Evaluation of attraction of avocado fruit borer *Stenoma catenifer* using four kinds of traps mixing with pheromone and hydrolyzed protein

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Summary

This work was carried out in the municipality of La Ceja -Antioquia, from June 27/2018 to November 13/2018 , in avocado plantations using Hass and Reed varieties; the crop was planted 20 years ago and was affected by fruit borer moth *Stenoma catenifer*. 36 plugs of commercial lure were evaluated; the lure´s active ingredient is (9Z)-9,13-tetradecadien-11.ynal. The lures were putted inside of 21 prisma shape traps, and 5 Jackson trap, both traps were spreaded with a commercial glue SAFERTAC® as sticky substance: Five (5) McPhail traps and 5 gallon traps[1], were baited with CEBOFRUT® (hydrolyzed protein with a boron added) as feeding lure plus specific pheromone for *S catenifer*. Every week, each trap was monitored and rebaited with Cebofrut. The monthly monitoring reported the number of *Stenoma catenifer* adults, and take them to the Safer Agriobiologicos laboratory in order to verify the correct taxonomy of the insect using referenced material of *S. catenifer* previously identified by molecular taxonomy. The analysis was made in R-Studio® program. The results of Kruskal-Wallys test, showed that there are statistical differences between at least two types of traps with a *p-value<0.01*, also, by the Dunn test, was found that McPhail trap with both, the pheromone and hydrolyzed protein (Cebofrut), show statistical differences comparing with other traps, having a *p-value<0.025*, catching on 0.22 insects/week, respect to 0.05 insects/week of Gallon trap, 0.04 insects/week of prismatic trap and 0.03 insects/week for Jackson trap. Therefore we can conclude that the McPhail trap mixed with pheromone and hydrolyzed protein, was the best method to trap *S. catenifer* in the researched area.

[1] Galonera Trap: refers to the 4 liters plastic recipient opened lateraly in both sides.

Keywords: Lure, Monitoring, Pest.

Introduction.

The avocado plantations in Colombia, got social and economic importance, because since 2013 to 2017 this crop has increased Its production area in 51% (Piedrahita, 2018). So, for 2017, from Colombia was exported more than 35 millions of dollars in avocado, compared with previous year, (Dinero, 2017), generating an important demand of workforce, estimated in 54 thousand of Jobs, with a projected annual jobs growth of 8.4% (Minagricultura, 2018).

For this reasons, the avocado crops, has great importance in Colombia, but at the same way of others crops, there are many pest that avoid an optimal avocado production, some of them, related whit seeds and root problems (Castaño-Zapata & Leal, 2017), just like *Phythophthora cinamommi*, the most important root problem of avocados Colombian orchards.

By the other hand, there are many insects affecting the normal development of avocado productions, between the most important, are the Trips, some beetles specially Melolonthidae and Curculionidae families (ICA, 2012).

However, the avocado fruit borer *Stenoma catenifer* Miller, (Lepidoptera-Elachistidae) is considered the most limiting pest of avocado orchards, with reported losses of 95% of avocado productions (Manrique-Burbano, et al., 2009). This insect is really important, because is considered a quarantine pest for some countries limiting the free trade (ICA, 2016).

Another problems, with the control of the avocado fruit borer is the restriction of some insecticides, that cause residuality on the fruits (AGQ Labs, 2019), as well as, the risk of some quarantine insects arriving to the destination country.

For this reason is important to carry on integrated pest management that allow the control of *S. catenifer* populations. In this case, the use of sex pheromones, has been widely applied for monitoring in others crops, and according to the importance of the avocado fruit borer, were carried out some researches to promote the use of the sex pheromone, for monitoring this insect in the avocado orchards (Hoddle, et al., 2011).

However *S catenifer* sex pheromone, has a catchings low ratio because is necessary install a sex pheromone trap each 12 ha, in a period of 15 days to catch only one insect. (Hoddle, 2016).

For these reason, has been searched different strategies, to get a better ratio of *S. catenifer* catchings, using other kind of traps, as well as, the evaluation of different heights to optimize catchings of this insect. (Hoddle,et al.2011). Also, it is necessary to evaluate the IMP under different climatic conditions in order to define a better IMP strategies in each region.

In this work, was evaluated the attraction of avocado fruit borer *Stenoma catenifer* using four kinds of traps mixing pheromone and hydrolyzed protein, to determine which one is better and implement it in the IPM to improve this pest control.

Materials and Methods

The research was carried out in the municipality of La Ceja (Antioquia department) on avocado orchards with Hass and Reed varieties, with 20 years old, where the avocado fruit borer was present. The sex pheromone corresponding to commercial formulations of silicon septum with (9Z)-

9,13-tetradecadien-11.ynal) were putted in four kinds of traps corresponding to prismatic trap (Hoddle, et al., 2011), with 21 units, and Jackson trap with 5 units, spreaded with commercial glue SAFERTAC®; additionally were installed 5 units of McPhail and "Galonera" trap, baited with hydrolized protein (CEBOFRUT®) and specific pheromone to catch *S. catenifer*

The traps were distributed randomized, at height of 1.70 m on the avocado stems according with other researchers (Hoddle, et al., 2011). Each trap was monitored weekly, from January 27 to November 13 of the year 2018. The insects of each traps, were taken to the lab of Safer Agrobiologicos to define the correct taxonomy using morphological characteristics (Royals & Passoa, 2016), and also, comparing with the insects already identified by molecular methods.

With the catchings information, were made a data base, in Excel®, and after it was analyzed with *Rstudio*® statistical program. The normal test of Shapiro-Wilk, and Levenne test, gives that there are not normality neither hocedasticity, in this case, was made the Kruskal-Wallys test, and posterior comparison of median Dunn test, for determine the existence of statistical differences between the treatments.

Results

According to the results, the best rate of caught was the McPhail trap, with 0.22 insects . $week^{-1}$. $Trap^{-1}$, followed by the Galonera trap with 0.05 insects.$week^{-1}$.$Trap^{-1}$. The third place was the prismatic trap with 0.04 insects . $week^{-1}$. $Trap^{-1}$, and finally, was the Jackson trap with 0.03 insects . $week^{-1}$. $Trap^{-1}$ (Figure 1).

According to Kruskal-Wallys test, there are statistic differences in the *S. catenifer* catchings, between almost two of the four treatment with a significance of *p-value<0.01* (Table 1).

The median comparison, for Dunn test, show that the *S. catenifer* caught in McPhail trap baited with CEBOFRUT and with sex pheromone, has statistical differences respect the others treatments. With a *p-value<0.025*

Discussion

The best catchings were found in the traps with sex pheromone and hydrolyzed protein (CEBOFRUT®), corresponding to McPhail traps and showing the benefits of a mixed attraction effect, just like happened in the *Rhynchophorus palmarum*, catchings that increases when the lure is combined with kairomones (Moya-Murillo, et al., 2015).

The McPhail trap, has statistical differences respect Galonera trap, and this can be interpreted like an additional attraction of this pest insect by the yellow color of the McPhail trap base, (Figure 2)

By the other way, we found a low rate of catchings with prismatic and Jackson trap, with 0.04 and 0.03 insects . $week^{-1}$. $Trap^{-1}$ respectively. This results, are more lower than the reported for *S. catenifer* in avocado orchard in Guatemala with a rate of 0.22 insects . $week^{-1}$. $Trap^{-1}$ (Hoddle, 2016).

According with the present work has been demostrated that the attractions of pheromone, is not enough to carry on early detection of *S. catenifer,* and It is necessary to use additional strategies like the uses of McPhail trap with hydrolyzed protein together with pheromone, for the opportune monitoring of avocado fruit borer (Landry & Roque-Albelo, 2003); another advantage of Mcphail trap is that permit catchings of other

insect pests as Trips, Flies and Melolontidae bettles.

Likewise, was found, that the Prismatic trap designed and evaluated to capture *S. catenifer*, in avocado orchards (Hoddle, 2016), showed no advantage among the others generic traps, like Galonera or Jackson traps. In this way, to monitor *S. catenifer* is recommended install the McPhail trap with hydrolyzed protein, and inside this one put sex pheromone to allow the earlier monitoring of avocado fruit borer.

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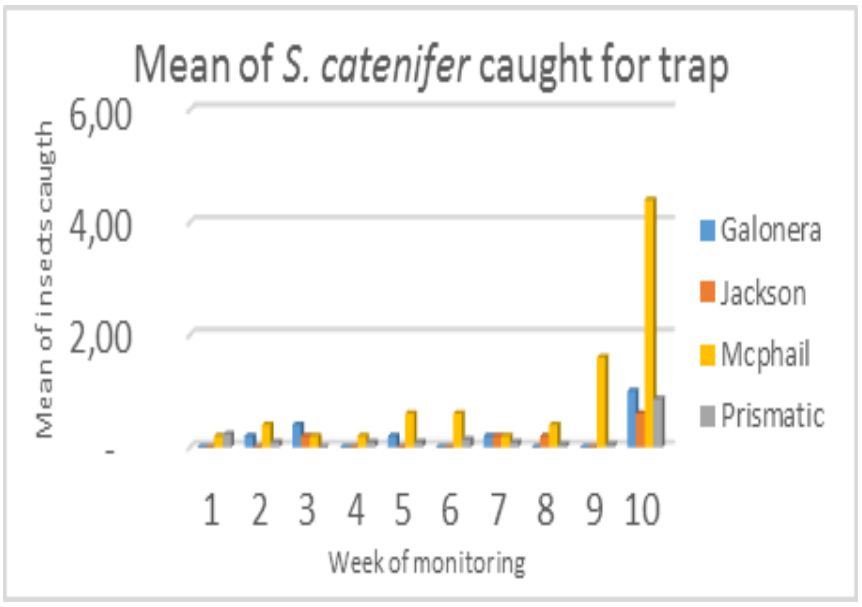

Figure 1. Mean of *S. catenifer* caught for trap.

Table 1. Significance of Kruskal-Wallys test

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Kruskal-Wallis rank sum test

    data:  Total by Trampa
        Kruskal-Wallis
     chi-squared = 15.685,
             df = 3,
       p-value = 0.001316
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Table 2. Median comparison, for Dunn test.

Kruskal-Wallis rank sum test

data: x and group
Kruskal-Wallis
chi-squared = 15.6848,
df = 3,
p-value = 0

Comparison of x by group
(No adjustment)

Col Mean- / Row Mean	galonera	jackson	Mcphail
jackson	0.930017 0.1762		
Mcphail	-2.524333 **0.0058***	-3.454351 **0.0003***	
Prismati	0.482462 0.3147	-0.699569 0.2421	3.690834 **0.0001***

alpha = 0.05
Reject Ho if p <= alpha/2

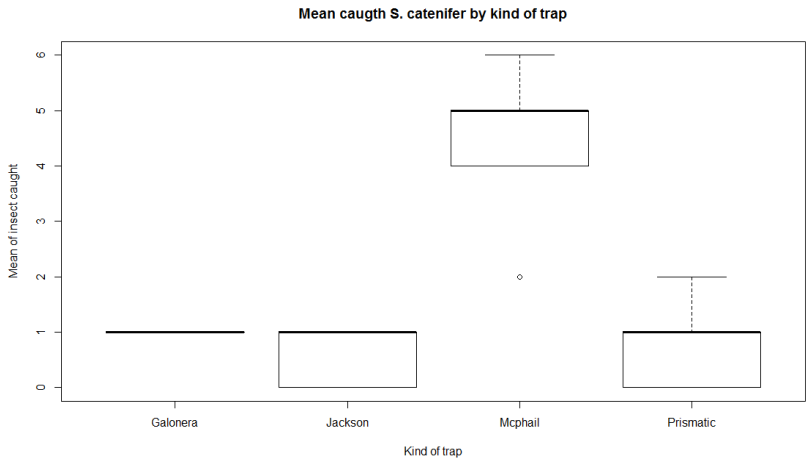

Figure 2. Catching mean of *S. catenifer* by different sort of traps.