Technical Note: A method for establishing native wildflower strips for wild bee conservation and native seed production on farmlands.

Casey M. Delphia[1,2], Laura A. Burkle[1], and Kevin M. O'Neill[2]; [1]Departments of Ecology and [2]Land Resources and Environmental Sciences, Montana State University.

Why plant flower strips? Due to the value of pollination services and recent declines in honey bees, strategies are needed to promote wild bees in agroecosystems. Among the critical resources required by bees are pollen and nectar, which must be available throughout the growing season and within bees' foraging ranges. Therefore, we explored the use of native perennial wildflower strips for enhancing pollinator habitat on farmlands and providing food resources to bees beyond the blooming period of crops. We were also interested in determining whether wildflower strips could be economically advantageous to producers for native seed sales, providing an additional incentive to encourage producer adoption. Here, we outline our methods for establishing flower strips and discuss our findings regarding wild bee visitation to flower strips and seed production.

Planting flower strips. How did we do it? We selected nine native perennial wildflower species from different plant families with different flower colors, shapes, and bloom times, in order to provide floral resources for a diversity of bee species throughout the growing season (Table 1). We also chose plants that would grow well on farmlands in full sun and with potentially limited water. For more information on each of the plant species used in this project, see our Plant Fact Sheets. To initiate flower strips, we seeded plants in the greenhouse in conetainers (SC10U-98 cells per tray; Fig. 1a) in early spring and transplanted 153 wildflower plugs into flower strips (4ft x 108ft = 432ft^2) on four farms in early June. Flower strips were prepared in a manner consistent with each site's farming methods, including bare soil, InfraRed Transmitting (IRT) plastic mulch, or black landscape fabric, and were positioned at one edge of the farm, so as not to interfere with farming activities (Fig 1b, c). For research purposes, each strip was further broken up into 27 smaller plots (approx. 16ft^2) to accommodate three replicates of each of the nine plant species, though this would not be necessary otherwise. We planted each species at a different density per plot, either five, six, or nine plugs, based on its growth habit to maximize space (Table 1; Fig. 2a, b). We hand-watered the flower strips for the first two weeks, then each strip received water approximately weekly via overhead irrigation or drip tape depending on the site's farming methods. At larger spatial scales, seeding may be an easier approach to establish plantings, however it would likely take an additional year for plants to reach their maximum size.

Common name	Scientific name	Total plugs per strip
Harebell	*Campanula rotundifolia*	27 (3 groups of 9)
Showy fleabane	*Erigeron speciosus*	15 (3 groups of 5)
Blanket flower	*Gaillardia aristata*	15 (3 groups of 5)
Sticky geranium	*Geranium viscosissimum*	15 (3 groups of 5)
Maximilian sunflower	*Helianthus maximiliani*	15 (3 groups of 5)
Hairy false golden aster	*Heterotheca villosa*	18 (3 groups of 6)
Beebalm	*Monarda fistulosa*	15 (3 groups of 5)
Yellow penstemon	*Penstemon confertus*	18 (3 groups of 6)
Silverleaf phacelia	*Phacelia hastata*	15 (3 groups of 5)

Table 1. Native perennial wildflower species and density of plantings in flower strips at participating farms.

Figure 1. Planting a flower strip in IRT plastic mulch at a participating farm. A) wildflowers in conetainers in the greenhouse, B) plugs ready for transplanting, and C) watering newly transplanted flower strip.

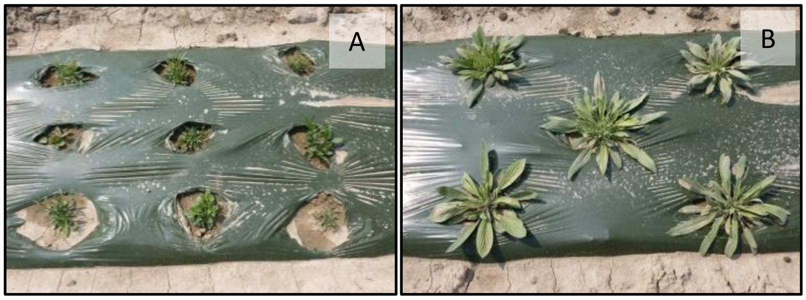

Figure 2. Examples of different planting densities. A) harebell and B) silverleaf phacelia.

Flower strip establishment. Seven of the nine species flowered some during the year they were planted. Overwintering success was high for the majority of species across all farms with the exception of *H. villosa* and *C. rotundifolia*, which were moderate to high, and *P. hastata*, which was low to high, depending on the farm. All plants that successfully overwintered bloomed abundantly in their second and third years (Fig. 3a-c).

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Wild bees. We sampled bees visiting the flower strips weekly throughout the summer over two years (Fig. 4) and documented over 130 species of wild bees visiting flower strips across farms, which is more than 50% of all bee species recorded on farms. Wild bee visitors included bumble bees, sweat bees, resin bees, leafcutting bees, masked bees, long-horned bees, and mining bees.

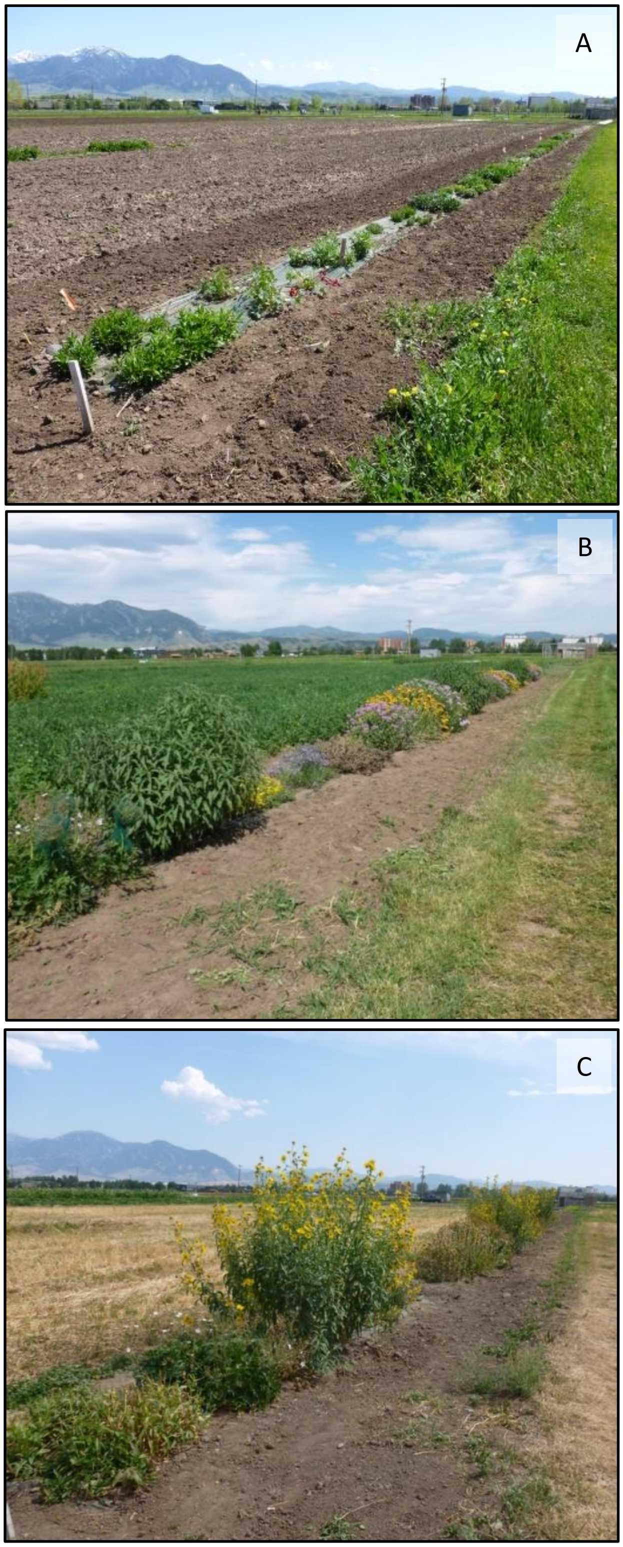

Figure 3. Flower strip development the year after planting: A) late-May, B) early-July, and C) mid-August.

Native wildflower seed. We harvested seed from all plant species as it matured in late summer through fall over two years (Fig. 5) to determine if the sale of seed could provide an additional economic incentive for adopting this habitat management strategy.

Economic analysis. We recorded all costs associated with harvesting and cleaning seeds, as well as those associated with establishing and maintaining flower strips over three years, and compared this to the potential revenue from seed sales based on current market values. The cost to establish a flower strip of the same size used in our research is between $200-$560 for plant materials, depending on whether plugs are purchased wholesale or retail, plus labor to plant and weed during the first growing season. The latter varied from $45-$130 per farm (calculated at minimum wage), depending on the use and type of weed barrier and weed pressure. Weeding costs in the second and third growing season ranged from $22-$165 per farm. Our analysis indicates that revenue from native wildflower seed sales could exceed the costs associated with establishing and maintaining flower strips by the start of the third growing season. Profits, however, varied greatly by plant species and farm, indicating that some species may be more profitable to grow for seed than others and that farms vary considerably in seed yields, likely due to factors including local climate and farm management methods.

Figure 4. Sampling wild bees from a flower strip in early July.

Figure 5. Tub filled with *P. confertus* stems and seed collected in September.

Benefits of flower strips. The suite of plant species in our flower strips provided food resources for a diverse and abundant community of wild bees present on and around farms, strengthening the value of these plantings for promoting pollinator conservation. In addition, harvesting seed from flower strips for sale has the potential to be profitable and pay for costs associated with its' establishment, adding an additional economic benefit. We hope these findings encourage greater adoption of this promising on-farm management strategy.

Financial assistance. The USDA Natural Resources Conservation Service (NRCS) offers cost-share programs to help producers establish pollinator plantings using native plants. For more information on current opportunities, check with your local NRCS office or visit www.nrcs.usda.gov.

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