CHLORANTRANILIPROLE/LAMBDA-CYHALOTHRIN, A NEW INSECTICIDE MIXTURE TO CONTROL *TUTA ABSOLUTA* AND *SPODOPTERA LITTORALIS* IN TOMATO

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SUMMARY

A study was performed in the period May-July 2011 by Bioagritest test facility according to EPPO guidelines and Principles of Good Experimental Practice (GEP), in the land of Eboli (SA), southern Italy, with the purpose to test a new insecticide mixture in the defense strategies of processing tomato against *Tuta absoluta* and *Spodoptera littoralis*.

The insecticide mixture Chlorantraniliprole 100 g/λ-Cyhalothrin 50 g/l 0,4 lt/ha was applied in a tomato field in four (A-B-C-D) application timings (a.t.) alone (treatment 2) and in two a.t. (A-B) combined with emamectin benzoate 0,5%, 1,5 Kg/ha (a.t. C-D) (treatment 3). Its effect in containing insect populations was compared with that exerted by emamectin benzoate 0,5%, 1,5 Kg/ha (a.t. A-B-C-D) (treatment 4) and the combination of chlorantraniliprole 35%, 0.115 Kg/ha (a.t. A-B) and indoxacarb 30% 0.125 Kg/ha (a.t. C-D) (treatment 5).

Application of treatments (trt.) and mode of assessment (2 assessments), recording and measurements followed the guidelines foreseen by EPPO Standards PP1/150 and PP1/275.

The lepidoptera infestation in the tomato crop was very high on both the leaves and fruits, and this enabled us to evaluate the efficacy of the tested products in conditions of severe pests infestation.

If we consider the leaf damage, either as number of mines by *T. absoluta* or as % of leaf erosion by *S. litteralis*, all the treatments values were statistically lower than control, but with no difference among them. But when using as an infestation threshold the percentage of damaged fruits (much more relevant in economic terms), we observed statistically significant differences among treatments. Actually, treatment with chlorantraniliprole-λ-cyhalothrin mixture was significantly more effective than the one with emamectin benzoate in reducing the attack of *T. absoluta* on tomato fruits, in both dates of assessments.

As concerns damage by *S. littoralis* on the fruits, at the first assessment, trt. 2 and trt. 5 significantly reduced the percentage of infested berries in comparison with the control, whereas the infestation was not significantly reduced by trt. 3 and trt. 4. At the second assessment, no statistically significant difference between the four different treatments was observed.

Since the infestation of tomato fruits by *S. littoralis* was much lower than the one caused by *T. absoluta*, the overall performance of the four insecticide treatments was mainly due to the control effects towards *T. absoluta*.

Key words: *Tuta absoluta, Spodoptera littoralis*, chlorantraniliprole-λ-cyhalothrin, insecticide, tomato.

INTRODUCTION

Processing tomato is a typical crop of the spring-summer season in the area of Eboli (SA), Campania Region, southern Italy. The tomato industry in Italy is attacked by many plant, animal, viral and virus - like pests (Crescenzi, Acta horticolturae 2008). Prevention, and in particular the use of healthy plant propagation material, is a strategic element for its healthy cultivation in Italy (Fanigliulo *et al.*, 2011). A study was performed in the period May to July 2011 by Bioagritest Facility according to EPPO guidelines and Principles of Good Experimental Practice (GEP), in the land of Eboli (SA), with the purpose to test a new insecticide mixture - chlorantraniliprole/lambda-cyhalothrin - in the defense strategies of tomato. Chlorantraniliprole is an insecticide (anthranilic diamide) that exhibits larvicidal activity as an orally ingested toxicant, with a new mode of action (group 28 in the IRAC scheme): it targets insect ryanodine receptors (RyRs), disrupting the $Ca2+$ balance. It shows very high biological activity on several lepidopteran species, including the difficult-to-control endocarpic ones. λ-Cyhalothrin is a type II pyrethroid which affects chloride and calcium channels that are important for proper nerve function (Burr and Ray 2004). It is a broad spectrum, non systemic insecticide, effective at low application rates against major insect pests in a wide range of crops. It acts by direct contact with insects or after ingestion.
The area chosen for the realization of the experiment was monitored with sex pheromone traps in 2009 and 2010, and high populations of lepidopteran pests of tomato were registered. In particular, in the tomato field chosen for the test, very high catches of *Tuta absoluta* and *Spodoptera littoralis* were recorded. We used a homemade model of pheromone trap that is very commonly used by local farmers in the Eboli area (Figure 1). The tomato variety chosen for the experiment was "Defender F1", a prismatic hybrid ideal for the production of pulp, past and concentrated tomato.

MATERIALS AND METHODS

The insecticide mixture Chlorantraniliprole 100 g/λ-Cyhalothrin 50 g/l 0,4 lt/ha was applied in a tomato field in four (A-B-C-D) application timings (a.t.) alone or in two a.t. (A-B) followed by two other a.t. with Emamectin benzoate 0,5%, 1,5 Kg/ha (a.t. C-D). Its effect in containing insect populations was compared with that exerted by Emamectin benzoate 0,5%, 1,5 Kg/ha (a.t. A-B-C-D) or the combination of Chlorantraniliprole 35%, 0.115 Kg/ha (a.t. A-B) and Indoxacarb 30% 0.125 Kg/ha (a.t. C-D).
Application of treatments and mode of assessment, recording and measurements followed the guidelines foreseen by EPPO Standards PP1/150 and PP1/275. In particular, applications were done at the following phenological growth stages (BBCH-identification keys) of tomato:

A. 51 (1^{st} inflorescence visible, first bud erect)
B. 61 (1^{st} inflorescence: first flower open)
C. 63 (3^{rd} inflorescence: first flower open)
D. 71 (3^{rd} fruit cluster: first fruit has reached typical size).

For every experimental treatment, we assessed leaf infestation by *T. absoluta* on at least 50 randomly taken tomato leaflets per plot, recording the number of leaf mines, while for *S. littoralis* we evaluated the percentage of eroded leaf surface on at least 50 randomly taken tomato leaflets per plot. Damage on tomato berries by each species was calculated as a percentage of damaged fruits on at least 50 tomato fruits per plot. The field was also examined for the presence of phytotoxic effects.

Collected data were processed first with two-way analysis of variance (ANOVA) test, considering the type of treatment and the date of assessment as the two main factors, and, subsequently, for each date of assessment, with one-way ANOVA, in relation to the type of treatment.

The parameter "leaf mines" produced by *T. absoluta* has been transformed as $X' = \sqrt{(X + 1)}$, before analysis (Zar, 2009), while the percentage values, both of foliar erosion by *S. littoralis* and infestation of berries for both lepidopteran, were subjected to angular transformation, as proposed by Freeman and Tukey (1950), to avoid the problems of deviation from normality (Zar, 2009).

When the Anova returned a significant F value, both the Tukey test and that of Bonferroni were subsequently used for the separation of the means.

All analyzes were performed using the statistical program Systat®, Version 13.

Table 3. Description of treatments (trt.)

Trt.	Active Ingredient	Code or Commercial Name	Content A.I.	Timing	Dose/Ha
1	Control	–	–	–	–
2	Chlorantraniliprole + λ-Cyhalothrin	A15397 (Syngenta Crop Protection)	100g/L 50g/L	A-B-C-D	0,4 L
3	Chlorantraniliprole + λ -Cyhalothrin	A15397 (Syngenta Crop Protection)	100g/L 50g/L	A-B	0,4 L
	Emamectin Benzoate	Affirm (Syngenta Crop Protection)	0.95%	C-D	1,5 Kg
4	Emamectin Benzoate	Affirm (Syngenta Crop Protection)	0.95%	A-B-C-D	1,5 Kg
5	Chlorantraniliprole	Altacor (DuPont Crop Protection)	35%	A-B	0.115 Kg
	Indoxacarb	Steward (DuPont Crop Protection)	30%	C-D	0.125 Kg

RESULTS AND DISCUSSION

The choice of the area of Eboli (SA), and of the field itself in the Sele Plain has proved suitable for the purpose of the study, thanks to the availability of historical data and a monitoring network by Bioagritest that permits to correctly identify the most appropriate test areas, in relation to the culture and to the target parasites. The infestation of lepidopteran in the cultivation of tomato, and in particular of *T. absoluta* and *S. littoralis*, were very high on both the leaves and fruits, and this has enabled us to evaluate the tested products under severe infestation of the target pests.

All the products compared in the different treatments have shown a good control and containment against the two lepidopteran (Figures 2-3-4), and without causing phytotoxicity effects on tomato plants.

The study has gained good results for the experiment carried out and has achieved the goal to have a good evaluation of the different active ingredients used in the test. It also has made it possible to draw some considerations, with due caution for the fact that it is a single study with levels of infestation not predetermined, and therefore susceptible to further confirmations in different situations of population dynamics.

The first consideration concerns the use of homemade pheromone traps that, commonly used in the area because easily made and low cost, do not seem to provide very reliable indications in terms of forecasting the next infestation and decision making (Figures 5 and 6). Clearly, this finding cannot be read as an outright negative opinion on the use of this type of homemade trap. Too many factors, in facts, contribute to their overall performance, i.e.: the shape, positioning, the pattern of insect flight, the type of dispenser, the pheromone mixture, and so on. But, as a matter of fact, given the conditions and population dynamics we observed in the year of the experiment (2011), the decision to perform the first treatment, in part justified by the catches of males obtained, turned out, in retrospect, not to be justified. Infestation of lepidopteran in the control plots, actually, began to grow only after second treatment (Figures 5 and 6).

Another consideration is about the different evaluation of the treatments according to the parameter considered for assessing the degree of infestation.

If we consider the damage on leaf surface (mines of *T. absoluta* and % of leaf erosion by *S. litteralis*), all the four treatments gave a significantly lower damage than the control, but we did not detect any significant difference among them, for both pests.

When we consider as parameter in infestation the percentage of damaged fruits (more significant in practical and economic terms), the results differ significantly.

Treatment 2 proved significantly more effective than trt. 4 in reducing the attack of *Tuta absoluta* on tomato fruits, at both dates of assessment.

As concerns damage by *Spodoptera littoralis* on the fruits, at the first assessment, trt. 2 and trt. 5 significantly reduced the percentage of infested berries in comparison with the control, whereas both treatments 3 and 4 did not differ statistically from the control. At the second assessment, no statistically significant difference between the different treatments was observed.

Since the infestation of tomato fruits by *S. littoralis* was lower than that caused by *T. absoluta*, the overall performance of the four insecticide treatments was mainly due to the control effects towards *T. absoluta*.

All this considered, the treatment 2 (chlorantraniliprole + λ-cyhalotrin) has shown the best performance, showing a better control on both the leaves and fruits. Treatments 3, 4 and 5, in turn, although showing a slightly lower activity of control, have shown an overall good control of the crop.

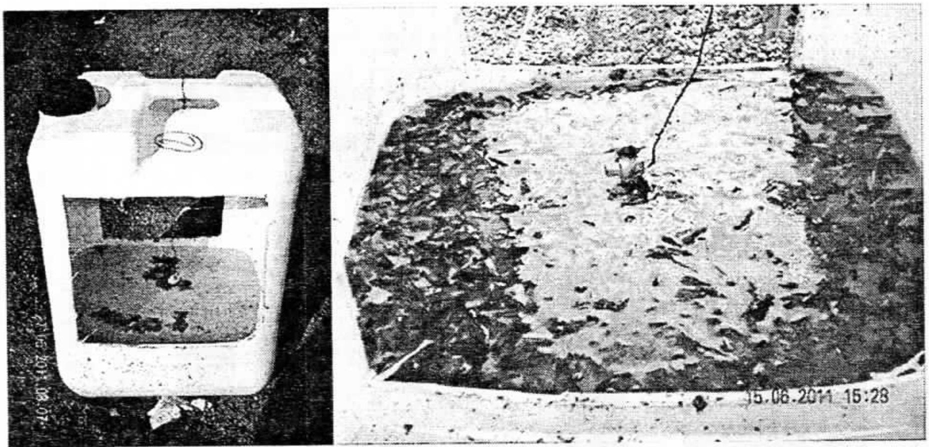

Figure 1. Homemade model of pheromone trap commonly used by local farmers in the Eboli area. Male catches on the right.

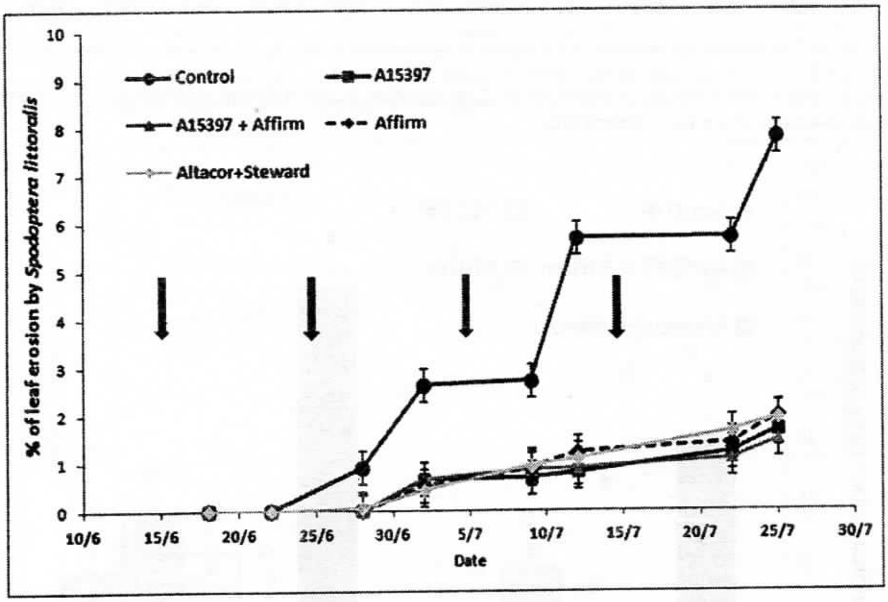

Figure 2. Homemade model of pheromone trap that is very commonly used by local farmers in the Eboli area Percentage of leaf erosion (mean±SE) produced by *S.littoralis* in the different treatments. The arrows indicate the date of the four applications.

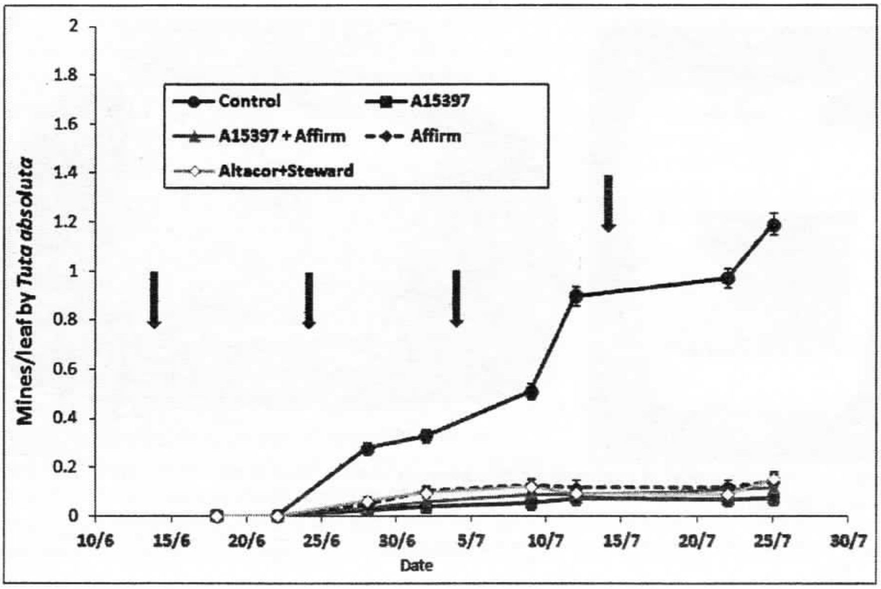

Figure 3. Leaf mines (mean±SE) produced by *Tuta absoluta* in the different treatments. The arrows indicate the dates of the four applications.

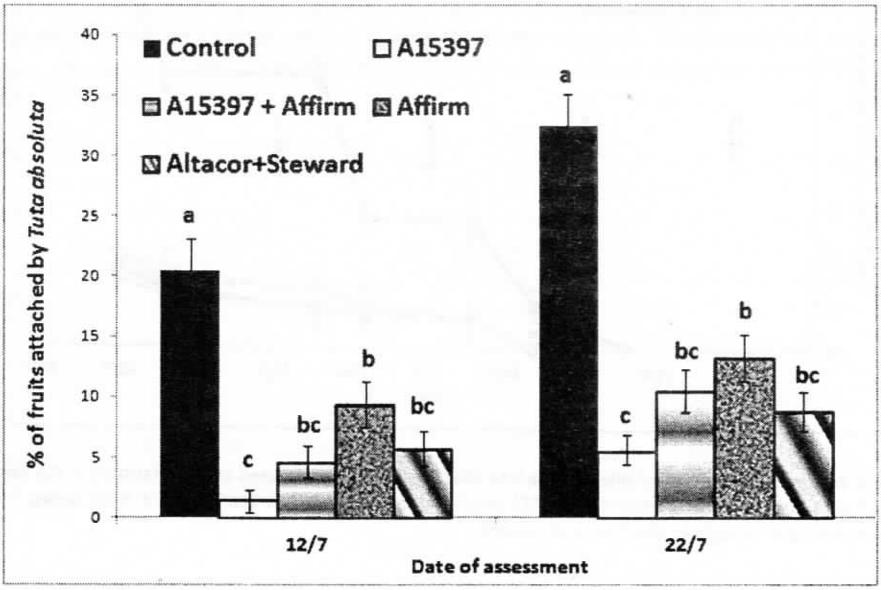

Figure 4a. Percentage of tomato fruits (mean±SE) attacked by *T. absoluta* as related to the different tratments. Within each date, bars marked with different letters differ significantly (α=0.05, Tukey Honestly-significant-difference test and Bonferroni's test).

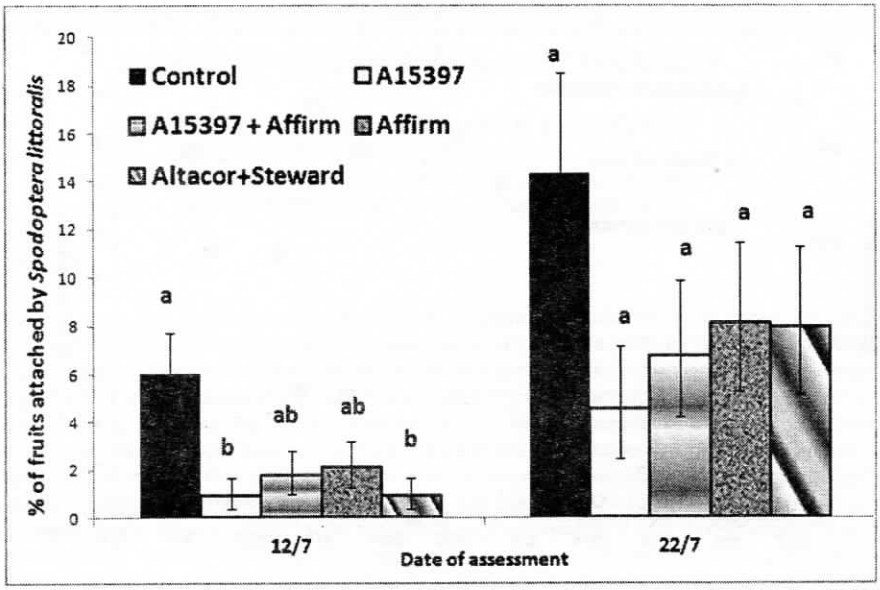

Figure 4b. Percentage of tomato fruits (mean±SE) attacked by *S. littoralis* as related to the different tratments. Within each date, bars marked with different letters differ significantly (α = 0.05, Tukey Honestly-significant-difference test and Bonferroni's test).

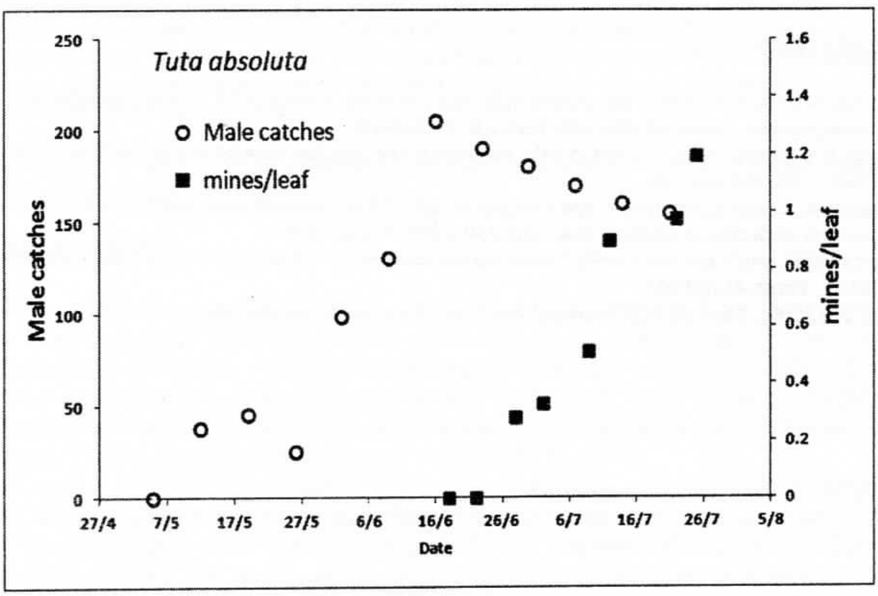

Figure 5. Male adult catches of *T. absoluta* by homemade pheromone traps and subsequent leaf damage in the control plots.

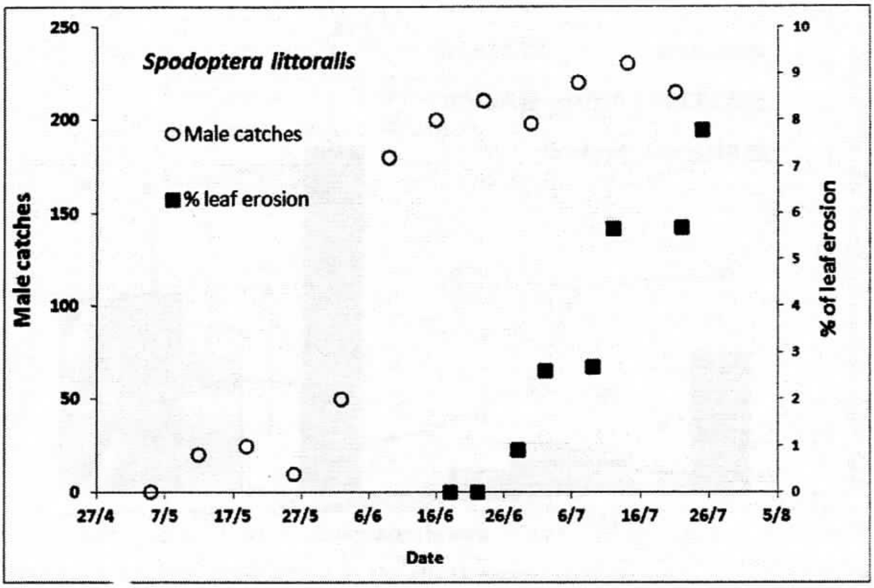

Figure 6. Male adult catches of *S. littoralis* by homemade pheromone traps and subsequent leaf damage in the control plots.

LITERATURE

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