Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

https://doi.org/10.23913/ride.v13i26.1479

Artículos científicos

Eficiencia de la reutilización de la patente caja iniciadora de insectos

Reuse efficiency of the insect starter box patent

Eficiência de reutilização da patente da caixa inicial de insetos

Nancy Elizabeth Ambriz Trujillo
Universidad de Guadalajara, México
nancy.ambriz@cucsur.udg.mx
https://orcid.org/0000-0001-5848-0746

Rosales-Rentería, R. R.
Universidad de Guadalajara, México
ricardo.rosales@cucsur.udg.mx
https://orcid.org/0000-0002-1645-5400

Resumen

El objetivo del estudio fue demostrar que la eficiencia de la Caja Iniciadora de Insectos (patente) es sustentablemente viable y reutilizable en más ocasiones, en comparación con las otras dos cajas: la caja de laboratorio (madera) y la caja comercial (cartón). Para llevar a cabo esta investigación, primero se capturaron abejorros de la Sierra de Neverías y, ya en el laboratorio, se colocó una reina de *Bombus ephippiatus* en cada caja. En total, se utilizaron 60 abejorros, 1 abejorro por caja, y 20 abejorros en total por cada tipo de caja con material distinto. Los resultados fueron los siguientes: en las cajas de cartón, se desecharon el 100% después de utilizarlas, independientemente de si desarrollaron nido o no; mientras que las cajas de madera se reutilizaron en un 55% después de desarrollar nido. Por otro lado, la Caja Iniciadora de Insectos se reutilizó en un 100% después de desarrollar nido o no, y esta caja pudo ser reutilizada un sinfín de veces. Por lo tanto, se concluye que la patente Caja Iniciadora de Insectos es 100% reciclable después de desarrollar nido o no, y sustentablemente viable para su reutilización en comparación con la caja de laboratorio (madera) y la caja comercial (cartón).

Palabras claves: Caja iniciadora, insectos, cría artificial, reutilizable y abejorros.

Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

Abstract

The objective of the study was to demonstrate the efficiency of the Insect Starter Box (patent) is sustainably viable and reusable on more occasions compared to the two boxes, both the laboratory box (wood) and the commercial box (cardboard). To carry out this research, bumblebees were first captured from the Sierra de Neverías and in the laboratory a queen of Bombus ephippiatus was placed per box, a total of 60 bumblebees, 1 bumblebee per box, 20 bumblebees in total per box, different material. Resulting as follows: in the cardboard box 100% was discarded after use whether they developed a nest or not, while the wooden boxes were reused 55% after developing a nest and the Insect Starter Box was 100% reused. after developing nest or not and this box could be reused countless times. Therefore, it is concluded that the Insect Starter Box patent is 100% recyclable after developing a nest or not and its reuse is sustainably viable compared to the laboratorio box (wood) and the commercial box (cardboard).

Keywords: Starter box, insects, artificial breeding, reusable and bumblebees.

Resumo

O objetivo do estudo foi demonstrar que a eficiência da Insect Starter Box (patente) é viável de forma sustentável e reutilizável em mais ocasiões, em comparação com as outras duas caixas: a caixa de laboratório (madeira) e a caixa comercial (papelão). Para realizar esta pesquisa, primeiro foram capturados zangões da Serra de Neverías e, uma vez no laboratório, uma rainha Bombus ephippiatus foi colocada em cada caixa. No total foram utilizados 60 abelhões, 1 abelhão por caixa e 20 abelhões no total para cada tipo de caixa com material diferente. Os resultados foram os seguintes: 100% das caixas de papelão foram descartadas após o uso, independentemente de terem feito ninho ou não; enquanto as caixas de madeira foram reaproveitadas em 55% após o desenvolvimento do ninho. Por outro lado, a Insect Starter Box era 100% reutilizável após o desenvolvimento do ninho ou não, e esta caixa poderia ser reutilizada infinitas vezes. Portanto, conclui-se que a patente Insect Starter Box é 100% reciclável após o desenvolvimento do ninho ou não, e sustentávelmente viável para reutilização em comparação com a caixa de laboratório (madeira) e a caixa comercial (papelão).

Palavras-chave: Starter box, insetos, reprodução artificial, reutilizáveis e zangões.

Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

Fecha Recepción: Julio 2022 **Fecha Aceptación:** Mayo 2023

Introduction

In 1987, Biobest was the first company in the world to develop a method for the industrial production of bumblebees. Which used a bottle with a food solution and, under it, is a plastic box. Both the lid and the inner box contain grids that guarantee optimal aeration and prevent condensation. The outer packaging is made of corrugated, non-deformable and recyclable cardboard with water-repellent characteristics; this box contains the brood (eggs, larvae and pupae) to artificially rear the bumblebees (Coll, M., 2003).

The artificial rearing of bumblebees can be carried out from fertilized queens collected in the field in spring when they emerge from their hibernation, resulting in a 20 to 50% success rate at the start of the colony (Salvarrey, Arbulo, Santos and Invernizzi, 2013).

For the scale production of bumblebee colonies, it is also sought to improve the design of the breeding boxes to maintain stable environmental conditions in production conditions (Cruz, P., Escobar, A., Almanza, M. and Cure, J. ., 2008).

After the colonies reached an approximate number of 8 to 10 workers, they were relocated to wooden breeding boxes of dimensions 12 x 19 x 18 cm. Two important modifications were made to these breeding boxes described by Almanza (2007): thermal insulation (thermolón) was added to the four external walls and the wooden floor of the box was modified, adding a metal ventilation mesh (Cruz, P., Escobar, A., Almanza, M. and Cure, J., 2008).

Another type of boxes that are used for the rearing of Bombus hypocrita bumblebees are individual wooden boxes with two chambers of 150 x 80 x 65 mm, which have a brood chamber and a feeding chamber separated by a wooden board provided with a passage hole 1.5 cm in diameter (Ono et al., 1994).

Queens are often placed in small boxes, and once they lay eggs, they are moved to other boxes that are strong enough for the jaws of the bumblebees. These can be of different materials: wood is the most used. Plexiglas can also be used to allow better viewing inside the nest, while heavy cardboard and poured plaster are other possible construction materials. (Mader, E., Spivak, M., y Evans, E., 2010).

Another type of box used for breeding bumblebees is the Tripol brand, which is offered in two sizes: one is the 29 x 26 x 21 cm box for the greenhouse, and another 86 x 26 x 86 x 26 cm for the open field. 23 cm (Tripol, 2022).

An additional design that is used is a transparent box in which the behavior of the bumblebees is perfectly observed, with a transparent PET lid and a grid that separates the food (Yoon, H., Lee, K., and Kim, M ., 2011).

This research arose from the need to create a reusable box that was sustainably viable and that would facilitate the artificial rearing of bumblebees under laboratory conditions. Once the box was created, it was patented at the Mexican Institute of Intellectual Property (IMPI) on September 14, 2018.

General objective

- Compare the efficiency of the Insect Starter Box with the Laboratory Box (wood) and Commercial Box (cardboard) and see which of the three boxes is sustainably viable and reusable in bumblebee rearing under laboratory conditions.

Specific objectives

- Capture bumblebees and then place one for each box that will be tested under laboratory conditions and verify which one is sustainably viable and reusable.
- Compare the efficiency of this box with other boxes already used and compare which of them is more viable for use.

Materials and methods

The study was carried out in the Bee Laboratory, located within the facilities of the University Center of the South Coast, based in the city of Autlán de Navarro, Jalisco, Mexico (Ambriz et al., 2020, citing Daniel Cauas, 2015).

Twenty acrylic boxes (insect starter box) were placed, each box with a Bombus ephippiatus queen captured in Neverías, which is located in the Sierra de Cacoma at 2200 m asl and its location is North 19.8562°, East -104.444° , South 19.8349° and West -104.487° (Ambriz et al., 2020, citing Alan Rockefeller, 2021). These bumblebees were collected when they forage with an entomopathogenic net (Salvarrey, Arbulo, Santos and Invernizzi, 2013). Immediately, they were placed in 250 ml plastic bottles, which were filled with 70% ethanol for preservation (Vargas et al., 2020). In the same way, 20 wooden boxes with a transparent lid and 20 commercial boxes were placed. It should be noted that all the queens were fed with fresh pollen pellets and natural syrup.

Experimental units (boxes) are considered disposable when they can no longer be repaired or trying to fix them is more expensive than buying new. For example, the wooden boxes that can no longer be used for breeding bumblebees are those that show damage to the base due to the bites of the bumblebee jaws and this has to be completely replaceable. Another characteristic for the box to be replaced is when it is mostly damp and the base has to be completely changed, since trying to repair them is more expensive than buying new boxes. As for the plastic boxes, they are unusable to be reused when the box presents a rupture through which the syrup spills or begins to detach from its sides, as long as it cannot be glued or, when it is glued, it is left out of square and on its sides. there is a syrup leak or the bumblebees can escape through some crack. In the case of the cardboard boxes, once the nest has developed, they are useless because the entire base is moistened with the food and waste of the bumblebees and, by its nature, the material is not replaceable, for which reason each time If you want to develop a nest, you should use a new box.

Results

The efficiency of the reuse of the Insect Starter Box compared to the laboratory box (wood) and the commercial box (cardboard) shows that, although a similarity is seen in the results in terms of nest development, it is important to highlight that all the cardboard boxes were used only once, since they were unusable for reuse. As for the wooden boxes, most of them could be reused again after this experiment, and the Insect Starter Boxes could all be reused after developing or not developing nests.

The percentage of queens that developed a nest and the percentage of dead queens were similar ($P>0.05$) among the three box types. The percentage of reuse of the boxes to develop nests was significantly affected ($P<0.0001$) by the type of box. The Insect Initiator Boxes of the patent presented 100% reuse and the wooden boxes 90%, but none of the cardboard boxes was reusable after the experimental process (Table 1).

Table 1. Percentage of Bombus ephippiatus Queens that developed nest and percentage of reuse of the Insect Starter Box compared to two different boxes.

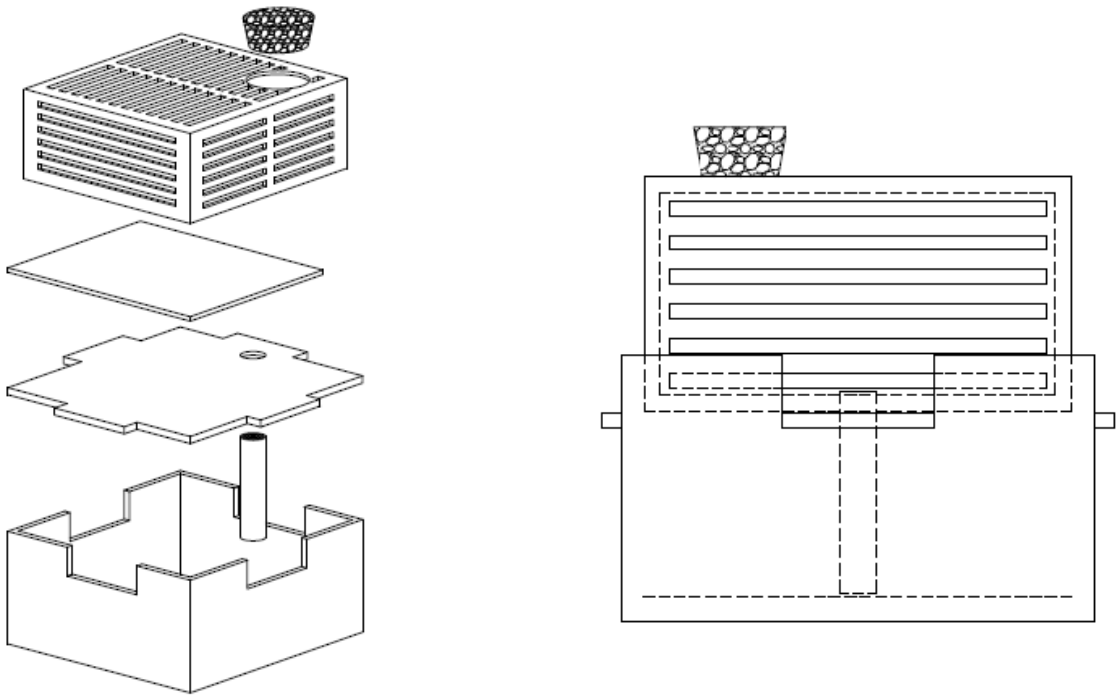
Variable	Type of box			Probability
	Patent	Wood	Cardboard	
Nest development (%)	60 (12/20)	55 (11/20)	60 (12/20)	0.93
Dead (%)	40 (8/20)	45 (9/20)	40 (8/20)	0.93
Reuse (%)	0 (0/20)	90 (18/20)	100 (20/20)	<0.0001

Source: Nancy Elizabeth Ambriz Trujillo (2023).

Of the experimental units of the wooden box, 11 of 20 did develop nests, and in turn, 9 can be reused, since two were damaged and repairing them would be more expensive than buying new ones. Of the cardboard boxes used, 12 out of 20 developed nests, none of which can be reused because they are unusable for reuse, since these boxes cannot be washable due to their material. Also, the syrup dispenser solidifies over time and therefore would not provide syrup for the bumblebees to feed on. From the Insect Starter Box, 12 out of 20 developed nests, of which, after this experiment, all may be reusable, since the material from which they are made is completely washable and they did not suffer damage.

In addition, it was observed that 12 of 20 (60%) Bombus ephippiatus queens developed a nest in the "Insect Starter Box" (once the queen oviposited and between 5 and 7 workers hatched, it is necessary to move them to a box where they will fully develop). the nest). But it is worth mentioning that, due to the nature of the box, it allows the behavior of the bumblebee to be observed at all times without disturbing it, and also, due to its two compartments, it allows the syrup to be placed in the lower part, thus avoiding direct contact with the insect. and thus avoiding his death, either by drowning in the syrup or because he gets stuck. In addition, this box, because it has grids on the sides and the top, has perfect aeration, it has a cotton straw that allows the syrup to rise to feed the bumblebee, this box has a cork that you can remove and so on. place the insects In addition, this box has a double use, it is used to transport insects without damaging them. See figure 1.

Figure 1. Three-dimensional figure of the Insect Starter Box in two different planes. Measures 9 x 9 x 8.5cm.



Source: Nancy Elizabeth Ambriz Trujillo (2018).

It was also observed that 11 of 20 (55%) Bombus ephippiatus queens that were placed in the wooden boxes developed nests. It should be noted that this box had an acetate on top to observe the behavior of the bumblebees, but when they developed a nest and finished their cycle, they were discarded, since the jaws of the bumblebees are very strong and they made holes in the boxes where they were. one or another bumblebee managed to escape (captured and discarded). In addition, due to the humidity generated by the bumblebee colony, the box became damp and could no longer be reused.

In the commercial box (cardboard) it was observed that 12 of 20 (60%) Bombus ephippiatus queens that were placed in the commercial box managed to develop a nest. But it should be noted that, due to the nature of this box, it was not possible to fully observe the behavior of the bumblebees even though they had everything necessary to develop a nest. It should be noted that, after a single use, all the boxes were discarded because the box became unusable, as the syrup solidifies over time and clogs the tube, and consequently the bumblebees can no longer be fed.

Discussion

The results presented by Yoon, et al. (2011), mention that they developed a combined box made with a transparent PET (polyethylene terephthalate) film that allows easy observation of the behavior of bumblebees. This box is developed with a box lid with a hole for feeding and ventilation, an oviposition dish, a separator bar, a conical tube and a plug for flight openings, a sugar water box and a lid to protect against contamination. This box could serve as an effective box for oviposition and development of bumblebee colonies. While the results that were presented in this investigation, the Insect Starter Box, in addition to being reused countless times in the development of bumblebee nests, serves as a box to transport any insect and, due to its totally transparent material, allows to observe at all times the behavior of insects. Due to its design, which contains ventilation grills on the upper sides of the box and on the roof, it has sufficient aeration for insects.

Studies carried out by Veen (2021) mention that, once the queens have been captured, they should be transferred to small wooden boxes (starter boxes) with the following characteristics: the measurements are 9x8x5 cm. These boxes have a glass in front to be able to observe the behavior during the first stages. The floor of the box has a grid, and on top of the grid, a piece of cardboard is placed where the queen begins the pose. On the back it has a perforation where a test tube enters that works as a drinker. Once the colony has 6-7 workers, they are transferred to larger wooden boxes. While in this investigation, the queens were placed in a completely transparent acrylic box (insect starter box) with measurements of 9x9x8.5 cm that has two compartments: the lower compartment contains the syrup, and this goes up through a cotton straw. , while the upper part contains the pollen. In addition, this box has grids on its four sides and also on the roof, which gives it sufficient ventilation for bumblebees (see figure 1). Also, once the colony has between 5 or 7 workers, it is transferred to another box to develop the nest.

In the results presented by Salvarrey (2013), it is mentioned that the captured queens were placed inside wooden boxes (starter boxes) of 5x10x10 cm with removable glass side walls. At one end of the starter box, a ball of pollen and sugar syrup was placed on a small cardboard box. A dispenser with 50% sugar syrup was inserted into a hole in the top of the starter box. While in this investigation, the captured queens were placed in a totally transparent acrylic box measuring 9x9x8.5 cm and with two compartments: the lower part contains the natural syrup and this goes up through a cotton straw to prevent the bumblebees

stick to each other, and the upper part contains the pollen ball and in this part they will start the nest. It should be noted that the upper part contains grids for aeration of insects.

Conclusion

The results found in this investigation serve to affirm that, after submitting it to bumblebee breeding tests, the Insect Initiator Box, comparing it with the Laboratory Box (wood) and the Commercial Box (cardboard), can be reused an endless number of times. In addition, it has the advantage of using said box as a transporter of insects, allowing the observation of the behavior of the bumblebees without disturbing them. Thanks to its design, the box provides protection, aeration and feed separation, and being 100% reusable, it is sustainably viable.

Future lines of Research

- Creation of another patent to make copulation of bumblebees more efficient.

References

Ambriz, N., Rosales, R., Sandoval, J. (2020). Los abejorros Bombus impatiens y Bombus ephippiatus pueden copular, pero no generan descendencia. *Revista Iberoamericana de las Ciencias Biológicas y Agropecuarias. (9), 18*. https://doi.org/10.23913/ciba.v9i18.102

Almanza, M., 2007. Managment of Bombus pauloensis bumblebees to pollinate Lulo (Solanum quitoense L), a native fruit from Andes of Colombia. Ecology and Development (25) 1. ZEF Bonn. https://www.researchgate.net/publication/283083749_Desarrollo_de_Dos_Colonias_de_Bombus_Atratus_Hymenoptera_Apidae_Mantenidas_Bajo_Dos_Modos_de_Alimentacion

Coll, M. (2003). Los abejorros polinizadores – Horticultura – Interempresas. (6) https://www.interempresas.net

Cruz, P., Escobar, A., Almanza, M. T., & Cure, J. R. (2008). Implementación de mejoras para la cría en cautiverio de colonias del abejorro nativo Bombus pauloensis (= B. atratus) (Hymenoptera: Apoidea). *Revista Facultad de Ciencias Básicas*, *(4)* 1-2, 70-83.

Mader, E., Spivak, M., Evans E. (2010). Managing Alternative Pollinators: A Handbook for Beekeepers, Growers, and Conservationists. SARE Handbook (11) NRAES-186. https://www.sare.org/wp-content/uploads/Managing-Alternative-Pollinators.pdf

Ono, M., Mitsuhata, M., Sasaki, M. (1994). Use of Introduced Bombus terrestris Worker Helpers for Rapid Development of Japanese Native B. hypocrita Colonies (Hymenoptera, Apidae). Applied Entomology and Zoology. (29) 3.

Salvarrey, S., Arbulo, N., Santos, E. y Invernizzi, C. (2013). Cría artificial de abejorros nativos Bombus atratus y Bombus bellicosus (Hymenoptera, Apidae). Agrociencia Uruguay – (17) 2:75-82. https://www.researchgate.net/publication/317448179

Tripol (2022). 3 Colmena abejorros polinización – FertiTienda. Ficha técnica. https://fertitienda.com › Control Biológico

Vargas, H., Acuña, J., Rodríguez, G., Grifaldo, P., García, P., & Lázaro, M. (2020). Fluctuación poblacional de familias de ácaros asociados a plantas de zarzamora (Rubus fruticosus). *Ecosistemas Y Recursos Agropecuarios*, (*7)* 2.

https://doi.org/10.19136/era.a7n2.2435 (Original work published 30 de septiembre de 2020)

Veen (2021). Cantidad de alimento requerida por una colonia de Bombus ephippiatus durante las etapas de su desarrollo y el comportamiento de alimentación de las obreras jóvenes. (Tesis de maestría). Universidad Nacional. Heredia. Costa Rica. https://repositorio.una.ac.cr › bitstream › handle

Yoon, H., Lee, K. y Kim, M. (2011). Transparent Bumblebee Box for Colony Foundation or Sale. (26) 4. Fecha de consulta 16 de abril 2022 https://agris.fao.org › search

Rol de Contribución	Autor (es)
Conceptualización	Nancy
Metodología	Nancy y Ricardo igual
Software	Ricardo
Validación	Nancy principal y Ricardo
Análisis Formal	Nancy y Ricardo igual
Investigación	Nancy principal y Ricardo
Recursos	Nancy y Ricardo igual
Curación de datos	Nancy
Escritura - Preparación del borrador original	Nancy
Escritura - Revisión y edición	Nancy y Ricardo
Visualización	Nancy y Ricardo apoyo
Supervisión	Nancy
Administración de Proyectos	Nancy
Adquisición de fondos	Nancy