Doug Goehring, Agriculture Commissioner

Honey Bee Research

Samantha Brunner

State Apiary Inspector

Plant Industries Division Director

Request

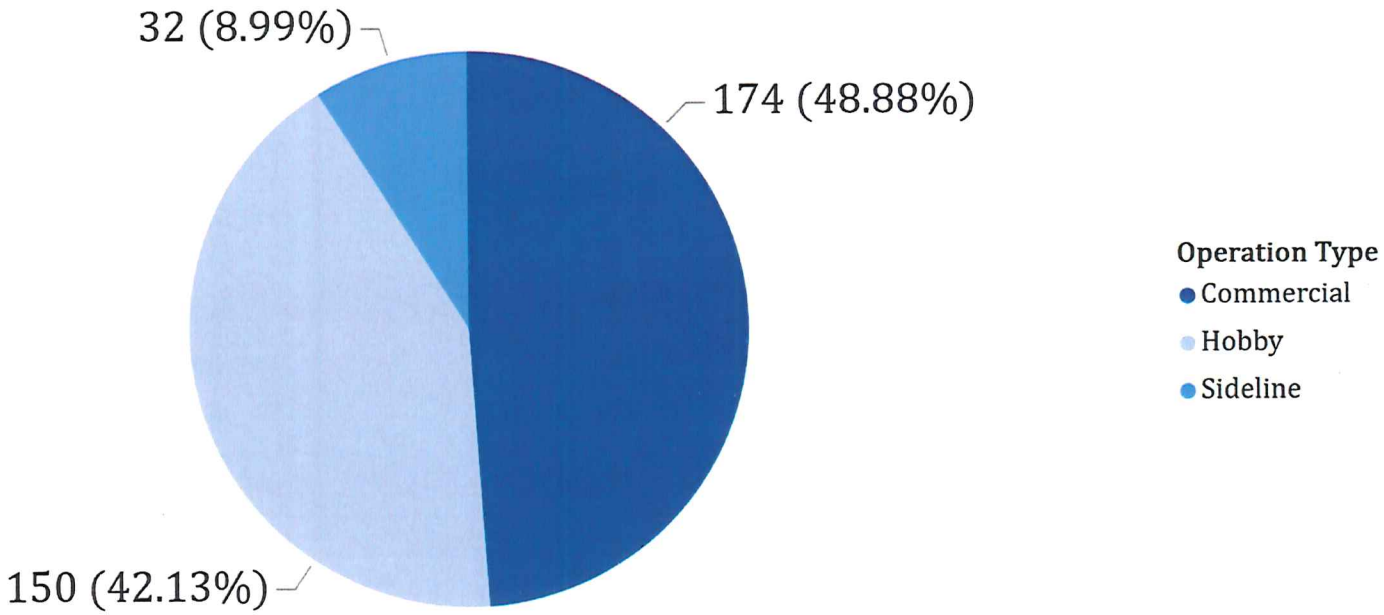
- **#1 PRIORITY:** 2 FTE's for honey bee research - NDSU Main Campus
  - 1 researcher
  - 1 research assistant
- 2 FTE's for honey bee research- Hettinger Research and Extension Center
  - 1 researcher
  - 1 research assistant

NDDA Apiary Program Activities

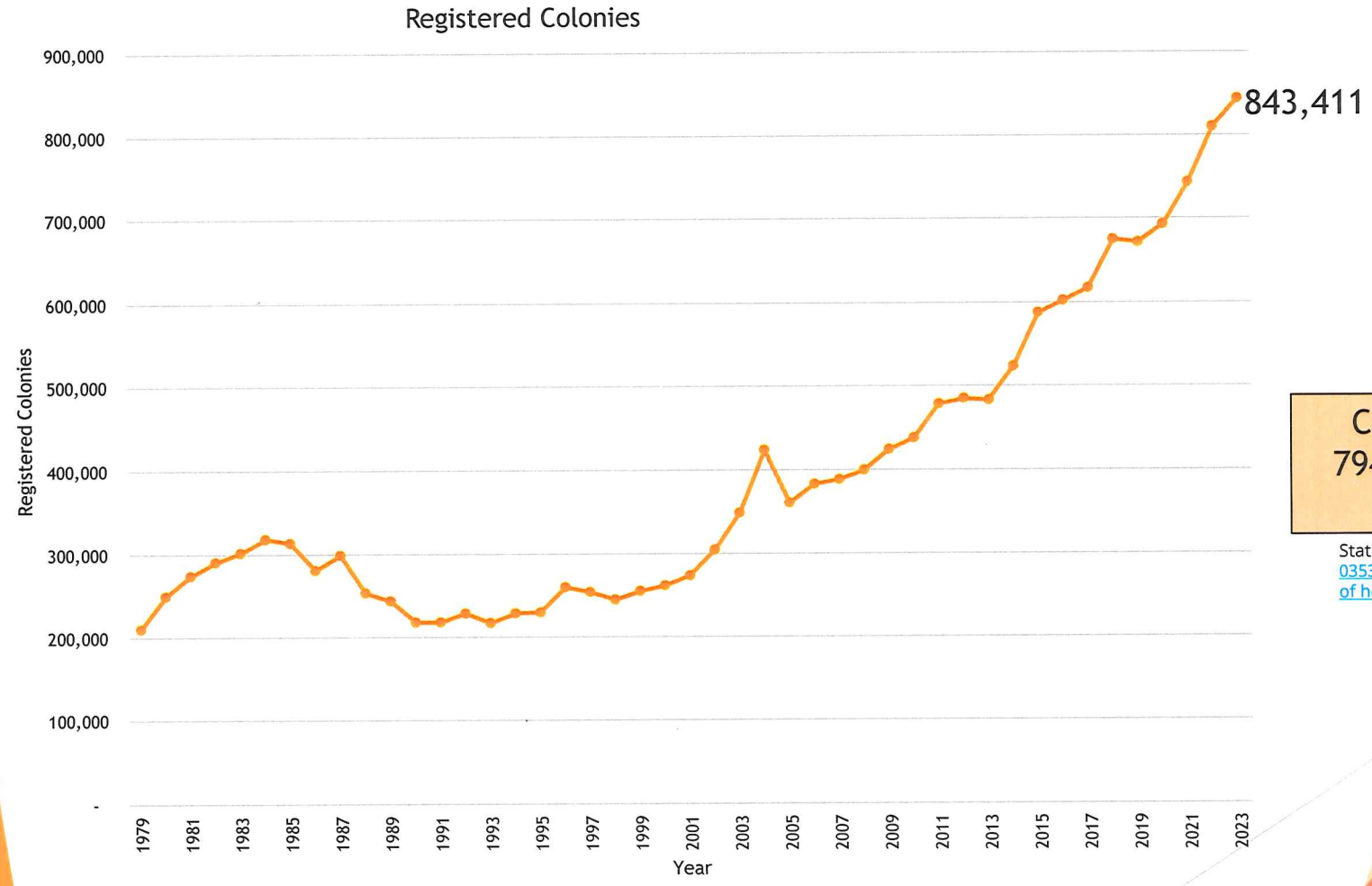
- Published the North Dakota Pollinator Plan
  - Developed as a response to growing need for a balanced public policy that mitigates risk to honey bees, while minimizing the impact of that mitigation on production agriculture.
  - First in the nation to publish a pollinator plan
  - Most states now have a plan that used the ND Pollinator Plan as their base document
- Outreach and Education Events with groups of all ages
- Compliance checks and work with landowners on beekeeping related issues
- License all beekeepers, total colony numbers and apiary placement
- Manage the online "Sensitive Area Map" and licensing and registration system for beekeepers and the public
- Conduct inspections for the health and movement of honey bees
- Conduct disease diagnostics as requested by beekeepers
- Check mite levels of apiaries throughout the season
- Play active roles in national discussions and activities with beekeepers, researchers and other apiary inspectors
- Members of the Apiary Inspectors of America
- California Pre-Inspection Program
- Sample and test for current and emerging honey bee pests

Apiary Program 2023

Licensed Beekeepers	Total Colonies	Registered Locations
356	843,411	20943



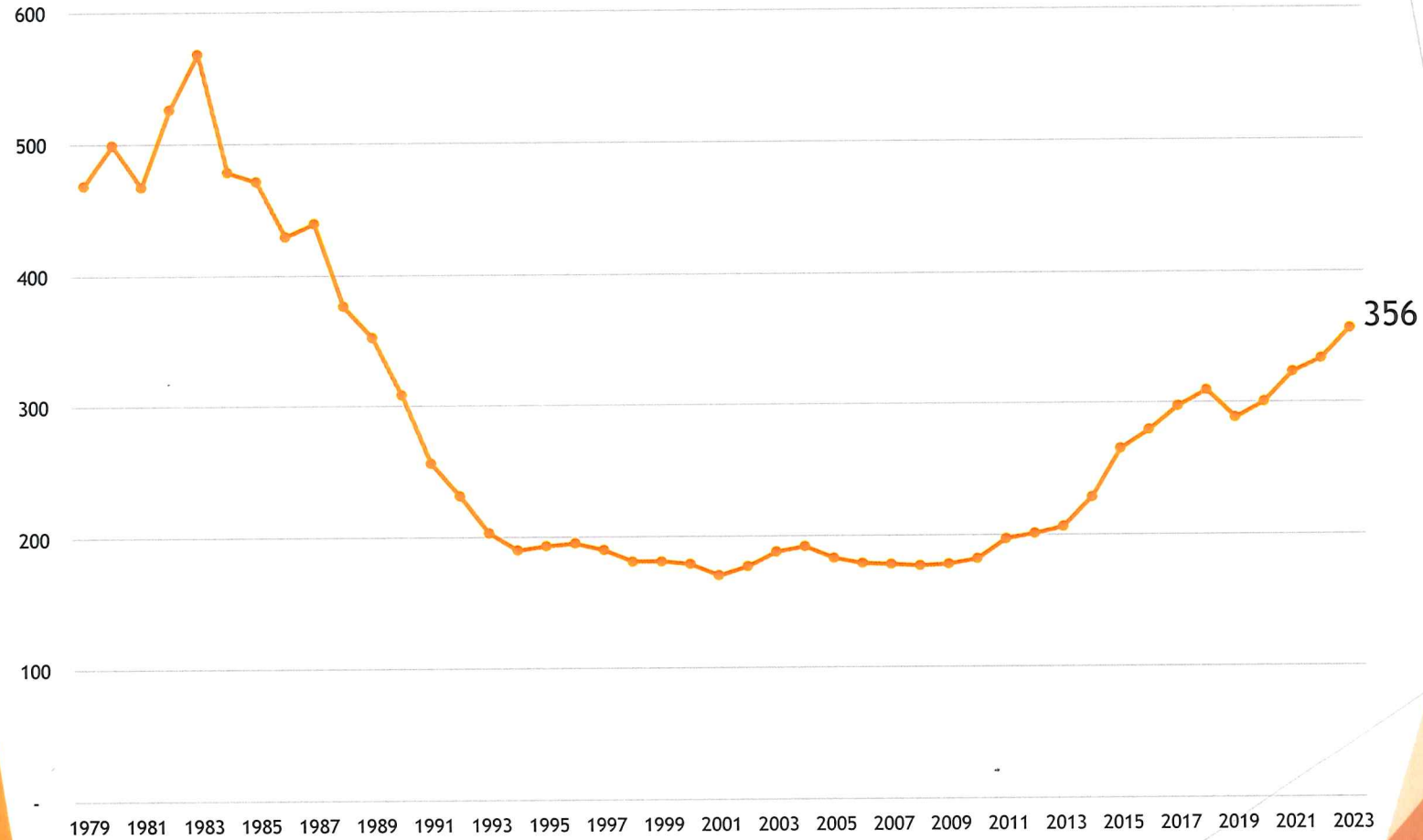
Hobby: 1-50 colonies Sideline: 51-500 Commercial: 501+

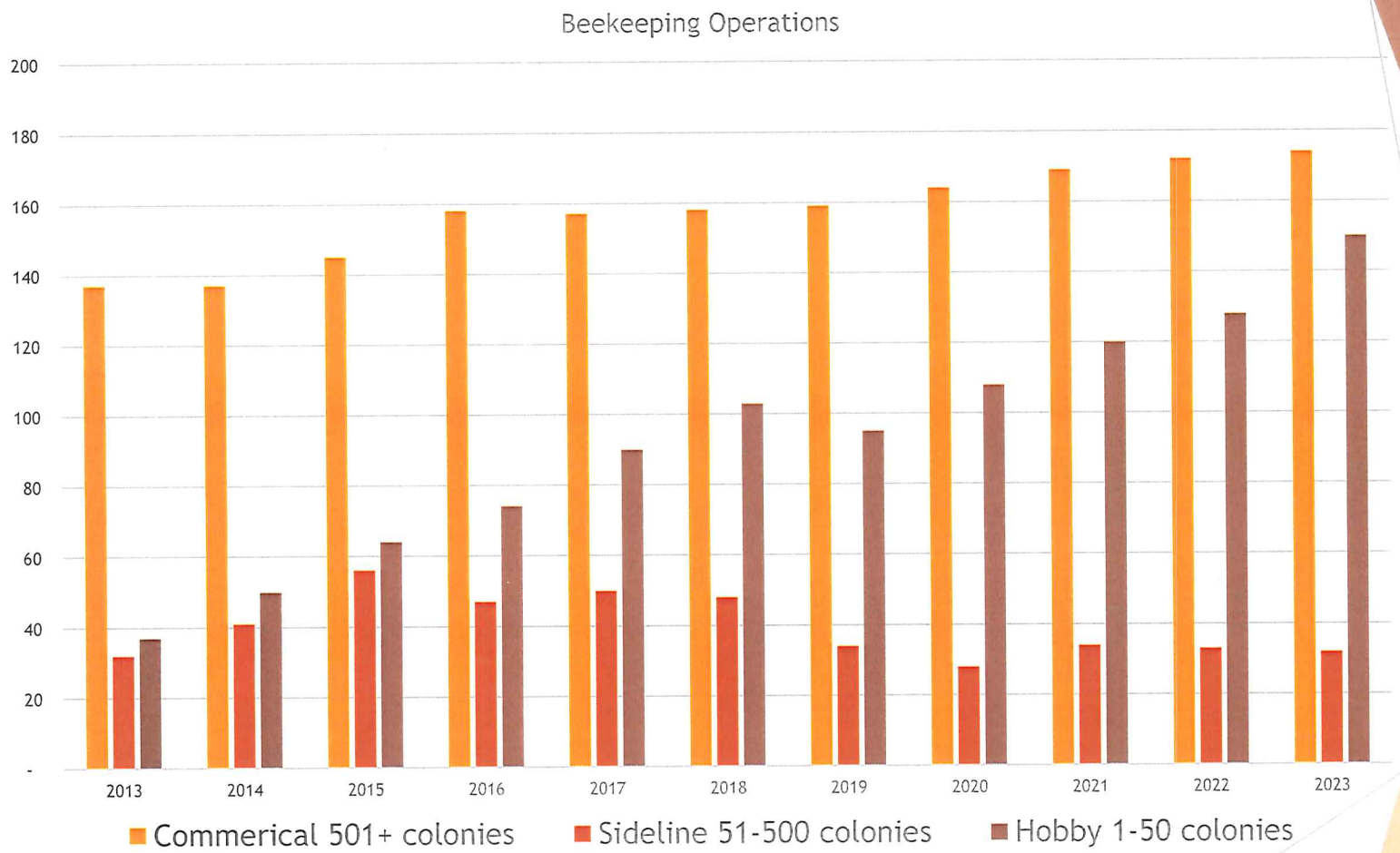


Canada reported 794,341 colonies in 2023

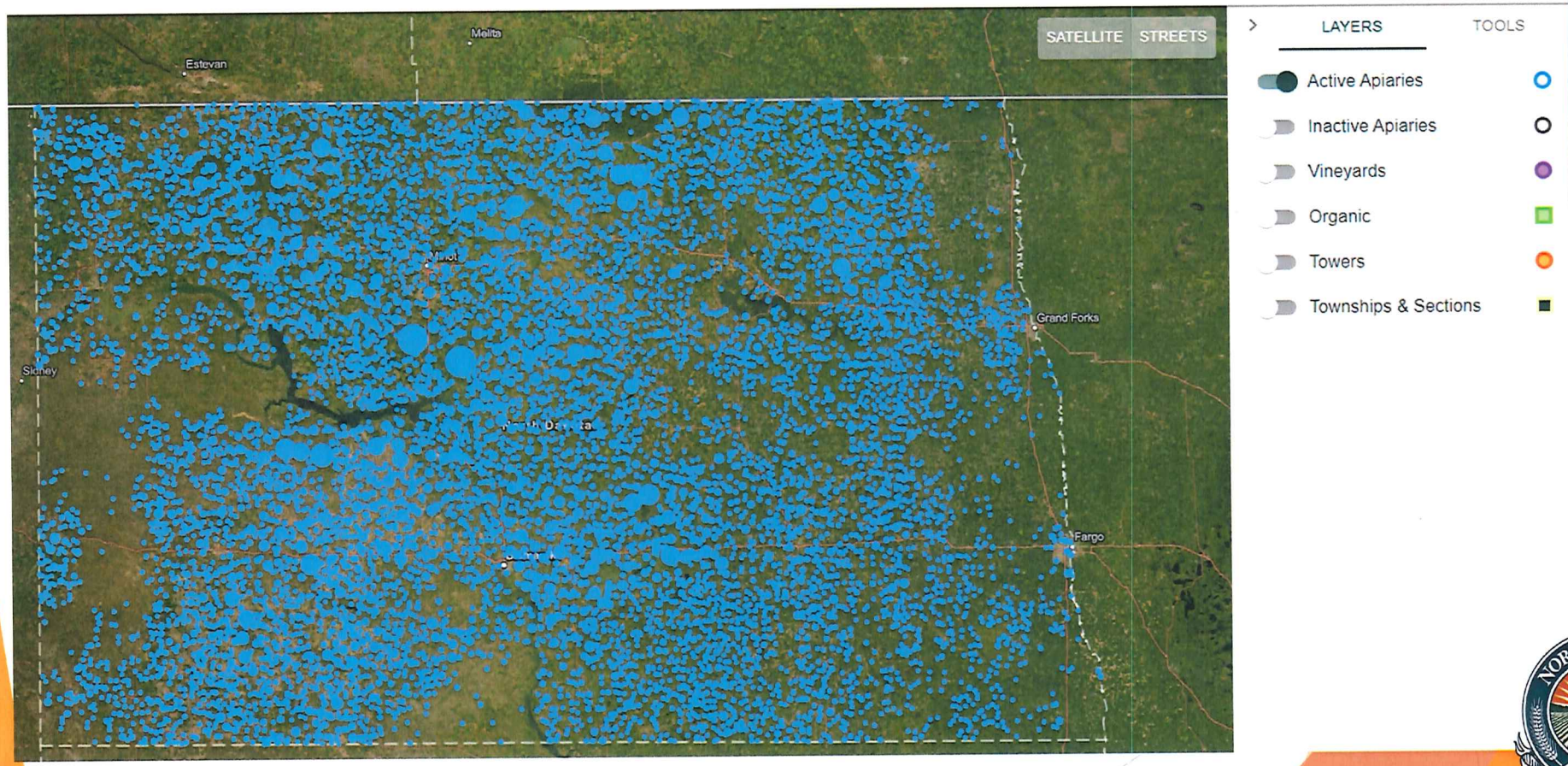
Statistics Canada. Table 32-10-0353-01 Production and value of honey

Licensed Beekeepers



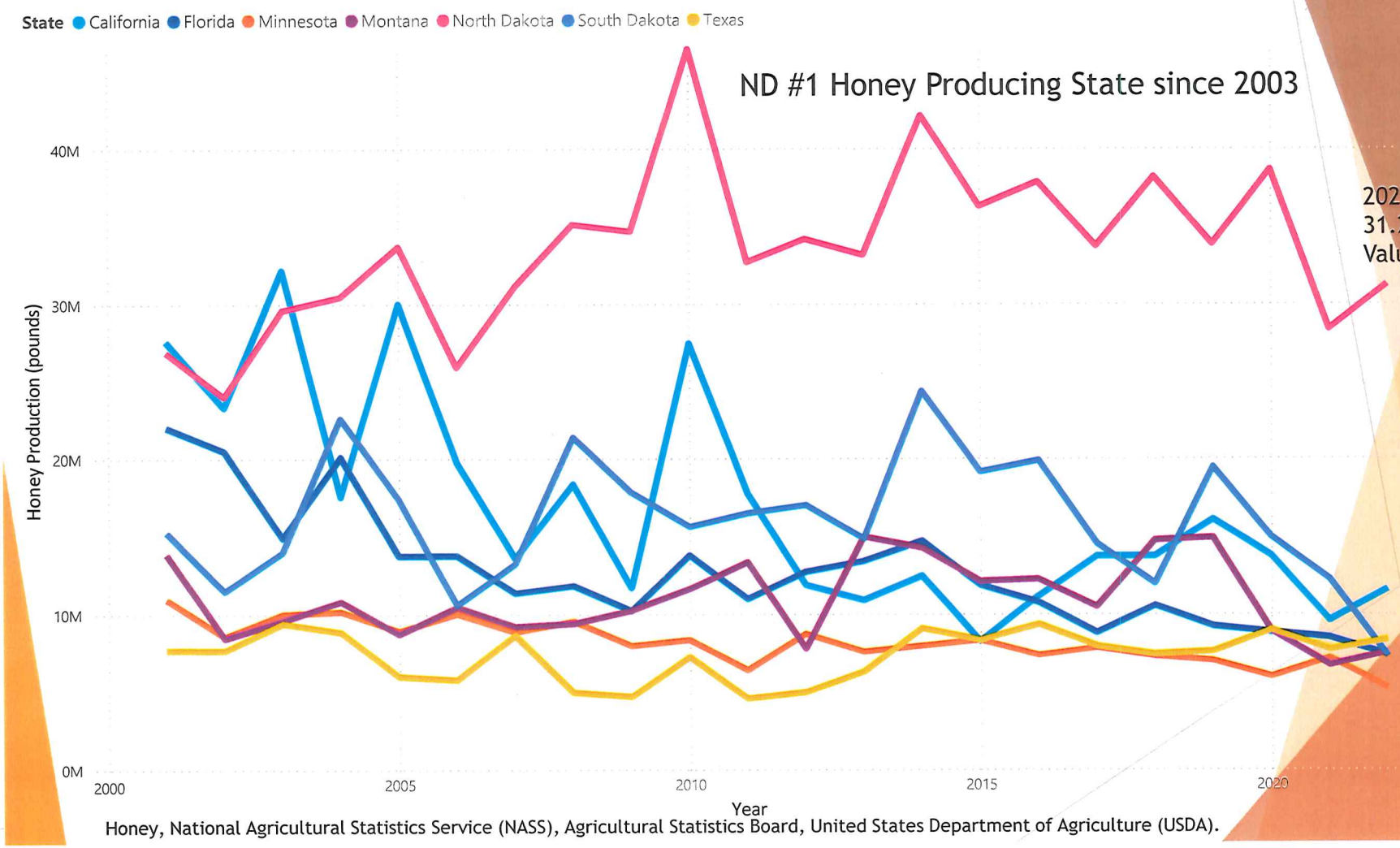

Beekeeping Operations
200
180
160
140
120
100
80
60
40
20
-
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Commerical 501+ colonies
Sideline 51-500 colonies
Hobby 1-50 colonies

ND Sensitive Area Map



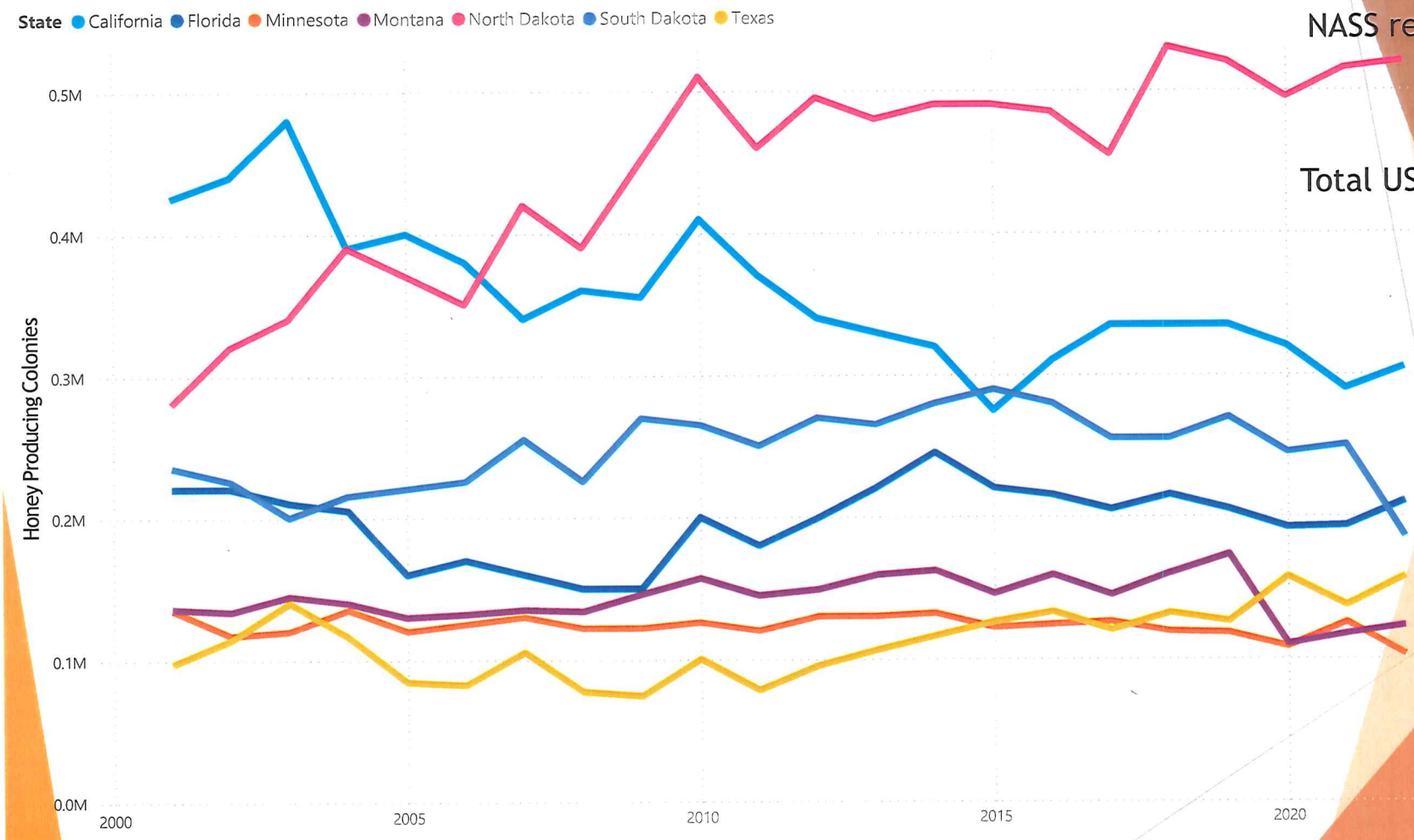

Pollination in ND

Honey Production



Honey, National Agricultural Statistics Service (NASS), Agricultural Statistics Board, United States Department of Agriculture (USDA).

Honey Producing Colonies



NASS reports ND colonies:
520,000

Total US colonies in 2022:
2,667,000

Honey, National Agricultural Statistics Service (NASS), Agricultural Statistics Board, United States Department of Agriculture (USDA).

2023 Inspection Numbers

External Inspections
- 156 different beekeepers
- 988 locations

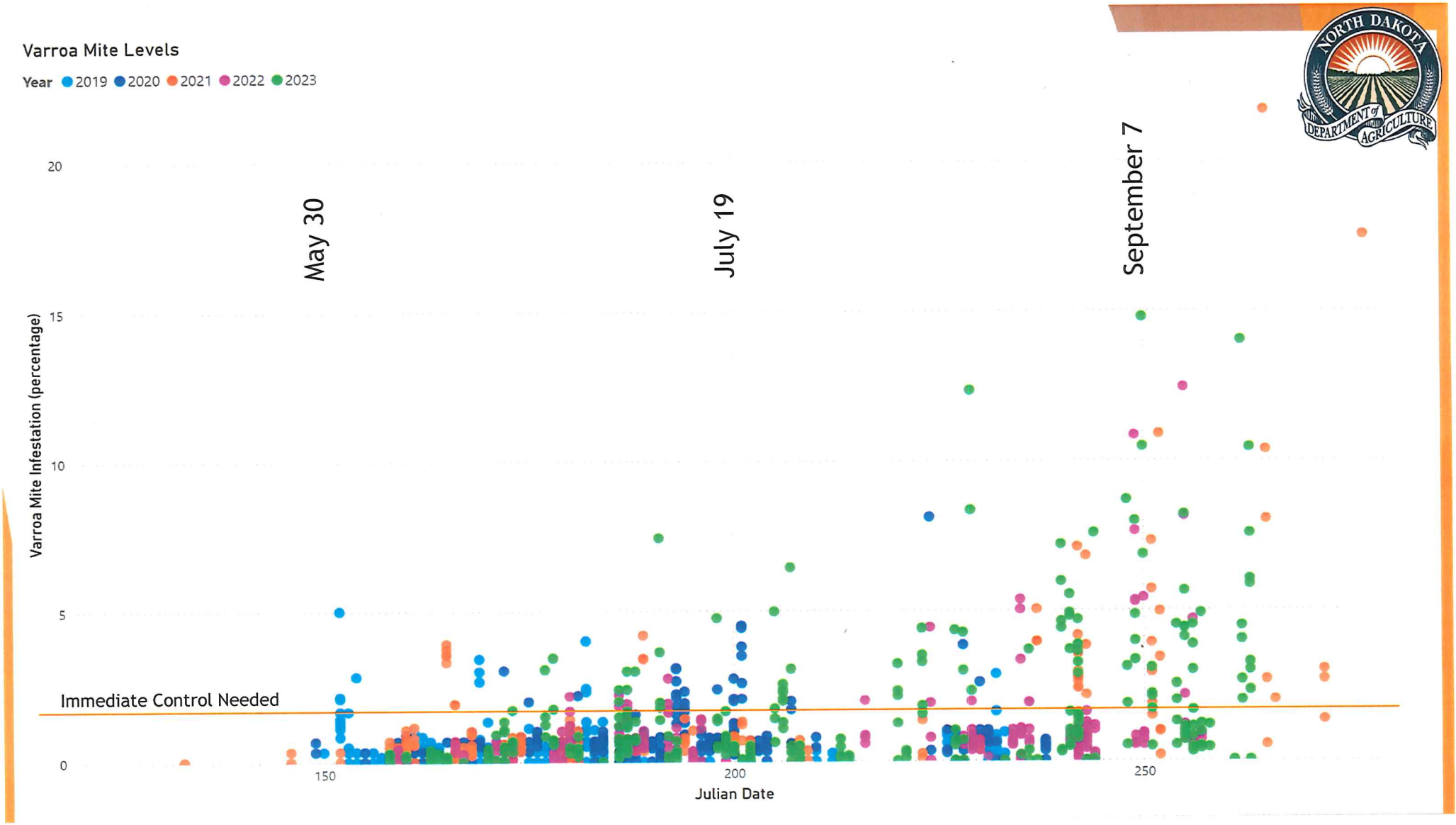
In-Hive Inspections (2 staff)
- 52 different beekeepers
- 334 locations
- Collected samples at 323 locations
  - Hive debris (testing for Tropilaelaps)
  - Adult Bees (analyzed at the NAGC for 21 different pests)
  - Adult Bees (Nosema Spore counts, done in office)

California Pre-Inspection

Year	2020	2021	2022
Participants	28	29	28
Inspections Passed	51	47	45
Colonies Certified	77,804	80,949	87,495
Inspections Failed	N/A	5	6
Colonies Failed	N/A	4,917	4500
Re-inspections	N/A	2	2
Colonies Recertified	N/A	3,752	1364

Varroa Mite (*Varroa destructor*)

Massachusetts Apiary Program


Varroa Mite Levels
Year 2019 2020 2021 2022 2023
20
15
10
5
0
Varroa Mite Infestation (percentage)
May 30
July 19
September 7
Immediate Control Needed
150
200
250
Julian Date

Varroa Resistance to Amitraz Confirmed!

- Dr. Frank Rinkevich (USDA-ARS Baton Rouge, LA)
- Found across the US, **including in North Dakota**
- Genetic markers for resistance identified
- Currently working with the National Agricultural Genotyping Center (Fargo) to develop a test available to beekeepers
- NDDA will assist collecting Varroa Samples in 2024

Amitraz strip (photo: Mann Lake)

NAGC
NATIONAL AGRICULTURAL GENOTYPING CENTER

USDA Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

NORTH DAKOTA DEPARTMENT of AGRICULTURE

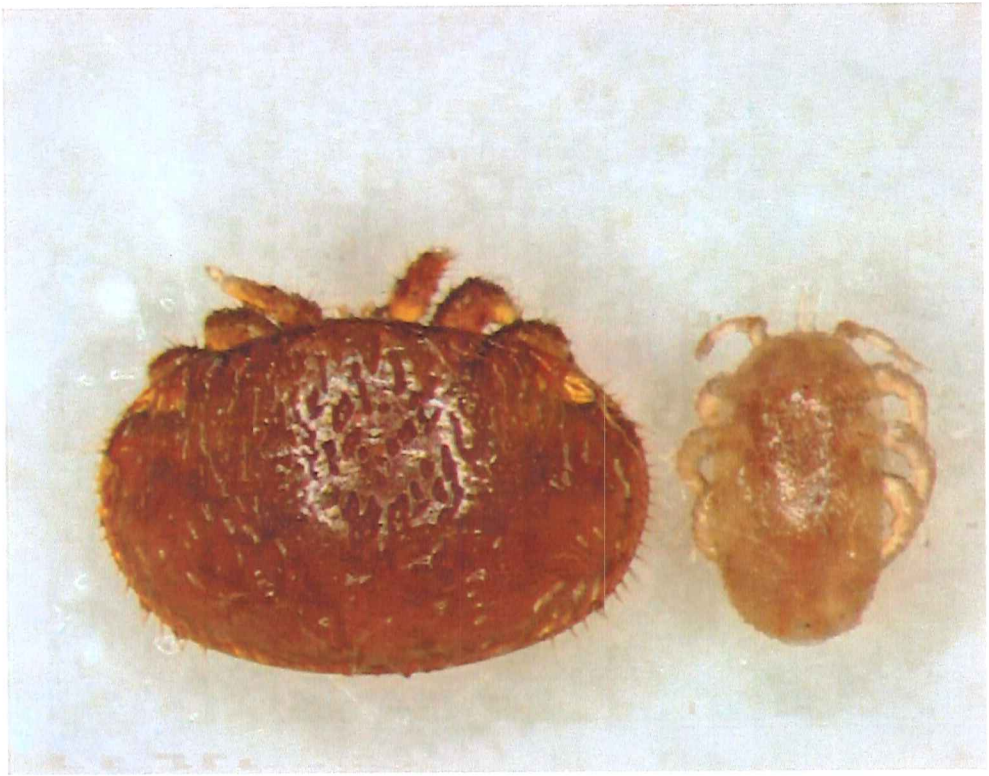
Tropilaelaps

Currently NOT found in North America

Reproduces faster than Varroa

Major knowledge gaps with biology, management and impacts on US beekeeping industry

Expected to be deadlier to US honey bees than Varroa mites



Varroa mite (left) and Tropilaelaps mite (right)

Photo by I.B. Smith Jr./ USDA-BRL

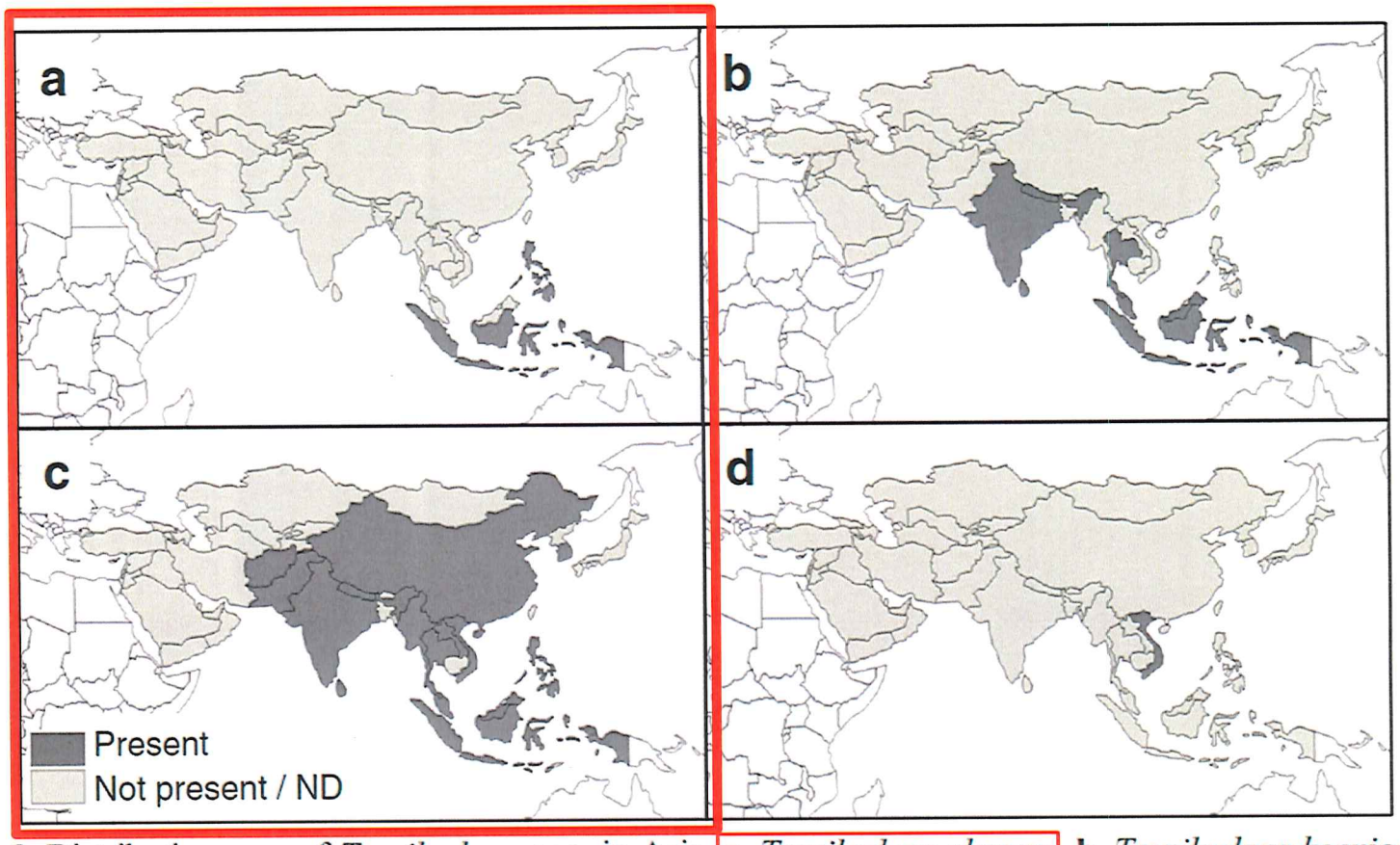


Figure 3. Distribution map of *Tropilaelaps* spp. in Asia. **a** *Tropilaelaps clareae*, **b** *Tropilaelaps koenigerum*, **c** *Tropilaelaps mercedesae*, and **d** *Tropilaelaps thaii*. *Dark gray* indicates Asian countries where the parasite has been detected in at least one honeybee species; *light gray* indicates Asian countries where the parasite has not been detected or no data (*ND*) are available.

Chantawannakul, P., de Guzman, L.I., Li, J. *et al.* Parasites, pathogens, and pests of honeybees in Asia. *Apidologie* **47**, 301–324 (2016). https://doi.org/10.1007/s13592-015-0407-5

2.3.6. Canada's sources of package honey bee imports – by volume (kilograms)

	2017	2018	2019	2020	2021	2021 % Share
Australia	2,880	7,959	13,462	720	8,661	100.0%
New Zealand	20,637	16,839	25,308	12,010	0	0.0%
Chile	3,870	6,840	2,569	1,016	0	0.0%
Total	**27,387**	**31,638**	**41,339**	**13,746**	**8,661**	**100.0%**

Notes:
Does not include queen bees and live bees that are not honey bees.
Source: Statistics Canada. (CATSNET, February 2022)

2.3.8. Canada's sources of queen bee imports – by quantity (number)

	2017	2018	2019	2020	2021	2021 % Share
United States	218,058	220,270	208,530	193,794	220,403	84.1%
Italy	0	0	0	4,089	17,170	6.6%
New Zealand	1,609	21,983	2,843	8,721	5,452	2.1%
Australia	8,527	9,676	7,837	3,023	7,302	2.8%
Chile	7,834	9,762	16,718	3,625	7,554	2.9%
Others	82	427	0	691	4,132	1.6%
Total	**236,110**	**262,118**	**235,928**	**213,943**	**262,013**	**100.0%**

Source: Statistics Canada. (CATSNET, February 2022)

National Honey Bee Survey

Tropilaelaps test: Bump Method
24 samples per year
Efficacy has been in question- Better testing methods available
Results take 6+ months

NDDA Sampling

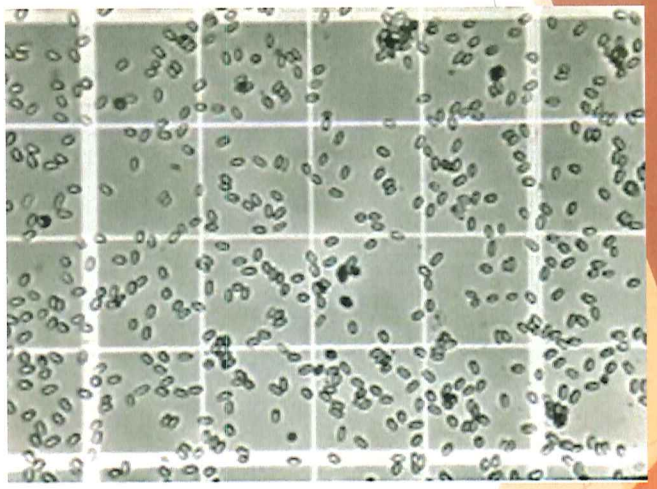
Some Specialty Crop Block Funding

Molecular analysis of samples
Fast results
Waiting on efficacy data
287 Hive debris samples in 2023 from North Dakota
131 Hive debris samples in 2023 from Across the USA

Results received in 2-3 weeks ALL NEGATIVE

Nosema ceranae

- **Failure to thrive**
- Colony has resources, honey and pollen
- Queen appears to be laying right
- No dysentery (common with N. apis)
- No obvious pathogen or disease
- Colony stays small



https://bee-health.extension.org/testing-for-nosema-spores/

Nosema Project

Specialty Crop Block Grant

- Collaborating with Apiary Inspectors
  - Massachusetts
  - Vermont
  - Maine
  - South Dakota
  - Montana
  - North Dakota
- Evaluate hive strength
- Collect hive samples
  - Full pathogen panel from the NAGC (21 pests identified)
  - Nosema spore counts (microscopy- in office)
  - NAGC analysis of Nosema slurry
- Correlate data with NAGC analysis

NAGC
NATIONAL AGRICULTURAL GENOTYPING CENTER

NORTH DAKOTA DEPARTMENT of AGRICULTURE

Routine Diagnostics

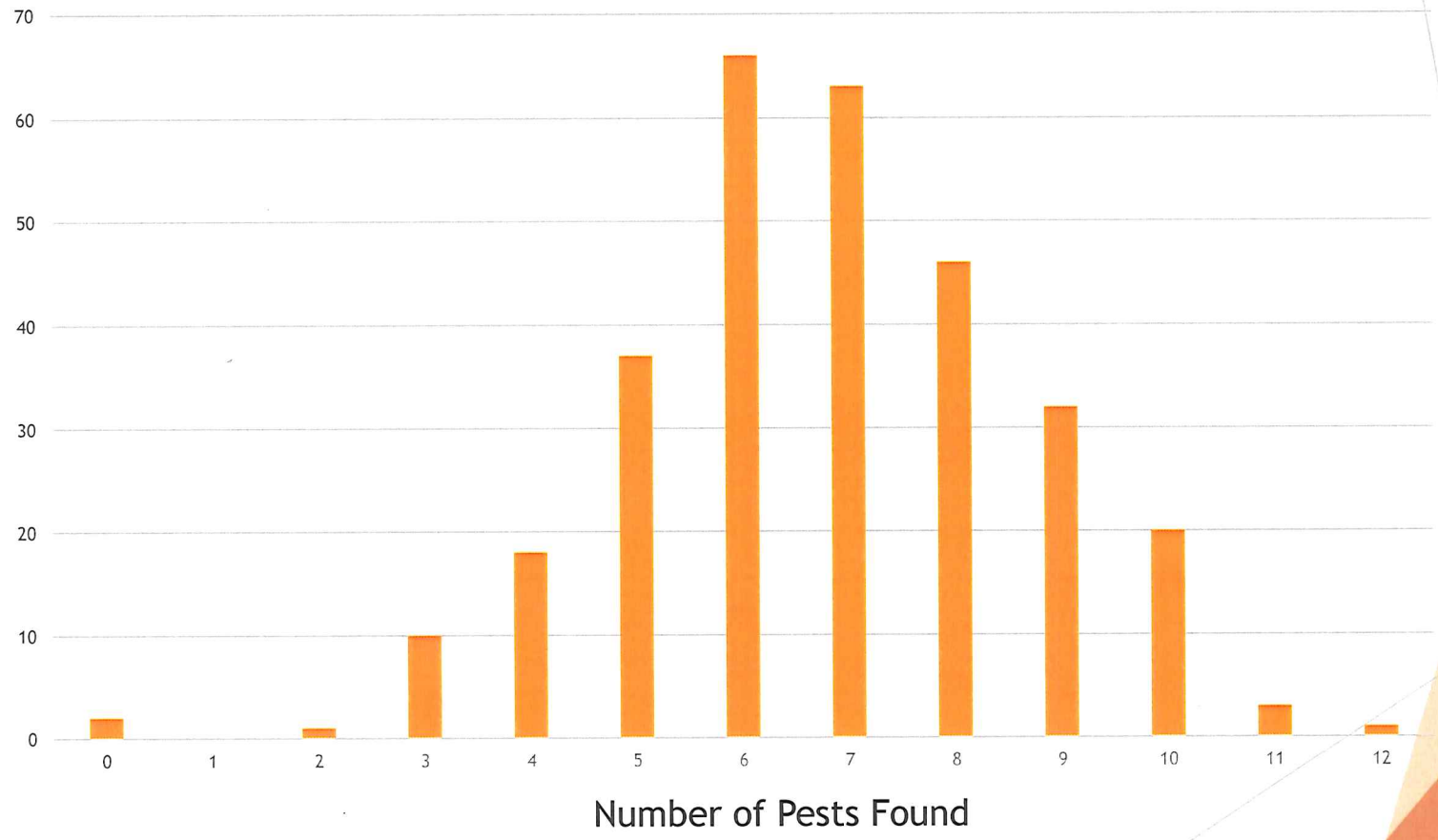
- Varroa Mite
- Chalkbrood
- Nosema
- Queen issues
- Pesticide testing
- NAGC Molecular Analysis

National Agricultural Genotyping Center

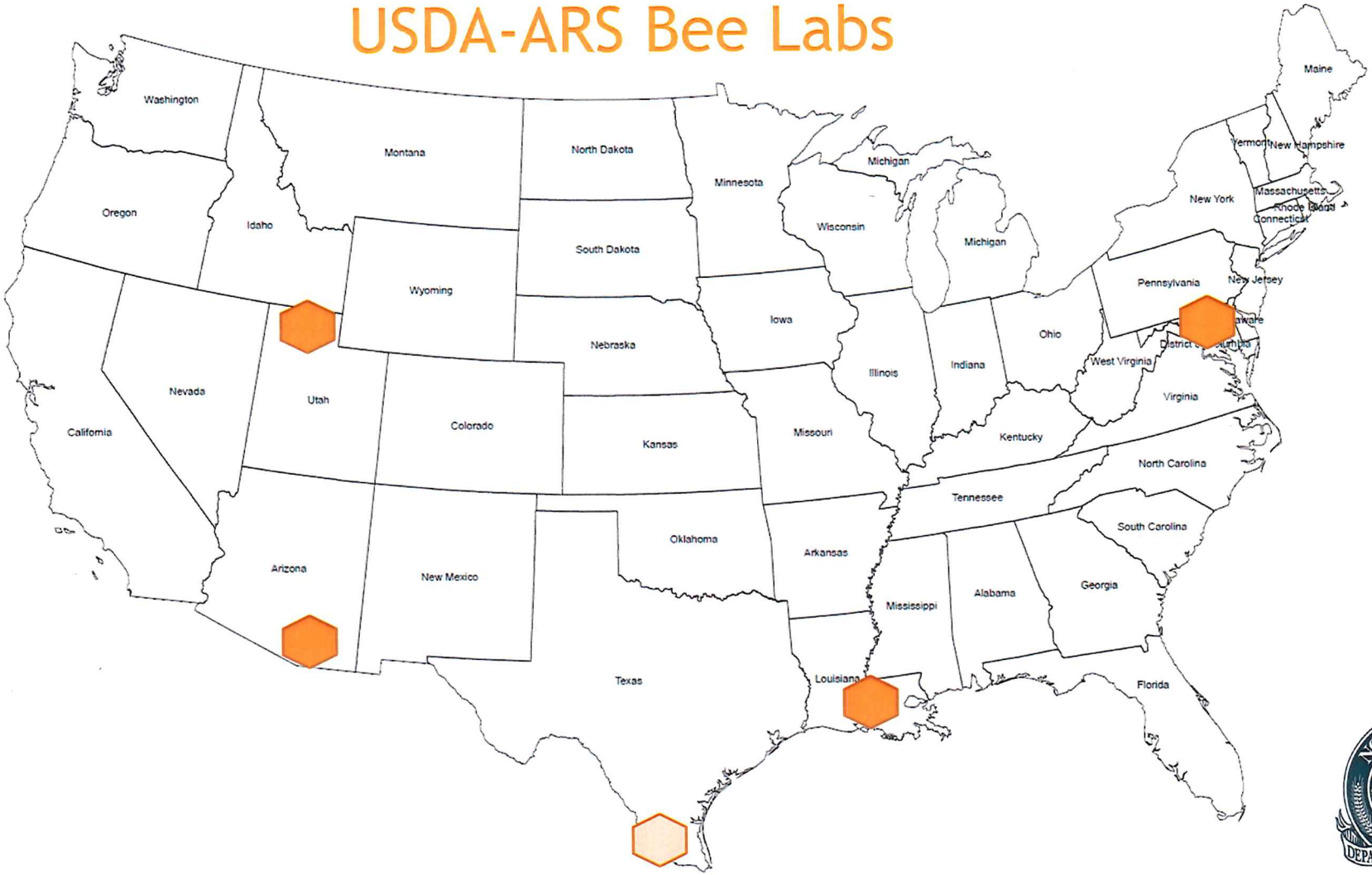
- Acarapis woodi (tracheal mite)
- Acute Bee Paralysis Virus
- American Foulbrood
- Ascosphaera apis (chalkbrood)
- Black Queen Cell Virus
- Chronic Bee Paralysis Virus
- Crithidia mellificae
- Deformed Wing Virus-A
- Deformed Wing Virus-B
- Deformed Wing Virus-C
- European Foulbrood
- Israeli Acute Bee Paralysis Virus
- Kashmir Bee Virus
- Lake Sinai Virus 1
- Lake Sinai Virus 2
- Lotmaria passim
- Nosema apis
- Nosema ceranae
- Sacbrood Virus
- Slow Be Paralysis Virus
- Tropilaelaps spp.

Results from 2023 Samples of Adult Bees

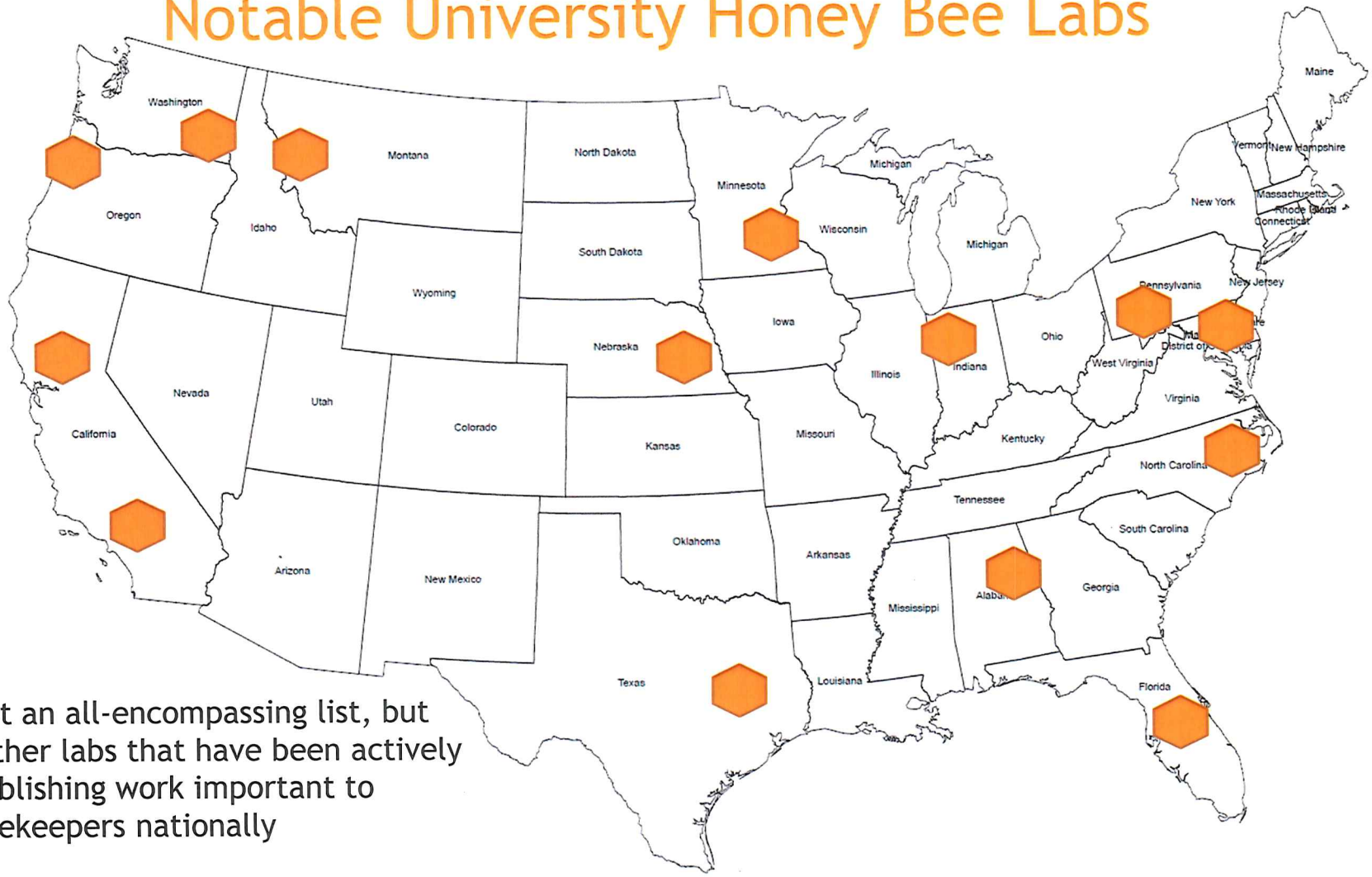
Ascosphaera apis (chalkbrood)	35.45%
Acute Bee Paralysis Virus	16.72%
American Foulbrood	0.67%
Acarapis woodi (tracheal mite)	6.35%
Black Queen Cell Virus	97.99%
Chronic Bee Paralysis Virus	12.71%
Crithidia mellificae	0.67%
Deformed Wing Virus-A	78.93%
Deformed Wing Virus-B	94.65%
Deformed Wing Virus-C	0.33%
European Foulbrood	28.76%
Israeli Acute Bee Paralysis Virus	21.74%
Kashmir Bee Virus	0.00%
Lotmaria passim	15.05%
Lake Sinai Virus 1	50.17%
Lake Sinai Virus 2	30.77%
Nosema apis	1.00%
Nosema ceranae	86.96%
Slow Be Paralysis Virus	0.00%
Sacbrood Virus	99.00%
Tropilaelaps spp.	0.00%


Pests Per Colony of Honey Bees
70
60
50
40
30
20
10
0
0
1
2
3
4
5
6
7
8
9
10
11
12
Number of Pests Found

USDA-ARS Bee Labs



Notable University Honey Bee Labs



Not an all-encompassing list, but rather labs that have been actively publishing work important to beekeepers nationally

NORTH DAKOTA DEPARTMENT of AGRICULTURE

Doug Goehring, Agriculture Commissioner

Samantha Brunner

State Apiary Inspector

Plant Industries Division Director

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701-328-4765

Honey Bee Research Grants

Grants funded cooperatively by ND Department of Agriculture funding and the ND Beekeeper's Association through honey fund- checkoff dollars

Date	Recipient	Project title	Amount
2012	Christi Heintz, Project Apis m.	Pollen Nutrition and Honey Bee Health	$ 27,500
2012	Marla Spivak, Univeristy of Minnesota	Bee Informed Partnership, Honey Bee Tech-Transfer Team to Monitor Colony Health in the Upper Midwest	$ 29,830
2012	Matthew Smart, University of Minnesota	The effects of landscape on honey bee health and immunity in a managed, migratory beekeeping operation	$ 38,256
2014	Randy Oliver	Honey Bee Health Research	$ 5,000
2014	Marla Spivak, Univeristy of Minnesota	Bee Breeding and Management	$ 10,000
2015	Marla Spivak, Univeristy of Minnesota	Evaluating the Potential Benefits of Native Prairie Flowers for Honey Bees	$ 17,729
2015	Marla Spivak, Univeristy of Minnesota	Enhancing the Tech-Transfer Team Program for the Commercial Beekeeping Industry	$ 24,541
2015	Marla Spivak, Univeristy of Minnesota	Bee Breeding and Management	$ 18,316
2015	Christi Heintz, Project Apis m.	Varroa mite control: Developing carriers for natural miticides.	$ 22,000
2016	FELIRC	Monitoring native pollinator communities throughout North Dakota	$ 20,000
2016	Daniel Downey, Project Apis m.	Measuring Varroa-resistant stock performance in ND- Year 1	$ 35,000
2016	Zachary Huang, Michigan State University	Varroa control using new plant based chemicals	$ 27,431
2017	Juliana Rangel, Texas A&M University	Evaluation of the Predatory Mite Stratiolaelaps scimitus for biological control of Varroa mites	$ 23,863
2017	Daniel Downey, PAm	Measuring Varroa-resistant stock performance in ND- year 2	$ 43,420
2017	Julie Shapiro, Honey Bee Health Coalition	Bee Integrated Demonstration Project	$ 25,000
2017	Marla Spivak, Univeristy of Minnesota	Enhancing the Tech-Transfer Team Program for the Commercial Beekeeping Industry	$ 63,380
2019	Brock Harpur, Purdue University	Using genomics to predict quality: which genes produce the best drones for ND	$ 35,489
2020	Marla Spivak, University of Minnesota	Enhancing the Tech-Transfer Team Program for the Commercial Beekeeping Industry	$ 30,741
2020	Karen Rennich, BIP	Enhancing the Tech-Transfer Team Program for the Commercial Beekeeping Industry	$ 28,565
2021	Nathalie Steinhauer, BIP	Uncovering the Transmission Risks of Honey Bee Viral Variants	$ 59,996
2021	Zachary Lamas, University of Maryland	Varroa control: New finding to create a bait trap	$ 57,175
2022	Nathalie Steinhauer, BIP	Evaluating effectiveness of prophylactic Nosema treatment for ND honey producers	$ 53,713
2022	Zachary Bateson, NAGC	Tracking Viral Titers in Colony Sub-Populations	$ 23,580
2022	Garett Slater, USDA	Which Queens Produce the Best Bees for North Dakota Beekeepers?	$ 80,000

Since 2012, funded 24 projects totaling $800,525

ND Specialty Crop Block Grants involving Bees

16-236 - $90,646.00 - Using biofertilizers to enhance mutualisms between specialty crops and beneficial insects

North Dakota State University will investigate the impact of biofertilizers on plant growth and floral traits relevant for beneficial insects, such as pollinators and natural enemies, using three types of specialty crops (confection sunflower, edamame, field peas). We will partner with local organizations that support specialty crops to share educational information and research results at conferences/meetings or via printed/online media.

17-360 - $51,522.00 - Evaluating Underutilized U.S. Native Trees and Shrubs for North Dakota

The North Dakota State University Woody Plant Improvement Program will evaluate numerous U.S. native plants for landscape use and commercial nursery production to determine propagation methods, establishment, winter and drought hardiness, soil adaptation, pest susceptibility, aesthetic characteristics and survival in North Dakota within two different USDA hardiness zones (3b and 4a) with disseminating results to specially crop beneficiary through website publications, presentations and field days.

17-371 - $98,474.00 - Breeding and Selection of Vegetable Crops for Northern Climate

North Dakota State University will breed and develop new cultivars of tomato, peppers, and selected cucurbit crops including squash, pumpkin and melons. Research focus will on genetic improvement in these crops for earliness, disease resistance, and higher nutritional quality. The ultimate goal is to develop and release new cultivars of selected vegetable crops that are suited for northern climate. Success of this research will enhance local production and consumption of vegetables in the northern plains region.

17-377 - $32,950.00 - Making Better Selections of Japanese Haskap for North Dakota

The Carrington Research Extension Center (CREC) will investigate and plant new breeder selections of Japanese haskap and Japanese haskap crosses to replace commercial selections currently available in North Dakota and the US. The selections made in this project will produce a larger fruit crop that clings well in windy conditions. Additionally, we will use established haskap plants to study novel pollination strategies that will increase fruit production.

18-249 - $342,322.00 - A Quantitative and Longitudinal Study of Honey Bee Health

The National Agricultural Genotyping Center will perform a two-year honey bee study on the relationship between colony loss and pathogen loads to inform disease management and minimize premature losses within beekeeper operations in North Dakota, the top honey-producing state.

18-267 - $127,085.00 - Enhancing dry bean production with adjacent pollinator habitats: Quantifying the range and extent of benefits.

North Dakota State University will work to enhance dry bean production by encouraging insect pollination in dry beans. We will perform research to quantify the benefits of pollinators for dry bean yield and quality. We will also research how to encourage pollinators in beans by establishing adjacent

pollinator habitats. Then, we will disseminate our results to stakeholders through NDSU Extension fact sheets and field days performed at participating field stations.

To perform this research we will conduct field experiments at the Carrington and Hettinger Research Extension Centers (REC). Over two years, in at least two fields at each REC (8 total) we will plant pollinator habitats using a mix of annual flowers. These habitats will be at the edge of the field, in relatively less productive areas, where producers may plant them. We will then plant dry beans in long strips with one end of the strip adjacent to the annual flower plantings. Surveys will quantify pollinators in flowers and beans while determining if pollinator visits change with distance to flowers. We will also perform cage experiments at varying distances from pollinator habitat. Half the cages will completely enclose beans so pollinators cannot visit. The other half will mimic cage shading but still allow pollinators to visit bean flowers. We will then compare bean yield and quality among cages and see if that difference changes with distance to pollinator habitat.

This research will be an important step in improving bean production while helping promote local pollinators.

18-NDDA - $54,354.25 - Honey bee colonies outside the North Dakota Heritage Center for Educational Purposes

The North Dakota Department of Agriculture (NDDA) will place two living honey bee colonies outside the North Dakota Heritage Center and Museum as part of an educational display. The colonies will be managed by NDDA Staff and used as education and outreach for the honey industry, focusing on how honey bees are managed, the necessary environmental and ecological resources for successful honey production, and the threats facing honey producers and their bees. To make this as safe as possible for the general public some alterations to the grounds including landscaping and a fence will need to be installed.

DA2323-13 - $130,251.00 - Nosema infection analysis in Honey Bees and Surveillance of Exotic Tropilaelaps Mites

The North Dakota Department of Agriculture will collect information on hive health from a total of 100 colonies over the summer in North Dakota and look for correlations of hive health, Nosema spore counts, and molecular results. Molecular diagnostics, while helpful, currently don't relate to traditional spore counts that have been used for diagnosing Nosema infection levels. This study will work to correlate spore counts with molecular test results. Hive strength assessments and varroa mite levels taken along with the Nosema results will aim to help provide some guidance on what levels of Nosema relate to impacts on hive health. Molecular tests will also show other viruses, pests and pathogens that may be present in the samples.

A second component of the project will be to collect adult bees and hive debris samples from 600 colonies
across the United States. These samples will be screened for the exotic pest of honey bees, Tropilaelaps spp.,
using molecular diagnostics. Tropilaelaps mites are not currently known to exist in North America, but surveillance and early detection are key for any hope of controlling them when they do arrive.

19-434 - $75,751.00 - Optimizing the deployment of bee-vectored Clonostachys rosea for managing Sclerotinia head rot in confection sunflowers

The North Dakota State University Carrington Research Extension Center, in cooperation with the NDSU Langdon Research Extension Center, will conduct multi-location field trials and conduct outreach to North Dakota and Minnesota sunflower producers to improve the management of Sclerotinia head rot of confection sunflowers, a sporadic but serious disease for which no management tools are currently available. Field trials will be established to develop rigorous recommendations for the deployment of a novel disease management strategy that has conferred consistent, strong control of head rot even under severe disease pressure. In field trials conducted in Langdon and Carrington in 2016, 2017 and 2018, the use of bees to inoculate sunflower heads with strain CR7 of the fungal biological control agent Clonostachys rosea conferred 33 to 60 percent reductions in Sclerotinia head rot under moderate to severe disease pressure. The biological control agent is deposited with an automated dispenser on the surface over which the bees travel as they exit their hives, and the bees deposit the biological on sunflower florets as they pollinate. This project seeks to determine the spatial distribution of bee hives required to achieve satisfactory control of head rot by quantifying the distance away from bee hives that satisfactory disease control is achieved. The project will contribute to the development of rigorous recommendations for managing Sclerotinia head rot in confection sunflowers, and results with be disseminated to producers and industry stakeholders at outreach meetings, in trade publications, and with reports published online.

20-480 - $105,630.00 - Managing Sclerotinia head rot in confection sunflowers with bee-vectored Clonostachys rosea and partially resistant hybrids

The North Dakota State University Carrington Research Extension Center, in cooperation with the NDSU Langdon Research Extension Center, will conduct multi-location field trials and outreach to North Dakota and Minnesota sunflower producers to improve the management of Sclerotinia head rot of confection sunflowers, a sporadic but serious disease for which no management tools are currently available. Field trials will be established to develop rigorous recommendations for the combined deployment of partially resistant hybrids and a novel disease management strategy that has conferred consistent, strong reductions in head rot. In field trials conducted in Carrington and Oakes, the least susceptible confection hybrid had 30 to 89% lower incidence of Sclerotinia head rot than the most susceptible hybrids under moderate to severe head rot pressure. In field trials conducted in Langdon and Carrington in 2016-2019, the use of bees to inoculate sunflower heads with strain CR7 of the fungal biological control agent Clonostachys rosea conferred 26 to 60 percent reductions in Sclerotinia head rot under moderate to severe disease pressure. This proposal seeks to integrate these management strategies, to determine the spatial distribution of bee hives required to achieve satisfactory control of head rot by quantifying the distance away from bee hives that satisfactory disease control is achieved, and to generate additional data on the relative susceptibility of confection hybrids. The project will contribute to the development of rigorous head rot management recommendations for confection sunflowers. Results will be disseminated at outreach meetings, in trade publications, and with reports published online.

21-340 - $179,861.00 - Using Honey Samples to Monitor Pathogens and Parasites in North Dakota Beekeeping Operations

The National Agricultural Genotyping Center (NAGC) will develop molecular diagnostics for two parasitic protozoans and the Tropilaelaps mite to incorporate into a surveillance program using honey samples from commercial and hobby beekeepers in North Dakota.

21-351 - $118,483.00 - Managing Sclerotinia head rot in confection sunflowers with bee-vectored Clonostachys rosea and partially resistant hybrids

The North Dakota State University Carrington Research Extension Center, in cooperation with the NDSU Langdon Research Extension Center, will conduct multi-location field trials and outreach to North Dakota and Minnesota sunflower producers to improve the management of Sclerotinia head rot of confection sunflowers, a sporadic but serious disease for which no management tools are currently available. Field trials will be established to develop rigorous recommendations for the combined deployment of partially resistant hybrids and a novel disease management strategy that has conferred consistent, strong reductions in head rot. In field trials conducted in Carrington and Oakes, the least susceptible confection hybrid had 30 to 89% lower incidence of Sclerotinia head rot than the most susceptible hybrids under moderate to severe head rot pressure. In field trials conducted in Langdon and Carrington in 2016-2020, the use of bees to inoculate sunflower heads with strain CR7 of the fungal biological control agent Clonostachys rosea conferred 13 to 60 percent reductions in Sclerotinia head rot under moderate to severe disease pressure. This proposal seeks to integrate these management strategies, to determine the spatial distribution of bee hives required to achieve satisfactory control of head rot by quantifying the distance away from bee hives that satisfactory disease control is achieved, and to generate additional data on the relative susceptibility of confection hybrids. The project will contribute to the development of rigorous head rot management recommendations for confection sunflowers. Results will be disseminated at outreach meetings, in trade publications, and with reports published online.

DA02325-05 - $102,094.00 - Honeybee Virus and Pathogen Survey and Research Publication

The North Dakota Department of Agriculture (NDDA) will document the presence or absence of various honeybee pests and pathogens through a comprehensive survey and provide outreach and education to the beekeeping industry and the general public. NDDA will also publish a booklet with all the previously funded research projects funded by various grant programs that NDDA administers.

22-228 - $118,466.00 - High-throughput screening for the genetic markers of Africanized honey bee colonies

The National Agricultural Genotyping Center (NAGC) will develop a high-throughput genetic test to survey colonies for a common marker associated with Africanized honey bees (AHB). The test will help apiary inspectors and beekeepers identify AHB and limit the further spread of aggressive colonies and AHB traits associated with reduced honey production.

DA02326 - $151,008.80 - Diagnostics of Nosema Infection in Honey Bees

Apiary inspection programs from the North Dakota Department of Agriculture, South Dakota Department of Agriculture and Natural Resources, Massachusetts Department of Agricultural Resources, Montana Department of Agriculture, Maine Department of Agriculture, Conservation and Forestry and

Vermont Agency of Agriculture, Food and Markets will collect information on hive health from a total of 1200 colonies (over 2 years) and look for correlations of hive health, Nosema spore counts, and molecular results. Molecular diagnostics, while helpful, currently don't relate to traditional spore counts that have been used for diagnosing Nosema infection levels. This study will work to correlate spore counts with molecular test results. Hive strength assessments and varroa mite levels taken along with the Nosema results will aim to help provide some guidance on what levels of Nosema relate to impacts on hive health. Molecular tests will also show other viruses, pests and pathogens that may be present in the samples.

NORTH DAKOTA POLLINATOR PLAN

A North Dakota Department of Agriculture Publication

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Revised February 2016

Doug Goehring
Agriculture Commissioner

NORTH DAKOTA
DEPARTMENT of AGRICULTURE

North Dakota is a giant in production agriculture. Our state leads the nation in the production of many grains, oilseeds, legumes and other crops. To the surprise of some, North Dakota is also the national leader in honey production. Relations between our farmers and beekeepers have traditionally been cordial, even friendly, but in recent years some tensions have arisen over unexplained increases in honey bee mortality, a phenomenon some have blamed on agriculture.

The North Dakota Pollinator Plan was developed in response to a growing need for a balanced public policy that mitigates risk to honey bees, while minimizing the impact of that mitigation on production agriculture.

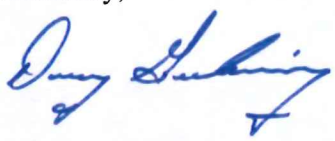
Reducing honey bee exposure to pesticides is ideal. Our hope is to achieve this while continuing to provide access to habitat that supports bee health and derived benefits to agriculture.

This pollinator plan is not a static document, but a work in progress. We intend to revisit this document annually and update as needed. Far too little is known about the factors that may affect honey bee health. Research focusing on nutrition, bee repellants and the effects of pesticides is important. Other research into honey bee health, disease and parasite resistance and genetic diversity is also urgently needed so that more effective and comprehensive strategies can be put in place. We believe research can provide new answers and better solutions to the current dilemma.

Finally, effective communication among all parties is essential to the success of this plan. Unless we communicate freely and openly with one another, the rest of our goals cannot be reached.

Working together – farmers, beekeepers, pesticide applicators, scientists – North Dakota can protect its honey bees, while maintaining its position as a leading supplier of food, feed, fiber, and fuel for our nation and the world.

Sincerely,



Doug Goehring
Agriculture Commissioner

Introduction

North Dakota leads the nation in the production of over a dozen commodities including flax, sunflower, dry beans, canola, spring wheat, etc. North Dakota is also the top honey producing state in the nation. Beekeepers bring approximately half a million hives into North Dakota each year. With such a large number of hives in the state, and with over 90 percent of North Dakota acreage being used for agriculture, it is inevitable that hives will be placed in close proximity to areas where a variety of crops are grown and pesticides are commonly used.

Managed bees and wild pollinators are important to U.S. agriculture. Over 90 crops in the U.S., including almonds, tree fruits, cotton, berries, and many vegetables, are dependent on insect pollinators, such as the honey bee, for reproduction (USDA 2013). Bee-pollinated crops account for 15 to 30 percent of the food we eat (USDA 2013). Although not completely dependent on insect pollination, crops such as canola, dry edible beans, buckwheat, and sunflowers have been shown to greatly benefit from bee pollination. Almost all of the honey bees found in ND spend their winters in warmer climates contributing to the success of agriculture nationwide. North Dakota has been referred to as the "last frontier" where beekeepers can bring their bees to recover from the stress of pollination services and have adequate forage to produce high quality honey. This resting period is an important factor contributing to their winter survival.

A common misconception about ND beekeepers is that none of them are ND residents. This is not true; many of our 205 beekeepers consider ND their home and only follow their bees out of state for a few months each year.

Beekeepers have suffered significant colony losses over the past decade, raising questions about the sustainability of managed colonies in the U.S. This issue has gained national attention, and in response the U.S. Department of Agriculture (USDA) created the Colony Collapse Disorder (CCD) Steering Committee in 2007. Made up of personnel from USDA's Office of Pest Management Policy, National Institute of Food and Agriculture, Agricultural Research Service, Animal and Plant Health and Inspection Service, and the Natural Resources Conservation Service, as well as staff from the U.S. Environmental Protection Agency (EPA), and public and private partners, the CCD Steering Committee was formed to look at factors contributing to bee decline.

The CCD Steering Committee hosted the National Honey Bee Health Stakeholder Conference in October 2012 to discuss multiple factors influencing honey bee health. The committee concluded that there are multiple factors impacting the decline of the honey bee in the United States and that no one factor can be blamed for the declines. These factors include pests, parasites, diseases, low genetic diversity and poor nutrition. The Steering Committee also concluded that additional research is needed to determine to what extent pesticides are contributing to the declines.

Even with significant losses by some beekeepers each year, North Dakota produced over 34 million pounds of honey in 2012, which made up over 23 percent of the honey produced nationally (USDA 2013). In addition to honey, the wax, pollen and propolis is also collected and sold in a variety of products including soaps, lotions, and vitamins.

Challenges Faced by Beekeepers

Beekeepers face a challenging task of keeping colonies alive with the threat of Colony Collapse Disorder, Varroa mites, Tracheal mites, small hive beetles, bacterial, fungal and viral diseases, declining quality forage, and pesticide exposure. Nationally, year to year colony survival is variable with some beekeepers reporting losses as high as 30%.

Growers and pesticide users cannot help beekeepers manage threats from mites, beetles and the microbes that weaken their hives. They can, however, help with reducing their exposure to pesticides and improving the quality of forage available. Even though Varroa is considered the greatest threat to honey bee colonies, a strong colony can handle the pressures of this tiny creature better than one exposed to various pesticides and poor forage that weaken the hive.

Honey bees feed on pollen for their protein source, and utilize nectar for carbohydrates. They must obtain these nutrients from a variety of plants in order to obtain all the essential amino acids and nutrients required to build and maintain a strong hive. Bees can become easy targets for pests, predators and pathogens when they do not obtain the proper balance of nutrients. Bees provided with high quality forage are better able to handle stressors from all directions including pesticides.

Honey bees are commonly exposed to pesticides either intended for use in agricultural production or in an attempt to rid them of the Varroa mite. Agriculturally-applied pesticides can impact bees from direct contact with the insect or by contaminating forage. Beekeepers worry not only about immediate lethal effects from exposure but also the more subtle sub-lethal impacts such as increased brood mortality and reduced adult longevity.

Challenges Faced by Growers

Growers face many challenges in an attempt to obtain acceptable yields. Growers contend with insect pests, diseases, weeds, drought, overland flooding and other factors that impact crop production and quality. They have a variety of pest management tools and strategies to choose from. While growers do not have to try to kill a mite on an insect, they often need to eliminate pests and competing plants without impacting yields. They also must consider the timing of pesticide applications with respect to harvest and rotational intervals. Even with integrated pest management systems, pests often are able to adapt quickly to different methods, rotations, or pesticides, or reproduce so quickly that they seem to explode within a short amount of time. Because of the nature of such pests, making timely chemical applications as part of an IPM plan are often essential to manage pests effectively.

Beekeepers can have difficulty finding land that will not be exposed to pesticides. Growers face difficult decisions when managing pests and minimizing impacts to pollinators. This plan should demonstrate how they can do both. Following the Best Management Practices (BMPs) within this document will help ensure abundant, affordable, safe, and nutritious food for years to come.

Challenges Faced by Pesticide Users

Pesticide users face many challenges in North Dakota. There are over 12,000 registered pesticides in North Dakota that are used to manage agricultural and non-agricultural pests. In many cases, pesticide applicators have a limited time window to make an application. Factors such as pest infestation levels, temperature, precipitation, wind speed, water levels, use buffers,

and presence of pollinators all affect pesticide choices and decisions on when, where, and how to apply pesticides. Applicators also must pay attention to the location of sensitive sites adjacent to treatment sites, such as surface water, endangered species, organic fields, vineyards, and beehives. The ideal time to apply many of these chemicals is likely to coincide with when the pollinators are most active, putting pesticide applicators in a difficult position of balancing pest management needs and protecting pollinators.

The Plan

The goal of this plan is not to eliminate pesticide use or to ban pesticides in hives or in close proximity to hives. Instead, the goal is to bring awareness to the issues faced by all parties and find a way for everyone to be part of a solution. The following Best Management Practices (BMPs) were developed with this in mind.

The North Dakota Department of Agriculture (NDDA) hosted two multi-stakeholder discussions in the past year focused on pollinator issues. These provided an opportunity for landowners, beekeepers, pesticide users, government officials, and other stakeholders to discuss pollinator/pesticide issues and offer input on reasonable practices that beekeepers, landowners, and pesticide applicators could do to protect pollinators and minimize impacts to livestock and crop producers.

The Pollinator Plan contains voluntary BMPs for pesticide users, landowners/growers, and beekeepers in hopes of creating the following positive outcomes:

- Ensuring positive relationships and peaceful co-existence among beekeepers, landowners, and pesticide applicators,
- Reducing pesticide exposure and subsequent risk of pesticides to pollinators,
- Ensuring both a robust apiary industry and agriculture economy, and
- Continued high compliance with state pesticide and apiary requirements.

Beekeeper BMPs

- **Work with landowners to choose hive locations.** Ideal hive locations will have minimal impact on agricultural activities but will still have adequate access to forage and water. Avoid low spots to minimize impacts from drift or temperature inversions on hives. Give consideration to timing after rain events when determining which roads to travel. Discuss with landowners preferred roads/trails to use. Beekeepers should also request contact information for applicators, renters, and neighbors (if applicable).

- **Be cognizant of neighboring landowners when placing and moving hives.** Neighboring landowners often use the same roads, trails, and section lines. Do not block these right-of-ways or place hives so close they may cause problems for other land-users. Take appropriate steps to ensure that bees do not negatively affect operations of neighboring landowners, such as considering the proximity of hives to neighbor's yard, bins, equipment, or storage sites.

- **Ensure managed honey bees have sufficient resources throughout the year.**
    - Availability of sufficient forage and water may change throughout the year. If water or forage sources become limited, ensure bees are not watering or foraging at or near

locations that could be bothersome for landowners or agricultural practices (i.e. bees utilizing livestock tanks for water sources).

- Be cognizant of available water sources and provide water if natural sources become depleted or unacceptable. Water sources that do not provide breeding sites for mosquitoes are preferable.
- Move hives to a new location when forage is diminished to ensure bees don't become an inconvenience to others in the area.

- **Comply with all requirements of the ND beekeeping law.**
  - Obtain Beekeeper's License each year – new legislation has been added conditions of licensure to the beekeeping law. These conditions must be agreed upon by the beekeeper prior to the issuance of a license.
    - An apiary will not be placed at a location without first obtaining the consent of the property owner; and
    - An apiary will be relocated at the request of the agriculture commissioner if:
      - The commissioner, after examining documentary evidence, has determined that the health or welfare of an individual is endangered as a result of the apiary's location;
      - The individual referenced in paragraph 1 (above) resides on land contiguous to that on which the apiary has been placed;
      - The commissioner has identified another acceptable location for placement of the apiary; and
      - There are no other contractual or other legal impediments to the relocation.
  - Register all apiary (hive) locations
  - Clearly post contact information and beekeeper ID number at all hive locations

Continue to provide up to date hive locations throughout the season. This ensures that all locations are accurate when applicators attempt to locate them. The NDDA has created an interactive map and registration system that will allow beekeepers to mark what apiary locations are active and which are empty with just the click of a button. This information can be updated at any time by logging into your beekeeper account and editing each location. This system will also allow beekeepers to add and delete locations without the added processing time of mailing the information in to the department. The map can be found on the NDDA homepage (http://www.nd.gov/ndda/).

- **Work constructively with applicators when notified of upcoming pesticide applications.** One of the recommended BMPs for pesticide applicators is to contact nearby beekeepers prior to making pesticide applications. Block, move, or net hives when applicators inform you they are going to apply pesticides, or find other strategies to allow pesticide applicators to manage pests while minimizing pesticide exposure by bees.

- **Notify landowners and applicators when arriving and when moving hives.** If possible, notify nearby pesticide applicators and landowners when you place or move beehives. This will ensure they are aware of current hive locations and can notify you before making pesticide applications. Contact information for nearby pesticide applicators can usually be obtained from landowners.

- **Obtain landowner permission for hive placement every year and keep in contact.** As landowner information changes, it is important to ensure everybody is aware and bees are not placed without permission. This step is imperative to ensure hives to do not become a nuisance.

- **Report all suspected pesticide-related bee kills to the NDDA pesticide program immediately.** Inspect bee behavior regularly. The NDDA is the lead pesticide regulatory agency in the state. The NDDA will respond to complaints, including collecting and analyzing the location for pesticide residues. Some pesticides degrade rapidly, and timely reporting will aid the pesticide investigation. Beekeepers can report suspected pesticide incidents by calling 1-800-242-7535 or 701-328-2231 and asking to speak to a representative from the pesticide program.

- **Use registered pesticides according to the label**. When pesticide use is necessary to manage pests within hives, use registered pesticides and comply with all restrictions, precautions, and directions found on the pesticide label. Failure to comply with label directions may decrease the effectiveness of pesticides, increase the risk of adverse effects to bees, cause unsafe pesticide residues in honey and other products, and potentially lead to pesticide resistance. Contact the NDDA pesticide program with any questions on pesticide labeling or to determine whether a pesticide is registered in the state.

- **Ensure hives are easily visible to applicators.** Hives must be visible so applicators can locate them before spraying. It is strongly suggested that hives are painted white, or a color that stands out from the surrounding area.

Landowner/Grower BMPs

- **Work with beekeepers to choose hive locations.** Ideal locations for hives will have minimal impact on farming/ranching operations, but will still allow bees to access forage and water. Communicate with beekeepers which roads/trails can be problematic when wet and any preferred traffic routes. Landowners may also want to provide contact information for applicators, renters, and neighbors (if applicable).

- **Communicate with renters about bee issues**. Renting land for agricultural production is a common practice. Landowners and renters should discuss bee issues, such as who has authority to allow bees, how long they will be allowed, and hive placement. These issues should be addressed and included when rental agreements are negotiated.

- **Communicate with pesticide applicators whose responsibility it is to look for hives, notify neighbors, etc.** When contracting with commercial pesticide applicators, make sure that there is a clear understanding of who has the responsibility to identify hive locations and communicate with beekeepers. Applicators may do this as part of their standard procedures, but some landowners may prefer to make beekeeper contacts themselves.

- **Agronomists should consider pollinator impacts when making pesticide recommendations.** Ensure that agronomists and crop consultants consider pollinator issues when making pesticide recommendations, including product choices and pesticide timing decisions.

- **Plant bee forage.** Plant flowering plants, trees, and shrubs to improve bee forage,

especially in non-farmable or non-crop areas. Doing so provides forage and it may also concentrate bees away from fields to be treated with pesticides, thereby minimizing impacts to pollinators.

- Many pesticide labels require untreated **vegetative buffer strips** around sensitive sites. Plant flowering plants in those buffer strips to provide additional bee forage.
- If planting **cover crops**, add flowering plants into the mix. Even a small percentage of flowering plants can provide a considerable amount of forage for pollinators.

• **Utilize alternatives to talc/graphite in planters.** When planting seeds treated with insecticides, utilize alternatives to talc/graphite as they become available. The talc and graphite can abrade the insecticide treatment off of the seeds, thereby creating insecticide-containing dust that can drift onto hives and flowering plants.

Pesticide User BMPs

• **Use Integrated Pest Management (IPM).** Utilize economic thresholds and integrated pest management (IPM) to determine if insecticides are required to manage pests. When insecticides are required, try to choose insecticides with low toxicity to bees, short residual toxicity, or repellent properties towards bees.

• **Use registered pesticides according to the label.** Pesticide label language is developed to ensure that pesticides will not pose a risk of unreasonable adverse effects to human health or the environment. Failure to comply with the label not only puts humans and the environment at risk, it is also illegal. Many pesticides, especially insecticides, have use restrictions prohibiting applications when bees are foraging in the treatment area. Some labels prohibit applications when crops are blooming and require that the applicator notify beekeepers in the area prior to application. Always comply with these and other label restrictions to reduce risks. Applicators are bound by all directions, precautions, and restrictions on pesticide labeling, even when following other BMPs. Contact the NDDA with any questions on pesticide label language.

• **When possible, apply pesticides early morning or in the evening.** Pollinators are most active during daylight hours and when the temperature is over 55 degrees Fahrenheit. Apply pesticides early in the morning or in the evening when bees are less active to reduce the chances that bees will be foraging in or near the treatment site.

- Be cognizant of temperature restrictions on pesticides. The efficacy of some pesticides is reduced at certain temperatures.
- Be aware of temperature inversions when choosing the best time for applications.

• **Avoid drift.** Pesticide drift involves the off-site movement of pesticides through the air from the treatment site to adjacent areas, either in the form of mist, particles, or vapor. Drift reduces the effectiveness of the chemical applied since only part of the applied amount reaches the target. Drifting chemicals also pose a risk to non-target organisms that come in contact with the off-target residues. These insecticides can negatively affect bees and other beneficial insects by direct contact or by contaminating their forage and habitat. Drifting herbicides have the potential to further reduce quality forage available to pollinators. Contact NDSU Extension Service for more information on how to reduce pesticide drift.

- **Identify and notify beekeepers in the area prior to pesticide applications.** Bees will fly several miles to find quality forage. Therefore, pesticide applicators should identify and notify beekeepers within two miles of a site to be treated at least 48 hours prior to application or as soon as possible. Timely notification will help ensure ample time for the beekeeper and applicator to develop a mutually acceptable strategy to manage pests while mitigating risk to honey bees. This may include covering hives, moving hives, or choosing the time of day to apply. **Notifying beekeepers does not exempt applicators from complying with pesticide label restrictions. Many insecticide labels prohibit use if pollinators (bees) are present in the treatment area.*

The NDDA has created an interactive searchable map where pesticide applicators can identify registered bee yards and other pesticide-sensitive sites. The GIS Map for Applicators also contains beekeeper contact information and can be found on the NDDA homepage (http://www.nd.gov/ndda/). New features have been added to this map allowing applicators to create watch regions where they will be notified if any hives are added to or removed from a set area. This site also allows applicators to create an application region and the site will notify beekeepers of a pending application.

- **Choose products with lower risk to bees.** Avoid dusts and wettable powder insecticide formulations. Dust and wettable powder pesticide formulations can leave a powdery residue which sticks to hairs on bees. Bees then bring the pesticide back to the hive and potentially expose the entire hive to the pesticide for an unknown amount of time. Granular and liquid formulations are safer for pollinators since granules are not typically picked up by bees, and liquids dry onto plant surfaces. Also choose products with lower residual toxicity to bees. Note that the NDDA will be working with NDSU to develop guidance on product choices to reduce risk to bees.

Supporting Pollinator Forage & Habitat

- **Bee Forage**. Everyone can plant forage for bees. Plants that support pollinators are also beneficial for other wildlife, are often visually attractive, and can help improve soil health. Flowers often come to mind when thinking about bees, but bees also utilize trees, shrubs, and other less-noticeable plants for pollen and nectar sources. It is important to consider diversity when choosing plants to ensure adequate forage for the entire growing season. Diversity will also ensure pollinators have access to all of the nutrients they require to be healthy. Here are some easy, efficient ways to improve pollinator forage.

    - **Municipalities** can plant trees, shrubs and flowers that provide good forage for all types of pollinators. Diversity is important, the pollen and nectar of each species carries a different nutrient load for the pollinators. This can be worked into new plantings, every time a plant is added/replaced choose a variety that will contribute to pollinator forage. Foraging honey bees are typically not aggressive.

    - **Counties** can create bee forage along secondary roads. Secondary road ditches often contain several species of plants that provide forage for pollinators. It is a common practice to mow ditches for the safety of motorists and to prevent drifting snow. Consider spot spraying noxious weeds and mowing ditches later in the year to ensure that bee forage is available. Incorporate short forbs into secondary road ditches to minimize attracting large wildlife.

- **Homeowners** can put out flower pots, create flowerbeds, plant trees or shrubs, or establish gardens to provide forage. Homeowners should also take special precaution when applying pesticides. The pesticide user BMPs apply to anyone using pesticides. Remember, the pesticide label is the law and it is in place to minimize risk to the environment and human health.

• **Create habitat for beneficial, wild pollinators.** Roughly 70 percent of native bees nest in the ground. They burrow into areas of well-drained, bare, or partially vegetated soil. Other bees nest in abandoned beetle houses in snags or in soft centered, hollow twigs and plant stems. Bees will also utilize dead trees and branches. Habitats can be created by leaving deadfalls and brush piles as nesting habitat. Consider the type of habitat you wish to create and pollinators you want to attract. Be cognizant that certain structures might attract other animals such as fox, coyote, skunks, and porcupines.

• **Public land access**. Public land typically does not incorporate crop production and large scale insecticide use. There are some agencies that allow beekeepers to place honey bees on state and federal lands. Contact NDDA for more information. Permission must be obtained and locations placed on state or federal lands also need to be registered with the NDDA.