

## Insect Pollination at North Central Regional Plant Introduction Station — Past and Present®

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### **HISTORICAL DEVELOPMENT OF CONTROLLED INSECT POLLINATION AT NORTH CENTRAL REGIONAL PLANT INTRODUCTION STATION**

- Herb Spencer working in open plots in front of original wood-frame screen cages containing plants and honey bees ca 1965.
- 1957 — Honey bees were first used to pollinate cages of carrots, beets, celery, and onion; seed production in cages (consisting of wood frames covered with screen) was compared to that in open-pollinated plots of same accessions (Hoover, 1957).
- 1970s — 50 to 70 accessions of carrots, onions, parsley, and celery were increased in cages out of total 3,000 to 3,500 accessions grown annually.
- 1978 — Major improvements in 1.5 m × 1.5 m × 6 m (5 ft × 5 ft × 20 ft or “small”) field cage used for controlled insect pollination including metal cage frame covered with Lumite® flat screen and development of nucleus honey bee hive box (Ellis et al., 1981).
- 1982 — Development of 3 m × 3 m × 6 m (10 ft × 10 ft × 20 ft or “large”) cage constructed of metal frame and fitted Lumite® screen for pollination of wild-type sunflowers; also initiated use of 50% sugar syrup to feed honey bees retained inside of these large cages as the fitted screen did not allow for shifting bees outside to forage (Collison and Wilson, 1985).
- 1985 to 1988 — Found that a combination of flies and honey bees used for carrot pollination resulted in production of larger seed quantities (Wilson, et al., 1991).
- Houseflies were reared periodically at North Central Regional Plant Introduction Station (NCRPIS) from 1985 through 2004. Since 2004 all pupae have been purchased from outside sources.
- 1989 to 1990 — First use of alfalfa leafcutting bees and bumblebees as comparative pollinators in field cage study (Wilson and Roath, 1992).
- 1992 to 1995 — Studies of *Osmia* bee rearing and use for pollination of *Brassica* in early spring field cages (Wilson and Ablel, 1996; Abel and Wilson, 1998; Wilson et al., 1999).
- 1992 — Constructed indoor overwintering facility for honey bees (Wilson et al., 2000).
- 1993 — Native *Bombus* rearing trials and construction of domiciles was begun. Honey bee feed was switched from sugar syrup to high fructose corn syrup (Abel, 1993).

- Winter 2000/2001 — First use of blue bottle flies for greenhouse carrot pollinations (Unknown, 2000); NCRPIS rearing trials of blue bottle flies (Chaudhury and Alvarez, 1999; Chaudhury et al., 2000).
- 2002 — Development of greenhouse cages for wild *Cucumis* pollination with weak honey bee nucs and alfalfa leafcutting bees.
- 2003 — Honey bee feed container improvement to reduce robbing and syrup waste
- 2004 — Two 3785-L (1000-gal) polyethylene storage tanks for corn syrup were installed.
- 2004 — First field trials of alfalfa leafcutting bees for general germplasm regeneration in umbel and *Cucumis* field cages.
- 2006 — About 1100 accessions of umbels, brassicas, ornamentals, herbs, wild-type sunflowers, and vegetables were insect-pollinated in cages.

### **MISSION: PROVIDE ADEQUATE NUMBERS OF HEALTHY INSECTS FOR PLANT POLLINATIONS**

Controlled pollination of individual plant accessions maintained at NCRPIS is necessary in order to preserve the original genetic diversity of the plant populations.

Some plants are more effectively pollinated by insects than by hand. In addition, insects may be more economical (reduced time and labor costs) than hand pollination of crops.

At NCRPIS, insect pollinators are added to caged accessions of *Brassica* and other oilseed crops, miscellaneous umbels, wild-type sunflowers, vegetables such as cucurbits, as well as some ornamental and medicinal plant species.

### **CURRENT INSECT POLLINATORS USED AT NORTH CENTRAL REGIONAL PLANT INTRODUCTION STATION**

#### **HONEY BEES (*Apis mellifera*) — The Primary Pollinator.**

- Utilized at NCRPIS from 1957 to present.
- Placed in ca 800 cages/year in field and greenhouse.
- Domiciles can be used in multiple cages throughout the growing season
- Social bee with 2000 to 4000 bees per cage.
- Traditionally used to pollinate many different plants and for honey production; at NCRPIS used on many plants but honey fed back to the bees.
- Forage best at 15 to 32 °C (60 to 90 °F).
- Rearing is well established but costly due to the equipment and amount of continuing care required.
- Can be aggressive and sting.

#### **BUMBLEBEES (*Bombus impatiens*) — The Versatile Pollinator.**

- Utilized at NCRPIS from 1989 to present.
- Used in ca 10 cages/year in field and greenhouse.
- Domiciles can be reused in other cages as long as colony thrives.

- Social bee with ca 50 bees per domicile.
- Traditionally used to pollinate many different plants; at NCRPIS used mainly for ornamentals with trumpet-shaped flowers.
- Work in rainy, cool, and windy weather at 13 to 32 °C (55 to 95 °F); active for many hours each day.
- Rearing proved difficult, so commercial colonies are used; expensive to purchase.
- Can be mildly aggressive and sting.

***Osmia cornifrons* and *Osmia lignaria* — The Spring Pollinator.**

- Utilized at NCRPIS from 1992 to present.
- Used in ca 200 field cages annually, April to June; can be used in 10 to 15.5 °C (50 to 60 °F) greenhouse in April.
- Domiciles can not be relocated from one cage to another
- Solitary bee with ca 40-bee cells per cage.
- Traditionally used for early blooming fruit trees; at NCRPIS used for early season *Brassica*, miscellaneous umbels, and ornamentals.
- Forage best at 10 to 30 °C (50 to 85 °F).
- Rearing is established, not costly, but can not be manipulated outside the normal springtime life cycle.
- Non-aggressive.

**Alfalfa leafcutting bee (*Megachile rotundata*) — The Supplemental Pollinator.**

- Utilized at NCRPIS from 2004 to present.
- Used in ca 40 greenhouse cages and ca 200 field cages.
- Variable life span depending on time of year and crop.
- Solitary bee with 20 to 40 bees per cage; cells require 28 days incubation in lab.
- Traditionally used to pollinate forage legumes and blueberries; at NCRPIS used on cucurbits, *Daucus*, *Brassica*, *Melilotus*, *Angelica*, *Potentilla*, *Ocimum*, wild-type *Helianthus*, oilseeds such as *Brassica* and *Erysimum* all of which have small to medium-size flowers of “flat or open” nature.
- Work best at 26.5°C (80°F) or above in dry conditions, do not work well in cooler wetter weather.
- Rearing is established; bees are low cost and require little care once they have emerged from leaf cells.
- Non-aggressive but will bite if squeezed.

**ABOUT NORTH CENTRAL REGIONAL PLANT INTRODUCTION STATION**

- The North Central Regional Plant Introduction Station, or NCRPIS, is a joint venture among USDA-ARS, the Agricultural Experimental Stations of the 12 North Central States, and Iowa State University (ISU).
- As a component of the National Plant Germplasm System (NPGS), NCRPIS is dedicated to the conservation and utilization of plant genetic resources.
- The station was established in 1948 as one of four regional stations in the United States. (Wilson, et al., 1985).
- Mission related germplasm activities at the station include : Acqui-

sition, Maintenance, Regeneration, Distribution, Characterization, Enhancement, and Evaluation.

- The NCRPIS collections include over 49,500 accessions of 1860 species representing ca 340 genera distributed among five curatorial projects.
- Offices and laboratories are located on campus in the Agronomy Building at ISU, and at the headquarters and farm facilities located at the south-west corner of State Avenue and Mortenson Road.

Pollination Personnel. Research Entomologist R.L. Wilson and technician Sharon McClurg ca 1991. Craig Abel and Steve Hanlin — entomologists in charge of NCRPIS controlled-pollination program.

Prior to 1986, curatorial and farm staff performed all honey bee work in addition to their regular duties. In 1986 the first USDA-ARS technician (Bill Hotchkiss) was hired specifically to handle the controlled insect pollinators under the supervision of research entomologist R.L. Wilson (1980–2000). This position was later filled by Craig Abel (1988–1998) and upgraded to a support scientist. In addition to supplying honey bees for ca 800 field cages, Abel initiated a strong program of pollinator research with the aid of Dr. Wilson. Since 1999, Steve Hanlin has continued to supply high quality nucs of honey bees and has implemented regular use of alfalfa leafcutting bees with assistance from Sharon McClurg (1984 to present). A number of temporary student workers have also been essential to the success of the controlled pollination program.

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