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Honey Bees Deliver Beneficial Fungi to Strawberries and Increase Yield

by Linda McCandless

GENEVA, NY: The most industrious flying machines in nature's kingdom are being used to deliver a beneficial fungus to strawberry fields. The fungus fights gray mold, and all the bees have to do to pick up their payload is walk across their doorstep on their way out of the hive.

"Over the last five years, studies have successfully shown that honey bees can disseminate beneficial fungi, bacteria, and viruses to strawberries, pome fruits, and clover," says Joseph Kovach, an entomologist at Cornell University. "Our studies show that bumble bees and honey bees can disseminate spores of *Trichoderma* to strawberry flowers to control *Botrytis* fruit rot."



Entomologist Joseph Kovach has applied for a patent on the flip-top biocontrol dispensers for bee hives he has developed in the IPM program at Cornell.

CREDIT: NYSAES/Cornell

Kovach, who is the Integrated Pest Management Fruit Coordinator at the New York State Agricultural Experiment Station in Geneva, NY, is awaiting a patent for the bee 'footbath' he has developed over the past five years. The box fits across the bee hive entrance and is designed to be filled with any number of biocontrols, but the fungus-among-us-the one Kovach has commercially tested with New York strawberry growers-is the naturally occurring beneficial called *Trichoderma harzanium* 1295-22, commonly known as T22.

As bees exit the hive on their way to the field, they walk across the 'footbath' of gray powder, picking up as many as 100,000 *Trichoderma* spores per bee. As they forage for nectar and pollen, the

bees leave spores of T22 behind in the flowers. T22 fights the familiar gray mold known as Botrytis fruit rot by outcompeting the rot, spore for spore.

Botrytis is damaging because it extensively sporulates in strawberry flowers and can spread quickly, particularly under the warm, wet conditions common at bloom time. As the fruit matures, Botrytis develops into a noxious gray mold that renders berries inedible. Consumers won't buy moldy strawberries and grower profits disappear into the nearest compost bin. To fight Botrytis, growers usually apply one or two chemical fungicides at bloom time. Trichoderma can be applied as a spray, but coverage would be wasted because sprays cover leaves as well as flowers. Bees are by far the most efficient and effective delivery system. Bees achieve better control, using one-tenth of the amount that would have to be used in a



Joseph Kovach inspects a super of bees that deliver Trichoderma to strawberry fields to fight gray mold. Pollination by bees also increases yield. CREDIT: NYSAES/Cornell

sprayer.

Ten berry growers in eight counties in New York have tested bee-delivered T22 using the hive inserts developed by Kovach and his research team. The inserts slip into a reusable, lightweight

'doorstop'. The only maintenance required on the part of the grower or the beekeeper is to change the insert when it is empty, which could be every five to seven days during bloom, depending on bee activity and the weather. T22 looks like smoke-colored dust.

"We set out to answer four important questions," said Kovach. "Can bees pick up the spores [yes], can they deliver it [yes], can they deliver enough for effective control in a commercial field [yes], and does the Trichoderma harm the bees [no]."

Kovach's experiments yielded other extremely important data. "Not only did bee-delivered Trichoderma provide control equivalent to that delivered by chemical fungicides available to growers, but growers were able to maximize strawberry yields through better pollination," said Kovach.

Strawberries are primarily wind- and gravity-pollinated but using honey bees as pollinators produces more seeds and fleshier berries. On the average, a 20 percent increase in berry size was reported in data collected over five years due to honey bee pollination alone.

"Several studies have shown that strawberry fruit weight can be increased from 18 to 26 percent by adding hives to strawberry fields. Results from our studies also showed fruit weight increases of between 25 to 35 percent. This increase is primarily due to increased seed numbers per fruit because of better pollination," said Kovach. More seeds develop when a flower is pollinated by a bee than when strawberries are pollinated by wind or gravity. A strawberry increases in size to hold the greater number of seeds.

T. harzianum is a Cornell-patented fungal biological control agent that has proven efficacy against a wide range of plant pathogenic fungi. Bioworks, Inc., located in Geneva, manufactures large quantities of this biocontrol agent for use as a seed treatment, as an in-furrow pre-plant additive, and for greenhouse use.

T22 has received approval by the Environmental Protection Agency. Toxicity testing on vertebrate species indicates no pathogenic or toxic effect. However, EPA approval is needed to get the fungus registered for food use on both the strawberries, and in beehives that may also be producing honey for human consumption.

"I've taken the technology as far as I can," says Kovach. He expects to continue his research to harness honey bees and bumble bees into delivering any number of biocontrol agents to various fruits and vegetables.

"Bees work seven days a week all season long, are incredibly industrious, never complain, never clog up, and are capable of pinpoint accuracy as far as a delivery mechanism for biologicals is concerned," says Kovach. He expects commercial beekeepers to provide a ready market for the new T22 'footbaths' once the regulatory challenges are met and the patent granted. He says the demand by strawberry growers for bee pollination services has already increased.

New York ranks seventh in the nation in the production of strawberries, with 2,200 acres producing nearly 10 million lbs. of berries worth \$9.6 million.

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