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PERSISTENCE OF THE FUNGICIDES TETRACONAZOLE AND PENCONAZOLE RESIDUES ON AND IN SOME VEGATABLES GROWN IN THE GREENHOUSE AND UNDER DIFFERENT ENVIRONMENTAL CONDITIONS

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ABSTRACT

The initial deposits of tetraconazole on and in cucumber, tomato and green pepper fruits were 0.19, 0.20 and 0.25 ppm, respectively. The obtained residual half-life values (RL_{50}) of tetraconazole on and in cucumber, tomato and green pepper fruits were 1.8, 1.87 and 2.55 days, respectively. The initial deposits of penconazole on and in cucumber, tomato and green pepper were 0.13, 0.09 and 0.24 ppm, respectively. The estimated half-life (RL_{50}) of the penconazole in cucumber, tomato and green pepper fruits was 3.3, 1.5 and 4.97 days, respectively.

Washing removed 57.89, 55.50 and 84.0% of the initial residues of tetraconazole found on cucumber, tomato and green pepper fruits, respectively. While for penconazole the corresponding values were 80.77, 83.33 and 70.83%.

The calculated half-life periods were 6.76 and 4.45 hours for tetraconazole and penconazole when exposed to sunlight.

Moreover, the dissipating rate of tetraconazole was more rapid than penconazole when exposed to UV-light. The statistical half-life times for tetraconazole and penconazole were 9.83 and 15.64 hours, after exposure to UV-light.

The results showed that penconazole was degraded more rapidly at different temperatures than tetraconazole. Statistically half-life times of tetraconazole were 49, 10.5, 3.69 and 2.09 days at 25, 35, 40 and 45 °C, respectively. While for penconazole the corresponding values were 9.14, 2.05, 1.46 and 0.65 days at 25, 35, 40 and 45 °C, respectively.

Key words: *greenhouse, penconazole, persistence, tetraconazole.*

1. INTRODUCTION

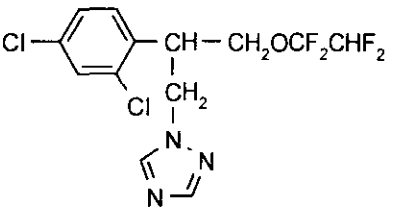
Greenhouse production of crops requires pesticide application due to the high liability of the crops to be infected with some diseases. Powdery mildew is the most common disease of the plant family cucurbitaceae. This disease can cause considerable damage to growing plants unless proper treatment is carried out at the proper time. As a result of this treatment accumulation of residues take place at levels considerably higher than those of the permissible residue levels of pesticides. Tetraconazole and penconazole are broad-spectrum systematic triazole fungicides. They have recently been registered in Egypt (Anonymous, 2001) and various countries. Both fungicides are steroid demethylation inhibitors acting mainly on the vegetative stages of fungi by blocking the mycelial growth either inside or on the surface of the host plant. Tetraconazole and penconazole are effective in controlling a broad spectrum of diseases such as powdery mildew and scab on fruit. (Khalfallah *et al.*, 1998). The literature concerning the analysis of tetraconazole residues in different matrices is limited. Recently a modified multiresidue method was reported by Khalfallah *et al.*, (1998, who suggest silica gel-activated carbon for the extraction, purification and gas-liquid chromatography with nitrogen phosphorus detection for the determination of tetraconazole residues in cucumbers.

The aims of this study were: 1) to determine the persistence of tetraconazole and penconazole residues in cucumber, tomato and pepper fruits in the greenhouse 2) to investigate the effect of washing on the removal of the fungicide residues from cucumber, tomato and pepper 3) to determine the effect of temperature, direct sunlight and UV-light, on the persistence of both tested fungicides.

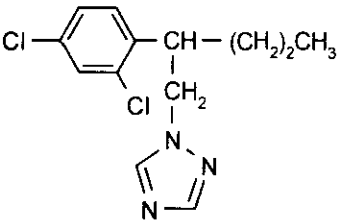
2. MATERIALS AND METHODS

2.1. Fungicides used

Tetraconazole (Domark 10% EC)
Chemical name: [(±)-1-{2-(2,4-dichloorophenyl)-3-1,1,2,2-tetrafluoroethyl)-propyle}-1H- 1,2,4-triazole.



Penconazole (Topaz 100 EC)
Chemical name: (1-{2-(2,4-dichloorophenyl)-pentyl}-1H-1, 2,4-triazole).



2.2. Greenhouse trial design

The applications were conducted in a total of three experiments, 425 m^2 used for the growth of tomatoes (Epiza) and 238m^2 for growing cucumber (delta star) and green pepper (roamy hagen). Each crop was grown in 1.0 m rows with a distance of 0.5 m between plants. A single application of tetraconazole or penconazole was performed in each greenhouse

in December 2004. Tetraconazole (Domark 10% EC) was sprayed at the rate of 50 cm^3 / 100 L.water as recommended by using a knapsack sprayer equipped with one nozzle. Penconazole (Topaz 100 EC) was applied at the rate of 25 cm^3 / 100 L water. During the experiment the registered temperatures ranged from 24 to 26 °C.

2.3. Sampling and storage

For each vegetable, samples were collected randomly at 0, 1, 2, 5, 7, 11, 14 and 19 days after application of tetraconazole and penconazole. The samples consisted of 10 cucumbers, 15 tomatoes and 10-15 green peppers. Immediately after collection, the samples were put into polyethylene bags and transported to the laboratory where they were stored in individual polyethylene bags at -20 °C until extraction. Each sample was divided into two parts. The first was subjected to washing with tap water; to study the effect of washing on the loss of the two tested fungicides. The second part was analyzed without being washed. Each sample was chopped and divided into three sub samples/ replicates (100 g).

2.4. Extraction and clean up procedure

A 100 grams sample was transferred into a glass jar blender with 30 grams anhydrous sodium sulfate and 200 ml ethyl acetate, and then was blended for 3 min. The macerate was filtered through a pad of cotton into a graduated cylinder. A known volume of the extract was evaporated just to dryness using a rotary evaporator. The residue was dissolved in 5 ml methanol and cleaned up according to Jhonson (1963) using coagulating solution (0.5g. ammonium chloride and 1.0 ml 85% orthophosphoric acid solution in 400 ml distilled water). The residue was thoroughly mixed with 10 ml of cooled freshly prepared coagulating solution, then quantitatively transferred and filtered through a column of 2.5 m diameter packed with a 5.0 cm layer of Hyflo-supercell. The transfer was repeated three-times using 5.0 ml methanol and 10 ml coagulating solution each time.

The filtrate was then collected in a 250 ml separatory funnel and extracted with 100, 50 and 50 ml chloroform. The extracts were collected and evaporated under vacuum to dryness; the residues were then dissolved in ethyl acetate (HPLC grade) for GC analysis.

2.5. Effect of environmental conditions

To study the effect of temperature, UV-light and sunlight on the fate of tetraconazole and penconazol, one ml acetone containing 100 µg a.i was spread on the surface of uncovered petri dishes (5 cm i.d) and the solvent was left to dry.

A group of treated petri-dishes were exposed at 25, 35, 40 and 45 °C for different periods of exposure from 0 to 144 hours inside a dark electric oven to study the effect of temperature. Another group of treated petri dishes were exposed to an ultraviolet lamp (254 nm) at a distance of 12 cm for 0, 3, 6, 12 and 24 hours to study the effect of UV-light. The other treated petri dishes were exposed to direct sunlight for 0, 1, 3, 4, 6, 8, 12, 24 and 48 hours. Dominating temperature ranged between 35 – 40 °C.

2.6. Gas chromatographic analysis

A Hewlett-Packard serial 6890 gas chromatograph, equipped with an ECD, programmed for external standardization using peak area, was used. The column was DB-17, (15 m x 0.32 mm x 0.52 µm film thickness) and the injection port temperature was 280 °C, the column temperature was 200 °C and the detector temperature 300 °C. The carrier gas was nitrogen at a flow rate of 2 ml/min. Under these conditions the retention time (R_t) for tetraconazole and penconazole were 2.1 and 2.5 min, respectively.

2.7. Recovery studies

Known quantities of tetraconazole and penconazole were added to untreated samples of cucumber, tomato and green pepper at fortification levels of 0.5 ppm and 1.0 ppm. Simultaneous processing frequently checked recovery of over all method. Average percentages recovery of tetraconazole from

spiked samples were 96.88, 94.04 and 90.30% at the high spiking level, and 90.6, 89.99 and 91.95% at the low spiking level for cucumber, tomato and green pepper, respectively. The percentage recovery of penconazole at the high spiking level was 98.98, 96.17 and 101.3% and at a low level was 80.1, 90.22 and 92.01% for cucumber, tomato and green pepper, respectively.

2.8. Kinetic study

The rate of degradation of the tested pesticides and half-life periods RL_{50} on cucumber, tomato and green pepper fruits were calculated according to the equation (Moye *et al.*, 1987).

$RL_{50} = \ln 2 / K = 0.6932/k$

$$K = 1 / tx \cdot \text{Ln} \frac{a}{bx}$$

Where:

K = Rate of decomposition

tx = Time in days

a = Initial residue

bx = Residue at x time

3. RESULTS AND DISCUSSION

3.1. Unwashed fruits

3.1.1. Residues of tetraconazole

The values of tetraconazole residues and its loss percentage detected in cucumber, tomato and green pepper fruits are given in Table (1). The initial deposit on and in cucumber was 0.19 ppm one hour after application. It decreased to 0.10, 0.06, 0.035, 0.028, 0.013 and 0.002 ppm 1, 2, 5, 7, 11 and 14 days after application, respectively, with 47.36, 68.42, 81.58, 85.26, 93.15 and 98.94% loss. No detectable residue of tetraconazole was observed after 19 days.

Table (1): Residues of tetraconazole on and in cucumber, tomato and green pepper fruits.

Time after application (days)	Tetraconazole											
	Cucumber				Tomato				Pepper			
	Unwashed		Washed		Unwashed		Washed		Unwashed		Washed	
	ppm	% loss	ppm	% loss	ppm	% loss	ppm	% loss	ppm	% loss	ppm	% loss
Initial	0.19	0.00	0.08	57.89	0.20	0.00	0.089	55.50	0.25	0.00	0.04	84.00
1	0.10	47.36	0.04	60.00	0.12	40.0	0.058	51.66	0.17	32.0	0.021	87.64
2	0.06	68.42	0.02	66.66	0.07	65.0	0.02	71.42	0.10	60.0	0.01	90.00
5	0.035	81.58	N.D.	---	0.028	86.0	N.D.	---	0.073	70.80	N.D.	---
7	0.028	85.26	N.D.	---	0.011	94.50	N.D.	---	0.045	82.0	N.D.	---
11	0.013	93.15	N.D.	---	0.003	98.50	N.D.	---	0.011	95.60	N.D.	---
14	0.002	98.94	N.D.	---	N.D.	---	N.D.	---	0.005	98.0	N.D.	---
19	N.D.	---	N.D.	---	N.D.	---	N.D.	---	N.D	---	N.D.	---
K (mathematically)	**0.3424**				**0.3706**				**0.2708**			
RL_{50} (days)	**1.80**				**1.87**				**2.55**			

K= rate of decomposition

RL_{50}= half life in days

ND= non detectable

The initial deposit of tetraconazole on and in tomato fruits was 0.20 ppm one hour after application. The residues decreased to 0.12, 0.07, 0.028, 0.011 and 0.003 ppm indicating rates of loss 40.0, 65.0, 86.0, 94.50 and 98.50% 1, 2, 5, 7 and 11 days after application, respectively. The percentage loss decreased from two days to 11 days of application with disappearance rate of 98.50%. On the other hand, the initial deposit of tetraconazole on and in green pepper fruits was 0.25 ppm one hour after application. The residues decreased to 0.005 ppm indicating a loss rate of 98.0% 14 days after application. The obtained residual half–life values (RL_{50}) of tetraconazole on and in cucumber, tomato and green pepper fruits were 1.8, 1.87 and 2.55 days, respectively.

The MRL of tetraconazole was not yet established in Codex (2003). But tetraconazole is already registered for use on cucumber in Italy and Spain, with a MRL 0.2 mg/kg, and a preharvest interval (PHI) of 7 days. From the results in Table (1) the tetraconazole residues in cucumber, tomato and pepper fruits following this interval (7 days) were 0.28, 0.011 and 0.045 ppm, respectively. These results agree with those obtained by Khalfallah *et al.*, (1998) who found that the tetraconazole residues in cucumber after 7 days were 0.025 and 0.061 ppm for the two application doses 4.0 and 8.0 g a.i. / 100 liter water. Thus according to our results the PHI of tetraconazole was one day after application for cucumber, tomato and pepper fruits.

3.1.2. Residues of penconazole

The data presented in Table (2) show that the initial deposit of penconazole on and in cucumber fruits was 0.13 ppm one hour after application. It decreased to 0.085, 0.055, 0.05, 0.045, 0.035 and 0.025 ppm indicating the rates of loss were 34.61, 57.69, 61.53, 65.58, 73.07 and 80.77% 1, 2, 5, 7, 11 and 14 days after application, respectively.

The data presented in Table (2), also show that the initial deposit of penconazole in tomato fruits (0.09 ppm) was considerably lower than that detected in cucumber. This might be due to the spherical rounded smooth surface of tomato fruits,

which decreased the deposits more than on the cucumber fruits (EL-Sayed *et al.*, 1976). The initial deposit residues then gradually decreased to 0.05, 0.04, 0.003, 0.002 and 0.001 ppm corresponding to rates of loss of 44.44, 55.55, 96.66, 97.78 and 98.89% at 1, 2, 5, 7 and 11 days after application, respectively. No residues of penconazole could be detected in tomato fruits after 14 and 19 days after application.

The data in Table (2) show that the initial deposit of penconazole on and in green pepper was 0.12 ppm one hour after application, then gradually decreased to 0.105 ppm at one day after application revealing 12.50% loss. This value declined to 0.065, 0.055, 0.015 and 0.005 ppm corresponding to rates of loss of 45.83, 54.16, 87.50 and 95.83% at 2, 7, 14 and 19 days after application, respectively. The estimated half-life (RL_{50}) of penconazole in cucumber, tomato and green pepper fruits was 3.3, 1.5 and 4.97 days, respectively.

According to the Codex Alimentarius Commission (2003), the maximum residue limit for penconazole on cucumber and tomato is 0.1 and 0.2 ppm. The corresponding recommended pre harvest interval (PHI) is 7 days for cucumber and one day for tomato after application.

From the above results, the short persistence in cucumber, tomato and green pepper fruits could be due to a variety of environmental factors. Growth also may be responsible to a certain extent for decreasing the pesticide residue concentrations due to growth dilution effect, (Walgenbach *et al.*, 1991).

Such results are in agreement with those reported by EL-Bouze *et al.*, (2005) who found that the residue half-life of tetraconazole in cucumber growing under the greenhouse conditions was 6.63 days after application, Khalfallah *et al.*, (1998) who reported that tetraconazole residues dissipated relatively rapidly, with a half-life of 7 days in green house grown cucumber. Nasr and Almaz (2004) reported that the half-life of te.raconazole on sugar beet under field conditions was 3 days. Ahmed *et al.*, (2004) indicated that the initial deposits of penconazole on and in cucumber and green pepper under plastic green house conditions were 0.34 and 0.635 ppm.

Table (2): Residues of penconazole on and in cucumber, tomato and green pepper fruits.

Time after application (days)	Penconazole											
	Cucumber fruits				Tomato fruits				Pepper fruits			
	Unwashed		Washed		Unwashed		Washed		Unwashed		Washed	
	ppm	% loss	ppm	% loss	ppm	% loss	ppm	% loss	ppm	% loss	ppm	% loss
Initial	0.13	0.00	0.025	80.77	0.09	0.00	0.015	83.33	0.12	0.00	0.035	70.83
1	0.085	34.61	0.015	82.35	0.05	44.44	0.006	88.00	0.105	12.50	0.03	71.42
2	0.055	57.69	0.01	81.81	0.04	55.55	0.005	87.50	0.065	45.83	0.02	69.23
5	0.05	61.53	N.D.	---	0.003	96.67	N.D.	---	0.06	50.00	N.D.	---
7	0.045	65.38	N.D.	---	0.002	97.78	N.D.	---	0.055	54.16	N.D.	---
11	0.035	73.07	N.D.	---	0.001	98.89	N.D.	---	0.035	70.83	N.D.	---
14	0.025	80.77	N.D.	---	N.D.	---	N.D.	---	0.015	87.50	N.D.	---
19	N.D.	---	N.D.	---	N.D.	---	N.D.	---	0.005	95.83	N.D.	---
K (mathematically)	**0.3138**				**0.4610**				**0.1393**			
RL_{50} (days)	**3.3**				**1.5**				**4.97**			

K= rate of decomposition

RL_{50}= half life in days

ND= non detectable

Generally these findings are similar to those obtained by AL-Azawi, *et al.*, (1991); Youssef *et al.*, (1995); Valverde-Garcia *et al.*, (1993); AL-Khalaf *et al.*, (1995); Antonious *et al.*, (1998); Menkissoglu *et al.*, (1998); Martinez Vidal *et al.*, (1998); EL-Bakary *et al.*, (1999) and Prieto *et al.*, (2002).

3.3. Influence of washing on residue levels of tetraconazole and penconazole on cucumber, tomato and green pepper fruits

The effect of washing with tap water on the residue levels of tetraconazole and penconazole on cucumber, tomato and green pepper are shown in Tables 1 and 2. Washed the contaminated fruits of cucumber, tomato and pepper grown in greenhouses were analyzed to determine portions of the residue levels. Washing removed 57.89, 55.50 and 84.0% of the initial residues of tetraconazole found on unwashed cucumber, tomato and green pepper fruits, respectively. Washing of treated fruits collected after one and two days after treatment were removed 60.00 and 66.66% from cucumber fruits; 51.66 and 71.42% from tomatoes and 87.64 and 90% from green peppers, respectively.

Washing with tap water removed 80.77, 83.33 and 70.83% of the initial residues of penconazole determined on unwashed cucumber, tomato and green pepper fruits, respectively. Washing after one and two days removed 82.35 and 81.81% from cucumber fruits, 88.00 and 87.50 % from tomato fruits and 71.42 and 69.23% from green peppers.

The forementioned results agree with the results of Sallam and El-Nabarawy (2001) who reported that the washing process removed from 29.14 to 56.75% of the residues from profenofos on moloukhia leaves. Shiboob (2001) found that washing with tap water removed 80.99, 81.06 and 98.67% of profenofos on sweet pepper, hot pepper and eggplant, respectively.

According to the data of Table (2) and remarks of El-Kins (1989) and Tag El-Din (1993) removal of pesticide residues by washing depends on several factors: character of the surface of the plant food (smooth or rough, waxy or non-waxy), surface to volume ratio (washing is more effective for bigger fruits)

reference point of residue levels (higher levels easier to remove); chemical and physical properties of the applied pesticides, the length of time that the pesticide has been in contact with the plant foods, rate and number of applications and penetrability of pesticide into fruit tissues . Also the obtained results are in agreement with those findings of Ismail *et al.*, (1993); Hegazy *et al.*, (1997); Hegazy and Nasr (2003) Thabit (2002); Nasr and Abd EL-Aziz (2005) and El-Refahey (2003).

3.4. Effect of environmental factors

The present studies investigated the effect of temperature, UV-light (short waves, 254 nm) and direct sunlight on the stability of tetraconazole and penconazole.

3.4.1. Effect of direct sunlight

The data presented in Table (3) show that photodecomposition is positively correlated with the exposure period. It could be concluded that the residues of the tested fungicides greatly deteriorated when exposed to direct sunlight especially for long periods. The results (Table 3) show that the amounts of penconazole decreased sharply from zero to one hour with a disappearance rate of 41.80% / hour, while this value was 14.66% / hour for tetraconazole. From the 3rd hour the degradation of both tetraconazole and penconazole became slower and more gradual up till the 48 hours of exposure. The results also revealed that the percentage loss of tetraconazole and penconazole after 48 hours of exposure to sunlight was 84.50 and 89.99%. The calculated half–life periods were 6.76 and 4.45 hours for tetraconazole and penconazole.

3.4.2. Ultra-violet light

The effect of ultraviolet (UV) light on pesticides is of considerable interest to the research workers. It has been demonstrated that UV light produces chemical changes in a large number of pesticides. Several types of photodecomposition such as hydrolysis, oxidation and isomerization occur. If similar reactions occur under field

conditions, such investigations will be of great importance in view of environmental contamination, pesticide residues in agricultural products and practical use of pesticides.

Generally, it is known that photodecomposition is positively correlated with the exposure period. The data in Table (3) also show that the decomposition percentages of tetraconazole and penconazole were influenced when exposed to UV light as a thin film on a glass surface. Moreover, the decomposition rate of tetraconazole was more rapid than penconazole.

3.4.3. Effect of different temperatures

The results in Tables (4 and 5) summarize the effect of four different temperature levels (25, 35, 40 and 45°) on the stability and degradation of tetraconazole and penconazole. The results indicated that the persistence of tetraconazole was influenced by temperature and period of exposure. It is evident that there is a positive relationship between the degree of temperature and the rate of degradation. The results clearly showed that penconazole was degraded more rapidly at different temperatures than tetraconazole.

The data presented in Table (4) demonstrated no thermal decomposition of tetraconazole for 6 hours at 25 and 35°C, while the percentage losses were 0.08 and 1.35% at 40 and 45 °C, respectively. The results showed that the percentage losses of tetraconazole were 0.3, 2.66, 4.54 and 6.54% after 24 hours of exposure to temperatures of 25, 35, 40 and 45 °C, respectively. The results also revealed that the percentage losses of tetraconazole after 144 hours of exposure to temperatures of 25, 35, 40 and 45 °C were 22.37, 44.22, 91.55 and 98.62%, respectively. Statistical half-life times of tetraconazole were 49, 10.5, 3.69 and 2.09 days at 25, 35, 40 and 45 °C, respectively.

On the other hand, the results in Table (5) also indicated that the percentage losses of penconazole were 0.05, 5.19, 10.67 and 29.71% at 25, 35, 40 and 45 °C, respectively after 6 hours. The results also revealed that the percentage losses of penconazole after 144 hours of exposure to temperatures of 25, 35, 40 and 45 °C were 47.18, 95.50, 97.79 and 99.92 %,

respectively. The times taken for 50% degradation (RL_{50}) of penconazole were 9.14, 2.05, 1.46 and 0.65 days at 25, 35, 40 and 45 °C, respectively.

Table (3): Effect of UV light and direct sunlight on tetraconazole and penconazole.

Exposure time (hours)	Tetraconazole				Penconazole			
	UV – light		Direct sunlight		UV – light		Direct sunlight	
	µg	% loss	µg	% loss	µg	% loss	µg	% loss
Zero	100	0.00	100	0.00	100	0.00	100	0.00
1hr	89.84	10.16	85.34	14.66	90.30	9.70	58.20	41.80
3	69.90	30.10	55.60	44.47	83.90	16.10	52.54	47.46
4	---	---	54.53	45.47	---	---	51.13	48.87
6	58.56	41.44	48.77	51.23	78.86	21.14	43.62	56.38
8	---	---	38.25	61.75	---	---	35.35	64.65
12	46.78	53.22	35.69	64.31	67.40	32.60	28.68	71.32
24	33.27	66.73	25.52	74.48	43.06	56.94	23.94	76.06
48	---	---	15.50	84.50	---	---	10.01	89.99
K (mathematically)	**0.0705**		**0.1025**		**0.0443**		**0.1556**	
RL_{50} (hours)	**9.83**		**6.76**		**15.64**		**4.45**	

K= rate of decomposition
RL_{50}= half life in hours

Table (4): Effect of different degrees of temperature on the stability of tetraconazole.

Exposure time (hours)	Amount of Tetraconazole (µg)							
	25 °C		35 °C		40 °C		45 °C	
	µg	% loss	µg	% loss	µg	% loss	µg	% loss
0	100	0.00	100	0.00	100	0.00	100	0.00
6	100	0.00	100	0.00	99.92	0.08	98.65	1.35
24	99.70	0.30	97.34	2.66	95.46	4.54	93.46	6.54
48	98.33	1.67	89.66	10.34	69.90	30.10	66.72	33.28
96	93.39	6.61	70.28	29.72	14.27	85.73	2.28	97.72
144	77.63	22.37	55.78	44.22	8.45	91.55	1.38	98.62
K (mathematically	**0.01414**		**0.0660**		**0.1878**		**0.3306**	
RL_{50} (days)	**49**		**10.5**		**3.69**		**2.09**	

K= rate of decomposition
RL_{50}= half life in days

The results obtained agree with the findings of Barakat *et al.*, (1999); Barakat *et al.*, (2001); Nasr *et al.*, (2003); Nasr and Al-Maz (2004). Penconazole showed a high degradation rate more than tetraconazole when exposed to high degrees of temperature (45 °C) within the period of experiment. So it is

recommended for the use in area with dominant low temperature 25 –35 °C.

Table (5): Effect of different degrees of temperature on the stability of penconazole.

Exposure time (hours)	Amount of Penconazole (µg)							
	25 °C		35 °C		40 °C		45 °C	
	µg	% loss	µg	% loss	µg	% loss	µg	% loss
0	100	0.00	100	0.00	100	0.00	100	0.00
6	99.95	0.05	94.81	5.19	89.33	10.67	70.29	29.71
24	90.08	9.92	71.16	28.84	65.98	34.02	22.80	77.20
48	78.53	21.47	45.60	54.40	29.29	70.71	10.08	89.92
96	62.04	37.96	10.71	89.29	5.77	94.23	0.91	99.09
144	52.82	47.18	4.50	95.50	2.21	97.79	0.08	99.92
K (mathematically)	**0.0758**		**0.3373**		**0.4716**		**1.0663**	
RL_{50} (hours)	**9.14**		**2.05**		**1.46**		**0.65**	

The effects of UV on tetraconazole and penconazole have stimulated chemical modifications of the molecular structure of the pesticides or the use of UV-absorbing materials in pesticide formulations. However, both methods suffered from serious drawbacks since the chemical modification may affect the pesticidal activity of the compounds or their biodegradability may introduce ecological problems related to soil and water population (Rozen and Margulies 1991). The radiation energy of the sunlight might be absorbed by a pesticide molecule principally at a given wavelength. The energy might increase the transitional, rotational, vibrational or electronic energy of the molecule. If enough energy was absorbed to interact with the electrons of the molecules an electronically excited molecule would result. Energy might disappear or change from the molecule in a number of ways, one of which is chemical reaction (Plimmer 1970). From the above results, it can be observed that sunlight is more effective than UV-light in accelerating the photodecomposition of tetraconazole and penconazole. This may be due to thermal, evaporational and light intensity considerations.

4. REFERENCES

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ثبات متبقيات مبيدي الفطريات التتراكونازول والبنكونازول على وداخل بعض محاصيل الخضر في الصوب الزراعية وتحت الظروف البيئية المختلفة

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ملخص

قدر مدى ثبات متبقيات كل من مبيدي التتراكونازول والبنكونازول في ثمار نباتات الخيار ، الطماطم و الفلفل الأخضر تحت ظروف الصوب الزراعية باستخدام جهاز التحليل الكروماتوجرافى الغازي المزود بكشاف. أوضحت الدراسة أن الكمية الأولية من مبيد التتراكونازول على وفى داخل ثمار نباتات الخيار ، الطماطم و الفلفل الأخضر كانت ٠,١٩ ، ٠,٢٠ ، ٠,٢٥ جزء في المليون على الترتيب. وبالنسبة لمبيد البنكونازول فكانت ٠,١٣ ، ٠,٠٩ ، ٠,٢٤ جزء في المليون. وكانت فترة نصف العمر لمبيد التتراكونازول على ثمار نباتات الخيار ، الطماطم و الفلفل الأخضر هي ١,٨ ، ١,٨٧ ، ٢,٥٥ يوما على الترتيب. وبالنسبة لمبيد البنكونازول فكانت ٣,٣ ، ١,٥ ، ٤,٩٧ يوما.

كذلك أدت عمليه غسيل الثمار بالماء إلى إزالة ٥٧,٨٩ ، ٥٥,٥ ، ٨٤,٠ % من الكمية الأولية لمبيد التتراكونازول الموجودة على ثمار نباتات الخيار ، الطماطم و الفلفل الأخضر. و بالنسبة لمبيد البنكونازول فقد أدت عملية الغسيل بالماء إلى فقد ٨٠,٧٧ ، ٨٣,٣٣ ، ٧٠,٨٣% على الترتيب. وأوضحت النتائج أن فترة نصف العمر لمبيدي الـ التتراكونازول والبنكونازول هي ٦,٧٦ و ٤,٤٥ يوما على الترتيب عقب تعرضهما لضوء الشمس المباشر. كذلك وجد أن معدل تحطيم مبيد التتراكونازول كان أسرع من مبيد البنكونازول عند تعرضهما للأشعة فوق البنفسجية، وكانت الفترة اللازمة لاختفاء ٥٠% من الـ التتراكونازول والبنكونازول هي ٩,٨٣ و ١٥,٦٤ يوما على الترتيب. وأوضحت النتائج أن مبيد التتراكونازول يتحطم بصورة أسرع من مبيد البنكونازول عند تعرضه لدرجات الحرارة المختلفة ، وكانت فترة نصف العمر لمبيد التتراكونازول هي ٤٩,٠ ، ١٠,٥ ، ٣,٦٩ و ٢,٠٩ يوما على درجات حرارة ٢٥ ، ٣٥ ، ٤٠ و ٤٥ °م على الترتيب. وبالنسبة لمبيد البنكونازول فكانت فترة نصف العمر له هي ٩,١٤ ، ٢,٠٥ ، ١,٤٦ و ٠,٦٥ يوما على درجات حرارة ٢٥ ، ٣٥ ، ٤٠ ، ٤٥ °م على الترتيب.

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