INDOXACARB AS ALTERNATIVE FOR CONTROLLING *TUTA ABSOLUTA* (MEYRICK) (LEPIDOPTERA: GELICHIIDAE)

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ABSTRACT

The tomato plants give high potential yield in Albania farm conditions, both in open field and in protected area too. *Tuta absoluta* is the most harmful pest of tomato causing a considerable damage as well as with the high population dynamic in low costal area of Albania. In the lack of control measure, the percentage of damage caused by this pest on tomato in greenhouses and open-field can achieve very high level. In this context the integration of control measures is crucial to achieve successfully the controlling of this pest. The use of pesticides based on different chemistries and with varying modes of action is an important component of an integrated pest management strategy. We have used Avaunt 15 EC (Indoxacarb) to control *Tuta absoluta* besides mass capture. The decision scheme of using insecticides for management of *Tuta absoluta* is largely based on adult captures in sexual pheromone traps. Time of intervention with Avaunt 15 EC (Indoxacarb) in our experimental is based on economical threshold: 100 males per pheromone trap per day, 2 females per plant, 26 larvae per plant, 8% defoliation. As a final conclusion using Indoxacarb is a useful chemical compound for controlling *Tuta absoluta* both in open and protected field. The usage of Avaunt 15 EC (Indoxacarb) does not give high technical effect but must be combined with other control measures especially with mass capture technique.

Keywords: Indoxacarb, *Tuta absoluta*, monitoring, economical threshold, pheromone.

INTRODUCTION

The tomato leaf miner, *Tuta absoluta* Meyrick (Lepidoptera: Gelechiidae) is one of the most devastating tomato pests in South America [4, 11]. During 2007, *Tuta absoluta* was detected in several locations throughout the Spanish Mediterranean Basin, the most important tomato growing region in the country. Since then, its presence has also been confirmed in Algeria, Canary Islands, France, Italy, Morocco, and Tunisia in 2008, and in Albania, Bulgaria, Cyprus, Germany, Malta, Portugal, Switzerland, the Netherlands, and the United Kingdom in 2009 [12, 13, 15].

Tuta absoluta is the main pest causes a considerable damage as well as with the high population dynamic in low costal area of Albania [6]. The first infections were observed in the field tomatoes in July 2009 in Levan (Fier) and Novosel (Vlore) in protected area. In accordance with climatic conditions of Albania *Tuta absoluta* gives four generations starting from March till July [6]. In the lack of control measure, the percentage of damage caused by this pest on tomato in greenhouses and open-field can achieve very high level [7]. In this context the integration of control measures is crucial to achieve successfully the controlling of this pest. Mass capture technique used alone does not guaranty a total effectiveness but it is necessary to be accompanied with other methods [7].

Integrated Pest Management (IPM) program for controlling *Tuta absoluta* might be applied in different strategies including: mass trapping technique, light traps, insecticides as well as biological insecticide [7]. Integrated Pest Management (IPM) means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other animal health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms. In other words, all available control options (e.g. cultural, physical, biological, chemical) should be considered and applied reasonable by farmers. Nevertheless, IPM is not simply a toolbox and integration of control options. It also involves measures (e.g. prevention, monitoring, forecasting, early diagnosis) which help slow the development of pest populations [1].

The use of pesticides based on different chemistries and with varying modes of action is an important component of an integrated pest management strategy. Hence, pesticides will continue to be an integral component of pest management programs due mainly to their effectiveness and simple use [3, 9]. Chemical control has been the main control measure used since the pest was reported. Unfortunately, as is often the case, frequent and intense application of insecticide leads to resistance by the pest. To avoid this, insecticides should not be used early in the cropping season and definitely not when signs of *Tuta absoluta* are absent. Low infestations should be controlled with the minimal application frequency possible of chemical insecticides. When chemical insecticides are to be used for the control of an infestation, different active ingredients should be used alternately and not mixed together all at once, otherwise this will allow the pest to build up resistance in a shorter span of time [18].

The experiment objective is the usage of Indoxacarb for controlling *Tuta absoluta*, beside mass capture technique.

METHODOLOGY

The experiment of 2014-2016 was carried out in low coastal area, at the Sukth`s greenhouses, with surface of 2 hectare covered with glasses. The experiment was developed in the first culture of the planted tomatoes in the greenhouse.

Pheromone traps of different designs are available to detect tomato leaf miner activity. One option is to use pan traps filled with soapy water (the soap helps break the surface tension of the water) with the lure secured above the water with a wire attached at both ends of the container. The traps should be placed at the base of plants mostly in greenhouse situations. Pan traps with water can capture large numbers of adult males without becoming saturated with insects. Another option is to place the lure in a sticky delta trap. With tomatoes, delta traps should be hung on stakes near plant foliage, about 1 meter off the ground. In general, trap location should not be higher than 30-60 cm above the top of the tomato or other host plants because *Tuta absoluta* males fly close to the host plants. In heavy infestations, sticky inserts may become saturated with trapped males or moth scales causing them to lose their effectiveness at capturing and retaining additional moths. In these situations, the traps should be serviced more frequently. The level of risk may be estimated based on the number of males trapped within a given period. Besides setting different types of traps, regular visual inspection of plants is also very important for adequate decision-making on control actions. This type of inspection helps to reveal the occurrence of different developmental stages of the pest as well as the symptoms of damage as early as possible [1].

In order to monitor the tomato moth *Tuta absoluta* in experimental area, 4 pheromone traps were installed. The experimental scheme was divided into 4 variants with an area of 0.5 hectare. The flies counting and their monitoring into pheromone were performed on regular weekly basis intervals. There are used pheromone lures couplet with Delta traps (0.5 mg E3Z8Z11-14Ac, 0.024 mg E3Z8-14Ac) Product Code PH-937-IRR) [17]. The intervention for controlling of *Tuta absoluta* is based on fly dynamic [6]. In each plot 10 plants are treated with Avaunt 15 EC (Indoxacarb). The dosage of Indoxacarb was 25 gram per 100 liter water. For each generation are done two treatments as per the above dosage with intervals application 14 days. The decision scheme of using insecticides for management of *Tuta absoluta* is largely based on adult captures in sexual pheromone traps [5] as adult catches are correlated with larval damages and yield losses [5, 14, 16]. Time of intervention with Avaunt 15 EC (Indoxacarb) in our experimental is based on economical threshold: 100 males per pheromone trap per day, 2 females per plant, 26 larvae per plant, 8% defoliation [2, 16].

RESULTS AND DISCUSSION

The tomato plants give high potential yield in our farm conditions, both in open field and in protected area (glasshouses) too [7]. In the experimental field, in tomato plants there are the primary pest and secondary one [7]. The presence of primer pest per each year is upper economical threshold [7]. Controlling those pests needs a lot of plant protection products. In this context, the usage of chemical compounds by the farmers does not guaranty a high level of control [6].

The monitoring technique is a basic element to determine the correct timing for insecticide applications leading to a reduction and to implement mass capture [8]. The plant protection product Indoxacarb is used in the experiment to know the technical effectiveness besides of mass capture technique. The dosage used was 25ml/100 l water.

Indoxacarb is a non-systemic, synthetic organophosphate replacement insecticide used to control sucking insects. Indoxacarb affects insects from direct exposure and through ingestion of treated foliage/fruit. Once indoxacarb is absorbed or ingested, feeding cessation occurs almost immediately. It kills pests by binding to a site on sodium channels and blocking the flow of sodium ions into nerve cells. The result is impaired nerve function, feeding cessation, paralysis, and death. It may take days for insects to die [10].

100 fruits and leaves are analyzed 7 days after second treatment with Avaunt 15 EC (Indoxacarb) to assess the technical effectively of insecticide used. The calculations are performed based on the following formula (1) [7].

$$\text{Attacked fruits and leaves} = \frac{\text{Total fruits and leaves analyze} - \text{Attacked fruits and leaves}}{\text{Total fruits and leaves}} \times 100 \quad (1)$$

Indoxacarb	Date of analyze	Leaves				Fruits			
		Analyzed	*Attacked*	*Not attacked*	*% of uninfected*	*Analyzed*	*Attacked*	*Not attacked*	*% of uninfected*
Generation I	20 - Mar	100	33	67	67%	-	-	-	-
Generation II	25 - May	100	46	54	54%	100	60	40	40%
Generation III	15 - Jun	100	49	51	51%	100	56	44	44%
Generation IV	21 - Jul	100	50	50	50%	100	44	56	56%

Table 1. Data of treatment with Avaunt 15 EC (Indoxacarb) 7 days after second treatment during the year 2014

Indoxacarb	Date of analyze	Leaves				Fruits			
		Analyzed	*Attacked*	*Not attacked*	*% of uninfected*	*Analyzed*	*Attacked*	*Not attacked*	*% of uninfected*
Generation I	20 - Mar	100	41	59	59%	-	-	-	-
Generation II	25 - May	100	36	64	64%	100	58	42	42%
Generation III	15 - Jun	100	48	51	52%	100	56	44	44%
Generation IV	21 - Jul	100	47	53	53%	100	45	55	55%

Table 2. Data of treatment with Avaunt 15 EC (Indoxacarb) 7 days after second treatment during the year 2015

Indoxacarb	Date of analyze	Leaves				Fruits			
		Analyzed	*Attacked*	*Not attacked*	*% of uninfected*	*Analyzed*	*Attacked*	*Not attacked*	*% of uninfected*
Generation I	20 - Mar	100	33	67	67%	-	-	-	-
Generation II	25 - May	100	36	64	64%	100	59	41	41%
Generation III	15 - Jun	100	68	32	32%	100	62	38	38%
Generation IV	21 - Jul	100	65	35	35%	100	36	64	64%

Table 3. Data of treatment with Avaunt 15 EC (Indoxacarb) 7 days after second treatment during the year 2016

Based on the treatments carried out with Indoxacarb resulted that the technical effects for first year vary from 50% to 67% on leaves and from 40% to 56% on fruits (Table I). During the second year the technical effects vary from 52% to 64% on leaves and from 42% to 55% on fruits (Table 2), while in the third one technical effect vary from 32% to 67% on leaves and from 38% to 64% on fruits (Table 3). In the experimental field are also identified all pests present, which are divided in primary and secondary ones. Following (Table 4) are shown the pests evident in our experiment with their respective diffusion and dispersion rate. Based on the achieved results, *Tuta absoluta* is the most harmful pest of tomato in open field and protected area.

Most important pests			
Tuta absoluta	+	+	
Panonychus ulmi	+		
Aphididea	+	+	
Trialeurodes vaporarioum	+	+	+
Tetranychus urticae	+	+	
Meloidogyne incognita	+	+	+
	Distribution of the pests		
Less important pests			
Psylla of potates	+		
Thrips	+		
Liriomyza spp.	+		
Snails	+		

Table 4. Data of infection tomato pests in Durres (regional cultivation of tomato)

Note:

+++ = the existence of such pests is noticed in different years, causing damages / sporadically diffused with large intensity

++ = diffused over certain years but with low or medium dispersion rate

+ = diffused over certain years with a low dispersion rate or sporadically dispersed with a low to medium distribution.

CONCLUSIONS

Indoxacarb is a useful chemical compound for controlling *Tuta absoluta* both in open and protected field. The usage of Avaunt 15 EC (Indoxacarb) does not give high technical effect but must be combined with other control measures especially with mass capture technique.

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