Appendix S1. Methods and analysis of establishing and maintaining wildflower plantings

Field margins were prepared for the establishment of wildflower plantings with an application of 1% glyphosate herbicide at 200 L/ha (Roundup®, Monsanto, Creve Coeur, MO) in the fall of 2008 and again in early spring 2009 (Year 1). The sites were not tilled, to reduce the germination of dormant weed seeds. A perennial wildflower seed mix (Michigan Wildflower Farm, Portland, MI) was selected that consisted of 15 species of Michigan native wildflowers with bloom periods that together span May through October and have been shown to be attractive to bees (Tuell *et al.* 2008). To reduce competition with invasive plants, provide fuel for potential controlled burnings for future management, and provide nesting habitat for ground nesting bees (Goulson, Lye & Darvill 2008), three native grass species were also included in the seed mix (Table S1a). The seeds were combined with sawdust at 1:10 ratio, and hand-broadcasted into the prepared sites in early May of Year 1 at 2.25 kg/ha, and the sites were then lightly raked, rolled, or "cultipacked" in order to maximize soil-seed contact. Establishment rates in the first year were low with few wildflowers blooming per site, so in the spring of 2010, we used a hand-operated seed spreader (Earthway Products, Inc., Bristol, IN) to add another 2.25 kg of seed per hectare combined with vermiculite at 1:10 ratio at four of the five sites, for a total of 4.5 kg of native seed per hectare (Table S1a). The fifth field site was predominately covered with weeds with little germination of native wildflowers in Year 1, so this site was treated again with glyphosate in the fall of Year 1 and early spring of Year 2. This site was reseeded with a total of 4.5 kg/ha of native seed mix (Table S1a) using a hand-operated seed spreader.

According to standard prairie plant establishment procedures in Michigan, the plantings were mowed (8-12 cm height) two to three times during the first year of establishment to prevent seed set by annual weeds (Stewart 2009). During the second year, half of each planting was mowed two to three times while alternating which half was mowed to allow for weed control as well as for some of the native wildflowers to bloom and set seed. The plantings were not mowed in the third or fourth years.

Establishment of wildflowers within the plantings was assessed once each fall in Years 1-4 by randomly sampling the five wildflower plantings and their corresponding control perimeters using a 1 m^2 polyvinyl chloride (PVC) quadrat. The quadrat was randomly tossed within the plantings and control perimeters 20 times and all the grasses and forbs within the 1 m^2 area were counted, identified, and recorded. We determined the density of plant species seeded by us and those not seeded by us (volunteer) per square meter and visually estimated their relative coverage area within the quadrat. Seeded plant density was compared between the flower and control treatments for each individual year using a generalized linear mixed model (GLMM) with treatment (wildflowers or control) as the fixed coefficient, farm site as a random factor, Poisson distribution, and a log link function (Bolker *et al.* 2009) (SPSS, Version 20, IBM Corp., Armonk, NY). The percent coverage of seeded and volunteer plant species were transformed (ln +1) and compared separately for each treatment for each of the four years using a GLMM with treatment as the fixed coefficient, farm site as a random factor, normal distribution, and an identity link function.

The density of wildflower blooms within the plantings and control perimeters was also determined by sampling the wildflower plantings and their corresponding control perimeters using a 1 m^2 PVC quadrat. Similar to the previous methods, all the flowers that were in bloom within the 1 m^2 area were recorded as described above, and composites and umbels were considered individual flowers. This was done once every two weeks from May through September in 2010 and 2011 (Years 2 and 3, respectively). Bloom density per square meter was averaged for and compared between the flower and control treatments for each individual year using a GLMM with treatment as the fixed coefficient, farm site as a random factor, a Poisson distribution and a log link function.

In all four years of this study the density of seeded plants per square meter within the wildflower plantings was greater than the density of seeded plants in the control mown grass field margins (Table S1b). The percent coverage of the seeded plants was also significantly greater during each of the four years within the wildflower plantings (Table S1b). The density of the seeded plants was significantly greater in Year 4 than in Year 1 within the wildflower plantings (Flower: $F_{1,7} = 8.8$, $P = 0.021$), but did not significantly change across the years for the control field margins ($F_{1,7} = 14.9$, $P = 0.41$). Similarly, the percent coverage for seeded plants was significantly greater in Year 4 in the wildflower plantings compared to Year 1 ($F_{1,7} = 19.2$, $P = 0.003$). The percent coverage of seeded plants did not change significantly from Year 1 to Year 4 in the control treatments ($F_{1,7} = 0.78$, $P = 0.41$). Also, there was no difference in percent coverage of volunteer plants between the two treatments during 2010, whereas in 2011 the control field margins had significantly greater coverage of volunteer plants than the wildflower plantings (Table S1b). The percent coverage of volunteer plants did not change significantly from year to year for either treatment (Flower: $F_{1,7} = 0.54$, $P = 0.49$; Control: $F_{1,7} = 1.7$, $P = 0.23$).

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Table S1a. List of native Mid-Western perennial wildflowers, grasses, bloom periods, and respective seeding rates for seed mix sown in the wildflower plantings.

		Bloom Period						Seeding Rate	
Common Name	**Scientific Name**	M	J	J	A	S	O	**(kg/ha)**	**Seeds^{-1} m^{2}**
Flowers									
Golden Alexanders	*Zizia aurea*	X	X					0.07	10.88
Foxglove beard-tongue	*Penstemon digitalis*		X	X				0.14	64.24
Sand coreopsis	*Coreopsis lanceolata*		X	X				0.28	19.76
Black-eyed Susan	*Rudbeckia hirta*		X	X	X	X		0.14	90.94
Swamp milkweed	*Asclepias incarnata*			X	X			0.28	4.74
Butterfly milkweed	*Asclepias tuberosa*			X	X			0.14	3.78
Wild bergamot	*Monarda fistulosa*			X	X			0.07	69.18
Joe pye-Weed	*Eupatorium maculatum*			X	X	X		0.03	48.94
Boneset	*Eupatorium perfoliatum*			X	X	X		0.28	39.54
Blue lobelia	*Lobelia siphilitica*			X	X	X		0.14	61.78
Yellow coneflower	*Ratibida pinnata*			X	X	X		0.14	14.82
Cup plant	*Silphium perfoliatum*			X	X	X		0.28	1.38
Stiff goldenrod	*Solidago rigida*				X	X	X	0.28	20.26
New England aster	*Symphyotrichum novae-angliae*				X	X	X	0.14	32.62
Smooth aster	*Symphyotrichum laeve*					X	X	0.28	13.58
Grasses									
Canada wild-rye	*Elymus canadensis*		X	X	X			0.28	22.61
Indiangrass	*Sorghastrum nutans*			X	X	X		0.28	11.86
Big bluestem	*Andropogon gerardii*			X	X	X	X	1.23	9.88

Table S1b. Comparison of the average (± SE) number of seeded plants per m^2, a comparison of the average percent coverage (± SE) of seeded and volunteer plants, and the number of flower blooms per m^2 within the flower and control treatments over four years.

			Year			
	Plant type	**Treatment**	**1**	**2**	**3**	**4**
Plant density	Seeded	Flower	8.7 ± 1.7	10.1 ± 1.9	11.2 ± 1.8	10.2 ± 1.6
(per m^2)	Seeded	Control	0.01 ± 0.003	0	0.01 ± 0.003	0
		$F_{1,8}$	161.6	47.8	49.3	47.9
		P	0.0009	< 0.0001	< 0.0001	< 0.0001
% coverage	Seeded	Flower	5.1 ± 1.1	13.6 ± 3.5	24.6 ± 5.1	26.3 ± 5.3
		Control	0.3 ± 0.3	0	0.05 ± 0.05	0
		$F_{1,8}$	19.7	14.9	23.1	24.1
		P	0.002	0.005	0.001	0.003
	Volunteer	Flower	42.6 + 10.1	60.6 ± 6.4	49.7 ± 4.2	42.3 ± 5.8
		Control	86.1 ± 2.0	87.8 ± 2.9	89.3 ± 3.6	88.8 ± 1.2
		$F_{1,8}$	27.3	14.9	57.4	91.1
		P	0.001	0.005	0.0009	0.0007
Bloom density	Seeded	Flower	-	4.7 ± 0.9	11.5 ± 2.3	-
(per m^2)		Control	-	0.1 ± 0.08	0.03 ± 0.03	-
		$F_{1,8}$	-	62.7	76.7	-
		P	-	< 0.0001	< 0.0001	-
	Volunteer	Flower	-	43.8 ± 10.9	90.7 ± 27.9	-
		Control	-	12.9 ± 3.5	22.9 ± 9.9	-
		$F_{1,8}$	-	2.9	11.1	-
		P	-	0.09	0.001	-

Appendix S2. Wildflower planting establishment costs and the estimated profits from these plantings

The expenses that growers face when preparing, establishing, and maintaining wildflower plantings to support pollinators are extensive and may impede widespread adoption of this approach. To better understand the costs and benefits of adding these resources to farms, our grower cooperators recorded all the expenses involved in establishment, including site preparation, wildflower seeds, site maintenance, and labor during the four-year period of this study. We were then able to use the estimated yield calculations to determine the increase in profit from the establishment of wildflowers over time.

In Michigan, USA, the Conservation Reserve Program (CRP) supported through the Natural Resources and Conservation Service and administered by the Farm Services Agency provides subsidies to establish pollinator habitat within farm landscapes. The State Acres for Wildlife Enhancement (SAFE) provides an incentive payment up to $124 per 0.4 ha of land planted and an initial 90% cost-share (up to $600) for the costs of establishing the wildflowers. Additionally, the program requires growers to dedicate at least 0.8 ha of their farmland to wildflower plantings and growers receive $62 annually in land rental payment per 0.4 ha of wildflower habitat (NRCS 2010).

From grower questionnaires we learned that each hectare of wildflower planting requires on average $222 to prepare it for wildflower establishment and the seed mix cost $2,224. At the labor rate of $10 h^{-1} site preparation cost $49 in labor, and on average $198, $148, $99, and $49 were spent on maintenance in Years 1 through 4, respectively. It is expected that the maintenance costs will be $49 for the subsequent years with an added $247 to conduct mid-contract maintenance for each hectare in Year 5. Using these data, we calculated the relative cost of wildflower planting establishment with and without the subsidy (Cost = (size of planting x site preparation cost ha^{-1}) + (size of planting x seed cost ha^{-1}) + (size of planting x salary x establishment costs for that year)).

Fruit yield (kg ha^{-1}) for field sites was estimated by multiplying percent fruit set, berry weight, bushes ha^{-1}, and average number of flowers $bush^{-1}$. Comparing fruit yield from crop fields adjacent to wildflower plantings to those adjacent to control field perimeters we were able to determine the percent yield change each year due to the addition of wildflower habitat (Percent yield change = (avg. yield flower treatment – avg. yield control treatment) / avg. yield flower treatment). We used the average, maximum, and minimum price of US blueberries, \$4.72 kg^{-1} (Joshua 2011), along with the estimated yield to calculate the expected profit increase due to the wildflower plantings for each of our farm sites (profit = [(yield x price kg^{-1}) x (size of crop field x proportion of crop field enhanced) x (1 + percent yield increase)] – [(yield x price kg^{-1}) x (size of crop field x proportion of crop field enhanced)] – [costs of establishment and maintenance]).

To determine the general effect of wildflower plantings on profit from blueberry fields, we assumed a single standard 0.8 ha wildflower planting (80 x 100 m), a minimum for the CRP-SAFE program (NRCS 2010), established on marginal land adjacent to the shorter edge of a typically-sized 4 ha highbush blueberry field (100 x 400 m). In this study we measured pollination in roughly 4.5% of the 4 ha blueberry field area, so we used this value as a very conservative estimate of the area of crop field enhanced by the adjacent planting. Using these values, along with the US average blueberry price of \$4.72 kg^{-1} (Joshua 2011), average yield of 6,657 kg ha^{-1} (Joshua 2011), our measured changes in yield in response to the planting, and the costs associated with establishment (with and without subsidy), we calculated the cumulative profit for a 4 ha blueberry field in response to establishing a 0.8 ha wildflower planting based on our data. We then assumed that by Year 10 the expected yield would increase to 8,597 kg ha^{-1}, or roughly 30% higher than the average, which is on the upper scale of US blueberry production (Joshua 2011). In order to extrapolate a 30% increase in yield by Year 10, we assumed that the change in percent yield between the wildflower and control treatments would increase by 4% from Year 4 to Year 5 and then decrease by half sequentially each year thereafter (Table S2). These calculations were then repeated using the national US minimum blueberry price of \$3.75 kg^{-1} (Joshua 2011) without subsidy and the maximum price of \$7.12 kg^{-1} (Joshua 2011) with subsidy to highlight the range of possible profits.

We found that after Year 1 there was a 1% decrease in blueberry yield within the area of the crop fields sampled adjacent to the wildflower plantings when compared to the samples taken from the control sites (Table S2). The small decrease in yield along with the initial expenses of the wildflower planting establishment resulted in negative profit for both unsubsidized and subsidized plantings. The small decrease in yield during the first year may be due to the disturbance of former populations of pollinators and the removal of potential resources during preparation of the sites for wildflower establishment. After Year 2, when vegetative and floral resources began to grow back, we found that the percent yield change between flower and control treatments positively favored the enhanced sites, with greater yields being measured for the following two years and extrapolated out to Year 10 for our theoretical 4 ha farm (Table S2). The positive changes in yield in response to wildflower plantings result in an overall increase in yield and therefore positive additional profit for the grower (Fig. 4).

The calculated expenses associated with the establishment of a 0.8 ha wildflower planting at a 4 ha highbush blueberry farm is substantially higher at the unsubsidized farm than for the farm receiving assistance. Therefore, while the cumulative profits based on US average price for highbush blueberries for the unsubsidized and subsidized farms are both expected to make a positive profit during the fourth year, the subsidized farm is expected to have considerably higher profit (Table S2). Either way, within the first four to five years the increase in profit due to the benefits of wildflower plantings on adjacent crop yield offsets the growers' costs associated with preparation, establishment, and maintenance of wildflower plantings.

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Table S2. Estimated costs and profits from the establishment of wildflower plantings to support pollination in adjacent highbush blueberry fields, over a 10 year period. Costs and profits were based on grower expenses and US average price ($4.72 kg^{-1}) and yield (6,657 kg ha^{-1}) for highbush blueberry (Joshua 2011). Change in percent yield between the wildflower and control treatments for the first four years was calculated from our data, thereafter assuming that the change in percent yield decreased by half each year. Calculations are made for a 4 ha highbush blueberry field with a 0.8 ha wildflower planting under unsubsidized and unsubsidized scenarios.

			Unsubsidized				Subsidized			
	Year	% yield change	Annual cost (USD)	Cumulative cost (USD)	Annual profit (USD)	Cumulative profit (USD)	Annual cost (USD)	Cumulative cost (USD)	Annual profit (USD)	Cumulative Profit (USD)
From data	0	-	2020	2020	-2020	-2020	1270	1270	-1270	-1270
	1	-0.6	160	2180	-195	-2215	110	1380	-145	-1415
	2	3.1	120	2300	56	-2159	70	1450	106	-1309
	3	18.2	80	2380	960	-1200	30	1480	1010	-299
	4	22.2	40	2419	1230	31	-10	1469	1280	981
Extrapolated	5	26.2	240	2659	1260	1291	190	1659	1310	2291
	6	28.2	40	2699	1575	2866	-10	1649	1625	3916
	7	29.2	40	2738	1633	4498	-10	1638	1683	5598
	8	29.7	40	2778	1661	6160	-10	1628	1711	7310
	9	29.9	40	2818	1676	7835	-10	1618	1726	9036
	10	30.1	40	2857	1683	9518	-10	1607	1733	10769