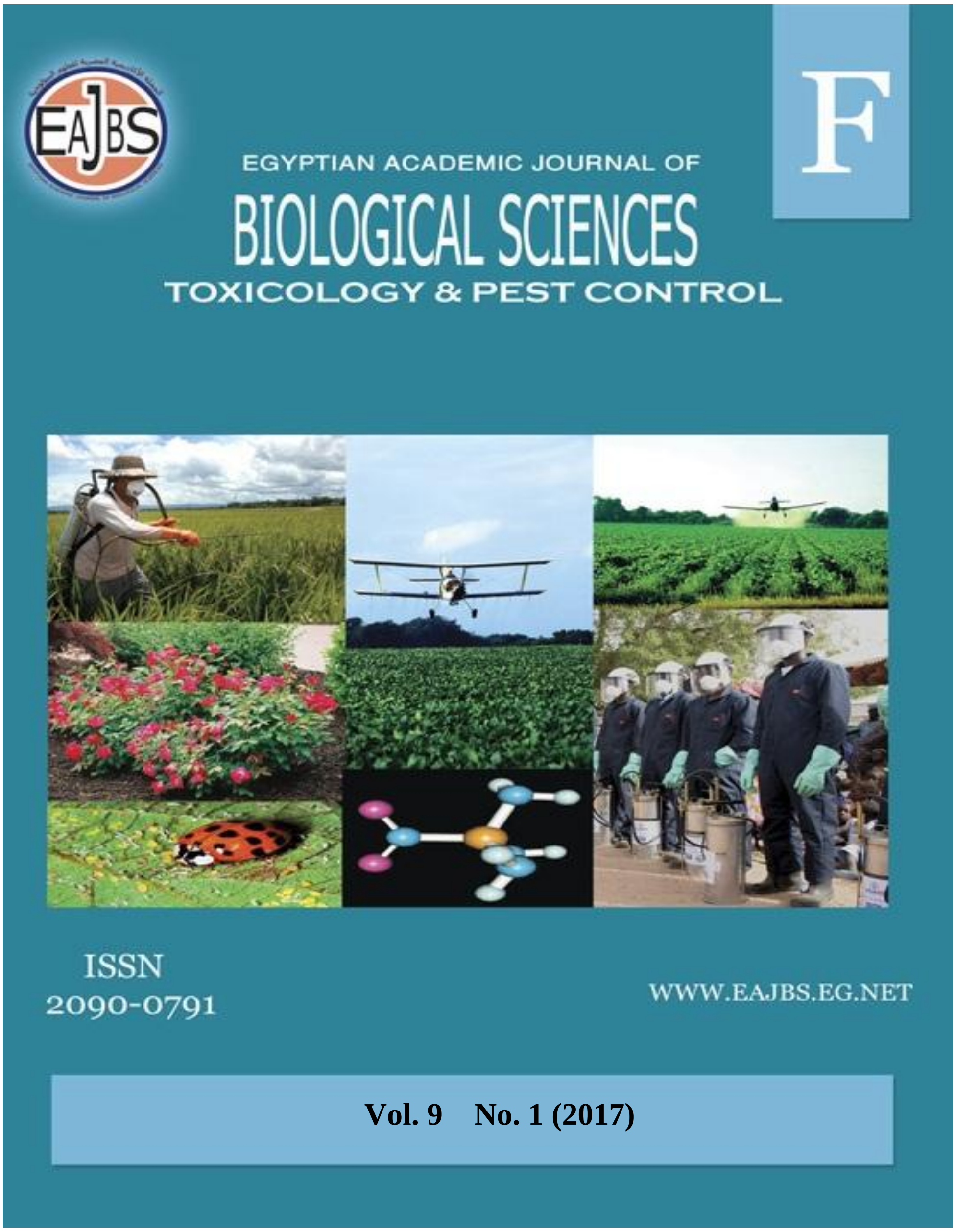

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Side-Effects of Pesticides on Non-target Organisms:
2- In Egyptian Vegetable Crop Fields and Greenhouses

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ABSTRACT

In the context of field vegetable crops and through 75 field trials, the direct count technique (100 leaves/ crop/ site/ date) was practiced to collect field data. The study included 4 crops; tomato, potato, cucumber, and pepper cultivated in open fields, and cucumber and pepper, cultivated in greenhouses (GH) through the period 2013-2016. The field trials were 29, 12, 9 and 7 in tomato, potato, cucumber and pepper fields and 16 and 2 in tomato and pepper greenhouses, respectively, conducted at: 33, 20, and 22 in Menoufia, Fayoum and Behera (Nubaria) Governorates, Egypt. Non-target pests and beneficials considered were: *Bemesia tabaci* (Genn.) *Aphis gossypii* (Glov.), jassids and *Tetranychus urticae* Kock as non-target pests and *Coccinella undicumpunctata* L., *Chrysoperla carnea* (Steph.) as predators. Twenty-six pesticides targeted the insect pests and mites, and 10 targeted the plant diseases were applied. Based on the IOBC classification, almost all pesticides used (different groups) showed different mortality rates and population reductions, ranged between the toxicity levels of 2–4, represented by 11, 28 and 12 pesticides at the levels 2, 3, and 4, respectively. Eight pesticides; Actellic, Chess, Commando, Imaxi, Proclaim, Rodiant, Super actara, and Tafaban were recorded as class 4, to non-target pests as well to the predators. For the predators, only the highest toxicity levels 3 and 4 were recorded. Therefore, selectivity of pesticides to non-target beneficial arthropods should be a key data for the implementation of IPM programs. Random analysis of pesticide residues in fruits showed some residue (6 compounds and/or microbes) in the fruits of pepper.

INTRODUCTION

Pesticides are an integral part of agriculture. Much crop production in Egypt is likely to remain dependent on the continued pesticide use. Despite many advantages of pesticides, there are some potential hazards or risks when using farm chemicals. Pesticides research generally involves comparing the level of toxicity of different compounds or comparing the susceptibility of different pest species or the same species from different environments.

Side-effects of usage some pesticides result in unfortunate consequences to many non-target organisms, particularly natural enemies and pollinators (El-Heneidy *et al.*, 1987, 1991, 2015, Goda *et al.*, 2016, and Adly, 2016). Beneficial organisms include various parasitic and/or predacious insects, mites, nematodes, fungi, bacteria, and other microorganisms that feed on or parasitize pest species. The value of these organisms to agriculture and the environment is likely underestimated.

Such approach is necessary to produce scientific and technical information in order to develop and enhance the ecotoxicological risk assessment. Risk assessment of pesticides on beneficial organisms has been evaluated under semi-and field conditions, following the protocols developed by the IOBC (International Organization of Biological Control) - group ‘Side-effects of Pesticides on Beneficial Organisms’ (Hassan, 1977, 1985 and Sterk *et al.*, 1999).

Destructive insects, mites and diseases are still the most limiting factors of vegetable crop production quality and quantity not only in Egypt but also in many other countries. The vegetable crops represent one of the major groups of crops that have to be produced under least contaminated conditions. The residues in eaten food for humans and feed for livestock can be a consequence of direct application of a chemical to the food source, by the presence of pollutants in the environment or by transfer and bio-magnification of the chemical along a food chain. Not all residues are undesirable, although good agricultural practice must be observed to prevent unnecessary and excessive levels of residues. Vegetable crops are harvested frequently at close intervals, and thus the intensive use of chemicals becomes questioned due to the possible contamination of products with chemical residues (Perdikis *et al*., 2008). A growing consumer market of vegetable production is thus one of the main factors encouraging farmers to convert to organic agriculture production. Increased consumer awareness of food safety issues and environmental concerns has also contributed to the growth in organic farming over the last few years. Therefore, there is a real need to reconsider the level of toxicity of different compounds recommended to be used against different pests, especially in the vegetable crop fields and/or greenhouses.

The present study is a contribution for minimizing risks of recommended agricultural pesticides in Egyptian agro-ecosystems, fields and greenhouses, to non-target organisms in some major vegetable crops.

MATERIALS AND METHODS

Vegetable crops and working sites

Field studies included 4 selected major vegetable crops; tomato, potato, cucumber and pepper, implemented in 2-4 locations/ Governorate, in 3 Egyptian Governorates; Menoufia represented the middle of the Delta (Lower Egypt), Fayoum represented Middle Egypt, and Behara (Nubaria) represented new reclaimed areas, through the 3 successive growing seasons 2013 - 2015. The study included the 4 selected vegetable crops, cultivated in open fields and only the 2 crops; cucumber and pepper, that cultivated in commercial greenhouses. Total working sites were, 9: Tala and Quesna districts (Menoufia Governorate), Etsa, Fayoum and Abshway districts (Fayoum Governorate), and Nubaria, South Tahrir, Adam and Abdel Wahab villages (Nubaria region – Behera Governorate) throughout the study period. Experimental fields (about 2-5 feddans site/ crop) and large commercial greenhouses were selected for the evaluation. All sites received regular agricultural and chemical practices as recommended by the Ministry of Agriculture (MoA).

Recommended Pesticides

Safety levels of different groups of the pesticides recommended by the MoA to be used in the selected 4 vegetable crop fields and/or greenhouses against non-target pests and beneficial's (only insect predators) were evaluated. The formulated pesticides were tested at the maximum recommended field rates for one application, on the basis of available commercial formulations. Most products were applied as spray mixtures in water.

Methodology

The direct count technique was practiced by specialists to collect field data. A pre-treatment population density was estimated one day or on the same day of the pesticide application. Afterwards, inspection interval was on day 1, 3, 7, and 10. The sample size was 25 leaves x 4 replicates (= 100 leaves/ crop/ site/ date). Reduction percentages of the population of each of the selected non-target and predatory species were estimated. The reduction percentage in the population at day 1 post treatment was calculated as initial kill, while that in the following days post treatment was considered as residual or latent effects. Reduction percentages were calculated and corrected, using the Henderson and Tilton (1955) equation:

Reduction % = (1 – A/B x C/D) x 100

Where:

A = No. of individual post-treatment

B = No. of individual pre-treatment

C = No. of individual in the check pre-treatment

D = No. of individual in the check post-treatment

Side effects of the studied pesticides on non-target organisms (pests and predators), recorded in the 4 vegetable crops, were estimated under field and/or greenhouse conditions, following the protocols developed by the IOBC (International Organization of Biological Control) -group ‘Side-effects of Pesticides on Beneficial Organisms’ (Hassan, 1977 and Sterk *et al.*, 1999). Pesticides were classified into the toxicity categories proposed by the IOBC working groups for semi- and field trials as: Class 1: harmless (< 25% mortality), Class 2: slightly harmful (25-50%), Class 3: moderately harmful (51-75%) and Class 4: harmful (> 75%) (Hassan, 1985). Selective biological or chemical compounds are needed in such cases (Hassan, 1994).

Pesticide residues

Random fruit samples from treated vegetable crops, planted under greenhouse conditions were collected (I Kg from each) for analysis of pesticide residues. The analysis was carried out by the specific Central Laboratory of Residue Analysis of Pesticides and Heavy Metals in Food, Agricultural Research Center, Ministry of Agriculture, Giza, Egypt. Official certificates of analyzes results were given. The technique used was the quick and easy method (QuEChERS) for determination of pesticide residues in foods using LC-MSMS, GC-MSD (European Standard Method EN 15662:2008).

RESULTS AND DISCUSSION

A total of 36 pesticides (different groups, targeting different pests) on the 4 vegetable crops (tomato, potato, cucumber and pepper) in field trials, at the 9 sites (3 Egyptian Governorates) was evaluated under field and/or greenhouse conditions through the 3 seasons 2013-2015. Recommended pesticide names, groups, field application rates, vegetable crops and target pests are listed in Table (1). Twenty-six pesticides targeted the insects and mites, and 10 targeted the plant diseases. As shown in the table, the target pests are mainly the insect species; *Bemesia tabaci*, *Aphis gossypii*, *Tuta absoluta* and the spider mite, *Tetranychus urticae* and accidentally *Helicoverpa armigera, Phethoremia opercullela, Agrotis ipsilon* and jassids, as well are the plant diseases; downy and powdery mildew, and early and late blight.

Table 1: List of pesticides, common names, groups, rates of application, selected vegetable crops, and target pests.

Pesticide	Common Name	Group	Rate of Application	Crop	Target Pest
Acrobat copper, 46% WP	Copper oxychloride	Cinnamic acid	150 ml/ 100 L w	Cucumber (GH)	Downy mildew
Actara 25% WG	Thiamethoxan	Neonictinoid	20 gm/ 100 L w	Tomato	*Bemesia tabaci*
Actellic 50%	Pirimiphos-methyl	OP	375 ml/ 100 L w	Tomato	*B. tabaci*
Agrothion 57% EC	Malathion	OP	I L/ feddan	Potato	*Phethoremia opercullela*
Avant 15% SC	Indoxacarb	Oxadiazine	100 ml/ 100 L w	Tomato	*B. tabaci*
Challenger 36% SC	Chlorfenopyr	OP	45 ml/ 100 L w	Tomato	*Tetranychus urticae*
Chess 50% WG	Pymetrozine	Triazine	125 gm/ 100 L w	Cucumber	*B. tabaci*
Commando 35% SC	Imidoclopride	Neonictinoid	75 ml/ 100 L w	Cucumber (GH)	*Aphis gossypii, B. tabaci,*
Confidate 35% SC	Imidacloprid	Neonicotinoid	75 g/100 L w	Tomato	*B. tabaci*
Cure M 72% WP	Mancozeb	Benzamide	250 g/ 100 Lw	Cucumber (GH)	Downey mildew
Delta care10% EC	Hexythiazo	Benzamide	50 ml/ 100 L w	Cucumber (GH)	*T. urticae*
Dithane M45 80% WP	Mancozeb	Dithiocarbamate	250g /100 L w	Potato	Early blight
Dursban 48% EC	Chlorpyrifos	OP	1 l / feddan	Potato	*Agrotis ipsilon*
Imaxi 35% SC	Imidacloprid	Avarmectin	75 ml/ 100 L w	Tomato	*B. tabaci*
Invinito 68.75% SC	ide	e	125 ml/100 L w	Cucumber	Downy mildew
Kocide 53% DF	Copper hidroxide	Copper hidroxide	180 g/ 100 Lw	Cucumber (GH)	Downey mildew
Maccomite 10% WP	Hexythiazox	Accaricide	30 gm/ 100 L w	Pepper	*T. tabaci*
Match 5% EC	Lufeneuron	Chitin synthesis Bentoylure	160 ml/ feddan	Tomato	*Tuta absoluta*
Mospilan 20% SP	Acetamiprid	Neonicotinoid	10 g/100 L w	Pepper, Cucumber, Tomato	*B. tabaci, A. gossypii*
Nomolt 15% SC	Teflupenzerone	Benzoulurea	160 ml/ fed	Tomato	*T. absoluta, B. tabaci*
Ortus Super 5% EC	Fenpyroximate	Metachondria complex	50 ml/ 100 L w	Cucumber (GH)	*T. urticae*
Pandel 8% SC	Sulfer	Inorganic sulfur	100 ml/ 100 L w	Cucumber (GH)	Powdery mildew
Pasha 1.9% EC	Emamectin benzoate	Avarmectin	250 ml /100 L w	Potato	*B. tabaci*
Pride 20% EC	in	ine	60 ml/ 100 L w	Tomato	*T. urticae*
Proclaim 5% SG	Emamectin Benzoate	Avermectin	80 g/ feddan	Tomato	*Helicoverpa armigera, T. absuluta*
Punch 40% EC	Flusilazole	Triazole	40 ml/ 100 L w	Pepper	Powdery Mildew
Ralex 50% WP	Penconazole	Triazole	150 g/ 100 L w	Potato	Late blight
Ridomil Gold M 68% WG	Metalaxl M+Mancozeb	Phenylamide acylaanil + dithiocarbamate	200g/ 100 L w	Cucumber, Pepper	Downy Mildew
Radiant 12% SC	Spintoram	Spinosyns	35 ml/ feddan	Tomato	*T. absoluta*
Sanmite 20% WP	Pyridabon	Acaricide	65 ml/ 100 Lw	Cucumber (GH)	*T. urticae*
Selecron 72% EC	Profenofos	OP	187.5 ml/ 100 L w	Tomato	*B. tabaci*
Super actara 25% WG	Thiamethoxan	Neonictinoid	20 gm/ 100 L w	Tomato	*B. tabaci*
Switch 62.5% WG	il-Fludioxonil	midine	75 g/ 100 L w	Cucumber (GH)	Fruit rot
Tafaban 48% EC	Chlorpyrifos	OP	1 l / feddan	Tomato	*T. absoluta*
Topas 10% EC	Penconazole	Triazole	25 cm/ 100 L w	Pepper	Powdery Mildew
Vertimic 1.8% EC	Abamectin	Avermectin	25 ml + 40 ml KZ oil / 100 L w	Cucumber	*B. tabaci, T. urticae*

GH = Greenhouse Highlighted pesticides = Pesticides used against plant diseases.

Side-effect of Pesticides

The study included the 4 selected vegetable crops, cultivated in open fields, beside the only cucumber and pepper, that cultivated in greenhouses (GH). A total of 75 field trials, at all sites, was carried out; 29, 12, 9 and 7 in tomato, potato, cucumber and pepper fields, and 16 and 2 in tomato and pepper greenhouses, respectively. The 75 field trials were conducted as follows: 33 in Menoufia Governorate (26 at Tala and 7 at Quesna), 20 in Fayoum Governorate (15 at Abshway, 3 at Fayoum, and 2 at Etsa), and 22 in Nubaria (13 at South Tahrir, 5 at Abdel Wahab, 2 at Adam and 2 at Nubaria villages). Non-target pests and beneficials, considered in the present evaluation, were: *B. tabaci*, *A. gossypii*, jassids and *T. urticae* as pests and *Coccinella undicumpunctata* and *Chrysoperla carnea* as predators. Because of the few data collected on some other pests and predators, they were neglected.

In general, under normal field practices, the behavior of a pesticide after application can vary considerably, therefore, it is clearly demonstrated that several non-target organisms (pests and/or predators) were negatively affected by the use of pesticides. Different reduction rates in their populations as direct effects of the applications were recorded. Reduction percentages varied at different pest and/ or predatory species evaluated as well for each pesticide used. A list of selective pesticides, vegetable crops, mean percentages of reduction in non-target organisms (pests and predators) and their toxicity levels (between brackets) according to the IOBC classification (Hassan, 1977 and 1994) is given in Table (2).

According to the IOBC classification, almost all pesticides used to demonstrate different mortality rates and population reduction rates, ranged between the toxicity levels 2–4, represented by 11, 28 and 12 pesticides at the levels 2, 3, and 4, respectively. None was recorded at level 1 (harmless). Percentages of each level attained 58 & 21% for *B. tabaci*, and 55 & 30% for *A. gossypii* of the levels 3 and 4, respectively. While they were 67.7% of level 3 for Jassids and 75% of level 2 of *T. urticae*. It seemed that the spider mite was more tolerant to the pesticides than the other 3 insects. For the predators, only higher toxicity levels 3 and 4 were recorded, accomplishing 50% in both for *C. undecimpunctata*, and 41 & 59% at the same levels for *C. carnea*, respectively (Table 2).

Generally, it is clearly demonstrated that several non-target organisms were affected by the use of pesticides, but the ones targeted plant diseases were less toxicity to the predators as they did not exceed the level 3. Some of these pesticides; commando 35% and ortus super 15% that used in the greenhouses, recorded toxicity level 4 to the predators. Percentages of reduction in the predator populations were higher than in the non-target pests as they ranged between 50.2-94.6% for *C. undecimpunctata*, and 57.5-92.9% for *C. carnea*, therefore, in all cases, the toxicity levels recorded for the predators were either 3 or 4 (Table 2). As also summarized in the table, most of the pesticides showed a toxicity level ranged between class 3 (moderately harmful, 51-75%) and class 4 (harmful, > 75%). Only 6 pesticides showed class 2 (slightly harmful, 25-50%) for non-target pests none recorded for the predators. The pesticide, confidante, applied in tomato fields, demonstrated a slight harmful effect (class 2) to the spider mite, *T. urticae* but on the other hand, it was harmful (class 4) to the predators. Eight pesticides, presented different groups such as; Organophosphorus (OP), Avamectin, Spinosyns, and Neonictinoid, were recorded as class 4, to non-target pests as well to the predators, these were: Actellic, Chess, Commando, Imaxi, Proclaim, Rodiant, Super actara, and Tafaban.

Table 2: List of pesticides, selected vegetable crops, mean percentages of reduction in non-target organisms (pests and predators) and their toxicity levels (between brackets) according to the IOBC classification (Hassan, 1994).

Pesticide	**Crop**	**Non-target (pests)**				**Non-target (predators)**	
		B. tabaci	***A. gossypii***	**Jassids**	***T. urticae***	***C. undecimpunctata***	***C. carnea***
Acrobat copper, 46% WP	Cucumber (GH)	-	68.88% (3)	-		71.88 % (3)	-
Actara 25% WG	Tomato	-	78.64% (4)	-	17.80% (1)	75.0% (3)	-
Actellic 50%	Tomato	-	83.2% (4)		-	94.6% (4)	92.9% (4)
Agrothion 57% EC	Potato	68.75% (3)	-	-	-	79.07% (4)	-
Avant 15% SC	Tomato	-	68.51% (3)	-	-	-	-
Challenger 36% SC	Tomato	66.10% (3)	-	-	-	72.16% (3)	71.32% (3)
Chess 50% WG	Cucumber	-	82.3% (4)	-	-	88.4% (4)	88.9% (4)
Commando 35% SC	Cucumber (GH)	78.06% (4)	-	-	-	84.95% (4)	
Confidate 35% SC	Tomato	-	-	-	38.10% (2)	-	86.50% (4)
Cure M 72% WP	Cucumber (GH)	-	50.67% (3)	-	-	69.00% (3)	-
Delta care10% EC	Cucumber (GH)	62.12% (3)	-	51.25% (3)	-	-	72.24% (3)
Dithane M45 80% WP	Potato	53.12% (3)	57.14% (3)	45.00% (2)	-	61.63% (3)	57.50% (3)
Dursban 48% EC	Potato	-	-	72.32% (3)	-	88.92% (4)	-
Imaxi 35% SC	Tomato	-	83.34% (4)	-	-	87.50% (4)	84.72% (4)
Invinito 68.75% SC	Cucumber	-	94% (3)		-	-	59.10% (3)
Kocide 53% DF	Cucumber (GH)	33.62% (2)	40.14% (2)	-	-	57.81% (3)	-
Maccomite 10% WP	Pepper	54.76% (3)	-	-	-	-	-
Match 5% EC	Tomato	49.50% (2)	43.60% (2)	69.06% (3)		50.20% (3)	
Mospilan 20% SP	Pepper, Cucumber, Tomato	-	84.20% (4)	66.38% (3)	49% (2)	84.40% (4)	-
Nomolt 15% SC	Tomato	73.70% (3)	69.90% (3)	-	-	70.20% (3)	69.10% (3)
Ortus Super 5% EC	Cucumber (GH)	64.99% (3)	-	70.00% (3)	-	-	81.34% (4)
Pandel 8% SC	Cucumber (GH)	60.49% (3)	64.11% (3)	-	-	69.45% (3)	-
Pasha 1.9% EC	Potato	-	68.88% (3)	66.67% (3)	-	85.00% (4)	80.77% (4)
Pride 20% EC	Tomato	-	-	-	-	82.50% (4)	77.16% (4)
Proclaim 5% SG	Tomato	85.00% (4)	74.20% (3)	77.70% (4)	-	84.20% (4)	83.60% (4)
Punch 40% EC	Pepper	59.79% (3)	-	-	-	-	66.45% (3)
Ralex 50% WP	Potato	47.06% (2)	55.08% (3)	-	-	59.76% (3)	-
Ridomil Gold M 68% WG	Cucumber, Pepper	57.44% (3)	-	-	27.00% (2)	64.58% (3)	-
Radiant 12% SC	Tomato	84.70% (4)	-	-	-	88.00% (4)	-
Sanmite 20% WP	Cucumber (GH)	71.00% (3)	-	75.07% (4)	-	-	68.81% (3)
Selecron 72% EC	Tomato	-	-	-	-	85.02% (4)	81.50% (4)
Super actara 25% WG	Tomato	-	80.32% (4)	-	-	93.65% (4)	88.27% (4)
Switch 62.5% WG	Cucumber (GH)	-	-	-	-	63.28% (3)	-
Tafaban 48% EC	Tomato	79.54% (4)	-	-	-	80.95% (4)	-
Topas 10% EC	Pepper	48.81% (2)	46.62% (2)	-	-	57.33% (3)	-
Vertimic 1.8% EC	Cucumber	-	67.33% (3)	-	-	73.46% (3)	-

Pesticide Residues

Random fruit samples from treated tomato and pepper, planted under greenhouse conditions were collected at harvesting time (I Kg from each) for analysis of pesticide residues. Analyzes data are presented in Table (3). As shown in the table, some residue compounds and/or microbes were found in the fruits, especially in pepper, where 6 compounds were found. Greenhouse vegetables are sold exclusively for fresh market consumption and demand for a blemish-free product from consumers makes effective pest management crucial. Not all residues are undesirable, although good agricultural practice must be observed to prevent unnecessary and excessive levels of residues. Vegetable crops are harvested frequently at close intervals, and thus the intensive use of chemicals becomes questioned due to the possible contamination of products with chemical residues (Perdikis *et al*., 2008).

Table 3: Analysis of pesticide residues in tomato and pepper fruits collected randomly from greenhouses treated with pesticides

Compound or microbe	Tomato	Pepper
Propamocarb	-	< LOQ
Acetamiprid	-	0.03 mg/Kg
Diazinon	-	0.02 mg/Kg
Cypermethrin	-	0.03 mg/Kg
Lambda-Cyhalothrin	-	0.01 mg/kg
Chlorpyrifos	-	0.1 mg/Kg
Thiacloprid	< LOQ	-

In Egypt as well worldwide, the side-effects of usage some pesticides result in unfortunate consequences to many non-target organisms, particularly natural enemies and pollinators. Such applications showed a negative impact of the pesticides, as a sharp decline (about 70–80% reduction in the numbers of predatory species populations) recorded in cotton field post applications as well as in wheat, tomato fields and greenhouses, as the reduction in numbers of predatory and parasitoid species ranged between 68–72% (El-Heneidy *et al.,* 1987, 1991, 2015, Goda *et al.,* 2016, and Adly 2016).

It is known that the populations of many arthropod species can develop various degrees of resistance to the pesticides action. Early detection of pesticide resistance provides a basis for management of resistant pest population (Abdel–Baset, 2009). Therefore, selectivity of pesticides to non-target beneficial arthropods is a key data for the implementation of IPM programs (Jansen *et al.*, 2008). In the context of a sustainable agriculture and IPM implementation, these beneficial arthropods must be preserved from adverse effects, especially from non-selective pesticides. By eliminating pest natural enemies, non-selective pesticides can enhance pest outbreak, with population levels that even reach higher levels than those observed without any pesticide treatment (Croft and Slone, 1998). Both pest outbreak and pest resurgence multiply pest problems and pesticide use, increase cost production and negative impact of pest control on human health and the environment.

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ARABIC SUMMARY

التأثيرات الجانبية للمبيدات على الكائنات غير المستهدفة،
٢- فى حقول محاصيل الخضر والصوب الزراعية

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في إطار محاصيل الخضر، ومن خلال ٧٥ تجربة ميدانية، تم استخدام تقنية العد المباشر (١٠٠ ورقة / محصول / موقع / تاريخ) لجمع البيانات الحقلية. شملت الدراسة ٤ محاصيل: هى الطماطم، والبطاطس، والخيار، والفلفل المزروعة في الحقول المفتوحة، والخيار والفلفل، المزروعة في الصوب الزراعية وذلك خلال الفترة ٢٠١٣- ٢٠١٦. بلغ عدد التجارب الحقلية ٢٩ و ١٢ و ٩ و ٧ في حقول الطماطم والبطاطس والخيار والفلفل و ١٦ و ٢ في صوب الطماطم والفلفل على التوالي، أجريت الدراسة في ٣٣ و ٢٠ و ٢٢ حقلا في محافظات المنوفية والفيوم والبحيرة (النوبارية) بمصر. شملت الدراسة الآفات غير المستهدفة التالية: *Bemesia tabaci* (Genn.), *Aphis gossypii* (Glov.), jassids, *Tetranychus urticae* Kock، والحشرات النافعة (المفترسات الحشرية): *Coccinella undicumpunctata* L., *Chrysoperla carnea* (Steph.) . استهدف ستة وعشرون مبيدا الآفات الحشرية والأكاروسات، بينما استهدف ١٠ منها الأمراض النباتية. بناء على تصنيف المنظمة الدولية للمكافحة الحيوية (IOBC)، أظهرت جميع المبيدات المختبرة (مجموعات مختلفة) معدلات موت مختلفة وخفض فى التعداد تراوح بين مستويات سمية (٢-٤)، تمثل فى ١١ و ٢٨ و ١٢ مبيدا في المستويات ٢ و ٣ و ٤، على التوالي. سجلت ٨ مبيدات هى: Actellic, Chess, Commando, Imaxi, Proclaim, Rodiant, Super actara, Tafaban المستوى ٤ (أعلى مستوى سمية > ٧٥%) فى كل من الآفات غير المستهدفة والمفترسات. سجل المستويين ٣ و ٤ فقط بالنسبة للمفترسات، ولذلك ينبغي أن تكون سمية المبيد للحشرات النافعة من الأسس الرئيسية فى الأختيارعند تنفيذ برامج المكافحة المتكاملة للآفات. أظهر التحليل العشوائي لبقايا مبيدات الآفات فى الثمار وجود بعض المتبقيات (٦ مركبات و/أو ميكروبات) في ثمار الفلفل.