justBees
FOR SUCCESSFUL POLLINATION

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BACKGROUND

Bumblebees have been reared commercially for pollination services since the 1980's. In this practice, bumblebee colonies are reared in captivity and then individual colonies are shipped around the globe to aid the pollination of crops, especially soft fruits like tomatoes, raspberries, strawberries, peppers, etc. The main purchasers are greenhouse operating companies (many greenhouse's plants are almost exclusively require bumblebee for pollination as they are capable to "buzz pollinate") and professional agricultural producers where colonies are used for the supplemental pollination services. Growers of the field crops benefit from the fact bumblebees get to work earlier in the year when temperatures are lower, with poor and changeable weather conditions. Unlike honeybees, that only tend to fly in good weather, bumblebees go about their business pollinating crops in rainy and cloudy conditions, thus making them ideal pollinators for some specific crops. However, imported bumblebee colonies may face stressors that may affect their health. Signs of colonies facing stressors like parasites or diseases include inactivity, lethargic and unresponsive bumblebees, the queen of the colony may die, etc. Also, when used as the supplemental pollination service or after being displaced from greenhouses, commercially produced bumblebees interact with native bumblebees and other pollinators after importation during shared flower use. This interaction brings an associated risk of parasites imported colonies may carry, thus infecting and harming native bees and other pollinators.

IDENTIFIED PROBLEMS

Serious and reputable bumblebee rearing companies take measures to avoid any health risk related to their colonies. The EU and national regulations also ensure commercially produced bumblebee colonies are sold and imported as being parasite-free. According to legislation, bumblebee colonies must be accompanied by a health certificate to their final destination.

Studies have found that incidences of some parasites among wild bee populations increase proportionally with proximity to sites with commercial colonies.

Disease transmission is the most frequently addressed issue concerning to commercial bumblebees. Imported bumblebees carrying any parasites can pass these pathogens on to wild bee population and other wild pollinators.

Another issue is spill over into natural habitats, which may also pose risks by competition for floral resources to other pollinators. As the most research studies in general asses only competition between wild pollinators and managed honeybees, might be said that this topic with commercial bumblebees is completely understudied.

The prevalence and intensity of parasite infections might increase during shipping from the production facilities to the end-user.

The third problem relates to the transfer of genes between greenhouse pollinators and wild populations. One recent study in Spain reported only 19% of analysed bumblebees could be assigned to pure native genetic clusters, even at 60 km from areas where commercial bumblebees were released.

COLONY LIFECYCLE

As the first step in bumblebee colonies production, rearing companies stimulate bumblebee queens to lay eggs. These eggs take up to five weeks to fully develop, from egg to larva to pupa until finally, they are fully grown workers. In this period colonies are usually delivered to destination, greenhouses or field crops. Worker bees are the main pollinating force of the colony as they collect pollen and nectar to feed their queen and developing larva.

Producer recommendation is that commercial bumblebee colonies are only fit to be used for approximately 8 weeks after delivery

At some point of time the queen starts laying eggs that will develop into reproductive individuals - future queen bees and drones (male, reproductive, bees). This marks the colony coming to the end of its life cycle, as the males and new queen

will soon start to emerge. Time to dispose colony from the site, as male bees prevail in the colony, usually happens at the end of week 8 upon delivery (at this moment a full colony life cycle length is around 14 weeks).

Growers usually order colonies well in advance of required delivery. The timing depends on the target crops and when they flower, require or are receptive to supported pollination. Recommendation is to place boxes when the crop is in 5 to 10% bloom.

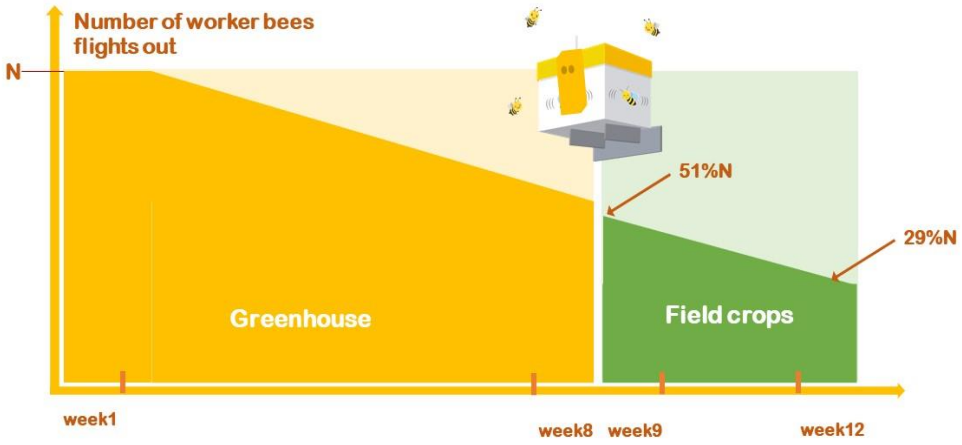
WORKER BEE FLIGHTS OUT MEASUREMENTS

During June and July this year we at Just Bees had conducted a measurement of the worker bee in/out flights with the aim to explore worker bee activities in the post-greenhouse period. A very specific feature implemented on our IoT monitoring device, which differentiates worker bees from drones and queen, enabled us to trace and measure worker bee flights separately, along with drone bees and queen activities.

One bumblebee colony was placed in the commercial greenhouse for pollinating cherry tomato crops for a period of 8 weeks. On a day of colony opening our IoT device was mounted on the hive's entrance. At the same time, from same greenhouse operating company we took another colony, just being disposed after 8 weeks in use, and brought it to rural area surrounded with typical July's flora for foraging. Measurements for this disposed colony lasted 4 weeks.

Besides counting in/out flights we measured, analysed, and correlated other parameters like in hive sound, climate conditions - temperature, humidity, and pressure in hive and outside, and finally daylights data.

MEASUREMENT RESULTS



Out of data privacy reason we don't show here the exact number of flights and we simplified it by marking the number of flights in the week1 as N.

Although came out from a very simplified approach, obtained data showed that worker bee in/out flights data in the post-greenhouse period (week9-week12) are comparable with the flight numbers in the first weeks of operation. The number of worker (pollinating) bee flights on the beginning of week9 equals to 51% of the number of worker bee flights in the week1. This numbers then drops, however just in the week11 number falls below 40% of the fights in week1. Final measurements by the end of week12 showed flights number as 29% of the flights in the week1.

Number of worker bee flights in the week9 equals to 51% of the worker bee fights in the week1

This measurement data shows an intense worker bee's foraging activities in the post greenhouse period which last even 4-5 weeks after disposal. On the other side, these foraging activities could bring the risk for native pollinators if disposed colonies are not handled in a responsible manner. This was not the case obviously with our disposed colony as bee flights were not suddenly dropped at any point during measurements. However, besides producer's instruction, a clear regulation how to manage disposed colonies is usually missing.

CONCLUSION

The use of managed pollinators such as honeybees and commercial bumblebees is an accepted reality. This article represents our attempt for the responsible management of imported bumblebee colonies to tackle the worrying decrease in wild pollinator populations that are crucial for the pollination of a wide variety of crops. Colony monitoring happens periodically and often signs of colonies facing stressors are missed. Consequently, closing and sealing up colony to prevent spread of pathogens might come too late. Also, after 8 weeks use on site, some colonies are disposed and just left outside without any worry how it impacts native pollinating populations. In conclusion, more effective disease detection and management strategies, like collecting and recycling a colony's waste recently introduced by one of the most reputable colony producer, are needed to reduce the pathogen spill-over threat from commercially produced bumblebees.

* Some content in this article refers to "*Guideline for users of imported bumblebee colonies*", published by *All-Ireland Pollinator Plan (www.pollinator.ie)*

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JUST BEES is an innovative start up dealing with supporting pollination, bees protection and conserving biodiversity.