WORLD COTTON RESEARCH CONFERENCE-3

COTTON PRODUCTION FOR THE NEW MILLENNIUM

WORLD COTTON RESEARCH
- 3 -
CONFERENCE

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Spinosad: a new chemistry to solve the pyrethroid resistance of *Helicoverpa armigera* (Hübner) in West Africa

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ABSTRACT

The major insect pest of cotton and vegetable in West Africa, the bollworm Helicoverpa armigera *(Hübner), recently developed resistance to pyrethroids via the overproduction of oxidases, leading to control failures in the field. One way to overcome this problem is restriction in pyrethroid use. Tested for six years in cotton, spinosad (Laser®) proved to be efficient for the control of* H. armigera. *Furthermore, no cross-resistance has been detected in a selected pyrethroid-resistant strain. Spinosad can be recommended to manage bollworm resistant populations in West Africa.*

Introduction

Pyrethroid resistance in *Helicoverpa armigera* (Hübner) from West Africa is due to greater degradation of pyrethroids involving oxidases from the P450 family (Martin *et al*., 2002). Following the failure of treatments to control *H. armigera* in cotton, an insecticide resistance management strategy (IRM) was implemented with success in 1999 (Figure 1). IRM was based on the limitation of pyrethroid use and their replacement with endosulfan and profenofos (Ochou and Martin, 2001). Because spinosad (Laser®) is a new insecticide with a novel mode of action, it could be an alternative to these older products.

In the present study, bioassays with spinosad were done with a deltamethrin selected resistant strain of *H. armigera* and compared with a susceptible one to show any cross-resistance. At the same time, spinosad was tested in cotton fields to prove its efficacy in the IRM strategy recommended in West Africa.

Experimental procedure

The pyrethroid resistant *H. armigera* strain was collected from cotton in Côte d'Ivoire and selected with deltamethrin for ten generations. It was compared with the susceptible *H. armigera* strain BK77. Standard cotton leaf-dip bioassay (IRAC N°7) and feeding bioassays on artificial diet were used to determine spinosad toxicity according to Young *et al.* (2000).

The field trial was conducted in a Fisher block with eight replicates, at the Cotton Research Station of Bouaké. Spinosad was used at 48 g a.i./ha in association with chlorpyriphos at 300 g a.i./ha to control mites. The checks were endosulfan and profenofos at 700 g a.i./ha. These insecticides were applied two times in the first window, as per IRM strategy, and compared with the untreated. Subsequently from 72 to 115 days after emergence (DAE), the treated plots were sprayed four times with the same mixture, cypermethrine + profenofos (36+150 g a.i./ha). Individual plots were scouted once a week from 30 to 66 DAE.

Results and discussion

Spinosad is a new molecule efficient to control *Jacobiella facialis, H. armigera* and *Earias* spp., which are the major cotton pest in the first stage of the Insecticide Resistance Management strategy (Figure 2). This molecule gives the same cotton yield as endosulfan and profenofos when used in the first stage of IRM (Figure 3).

Spinosad shows no cross-resistance with deltamethrin. LD_{50}s for the pyrethroid resistant strain BK99R10 and susceptible strain BK77 were not statistically different with leaf-dip bioassay and ingestion assay respectively (Table 1). Furthermore, dose-mortality data showed a similar response for the deltamethrin selected strain and a field strain BK01 collected from cotton in October 2001 (Figure 4). Moreover, this molecule appears to be a good alternative to endosulfan and profenofos since it is less toxic to mammals and beneficials insects (Borth *et al*., 1996).

Conclusion

The IRM strategy proved successful during the first three years of its widespread use at a regional scale as there was no longer any field infestation problem due to the bollworm *H. armigera*. To keep this advantage we recommended the implementation of mosaic strategy with spinosad, endosulfan and profenofos. Therefore, the overall toxicity level of cotton insecticides and the risk of resistance will be reduced.

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Table 1. Toxicity of insecticides to the susceptible (BK77), and the resistant strain (BK99R10) of H. armigera with leaf-dip assay (LD) and ingestion assay (Ing.)

Active ingredient	Strain	Slope ± se	LD_{50}	(95% CL)	RF_{50} [1]
Spinosad (LD)	S	1.72 ± 0.25	0.916 mg/ml	(0.626-1.233)	
(Nicotinic receptor activator)	R	1.35 ± 0.28	0.387 mg/ml	(0.114-0.730)	0.4 ns
Spinosad (Ing.)	S	2.36 ± 0.35	0.395 µg/g	(0.252-0.526)	
(Nicotinic receptor activator)	R	1.15 ± 0.17	0.254 µg/g	(0.106-0.442)	0.5 ns
Deltamethrin (Ing.)	S	1.72 ± 0.37	0.023 µg/g	(0.007-0.043)	-
(Pyrethroid)	R	1.80 ± 0.39	4.945 µg/g	(2.485-7.264)	215 s

[1] Resistance Factor = LD_{50} resistant strain / LD_{50} susceptible strain.

Figure 1. Insecticide Resistance Management strategy recommended in Côte d'Ivoire, West Africa. Pyrethroid alternatives are used in the first stage.

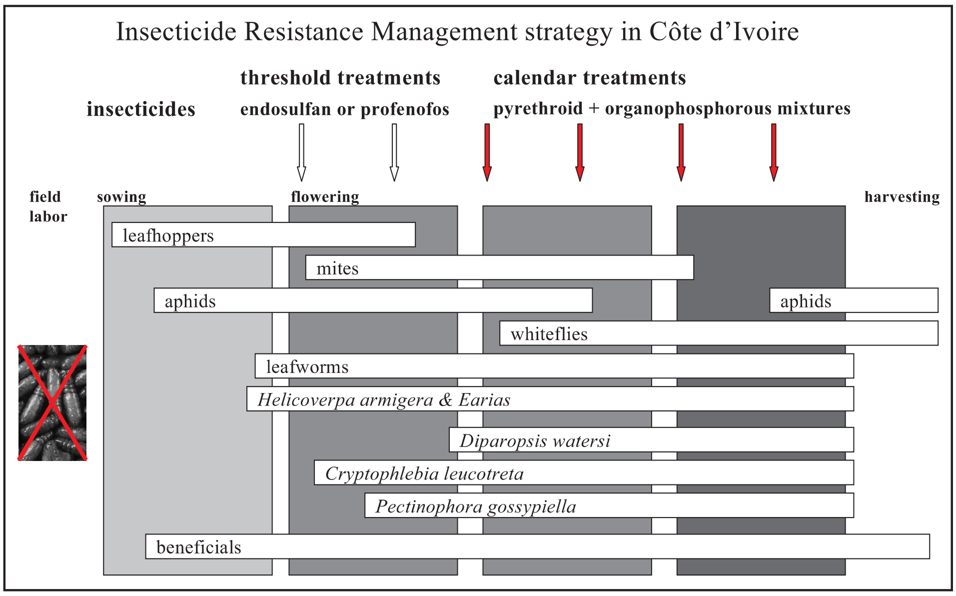
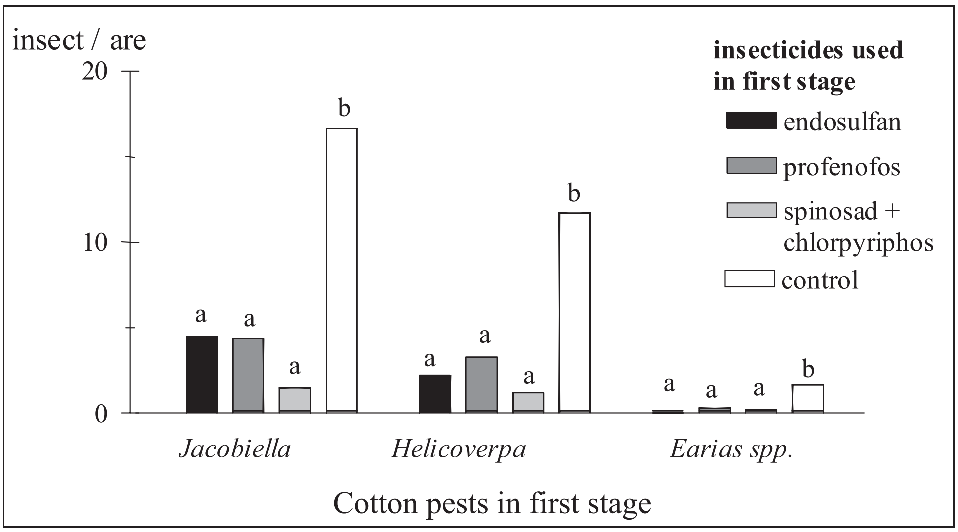


Figure 2. Mean of cotton pests during the first stage of the Insect Resistance Management strategy with endosulfan (700 g/ha), profenofos (700 g/ha) or spinosad (48 g/ha) compared with control (no treatment).



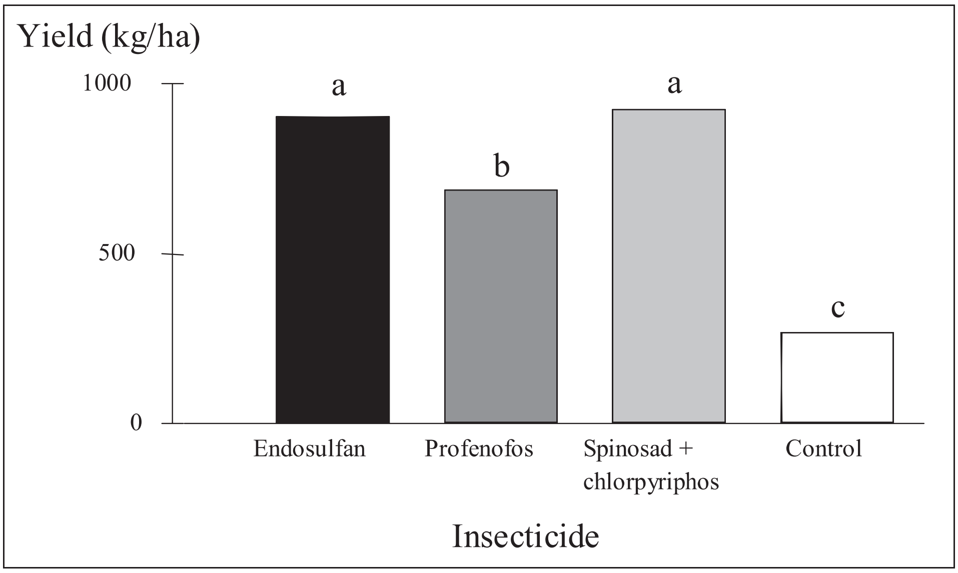


Figure 3. *Cotton yield with endosulfan (700 g/ha), profenofos (700 g/ha) and spinosad + chlorpyriphos (48+300 g/ha) used in the first stage of the Insecticide Resistance Management strategy and compared with the untreated control.*

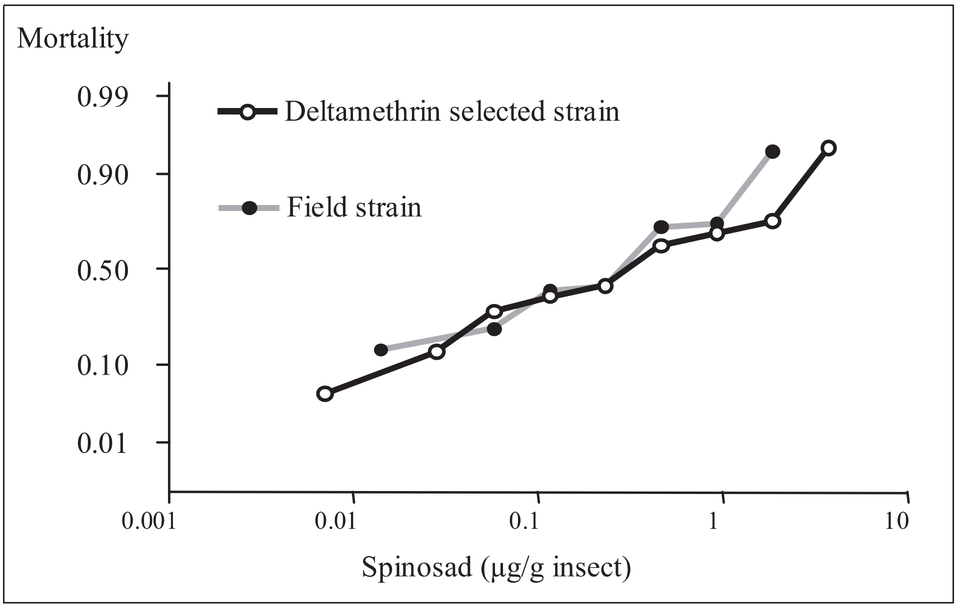


Figure 4. *Ingestion toxicity of spinosad for* H. armigera *field strain BK01 (•), and deltamethrin-selected strain BK99R10 (o).*