Short Communication

Mass production of *Telenomus remus* Nixon with an artificial diet and with leaves of *Ricinus communis* L., and its practical use in the control of the fall armyworm *Spodoptera frugiperda* (J.E. Smith)

Abstract

Mass production of *Telenomus remus* (Nixon) (Hymenoptera: Scelionidae) through artificial and natural diets for biological of the fall armyworm *Spodoptera frugiperda* (J.E.Smith) is discussed. The diet based on *R. communis* leaves, is less expensive since does not need high cost materials and other devices, one limitation is to produce high numbers of parasitoids related to the high need of leaves. Good effectiveness of *T. remus* has been recorded, when used at a rate of 6000-8000 individuals/ha/release, obtaining a high level of control and economic benefits.

Keywords: Diet, Telenomus, Spodoptera, rearing, ricinus leaves

Volume 12 Issue 1 - 2024

Francisco Ferrer Wurst,[1] Jorge Salas Aguilar[2]
[1]Academia de Ciencias Agrícolas (ACAV), Barinas, Venezuela
[2]Instituto Nacional de Investigaciones Agrícolas (INIA), Lara, Venezuela

Correspondence: Francisco Ferrer Wurst, Academia de Ciencias Agrícolas (ACAV). Barinas, Venezuela, Email donfranciscowurs@gmail.com

Received: February 26, 2024 | **Published:** March 20, 2024

Introduction

Spodoptera frugiperda native to Americas, recently expanded to Africa in 2016 and to Asia in 2018[1] is currently causing losses due to damage to corn and other crops. A biological control strategy through *Telenomus remus* Nixon is very necessary.

In 1987, after its successful adaptation, a methodology of mass production was achieved in Venezuela, using 2 diets, one artificial and the other natural to breed its host *S. frugiperda*.

Breeding on an artificial diet

The diet used for the production of *S. frugiperda* consists of the following elements ascorbic acid 50 g, sorbic acid 10 g, agar 80 g, oxytetracycline 5% with B vitamins (veterinary use), 10 g, formaldehyde 5 mi, wheat germ 60 g, grass flour 500 g, soy flour 400 g, wheat flour 400 g, yeast 220 g, methyl paraben 20 g, sugar 50 g, Propionic solution* 50 mi and water 8 liters (*Mixture of Solution A: Propionic acid 418 mi + 82 mi of distilled water and Solution B: Phosphoric acid 42 mi + 458 mi of water distilled).

To begin breeding the host insect, pairs of adults of *S. frugiperda* were placed inside a 4-gallon container lined with base 20 bond paper, letter size and another folded in folds, these mate and the females lay their eggs, which are collected from the second day and for seven consecutive days they are collected the eggs and are quantified. Eggs are placed in 250cc glass containers in which the small larvae emerge, and then 3 to 4 larvae are placed in a 30cc diet cup, using a fine brush (No. 0).

The development time of the larva from when it is placed in the cups with diet is approximately 14 days until reaching the pupa or chrysalis state. The chrysalises are collected manually and then disinfected with a formaldehyde solution at 3%, then rinsed with distilled water and air dried. The collected chrysalises in a number of 200 to 300 they are placed in 40x50x40cm wooden cages covered with mosquito mesh. The adults or moths are born in approximately 5 days and sexed visually (the females are uniformly grayish in color and have the abdomen more robust than that of males) and 100 pairs are placed in cylindrical containers of 20cm diameter by 20cm high) to get the eggs lined up on paper inside of the cylinder. The egg masses are removed daily to continue with the massive breeding and *Telenomus* production. Moth production is recorded using cards that identify daily production lots. The number of eggs in the oviposited masses is estimated by means of a pattern of silhouettes which correspond to areas that have been established through counts of eggs found in the mass. This is a task that estimates the number of eggs in a practical way.

With the aim of searching for new alternatives for biological controllers of pests, the company Servicio Biologico, C. A, (SERVBIO) began the production of them in different crops. Since 1979, the production of *T. remus* to control *S. frugiperda* has been carried out.

Also in 2007, successes are reported at semi-commercial and commercial levels of control exerted in several regions of the country. The future perspectives of the need for this parasitoid are very large due to the extensive areas to be planted, which requires a large volume of production to meet needs.

Breeding of the host on castor leaves (*Ricinus comunis*)

Between 100 to 200 newly emerged larvae of *S. frugiperda* from castor oil leaves are placed in jars of a gallon capacity, a vegetable that has been shown to have anti-cannibalistic properties, which guarantees sustained production. Previously, the castor leaves are washed with formaldehyde at 5%, rinse and dry. The leaves are changed whenever necessary, generally interday. Once the larvae reach a size of approximately 1cm in length, 100 to 200 larvae are placed in tapers (plastic cages) of 40x30x25cm, with lid and with attached fabric to allow ventilation. When it comes to big numbers (500 or more), rectangular cages of 100x8 x40 cm can be used, made with wooden slats covered with greenhouse fabric. These must have a material inert at the bottom such as sand or disinfected sawdust. In this stage the castor oil leaves are replaced when necessary. The formation of chrysalises from the beginning lasts approximately 14

days. No artificial diets or expensive utensils are required. Any person or farmer can produce *S. frugiperda* in a small space. According to preliminary work, cannibalism among the larvae is lower and a higher production of larvae[2] than in artificial diets. Among the disadvantages of this technique is that it takes up a lot of space and is not ideal for producing large volumes. If precautions are not taken, breeding can become contaminated, and requires a trained labor in case of produce large volumes of larvae and establish a sustained production of *R. communis*.[3]

It is a simple methodology that can be adopted by corn producers in tropical climates, like Africa where this plant originates.

Breeding of the parasitoid *T. remus*

Breeding begins with a group of *S. frugiperda* eggs previously parasitized and placed in glass containers of 3.75-liter capacity. Adults or wasps of *T. remus* emerge from the eggs in the first 8-9 days of being parasitized, first the males and the next day the females.

To initiate mass production of *T. remus*, freshly laid *S. frugiperda* eggs are placed oviposited in the ratio of 60:1 during the first 24 hours and then in the four subsequent days' in proportions of 40:1; 30:1; 20:1 and 10:1. The eggs parasitized are collected daily and placed in "delarve" (elimination of the larvae emerging from unparasitized eggs) for an additional 3 days. The parasitized eggs, prior to their release, are placed in plastic containers of 5oz capacity where the wasps are born and once emerged, they are released into fields. Thin strips of paper are placed in each container to support *Telenomus* wasps which are provided with water in the upper part by means of a moistened cotton and also honey on the walls of the container using a fine brush. The recommended number of wasps to place per container is 8000-10000.

Parasitized eggs after delarving can be stored at a temperature of 8°C for a period of no more than 7 days, in order to match the production date with the date of obtaining the wasps for their release according to the needs of the case. Good effectiveness of *Telenomus* has been recorded, when used at ratio of 6000-8000 individuals/ha/release.

The described diet production technique has been used to produce up to 60 million of *Telenomus* in one year in SERVBIO, on a commercial basis. However, the method of castor oil plant has been used on a limited way to serve small areas and it looks like a promise for small producers to carry out their own production. In the case of Venezuela and Perú, this methodology has been used for more than twenty years, however, a larger scale implementation has not been seen. For example, in the Las Velas valley, Yaracuy State, Venezuela, a corn producer established a small farm and began to distribute its production. This initiative of more releases carried out with material produced with diets from the company SERVBO in this area led to a drastic reduction in the use of chemicals, when applied under the framework of Integrated Pest Management (IPM).[4–11]

Acknowledgments

None.

Conflicts of interest

The authors declare that there are no conflicts of interest.

References

1. Goergen G, Kumar PL, Sankung SB, et al. First report of outbreaks of the fall armyworm *Spodoptera frugiperda* (JE Smith) (Lepidoptera, Noctuidae), a new alien invasive pest in west and central África. *Plos One*. 2016;11(10):0165632.
2. Vásquez de M. Cría de *Spodoptera frugiperda* en dieta artificial y natural para la producción de parasitoides. tesis de grado para optar al título de magíster en educación. mención enseñanza de la biología universidad pedagógica experimental libertador. Instituto pedagógico de barquisimeto. subdirección de investigación y postgrado. subprograma maestría enseñanza de la biología. *Barquisimeto Edo Lara*. 1997;101.
3. Maldonado HA, Polanía IZ. Evaluación de dietas merídicas para la cría en laboratorio de *Spodoptera Frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae). *Revista U.D.C.A Actualidad & Divulgación Científica*. 2009;12(1):79–90.
4. Villalobos VJC. Control con extractos de hojas, tallos y semillas de higuerilla (*Ricinus communis* L.) en posturas y larvas del gusano cogollero del maíz (*Spodoptera frugiperda* J.E. Smith), en un entisol de Pacacocha Pucallpa. Tesis para optar al Título de Ingeniero Agrónomo. 2012.
5. Ferrer FR. Biological control of agricultural insect pests in Venezuela: advances, achievements, and future perspectives. *Biocontrol News and Information*. 2001;22(3):67N–74N.
6. Ferrer Wurst, F. 2021. Control biológico de plagas agrícolas en Venezuela: los logros históricos de la empresa servicio biológico (SERVBIO). *Trop J Environ Sci*. 2021;55(1):327–344.
7. Martínez LM, Cortes PE, López JR, et al. Desempeño del gusano cogollero *Spodoptera frugiperda* (Smith) (Lepidóptera: Noctuidae) alimentado con maíz e higuerilla. *Entomología Mexicana*. 2012;2:397–403.
8. Noticias ONU. Alerta por plaga de gusanos que atraviesa continentes. 2018.
9. Morales P, Noguera Y, Escalona E, et al. 2010 sobrevivencia larval de *Spodoptera frugiperda* smith con dietas artificiales bajo condiciones de laboratorio. *Agronomía Trop*. 2010;60(4):375–380.
10. Murúa MG, Virla EG. y Defagó V. Evaluación de cuatro dietas artificiales para la cría de *Spodoptera frugiperda* (Lep.: Noctuidae) destinada a mantener poblaciones experimentales de himenópteros parasitoides. *Bol San Veg Plagas*. 2003;29:43–45.
11. Ruíz MLS, Rodríguez YMG, Martínez RT, et al. Procedimientos para establecer y mantener una cría del gusano cogollero *Spodoptera frugiperda* (J.E. Smith) en condiciones de laboratorio. *AIA Avances en Investigación Agropecuaria (Enero)*. 2022;26(1)134–154.