

Final Report

Project Title: Bee-friendly beef: Integrating native wildflowers into Southeastern grazing systems

Grantee Name. Virginia Tech

Project PD or key team member names. Benjamin Tracy PD (Virginia Tech), Pat Keyser (University of Tennessee), Amy Johnson (Virginia Working Lands)

Project start and end date: 4/26/20- 2/27/25

Award number (FAIN): NR203A750008G005

1. Project Summary:

Pollinator populations have declined in recent decades due, in part, to changing land-use patterns and a lack of flower resources. Declining pollinator populations could affect food production as approximately 75% of all crops depend on pollinators to produce fruits. Pollinator declines potentially could be reversed by adding native wildflowers into pastures thus creating 'bee-friendly' production systems. Over a five-year period, we collected data from on-farm study sites, grazing trials, and small plot field experiments to answer questions about how to establish wildflowers in pastures, how well they persisted in pastures, and how their presence would affect cattle performance and pollinator populations. We also conducted a large consumer survey to learn if people would pay more for beef raised on bee-friendly beef pastures.

The most successful method for establishing wildflowers involved using Roundup herbicide and tillage to suppress weeds along with a cold treatment for the seed before planting. Of the 15-20 wildflower species we worked with, black-eyed Susan, oxeye sunflower, and tick trefoil were the most persistent in pastures. Pollinator abundance was typically about three times greater in wildflower-enhanced pastures, yet the presence of wildflowers did not reduce cattle performance. Based on surveys, we found that U.S. beef consumers may pay \$1-2 more per pound for ground beef raised on bee-friendly beef pastures, which could be an economic incentive for producers to adopt these practices.

2. Project Goal and Objectives:

The main goal of this project was to find the most effective ways to add wildflowers to typical southeastern pastures and learn how the addition of these wildflowers would affect cattle performance and pollinator abundance. Specifically, we addressed the following objectives: **1) Demonstrate the establishment and persistence of wildflowers in grazing systems, 2) Assess the benefits of wildflower-enhanced grazing systems for cattle, 3) Assess the benefits of wildflower enhanced grazing systems for pollinators, and 4) Calculate the economic potential of wildflower-enhanced grazing systems.** In addition to these study objectives, we created educational materials and provided outreach about wildflower-enhanced grazing systems.

3. Project Background:

In the Southeastern U.S, the “fescue belt” covers 37 million acres across 15 states. These pasturelands are dominated by tall fescue (*Festuca arundinacea*), which was imported into the US as a forage crop because of its drought tolerance, persistence, and productivity in this region of the US. Except for European white clover (*Trifolium repens*), tall fescue pastures typically lack flowering plants that can attract pollinators. While white clover can provide nectar and pollen resources for some pollinator species, these mostly benefit European honeybees (*Apis mellifera*). Native flowering plants are more beneficial for our

native pollinators.

Approximately 75% of crop species depend on pollinators to produce fruit. The value of this service is estimated at more than \$200 billion per year. In the fescue belt, major crops that benefit from pollinators include apples, alfalfa, tomatoes, cotton, cucumbers, squash, and watermelon. Both managed honeybees and native pollinator populations have experienced major declines in recent decades. These population declines could negatively affect fruit, vegetables, and possibly honey production across the southeast. Adding wildflowers to tall fescue pastures could help reverse these declines in pollinator populations.

Before this happens, it will be necessary to develop more effective methods for establishing wildflowers into existing tall fescue pastures as this can be difficult to do successfully. Protocols for planting native wildflowers into tall fescue pastures have not been tested previously. Moreover, we lacked information about how pollinators and cattle might be affected by wildflower inclusion in pastures. Information on the potential economic benefits of wildflower-enhanced pastures was also in short supply. In this project, we developed and demonstrated methods for establishing wildflowers into tall fescue pastures, documented the impacts of wildflowers on cattle and pollinators, and estimated the economic value of wildflower-enhanced grazing systems through surveys. One goal of the project was to update the NRCS conservation practice standard for forage and biomass planting (code 512) to include guidance for pollinator conservation in actively grazed pasture lands in the southeastern US.

4. Project Methods:

Objective 1) Demonstrate the establishment and persistence of wildflowers in grazing systems

Four field experiments in Virginia were conducted over a 5-year span to demonstrate various methods used to establish wildflowers. A fifth experiment in Tennessee involved pasture plots that were overseeded with wildflowers to evaluate establishment success and monitor persistence. Details on specific experiments and methodologies can be found in the following publications:

<https://doi.org/10.3390/agronomy14112676>

<https://doi.org/10.3390/agronomy14051041>

<https://doi.org/10.3390/agronomy14102184>

<https://doi.org/10.1111/gfs.12651>

Objective 2) Assess the benefits of wildflower-enhanced grazing systems for cattle

Separate from the wildflower establishment studies, two side-by-side grazing trials were done at the Virginia Tech and University of Tennessee locations, respectively. Cattle groups grazed pastures that were either enhanced with wildflowers or had no wildflowers and

weight gain was monitored over three years. At the Tennessee location, various wildflower species were grown in pure stands and harvested each summer and analyzed for forage quality/feeding value for cattle. Details on specific experiments and methodologies can be found in the following publications:

<https://doi.org/10.1002/csc2.70030>

<https://doi.org/10.3390/agronomy14102184>.

[doi: 10.6084/m9.figshare.17208854.v1](https://doi.org/10.6084/m9.figshare.17208854.v1)

Objective 3) Assess the benefits of wildflower enhanced grazing systems for pollinators

Pastures at five on-farm locations in northern Virginia were planted with two different wildflower mixtures and pollinator surveys were done over three consecutive years at the on-farm sites. The Smithsonian's Virginia Working Landscapes (VWL) research team established these on-farm sites with participating cattle and sheep producers on six working farms (see Figure 31). On each farm, one actively-grazed pasture (at least 10 acres) was selected for the study and divided into two experimental treatments. Half of the pasture served as the "wildflower-enhanced" treatment, and the other half served as a control. Baseline vegetation surveys were conducted in the study fields during the 2021 growing season, followed by a fall field preparation (grazing or bushhogging) to reduce the cover of non-native vegetation and subsequent cover crop planting in the treatment fields. A second field preparation (herbicide application and/or disking) in spring 2022 was conducted in the treatment fields, followed by interseeding a native wildflower seed mix via either a broadcast spreader or seed drill in at least 25% of the treatment fields. Two nontoxic, native wildflower seed mixes were tested across the six on-farm trials in this study, one native to the eastern United States (n= 4 farms) and the other regionally native to Virginia (n= 2 farms). Livestock were removed from the treatment fields during the initial 2022 growing season to promote establishment success of the seed mixes. With the support of VWL's community scientists, teams of scientists and volunteers conducted vegetation and pollinator surveys in the study fields post-seeding during the 2022-2024 growing seasons to monitor wildflower establishment and persistence, changes in the vegetation community, and the response of the pollinator community. Pollinator surveys were also conducted in the side-by-side grazing trial conducted in Virginia. Details on the survey methods for the side by side grazing trial can be found in the following publication:

<https://hdl.handle.net/10919/134995>

Objective 4) Calculate the economic potential of wildflower-enhanced grazing systems

A nationwide survey was conducted involving over 2000 beef consumers in the US. The survey asked various questions about purchasing options for ground beef using different labels describing how the beef was raised (e.g., bee-friendly vs organic). Details on the survey methods can be found in the following publication:

<https://hdl.handle.net/10919/121608>

5. Project Results: (note citations are listed in Publications section)

Objective 1) Demonstrate the establishment and persistence of wildflowers in grazing systems

- A three-year study was conducted in Tennessee where 11 different wildflower species were overseeded into stands of native warm-season grasses and grazed by cattle.. Black-eyed Susan, lanceleaf coreopsis, oxeye sunflower, and purple coneflower had the longest flowering times, which should benefit pollinators. Under grazing, black-eyed Susan, oxeye sunflower, and ticktrefoil were the most persistent. These species should be considered for use in mixtures shown into grazed pasturelands. See this publication for more information: <https://doi.org/10.1111/gfs.12651>
- Based on the study mentioned above and observations from grazing trials, we recommend the following species mix and seeding rates for successful establishment of wildflowers in pastures (Table 1). Many wildflowers are resistant to Plateau herbicide and application can aid wildflower establishment by suppressing weeds. Recommended application rates for Plateau are listed on the table. We should mention that wildflowers have considerable genetic variation, and some individuals may be more susceptible to Plateau than others.
- Wildflower establishment was also evaluated on six on-farm sites in Northern Virginia. As mentioned in the methods section, these were planted with native wildflowers in 2021. Collectively, 14 out of 16 species planted established well in the wildflower-enhanced pastures. Across three years of data collection, black eyed Susan, wild bergamot, grey-headed coneflower, early goldenrod, flat top goldenrod, purple coneflower, and flattop goldenrod were the most consistently persistent.
- In addition to the on-farm studies, we collected wildflower establishment data from a series of small plot experiments. Overall, the results clearly showed that intensive site preparation to control weeds was critical for good establishment of wildflowers. We found that Roundup/glyphosate or tillage alone or in combination can effectively suppress weeds and lead to better establishment success (Figure 1). Please see the following publication for more details- <https://doi.org/10.3390/agronomy14112676>
- In the same study, a we tested a range of planting rates for wildflowers and found good evidence that rates between 2 and 10 lbs. per acre can be very effective for good producing good establishment. Higher planting rates above 10 lbs/ac. do not necessarily improve establishment success though.

Table 1. A recommended wildflower mix, seeding rates and plateau herbicide application rates derived from work conducted at the University of Tennessee during this project.

Common Name	Latin Name	Seeding rate (lb/ac)	Plateau (per label)	
			seedling	established
Black-eyed Susan	<i>Rudbeckia hirta</i>	0.25	4 oz	8 oz
Lanceleaf coreopsis	<i>Coreopsis lanceolata</i>	0.50	4 oz	
Ticktrefoil	<i>Desmodium</i> spp.	1.00	4 oz POST	
Purple coneflower	<i>Echinacea purpurea</i>	0.70	4 oz	8 oz
Oxeye sunflower	<i>Heliopsis helianthoides</i>	0.50	none ¹	
Upright prairie coneflower	<i>Ratibida columnifera</i>	0.50	4 oz	6 oz
Partridge pea	<i>Chamaecrista fasciculata</i>	1.00	4 oz	12 oz
Maximilian sunflower*	<i>Helianthus maximiliani</i>	0.25	none	
Cup plant*	<i>Silphium perfoliatum</i>	0.25	none	
Wild bergamot	<i>Monarda fistulosa</i>	0.25	4 oz POST	
Mountain mint	<i>Pycnanthemum tenuifolium</i>	0.25	none ²	

¹ per guidance from commercial growers; also, not mentioned on label

² not mentioned on label

* These species can become quite large in pastures, and may be of concern to producers

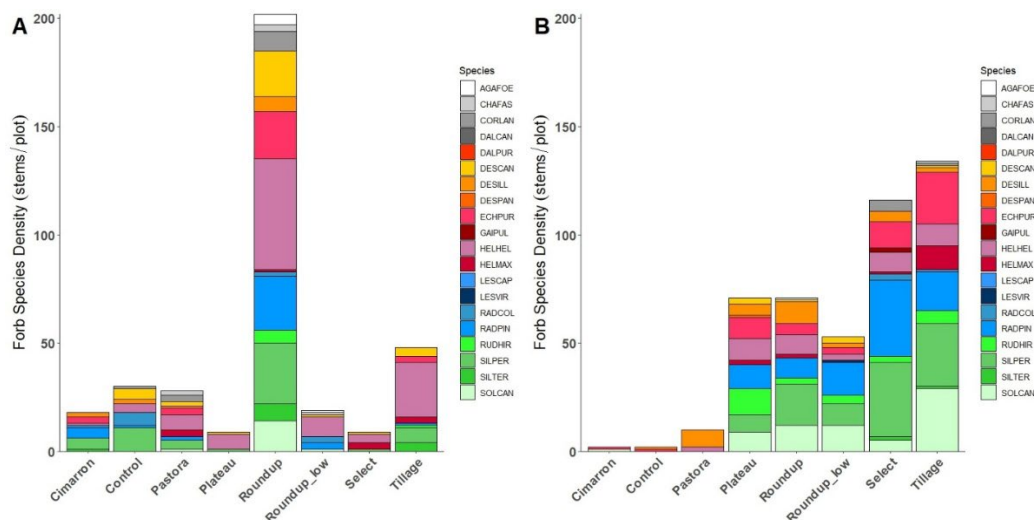


Figure 1. Wildflower establishment in response to site preparation with tillage and several herbicides. Species listed in caption are shown in Table 2.

Table 2. Wildflower species and seeding rates used in small plot experiments conducted in Virginia. Table modified from <https://doi.org/10.3390/agronomy14112676>

Species	Code	Family	Seeds kg ⁻¹	Pure Live Seed (PLS)	Seeding Rate (kg ha ⁻¹)
<i>Agastache foeniculum</i>	AGAFOE	Lamiaceae	3,080,000	0.99	0.03
<i>Chamaecrista fasciculata</i>	CHAFAS	Fabaceae	143,000	0.97	0.78
<i>Coreopsis lanceolata</i>	CORLAN	Asteraceae	486,200	0.83	0.22
<i>Dalea candida</i>	DALCAN	Fabaceae	611,600	0.75	0.22
<i>Dalea purpurea</i>	DALPUR	Fabaceae	660,000	0.91	0.11
<i>Desmanthus illinoensis</i>	DESILL	Fabaceae	187,000	0.59	0.56
<i>Desmodium canadense</i>	DESCAN	Fabaceae	159,500	0.93	0.11
<i>Desmodium paniculatum</i>	DEAPAN	Fabaceae	440,000	0.96	0.22
<i>Echinacea purpurea</i>	ECHPUR	Asteraceae	254,460	0.91	0.44
<i>Gaillardia pulchella</i>	GAIPUL	Asteraceae	506,000	0.91	0.22
<i>Helianthus maximiliani</i>	HELMAX	Asteraceae	431,992	0.79	0.22
<i>Heliopsis helianthoides</i>	HELHEL	Asteraceae	224,400	0.92	0.44
<i>Lespedeza capitata</i>	LESCAP	Fabaceae	605,000	0.95	0.22
<i>Lespedeza virginica</i>	LESVIR	Fabaceae	352,000	0.98	0.33
<i>Ratibida columnifera</i>	RATCOL	Asteraceae	1,478,400	0.89	0.11
<i>Ratibida pinnata</i>	RATPIN	Asteraceae	978,942	0.95	0.11
<i>Rudbeckia hirta</i>	RUDHIR	Asteraceae	3,466,672	0.89	0.03
<i>Silphium perfoliatum</i>	SILPER	Asteraceae	220,000	0.90	0.44
<i>Silphium terebinthinaceum</i>	SILTER	Asteraceae	37,400	0.78	2.90
<i>Solidago canadensis</i>	SOLCAN	Asteraceae	10,120,000	0.57	0.01

- Across these planting rates, we found that cold treatments of wildflower seed were found to improve establishment success. While effective, this method is probably impractical when planting large quantities of seed. See this publication for more details: <https://doi.org/10.3390/agronomy14112676>
- Additional experiments tested different planting arrangements, sequences, and timings for establishing wildflowers with native grasses. Our results showed that it is best to seed grass first, control weeds, and then sow wildflowers the following year. Details about these experiments can be found in: <https://doi.org/10.3390/agronomy14051041>

Objective 2) Assess the benefits of wildflower-enhanced grazing systems for cattle

- Results from the side-by-side grazing trial conducted in Tennessee (Figure 2), cattle weight gain was consistently greater for calves grazing pastures that were planted with wildflowers - average daily gain 1.70 vs. 1.54 lbs./day. The better gains on wildflower-enhanced pastures were likely the result of more stable forage quality across the season that produced higher overall weight gain in cattle. Please see this publication for more information: <https://doi.org/10.3390/agronomy14102184>.

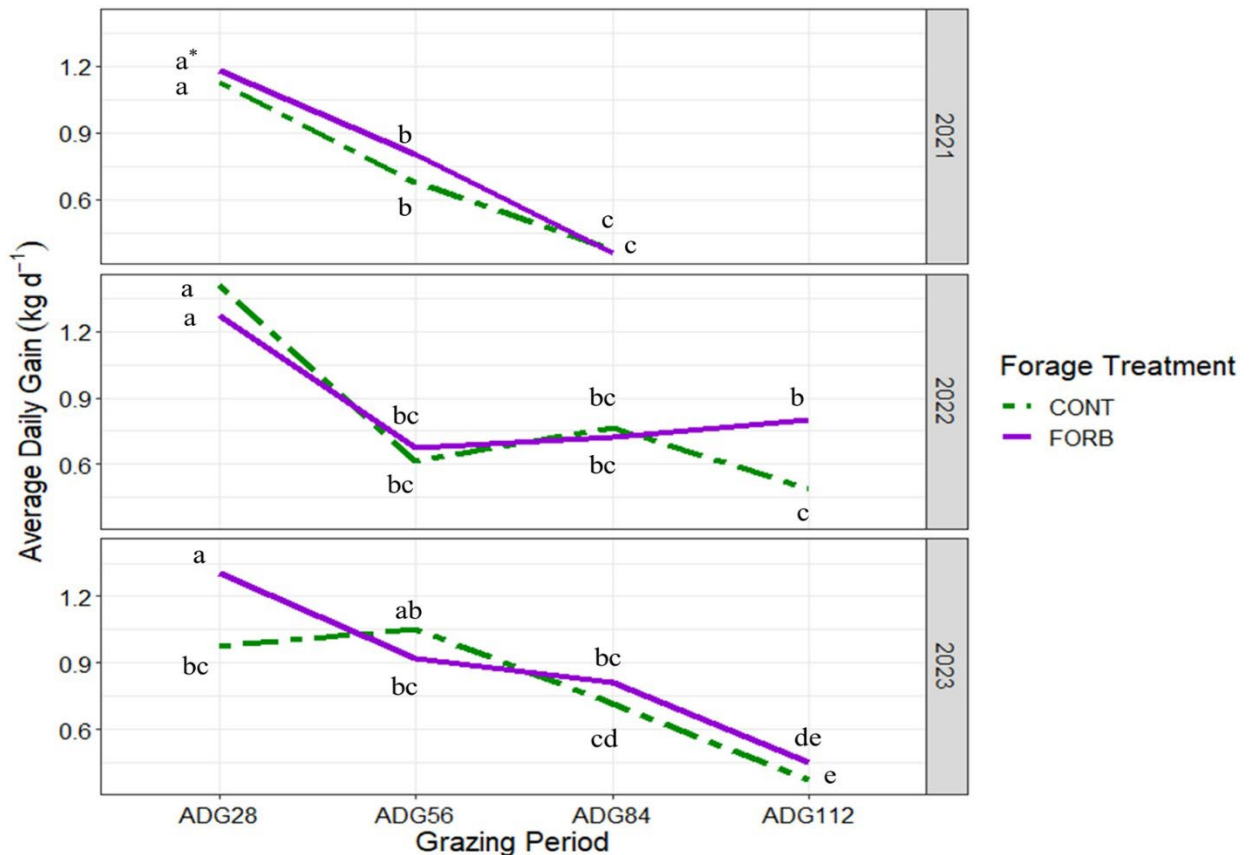


Figure 2. Average daily gain of weaned calves grazing warm-season grass pastures (CONT) and pastures enhanced with wildflowers (FORB) by 28-day periods, 2021–2023, at the East Tennessee AgResearch and Education Center, Holston Unit, Knoxville, TN, USA.

- Related to the grazing study done in Tennessee, nutritional analysis was conducted for 12 wildflower species to document the potential feeding value of these plants to cattle. Overall, many wildflowers had desirable levels of crude protein (10.5-18.9%) and low fiber contents. These nutritional characteristics could help cattle gain weight if they consume wildflowers. <https://doi.org/10.3390/agronomy14010028>
- A similar side-by-side grazing trial was also conducted in Virginia. Here, cattle weight gain was unaffected in wildflower-enhanced pastures. The result means that producers can devote as much as 10% of their pastures to wildflowers without incurring any negative effects on cattle weight gain. <https://hdl.handle.net/10919/134995>
- In a different 3-year grazing trial conducted in Virginia, we found good evidence that weight gain was higher when cattle had access to pastures with native warm-season grasses and white clover compared with grass-only pastures. White clover blooms are an important resource for pollinators – especially honeybees. All in all, we did not find any evidence that wildflower enhancement of pastures would be detrimental to cattle

production. See the following publication for more details:
<https://doi.org/10.1002/csc2.70030>

Objective 3) Assess the benefits of wildflower-enhanced grazing systems for pollinators

- To evaluate whether more pollinators were attracted to wildflower-enhanced pastures, we conducted field surveys over 2 years. As we expected, native wildflower-enhanced pastures were home to more than three times more pollinators compared with grass-only pastures, and those pollinator groups were also more diverse. The wildflower areas simply had many more flowers compared to the untreated pastures, and those flowers provided abundant blooms across the season. <https://hdl.handle.net/10919/134995>
- As mentioned above, the Smithsonian's Virginia Working Landscapes (VWL) research team established on-farm study sites in Northern Virginia with participating cattle and sheep producers on six working farms (Figure 3). After three years of survey, they found greater total pollinator abundance across all surveyed taxa in the wildflower-enhanced pastures compared to traditional pastures (Figure 4). The pollinator taxa most significantly impacted in the wildflower-enhanced treatment fields were bumble bees, butterflies and moths, flies, honeybees, and small native bees.

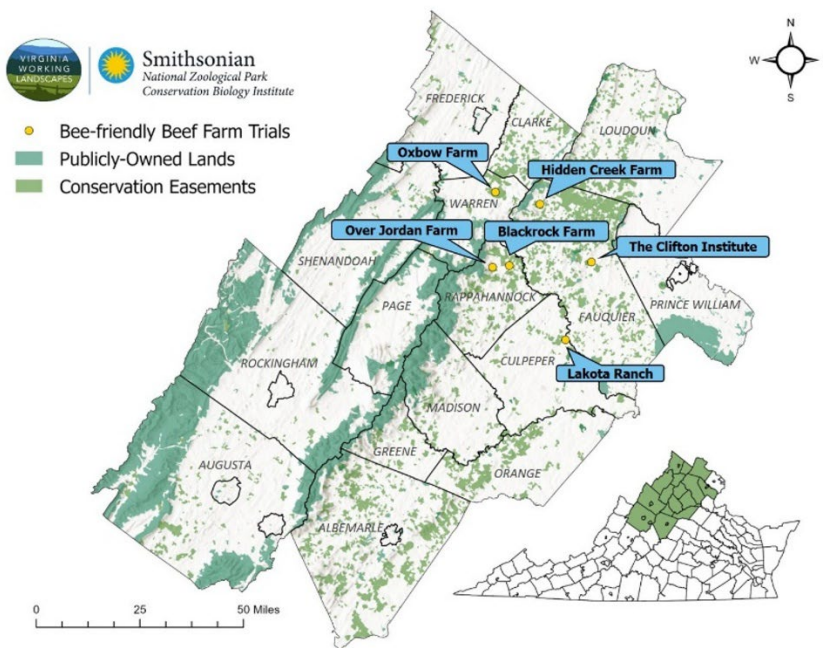


Figure 3. Locations of six on-farm trial sites in Northern Virginia.

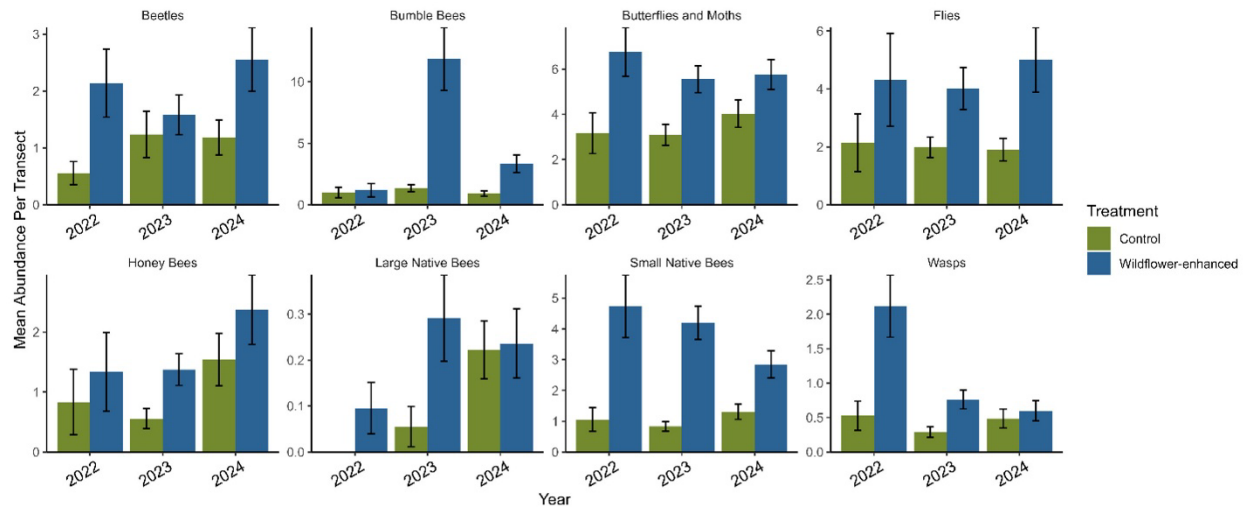


Figure 4. Mean abundance of the pollinator taxa from on-farm sites in northern Virginia in the wildflower-enhanced and control treatment fields (2022-2024).

Objective 4) Calculate the economic potential of wildflower-enhanced grazing systems

- Our study also had a socioeconomic component that involved a nationwide survey conducted involving over 2000 beef consumers in the US. Results from the survey found that, on average, consumers were willing to pay \$1.06 per pound extra for ground beef raised on ‘bee-friendly’ pastures (Figure 5). Beef consumers who were knowledgeable about pollinator decline are willing to pay even more - \$1.79/lbs. These results were encouraging as they suggest that livestock producers potentially could be rewarded financially for adopting bee-friendly beef management schemes in their pastures.

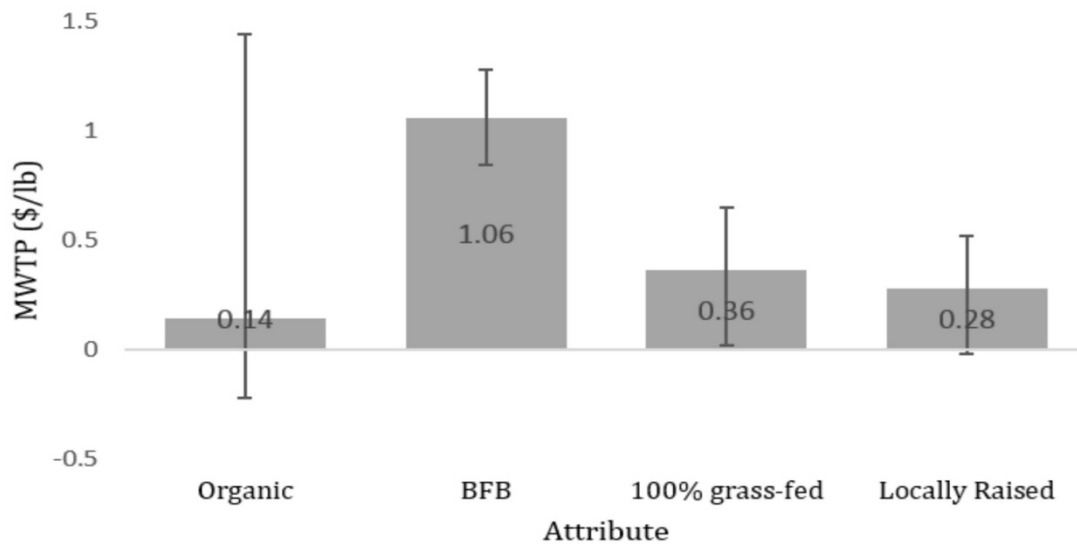


Figure 5. Maximum willingness to pay (MWTP) summary from Nationwide consumer survey. Attributes include beef raised from organic farms (Organic), BFB – bee friendly beef, 100% grass fed and beef raised from local farms.

6. Project Outputs:

Publications:

Bellangue, D., Barney, J., Flessner, M., Kubesch, J., O'Rourke, M., Tracy, B., Reid, J.L. 2024. Site Preparation and Planting Strategies to Improve Native Forb Establishment in Pasturelands. *Agronomy* 14, 2676. <https://doi.org/10.3390/agronomy14112676>

Chishimba, E. 2024. Essays on the economics of bee-friendly beef. PhD Dissertation. Department of Agriculture and Applied Economics. Virginia Tech. 179 pp. <https://hdl.handle.net/10919/121608>

Kubesch, J. 2023. Evaluating native warm-season grass and wildflower mixtures for beef cattle production in the Mid-Atlantic. PhD Dissertation, School of Plant and Environmental Sciences, Virginia Tech <https://vtechworks.lib.vt.edu/items/78f3e88a-2d22-41c6-87b5-770ef220333c>

Kubesch, J., Greiner, S., Pent, G., Reid, J., Tracy, B.. Evaluating Different Methods to Establish Biodiverse Swards of Native Grasses and Wildflowers for Pasturelands. *Agronomy* 2024, 14, 1041. <https://doi.org/10.3390/agronomy14051041>

Kubesch, J., Greiner, S., Pent, G., Reid, J., & Tracy, B. 2025. Diversifying tall fescue pastures with native warm-season grasses and white clover improves beef cattle performance.

Crop Science, 65, e70030. <https://doi.org/10.1002/csc2.70030>

Prigge, J. (2024). *Bee Friendly Beef: Integrating Pollinator-Friendly Native Forbs into Native Grass Pastures*. [PhD Dissertation, University of Tennessee].
https://trace.tennessee.edu/utk_graddiss/10414/

Prigge, J., E. Bisangwa, J. Richwine, V. Sykes, J. Ivey, P. Keyser. 2024. Native Forbs Provide Pollinator Resources and Improve Forage Nutrient Composition, Animal Performance, and Pasture Productivity. *Agronomy*, 14, 10, 2184.
<https://doi.org/10.3390/agronomy14102184>.

Prigge, J., E. Bisangwa, J. Richwine, K. Swilling, P. Keyser. 2023. Blooming and Forage Characteristics of Twelve Native Forbs Subjected to Repeated Defoliation. *Agronomy*, 14, 1, 28. <https://doi.org/10.3390/agronomy14010028>.

Prigge, J., E. Bisangwa, P. Keyser. 2021. Animal performance and pasture productivity of weaned steers grazing native warm-season grass pastures with and without interseeded native forbs and legumes. In: *2021 UT Beef and Forage Center Annual Research Report*. University of Tennessee, Knoxville, TN. [doi: 10.6084/m9.figshare.17208854.v1](https://doi.org/10.6084/m9.figshare.17208854.v1)

Richwine, J., P. Keyser; J. Zobel; F. Walker. 2024. Native Forbs Interseeded into Native Grass Pastures Persist Under Grazing. *Grass Forage Sci.*, 2, 79, 328-341.
<https://doi.org/10.1111/gfs.12651>

Stewart, H. 2025. Wildflowers in Working Landscapes: Establishment Methods and Impacts on Pollinators and Cattle. MS Thesis, School of Plant and Environmental Sciences. Virginia Tech. 53pp. <https://hdl.handle.net/10919/134995>

Media:

Beef friendly Beef Facebook site; <https://www.facebook.com/beesandbeef/> (24 likes)

Featured posts on the Smithsonian's National Zoo and Conservation Biology Institute and Smithsonian's Earth Optimism social media accounts on various platforms. The project has been featured numerous times with special highlights for Pollinator Week 2023 and 2024. These posts reached over 60K viewers:

- <https://www.facebook.com/nationalzoo/videos/1282304055994315>
- <https://www.facebook.com/nationalzoo/videos/6281513798552330>
- <https://www.instagram.com/p/C9xQXKLxIWh/>
- <https://www.instagram.com/p/C8XNrT8xxl3/>

Websites:

Bee-friendly Beef Website; Site was intended to showcase results from the three study locations. <https://beesandbeef.spes.vt.edu/>

- Software – NA

Conference attendance:

Prigge, J. L. 2024. Bee Friendly Beef: Integrating Pollinator-Friendly Native Forbs into Native Grass Pastures. Eastern Native Grasslands Symposium, Philadelphia, PA. 55 present

Prigge, J. L.; P. D. Keyser; J. D. Richwine; E. Bisangwa; K. J. Swilling. 2023. Diverse Pasture Performance, Persistence, and Management. Bee-Friendly Beef Producer Workshop. Smithsonian Institute, Front Royal, VA. 50 present

Keyser, P., J. Prigge, J. Richwine, E. Bisangwa, and K. Swilling. 2023. *Creating Higher Diversity Native Grass Pastures*. Bee-Friendly Beef Producer Workshop, UT, VT, and Smithsonian Conservation Biology Institute. August 3, 2023, Front Royal, VA. 50 present.

Shibley, E. T., N. A. Izlar; A. E. Johnson; P. Kietzman. May 2025. *Bee-Friendly Beef: Harnessing Community Science to Identify Conservation Solutions on Working Lands*. Conference for Advancing Participatory Sciences, Portland, OR. [Submitted]

Johnson, A. E. October 2024. *From Research to Roots: Developing Farmer-Scientist Partnerships for Conservation*. UN Biodiversity Meeting at COP16, Cali, Colombia. 1000+ present.

Izlar, N. A. March 2024. *Bee-Friendly Beef: Integrating Native Wildflowers into Traditional Grazing Systems*. Virginia Chapter of The Wildlife Society Annual Meeting, Front Royal, VA. 150 present.

Johnson, A.E. March 2024. *Connecting Communities for Working Lands Conservation*. Forum for the Future of Agriculture. Brussels, Belgium. 1000+ present.

McDonough, S. B. February 2024. *The Root of the Problem: Lawn Culture in the United States*. The Fauquier and Loudoun Garden Club Monthly Meeting, Loudoun, VA. 50 present.

Shibley, E. T., N. A. Izlar; A. E. Johnson. December 2023. *Conserving Wildlife Through Regenerative Agriculture*. Virginia Farm to Table Conference, Weyers Cave, VA. 300 present.

Izlar, N. A.; E. T. Shibley; A. E. Johnson. October 2023. *Bee-Friendly Beef: Integrating Native Wildflowers into Traditional Grazing Systems*. Rappahannock River Roundtable Symposium, City, VA. 75 present.

Johnson, A. E.; E. T. Shibley; N. A. Izlar. August 2023. *Bee-friendly Beef: Case studies and*

preliminary research findings from Virginia Working Landscapes Bee-Friendly Beef farms. Bee-Friendly Beef Producer Workshop. Smithsonian's National Zoo and Conservation Biology Institute, Front Royal, VA. 75 present.

Johnson, A. E.; E. T. Shibley; N. A. Izlar. July 2023. *Bee-friendly Beef: Case studies and preliminary research findings from Virginia Working Landscapes Bee-Friendly Beef farms.* Bee-Friendly Beef Producer Workshop, UT, VT, and Smithsonian Conservation Biology Institute. July 25, 2023, Knoxville, TN. 60 present.

Stewart, H., Tracy, B. 2024 Incorporating Native Wildflowers into Pasturelands to Support Pollinators [Abstract]. ASA, CSSA, SSSA International Annual Meeting, San Antonio, TX. <https://scisoc.confex.com/scisoc/2024am/meetingapp.cgi/Paper/160532>

J. Kubesch, B. Tracy 2022. Biodiverse forage mixtures for bees and beef cattle. *Virginia Tech Shenandoah Valley Agricultural Research and Extension Center 2022 Field Day Proceedings. Aug 3rd 2022 p.19*

Kubesch, J., Tracy, B. 2022 Biodiverse Forage Mixtures for Bees and Beef Cattle [Abstract]. ASA, CSSA, SSSA International Annual Meeting, Baltimore, MD. <https://scisoc.confex.com/scisoc/2022am/meetingapp.cgi/Paper/144463>

Tracy, B. 2023. CIG Showcase at the 78th SWCS International Annual Conference August 6-9, 2023 Community Choice Credit Union Convention Center Des Moines, Iowa. Title: Bee-friendly beef: Integrating native wildflowers into Southeastern grazing systems.

Kubesch, J., S. Greiner, G. Pent, L. Reid, B. Tracy 2023. Biodiverse Forage Mixtures for Bees and Beef Cattle-- Proceedings XXV International Grassland Congress, May 14-19, 2023, Northern Kentucky Convention Center in Covington, Kentucky USA p. 1213-1218.

Tracy B. 2022. Bee-friendly Beef. NCCC31 Ecophysiological Aspects of Forage Management Annual Meeting June 15-17, University of Wyoming (UW), Laramie, WY

Poster Presentations:

Izlar, N. A.; E. T. Shibley; A. E. Johnson. May 2024. *Bee-Friendly Beef: Integrating Native Wildflowers into Traditional Grazing Systems.* Smithsonian Botanical Symposium, US Botanic Garden. 100 present.

Prigge, J.; P. D. Keyser; J. D. Richwine; E. Bisangwa; K. J. Swilling. 2023. Diverse Pasture Performance, Persistence, and Management. Bee-Friendly Beef Producer Workshop. Smithsonian Institute, Front Royal, VA.

Prigge, J., and P. Keyser. 2022. Animal performance and pasture productivity of weaned steers grazing native warm-season grass pastures with and without interseeded native forbs and legumes. 12th Eastern Native Grass Symposium. Louisville, KY, Oct 4-6, 2022. Poster

Prigge, J. L.; E. Bisangwa; P. D. Keyser. 2022. Animal Performance and Pasture Productivity of Weaned Steers Grazing Native Warm-Season Grass Pastures with and Without Interseeded Native Forbs and Legumes. American Forage & Grassland Council Annual Conference. Wichita, KS.

Training or Outreach Events:

Prigge, J. L.; P. D. Keyser. 25 July 2023. Beef and Bees: Grazing High-Diversity Native Pastures Workshop. University of Tennessee Institute of Agriculture and Center for Native Grasslands Management, Knoxville, TN. 60 present

Keyser, P., J. Prigge, J. Richwine, E. Bisangwa, and K. Swilling. 2023. *Creating Higher Diversity Native Grass Pastures*. Bee-Friendly Beef Producer Workshop, UT, VT, and Smithsonian Conservation Biology Institute. July 25, 2023, Knoxville, TN. 60 present

Six Bee-friendly Beef fact sheets covering the following topics [in prep]:

- Establishment of native wildflowers into fescue pastures
- Establishment of native wildflowers into native warm season grass pastures
- Use of herbicide in wildflower enhanced pastures/weed control
- Benefits of native wildflowers to pollinators
- Grazing wildflowers – timing
- Grazing wildflowers – weight gain

[2023 Producer Workshop Summary](#). Smithsonian's National Zoo and Conservation Biology Institute, Front Royal, VA.

Featured in [Smithsonian's IMPACT Magazine Fall 2022](#)

7. Project Impacts:

- Total number of acres impacted. *~25 acres*
- Current NRCS Conservation Practices used/implemented/investigated; *NRCS conservation practice standard for forage and biomass planting (code 512)*
- Total number of participating producers. *Seven*

Impacts:

- We identified a suite of native wildflower species that are relatively easy to establish, persistent, and bloom frequently for pollinators. These wildflower species and seeding rates could be used to formulate wildflower mixtures for conservation goals related to increasing the biodiversity of mid-Atlantic pasturelands while maintaining beef

production.

- Our work provides guidance on simple, cost-effective site preparation methods that can be used to successfully establish wildflowers into existing pasturelands. These guidelines could form the basis for broader recommendations used for conservation plantings in pasturelands.
- Integrating native wildflowers into tall fescue pastures can boost flower resources while diversifying forage for livestock thus benefiting both pollinator communities and livestock operations simultaneously. Nutritional baselines developed from this project for wildflowers can help address producers' concerns about how these species contribute to the nutritional value of wildflower-enhanced pastures.
- Results from this project showed that the addition of wildflowers to pastures has either neutral or positive effects on cattle production. To our knowledge, this study was the first to document this result on cattle in the southeast US. Our findings should foster increased adoption of higher diversity native grass pastures that can generate both conservation benefits and good beef cattle production.
- Our work showed that consumers of beef value production practices that are environmentally friendly, sustainable, or "bee-friendly". Such added value could benefit profit margins for beef producers adopting conservation practices such as the addition of wildflowers to pastures.
- We also had impact through hands-on producer workshops and outreach materials generated during this project. These activities helped leverage connections with a network of livestock producers and land managers to disseminate study findings and share knowledge across working farms in Virginia and Tennessee.

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