both feeding and nesting habitat for native pollinators. If these areas must be treated, time applications or use other tactics to minimize impact on pollinators.
- **Establish good relations and communication with your local beekeepers.**



**Kentucky State Apiarist
Dr. Tammy Horn Potter.**

Landowners/Growers

Many landowners in Kentucky rent out a portion of their property for agricultural purposes. While they do not necessarily apply pesticides, the landowners can help to reduce exposure of pollinators on their property by facilitating communication between beekeepers and applicators.

- **Work with beekeepers to choose hive locations.** Ideal locations for hives will have minimal impact on farming operations but still will allow bees to access forage and water. Communicate with beekeepers which roads/trails can be problematic when wet and any preferred traffic routes. Landowners will also want to provide emergency contact information to beekeepers for pesticide applicators, renters, and neighbors (if needed).
- **Communicate with renters about bee issues.** Renting land for agricultural production is a common practice. Landowners and renters should discuss bee issues, such as who has authority to allow bees, how long the hives will be allowed, and hive placement. These issues should be addressed and included when rental agreements are negotiated.
- **When contracting with commercial chemical applicators, make sure that there is a clear understanding of who has the responsibility to identify hive locations and communicate with beekeepers.** Applicators may do this as part of their standard procedures, but some landowners may also prefer to make beekeeper contacts. Landowners can also remind applicators to comply with all label directions and restrictions, including communications with beekeepers.
- **Encourage or consider planting bee forage.** Plant diverse, native flowering plants, trees or shrubs to improve pollinator forage, especially in non-farmable or non-crop areas. Doing so provides pollinator forage and may also lure bees (and other pollinators) away from areas being treated with chemicals, thereby minimizing impacts to pollinators.

See also: plants.usda.gov/pollinators/Improving_Forage_for_Native_Bee_Crop_Pollinators.pdf
- Rural landowners should consider interseeding pastures, selecting cover crops, and establishing pollinator forage plants in buffer zones to provide high-quality pollinator forage (nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1143636.pdf).



- **If planting cover crops**, consider adding flowering plants into the mix, including milkweed. Even a small percentage of flowering plants can provide a considerable amount of forage for pollinators. Milkweed species are the only hosts for monarch butterfly caterpillars.
- **Alter mowing plans to provide cover for migratory birds.** This can be done by delayed mowing or reduced mowing or no-mowed swaths. This will enhance native flowering perennials, trees, and shrubs as forage and native pollinator habitat.
- **Leaving small patches of disturbed bare ground** provides attractive habitat for some types of native bees.

Governmental Agencies

- **Post spray schedules for routine applications for public access on respective agencies' websites.** List the products used with hyperlinks for additional information.
- **Use Integrated Pest Management (IPM) and economic thresholds to determine if insecticides are required to manage pests.** When insecticides are required, choose insecticides with low toxicity to bees, short residual toxicity, or repellent properties toward bees and other pollinators. Avoid spraying insecticides on habitats for native pollinators including, shrubs, and butterfly host plants such as milkweed.
- **When designing public landscapes, consider using suitably adapted, native flowering plants which can provide supplemental quality forage for pollinators.**
https://plants.usda.gov/pollinators/Improving_Forage_for_Native_Bee_Crop_Pollinators.pdf
- **Consider planting monarch waystations.**
pollinator.org/PDFs/Guides/EBFCContinentalrx13FINAL.pdf AND
monarchjointventure.org/images/uploads/documents/WFM_Brochure_final.pdf
- **Alter mowing plans to provide cover for migratory birds.** This can be done by delayed mowing or reduced mowing on no-mowed swaths. This will enhance native flowering perennials, trees, and shrubs as forage and native pollinator habitat.
- **Consider funding/participating in grants that would be science-based and focused on pollinator issues.** USDA-APHIS Honey Bee Health Survey administered via Kentucky Department of Agriculture State Apiarist program. See the following website for details: aphis.usda.gov/plant_health/plant_pest_info/honey_bees/downloads/SurveyProjectPlan.pdf
- **Consider flex-time schedules for crews so spraying is done during evening hours.**

Goal Two: Increase Pollinator Habitat

An increase in pollinator habitat benefits Kentucky because the state can reduce costs associated with spraying or mowing and increase nutrition or habitat for pollinators, but noxious weeds need to be controlled. In addition, how pollinator habitat is constructed is just as important as the goal to increase it. Kentucky has considered legislation that would certify “prescribed burn” professionals, but until this certification process is approved, most people should consult with state FSA conservation officials on how best to prepare the soil to attract pollinators. Please see the end of this document for resources to consult.

A. Kentucky Transportation Cabinet.

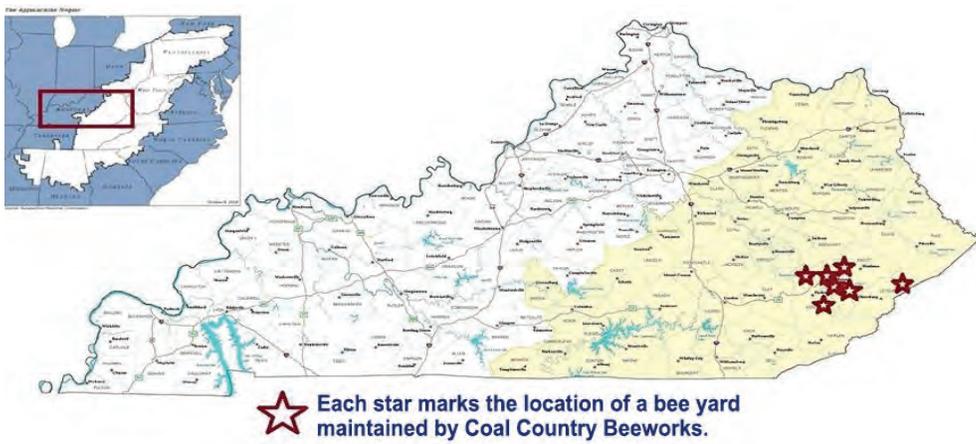
The Kentucky Transportation Cabinet has approximately 200,000 acres of right-of-way. Of that, it maintains about 100,000 acres with mowing, spraying, re-seeding, *etc.*

1. Overall, for its Pollinator Protection Zones, the Kentucky Transportation Cabinet has 35 sites in 10 of 12 districts across the state for a total of 71 acres.
2. The cabinet has converted former rest areas to monarch way-stations and provided pollinator plantings in Area 2 (Hardin County)
3. Kentucky passed a Highway Rights of Way law in 2010 allowing local Transportation officials to consider using pollinator habitat at interstate interchanges:
lrc.ky.gov/record/10RS/SJ177.htm
4. See Appendix 2 for example of seed mixture for monarchs.
5. As a matter of policy, the Kentucky Transportation Cabinet does not spray fence rows.
6. *Ongoing:* The Kentucky Transportation Cabinet is considering delaying some mowing schedules to reduce impact to the late-summer generation of monarchs.

B. Pollinator habitat on Kentucky surface mine sites.

Surface mining accounts for the loss of thousands of pollen and nectar-producing trees. Since 2008, major efforts have been made to address this aspect of reforestation, with an emphasis on economic development in forest-based beekeeping. The Five Steps of Forestry Reclamation Advisory is listed at the end of this document (Appendix 4). Grants have also been awarded to promote more pollinator habitat in Kentucky.

1. Pollinator Habitat Law, 2010. lrc.ky.gov/record/10rs/hb175.htm
2. Example of flower seed mix used on surface mine sites (See Appendix 4 for other surface mine site preparation)
3. Forestry Reclamation Advisory Memorandum on pollen-nectar production trees was published early in 2017.



4. The Cerulean Warbler Appalachian Forestland Enhancement Project enables partners to work with private landowners to enhance 12,500 acres of forest habitat on private lands for Cerulean Warblers and other wildlife: amjv.org/index.php/private_landowners/cerulean-warbler-appalachian-forestland-enhancement-project.

C. Monarch butterfly waystations.

Monarch waystations are places that provide resources necessary for monarchs to produce successive generations and sustain their migration. Without milkweeds throughout their spring and summer breeding areas in North America, monarchs would not be able to produce the successive generations that culminate in the migration each fall. Similarly, without nectar from flowers, these fall migratory monarch butterflies would be unable to make their long journey to overwintering grounds in Mexico. (Adapted from monarchwatch.org). Monarch Watch recommends that each monarch waystation have the following:

1. At least 10 milkweed plants (preferably two or more species).
2. At least four species of recommended nectar plants.
3. A good monarch waystation is also a pollinator garden and provides food, shelter and host plants for a variety of pollinator and wildlife species. (See Appendix 3 for current public waystations throughout Kentucky and certification information.)



The Kentucky Department of Fish & Wildlife is currently working on a monarch protection plan.

Tavia Cathcart Brown



D. Kentucky State Parks.

Jenny Wiley State Park and Big Bone Lick State Park are leading the state in terms of pollinator awareness education and demonstrations. Jenny Wiley maintains a monarch waystation, and Big Bone Lick State Park offers beekeeping programs for children and adults.

E. Natural Resources Conservation Service Nectar Corridors.

nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_017846.pdf

F. Native Bee Awareness.

Most native bees are solitary and nest in cavities in wood or tunnels they excavate in the ground. The number of native bee species in Kentucky is unknown; however, it is reasonable to expect that 400-500 species occur in Kentucky. Native bees are not only necessary for the pollination of flowering plants and trees, they are also necessary for the pollination of some of our agricultural crops. For example, bumble bees are capable of "buzz pollination" or sonication that helps plants such as tomatoes, blueberries, and cranberries, to name a few, produce fruit that is often larger and better quality. Honey bees do not or rarely "buzz pollinate." Native bees are also active earlier and later in the day and on cooler days than honey bees, increasing pollination services which can lead to increased yields.

Providing natural habitat either by leaving existing areas or planting sites with native species that flower throughout the season should be a standard practice for all Kentucky farmers.



Martin Brock

These bumble bees nested and stored a little honey in a farmer's hay bale.

G. Nature preserves.

Kentucky has 63 state nature preserves, encompassing over 27,000 acres, and many other nature preserves are under local ownership. These lands protect the state's most diverse natural habitats and provide a variety of nectar- and pollen-producing and nesting sites essential to native bees and other pollinators including butterflies, moths, wasps, flies, and beetles. Nature preserves also provide excellent foraging habitat for honey bees, and research has demonstrated that diverse areas of native wildflowers can be used by both honey bees and native bees to detoxify themselves after exposure to harmful chemicals. Nature preserves in proximity to agricultural fields and vegetable gardens provide habitat for native bees that are in turn performing essential pollination services free of charge. Protecting natural habitat is perhaps the best tool for ensuring healthy pollinator populations.



In summary, three steps are necessary to ensure successful conversion to pollinator habitat:

- 1) spend a lot of time on initial site prep, multiple herbicide treatments for invasive species, spring, summer and fall, again in spring;
- 2) plant at high native seed rate, minimum 40 native forb-grass seed per square foot, and 50-60 per square foot if you can afford it;
- 3) Pollinator Habitat Zones require maintenance after establishment, through fire preferably, and/or late winter mowing and light strip disking, but you have to do one or the other every year, or every other year. Also, if you don't want to plant forbs, plant good pollinator trees – poplar, black locust, maples, sourwood, linden, and many more.



Mike Sharp photo, 2012

Reforestation a reclamation site in Perry County.

Goal Three: Communication (partial listing, not meant to be comprehensive).

1. Electronic communication tool between chemical applicators and beekeepers.
2. Bee Aware Flags. Available for individual purchase: mississippi-crops.com/wp-content/uploads/2014/03/Bee-Aware-Order-Information.pdf
3. Kentucky State Fair.
4. Kentucky Department of Agriculture — monthly newsletter, bee association talks, pollinator updates. Website: kyagr.com/statevet/honeybees.html.
5. Kentucky State Beekeepers Association — website ksbabeekeeping.org, monthly updates on honey bee issues.
6. Electronic communication about pollinator issues on a seasonal basis.
7. Conferences at Kentucky universities.

Goal Four: Extension and Outreach (partial listing, not meant to be comprehensive)

1. Kentucky State Fair. Bees and Honey Exhibit, 4-H Cloverville, Kentucky Agriculture and Environment in the Classroom.
2. Public forums. Three in 2016, more forthcoming.
3. Universities and schools. a five-year, five-state grant from the Natural Resources Conservation Service to research the cerulean warbler and pollinator habitat (multi-stakeholders including Fish & Wildlife, KDA, *etc.*); Steele-Reese Native Bee grant; Morehead State University's program to become a bee-friendly campus; Murray State University's construction of an on-campus apiary.
4. Kentucky Department of Agriculture — State Apiarist and Division of Environmental Services.
5. Three USDA Honey Bee Health grants to the Kentucky Department of Agriculture, a USDA grant for a Purdue University research project, and a grant from the Natural Resources Conservation Service to research and provide education on the cerulean warbler and pollinator habitat.
6. Electronic communication about pollinator issues on a seasonal basis.



Conclusion

Kentucky faces a crossroads in the agricultural community as new sectors are emerging that are more heavily dependent on pollinators, and as the nation faces an ecological crisis with its pollinators. More specifically, as coal continues to decline in production, the state faces an economic crisis that may be partially alleviated by reviving Kentucky's once-dominant honey production industry. This document reflects policies to enhance communication among beekeepers, chemical applicators, and landowners; and to consider increasing habitat with a goal toward responsible economic development as well as providing nutrition and shelter. The plan should not remain static. Future iterations will appear at regular intervals to evaluate how pollinators are doing in the state, and tailor the Pollinator Protection Plan so that the Commonwealth may not only benefit from the services provided by pollinators but also provide nutrition and sanctuary to pollinators. Our state relies on a diverse agriculture sector. Our agriculture, in turn, relies on the services of a sustainable beekeeping industry and a healthy diverse ecosystem of native pollinators.

APPENDIX 1: Kentucky Soybean Promotion Board and Kentucky Soybean Association Commitments to Protecting Pollinators

Partnering for Improved Communication and Coordination

Kentucky soybean farmers know that pollinators are essential to agriculture, whether they are commercially-managed honeybees, wild bees, butterflies or other beneficial insects.

We are committed to being a positive partner in the Kentucky Department of Agriculture's Managed Pollinator Protection Plan process, and it is essential that we continue to re-evaluate how we can do things better on the farm. As active partners, we are working to make sure this new plan can be practically implemented by farmers and chemical applicators to achieve our shared goal of protecting pollinators.

Limiting insect damage is essential for growing crops, but we understand our obligation to use crop protection products responsibly for the good of pollinators, and the people who make their living from honey production and pollination services.

Investing in Pollinator Research

The Kentucky Soybean Promotion Board continues to fund research to help growers improve their Integrated Pest Management practices and use of non-foliar applications like insecticide seed treatments. While conventional wisdom from crop specialists has long held that soybeans do not benefit from insect pollination, the United Soybean Board has begun research partnerships in Iowa and Illinois to test new findings that bees can increase soybean production.

2013 research published in Environmental Chemistry Letters by Brazil's Federal University of Ceará found that wild pollinators increased soybean yield by 6 percent, and the introduction of honeybee colonies increased yields further by 18 percent. A 1975 study in Arkansas and Missouri found significant increases in seed yield up to 100 meters from apiaries.

How can soybean farmers better protect pollinators?

The United Soybean Board says that maintaining bee-friendly waterways, riparian corridors, field borders and planting cover crops are key steps. Cover crops increase the diversity of insects, most of which are beneficial for production, such as pollinators and predatory insects that feed on insect pests.

Scheduling of pesticide application after pollination and communication with beekeepers is key. For the long term, soybean research will prioritize genetics to increase nectar production and make soybeans a better forage crop for bees.

For more information, visit KySoy.org.

APPENDIX 2: Example of pollinator-friendly diverse seed mix.

Roundstone Native Seed 9764 Raider Hollow Road Upton, KY 42784

Kentucky Department of Transportation Pollinator/Monarch mix Acres: 1

Kind	Botanical name	PLS oz/ac	PLS lbs/ac	PLS lbs
Butterfly Milkweed	<i>Asclepias tuberosa</i>	18.91	1.182	1.182
Common Milkweed	<i>Asclepias syriaca</i>	17.92	1.120	1.120
Swamp Milkweed	<i>Asclepias incarnata</i>	10.00	0.625	0.625
Whorled Milkweed	<i>Asclepias verticillata</i>	1.15	0.072	0.072
Smooth Beardtongue	<i>Penstemon digitalis</i>	1.95	0.122	0.122
Lance Leaved Coreopsis	<i>Coreopsis lanceolata</i>	4.05	0.253	0.253
Blackeyed Susan	<i>Rudbeckia hirta</i>	3.35	0.209	0.209
Hoary Mountain Mint	<i>Pycnanthemum incanum</i>	1.25	0.078	0.078
Slender Mountain Mint	<i>Pycnanthemum tenuifolium</i>	1.25	0.078	0.078
Early Goldenrod	<i>Solidago juncea</i>	2.65	0.166	0.166
Bergamot	<i>Monarda fistulosa</i>	2.65	0.166	0.166
Spiked Blazing Star	<i>Liatris spicata</i>	3.35	0.209	0.209
Greyheaded Coneflower	<i>Ratibida pinnata</i>	3.00	0.188	0.188
Purple Coneflower	<i>Echinacea purpurea</i>	4.05	0.253	0.253
False Sunflower	<i>Heliopsis helianthoides</i>	3.00	0.188	0.188
Browneyed Susan	<i>Rudbeckia triloba</i>	3.00	0.188	0.188
Joe-Pye Weed	<i>Eupatorium fistulosum</i>	1.60	0.100	0.100
Iron Weed	<i>Vernonia altissima</i>	1.95	0.122	0.122
Sneezeweed	<i>Helenium autumnale</i>	1.95	0.122	0.122
Narrow-Leaved Sunflower	<i>Helianthus angustifolius</i>	1.95	0.122	0.122
New England Aster	<i>Aster novaeangliae</i>	2.30	0.144	0.144
White Wingstem	<i>Verbesina virginica</i>	2.65	0.166	0.166
Indian grass	<i>Sorghastrum nutans</i>	3.35	0.209	0.209
Little bluestem	<i>Schizachyrium scoparium</i>	6.85	0.428	0.428
Partridge Pea	<i>Cassia fasciculata</i>	1.25	0.078	0.078
Compass Plant	<i>Silphium laciniatum</i>	3.00	0.188	0.188
Cardinal Flower	<i>Lobelia cardinalis</i>	0.90	0.056	0.056
Lance-Leaved Goldenrod	<i>Euthamia graminifolia</i>	1.35	0.084	0.084
Boneset	<i>Eupatorium perfoliatum</i>	1.35	0.084	0.084
Spring Oats	<i>Avena sativa</i>	20.00		

Freight calculated at time of shipping 7.00 Lbs/acre of Forbs 27.0 Total Lbs/acre

APPENDIX 3. Current monarch waystation locations in Kentucky.

(Certification information available at monarchwatch.org).

Listing of public monarch waystations as of 11/2015 *

1. Berea Municipal Utilities, Berea
2. Happy Meadow Natural Foods, Berea
3. Berea Urban Farm, Berea
4. Daniel Boone National Forest Redbird District, Big Creek
5. New Beginnings Riding Stables, Bowling Green
6. Baker Arboretum, Bowling Green
7. Bowling Green Community Park
8. Buckhorn Lake Park, Buckhorn
9. Blue Star Memorial Garden, Cadiz
10. Sanders Park, Corbin
11. Cumberland Falls State Park, Corbin
12. Goebel Park, Covington
13. Boone County Garden Club, Crittenden
14. Boyle County Public Library, Danville
15. Boyle County Co-Op Extension, Danville
16. Centre College, Danville
17. Kentucky School for the Deaf, Danville
18. Mary Akin Garden at Constitution Square, Danville
19. Toyota Motor Engineering & Manufacturing North America, Erlanger
20. City Walking Trail, Flemingsburg
21. Commonwealth Gardens, Frankfort
22. Reserve by the Governor's Mansion, Frankfort
23. Frankfort Senior Center, Frankfort
24. Franklin County Cooperative Extension, Frankfort
25. Salato Wildlife Education Center, Frankfort
26. Liberty Hall Historic Site, Frankfort
27. Fort Wright Community Park, Fort Wright
28. Victorian Estates, Georgetown
29. Newtown Christian Church, Georgetown
30. Kentucky Dam Village State Park, Gilbertsville
31. Woodlands Nature Stations, Golden Pond
32. Creasey Mahan Nature Preserve, Goshen
33. Shaker Village of Pleasant Hill, Harrodsburg
34. Beaumont Inn, Harrodsburg
35. John James Audubon State Park, Henderson
36. Campbell County Cooperative Extension, Highland Heights
37. Jeffers' Bend Environmental Center, Hopkinsville
38. Marcum and Wallace Memorial Hospital, Irvine
39. Garrard County Cooperative Extension, Lancaster
40. Anderson County Library, Lawrenceburg
41. Floracliff Nature Sanctuary, Lexington
42. State of Kentucky Arboretum (2), Lexington
43. Cardinal Hill Rehabilitation Hospital, Lexington
44. St. Ann Street median, Lexington
45. Fayette County Cooperative Extension, Lexington
46. Waveland Museum, Lexington
47. Dogwood Park, Lexington
48. Wellington Park, Lexington
49. Morning Point, Lexington
50. Christian Towers, Lexington
51. St. Margaret St. median, Lexington
52. St. Michael's Episcopal Church, Lexington
53. Klausing Group Commercial Landscaping, Lexington
54. Lexington Public Libraries
55. Peace Meal Gardens, Lexington
56. McConnell Springs, Lexington
57. Ashland Terrace Retirement Home, Lexington
58. Raven Run, Lexington
59. Firebrook Estates, Lexington
60. Audubon Park (4), Louisville
61. Copper and Kings Brandy Co., Louisville
62. Landis Lake Subdivision, Louisville
63. Downtown Maysville
64. Morehead Community Park
65. Blue Licks State Park, Mount Olivet
66. Springhouse Gardens, Nicholasville
67. Paducah Airport Viewing Area, Paducah
68. Buddenbaum House, Paducah
69. Nannie Clay Wallis Arboretum, Paris
70. Central Kentucky Wildlife Refuge, Parksville
71. Madison County Cooperative Extension, Richmond
72. E. C. Million Community Park, Richmond
73. Dumont Hill Park, Scottsville
74. Red Orchard Park, Shelbyville
75. Pulaski County Cooperative Extension, Somerset
76. Pulaski County Public County, Somerset
77. Lincoln County Library, Stanford
78. Boone County Arboretum, Union

* **Note:** This is not an all-inclusive listing (78 out of 408). Some gardens are not certified under the names of their physical locations. Does not include public or private schools.

APPENDIX 4. Five steps for Forestry Reclamation Advisory on surface mine Sites (FRA).

1. Create a suitable rooting medium for good tree growth that is no less than four feet deep, and consists of topsoil, weathered sandstone, and/or the best available material.
2. Loosely grade the topsoil or topsoil substitutes established in step one to create a noncompacted growth medium.
3. Use ground covers that are compatible with growing trees.
4. Plant two types of trees – 1) early succession species for wildlife and soil stability, and 2) commercially valuable crop trees.
5. Use proper tree planting techniques.

APPENDIX 5. Challenges with creating more pollinator habitat.

1. Although prescribed burns are often the best way to prepare a site, many people do not feel comfortable burning their acreage. Consult with state FSA conservation agents until burn specialists are licensed by the state of Kentucky. For those with more interest in the legislation process for prescribed burn professionals, please go to kyfire.org. The Kentucky Prescribed Fire Council wishes to pass legislation that would indemnify agencies/private conservation practitioners, but it also would cause more regulation on burning in Kentucky.
2. Seasonality of seed can be an issue.
3. Availability of seed can be an issue.
4. If one patch of land is changed, it will impact other species that may or may not find the changes attractive.

Other Resources:

- Bee Forage: Recent research from Penn State suggests that bees can detoxify themselves if they have access to diverse flowers. says Dr. Christina Grozinger, “Natural Diet Helps Honey Bees Fend Off Pesticide Effects,” ezezine.com/ezone/archives/1636/1636-2014.11.03.14.21.archive.html
- Bee Hive Nets: Where to purchase bee nets. Dadant Supply, model #V02000, approximate cost \$28.95. Brushy Mountain, #985, approx. \$25.50 plus shipping and handling. As of this writing, Kelley’s Bee Supply does not have bee nets for purchase.
- Green Forests Work, LLC. For work on planting pollinator trees, understory, ground covers, greenforestswork.org.
- Honey testing: An example of one lab is the Palynology Laboratory, Department of Anthropology, Texas A&M, College Station, Texas, 77843-4352. Beekeepers should check for the most recent prices: txbeeinspection.tamu.edu/files/2014/10/TAIS-Submission-Form.pdf Samples need to be sealed in zip-locking bags, should be at least four ounces, and if you want samples back, include extra fees for the shipping and handling.

- Mason bee nest tubes and houses can be bought at garden.com for approximately \$20. Item #37-481.
- Monarch butterflies: monarchwatch.org.
- Moissett, Beatriz and Stephen Buchmann. *Bee Basics: An Introduction to Our Native Bees*. Can be downloaded free at fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5306468.pdf
- Prairie Moon Nursery in Minnesota has an excellent eight-step guide to helping landowners consider their goals and appropriate strategies to converting various land uses to pollinator habitat. See their website for a downloadable document: prairiemoon.com/how-to-grow-a-prairie-from-seed.html
- Prescribed Burn Info: 1. kyfire.org; 2. Wayne Pauley's *How to Manage Small Prairie Fires*, 1982 (book available at WildOnes.org and/or amazon.com).
- Pollinator education materials, legislative updates, planting guides: pollinator.org
- Pumpkin/squash bees: see *Pumpkin Production Guide*, NRAES-123. Cornell: Cornell University Press, 2003. Excellent guide for *Peponapis pruinosa* bees.

Additional References and Bibliography

- Angel, Patrick and C.M. Christensen. 1976. "Honey Production on Reclaimed Strip Mine Soil." *Hill Lands: Proceedings of an International Symposium*. Morgantown, W. Va., Oct. 3-9. West Virginia University. 708-711.
- Appalachian Regional Reforestation Initiative, Forestry Reclamation Advisory #14: *Re-Establishing Pollinator Habitat on Mined Lands Using the Forestry Reclamation Approach*.
 Authors: Tammy Horn Potter, Patrick Angel, Carl Zipper, Michael Ulyshen, Michael French, Jim Burger, and Mary Beth Adams. February, 2017. arri.osmre.gov/FRA/Advisories/FRA-14PollinatorHabitat-Feb2017.pdf
- Appalachian Regional Reforestation Initiative Statement of Mutual Intent Signing Ceremony. 2006. U. S. Fish and Wildlife Service, U. S. Forest Service, U. S. Dept. of Energy, and U. S. Office of Surface Mining. Nov. 3.
- Barton, Chris. 2007. *Reclaiming the Future: Reforestation in Appalachia* (DVD). Lexington, Ky.: University of Kentucky Cooperative Extension. arri.osmre.gov.
- Berenbaum, May. 2009. "Colony Collapse Disorder and Ruptured Ribosomes." scientificamerican.com. Aug. 25.
- Buchmann, Steve and G. P. Nabhan. 1996. *The Forgotten Pollinators*. Washington, D. C., Island P.
- Calderone, N.W. (2012). *Insect Pollinated Crops, Insect Pollinators and U. S. Agriculture: Trend Analysis of Aggregate Data for the Period 1992–2009*. PLoS ONE 7(5): e37235. doi:10.1371/journal.pone.0037235

- Cane, J.H., and V.J. Tepedino. (2001). "Causes and extent of declines among native North American invertebrate pollinators: detection, evidence, and consequences." *Conservation Ecology* 5:1.
- Dogterom, Margriet. 2009. *Pollination with Mason Bees: A Gardener's Guide to Managing Mason Bees for Fruit Production*. Beediverse Publishing.
- Dott, Don, Exe. Director. (2013) Kentucky State Nature Preserves Commission Biennial Report. Online resource available: naturepreserves.ky.gov/pubs/publications/2013%20Biennial_Report.pdf.
- Ellis AM, Myers SS, Ricketts TH (2015) "Do Pollinators Contribute to Nutritional Health?" *PLoS ONE* 10(1): e114805. doi:10.1371/journal.pone.0114805.
- Goulson, Dave, Elizabeth Nicholls, Christina Botias, Ellen Rotheray. 2015. "Bee declines driven by combined stress from parasites, pesticides, and a lack of flowers." *Science Express*. 26 Feb. 2015. science.sciencemag.org/content/347/6229/1255957.
- Horn, Tammy and Mike Studer. 2016. "Pesticide related bee kills: How to know, how to collect samples, how to report", *American Bee Journal*, June 2016.
- James, Rosalind and Theresa Pitts-Singer, eds. 2008. *Bee Pollination in Agricultural Ecosystems*. Oxford: Oxford University Press.
- Kearns, Carol and James Thomson. 2001. *The Natural History of Bumblebees: A Sourcebook for Investigations*. Boulder, University Press of Colorado. (Excellent guide for bumbles.)
- Kearns, C.A., D.W. Inouye. 1997. *Pollinators, Flowering Plants, and Conservation Biology*. *Bioscience* 47:297-307.
- Moissett, Beatriz and Stephen Buchmann. 2010. *Bee Basics: An Introduction to Our Native Bees*. Download: fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5306468.pdf
- Pauley, Wayne. *How to Manage Small Prairie Fires*. 1982. Dane County Park Commission, Wisconsin.
- Plant Species, Distribution Patterns, Seeding Rates, and Planting Arrangements for Revegetation of Mined Lands*. 1995. Technical Reclamation Memorandum #21. Frankfort, Ky.: Kentucky Department of Fish & Wildlife, Kentucky Department of Natural Resources, Division of Forestry, Kentucky Department of Surface Mining, Reclamation and Enforcement. Jan. 2006.
- Pumpkin Production Guide*, NRAES-123. Cornell: Cornell University Press, 2003.
- Potts, S.G., J.C. Biesmeijer, C. Kremen, P. Neumann, O. Schweiger, W.E. Kunin. 2010. "Global pollinator declines: trends, impacts and drivers." *Trends in Ecology and Evolution* 25:345-353.
- Shrader, Casey. *The Kentucky Pollinator Handbook*. NRCS. Available to download. 2016.
- United States Department of Agriculture (1980). *Beekeeping in the United States*, Agricultural Handbook 335. Washington, D.C.: U. S. Government Printing Office.
- Wilson, Joseph and Olivia Carril. (2016). *The Bees in your Backyard: A Guide to North America's Bees*. Princeton: Princeton University Press.

Acknowledgments

Thanks to **Dr. Ric Bessin**, University of Kentucky, who with me did much of the word-smithing, and to content contributors **Don Dott** (Kentucky Nature Preserves Commission), **Linda Porter** (Wild Ones Native Landscaping), **Brent Burchett** (Kentucky Soybean Association), **John Pitcock** (Kentucky Department of Agriculture), **Brent Harrel** (U. S. Fish & Wildlife Service/Kentucky), and **Joe Cain** (Kentucky Farm Bureau). — *Tammy Horn Potter, Ph.D.*

Photos in this report were originally published in 2015-16 issues of *BeeLines*, the monthly KDA e-newsletter from the Kentucky State Apiarist, or reprinted by permission of other publications and photographers.



**Kentucky
Department of
Agriculture**

RYAN F. QUARLES, Kentucky Commissioner of Agriculture

TAMMY HORN POTTER, Ph.D., Kentucky State Apiarist