SCBGP PROJECT PROFILE TEMPLATE

AWARD YEARS 2022 FORWARD

The State Plan should include a series of project profiles that detail the necessary information to fulfill the goals and objectives of each project. The acceptable font size for the narrative is 11 or 12 pitch with all margins at 1 inch. The following information must be included in each project profile.

PROJECT TITLE

Provide a descriptive project title in 15 words or less in the space below.

Enhancing the Indiana Honey Market: NMR as a Tool for Honey Characterization and Authentication

DURATION OF PROJECT

Start Date: October 1, 2023 **End Date**: September 30, 2025

PROJECT PARTNER AND SUMMARY

Include a project summary of 250 words or less suitable for dissemination to the public. A Project Summary provides a very brief (one sentence, if possible) description of your project. A Project Summary includes:

1. *The name of the applicant organization that if awarded a grant will establish an agreement or contractual relationship with the State Department of Agriculture to lead and execute the project,*
2. *The project's purpose, deliverables, and expected outcomes and*
3. *A description of the general tasks/activities to be completed during the project period to fulfill this goal.*

FOR EXAMPLE:
The ABC University will mitigate the spread of citrus greening (Huanglongbing) by developing scientifically-based practical measures to implement in a quarantine area and disseminating results to stakeholders through grower meetings and field days.

Purdue University Food Science and Entomology Departments will collect honey samples from beekeepers around Indiana to develop a fingerprinting methodology utilizing nuclear magnetic resonance to assess quality and authenticate the origins and purity of honey produced in Indiana. The information generated through the honey testing will allow us to A database for adulteration and origin testing through NMR fingerprinting will be established to allow honey producers to ensure the quality of their honey and increase the marketability of Indiana honey. After the methodology and database has been created, the testing can be offered as a service to apiary stakeholders in Indiana. This service will build a resource to promote the Indiana honey crop while assisting producers with research and development relative to honey quality and marketing. Additionally, this project will provide honey producers with a solution to challenges faced regarding authentication and quality certification of honey produced in Indiana.

PROVIDE A PROJECT TIMELINE BY QUARTER AND YEAR BELOW.

Year 1, Q1: Collect honey samples from Indiana beekeepers

Year 1, Q1-3: Develop NMR method for honey quality/authentication

Year 1, Q3-4: Compositional analysis of honey samples

Year 1, Q3-4: NMR profiling of honey samples

Year 1, Q4 & Year 2, Q1-2: Develop NMR database for honey fingerprinting

Year 2, Q3, Create honey testing service for Indiana beekeepers

Year 1, Q4 & Year 2, Q4: Present results and offer services to beekeepers in Indiana

Year 1, Q4 & Year 2, Q4: Publish results of project

DESCRIBE HOW YOUR ORGANIZATION WILL INTERACT WITH ANY PARTNERS ON YOUR PROJECT.

Our organization will interact with any partners through beekeeping industry meetings in Indiana, such as Indiana Bee School. Additionally, we will meet individually with beekeepers and other stakeholders to gain valuable insights and information about how this project can be most beneficial to honey producers in Indiana. We will be able to have in person and online meetings to expand our interactions with our partners. Our results and the product (a testing facility) are to be shared with beekeepers in Indiana at Purdue Field Day. This annual event is planned by the Purdue Bee Lab in Partnership with The Beekeepers of Indiana. It trains beekeepers in the latest skills and techniques. Beginning in 2023 and onwards, we have paired with Hives to Heroes and At Ease Orchards, two organizations that work with Veterans, first responders, and their families to help train them in new skills. Field day is free to veterans, first responders, and family members of, or persons with a disability thanks to this partnership. Our annual attendance is 200 people.

PROJECT PURPOSE

PROVIDE THE SPECIFIC ISSUE, PROBLEM OR NEED THAT THE PROJECT WILL ADDRESS

Authentication of honey has become increasingly important. Honey is a high-value sweetener with unique organoleptic and nutritional properties, and as such, is a target for adulteration. Additionally, honeys from specific geographical or botanical origins may feature higher market prices (Tsagkaris et al., 2021). Information from this work can be utilized to market Indiana honey and set it apart from other generic Honey products on the market. Honey production in the United States was 148 million pounds in 2020, with a total value of nearly $300 million. In 2020, U.S. honey prices increased 2% from $1.99 in 2019 to $2.03 per pound. However, honey production decreased in 2021. The number of honey producing colonies was down four percent, and the yield per colony was down two percent (USDA-NASS, 2021). Due to perceived benefits or differences in flavor, consumers are often willing to pay more for monofloral honey or honey from certain geographical origins (Schievano et al., 2016). Along with fiscal impacts on the beekeeping industry, honey adulteration could ultimately impact entire ecosystems. As the main pollinators of the majority of plants, bees contribute to the upkeep of biodiversity; and their loss would create a biological, environmental, agricultural, and economic catastrophe (Wu et al., 2017). One of the challenges facing beekeepers, especially female bee keepers, is the lack of knowledge on how to brand and sell their honey domestically and for export (FAO, 2021). Support and testing services for U.S. honey producers are important to ensure a quality honey supply.

1. LEVERAGING EFFORTS TO MARKET AND PROMOTE HONEY AS A SPECIALTY CROP

According to The Beekeepers of Indiana there are more than 30 regional beekeeping clubs or organizations across the state. As of 2019 there were more than 5,000 beekeepers in Indiana of which 2,000 or more are members of these clubs (Alvarado, 2019). Through this project we will reach active members of beekeeping clubs to improve the marketing and promotion of honey as a specialty crop in Indiana. Honey is a sweetener that is associated with health benefits and a nutritious diet. The levels of sugars and water in honey vary, but on average honey contains fructose

(38.19 g/100 g honey), glucose (31.28 g/100 g honey), maltose (7.97 g/100 g honey), sucrose (4.5 g/100 g honey), other sugars (0.86 g/100 g honey), and water (17.2 g/100 g honey). Honey also contains minor components such as phenolic compounds, proteins, free amino acids, enzymes, minerals, vitamins, organic acids, essential oils, pigments, and phospholipids. Acetylcholine and the precursor choline are also present in honey and are of bee origin (Wu et al., 2017). The composition of honey is impacted by botanical and geographical origin, soil, climate, harvest season, degree of maturation, along with harvest and processing conditions. A majority of the health benefits associated with honey are related to its antimicrobial and antioxidant capacities. Honey has also shown anti-inflammatory activity and prebiotic and probiotic effects (Machado De-Melo et al., 2018).

Adulteration occurs by the addition of sucrose syrups, industrial sugars, lower cost honeys, or by excessive feeding of bee colonies with these syrups during the main nectar period (Wu et al., 2017). After milk and olive oil, honey is the third most falsified food globally. Testing has improved since the 2013 "Honeygate," but the industry doesn't take advantage of sophisticated tests to detect chemical alterations or authenticity (Boffo et al., 2012; Cagliani et al., 2022; Spiteri et al., 2015). The amount of fake honey in the U.S. may be as high as 70%. The lack of advanced testing leaves consumers to rely on government regulators. Honey laundering undercuts the value of honey and decreases profits for U.S. beekeepers. This likely leads some producers to put a focus on pollination rather than honey production, propagating a vicious cycle leading to less authentic honey in the market. With high production costs, legitimate honey producers find it challenging to compete against prices or laundered honey that may be under $1. These conditions have led beekeepers to leave the industry (Copeland, 2020). The decrease in apiary workers from 2019 (25,000) to 2020 (24,000) has also been reported by the USDA (USDA-NASS, 2021). Ensuring honey is free of adulterants and that any botanical or geographical origin is accurate is important for consumers. Consumers have valid concerns regarding the quality of honey or the possibility of adverse health effects due to adulterants. However, individual consumers do not have any resources to ensure honey authenticity (Fakhlaei et al., 2020). Further, there are few options available for beekeepers to test their honey for contaminants. Thus, it is important for honey producers to work to find a solution to ensure the integrity of the U.S. honey supply.

2. ASSISTING PRODUCERS WITH RESEARCH AND DEVELOPMENT RELAVANT TO HONEY AS A SPECIALTY CROP

There have been many methods proposed for the characterization of honey and the detection of adulterants. It is important to understand these different methods and their limitations. Two of the key sugar components for honey adulteration are fructose and glucose. However, certain invert syrups may be designed to mimic the natural sucrose, glucose, fructose ratio of honey. These types of syrups may be difficult to detect, and other advanced methods may be needed to determine honey authenticity (Wu et al., 2017). There have been several methods developed in an attempt to authenticate honey. These include the use of gas chromatography, high-performance liquid chromatography, mass spectrometry (M.S.), anion exchange chromatography, polymerase chain reaction (PCR), and nuclear magnetic resonance (NMR). Many of these methods are able to detect some aspects of honey adulteration, but not all. (Fakhlaei et al., 2020). NMR methodology has been successfully used for assessment of European acacia honey origin and composition (Schievano et al., 2019), discrimination of monofloral and polyfloral honeys (Schievano et al., 2016), to ensure purity and authenticity of manuka honey (Spiteri et al., 2017), as well as for detection of adulteration in honey (Cagliani et al., 2022; Gallo et al., 2020; Musharraf et al., 2016) Fingerprinting methods using NMR or M.S. may be viable methods for developing a more comprehensive analysis of honey, allowing for the determination of adulteration and authentication of botanical and geographical origins.

3. ADDRESSING CHALLENGES CONFRONTING INDIANA HONEY PRODUCERS

For thousands of years, honey has been a primary source of sweetness, and it still is the prototype of an all-natural, healthy food. In particular, with the growing trends for organic food and a healthy lifestyle, honey has enjoyed steadily increasing popularity. Unfortunately, while demand is on the rise, supply is short, and we need to utilize testing methods for improving the quality and market of Indiana honey. The reasons for this are complex and interwoven and have their origin in bee diseases, climate change, and agro-industrial production methods. Consequently, an increasing number of honeys mixed with sweet syrups has been detected in international trade. Economically motivated adulteration includes mixing honey with cheap syrups but extends to disguising the geographic origin of a particular honey, a type of fraud known as 'honey laundering'. Honey laundering came to public attention recently in the 'Honeygate' scandal in the USA, where honey from China was wrongly declared on a large scale to obfuscate its country of origin. We request funds to build a high-throughput method for metabolic profiling and fingerprinting of honey using nuclear magnetic resonance (NMR) spectroscopy to analyze the authenticity and origin of honey. High-resolution NMR spectroscopy permits the non-targeted detection and - at the same time - quantification of typically several dozen substances within a single measurement. To do this, we will analyze a wide range of honey samples

from various origins and pollen sources, artificially adulterated honey samples with NMR, and develop a Nationally-available database.

Using a highly automated NMR approach combined with a carefully assembled database of authentic and known adulterated samples, it is possible to develop untargeted methods to establish quantitative molecular fingerprints characteristic for natural honeys from different varieties of different origins. An essential advantage of this approach is that even unknown adulterations can be detected by untargeted uni- or multivariate tests. Furthermore, since NMR covers the analytical statements of several methods conventionally used in quality and authenticity testing of honey, it can save time and costs and produce so far unavailable information on authenticity and adulteration. Information provided by fingerprinting analysis will help beekeepers and honey processors to add value to their products and prevent unfair market prices due to honey laundering.

References –

Alvarado, M. (2019). The Plight of the Honey Bee. Retrieved 03/07/2023 from https://www.indianaenvironmentalreporter.org/posts/caring-for-americas-favorite-pollinator-takes-patience-dedication-and-community#:~:text=Today%2C%20there%20are%20an%20estimated,clubs%20covering%20all%2092%20counties.

Boffo, E. F., Tavares, L. A., Tobias, A. C., Ferreira, M. M., & Ferreira, A. G. (2012). Identification of components of Brazilian honey by 1H NMR and classification of its botanical origin by chemometric methods. LWT, 49(1), 55-63.

Cagliani, L., Maestri, G., & Consonni, R. (2022). Detection and evaluation of saccharide adulteration in Italian honey by NMR spectroscopy. Food Control, 133, 108574.

Copeland, C. (2020). Honey is one of the most faked foods in the world, and the US goverment isn't doing much to fix it. Retrieved 01/14/2022 from https://www.insider.com/fake-honey-problems-how-it-works-2020-9

Fakhlaei, R., Selamat, J., Khatib, A., Razis, A. F. A., Sukor, R., Ahmad, S., & Babadi, A. A. (2020). The Toxic Impact of Honey Adulteration: A Review. Foods (Basel, Switzerland), 9(11), 1538. https://doi.org/10.3390/foods9111538

FAO. (2021). The challenge of BEE-ing in a pandemic. Retrieved 01/14/2022 from https://www.fao.org/fao-stories/article/en/c/1400118/

Gallo, V., Ragone, R., Musio, B., Todisco, S., Rizzuti, A., Mastrorilli, P., Pontrelli, S., Intini, N., Scapicchio, P., & Triggiani, M. (2020). A contribution to the harmonization of non-targeted NMR methods for data-driven food authenticity assessment. Food Analytical Methods, 13(2), 530-541.

Machado De-Melo, A. A., Almeida-Muradian, L. B. d., Sancho, M. T., & Pascual-Maté, A. (2018). Composition and properties of Apis mellifera honey: A review. Journal of apicultural research, 57(1), 5-37.

Musharraf, S. G., Ambreen Fatima, S., Siddiqui, A. J., Iqbal Choudhary, M., & Atta ur, R. (2016). 1H-NMR fingerprinting of brown rice syrup as a common adulterant in honey [10.1039/C6AY01082B]. Analytical Methods, 8(34), 6444-6451. https://doi.org/10.1039/C6AY01082B

Schievano, E., Finotello, C., Uddin, J., Mammi, S., & Piana, L. (2016). Objective definition of monofloral and polyfloral honeys based on NMR metabolomic profiling. Journal of agricultural and food chemistry, 64(18), 3645-3652.

Schievano, E., Stocchero, M., Zuccato, V., Conti, I., & Piana, L. (2019). NMR assessment of European acacia honey origin and composition of EU-blend based on geographical floral markers. Food chemistry, 288, 96-101.

Spiteri, M., Jamin, E., Thomas, F., Rebours, A., Lees, M., Rogers, K. M., & Rutledge, D. N. (2015). Fast and global authenticity screening of honey using 1H-NMR profiling. Food chemistry, 189, 60-66.

Spiteri, M., Rogers, K. M., Jamin, E., Thomas, F., Guyader, S., Lees, M., & Rutledge, D. N. (2017). Combination of 1H NMR and chemometrics to discriminate manuka honey from other floral honey types from Oceania. Food chemistry, 217, 766-772.

Tsagkaris, A. S., Koulis, G. A., Danezis, G. P., Martakos, I., Dasenaki, M., Georgiou, C. A., & Thomaidis, N. S. (2021). Honey authenticity: analytical techniques, state of the art and challenges. RSC Advances, 11(19), 11273-11294.

USDA-NASS. (2021). Honey. Retrieved 1/14/2022 from https://downloads.usda.library.cornell.edu/usda-esmis/files/hd76s004z/7h14bh90x/w9505v43v/hony0321.pdf

Wu, L., Du, B., Vander Heyden, Y., Chen, L., Zhao, L., Wang, M., & Xue, X. (2017). Recent advancements in detecting sugar-based adulterants in honey–A challenge. TrAC Trends in Analytical Chemistry, 86, 25-38.

PROVIDE A LISTING OF THE OBJECTIVES THAT THIS PROJECT HOPES TO ACHIEVE

Add more objectives by copying and pasting the existing listing or delete objectives that aren't necessary.

Objective 1	Objective 1 – To develop a comprehensive NMR method, evaluating and comparing both targeted and untargeted approaches in detecting honey adulteration, as well as botanical and geographical origins.
Objective 2	Objective 2 – Undertake an NMR study of the sugars of multiple (65-80) honeys of different geographical origins sourced across Indiana and the Midwest region.
Objective 3	Objective 3 – Build an accurate concentration distribution for minor saccharides of honeys. We will further use this "honey fingerprint" to verify the authenticity of some of these samples.
Objective 4	Objective 4 – Develop a quality and authenticity testing service for Indiana honey producers.

PROJECT BENEFICIARIES

Estimate the number of project beneficiaries: 200

Does this project directly benefit socially disadvantaged farmers and/or underserved communities as defined in the RFA? **Yes** ☐ **No** ☑

If you selected yes, please describe how the project directly benefits socially disadvantaged farmers and/or underserved communities.

Does this project directly benefit beginning farmers as defined in the RFA? **Yes** ☑ **No** ☐

If you selected yes, please describe how the project directly benefits beginning farmers.

We will reach out to beginning farmers in Indiana who have started honey production in the past 2 years or who have expressed interest in honey production to specifically educate them about our results and the product of this work (honey testing facility). This project will provide important information for beginning farmers about honey quality and the importance of honey authenticity. We can also reach the beginning farmers at the Bee School and Purdue Field Day events. These two events will be important to provide in depth education about the testing facility, our results, and how honey testing can benefit the profitability of their honey production operations. It is very important for beginning farmers to have this information and ability to test their honey crops. This project will allow us to conduct outreach to beginning farmers in Indiana and educate them on the benefits of honey testing.

Does this project directly benefit veteran farmers as defined in the RFA? **Yes** ☑ **No** ☐

If you selected yes, please describe how the project directly benefits veteran farmers.

Our results and the product (a testing facility) are to be shared with beekeepers in Indiana at Purdue Field Day with an annual attendance of approximately 200 people. This annual event is planned by the Purdue Bee Lab in Partnership with The Beekeepers of Indiana to train beekeepers in the latest skills and techniques. Beginning in 2023 and onwards, we have paired with Hives to Heroes and At Ease Orchards, two organizations that work with Veterans, first responders, and their families to help train them in new skills. The Field day is free to veterans, first responders, and family members of, or persons with a disability thanks to this partnership. As this will be a free event for veterans, we will make a specific effort to communicate with them and educate them about honey testing, our results, and the honey testing facility. This program and partnership will allow us to reach Veteran farmers and train them on the latest methods for improving honey crop yields. This event will also connect us with the Veteran farmers allowing us to introduce and provide the honey testing service for their honey crops.

STATEMENT OF ENHANCING SPECIALTY CROPS

By checking the box to the right, I confirm that this project enhances the competitiveness of specialty crops in accordance with and defined by the Farm Bill. Further information regarding the definition of a specialty crop can be found at www.ams.usda.gov/services/grants/scbgp. ☑

List of Specialty Crops: Honey

CONTINUATION PROJECT INFORMATION

Does this project continue the efforts of a previously funded SCBGP project? **Yes** ☐ **No** ☑

If you have selected "yes", please address the following:

DESCRIBE HOW THIS PROJECT WILL DIFFER FROM AND BUILD ON THE PREVIOUS EFFORTS

PROVIDE A SUMMARY (3 TO 5 SENTENCES) OF THE OUTCOMES OF THE PREVIOUS EFFORTS

PROVIDE LESSONS LEARNED ON POTENTIAL PROJECT IMPROVEMENTS

What was previously learned from implementing this project, including potential improvements?

How are the lessons learned and improvements being incorporated into the project to make the ongoing project more effective and successful at meeting goals and outcomes?

DESCRIBE THE LIKELIHOOD OF THE PROJECT BECOMING SELF-SUSTAINING AND NOT INDEFINITELY DEPENDENT ON GRANT FUNDS

The work from this proposal would initiate a program for honey testing services that would allow honey producers to provide a certificate of authenticity for their honey products. Going forward we hope to utilize this project to begin the creation of a database of unique honey fingerprints. This database could be used to authenticate and determine unique properties of honey for producers and consumers. A long term goal of this project will be to make a cost effective testing service available to beekeepers and the food industry to fight food fraud and certify a quality and stable honey supply while ensuring profitability to the stakeholders. Providing this information and service to beekeepers will ensure profitability of their business, therefore allowing them to enhance the health and vitality of honey bee colonies and in turn improve crop production. Ultimately, the fees from the testing service provided to the stakeholders would sustain the project in order for it to be independently funded over the long term.

OTHER SUPPORT FROM FEDERAL OR STATE GRANT PROGRAMS

The SCBGP will not fund duplicative projects. Did you submit this project to a Federal or State grant program other than the SCBGP for funding and/or is a Federal or State grant program other than the SCBGP funding the project currently?

Yes ☐ **No** ☑

IF YOUR PROJECT IS RECEIVING OR WILL POTENTIALLY RECEIVE FUNDS FROM ANOTHER FEDERAL OR STATE GRANT PROGRAM

Identify the Federal or State grant program(s).

Describe how the SCBGP project differs from or supplements the other grant program(s) efforts.

EXTERNAL PROJECT SUPPORT

Describe the specialty crop stakeholders who support this project and why (other than the applicant and organizations involved in the project).

This project is supported by multiple stakeholders in the Honey production industry. Members of industry organizations and local honey producers such as American Honey Producers Association (AHPA), The Beekeepers of Indiana, Eisele's raw honey will have a keen interest in this project as it will support the authentication, and marketing of honey produced in Indiana. Letters of support from various stakeholders from the Indiana honey industry are included with this proposal as proof of support.
These organizations aim to serve commercial beekeepers as well as beekeeping hobbyists in Indiana and this project will help beekeepers to better characterize the floral components, composition, and quality of honey produced in Indiana. Specifically, we will target beginning honey producers and veteran farmers in Indiana who will greatly benefit from the results of this project and gain increased profitability from a honey testing service. Stakeholders support this project's efforts to improve the marketability of locally produced honey in Indiana. The project will provide stakeholders with an important service to the honey industry.

EXPECTED MEASURABLE OUTCOMES

SELECT THE APPROPRIATE OUTCOME(S) AND INDICATOR(S)/SUB-INDICATOR(S)

You must choose at least one of the eight outcomes listed in the SCBGP Performance Measures, which were approved by the Office of Management and Budget (OMB) to evaluate the performance of the SCBGP on a national level.

OUTCOME MEASURE(S)

Select the outcome measure(s) that are applicable for this project from the listing below.

- ☐ **Outcome 1:** Increasing Consumption and Consumer Purchasing of Specialty Crops
- ☐ **Outcome 2**: Increasing Access to Specialty Crops and Expanding Specialty Crop Production and Distribution
- ☐ **Outcome 3**: Increase Food Safety Knowledge and Processes
- ☐ **Outcome 4**: Improve Pest and Disease Control Processes
- ☐ **Outcome 5**: Develop New Seed Varieties and Specialty Crops
- ☑ **Outcome 6**: Expand Specialty Crop Research and Development
- ☐ **Outcome 7**: Improve Environmental Sustainability of Specialty Crops

OUTCOME INDICATOR(S)

Provide at least one indicator listed in the SCBGP Performance Measures and the related quantifiable result. If you have multiple outcomes and/or indicators, repeat this for each outcome/indicator.

FOR EXAMPLE:
Outcome 1, Indicator 1.1a
Total number of consumers who gained knowledge about specialty crops, Adults 132.

Outcome 6, Indicator 1
Number of research goals accomplished [4].

Outcome 6, Indicator 4
Total number of research outputs published to industry publications and/or academic journals [2]. For each published research output, the: a. Number of views/reads of published research/data [500]. b. Number of citations counted [25].

Outcome 6, Indicator 3
Number of industry representatives and other stakeholders who engaged with research results [200].

MISCELLANEOUS OUTCOME MEASURE

In the unlikely event that the outcomes and indicators above the selected outcomes are not relevant to your project, you must develop a project-specific outcome(s) and indicator(s) which will be subject to approval by AMS.

DATA COLLECTION TO REPORT ON OUTCOMES AND INDICATORS

Explain how you will collect the required data to report on the outcome and indicator in the space below.

Outcome 6, Indicator 1. Data for each of the four research goals will be collected by each research group (Simsek & Harpur) and will be shared using electronic data platforms provided by Purdue University. Data about sample collection, processing and origins will be gathered when obtaining each honey sample for the project. Data will be generated regarding sample composition and NMR fingerprint profiling. Outcome 6, Indicator 3, Attendance at the Purdue Field day, the Bee School and any other events related to this project will be tracked and recorded for reporting. We will provide information about the project and testing service to stakeholders at these events and track the number of requests for services obtained. Outcome 6, Indicator 4, We expect to have two publications from this work, one of which will be in an industry publication and the second in an academic journal. The publications will reach industry and academic stakeholders. The numbers of views and citations will be tracked and reported to determine the reach of this work.
Outcome 6, Indicator 1. Progress for each research goal will be provided by written report on a quarterly basis to monitor progress of each step. Outcome 6, Indicator 3, We expect to reach about 200 stakeholders in Indiana based on the number of beekeepers and honey processors who attend the Purdue Field day. Our results and the product (a testing facility) are to be shared with beekeepers in Indiana at Purdue Field Day. This annual event is planned by the Purdue Bee Lab in Partnership with The Beekeepers of Indiana. It trains beekeepers in the latest skills and techniques. Beginning in 2023 and onwards, we have paired with Hives to Heroes and At Ease Orchards, two organizations that work with Veterans, first responders, and their families to help train them in new skills. Field day is free to veterans, first responders, and family members of, or persons with a disability thanks to this partnership. Our annual attendance is 200 people. . The number of participants reached at in person and virtual meetings will be tracked and reported to stakeholders at relevant meetings. Outcome 6, Indicator 4, Publications resulting from this work will be showcased to stakeholders at meetings.

BUDGET NARRATIVE

All expenses described in this Budget Narrative must be associated with expenses that will be covered by the SCBGP. If any matching funds will be used and a description of their use is required by the State department of agriculture, the expenses to be covered with matching funds must be described separately. Applicants should review the Request for Applications section 4.7 Funding Restrictions prior to developing their budget narrative.

BUDGET SUMMARY

Expense Category	Funds Requested
Personnel	$75,142.00
Fringe Benefits	$14,236.00
Travel	$6,000.00
Equipment	$0.00
Supplies	$46,800.00
Contractual	$0.00
Other	$5,590.00
Direct Costs Sub-Total	$147,768.00
Total Budget	$147,768.00

PERSONNEL

List the organization's employees whose time and effort can be specifically identified and easily and accurately traced to project activities that enhance the competitiveness of specialty crops. See the Request for Applications section 4.7.2 Allowable and Unallowable Costs and Activities, Salaries and Wages, and Presenting Direct and Indirect Costs Consistently under section 4.7.1 for further guidance.

#	Name/Title	Level of Effort (# of hours OR % FTE)	Funds Requested
1	**Person TBA, Graduate Student**	0.50 %	$13,525.00
2	**Person TBA, Undergraduate student**	192	$7,680.00
3	**Person TBD, Technician**	0.25 %	$33,937.00
4	**Person TBD, Undergraduate Student**	480	$20,000.00

Personnel Subtotal: $75,142.00

PERSONNEL JUSTIFICATION

For each individual listed in the above table, describe the activities to be completed by name/title including approximately when activities will occur. Add more personnel by copying and pasting the existing listing or deleting personnel that aren't necessary.

Personnel 1:	Graduate Student support for 3 months (50% effort) during summer. Will work with CO-PI Harpur to collect samples and prepare them for analysis. The graduate student will work with PI's to analyze samples and data to be presented to stakeholders.
Personnel 2:	Will assist with sample preparations and other simple laboratory tasks. The Simsek undergraduate will assist the technician with routine tasks to ensure project progress.

Personnel 3:	Responsible for the main efforts regarding sample analysis and overseeing work done by one undergraduate student. Will be responsible for assisting with experimental design, collecting data, data analysis, and writing reports and publications.
Personnel 4:	Will assist with sample collection and sample analysis for this project. The Harpur undergraduate students will work with the graduate student to complete laboratory work.

FRINGE BENEFITS

Provide the fringe benefit rates for each of the project's salaried employees described in the Personnel section that will be paid with SCBGP funds.

#	Name/Title	Fringe Benefit Rate	Funds Requested
1	Person TBD, Graduate Student	0.07 %	$1,002.00
2	Person TBD, Technician	0.32 %	$10,948.00
3	Person TBD, Undergraduate Student	0.08 %	$634.00
4	Person TBD, Undergraduate student	0.08 %	$1,652.00

Fringe Subtotal: $14,236.00

TRAVEL

Explain the purpose for each Trip Request. Please note that travel costs are limited to those allowed by formal organizational policy; in the case of air travel, project participants must use the lowest reasonable commercial airfares. For recipient organizations that have no formal travel policy and for-profit recipients, allowable travel costs may not exceed those established by the Federal Travel Regulation, issued by GSA, including the maximum per diem and subsistence rates prescribed in those regulations. This information is available at http://www.gsa.gov. See the Request for Applications section 4.7.2 Allowable and Unallowable Costs and Activities, Travel, and Foreign Travel for further guidance.

#	Trip Destination	Type of Expense (airfare, car rental, hotel, meals, mileage, etc.)	Unit of Measure (days, nights, miles)	# of Units	Cost per Unit	# of Travelers Claiming the Expense	Funds Requested
1	Bee School	Hotel	Nights	4.0	$100.00	3	$1,200.00
2	Indiana Bee farms	Mileage	miles	538.0	$0.43	2	$463.00
3	Indiana Bee farms	Hotel	Nights	4.0	$125.00	1	$500.00
4	Bee School	Hotel	Nights	4.0	$100.00	2	$800.00
5	Bee School	Milage	Miles	250.0	$0.43	2	$215.00
6	Bee School	Meals	Meals	5.0	$100.00	2	$1,000.00
7	Bee School	Milage	miles	250.0	$0.43	3	$322.00
8	Bee School	Meals	meals	10.0	$50.00	3	$1,500.00

Travel Subtotal: $6,000.00

TRAVEL JUSTIFICATION

For each trip listed in the above table describe the purpose of this trip and how it will achieve the objectives and outcomes of the project. Be sure to include approximately when the trip will occur. Add more trips by copying and pasting the existing listing or delete trips that aren't necessary.

Trip 1 (Approximate Date of Travel):	Hotel costs to stay for the Indiana Bee School event in 2024 and 2025 for Brock Harpur, a graduate student and undergraduate student working on this project to present results.
Trip 2 (Approximate Date of Travel):	Car milage for Harpur to travel to bee farms to collect honey samples in 2024 and 2025
Trip 3 (Approximate Date of Travel):	Hotel cost for Harpur to travel to Bee farms in Indiana to collect honey samples in 2024 and 2025
Trip 4 (Approximate Date of Travel):	Hotel for Simsek and Staff to attend the Bee school in 2024 and 2025
Trip 5 (Approximate Date of Travel):	Milage for Simsek group to attend Bee school in 2024 and 2025
Trip 6 (Approximate Date of Travel):	Funds for meals for simsek group to attend Bee School in 2024 and 2025
Trip 7 (Approximate Date of Travel February 24, 2024):	Milage for Harpur group (3) participants to attend Bee School in 2024 and 2025
Trip 8 (Approximate Date of Travel March 23, 2024):	Meals for Harpur group to attend bee school in 2024 and 2025

CONFORMING WITH YOUR TRAVEL POLICY

By checking the box to the right, I confirm that my organization's established travel policies will be adhered to when completing the above-mentioned trips in accordance with 2 CFR 200.474 or 48 CFR subpart 31.2 as applicable. ☑

EQUIPMENT

Describe any special purpose equipment to be purchased or rented under the grant. ''Special purpose equipment'' is tangible, nonexpendable, personal property having a useful life of more than one year and an acquisition cost that equals or exceeds $5,000 per unit and is used only for research, medical, scientific, or other technical activities. See the Request for Applications section 4.7.2 Allowable and Unallowable Costs and Activities, Equipment - Special Purpose for further guidance

Rental of "general purpose equipment'' must also be described in this section. Purchase of general purpose equipment is not allowable under this grant. See Request for Applications section 4.7.2 Allowable and Unallowable Costs and Activities, Equipment - General Purpose for definition, and Rental or Lease Costs of Buildings, Vehicles, Land and Equipment.

#	Item Description	Rental or Purchase	Acquire When?	Funds Requested
1				

Equipment Subtotal: $0.00

EQUIPMENT JUSTIFICATION

For each Equipment item listed in the above table describe how this equipment will be used to achieve the objectives and outcomes of the project. Add more equipment by copying and pasting the existing listing or delete equipment that isn't necessary.

Equipment 1:	

SUPPLIES

List the materials, supplies, and fabricated parts costing less than $5,000 per unit and describe how they will support the purpose and goal of the proposal and enhance the competitiveness of specialty crops. See Request for Applications section 4.7.2 Allowable and Unallowable Costs and Activities, Supplies and Materials, Including Costs of Computing Devices for further information.

Item Description	Per-Unit Cost	# of Units/Pieces Purchased	Acquire When?	Funds Requested
Laboratory Supplies and Chemicals	$17,400.00	2.0	October 1, 2023	$34,800.00
NMR Lab Fees	$5,000.00	2.0	October 1, 2023	$10,000.00
Purchase and Shipping of Honey	$1,000.00	2.0	October 1, 2023	$2,000.00

Supplies Subtotal: $46,800.00

SUPPLIES JUSTIFICATION

Describe the purpose of each supply listed in the table above purchased and how it is necessary for the completion of the project's objective(s) and outcome(s).

Laboratory Supplies and Chemicals: Simsek ($17,400 per year) will be used to purchase laboratory supplies (pipette tips, vials, test tubes, chemicals and other reagents) to conduct the experiments for this project. Supplies to analyze honey quality and composition and for NMR analysis.
NMR Lab Fees: Simsek ($5,000 per year) NMR Lab Fees will be used to pay for use of nuclear magnetic resonance (NMR) instrumentation for analysis of the honey samples.
Purchase and Shipping of Honey: Harpur ($1,000 per year) used to purchase honey samples and pay for shipping of honey samples from beekeepers around Indiana to Purdue. Purchase and shipping of 10 gallons of honey per year representative of N and S Indiana from available suppliers.

CONTRACTUAL/CONSULTANT

Contractual/consultant costs are the expenses associated with purchasing goods and/or procuring services performed by an individual or organization other than the applicant in the form of a procurement relationship. If there is more than one contractor or consultant, each must be described separately. (Repeat this section for each contract/consultant.)

ITEMIZED CONTRACTOR(S)/CONSULTANT(S)

Provide a list of contractors/consultants, detailing out the name, hourly/flat rate, and overall cost of the services performed. Please note that any statutory limitations on indirect costs also apply to contractors and consultants.

#	Name/Organization	Hourly Rate/Flat Rate	Funds Requested
1			

Contractual/Consultant Subtotal: $0.00

CONTRACTUAL JUSTIFICATION

Provide for each of your real or anticipated contractors listed above a description of the project activities each will accomplish to meet the objectives and outcomes of the project. Each section should also include a justification for why contractual/consultant services are to be used to meet the anticipated outcomes and objectives. Include timelines for each activity. If contractor employee and consultant hourly rates of pay exceed the salary of a GS-15 step 10 Federal employee in your area, provide a justification for the expenses. This limit does not include fringe benefits, travel, indirect costs, or other expenses. See Request for Applications section 4.7.2 Allowable and Unallowable Costs and Activities, Contractual and Consultant Costs for acceptable justifications.

Contractor/Consultant 1:	

CONFORMING WITH YOUR PROCUREMENT STANDARDS

By checking the box to the right, I confirm that my organization followed the same policies and procedures used for procurements from non-federal sources, which reflect applicable State and local laws and regulations and conform to the Federal laws and standards identified in 2 CFR Part 200.317 through.326, as applicable. If the contractor(s)/consultant(s) are not already selected, my organization will follow the same requirements. ☑

OTHER

Include any expenses not covered in any of the previous budget categories. Be sure to break down costs into cost/unit. Expenses in this section include, but are not limited to, meetings and conferences, communications, rental expenses, advertisements, publication costs, and data collection.

If you budget meal costs for reasons other than meals associated with travel per diem, provide an adequate justification to support that these costs are not entertainment costs. See Request for Applications section 4.7.2 Allowable and Unallowable Costs and Activities, Meals for further guidance.

Item Description	Per-Unit Cost	Number of Units	Acquire When?	Funds Requested
Graduate Student Fee Remissions	$931.67	6.0	October 1, 2023	$5,590.00

Other Subtotal: $5,590.00

OTHER JUSTIFICATION

Describe the purpose of each item listed in the table above purchased and how it is necessary for the completion of the project's objective(s) and outcome(s).

Graduate Student Fee Remissions: Fee Remissions are budgeted in accordance with university policy for the graduate student supported on this project per memo dated January 20, 2022. Charged monthly (3 months each summer - 2 summers)

PROGRAM INCOME

Program income is gross income—earned by a recipient or subrecipient under a grant—directly generated by the grant-supported activity or earned only because of the grant agreement during the grant period of performance. Program income includes, but is not limited to, income from fees for services performed; the sale of commodities or items fabricated under an award (this includes items sold at cost if the cost of producing the item was funded in whole or partially with grant funds); registration fees for conferences, etc.

Source/Nature of Program Income	Description of how you will reinvest the program income into the project to enhance the competitiveness of specialty crops	Estimated Income

Program Income Total: $0.00

Project Timeline

Task	Year 1				Year 2			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Collect honey samples from Indiana beekeepers	X				X			
Develop NMR method for honey quality/authenticity	X	X	X					
Compositional analysis of honey samples			X	X		X	X	
NMR profiling of honey samples			X	X		X	X	X
Develop NMR database for honey fingerprinting				X	X	X		
Create honey testing service for Indiana beekeepers							X	
Present results and service offering to beekeepers					X			X
Publish results in trade journals and academic publications					X			X

Budget Justification

Personnel

In accordance with 2 CFR 200 Uniform Administrative Requirements, Cost Principles, And Audit Requirements for Federal Awards, Purdue University tracks and reports its professional personnel on a percent of effort and not on an hourly basis. Salaries are adjusted by standard University inflation rates each fiscal year (July 1): 3% for faculty, 2.5% for professional and technical assistants, and 2% for post docs, graduate/undergraduate students and service staff.

Principal Investigator – Senay Simsek, no support requested, will oversee the work done by the technician and one undergraduate student in her group. Simsek will work with Harpur and staff to collect samples, organize experiments, and disseminate results of the project.

CoPI – Brock Harpur, no support requested, will oversee a graduate student and undergraduate students on this project. Harpur will work with Simsek and staff to coordinate sample collection analysis, data collection, and to disseminate the results of the project.

Professional Personnel – TBA Technician, 25% FY per year, will be responsible for the main efforts regarding sample analysis and overseeing work done by one undergraduate student. The technician will be responsible for assisting with experimental design, collecting data, data analysis, and writing reports and publications.

Graduate Student (1) – TBA, 50% effort per year, will work with Harpur to collect samples and prepare them for analysis. The graduate student will work with PI's to analyze samples and data to be presented to stakeholders.

Undergraduate Student (Simsek) - Undergraduate support (192 hours per year) will assist with sample preparations and other simple laboratory tasks. The Simsek undergraduate will assist the technician with routine tasks to ensure project progress.

Undergraduate Student (Harpur) - Undergraduate support (480 hours per year) will assist with sample collection and sample analysis for this project. The Harpur undergraduate students will work with the graduate student to complete laboratory work.

Fringe Benefits

Fringe benefits are budgeted in accordance with university policy as follows:

Faculty	26.97%
Professional	32.26%
Graduate Student	7.41%
Undergraduate Student	8.26%

Travel

Simsek ($1,000 per year) will be used to attend meetings to present the project results at industry or academic meetings (including to Indiana Bee School - Feb 2024; 25).

Harpur ($2,000 per year) will be used to cover travel and automobile costs to present on project to beekeepers across the state at local state meetings (Dates TBD) over the course of the experiment (including to Indiana Bee School - Feb 2024; 25).

Supplies
Simsek ($17,400 per year) Laboratory Supplies and Chemicals will be used to purchase laboratory supplies such as pipette tips, vials, test tubes, chemicals and other reagents to conduct the experiments for this project. This includes but is not limited to buffers, deuterium oxide, HPLC solvents, chemical standards, nuclear magnetic resonance tubes, HPLC vials, pasture pipettes, centrifuge tubes, syringe filters, and others. The supplies will be used to analyze honey quality and composition and for NMR analysis.
Simsek ($5,000 per year) NMR Lab Fees will be used to pay for use of nuclear magnetic resonance (NMR) instrumentation for analysis of the honey samples.
Harpur ($1,000 per year) Purchase and Shipping of Honey will be used to purchase honey samples and pay for shipping of honey samples from beekeepers around Indiana to Purdue University. Including the purchase and shipping of 10 gallons of honey in each year representative of N and S Indiana from available suppliers.

Equipment
None

Other Costs
Graduate Student Fee Remissions – Fee Remissions are budgeted in accordance with university policy for the graduate students supported on this project per memo dated January 20, 2022.

Indirect Costs
No indirect costs per sponsor policy in the request for proposal documentation.

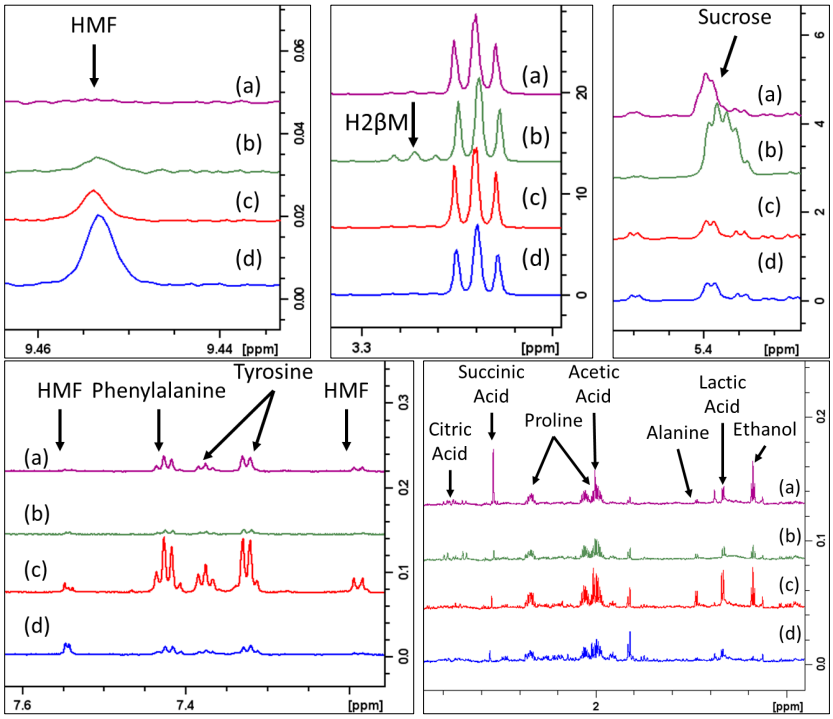

Figure 1. Key components identified in 1H nuclear magnetic resonance spectra for honey authentication (a-Boiler Bee Honey, b – Clover honey with corn syrup, c – Wildcat creek apiary, d – Madison's reserve)

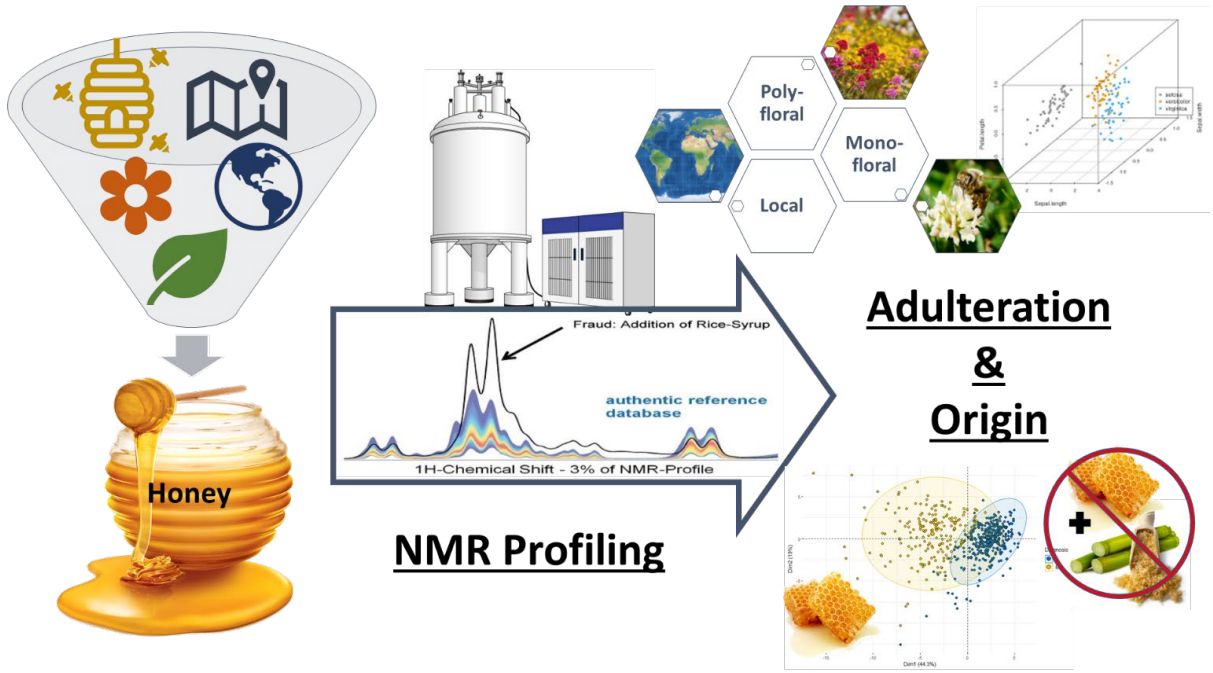

Figure 2. Developing a Database for Adulteration and Origin Through Nuclear Magnetic Resonance Fingerprinting

PRESIDENT
Chris Hiatt
36355 Kensington Dr.
Madera, CA 93636
559-232-2494
chrishiatt@ahpanet.com

VICE PRESIDENT
Steven Coy
358 State Hwy 13
Wiggins, MS 39577
601-530-6440
stevencoy@ahpanet.com

TREASURER
Doug Hauke
9316 Klondike Drive
Marshfield, WI 54449
715-676-2110
doug@ahpanet.com

EXECUTIVE SECRETARY
Cassie Cox
PO Box 435
Mendon, UT 84325
281-900-9740
cassie@ahpanet.com

EXECUTIVE COMMITTEE
Joe Sanroma
481 Highway 457
Lecompte, LA 71346
318-346-2805
j.sanroma@ahpanet.com

Doug Hauke
9316 Klondike Drive
Marshfield, WI 54449
715-676-2110
doug@ahpanet.com

Matt Halbgewachs
PO Box 228
Driftwood, TX 78619
512-740-8610
matt@ahpanet.com

Scott Hamilton
7012 Sky Ranch Rd.
Nampa, ID 83686
208-250-5344
scott@ahpanet.com

JB Meyer
1108 Regency Dr.
Madison, SD 57042
605-270-3448
JBMeyer@ahpanet.com

PAST PRESIDENT
Kelvin Adee
PO Box 368
Bruce, SD 57220
605-627-5621
kadee@ahpanet.com

LEGISLATIVE CHAIRMAN
Mark Jensen
PO Box 162
Power, MT 59468
406-463-2227
mark@ahpanet.com

AHPA
American Honey Producers Association

March 6, 2022

RE: Letter of Support - NMR as a Fingerprinting Tool to Develop a Database for the Characterization and Authentication of Honey

To the deciding party,

I am Chris Hiatt, president of American Honey Producers Association. In this position, I represent the interests of a very large number of commercial beekeepers, and others, in the United States.

Drs. Simsek and Harpur have proposed to use NMR to detect adultered honey and help beekeepers better characterize the floral components within their product. If successful, they will be offering this as a service to beekeepers nation-wide. As an experienced honey producer and representative of the AHPA, I can say unreservedly that this is an important contribution to the honey industry, and I support their proposal.

Sincerely,

Chris Hiatt

Chris Hiatt
President
American Honey Producers Association

Mitchell's Honey Company

New Paris, IN - The Buzzing Place To Be

March 23, 2023

RE: Letter of Support - NMR as a Fingerprinting tool to Develop a Database for the characterization and Authentication of Honey

To the deciding party,

I am Ethan Mitchell, Owner of Mitchells Honey Company located in New Paris Indiana managing 1,500 colonies. My operation is mostly focused on honey production for bulk sales and retail sales. We also focus on pollination services and queen breeding for survivability. Drs. Simsek and Harpur have proposed to use NMR to detect adultered honey and help beekeepers better characterize the floral components within their product. If successful, they will be offering this as a service to beekeepers nation-wide. As an experienced honey producer and representative of the AHPA, I can say unreservedly that this is an important contribution to the honey industry, and I support their proposal. The reason this would benefit not just beekeepers but also honey bees is, different floral sources affect honey bee health. Some floral sources have higher nutritional value than others. With the ability to test for such sources will help beekeepers identify what is best for the colony health. This knowledge to the beekeeper is vital in colony health and survivability. I am looking forward in working together to make this an option for beekeepers.

Sincerely,

Ethan Mitchell

22468 CR 50

New Paris, Indiana