BIBLIOGRAPHY

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ABSTRACT

The study was conducted to determine the number of *Trichoderma* spores that can be carried by *A. mellifera* from the hive before they forage, and to estimate the number of spores that are "deposited" to the plants when they forage.

A 10-month stock of *Trichoderma* KA pure culture was used using a selective medium and corn grits for mass production. The *Trichoderma* was put at the hive entrance using *Trichoderma* introduction box.

The study showed that the honeybees are efficient in carrying *Trichoderma* spores from the hive to the field.The honeybees picked-up 16,000 to as many as 167,000 *Trichoderma* spores and about 70% of these spores are "deposited" to the plants when the bees foraged.

RESULTS AND DISCUSSION

Trichoderma Spores Picked up by Bees Before Foraging

The result in Table 1 shows that all sample bees were able to pick-up *Trichoderma* spores ranging from 16 to 167 with a mean ranging from 40.50 to as high as 125.50. At 10^2 dilutions it means that a single bee picked up 167,000 *Trichoderma* spores. Such finding corroborates with the study of Kovach in 2000 who claimed that a single *A. mellifera* bee can pick up 100,000 *Trichoderma* spores.

The differences in the mean number of spores that the sample bees carried and as shown in the plated PDA from three honeybee samples (Fig. 10) can be attributed to the body parts of bees that probably got in contact with the spores as they passed by the TIB. It is possible that some of the bee samples walked thoroughly through the TIB such that there body parts caught more spores than the others. It is also possible that the bee samples varied in body size such that those with bigger body caught more spores than those with smaller body. Another possibility is that some of the bee samples must have stayed longer and therefore had more spores in their body. With this finding, a study to determine the body parts of the honeybees that can pick up *Trichoderma* spores is necessary as it may also lead to an appropriate design for TIB.

Table 1. Mean population count of *Trichoderma* spores (10^2 dilutions) picked up by honeybees as the exit from the TIB

BEE SAMPLES	RANGE	MEAN
Bee 1	16 - 82	49.00
Bee 2	37 - 98	67.50
Bee 3	84 - 167	125.50
Bee 4	98 - 106	102.50
Bee 5	77 - 113	95.00
Bee 6	24 - 57	40.50
	Total Mean	79.92

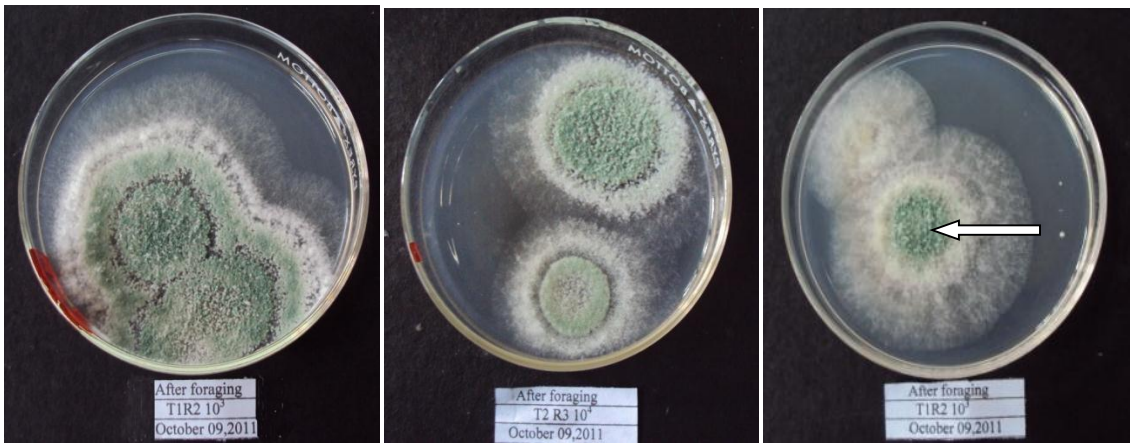

Figure 10. *Trichoderma* isolate on plated PDA after four days of incubation

Trichoderma Spores that was Left at the Body of a Forager Bee After Foraging

Table 2 shows that not all the *Trichoderma* spores that were carried by the bees from the TIB before foraging were left to the flowers when they foraged. In Bee 1 sample 5.00 spores were counted in the PDA culture media to as high as 32.50 spores in Bee 3 sample.

There was also a difference among the four samples where sample Bee 2 had 18.50 spores, sample B 4 20.00 had spores, sample B 5 had 19.50 while sample Bee 6 had 11.50.

The difference could be attributed to the part of the body where the spores were attached as the bee passed by the TIB, the distance by which the bee travelled from the hive to the flower, or the duration by which the bee foraged. It is possible that the spores on the dorsal part of the thorax maybe more difficult to be dislodged compared to those at the ventral side of the body or those in the antennae. It is also possible that some of the bee samples visited fully exposed flowers hence the spores at the ventral side of the thorax were not dislodged. Compared to the bees that visited partially hidden flowers, the bee body has to get in contact to some leaves and may have contributed in dislodging more spores to the flowers and therefore fewer spores were left to the body of the bees when they returned to the hive.

Nevertheless, the remaining *Trichoderma* spores on the body of the honeybees when they returned to the hive did not show any untoward effect to the bee colonies. This finding corroborates with the finding of Saclangan in 2008. In view of this, it can be claimed that *A. mellifera* is a good carrier of *Trichoderma* as biological control agent.

Table 2. Mean population count of *Trichoderma* spores (10^2 dilutions) left on honeybees after foraging

BEE SAMPLES	RANGE	MEAN
Bee 1	2 - 08	5.00
Bee 2	7 - 30	18.50
Bee 3	17 - 48	32.50
Bee 4	18 - 22	20.00
Bee 5	7 - 32	19.50
Bee 6	5 - 18	11.50
	Total Mean	18.33

Estimated *Trichoderma* Spores Deposited to Flowers by Foraging Bees

Table 3 shows the estimated number of spores of *Trichoderma* that was "deposited" by the bees on the flowers when they foraged. The number of spores ranged from 14.00 to 119 spores with a mean range of 29.00 to 93.00 spores and a total mean of 62.08 spores. In terms of percentage, about 70% of the *Trichoderma* spores that were carried from the hive were deposited by the bees to the plant. The finding further confirms that *Apis millefera* are efficient carrier of *Trichoderma* spores as reported by Saclangan in 2008.

In the trial, at 10^2 dilutions, sample Bee1 deposited as many as 80,000 spores; sample Bee 2, 68,000 spores; sample Bee 3, 119,000 spores; sample Bee 4, 82,000 spores; sample Bee 5, 81,000 spores; and Bee 6, 39,000 spores. At 10^2 dilutions a single bee can deposit as many as 119,000 *Trichoderma* spores and this corroborates with the finding of Kovach in 2000.

The number of *Trichoderma* spores needed to control fruit rot in a single flower, however, need to be studied.

Table 3. Estimated mean population count of *Trichoderma* spores assumed to have been "deposited" to the flowers by honeybees

BEE SAMPLES	RANGE	MEAN
Bee 1	14 - 74	44.00
Bee 2	30 - 68	49.00
Bee 3	67 - 119	93.00
Bee 4	80 - 84	82.00
Bee 5	70 - 81	75.50
Bee 6	19 - 39	29.00
	Total Mean	62.08

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at Entomology Apiary and Plant Pathology Laboratory from July to October 2011 to determine the number of *Trichoderma* spores that can be picked up by a forager bee before foraging, determine the number of *Trichoderma* spores that was left at the body of a forager bee after forging and determine the number of *Trichoderma* spores assumed to have been distributed by a forager bee.

The grown *Trichoderma* KA in sterilized corn grits was transferred in TIB using spatula. The TIB was attached to the hive entrance late in the evening and was visited at the morning for the collection of samples before and after foraging.

It was observed that all the collected samples which went out from the hive passing through TIB was efficiently picked-up and distribute *Trichoderma* spores but there were still *Trichoderma* spores attached to their bodies as they went back to the hive.

Conclusion

It is concluded that honeybee (*Apis mellifera*) is an effective carrier of the biological control agent *Trichoderma* KA.

Recommendation

Honey bees maybe used to distribute the biological control agent *Trichoderma* KA to flowering plants. It is also recommended to determine which body part of the honeybee carry the most number of the spores and if these are deposited all in one plant or more, and to determine the number of *Trichoderma* spores that can control the *Botrytis* fruit rot.

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