Bull. Environ. Contam. Toxicol. (1988) 40:80–85

Environmental Contamination and Toxicology

Degradation Behavior of Captan and Folpet on Greenhouse Tomatoes

M. S. El-Zemaity

Faculty of Agriculture, Ain Shams University, Cairo, Egypt

Information concerning the degradation of residues of phthalimide fungicides on green-house tomatoes is lacking. The behaviour of other fungicides residues on tomatoes has been studied by Vanachter et al. (1979), Van Wambeke et al. (1980) and Cabras et al. (1985 a and b).

The objective of this study, therefore, was to obtain kinetic data on the degradation behaviour of captan and folpet on green-house tomatoes and the influence of way and method of application in the degradation rate.

MATERIALS AND METHODS

Experiments were conducted at a green-house located in Lourinhã, 75 km. Northwest of Lisbon, Portugal. Tomato plants variety Demblo, receiving routine horticultural practices were sprayed with two fungicides; captan: 1,2,3,6-tetrahydro-N-(trichloromethylthio) phtalimide and folpet: N-(trichloromethyltio) phtalimide. Captan (W.P. at the rate of 200 g a.i./hl) was sprayed 7 times at 7 days intervals and 4 times at 15 days intervals by using a morotised knapsack mist-blower. Folpet (W.P. 50% at the rate of 250 g a.i./hl) was sprayed 4 times at 15 days intervals by using a knapsack sprayer and a motorised knapsack mist-blower. Four replicates were set-up for each treatment in a randomized block experiment. Each replicated plot was 7.2 m^2. The average temperatures in the green-house through the period of experiment were 11 - 17°C and relative humidities were 70 - 86%.

Sixteen fruits were collected at random from each treatment (4 fruits /plot). As soon as the fruits were picked up, they were put in perforated cardboard boxes and transferred to the laboratory. The fruits were chopped and blended. The blending was thoroughly mixed, 6 subsamples (100 g of each) were weighed into polyethylene sacs and kept deep frozen until extraction.

Samples were extracted and cleaned-up according to the method adapted by Falcão et al. (1982). Analyses were carried out by gas liquid chromatography using a Hewlett Packard model 5730A equipped with a ^{63}Ni electron capture detector. For the quantification of the residues a glass column 2m x 2mm i.d. packed with 5%OV-101 on Gas Chrom Q 80/100 mesh was used. Column temperature: 200°C; detector temperature: 300°C; injector temperature: 250°C and carrier ($Ar./CH_4$) flow rate: 60 ml/min. Data were confirmed on a 1m x 2mm i.d. glass column packed with 6%QF_1 + 4%SE-30 on Gas Chrom Q 80/100 mesh, the carrier flow rate being 40 ml/min. The average rates of recovery at fortification levels ranging from 0.5 to 2.0 ppm were 91% for captan and 96% for folpet. The residues were determined after last application at 0, 1, 3, 4 and 7 days and corrected according to the rate of recovery. The data were subjected to statistical analysis by the method of Timme and Freshe (1980).

RESULTS AND DISCUSSION

The residues data obtained for captan and folpet and their statistical analyses are summarized in Tables 1 and 2. All parameters indicate that the application of the two fungicides in different ways caused markedly influence on the degradation behaviour after last spray. Captan sprayed at 7 days intervals showed more persistant residues than sprayed at 15 days intervals. The half-life periods (T/2) were 11.2 and 4.5 days for captan sprayed respectively at 7 and 15 days intervals. Also, the degradation of folpet residues was influenced by the type of sprayer. The T/2 values were 4.9 and 7.0 days for folpet sprayed by a knapsack sprayer and by a motorised knapsack mist-blower, respectively. The different intercepts of folpet regression lines (A) are also a consequence of the different equipment used.

The straight lines obtained for captan and folpet when sprayed at 15 days intervals by plotting the logarithms of residues versus time are shown in Figure 1. Based on coefficient of determinations (r^2) the dependence of the logarithm of residues on time was obviously demonstrated for both fungicides when sprayed at 15 days intervals. This shows dependent pseudo-first-order reactions for the degradation behaviour of captan and folpet on tomatoes after repeated applications. These data are in agreement with FAO/WHO evaluation of some pesticide residues in food (1969) which showed that the initial level of folpet is reduced by one half within a week or two. Other fungicides, like dicarboximides showed a pseudo-first-order rate dependence on green-house tometoes, as reported by Cabras et al. (1985). Data show that in spite the difference of spray equippment used in application the residue pattern of folpet followed that of captan. In fact the slope of the degradation lines (B) and the degradation rates (K) for captan sprayed at 15 days intervals by using a motorised knapsack mist-blower were -0.068 and 0.156, wherease they were -0.062 and 0.142 for folpet sprayed at the same interval by using a knapsack sprayer. In FAO/WHO evaluation of some pesticide residues in food (1970) it is stated that the main degradation mechanism of folpet is pastulated to be the same as that for captan.

Table 1. Degradation of captan and folpet on tomatoes

Days after last application	Residues (ppm)							
	Captan[1] sprayed 7 times at 7 days intervals		Captan[1] sprayed 4 times at 15 days intervals		Folpet sprayed 4 times at 15 days intervals by using a knapsack sprayer		Folpet[1] sprayed 4 times at 15 days intervals	
	Determined[2]	Computed	Determined[2]	Computed	Determined[2]	Computed	Determined[2]	Computed
0 (ID)	2.73	2.10	1.84	1.65	2.22	1.99	3.29	3.09
1	2.00	1.97	1.19	1.41	1.63	1.73	3.10	2.85
3	-	-	0.98	1.03	1.46	1.30	2.60	2.41
4	0.86	1.64	1.03	0.88	0.85	1.13	2.18	2.22
7	1.96	1.36	0.53	0.55	0.83	0.73	1.68	1.73

[1] Fungicides sprayed by a motorised knapsack mist-blower

[2] Mean of 3 analyses

ID = Initial deposit

Table 2. Statistical quantities and methematical evaluation of the degradation of captan and folpet on tomatoes

Parameter	Captan* sprayed 7 times at 7 days intervals	Captan* sprayed 4 times at 15 days intervals	Folpet sprayed 4 times at 15 days intervals by using a knapsack sprayer	Folpet* sprayed 4 times at 15 days intervals
Intercept of regression line (A)	0.322	0.219	0.299	0.526
Slope of regression line (B)	-0.027	-0.068	-0.062	-0.043
Degradation rate (K)	0.062	0.156	0.142	0.158
Coefficient of determination (r^2)	0.161	0.922	0.832	0.991
Half-life (T/2, days)	11.2	4.5	4.9	7.0
Tenth-life (T/10, days)	37.2	14.7	16.2	23.3

* Fungicides sprayed by a motorised knapsack mist-blower

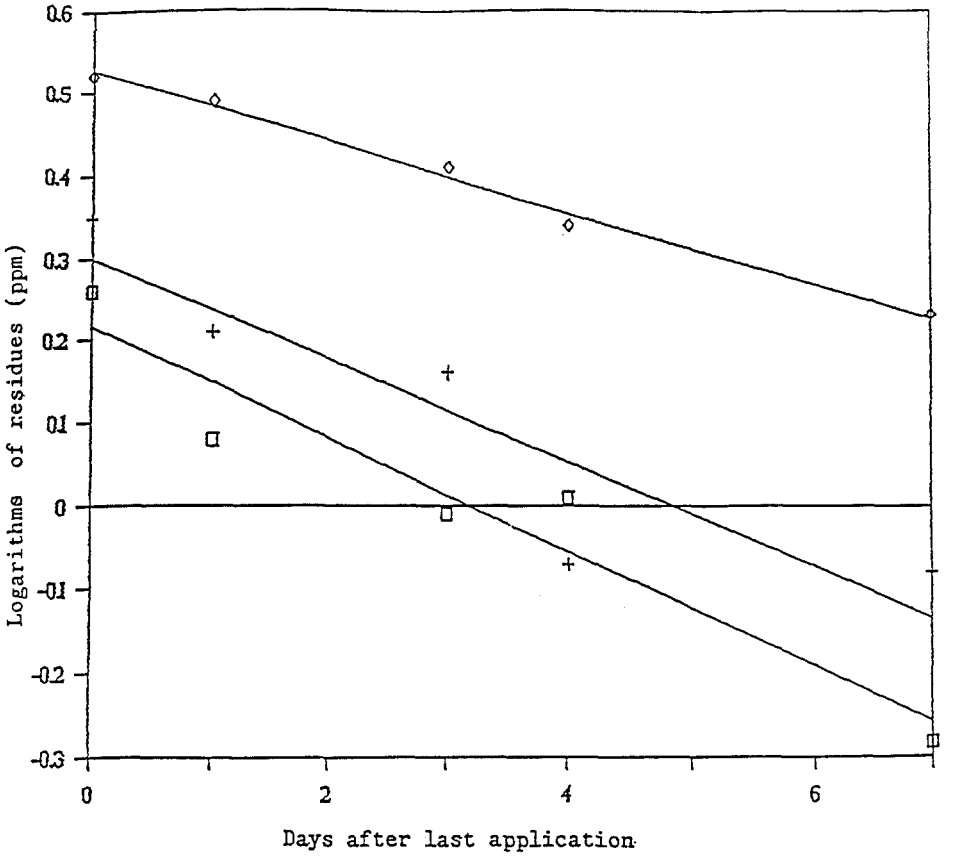

Figure 1. Degradation straight lines of Captan and Folpet on tomatoes

□ Captan sprayed 4 times at 15 days intervals by using a motorised knapsack mist-blower

+ Folpet sprayed 4 times at 15 days intervals by using a knapsack sprayer

◇ Folpet sprayed 4 times at 15 days intervals by using a motorised knapsack mist-blower

Judging from the regression equation the residues at the 7-day pre-harvest interval would probably not exceed significantly 1.36 ppm for captan and 1.73 ppm for folpet. The tenthlife period (T/10) for captan varied between 14.7 - 37.2 days, wherease the one for folpet varied from 16.2 - 27.9 days. This indicates that even after the safety interval the presence of captan and folpet residues is to be expected.

Acknowledgments. The determination of residues were done at the National Center for Protection of Agricultural Production, Oeiras, Portugal. The author wishes to thank Mrs. Ana Maria and Mr. Tainha for application of fungicides and collecting samples.

REFERENCES

Cabras P, Meloni M, Piriasi FM and Cabitza F (1985 a) Behaviour of acylanilide and dicarboximidic fungicide residues on green-house tomatoes. J Agric Food Chem, 33:86-89

Cabras P, Cabitza F, Meloni M and Pirisi FM (1985 b) Behaviour of some pesticide residues on green-house tomatoes. 2 - Fungicides, Acaricides and Insecticides, J Agric Food Chem, 33:935-937

Falcão M, Ferreira J e Querido R (1982) Método de análise cromatográfico para resíduos de fungicidas determináveis por captura de electrões, PPA(TR)-18/82, Ed. CNPPA, Oeiras, Portugal

FAO/WHO (1969) Evaluation of some pesticide residues in food, Joint Meeting on Pesticide Residues : 137 - 147.

FAO/WHO (1970) Evaluation of some pesticide residues in food, FAO/PL/1969/M/17/1; WHO/Food/Add/70/38

Frank R, Northover J and Braun HE (1985) Persistance of captan on apples, grapes and pears in Ontario, Canada, 1981-1983. J Agric Food Chem, 33:514-518

Timme G, Freshe H (1980) Statistical interpretation and graphic representation of degradation behaviour of pesticide residues. I. Pflanzenschutz-Nachrichten Bayer, 33:47-60

Vanachter A, Van Wambeke E and Van Assche (1979) Control of Botrytis cinerea on green-house tomatoes by repeated spraying with vinclozolin, iprodione and imazalil, and its influence on residue levels. C Proc Crop Con Pest Dis, 447-452

Van Wambleke E, Vanachter A and De Wit A (1980) Evaluation of vinclozolin and iprodione residues on tomato and on lettuce. Parasitica, 36:117-126

Received May 11, 1987;accepted August 19, 1987.