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Efficacy of some Fungicides against Early Blight with Special Reference to their Residues in Tomato Fruits

Tomader G. Abdel Rahman[*]; A.M.A. Ashour[**]; H.M.A. Badawy[***] and Nsreen D. Dib[****]

* *Plant Pathol. Res. Inst., ARC, Giza, Egypt.*
** *Plant Pathol. Dept., Fac. Agric., Cairo Univ.*
*** *Economic Entomol. & Pest. Dept., Fac. Agric., Cairo Univ.*
**** *Ministry of Higher Education, Syrian Arab Republic.*

Early blight disease caused by *Alternaria solani* (Ellis and Martin) Jones and Grout, attacks all grown tomato hybrids and varieties either under open field or in plastic house conditions resulting in a serious reduction in fruit yield. Under field trials the tested fungicides were arranged according to their efficacy as Ridomil Gold MZ, Oxy plus, Dolphin Alfa, Shirlan, Flint, Leimay, Ranman and Revus, in descending order. The extracted treated fruits gave the highest recovery percentage of fluazinam and trifloxystrobin. The initial deposits of fluazinam and trifloxystrobin in fruits were 0.236 and 0.179 ppm and their half-life values (RL_{50}) were 5.01 and 3.73 days after treatment, respectively. The results show that the detected residues of fluazinam and trifloxystrobin in tomato fruits after spraying directly were below the maximum residue limit. Accordingly, tomato fruits could be used safely for human consumption after one day of spraying with both fungicides.

Keywords: Early blight, fluazinam, fungicide residues, HPLC, tomato and trifloxystrobin.

Tomato (*Solanum lycopersicum* L.) is one of the most remunerable and widely grown vegetables in the world. There are several diseases on tomato caused by fungi, bacteria, viruses, nematodes and biotic factors (Shyam and Gupta, 2001). Early blight is the most noticeable disease caused by the fungus *Alternaria solani* (Ellis & Martin). In severe infection can lead to complete defoliation and yield losses up to 79% (Basu, 1974; Datar and Mayee, 1981). Fungicide treatments are the most effective way to control early blight disease. There were several fungicides including captafol, mancozeb, benomyl, carbendazim, metiram, copper oxychloride + dichlofluanid and copper oxychloride + folpet have been successfully used for the control early blight (McCarter *et al*., 1976; Poysa *et al*., 1993; Dillard *et al*., 1997; Babu *et al*., 2001; Wiik, 2004 and Anand *et al*., 2010).

Strobilurin fungicides are broad spectrum fungicides in many crops. They are excellent inhibitors of spore germination and known for their protectant activity. Trifloxystrobin is a derivative from strobilurin type and produced by *Strobilurus tenacellus* (Sauter *et al*., 1999). Ashour (2009) found that the tested fungicides, Consento (fenomen + propamocarb), Flint (trifloxystrobin), Score (difenoconazole), Sereno (mancozeb + fenamidone) and Tridex 80% (mancozeb) caused significant reduction in the linear growth of *A. solani* the causal of tomato early blight. Issiakhem and Bouznad (2010) found that difenoconazole was more effective than chlorothalonil against mycelial growth or conidial germination of *A. alternata* and *A. solani*. Batista Tolentino *et al*. (2011) noticed that there were no significant differences in the efficiency of azoxystrobin (8g/100 l), difenoconazole (50ml/100 l), metiram + pyraclostrobin (200g/100 l) and tebuconazole (100ml/100 l) for controlling early blight disease on tomato.

During the last decades, the increasing demand of food safety has stimulated research regarding the risk associated with consumption of fruit and vegetables as they constitute major part of human diet contributing nutrients and vitamins. Therefore, residues of pesticides could affect the ultimate consumers especially when these commodities are freshly consumed. In this regard, the fungicide fluazinam that belong to the chemical group 2,6-dinitroaniline was used against *Alternaria*, *Botrytis* and *Phytophthora infestans* (Leonard *et al*., 2001). There are only a few reports of ordinary quantity analytical methods focused on fluazinam and trifloxystrobin residues in plant products (Likas *et al.*, 2007; Oliva *et al*., 2007; Feng-Shu *et al*., 2008 and Nageswara Rao *et al*., 2010). The present investigation aimed to study the efficiency of the fungicides fluazinam and trifloxystrobin against tomato early blight disease under field conditions and determination their residues in tomato fruits.

Materials and Methods

1. Tested fungicides:

Eight fungicides belong to two chemical groups were evaluated for their efficacy against *A. solani* the causal of early blight disease. The first group contains the registered fungicides, Oxy plus (cooper oxychloride) 28.5% WP, Ridomil Gold MZ (metalaxyl-M + mancozeb) 68% WG, Dolphin Alfa (difenoconazol) 25% EC and Flint (trifloxystrobin) 50% WG, which were selected based on their widely commercial use in Egypt for controlling early blight disease on tomato. They were applied at their recommended rates as 250g, 200g, 50ml and 20g/100 l water, in respective order. The chosen fungicides represent different chemical groups, [acylalanine + carbamate], [triazole] and strbilurin type [oximinoacetate], respectively. The second group includes Shirlan (fluazinam) 50% SC, Revus (mandipropamid) 25% SC, Ranman (cyazofamid) 40% SC and Leimay (amisulbrom) 20% SC, which have widely commercial use against late blight disease at the recommended rates of 50ml, 50ml, 30ml and 40ml, respectively. They belong to the chemical groups [2,6 dinitroaniline], [mandelamide], [cyanoimidazole] and [sulphonamide], respectively.

2. Evaluation of tested fungicides against tomato early blight disease:

Two experiments were carried out under field conditions to evaluate the fungicidal efficiency against early blight disease of tomato during 2013 season. The first field trial was conducted in Qaha Res. Station, Agric. Res. Centre, Qalyubiya Governorate representing north of Egypt, while the second was managed in Fayoum Governorate representing south of Egypt. Apparently, healthy seedlings (30-days-old) of tomato hybrids Super GS and Super Strain B were transplanted at mid of

February and at the beginning of March in Fayoum and Qalyubiya Governorates, respectively. Traditional cultural practices and fertilizers were followed as commonly recommended. The field experiment was designed in a complete randomized block design including three plots as replicates for each treatment. Each plot was 6x7 ($42m^2$, 1/100 feddan). A Knapsack sprayer was used to apply the tested fungicides as foliar treatment. Tomato plants were observed from transplanting until the appearance of the initial early blight disease symptoms. Three sprays, 15 days intervals, were applied started at 14 and 22 of April, 2013 for Fayoum and Qalyubiya experimental fields, respectively. Three plots fungicides-free application were served as a check treatment. The tested fungicides were sprayed at their recommended rates of application against natural infection of tomato early blight disease. The average of disease incidence was calculated one day before spraying and 10 days after each spray according to Cooke *et al*. (2006). Mean area under the disease progress curve (AUDPC) was calculated according to equation of Louwes *et al*. (1996).

3. Different cleanup methods for determination of fluazinam and trifloxystrobin residues in tomato fruits:

Different cleanup methods were carried out in order to choice the convenient method for determination fungicides residues in tomato fruits.

Seven different purification methods were used for choosing the convenient cleanup method for fluazinam and trifloxystrobin according to numerous analytical methods of Alder *et al.* (2006); Feng-Shu *et al*. (2008); Araujo *et al*., 2010 and Nageswara Rao *et al*. (2010) were considered. Initially Acetone extraction method for tomato fruits was followed. Random untreated tomato fruits were weighted (150g) and blended for 3 min using Ultra Thorax 25 homogenizer and then spiked with 10ppm of fluazinam or trifloxystrobin prior to extraction by acetone. The extract was filtered through Buchner funnel containing a piece of cotton. This step was repeated two times and the filtrate was collected, transferred to 500ml separator funnel and shacked vigorously for 2 min with the different solvents as mentioned in Table (1).

Table 1. Different purification methods of acetone extract for determination of fluazinam and trifloxystrobin residues in tomato fruits

Method	Cleanup (Partition)
1	Petroleum ether +water (1:1) $\rightarrow$ Dryness (anhydrous ($NaSO_4$) $\rightarrow$ Evaporation
2	Petroleum ether $\rightarrow$ Dryness (anhydrous ($NaSO_4$) $\rightarrow$ Evaporation
3*	Petroleum ether $\rightarrow$ Dryness (anhydrous ($NaSO_4$) $\rightarrow$ Evaporation
4	Hexane $\rightarrow$ Dryness (anhydrous ($NaSO_4$) $\rightarrow$ Evaporation
5*	Hexane $\rightarrow$ Dryness (anhydrous ($NaSO_4$) $\rightarrow$ Evaporation
6	Dichloromethane $\rightarrow$ Dryness (anhydrous ($NaSO_4$) $\rightarrow$ Evaporation
7	Ethyl acetate $\rightarrow$ Dryness (anhydrous ($NaSO_4$) $\rightarrow$ Evaporation

***** After evaporation of petroleum ether and hexane, the residue was stored in the freezer, then dissolved in 30 ml cold aqueous acetone (1:1) for three times. Acetone extract was filtrated through filter paper (Whatman No.1) and partitioned three times with 20, 15 and 15ml dichloromethane. After evaporation, the fungicide residue dissolved in 1.0 ml of convenient solvent and determined by HPLC.

After separation and equilibration of the layers, the added solvent to acetone extract filtered through anhydrous sodium sulphate and then evaporated using a rotary evaporator on a water bath at 40-50°C. Residues of fluazinam or trifloxystrobin were determined using HPLC.

4- Determination of fluazinam and trifloxystrobin residues in tomato fruits:

Field experiment was carried out in Qalyubiya Governorate during 2013 season. A Knapsack sprayer was used in applying the tested fungicides as foliar treatment diluted with water. Tomato plants (var. Severa) were sprayed by Shirlan (fluazinam) 50% SC and Flint (trifloxystrobin) at their recommended rates of application. Three replicates of treated and untreated tomato fruits were randomly picked up one hour after application and then 1, 3, 5, 7, 9 and 11 days to detect the presence of both fungicides residues. Fruit samples were collected into clean paper bags and transferred to the laboratory for analytical processes. The whole samples were chopped into small pieces, mixed and divided into three sub-samples. The analytical method of Feng-Shu *et al.* (2008) was followed for determination of fluazinam and trifloxystrobin residues. Tomato sample (50g) was putted into taper bottle, 100ml acetone was added, and homogenized for 2 min using Ultra Thorax 25 homogenizer. The extract was filtered two times through Buchner funnel containing a piece of cotton. The filtrate was collected and 50ml of them was transferred to 500ml separatory funnel and shacked vigorously for 2 min with 50ml petroleum ether. After separation and equilibration of the layers, the petroleum ether layer was collected and acetone layer was re-extracted by another 50ml of petroleum ether again. The combined petroleum ether was filtrated through anhydrous sodium sulphate and evaporated to dryness using vacuum rotary evaporator at 40°C. Fluazinam residue dissolved in methanol, while residue of trifloxystrobin dissolved in acetonitrile for determination by HPLC.

Quantitative analysis of fluazinam and trifloxystrobin residues were performed by Hewlett-Packard HP series 1100 equipped with a degasser G1322A, quaternary pump G1311A, thermostatted column compartment G1316A, UV detector G1314A and Chemstation were used for analysis of fluazinam and trifloxystrobin. The system was equipped with a stainless steel column (20 cm X 4.6 mm i.d.) packed with ODS-Hypersil 5 µm. Fluazinam was eluted isocratically with methanol: water (90:10 v/v). UV variable wavelength detector was monitored at 240 nm. A 20 µl injector was used at a flow rate of 1.0 ml/ min., and the column temperature was 40°C. Under these conditions, the retention time (R_t) of fluazinam was 3.116 min. and it had a good chromatography separation under these conditions. Also, good linearity was obtained in the range of 1.25–10µg for fluazinam with correlation coefficient 0.99501. Trifloxystrobin was eluted isocratically with acetonitrile: water + 0.1% formic acid (70:30 v/v). UV variable wavelength detector was monitored at 240 nm. A 20 µl injector was used at a flow rate of 1.0 ml/ min, and the column temperature was 40°C. Under these conditions, the retention time (R_t) for trifloxystrobin was 5.358 min and it had a good chromatography separation under these conditions. Good linearity was obtained in the range of 1–8µg for trifloxystrobin with correlation coefficient 0.99876. The degradation rate and residual half-life periods (RL_{50}) of the two tested fungicides on tomato was calculated according to the equation of Moye *et al.* (1987).

R e s u l t s

1. Efficacy of tested fungicides against tomato early blight disease:

a. Fayoum field experiment:

Data in Table (2) presented the percentage of early blight incidence after 10 days of each spray with the candidate fungicides in addition to the efficacy percentage for the last recorded disease incidence and AUDPC values. The disease incidence of early blight at different experimental plots ranged from 3.85 and 6.21% one day before spraying.

Table 2. Effect of tested fungicides on tomato early blight disease under field conditions (Fayoum location)

Tested fungicide	Before spray	Disease incidence (%) after* 10 days of each spray			Efficacy (%)	AUDPC
		1st spray	2nd spray	3rd spray		
Oxy plus 28.5 % WP	4.88 d	5.03 cd	5.96 d	5.98 d	81.91	163.87
Ridomil Gold MZ 68%WG	4.06 e	4.14 d	4.14 e	5.25 d	84.12	131.92
Dolphin Alfa 25% EC	4.28 e	5.36 bc	6.62 c	6.95 c	78.97	174.07
Flint 50% WG	5.14 cd	6.46 bc	6.92 c	8.77 b	73.47	204.67
Shirlan 50% SC	5.38 bc	5.76 bc	7.24 c	8.76 b	73.50	203.55
Revus 25% SC	6.21 a	6.80 b	8.65 b	10.89 b	67.06	244.12
Ranman 40% SC	5.18 bc	6.77 bc	9.17 b	10.39 b	68.57	236.32
Leimay 20% SC	5.79 ab	6.28 bc	8.51 b	9.37 b	71.66	224.62
Control	3.85 e	18.70 a	24.7 a	33.06 a	---	602.32

* Figures in the same column having the same letter are not significantly different ($P< 0.05$).

After 10 days of the first, second and third spray, the disease incidence ranged between 4.14-6.80%; 4.14-9.17% and 5.25-10.89% in fungicidal treatments, meanwhile in fungicidal treatments, it reached 18.70, 24.70 and 33.06% in the check treatment, respectively. Generally, the results indicated that the in fungicidal treatments significantly decreased disease incidence comparing with the check treatment during the experimental period. In addition, it was observed that spraying tomato plants with Oxy plus and Ridomil Gold MZ caused the highest significant decrease in disease incidence during the experimental period. Based on the data of disease incidence percentages after 10 days of the first and second spray, the tested fungicides can classified significantly into three groups.

The first group contains Oxy plus and Ridomil Gold MZ, which gave the highest reduction in disease incidence percentages. The second group contains Dolphin Alfa, Flint and Shirlan, which gave moderate reduction in disease incidence. The last group contains Revus, Ranman and Leimay, which gave relatively the lowest reduction in disease incidence. Results of disease incidence after the third spray indicate that no significant differences were observed between the applied. In this regards, Shirlan, Revus, Ranman and Leimay and the recommended fungicide Flint against early blight disease. Ridomil Gold MZ and Oxy plus gave the highest effect followed by Dolphin Alfa. The recommended fungicides against early blight disease were arranged according to their efficacy percentages in the following descending order, Ridomil Gold MZ, Oxy plus, Dolphin Alfa and Flint. The corresponding order for the other tested fungicides was Shirlan, Leimay, Ranman and Revus. Although these fungicides are used against late blight disease but they gave high efficacy against early blight disease nearly to some recommended fungicides (Dolphin Alfa and Flint). The non-sprayed control plots had the highest AUDPC value for disease incidence. Efficacy percentages of tested fungicides were highly correlated with AUDPC values.

b. Qalyubiya field experiment:

Data in Table (3) showed that the percentage of early blight disease incidence under natural infection ranged between 1.76 and 2.86% one day before spraying. Disease incidence percentages in check treatment reached to 16.15, 20.79 and 25.72% after 10 days of the first, second and third spray, respectively. No significant differences between the tested fungicides were found after 10 days of the first spray.

Table 3. Effect of tested fungicides on tomato early blight disease under field conditions (Qalyubiya location)

Tested fungicide	Before spray	Disease incidence (%) after 10 days of each spray			Efficacy (%)	AUDPC
		1st spray	2nd spray	3rd spray		
Dolphin Alfa 25% EC	1.94c	3.42b	4.88d	5.75d	77.64	119.92
Flint 50% WG	2.20bc	3.84b	4.91d	6.15d	76.09	128.25
Shirlan 50% SC	1.87c	2.77b	4.78d	5.70d	77.84	113.40
Revus 25% SC	1.96c	3.57b	7.14b	8.89b	65.44	161.70
Ranman 40% SC	1.76c	4.06b	6.39bc	8.39b	67.38	154.50
Leimay 20% SC	2.63ab	3.88b	6.12c	7.37c	71.35	150.00
Control	2.86a	16.15a	20.79a	25.72a	---	491.40

In the second and third spray, the tested fungicides differed significantly for their disease reduction Table (3). Generally, the tested fungicides could be arranged according to their efficacy percentages in the following descending order; Shirlan (77.84%), Dolphin Alfa (77.64%), Flint (76.09%), Leimay (71.35%), Ranman (67.38%) and Revus (65.44%). It was observed that efficacy percentages of the tested fungicides were highly correlated with AUDPC values. Data in Tables (1 &2) indicate that there were compatible efficacy of tested fungicides against early blight disease of tomato in the two field trials at Fayoum and Qalyubiya Governorates.

2- Recovery percentages of fluazinam and trifloxystrobin from tomato fruits:

Determination of recovery percentages of fluazinam and trifloxystrobin depended on extraction from tomato fruits with acetone and then partition with different organic solvents were conducted for choosing the most suitable and efficient solvent in cleanup. Data presented in Table (4) indicated that recovery percentages of fluazinam and trifloxystrobin ranged between 27.5 - 99.0% and 43.6-123.0%, respectively. The acceptable range of recovery percentage ranged between 70 and 120% according to Anonymous (2009). Generally, methods 2 and 4 were the best methods in the determination of both fungicide residues because it has not any background with good recoveries. Accordingly, petroleum ether and hexane

Table 4. Recovery percentages of fluazinam and trifloxystrobin from tomato fruits using different purification methods

Tested method	Recovery (%)	
	Fluazinam	Trifloxystrobin
1	64.9	---
2	95.0	101.3
3	45.7	67.2
4	99.0	123.0
5	27.5	77.2
6	63.0	84.2
7	67.0	43.6

were the convenient solvents for purification of acetone extract, which the recovery percentages of fluazinam and trifloxystrobin reached to 95.0 & 101.3% and 99.0 and 123.0%, respectively.

3- Persistence of fluazinam and trifloxystrobin residues in tomato fruits:

Data presented in Table (5) showed persistence of fluazinam and trifloxystrobin residues in tomato fruits. The initial deposit of fluazinam in tomato fruits was 0.236 mg/kg one hour after application. The residue of fluazinam in tomato fruits within the first 24 hours after application decreased to 0.232 mg/kg with 1.70% loss. The rapid degradation started in the third day after spraying, which fluazinam residue reached 0.178 mg/kg with 24.58% loss. The fast degradation continued to reach 0.101 mg/kg with 57.20% loss after 5 days from application. The recovered amounts of fluazinam 7 and 9 days after application were decreased to 0.06 and 0.04 mg/kg with 74.58 and 83.05% loss, respectively. Samples of tomato fruits were free from any detectable residues of fluazinam after 11 days of application. The lowest disappearance rate per day was found within the first 24 hours, while the highest value occurred in the fifth day of spraying.

Table 5. Persistence of fluazinam and trifloxystrobin residues in tomato fruits

Days after application	Amount recovered (mg/kg)		Loss (%)		Rate of disappearance / one day	
	Fluazinam	Trifloxy-strobin	Fluazinam	Trifloxy-strobin	Fluazinam	Trifloxy-strobin
Initial	0.236	0.179	00.00	00.00	0.00	0.00
1	0.232	0.176	1.70	1.68	1.70	1.68
3	0.178	0.098	24.58	45.25	11.44	21.79
5	0.101	0.086	57.20	51.96	16.32	3.36
7	0.06	0.013	74.58	92.74	8.69	20.39
9	0.04	N.D.	83.05	---	4.24	---
11	N.D.	---	--	---	---	---

N.D.= Not detected.

Based on the previous results, the calculated half-life period (RL_{50}) of fluazinam on tomato fruits was 5.01 days. The results presented herein clearly show that the detected residues of fluazinam in tomato fruits after spraying directly was 0.236 ppm, which are below the maximum residue limit (0.5 ppm). The low initial amount in tomato fruits and the low no-effect levels permitted in food for human consumption allow the fungicide fluazinam to be applied shortly before harvest of edible crops**.**

The low initial deposit of trifloxystrobin (0.179 ppm) may be due to the low rate of active ingredient in spraying solution and the low surface area of tomato fruits, which received the spray solution of the tested fungicide. The amounts of trifloxystrobin were decreased slowly in tomato fruits one day after application to reach 0.176 with a low loss of 1.68%. The rapid degradation was occurred in the third day of application to reach 0.098 ppm with 45.25% loss. After five days of application, the residual amount was 0.086 ppm with 51.96% loss.

The corresponding values after 7 days were 0.013 ppm with a very high percent loss 92.74. Samples of tomato fruits were free from any detectable residues of trifloxystrobin after 9 days of application. The lowest disappearance rate per day was found within the first 24 hours, while the highest values occurred in the third and seventh day of spraying. Based on the previous results, the calculated half-life period (RL_{50}) of trifloxystrobin on tomato fruits was 3.73 days. The maximum residue limit of trifloxystrobin in tomato fruits is 0.5 ppm. The low initial amount in tomato fruits and the low no-effect levels permitted in food for human consumption allows the fungicide trifloxystrobin to be applied shortly before harvest of edible crops. From the present study it could be concluded that tomato fruits could be used safely for human consumption after one day from spraying with trifloxystrobin.

Discussion

Tomato early blight is one of the most common fungal diseases on tomato in Egypt (Haggag and Farghaly, 2007 and Derbalah *et al*., 2011). The causal pathogen, *Alternaria solani* penetrate fruits and leaves causing typical symptoms of concentric rings (Target board) that severely damage the foliage, resulting in reduced number and weight of fruit yield (Shyam and Gupta, 2001 and Agrios, 2005). Anand *et al*. (2010) noticed that tomato early blight and leaf spot are the most destructive diseases, which caused huge economic losses. Data in the present study indicated that there was compatibility in the efficiency of the tested fungicides against early blight disease on tomato in the both field trials. The recommended fungicides against early blight disease were arranged according to their efficacy percentages in the following descending order, Ridomil Gold MZ, Oxy plus, Dolphin Alfa and Flint. The corresponding order for the other tested fungicides was Shirlan, Leimay, Ranman and Revus. Although these fungicides use against late blight disease, they gave high efficacy against early blight disease near to the efficacy of some recommended fungicides (Dolphin Alfa and Flint).

Accordingly, fungicides forecasting systems that are available for early and late blight of tomato need modification. Several fungicides have been reported to be effective in controlling this disease such as captafol, mancozeb, copper oxychloride and chlorothalonil. The compounds; Shirlan, Leimay, Ranman and Revus are known to break down tolerance of the causal pathogen because their modes of action differed with the conventional fungicides. Holm *et al*. (2003) reported that decreased sensitivity to fungicides with a multi-site mode of action may be due to mechanisms such as detoxification, reduced uptake, or increased efflux of the fungicide.

Bruhn and Fry (1982) found that a strong gas phase activity is shown by metalaxyl, which aids the distribution within the canopy, and might be the case with Shirlan. Dahmen and Staub (1992) showed that difenoconazol was very effective against early blight as protective and curative, which may be due to its mode of action. In addition, persistence of difenoconazol on and in the leaf, and penetration behaviour may be reasons for its activity against a wide range of plant pathogenic fungi from the classes; Ascomycetes, Basidiomycetes and Deuteromycetes.

Schepers and Meier (2003) reported that mancozeb sticks less to the leaf surface compared to fluazinam. Evenhuis *et al*. (2006) found that protectants like Ranman, Shirlan and Curzate-M showed a reduction in number of lesions after multiple applications, which may be due to the redistribution of the contact fungicides from lower leaf layers to the developing growing point by splash of rain droplets or vapour activity. Also, Mantecón (2009) stated that preventive sprayings using strobilurin fungicides showed a complete control of early blight symptoms in the field, while triazole fungicides application didn’t gave complete control whether applied preventively or curatively. In the present study, the highest recovery percentage of fluazinam and trifloxystrobin was obtained using acetone in extraction and then partition with petroleum ether or hexane. Xu *et al*. (2009) revealed that the amounts and ratios of the eluting solvents (*i.e.*, acetonitrile/water, water, and acetone/hexane) were varied in extraction of tested pesticides. Optimal conditions for the pesticides varied, owing to their wide polarity range, ionization properties, and water solubility. Among all of the evaluated pesticides, the optimal results were obtained with acetonitrile/water (80:20). Generally, there are little literatures available to our knowledge about the residual determination of fluazinam and trifloxystrobin in tomato fruits. Fenoll *et al*. (2008) recorded that the half-life values of azoxystrobin and kresoxim-methyl on peppers were in the range of 10.28–15.21 days. The residues of both fungicides were below MRL after three days of application. Different variety, weather conditions and different dose can be responsible for the different dissipation rates of these fungicides. The lower persistence could be also due to a ‘dilution effect’ brought about by the rapid growth of the species studied. Romeh *et al*. (2009) reported that the dissipation of pesticide residues in/on crops depends on climatic conditions, type of application, plant species, dosage and interval between applications.

According to the report of Anonymous (2005) who mentioned that the maximum residue limit for fluazinam and trifloxystrobin on tomato is 0.5 ppm. The results presented herein clearly show that the detected residues of fluazinam and trifloxystrobin in tomato fruits after spraying directly were 0.236 and 0.179 ppm, which is below the maximum residue limit. So, tomato fruits could use safely for human consumption after one day of spraying. Sahoo *et al*. (2012) studied the dissipation of trifloxystrobin and tebuconazole following two applications of a combination formulation of Nativo 75% WG (trifloxystrobin 25% + tebuconazole 50%) at 250 and 500 g /ha at 10 days interval. The half-life periods for trifloxystrobin and tebuconazole on red chilli were 1.81 & 1.58 and 1.37 & 1.41 days at single and double application rates, respectively.

Trifloxystrobin residues were dissipated below its limit of quantification (LOQ) of 0.01 mg/kg after 5 and 7 days at single and double application dosages, respectively. These results are in agreement with the present study, in which samples of tomato fruits were free from any detectable residues of trifloxystrobin after 9 days of application. Fungicides are often used irrationally and in high dosages, which may lead to environmental contamination and health problems for field workers and consumers.

It is well known that using the fungicides is considered as the shortest way to obtain efficient results of disease management. However, due to the hazard effect on the human health, of the fungicides residue in the produced plant products especially vegetables, which are consumed after a short time of fungicides application, alternative schedule or a program of using fungicides before fruit harvesting are needed. Degradation studies of new fungicides; fluazinam and trifloxystrobin in tomato fruits were determined in this study in order to definite their persistence and pre-harvest intervals (PHI) under climatic conditions of Egypt.

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كفاءة بعض المبيدات الفطرية فى مكافحة الندوة المبكرة وتقدير متبقياتها فى ثمار الطماطم

تماضر عبد الرحمن جمعة* ، أحمد محمد عبد القادر عاشور ، هاني محمود عاشور بدوي*** ، نسرين درغام ديب ******

* معهد بحوث أمراض النبات ، مركز البحوث الزراعية ، الجيزة.
** قسم أمراض النبات ، كلية الزراعة ، جامعة القاهرة.
*** قسم الحشرات الاقتصادية والمبيدات, كلية الزراعة , جامعة القاهرة.
**** وزارة التعليم العالى – الجمهورية العربية السورية.

مرض اللفحة المبكرة المتسبب عن الفطر الترناريا سولاني يُهاجم كل أصناف وهجن الطماطم المنزرعة سواء فى الحقول المفتوحة أو في الصوب البلاستيكية مما أدى إلى انخفاض خطير في محصول الثمار.

تحت التجارب الميدانية تم ترتيب المبيدات الفطرية التى تم اختبارها تنازليا وفقـا لفعاليتـها كالتـالى:
Ridomil Gold MZ, Oxy plus, Dolphin Alfa, Shirlan, Flint, Leimay, Ranman and Revus

وقد تم الكشف عن متبقيات المبيدات المختبرة فى ثمار الطماطم بعد الرش وقد أظهرت النتائج أن متبقيات كل من مبيدي fluazinam و trifloxystrobin في الثمار بعد الرش مباشرة كانت دون الحد الأقصى.

وفقاً لنتائج هذه الدراسة يمكن أن تستخدم ثمار الطماطم بأمان للاستهلاك البشري بعد يوم واحد من الرش مع كل من مبيدات الفطريات fluazinam و trifloxystrobin المستخدمة.