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Microbiological Control using *Bacillus thuringiensis* (*Bti*) on Two Stages of Life of the Fly of the Fruits *Ceratitis capitata* (Wied) (Diptera:Tephritidae), L3 and the Adult

F. Hassani* and N. Gaouar Benyelles

Laboratory of Ecology and Management of the Natural Ecosystems, Tlemcen Algeria.

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The massive use of chemical insecticides comprises many disadvantages. However, among the principal ones, let us mention the contamination of the water and the sources of food, the intoxication of animal and vegetable species not targeted the concentration in the trophic chains and the selection of populations of devastating insects resistant to chemical insecticides. Increasing concerns of the public with regard to the potentially harmful effects of the massive use of chemical insecticides for the environment led the researchers to find solutions of replacement to the chemical fight. Among the solutions which were proposed, the use of micro-organisms entomopathogenes likes *Bacillus thuringiensis* (*Bti*). We tried to try out a microbiological control by studying the mortality rates caused by the application of *Bacillus thuringiensis* (*Bti*) in various amounts on the L3 stages and the adult of the fly.

Key words: *Ceratitis capitata*, microbiological control, *Bacillus thuringiensis*.

The purpose of our study lies within the scope of the improvement of the plant health situation on the level of the agrumicoles orchards, it is to carry out on the one hand, a comparative study of the infestation of two varieties of citrus fruits by *Ceratitis capitata* (Wied); and in addition, to test the effectiveness of *Bacillus thuringiensis* (*Bti*) and the possibility of its use in biological fight on a large scale.

MATERIAL AND METHODS

After the taking away of L3 starting from strongly infested oranges; these larvae are incubated in healthy oranges containing *Bti* with the following amounts: 25mg, 50mg, 75mg, and 100mg; in the presence of the witness with three repetitions for each one of them.

Each orange is placed in a plastic basin containing of sand for the pupaison and sponges wet to ensure a certain hygroscopy necessary to the development of different stages; the whole is surrounded by a tulle in order to avoid the exit of the imagoes during emergence and to allow ventilation.

Witness (0mg of *Bti* +20 L3),
1ier test (25mg of *Bti* +20 L3),
2nd test (50mg of *Bti* +20 L3),
3rd test (75mg of *Bti* +20 L3),
4th test (100mg of *Bti* +20 L3).

In the breeding of the adults, each basin includes/understands twenty pupes same age plus

* To whom all correspondence should be addressed.
E-mail: faicalhassani@yahoo.fr

a food substance containing an amount of *Bti,* placed in a sweetened solution. The goal of this breeding is to see the effect of this bacterium on the ravagers.

RESULTS

The breedings of *Ceratitis capitata* carried out at the laboratory made it possible to estimate the rate of parasitism of this insect; it was null (0%). Thus we confirmed the absence of a biological control exerted by its natural enemies. For this reason, we applied for the first time a stock of *Bacillus thuringiensis* (*Bti*) to two stages of life of this fly L3 and the adult to different amounts. We can say that effectiveness of *Bti* as a bacterium entomopathogene on the L3 stages and the adults of *C capitata* is estimated starting from the mortality of the L3 stage, calculated after the emergence of some imagoes which could resist. The capacity larvicide of this *Bacillus* on the mortality of L3 varies in a significant way according to various administered doses' bus Fobs = 7,91 for P = 0,009.

Results obtained after application of *Bti* to the following amounts

0 mg, 25mg, 50mg, 75mg and 100mg made it possible to obtain results represented daNS Fig. 1, proving the larvicide effect of this biological product (*Bti*) on the L3 stage of the ravageur.

Indeed, Fig. 1 shows that the larvae of this stage very sensitive to the strong amounts are justified by the witness.

The recently emerged imagoes are attracted by the substances sweetened to feed*;* it is in the latter that the microbial insecticide *Bacillus thuringiensis* was managed with various amounts.

The application of this insecticide showed a more significant effectiveness with the increase in the amount of *Bti.*

One can say that mortality is in close connection with the amount of microbial insecticide as the Fig. 2 shows it. Indeed, for amounts 25, 50, 75, 100 mortality was respectively 56.86%, 66.31%, 68.32%, 84.26%, whereas the witness presented a small percentage of mortality (22.5%).

In the same study one tried to see whether this bacterium had an impact on the sex-ratio i.e. on the mortality of the males and the females; the results obtained show a negative effect on the death rate that is for the males or on the females Fig. 3.

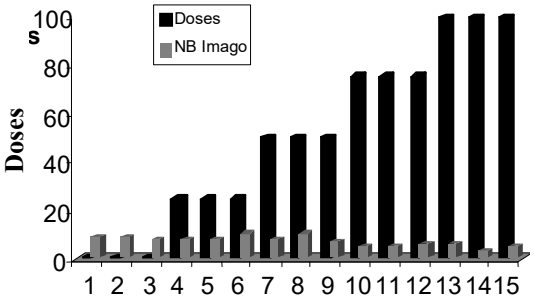

Fig. 1. Effect of *Bti* on L3 de *Ceratitis capitata*

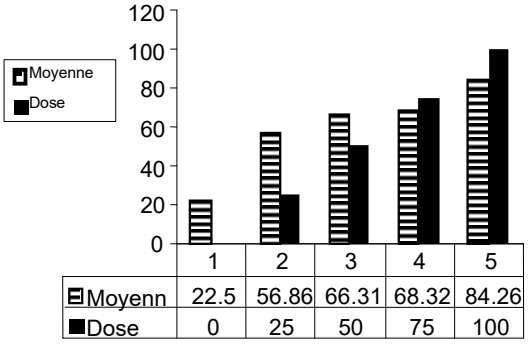

Fig. 2. Effect of *Bti* on the percentage of mortality of the imagoes

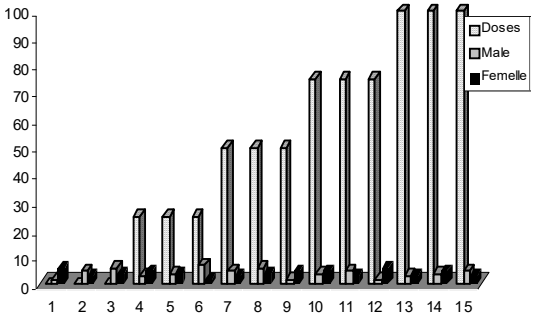

Fig. 3. Effect of *Bti* on the sex-ratio ratio

The variance analyses to two criteria of classification show that the amounts of *Bti* do not have any effect on the sex of the adults bus Fobs = 0.07 for P = 0,975.

The application of these various amounts in food proposed to the adults does not have any effect on survival of the flies.

DISCUSSION

In Tlemcen, we led studies to El-Fehoul showing that the western and southern exposures are those where the captures of *C. capitata* on citrus fruits are highest[1].

The emergences obtained at the laboratory show that the parasite of *Ceratitis capitata* in the two farms; Mousadek (Sidi Bounouare) and Beautiful Aidouni (Fehoul) are the hymenoptere Braconidae *Opius concolor*[1].

In the same family of Tephritidaes have finds *Bactrocera oleae*, Belhoucine and Gaouar[2] estimates a percentage from 12 to 27% of parasitism by *Opius concolor*, remained insufficient to exert a biological control.

This parasitoide which belongs to the hymenopteres, recognized by their sensitivity with respect to insecticides. In the orange groves, the application of a chemical campaign is obligatory as of the formation of the fruits, for this reason this beneficial species does not find any more to survive.

Our study which is spread out December until March does not reveal any presence of *Opius concolor*; either it is in the process of disappearance, or it has a preference for *Bactrocera oleos* by input in *Ceratitis capitata* during the period of October-November.

For these reasons, we let us recommend the microbiological fight containing *B.thuringiensis* (*Bti*), a bacterium which showed significant larvicide effect on the third stage (L3) with the amounts of 75 and juice 100mg/10ml. These same results were noted on several larvae of dipterous[3].

Researchers from the Pasteur institute in Paris, explain this toxicity by the synthesis of a crystalline structure by the bacterium, being able to kill the larvae of various insects of the order of the lepidopteres, dipterous and of coleopters[4].

With through a variance analysis, the results of the research of the effectiveness of *Bti* on the imagoes, revealed a positive effect of the factor amounts. The same results are obtained in Tlemcen confirm some as the death rate in the mosquitos (dipterous) depends at the same time on the amount and the time which while increasing, increase the effectiveness of the product[5].

By opposition with the results obtained by Ali[6]; Mulla[7]; Back[8]; Becker and Margalit[9] who insist on the fact that the effectiveness is related to some insects; whereas our experiments prove the opposite by the application of this product on the ceratite where mortality exceeded 50% of the larvae and the imagoes. These results push us to say that the list of the insects sensitive to the crystals of *Bti* is always indefinite.

Finally the impact study of *Bti* with various amounts showed that this bacterium has a positive effect on mortality of the larvae of the third stage and on the imagoes; also it is a bacterium which is not selective for the sex of the fly.

The capacity significant larvicide of *Bti,* encourages us to hope in the future, better a management of the biological checking routines which make it possible to decrease the toxic residues of the chemicals, because no stock of *Bti* was associated a food poisoning, which it is at the human ones or any other mammal.

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