Contract No. 008-098
“The Bee Integrated Demonstration Project”
Submitted by Keystone Policy Center
Primary Contact: Julie Shapiro
Directives B & C

PARTICIPANTS

<table>
<thead>
<tr>
<th>Sponsor</th>
<th>Cost Share</th>
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<tr>
<td>Keystone Policy Center/Members of the Honey Bee Health Coalition</td>
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<td>Other project sponsor match</td>
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<tr>
<td>Other project sponsor match (in-kind)</td>
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<td>Subtotal In-kind Cost Share</td>
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<td>North Dakota Industrial Commission</td>
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<td>Subtotal OHF funding</td>
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<td>Total Project Cost</td>
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Project Schedule – 3 years
Contract Date – 4/1/2017
Start Date – 4/1/2017
Completion Date – June 30, 2020

OPTICINE/STATEMENT OF WORK:
Demonstrate how effective best practices for bee forage and nutrition, crop pest control, varroa mite management, and farmer/beekeeper cooperation can be effectively combined and implemented into an integrated program.

STATUS:
A contract has been partially executed and forwarded to the Keystone Policy Center for their consideration.

The contract has been full executed.

1/29/2018 - A status report was received. It states in part:

Note: This is an interim report and funding reimbursement request for the first calendar year (2017). Our first annual report will be provided by the contract due date of June 30, 2018.

The overarching goal of the Bee Integrated Demonstration Project is to demonstrate how honey bee health can be improved by using a portfolio of tools together in the same agricultural landscape to address the primary risk factors affecting bee health. Specifically, this project will demonstrate how effective best practices for bee forage and nutrition, crop pest control, varroa mite management, and farmer/beekeeper cooperation can be effectively combined and implemented into an integrated program.

Progress toward objectives
Bee Integrated launched in April 2017, with three farmer/beekeeper pairs that will participate for 3 years. The following activities have occurred and/or are upcoming per the project work plan:
<table>
<thead>
<tr>
<th>Major Initiatives</th>
<th>Achievements in this Reporting Period</th>
<th>Associated Metrics</th>
</tr>
</thead>
</table>
| Pollinator bee forage improvement     | • Habitat planted on three sites in ND  
• USGS site visits for habitat transects and pollen collection are complete for 2017. All observations were completed as planned  
• Pollen sample processing is underway                                                           | • Forage density to determine success of plantings and bees’ utilization of pollen to determine the success of the plantings in providing forage desirable to bees - pollen collected and forage density assessed for 2017; pollen processing underway and to be reported in upcoming annual report. |
| Varroa mite control                   | Each beekeeper has met three times with Bee Informed Partnership’s Tech Transfer teams for varroa mite monitoring and treatment. | Varroa mite loads - data collected for 2017 and to be summarized in upcoming annual report                                                                 |
| Crop pest control                     | • Orientation and crop pest management training completed in April 2017, led by CTIC, Syngenta, DuPont and ND Dept of Ag | Number of confirmed hive mortality incidents associated with crop pest control (the goal is zero) - no incidents in 2017                                                                                    |
| Overall project measures              | • Participant survey drafted and distributed  
• BIP worked with beekeepers to prepare for following hives to CA to conduct mortality counts in Jan-early Feb 2018 in California  
• Bee Integrated will produce a summary data report for its first year in Q2 of 2018 | • Report on colony loss rate for the participating colonies and mortality information - data will be collected in Jan-early Feb 2018 in California and reported in upcoming annual report  
• Report on the evaluation of the changes of attitudes, knowledge and behavior of participating beekeepers and growers - first annual survey currently being administered and will be summarized in upcoming annual report  
• Comparison against control/‘business as usual’ sites - to occur with upcoming annual reporting  
• Report on honey production - estimated pounds of honey per hive for the participating yard - to occur with upcoming annual reporting |
| Outreach and communications            | • Two farmers have completed job swamps, joining their partnering beekeepers and USGS to install pollen traps and hive scales  
• Project communications plan was launched in August 2017 with a webpage, interactive online presentation, factsheet, press release, newsletter. Visit: |                                                                                                                                                        |
A status report was received. It states in part:

**Note:** We are submitting this as our ‘Annual Report’- however we submitted, earlier this year, an interim report for activities through 12/31/2017. Thus we are highlighting the more recent activities while still summarizing all activities covered by this first annual report.

### Pollinator Bee Forage Improvement

**Achievements Since 1/2018 Interim Report:**
- Habitat planted on three additional sites in ND in 2018 Site management and maintenance (as needed) for sites established in 2017 Pollen sample proceeding for 2017 collection, nearing completion.

**Achievements in First Year:**
- Habitat planted on six sites in ND USGS site visits for habitat transects and pollen collection are complete for 2017. All observations were completed as planned. Pollen analysis underway. Pollen sample processing is underway – pollen DNA extraction completed; DNA amplification and barcode reading ongoing. Protein analysis underway. All sampling approaching completion.

**Associated Metrics:**
- In 2017, the USGS Northern Prairie Wildlife Research Center (NPWRC) detected 31 unique species of flowering forbs in the habitat farmers established on BMP sites. The most commonly detected species were alfalfa, sweet clover, lacy phacelia, crimson clover, and bird’s-foot trefoil, representing 88% of all flowers detected in 2017 in both mixes.
- In addition to quantifying flowers on Bee and Butterfly Habitat Fund sites, NPWRC also quantified flower visitations made by honey bees and native bees. The three most visited plants were also the three most abundant species at the three sites: Phacelia, yellow sweet clover, and alfalfa.
- Pollen processing underway and to be reported when available.

### Varroa Mite Control

**Achievements Since 1/2018 Interim Report:**
- First varroa mite monitoring and treatment for six sites in 2018.

**Achievements in First Year:**
- Each beekeeper met 4 times with Bee Informed Partnership’s Tech Transfer teams for varroa mite monitoring and treatment in 2017.
- First varroa mite monitoring and treatment for all 6 sites in spring 2018.

**Associated Metrics:**
BMP yard mite loads were below thresholds at 3 of 4 monitoring periods. Lower mite populations were found in all three BMP yards (as compared to beekeeper average yards) during the August (post super) sampling period.

Crop Pest Control
Achievements Since 1/2018 Interim Report:
- Orientation and crop pest management training for new participants completed in April 2018, led by CTIC, USGS, ND Dept of Ag, and DuPont

Achievements in First Year:
- Orientation and crop pest management training completed in April 2017, led by CTIC, Syngenta, DuPont and ND Dept of Ag
- Orientation and crop pest management training for new participants completed in April 2018, led by CTIC, USGS, ND Dept of Ag, and DuPont.

Associated Metrics:
- No suspected pesticide incidents were reported for the Bee Integrated sites.

Overall Project Measures
Achievements Since 1/2018 Interim Report:
- Bee Integrated drafted a summary data report for its first year in Q2 of 2018; working on revising and including pollen data prior to year 1 report finalization.

Achievements in First Year:
- Bee Integrated drafted a summary data report for its first year in Q2 of 2018; working on revising and including pollen data prior to year 1 report finalization.
- Participant survey drafted and distributed BIP worked with beekeepers to prepare for following hives to CA to conduct mortality counts in Jan-early Feb 2018 in California.

Associated Metrics:
- Report on the evaluation of the changes of attitudes, knowledge and behavior of participating beekeepers and growers – first annual survey still being collected/analyzed.
- As estimated by number of frames of bees, colonies were consistently slightly larger in BMP yards in all three operations during all four observations throughout the year as compared to the beekeeper average yards.
- Colony loss data was inconclusive for 2017 and the project gained important learnings regarding tracking and assessing colony loss in the context of this project. Based on the methods used in 2017, the beekeepers’ average yards experienced higher mortality, than BMP sites in September and January monitoring; average and BMP yards experienced similar mortality in August.
- There were lessons learned this year regarding tracking hives for honey estimates that will be applied next year to get more accurate estimates of pounds of honey.

December 2018
Interim Report Received. The report states:

The project is one year into a three-year project, and for this reason, in general, year 1 results should be understood qualitatively, in aggregate, and as preliminary, as it is too early to meaningfully report data and trends in detail at this time. Some analyses for the second year are still underway (specifically, pollen analysis).

Pollinator Bee Forage Improvement
- Achievements since June 2018 Annual Report
  - Pollen ID complete for 2017 and underway for 2018.
USGS site visits for habitat transects and pollen collection are complete for 2017 and 2018. All observations were completed as planned.

Habitat site management and consultation for 2018 field season.

Achievements in since project start

Habitat planted on 6 sites in ND totaling 110 acres:
- Site 1, LaMoure, ND: 18 Acres
- Site 2, Streeter, ND: 40 Acres
- Site 3, Baldwin, ND: 15 acres
- Site 4, Hatton ND: 13 acres
- Site 5, Sheyenne, ND: 19 acres
- Site 6, Willow City, ND: 5 acres

USGS site visits for habitat transects and pollen collection are complete for 2017 and 2018. All observations were completed as planned.

Pollen ID complete for 2017 and underway for 2018.

Associated Metrics

- In 2017, the USGS Northern Prairie Wildlife Research Center (NPWRC) detected 31 unique species of flowering forbs in the habitat farmers established on BMP sites. The most commonly detected species were alfalfa, sweet clover, lacy phacelia, crimson clover, and bird’s-foot trefoil, representing 88% of all flowers detected in 2017 in both mixes
- In addition to quantifying flowers on Bee and Butterfly Habitat Fund sites, NPWRC also quantified flower visitations made by honey bees and native bees. In 2017, the three most visited plants were also the three most abundant species at the three sites: Phacelia, yellow sweet clover, and alfalfa.

**Varroa Mite Control**

Achievements since June 2018 Annual Report

- Two additional monitoring and treatment visits complete for second year (final visit is in CA almonds in Jan/Feb 2019)

Achievements in since project start

- Each beekeeper met four times in first year with Bee Informed Partnership’s Tech Transfer teams for varroa mite monitoring and treatment.
- Three visits complete for second year (final visit is in CA almonds in Jan/Feb 2019)

Associated Metrics

- In 2017, BMP yard mite loads were below thresholds at 3 of 4 monitoring periods. Lower mite populations were found in all three BMP yards (as compared to beekeeper average yards) during the August (post super) sampling period.

**Crop Pest Control**

Achievements since June 2018 Annual Report

- Annual survey for 2017 captured how practices were implemented and identified improvements for training for 2019.

Achievements in since project start

- Orientation and crop pest management training completed in April 2017, led by CTIC, Syngenta, DuPont and ND Dept of Ag.
- Second training in spring 2018 led by ND Dept of Ag and Corteva.
- Annual survey for 2017 captured how practices were implemented and identified improvements for training for 2019.

Associated Metrics
o No suspected pesticide incidents were reported for the Bee Integrated sites in 2017 or 2018 field seasons.
o Evaluations collected at the end of the trainings show that those who attended believed they would be able to follow these guides.
o Farmers did not generally use foliar pesticides, thus did not implement BMPs for these applications. In general, survey results indicate that additional training on the ASTA seed treatment guide will be helpful for the 2019 season to help remind farmers of best practices and available resources.

Overall project measures
- Achievements since June 2018 Annual Report
  o Participant survey administered and summarized for 2017.
  o BIP working with beekeepers to prepare for following hives to CA for 2019.
  o Drafted 2017 annual report –finalizing with remaining data.
- Achievements in since project start
  o Participant survey administered and summarized for 2017.
  o BIP working with beekeepers to prepare for following hives to CA for 2019.
  o Drafted 2017 annual report –finalizing with remaining data.
- Associated Metrics
  o In 2017, As estimated by number of frames of bees, colonies were consistently slightly larger in BMP yards in all three operations during all four observations throughout the year as compared to the beekeeper average yards.
  o Colony loss data was inconclusive for 2017 and the project gained important learnings regarding tracking and assessing colony loss in the context of this project. Based on the methods used in 2017, the beekeepers’ average yards experienced higher mortality, than BMP sites in September and January monitoring; average and BMP yards experienced similar mortality in August.
  o Results re: knowledge and attitudes as assessed by survey:
    ▪ Confirmation that best practices were most often implemented as planned, and insight into where adjustments or additional support could increase consistency.
    ▪ Broad agreement among participants that declines in bee health are the result of multiple interconnected causes.
    ▪ Consistent reports from both farmers and beekeepers of their belief that the land enrolled through BBHF benefited nearby bees.
    ▪ Consistent responses that participating in Bee Integrated has improved relationships of paired farmers and beekeepers.

Outreach and Communications
- Achievements since June 2018 Annual Report
  o August 2018 field tour with ESA with 50 participants; event highlights and Bee Integrated featured through newsletters and Entomology Today.
  o Bee Integrated video produced and shared through newsletters and at Entomological Society of America event; to be showcased at additional winter events.
  o Presentations at winter national beekeeping and crop production meetings in 2018; to occur again in 2019
  o Presentations at 2018 North Dakota Beekeepers annual meeting
  o Five of six job swaps complete
- Achievements in since project start
  o August 2018 field tour with ESA with 50 participants; event highlights and Bee Integrated featured through newsletters and Entomology Today.
Bee Integrated video produced and shared through newsletters and at Entomological Society of America event; to be showcased at additional winter events.

Project communications plan was launched in August 2017 with a webpage, interactive online presentation, factsheet, press release, newsletter. Visit the following site for these and the video: http://honeybeehealthcoalition.org/beeintegrated

Public acknowledgment of ND OHF funding – in presentations, factsheets, and web information

Presentations at winter national beekeeping and crop production meetings in 2018; to occur again in 2019

Presentations at 2018 North Dakota Beekeepers annual meeting

Pictures are available in the full report.

July 2019
Status report received. Achievements since the December 2018 Report include the following:

Pollinator Bee Forage Improvement
- Bee yards established on all six sites; hive scales and pollen traps installed
- First set of pollen samples of 2019 season collected

Varroa Mite Control
- Bee Informed Partnership’s Tech Transfer team consulted beekeepers individually on varroa control plans for the 2019 season
- Final round of colony observations completed for 2018 season.
- First round of colony observations of 2019 season completed.

Crop Pest Control
- Annual survey for 2018 captured how practices were implemented and identified improvements for training for 2019.
- Second orientation and crop pest management training for project farmers in March 2019 included specific guidance on seed treatment stewardship and IPM.

Overall Project Measures
- Farmer survey administered and summarized for 2018. Three beekeeper interviews outstanding.
- All but one beekeeper’s colonies successfully tracked through full rotation in 2018.
- 2018 annual report complete.

Outreach and Communications
- Bee Integrated video shared at American Beekeeping Federation and additional winter events.
- Presentations at winter national beekeeping and crop production meetings in 2019; forage component updates at North Dakota Beekeepers meeting in July 2019.
- All participant job swaps completed

Additional details, including pictures and graph, available in the full report.

January 2020
Status report received. Achievements since the July 2019 Report include the following:

Pollinator Bee Forage Improvement
Pollen samples and hive scale data of 2019 season collected and under review.
Varroa Mite Control

Second and third round of colony observations of 2019 season completed (final round to be completed early winter 2020). One beekeeper opted out of the varroa control component but agreed to continue with all other project activities.

Outreach & Communication
- Interviews conducted to create case studies and help promote broader adoption of the model; additional information to be rolled out in 2020.
- Creation of What We’re Learning Fact Sheet and updated website at www.honeybeehealthcoalition.org/bee-integrated
- Experience reported by participating farmers and beekeepers informing practice recommendations and plans for project scaling.

Additional details, including pictures, available in the full report.

June 2020

Status report received. Achievements since the January 2020 Report include the following:

Varroa Mite Control
- All four rounds of colony observations and Bee Informed Partnership consultations (monitoring/treatment) for the 2019 season completed
- 2020 spring BIP beekeeper consultation

Crop Pest Control
- Achievements since last report
- 2020 spring outreach/coordination with farmers

Overall Project Measures
- Hives tracked to California for winter 2020 sampling period/colony health assessment

Outreach and Communications
- Lessons learned shared at national beekeeping and farming conferences in winter 2020, highlighting farmer and beekeeper perspectives on the value of collaboration and of planting habitat
- Outreach to potential future partners to share the model and lessons learned.

A one page final summary of project is available. The report notes the following significant results:
- Bees at best practice sites are collecting a more diverse diet of pollen from various flowering pollinator forage species.
- Bee and Butterfly Habitat Fund sites have higher flower abundance and higher visits by native and managed bees as compared to other land use types
- Farmers report that the project has been well worth their time and effort; identifying a partnering beekeeper as a potential beneficiary was a critical motivator for BMP adoption.

Additional details, including pictures, are available in the full report. This contract is now closed. The full award amount was expended.

Dated: 6/23/2020