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Storage Conditions for Maintaining *Osmia cornifrons* (Hymenoptera: Megachilidae) for use in Germplasm Pollination

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ABSTRACT: In 1977, *Osmia cornifrons* (Radoszkowski) was introduced from Japan into the United States as an orchard pollinator. The bee is of interest to the North Central Regional Plant Introduction Station because it is a highly efficient, cool season pollinator. We have need for early spring pollinators to possibly replace honey bees (*Apis mellifera* Linnaeus) for pollination of *Brassica* spp. in field cages. We tested four overwintering storage treatments (outdoors, in an unheated machine shed, in a 4–5°C seed storage room, and in a 1–2°C growth chamber) to determine the optimal winter storage conditions for diapausing adults. Storage in the 1–2°C growth chamber resulted in the highest emergence of bees for three test dates (April, June, and August).

Osmia cornifrons (Radoszkowski) (Hymenoptera: Megachilidae) (hornfaced bees) are solitary bees that were introduced from Japan in 1977 into the eastern United States as an orchard pollinator (Batra, 1979). In Japan, it is used commercially as a pollinator of apples and peaches. It has now become established in several states and is useful in pollination of apples, cherries, and peaches.

Osmia cornifrons are also called mason bees because they use mud to build their brood cells. They build nests in tubular burrows in wood or plant stems (O'Toole and Raw, 1991). They can be managed by providing straws in which they build their nests.

At the North Central Regional Plant Introduction Station, honey bees, *Apis mellifera* Linnaeus (Hymenoptera: Apidae), are used for early season pollination of *Brassica* spp. in field cages. Getting enough honey bees for adequate pollination is often a problem because overwintered colonies are frequently small and need time to build worker populations. We order package bees and queens from southern states to obtain enough honey bees for our spring pollinations. However, this is expensive (we purchase about 250 packages at $35.00 apiece) and it risks the possibility of importing mites.

In 1992, we became aware of *O. cornifrons* as a manageable, early season pollinator. In February, 1993, Dr. S.W.T Batra, USDA-ARS Bee Research Laboratory, Beltsville, MD, provided diapausing *O. cornifrons* so we could test their pollination potential at the USDA-ARS North Central Regional Plant Introduction Station in Ames, IA. The bees were stored from February to May in an unheated room (ambient temperature plus −13° to −18°C and ambient RH) that is used to store apiary equipment during the winter. Cool, wet weather in March and April of 1993 prevented normal planting of *Brassica* germplasm in April. Then, warm weather during the first week of May caused all the bees to emerge before they were needed on the late planted *Brassica*, thus none were available for pollination in 1993.

We realized that we needed to determine how to handle the bees by finding the optimum overwintering storage conditions. This would provide us a technique to have bees available for *Brassica* spp. pollination when they are needed. This study reports the results or our storage trials.

Materials and Methods

Bees (N = 3500) were purchased from Orchard Bees in Auburn, IN, and received in October of 1993. Twelve straws were placed in each of four storage areas: (1) outdoors on the east side of a building with ambient temperatures and humidities, (2) an unheated machine storage area with ambient temperatures and RH, (3) a 4–5°C cold storage room used for plant germplasm at the North Central

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Table 1. Percent emergence of *Osmia cornifrons* under four storage conditions at Ames, IA.

Storage conditions	Date bees transferred to 26.7°C			Treatment mean[a]
	25 April	2 June	2 August	
Outdoors	91.1	94.0	60.0	82.7ab
Machine shed	88.0	99.0	52.0	69.0b
4–5°C	91.0	89.0	31.0	71.0b
1–2°C	98.6	100.0	91.0	96.9a
Monthly mean[b]	85.0a	95.5a	59.3b	

[a] Column means followed by the same letter are not significantly different according to the LSD test ($P < 0.05$).

[b] Row means followed by the same letter are not significantly different according to the LSD test ($P < 0.05$).

Regional Plant Introduction Station. The bees were placed inside a sealed plywood box in which a moist sponge was added. Humidity readings within the box were taken on three successive days using a digital thermohygrometer: the average RH was 74.7%, and (4) a 1–2°C growth chamber with an RH of 75%. The straws that overwintered outdoors and in the machine shed had to be moved inside to the seed cold storage area in early April to prevent emergence during warm conditions in early spring. On 25 April, 2 June, and 2 August, 1994, four straws (reps) containing about 12 bees each were removed from each storage treatment area. They were x-rayed (Faxitron shielded x-ray system, model 43855A) to determine the number of bees contained inside the straws. The straws were kept at 26.7°C until all the bees emerged. They were then counted and compared to the x-ray number for percent emergence. Data were analyzed with the FACTOR program of MSTAT-C (MSTAT Development Team, 1989). When the F-value for treatments was significant ($P < 0.05$), means were separated with the least significant difference (LSD) test ($\alpha = 0.05$) included in the RANGE program of MSTAT-C.

Results and Discussion

Table 1 lists the percent emergence in all of the storage areas for the three dates. Storage in the 1–2°C growth chamber and storage of straws outdoors had a statistically higher percentage emergence than did storage in the machine shed and in the 4–5°C seed storage cold room. There was a drop in overall percent emergence in August, except in the 1–2°C storage chamber.

The main problem with outside storage is controlling bee emergence until they are needed for pollination of *Brassica*. These bees normally emerge in synchrony with cherry and apple blossom. Holding the bee straws in the 1–2°C growth chamber provided the best overall conditions and gave us the best reliability for obtaining bees when we needed them for pollination of *Brassica* in cages.

Another factor, besides temperature, that may be important in bee emergence is relative humidity. The 1–2°C growth chamber and the 4–5°C seed storage room had RHs of about 75% vs. lower humidities for the other storage areas. Since the two temperature controlled areas had the same relative humidities, we feel that temperature played a more important role in bee emergence.

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