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Full Length Research Paper

Comparison of the effectiveness and attractiveness of the trap "Sentrap"and two home-made prototypes to "Multilure" (conventional trap) in male anihilation technique

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The average catches of *Bactrocera invadens* obtained from home-made open-bottom dry traps of mineral water translucent plastic bottles of 1.5 L, 5 L, and "Sentrap" Open-top Dry local Trap (plastic prototype improved by SENCHIM, an agrochemicals industry based in Senegal) were compared to the conventional trap "Multilure" (Better World Manufacturing, Inc.., Miami, FL). Results show that no significant difference was found when "Multilure" was compared to the 5 L plastic bottle trap. The study of the relationships between catches and type of trap was significant for all of them. Sentrap, "Multilure" and 1.5 L bottle trap exhibited a very high significant dependency relationships (r = -0.969, r = -0.903** and r = -0.801**; respectively and p< 0.01). And the 5 L bottle trap was significant with r = -0.801* and p< 0.05. Thus, in case of absence of conventional traps, the plastic bottle of 5 L could, therefore, be used as an alternative and its basal part painted in yellow should increase its efficiency. Also, due to simple design and less time needed for servicing "Sentrap", increasing its volume and openings and fixing firmly the upper part with a lid screw might improve its efficiency.**

Key words: Traps, catches, *Bactrocera.*

INTRODUCTION

If pests could be attracted to relatively few points where they would be either in contact with or consume the toxin then many of the objections that confront broadcasted pesticides could be overcome (Holler et al., 2004). Such bait stations and related devices have a long history in Tephritids (Cowley et al., 1990; Robacker et al., 1990) and are being used in Mauritius and Egypt to eradicate the oriental fruitfly and the peach fruitfly, respectively. Studies have shown that peak populations of *Bactrocera invadens* (Dew) (Drew et al., 2005), the most destructive species, occurs during the wettest periods with an abundance of food (Vayssières et al., 2005; Ndiaye et al., 2007) and that under such climate conditions, the use of killer-blocks is not recommended. In the absence and the high cost of conventional traps on the domestic market, several initiatives such as plastic bottles of mineral water are used as alternatives by producers.

Regarding partly the limited financial resources of these braves, SENCHIM (an agrochemical industry based in Senegal) has tried to improve the local plastic bottle trap, so-called "Sentrap". Finding an efficient local device, which is able to be included in an area-wide IPM program, would allow overcoming the large number of traps needed and the high operational costs. It will avoid the stealing of traps in non protected areas and solve the adverse effects of the climate (leaching of killer- blocks, easy degrading of the attractants etc). This study aims to compare the effectiveness and attractiveness of these different local trapping devices to the conventional trap "Multilure" (Better World Manufacturing, Inc.., Miami, FL),

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Table 1. Characteristics of the different traps used in comparison.

Type	Height (cm)	Diameter (cm)	Volume (cm^3)	Hole (cm)
1.5 L bottle trap[1]	21	7.5	927.28	2.8
5 L bottle trap[1]	21	14.5	3465.97	4.8
Sentrap[2]	17	9	1055.04	0.8
Multilure[3]	19	14	1335.28	3.5

[1] Local open-bottom dry trap of mineral water translucent plastic bottle of 1.5 L, [2] Local open-bottom dry trap of mineral water transparent plastic bottle of 5 L. Bottles are cut at the junction between the base of the conic part bearing the bottle neck and the cylindrical part at the bottom. Both parts are embedded and the conic part reversed after separation, [2] "Sentrap": Open-top dry local Trap (dry synthetic lure) of brown plastic bottle painted in yellow from the base on 7 cm. Eight (8) holes were drilled (diameter 0.8 cm) on the yellow part to allow for easier dissemination of the lure and access of flies inside the trap (figure 1).

Table 2. Estimation of population kurtosis of captures.

Treatment	Mean	N	SD	Kurtosis
Multilure	26521.33	12	7105.96	±1.407
1.5 L bottle trap	16020.75	12	5579.89	±0.569
5 L bottle trap	21691	12	6989.09	±0.130
Sentrap	18190.33	12	7336.89	±0.845

a new version of McPhail trap. This trap is well known in a broad scope in monitoring the population dynamics of insects, comparison of bait and prototype traps and large-scale control (Hall et al., 2007; Conway and Forrester, 2007).

MATERIALS AND METHODS

The study was conducted in the Niayes, a coastal area in Senegal, providing 60% of exported mangoes from Senegal in a 10-years-old orchard of fifty six (56) ha of the late season variety "Kent". Four (4) different devices were used in the test (Table 1). The experimental design was set in three (3) randomized blocks. Each type of trap (treatment) was repeated 4 times. The distance between traps was 50 m. Small killer-blocks (5 × 5 × 1.25 cm) of triplex are soaked in Mal'atrap, a mixture of 75% methyl eugenol (1,2-Dimethoxy 4 - (2-propenyl) benzene) and 25% malathion (dimethyl thiophosphate) and thiol mercaptodiéthyl succinate) which was supplied by SENCHIMI. The impregnation lasted for 3 days (Stonehouse et al., 2007) and then dried up to 15 min to avoid leakage. A wire was used to support the impregnated blocks inside the traps. Every 30 days, the Mal'atrap was applied with a brush on both sides of the blocks.

The branch serving as a support is coated with solid fat, about 10 cm in length on both sides of the string that suspends the trap to prevent any predatory activity of ants to adult flies dead at the bottom of the trap. Flies were collected separately every 10 days in plastic bags. The experiment lasted three months, from July 15 to October 15, 2008, the wettest period of the year. Each collecting sample was dated and labelled. Collected flies were sorted and counted in the laboratory. Data variability on individuals were analyzed using a one-way ANOVA, means separation between treatments were performed by the Tukey honestly significant difference (HSD) test with alpha equals to 5% after Levene's test to assess the equality of variances in samples. The dependence with variables such as time and catch was done using the test of Pearson correlation with SPSS version 10.0.5 (SPSS Advanced Statistics, 1999, Release 10.0.5 Chicago).

RESULTS AND DISCUSSION

The Levene's Test for equality of variances have shown no significant difference (p-value = 0.642 > 0.05). We can assume that the variances are approximately equal (p-value = 0.05 is higher than the p-value obtained from ANOVA = 0.003) with normal populations (kurtosis ranged from -2 to +2) (Feldman et al. 1987) (Table 2). In total, over the three months, individuals of *B. invadens* recorded from the classic "Multilure" traps were higher with a mean of 26521.33 individuals (32%); followed by the 5 L bottle trap 21691 (26%), "Sentrap" 18190.33 (21%) and the 1.5 L bottle trap 16020.75 (20%), respectively (Figure 2). The test statistic is the F value of F = 5.472. Using an α of 0.05, we have that $F_{.05;\ 3,\ 44}$ = 2.816. Since the test statistic is much larger than the critical value, we reject the equal population means and conclude that there is a (statistically) significant difference among the population means.

The p-value for 5.472 is .00325, so the test statistic is significant at that level. The differences between means of catch of "Multilure" to 1.5 L bottle trap, "Sentrap" and 5 L bottle trap were 116673, 92566 and 536.68, respectively. However, results from the Tukey's test indicated that only 5 L bottle trap was statistically comparable to "Multilure" (Table 3). Regarding their volume and diameter of holes as in Table 1, in some extend, these two characters allowed the flies to get easily in the traps. Thus, they should be considered also as key factors in their effectiveness. In a field experiment in Japan, a local new trap could capture sterile melon fly males in equal numbers compared with the Steiner trap, without a significant difference (Yomoto et al., 2006). From a point of view of the authors, this new trap can be

Figure 1. Picture of Sentrap designed by SENCHIM.

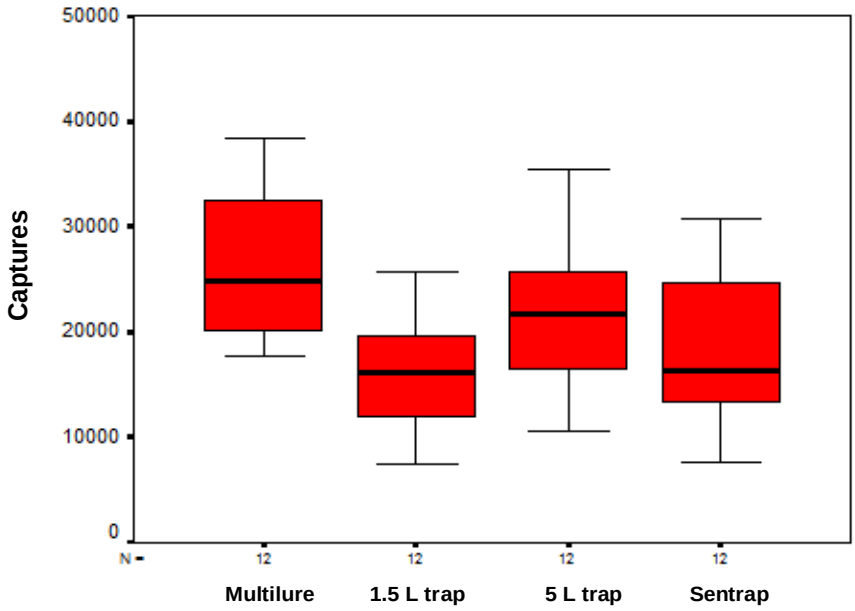

Figure 2. Catches for each type of trap (1.5 L, 5 L Multilure and "Sentrap") within the 3 blocks.

Table 3. Average catches of the different types of traps (1.5 L, 5 L, Multilure and "Sentrap") by Tukey's test.

Treatment	N	Sous-ensemble pour alpha = 0.05	
		Group 1 means	Group 2 means
1.5 L bottle trap	12	16020.75	-
Sentrap	12	18190.33	-
5 L bottle trap	12	21691	21691
Multilure	12	-	26521.33
Signification		187	0.314

The group averages for homogeneous subsets are displayed. α uses the sample size of the harmonic mean = 12.

Table 4. Results from Pearson correlation analysis between average catch and type of trap.

Trap type	*Pearson correlation *r*	Sig *(p(*bilateral)	Covariance
1.5 L bottle trap	-0.801**	0.009	-1612.134
Multilure	-0.903**	0.001	-3088.980
5 L bottle trap	-0.750*	0.020	-2314.250
Sentrap	-0.969**	0.000	-2765.559

**The correlation 9 is significant at the 0.01 level (bilateral). * The correlation 9 is significant at the 0.05 level (bilateral).

manufactured at a lower cost. The study of the relationship between catch at different times and type of trap showed that the co variances are all negative with high value, indicating opposite directions for variables and meaning a strong relationship.

However, Sentrap, "Multilure" and 1.5 L bottle trap exhibited a very high significant dependency relationships to the variables time and catch (r = -0.969**, r = -0.903** and r = -0.801**; respectively and p< 0.01). Consequently, these dependencies are more pronounced with Sentrap and Multilure. The common feature between these two (2) devices is their yellow basal colour. The response of tephritid fruit flies to variously coloured sticky traps was studied in the field in south-eastern Queensland over three seasons, according to Hill and Hooper (1984), Saturn Yellow captured significantly more flies than any of the other ten colours. Field tests on attraction of Caribbean fruit flies to 15×20 cm colored sticky traps revealed a clear preference for orange, followed by yellow according to Greany et al. (1977).

Field cage tests with medfly, *Ceratitis capitata*, were carried out in order to verify how the flies approach the trap body and the frequency of flies captured after landing. In terms of landing, regardless the bait, 59 to 80% of males and 50 to 71% of females arrived in the yellow bottom part of the trap (D´Agostino et al., 2006). The trap of the 5 L bottle trap was only significant with r = -0.801* and p< 0.05 (Table 4). However, it seems that by painting the basal part of traps in yellow, we should improve its efficiency.

During the period that lasted the experiment (July-September), the temperatures were highest and accompanied by heavy rains and violent winds. This has an adverse effect on "Sentrap". Hence, failing on the upper part with lid screw was observed with three "Sentrap". The lift-off of the upper part reflected a lack of strength of the trap and exposed to the air, the poisoned blocks used to catch and kill flies.

Conclusion

However, the 5 L bottle trap can be recommended for popular use as its catch was not different to "Multilure"'s and it is a cheaper trap, accessible to the majority of the producers. The yellow painting of the basal part might improve its efficiency. However, in regard to its handling characteristics, "Sentrap" is very simple in design and easy to use by the existence of a top lid screw. But it would be more efficient and competitive by increasing its volume and basal opening diameters. The upper part of "Sentrap" needs to be firmly affixed to prevent their detachment.

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