



A carpenter bee
(*Xylocopa suspecta*)
in a greenhouse
at Florilegus,
in Jundiaí, São
Paulo state

Winged PRODUCTION

Companies develop methods
for breeding insects for pollination
and pest control

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Nests of native carpenter bees are expected to be available in the coming months, for sale to passion fruit growers. When present in cultivated fields, these bees increase the number of fruits per plant through pollination. The insects are currently being produced on a pilot scale by Florilegus, a company in São Paulo that began its operations in 2013 for the purposes of producing and selling nests of carpenter bees of the *Xylocopa* genus. “Individuals and governments in a number of countries are attempting to raise the presence of pollinators, which are essential to the agricultural production chain and are often affected by intensive use of insecticides in farming,” explains animal scientist Paola Marchi, the founder of Florilegus. “Brazil, for example, is one of the biggest passion fruit producers, and large bees, such as carpenter bees, are essential because unpollinated flowers do not produce fruit. These bees are becoming increasingly scarce on farms, and there is growing demand for pollination services,” she says.

Growers will be able to obtain nests containing recently emerged insects, which can be released among flowering crops. “The appropriate number, according to area covered and the recommended time they should remain in the cultivated fields, is still going through adjustments,” Marchi says. Bees of the *Xylocopa* genus are known to frequently reuse their old nests and therefore can remain for in areas where passion fruit crops are

cultivated for several generations. For this to occur, however, the bees need proper conditions for survival, such as other plants from which they can gather pollen as well as a source of protein because passion fruit flowers only provide nectar, which is their source of energy.

In order to develop the technology for breeding carpenter bees, Marchi is studying their reproductive aspects, including the females' ability to produce offspring. "In addition, storage and incubation periods for immature specimens are being tested at different temperatures in order to calculate and manipulate the carpenter bees' emergence," Marchi says. "We are developing and refining techniques for multiplying the number of nests, as well as for transporting and installing them in cultivated fields."

Another company, PROMIP, in the municipality of Engenheiro Coelho in the Campinas Metropolitan Region is developing technology for breeding native bees for pollination. These bees are a stingless species known as *mandaguari* (*Scaptotrigona depilis*) that live in colonies and can pollinate crops such as strawberries, tomatoes and coffee. "We started the project in 2010," says founding partner Marcelo Poletti. "It was divided into three stages: laboratory assessment of mass production, study of the insects' compatibility with the chemicals used in agriculture, and effectiveness in the field. We are now in the final stage and should begin nest sales in 2016."

PROMIP already has three species of mites on the market (which are not insects but rather arachnids, like spiders and ticks) used for biological pest control. Two of these species, *Phytoseiulus macropilis* and *Neoseiulus californicus*, are used for control of another type of mite, the two-spotted spider mite (*Tetranychus urticae*), which causes damage to vegetables, fruits, flowers and other cultivated plants. The third species, *Stratiolaelaps scimitus*, is used as a control agent for the fungus gnat (*Bradysia matogrossensis*), an insect that feeds on mushrooms and attacks the roots of several crops, mainly during seedling formation. "We produce approximately 100 million specimens of all three species per month in our biofactory," Poletti notes. "They are sold to growers and resellers."

Another company, which has already established itself in the market, is Bug. Located in the city of Piracicaba, it raises four different species of small parasitoid wasps as well as the hosts on which they propagate. *Trichogramma galloi* and *Trichogramma pretiosum* are used to control sugarcane borer eggs (*Diatraea saccharalis*), a small moth that, during its larval stage, attacks sugarcane crops (see *Pesquisa FAPESP* Issue No. 195). "If the borer infestation spreads across 10% of the crop, losses can exceed R\$1,000.00 per hectare," explains Alexandre de Sene Pinto, a Bug partner and its director for research and development. The company also breeds *Telenomus podisi*, which parasitizes the eggs of the neotropical

brown stinkbug (*Euschistus heros*), an insect that damages crops such as soybeans, beans and rice. In addition, the small wasp *Bracon hebetor* eliminates the moth larvae that infest stored products such as tobacco and peanuts.

All of these tiny wasps are bred through the use of other insect species, which are raised at Bug's facilities for that specific purpose. Both species of the genus *Trichogramma* and *B. hebetor*, for example, are grown on eggs and larvae of the *Anagasta kuehniella* moth, and *T. podisi* is reared on the eggs of its natural host, the neotropical brown stinkbug. "The *Trichogramma galloi* species was first produced on a small scale in 2001, but today we produce about 250 million of these each day, which is enough to treat 7,000 hectares of sugarcane against borer eggs," says Sene Pinto.

FRUIT FLIES

Moscamed, in the city of Juazeiro, Bahia State, is a nonprofit public interest group with a different biological control strategy for pests. Its biofactory produces sterile male Mediterranean fruit flies (*Ceratitidis capitata*), which are released onto fruit crops (mango, grapes, guava, acerola, orange), mainly in Northeast Brazil, to compete with their wild cousins of the same genus (see *Pesquisa FAPESP* Issue No. 133). Moscamed president Jair Fernandes Virgínio explains that the variety of insect used for breeding is Vienna 8, which was developed by the International Atomic Energy Agency. Unlike wild lineages, male and female Vienna 8 pupae have different colors, making it possible to determine the sex of the insect that will emerge.

The company uses this attribute to eliminate females during the egg stage through hydrothermal treatment. Water heated to 34°C kills all eggs containing females, leaving behind only male eggs, which are then sterilized by radiation (X-rays or gamma rays) and released into the wild. The area is monitored beforehand in order to estimate the number of preexisting flies. "We release from one to



Bracon hebetor, a wasp raised at Bug, attacks a moth larva (*Ephestia* sp.)



A stingless bee, one type of insect raised for pollination at PROMIP, in the city of Engenheiro Coelho, São Paulo

will be released in experimental areas with sizes varying from 50 to 100 hectares,” he says. “Concurrently, under the same project, we’re going to test biological control using *Diachasmimorpha longicaudata*, a small wasp that feeds on the larva of the South American fruit fly. These small wasps will be released in areas where there are native fruits.”

Insect-producing companies are emerging because the use of insects in farming reduces or eliminates the need to employ chemicals such as insecticides. “In southern Brazil, the tobacco moth is responsible for the loss of up to 10% of the stored product, besides causing small farmers to use insecticides in environments frequented by their families and themselves, resulting in cases of poisoning,” says Kovaleski. In Rio Grande do Sul, he says, the South American fruit fly causes annual losses of nearly R\$30 million in apple crops alone—the cost of insecticides and crop damage during harvest—which represents 2% of the yield. The losses are caused by the absence of pollinators. “Not having these in the fields can result in a 40% reduction in productivity,” explains Poletti from PROMIP. ■

nine sterile males for each wild male,” Virgínio explains. “They will compete for the females. After a sterile male mates with a female in the wild, she will lay eggs on the fruit, but no offspring will be produced. Over time, as more sterile males are released, the population of flies is reduced to a level that won’t cause economic losses.”

A similar principle is being tested by the Grape & Wine Research Center, a unit of the Brazilian Agricultural Research Corporation (Embrapa Grape & Wine), in Bento Gonçalves, Rio Grande do Sul State. In this case, the test subject is the South American fruit fly (*Anastrepha fraterculus*), which damages apple and peach crops in the region, mainly apples and peaches. The difference is that both males and females will be sterilized, see-

ing as the sex of this fruit fly cannot be determined during the pupal phase. Therefore, some damage to fruit might be observed during early experimental releases. The flies continue to lay eggs, even when they are infertile. The premise is that, when the sterile insects are released, fly populations will be reduced.

According to Adalécio Kovaleski, a researcher in entomology at Embrapa Grape & Wine, the pupae will be produced at its Experimental Station for Temperate Climate Fruticulture (EFCT) in Vacaria, Rio Grande do Sul. They will be brought, each week, to the Center for Nuclear Energy in Agriculture at the University of São Paulo (CENA/USP) in Piracicaba, where they will be sterilized through exposure to radiation. “Back in Rio Grande do Sul, sterile adult flies

Projects

1. Production at a commercial scale of solitary bees of the species *Xylocopa frontalis* (Olivier) in a greenhouse for use in the pollination of passion fruit and other economic crops in Brazil (No. 2013/50035-5); **Grant Mechanism:** Innovative Research in Small Businesses Program (PIPE); **Principal Investigator:** Paola Marchi Cabral (Florilegus); **Investment:** R\$91,246.97.
2. Mass production and commercialization of *Trissolcus basalis* and *Telenomus podisi* egg parasitoids for soybean stinkbug control (No. 2005/60732-9); **Grant Mechanism:** Innovative Research in Small Businesses Program (PIPE); **Principal Investigator:** Alexandre de Sene Pinto (Bug); **Investment:** R\$419,460.00.
3. Mass rearing and commercialization of *Trichogramma* Spp and *Cotesia flavipes* for the control of agricultural pests (No. 2004/13825-9); **Grant Mechanism:** Innovative Research in Small Businesses Program (PIPE); **Principal Investigator:** Alexandre de Sene Pinto (Bug); **Investment:** R\$474,041.00.
4. Large-scale breeding of stingless bee colonies and their commercial use for agricultural pollination (No. 2012/51112-0); **Grant Mechanism:** Innovative Research in Small Businesses Program (PIPE); **Principal Investigator:** Cristiano Menezes (PROMIP); **Investment:** R\$627,224.03 and US\$3,913.46.