

Attitude[#] of operators as a factor of risk in pest sampling by sticky traps

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Sticky traps are time saving and the operator only has to change a flat device and do the counting on non-moving dead insects. Might we expect any measurable or significant differences related solely to an personal component or "attitude" of operators?. We attempted to test the attitude of operators, as a risk factor in sampling by sticky traps. Sixteen students in their last year of college, attending an optional course of pest diagnosis, were considered as operators. They received white cards with black dots that represented insects on sticky traps, and were asked to do the counting. There were two "density" (500 and 1000 dots) and three "counting methods" treatments (25, 100 and 400 cells within a grid). The difference between number of dots and the record of operators were analysed using ANVA and DGC test. Operators underestimated between 6% and 16% of the number of dots. Significant differences emerged between dot density, cell size and operators, where three groups emerged. This may become a risk, when an operator belonging to the "worst" group has to decide about some control procedure. The risk consist in not to control the pest when it is necessary. There seemed to be a behavioural feature of people, named here as "attitude", since did not depend on knowledge or training. Could it be changed by training?.

KEY WORDS: sticky traps, operators, attitude, risk

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Las trampas adhesivas reducen el tiempo de trabajo y el operador sólo tiene que cambiarlas y llevar a cabo el recuento de insectos muertos. Pueden esperarse diferencias en los recuentos entre los operadores debido a un factor personal o "actitud" de los mismos? Se trató de cuantificar ésta diferencia para operadores en el recuento de trampas adhesivas. Dieciséis estudiantes del último año de la carrera de agronomía que tomaban un curso optativo sobre diagnóstico de plagas, fueron considerados como operadores. Recibieron tarjetas blancas con puntos negros representando insectos en trampas adhesivas y se les pidió que hicieran el recuento de los mismos. Las tarjetas tenían 2 densidades diferentes (500 y 1000 puntos) y 3 métodos de recuento (grillas de 25, 100 y 400 celdas). La diferencia entre el número real de puntos y los recuentos fueron analizados mediante ANVA y DGC (prueba a posteriori). Los operadores subestimaron entre un 6 y 16% el número total de puntos. Las diferencias resultaron significativas por densidad de puntos, forma de recuento y operador, donde se formaron 3 grupos. Esto puede constituir un riesgo adicional en el manejo de plagas, si alguno de los operadores de peor comportamiento - desde éste punto de vista - tuviera que tomar alguna medida de control. El riesgo consiste en no tomar una medida de control, cuando ésta es necesaria. A partir de estos resultados, se observa entonces un rasgo de comportamiento, considerado como una "actitud", ya que no dependía de su conocimiento o entrenamiento previos. Podría ser cambiada mediante el entrenamiento?.

PALABRAS CLAVE: trampas adhesivas, operadores, actitud, riesgo

attitude: the way that you behave towards someone or in a particular situation. Longman Dictionaries (1995).

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INTRODUCTION

Sticky traps are considered a short-time tool for decisions in Integrated Pest Management, mainly for greenhouse crops and tiny flying insects, like thrips, whiteflies, miner flies, aphids and fungus gnats (Ship, 1995). Also time saving is an advantage against direct plant counting, a more refined and time-consuming method. Since they offer a rough image of pest density fluctuations, they may be considered a classification method rather than estimation one (Binns *et al.* 2000).

Several companies offer these traps around world (Koppert, 2008) and they are widely adopted for specific purposes, in greenhouse cultivation. In Argentine traps are poorly used and often misused (Carrizo, 2001).

Sampling by means of sticky traps is considered a safe, low-risk method from the point of view of the operator, since they could not introduce a bias in results. These traps need little training, since the operator only changes a flat device and does the counting on non-moving dead insects and traps can be counted and revised again.

On the other hand, better training and knowledge are required in sampling hoppers with net, a different kind of trapping method. Although an experienced scientist and other trained operators agree in the economic threshold, they obtain very different records (Schufran & Raney, 1989). In addition, for net sampling, time is a critical feature for their decisions and it is not possible to make a revision.

However, experience is not always as good as thought. An experimental research from Altman (1986), who tested agreement in diagnosis from radiologists, illustrate how the same xeromammograms lead experienced operators to amazingly different results, from normal and harmless to very seriously ill.

Would it be possible to expect any measurable or significant differences related solely to the "attitude" of operators with not other disturbing reasons for counting? We attempted to test this issue as a risk factor in sampling by sticky traps.

MATERIALS AND METHODS

Operators in this assay were sixteen students in their last year of college (bachelor degree in agronomy), about twenty-five years old, attending a course on pest diagnosis. Since this course was optional, we assumed they shared some interest in pests.

The assay was introduced in class, as an exercise required for credits. We did not aware the operators about our aim: to assess their performance. These operators had no experience in counts on sticky traps, and then we did not expect any difference in this matter. They were asked to do the counts and to write down the results in a table, within a period of two weeks.

The operators received white cards with black dots, which represented insects on sticky traps. This allowed us to exclude failures, mistakes or differences caused by knowledge of pests or any other, like stickiness.

Both patterns used were taken from Binns *et al.* (2000); but those small original squares were copied and enlarged, to reach the size of 100 cm². The first pattern used that contained 500 dots randomly distributed was taken from Figure 4.1.a., on page 64. The second one with 1000 dots and an aggregated disposition was taken from Figure 4.8.a., on page 74. Then, they represented two "density" treatments. After enlarged, we placed three different grids on each one that represented three "counting methods" treatments. This resulted in six different combined patterns (Table 1). They were rotated and mixed, and then disposed stuck to a piece of paper in order to exhibit them together. This last changed the appearance of the group and the operators did not notice the patterns were the same.

Operators were identified with number, according to alphabetical order of their names. Data - the difference between number of dots and the record of operators - were transformed to ranks, as a remedial measure for the violation of the assumptions of the model. The differences between the actual number of dots and the counts of operators were analysed using an ANVA model with operators as blocks and the DGC test (Di Rienzo *et al.* 2002). Tests were performed by means of InfoStat (2004) (alpha = 0.05).

Table 1. Assay arrangement. Cards type: [dots versus grid] patterns.

Tabla 1. Diseño del ensayo. Tipo de tarjetas: patrones [puntos versus celdas].

		Side length of cells (mm)		
		20	10	5
Number of dots (dot density)	500 (random)	X	X	X
	1000 (aggregated)	X	X	X
		25	100	400
		Total number of cells in the grid		

Table 2.a. ANVA results from InfoStat.

Tabla 2.a. Resultados del ANVA (salida de InfoStat).

Source of variation	SC	Gl	CM	F	p
Model	68,126.09	18	3,784.78	52.33	<0.0001 *
Operator (block)	12,429.00	15	828.60	11.46	<0.0001 *
Dot density	54,817.01	1	54,817.04	757.87	<0.0001 *
Cells size	880.05	2	440.02	6.08	0.0035 *
Error	5,569.41	77	72.33		
Total	73,695.50	95			

(*) significant effects. (*) efectos significativos.

RESULTS

Figure 1, shows that the operators underestimated, on average, between 6% and 16% of the number of dots (lowest and highest dot density, respectively). Results of the ANVA and comparisons were shown in Tables 2.a., c, and d., where significant differences appeared between dot density, cell size and operators. As expected, the highest difference appeared at the highest dot density. Unexpectedly, in the highest and lowest cell size, the operators obtained the same underestimation and in the middle size emerged the worst performance.

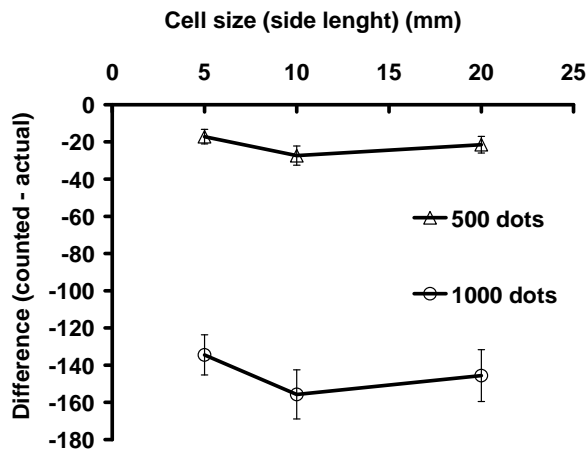


Figure 1. Differences between counted and real number of dots, by dot density and cell size. Bars are standard error.

Figura 1. Diferencias entre el número de puntos reales y contados, considerando densidad de puntos y tamaño de celdas. Las barras representan el error estándar.

Table 2.b. DGC Test (alpha: 0.05) for Dot density.

Tabla 2.b. Prueba DGC por densidad de puntos.

Dot density	Means	N	Groups
500	72.40	48	a
1000	24.60	48	b

Different letters within column means significant differences between groups for the DGC test. Diferente letra dentro de la columna implica diferencias significativas para la prueba DGC.

Table 2.c. DGC Test (alpha: 0.05) for Cells size.

Tabla 2.c. Prueba DGC por tamaño de celdas.

Cells size (number of squares in the grid)	Mean s	N	Groups
20 mm x 20 mm = 25 squares	51.77	32	a
5 mm x 5 mm = 400 squares	49.27	32	a
10 mm x 10 mm = 100 squares	44.47	32	b

Same letter within column means no significant differences between groups for the DGC test. La misma letra dentro de la columna implica diferencias no significativas para la prueba DGC.

Table 2.d. DGC Test (alpha: 0.05) for operators.

Tabla 2.d. Prueba DGC para operadores.

Operator	Sex (*)	Means	N	Groups
Op. 3	Male	66.50	6	a
Op. 8	Male	64.67	6	a
Op. 2	Male	63.92	6	a
Op. 16	Male	57.58	6	b
Op. 12	Female	53.42	6	b
Op. 10	Male	53.42	6	b
Op. 7	Female	50.17	6	b
Op. 4	Female	48.58	6	b
Op. 6	Male	47.83	6	b
Op. 1	Male	46.42	6	b
Op. 9	Female	46.33	6	b
Op. 11	Male	45.75	6	b
Op. 13	Male	42.00	6	b
Op. 5	Male	31.58	6	c
Op. 15	Male	30.00	6	c
Op. 14	Male	27.83	6	c

Same letter within column means no significant differences between groups for the test. (*) Differences between genders were not considered. La misma letra dentro de la columna implica diferencias no significativas para la prueba DGC. (*) No se consideró diferencias en la respuesta entre sexos.

Differences between operators are in Table 2.d., where three groups emerged. Results from operators were ordered from lowest to highest difference (or from best to worst performance) by dot density in Figure 2 and by cell size in Figure 3. In addition, two dotted lines illustrate those groups from Table 2.d.

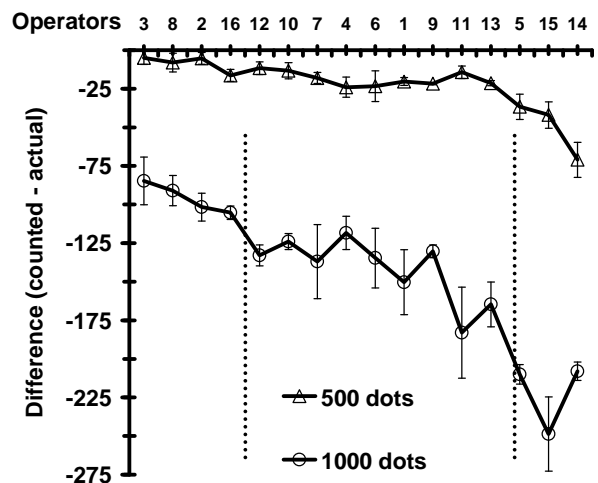


Figure 2. Differences between counted and real number of dots, by dot density and operator. Bars are standard error.

Figura 2. Diferencias entre número de puntos reales y contados, considerando densidad de puntos y operador. Las barras representan el error estándar.

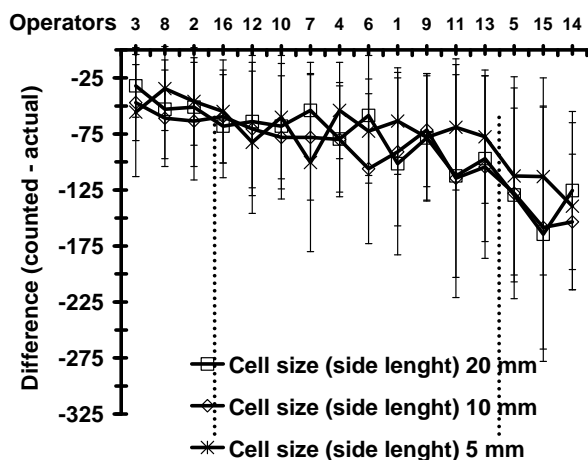


Figure 3. Differences between counted and real number of dots, by cell size and operator. Bars are standard error.

Figura 3. Diferencias entre el número de puntos reales y contados, considerando tamaño de celdas y operador. Las barras representan el error estándar.

DISCUSSION AND CONCLUSION

It seems obvious that a significant difference between performances of the operators may cause a direct influence in pest sampling decisions. However, it is not usually considered a relevant issue or a hazardous bias, probably because it is not expected to find any significant differences between operators. Moreover, it seems to be an issue either not very substantial or not very easily recorded. People involved in counting are only concern about cost with no other remarkable influence. Then, there are few reports about the quality of diagnosis from the view of the operator, except those from Altman (1986) in medical research.

In their paper, Schufrán & Raney (1989), explained differences between operators as matter of training, experience, knowledge, and biological features of hoppers (Acrididae: Orthoptera). However, all factors mentioned and others not mentioned (land difficulties, age of operators, pest density) were confounded and mixed by the design itself. Hoppers can jump and fly, and usually a part of them are capable to escape from the net. Moreover, since the real pest density is not known and insect populations are spatially variable, always a more trained or experienced operator is expected to be a better one.

On the opposite, significant differences in outputs from sticky traps counting are not usually expected, except for those due to training and knowledge, since the insects are already dead on the sticky surface. However, our design removed any possibility of differences from those issues, like in Altman *et al.* (1986).

On the other hand, differences because of density and counting method may be related to the visual capability of the operators, and more research is required to test

the relationship between the cell size of the grid and the optimal counting performance.

Probably the most unexpected finding was the difference between operators, and the clustering emerged (Table 2.d.). The operators which belong to the group "c" may be considered the worst - from this point of view - and those in "a", the best. Although the difference between operators was higher between the two dot densities, the clusters kept the same along the cell sizes.

A possible explanation seems to be a behavioural feature of people, named here as "attitude" that may become a risk when an operator belonging to the "c" group has to decide about a control procedure. The risk consist in not to control the pest when it is necessary, mainly because all operators underestimated the number of black dots.

Altman *et al.* (1986) showed that training was not the problem, because very trained and experienced radiologists produced amazingly different results. Furthermore, since their tests were about diagnosis of cancer, the operators had to be conscious about the consequences of their mistakes.

For pest diagnosis in crops, could this difference between operators be changed by training? Will this training reduce their differences? Or by the contrary, every group will change and improve? These questions require a design with two points of evaluation: before and after training.

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