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Residues of Captan and Folpet on Greenhouse Tomatoes with Emphasis on the Effect of Storing, Washing, and Cooking on Their Removal

M. S. El-Zemaity

Faculty of Agriculture, Ain Shams University, Cairo, Egypt

The accumulation effect of fungicides residues on green-house tomatoes can result from repeated applications of the same active ingredient (Robalo, 1980 and Cabras et al. 1985 a and b).Tainha and Rosa Cunha (1984) reported that fungicides residues on green-house tomatoes had revealed that propitious conditions for the appearance of dawny mildew might eventually lead to the occurence of residue levels higher than international MRL's at the end of preharvest interval. However, although a loss of fungicides occurs due to dilution during growth and degradation, it is possible to find consistent residues of the fungicides as a consequence of the frequent application of heavy dosages, together with, or because of a lack of respect for the statutory safety interval between treatment and harvest.

Thus it was thought appropriate to determine the magnitude of captan and folpet residues on green-house tomatoes and the effect of storing, washing and cooking on their removal.

MATERIALS AND METHODS

Experiments were conducted at a green-house located in Lourinhã, 75km 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-(trichloromethylthio) phtalimide. Captan (w.p. 83% at the rate of 200 g a.i./hl) was sprayed 4 times at 7 days intervals and 15 days intervals by using a motorised 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 plat was 7.2 m^2. The average temperatures in the green-house through the period of experiment were 11 - 17°C and relativi 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 sub-samples (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 Hewllet Packard model 5730A equipped with a ^{63}Ni electron capture detector. For the quantification of the residues a glass column 2 m x 2 mm i.d. packed with 5% OV-101 on Gas Chrom Q80/100 mesh was used. Column temperature: 200°C; detector temperature: 300°C; injector temperature: 250°C; carrier (Ar/CH_4) flow rate: 60 ml/min. Data were confirmed on a 1 m x 2 mm 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 2.0ppm were 91% for captan and 96% for folpet. The residues were determined after every application at 0 and 5 or 7 days.

In order to study the effect of storing, washing and cooking on the removal of fungicides residues, samples were taken and treated as shown in Table 2 before blending. The samples were extracted, cleaned-up and determined as previously described.

RESULTS AND DISCUSSION

As results in Table 1 show, the practice of successive application of the same compound can lead to an increase of residue levels even in the case of crops like tomatoes which are in continuous harvesting. Results show also that using these fungicides in different ways will result in different residue levels. Residues of captan sprayed at 7 days intervals were always higher than when sprayed at 15 days intervals. Moreover, the levels of folpet residues were influenced by the type of sprayer.

The maximum concentrations (initial deposits) of captan and folpet on green-house tomatoes were respectively 3.40 and 3.29 ppm after the fourth application. These concentrations were lower than the maximum residue limits established by EEC. In fact, the MRL's provided by EEC directive are 15 ppm for captan in vegetables in general and 5 ppm for folpet on tomatoes (EEC, 1976).

The percentages dissipation of captan residues after 7 days from application were 11.5 - 55.0 and 37.3 - 59.5 when sprayed at 7 and 15 days intervals, respectively. Wherease, the percentages dissipation of folpet in the same period were 51.8 - 62.6 and 32.8 - 48.9 when sprayed by using a knapsack sprayer and a motorised knapsack mist-blower, respectively which seems to show the influence of the spray equipment on the dissipation of residues. The previous findings are in agreement with Cabras et al. (1985) who reported that residues after repeated sprayings of dicarboximide showed accumulation on tomatoes several days after recommended preharvest times. Among acyla-

Table 1. Residues of captan and folpet on tomatoes grown under glass-house

Nº of application	Days after application	Captan[a] sprayed at 7 days intervals		Captan[a] sprayed at 15 days intervals		Folpet sprayed at 15 days intevals by using a knapsack sprayer		Folpet[a] sprayed at 15 days intervals	
		Residues[b] (ppm)	% dissipation	Residues[b] (ppm)	% dissipation	Residues[b] (ppm)	% dissipation	Residues[b] (ppm)	% dissipation
1st	0 (ID)	1.30	-	1.29	-	-	-	-	-
	7	1.15	11.5	0.63	51.2	0.64	-	0.69	-
2nd	0 (ID)	2.81	-	1.77	-	1.60	-	1.61	-
	5	1.38	50.9	1.02	43.5	1.07	33.1	1.18	26.7
4rd	0 (ID)	3.40	-	1.68	-	2.22	-	3.29	-
	7	1.62	52.3	0.53	59.5	0.83	62.6	1.68	48.9

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

[b] Mean of 3 analyses and corrected according to the rate of recovery

ID = Initial deposit

Table 2 . Effect of storing, washing and cooking on the removal of captan and folpet residues on tomatoes

Nº of application	Days after application	Treatments	Captan		Folpet	
			residues[a] (ppm)	% removal	residues[a] (ppm)	% removal
2 nd	0 (ID)	Without treatment	1.77 b	-	1.61 b	
		Storing (5 days under room conditions)	1.55 b	12.4	1.56 b	3.1
		Washing (house-hold washing)	0.04	97.7	0.04	97.5
		Cooking (15 min. at 100°C, without washing)	0.04	97.7	0.08	95.0
4 th	3	Without treatment	0.98 b	-	2.77 b	-
		Storing (5 days under room conditions)	0.83 b	16.8	2.43 b	12.2
		Washing (house-hold washing)	0.01	98.9	0.10	93.7
		Cooking (15 min. at 100°C, without washing)	0.03	96.9	0.05	98.1

[a] Mean of 3 analyses

[b] Means in the same column followed by the same letter do not differ significantly (P=0.05) by T-test
ID = Initial deposit

nides, furalaxyl and benalaxyl showed accumulation of residues but always at concentrations lower than legal limits even when harvested before the established preharvest intervals. CNPPA (1986) reported that the residues of captafol and folpet on green-house tomatoes ranged between 2.4 - 3.7 ppm for captafol and 1.3 - 2.2 ppm for folpet after 7 days from last application.

Considering the effect of storing, washing and cooking in the removal of captan and folpet residues on tomatoes, the data in Table 2 revealed nearly the same effect of washing and cooking. House-hold washing by using run tap water reduced captan residues by 97.7 - - 98.9 %. Similar levels of reduction were obtained by cooking tomatoes for 15 min. at 100°C without washing. Also, washing and cooking treatments reduced folpet residues by 93.7 - 97.5% and 95.0 - 98.1%, respectively. Several post-harvest treatments have been reported to remove captan residues on some commodities. For strawberries, a 20 min. coal water rinse removed 14%, calyx removal gave 36% reduction, calyx removal followed by a 5 min. cook gave 95% (Ritcey et al. 1984). In cherries Northover et al. (1986) showed that captan residues were easily removed with a 60 seconds tumbling wash in water. The same authors reported that 10 seconds of hand washing removed a maximum of 50% from the initial deposit of captan in peaches, wherease a light rinse removed substantially more from cherries. Even vigorous washing with a stiff bristle brush removed only 70% from peaches.

On the other hand, there was no markedly reduction of captan and folpet residues on tomatoes during storage for 5 days under room conditions either when sampling was immediately after application or when sampling was carried out 3 days after application. In fact residues of captan were reduced by 12.4 - 16.8 %, wherease those of folpet by 3.1 - 12.2 %. The slow dissipation of captan and folpet residues indicate that both compounds are persistent on stored tomatoes even under room conditions. This finding is in agreement with Koivistainen et al. (1965) who showed that captan dissipation slowly on tomatoes and was reduced by 54 - 61 % at 4 and 20°C only after 4 weeks. Northover et al. (1986) also reported that captan did not degrade on sweet cherries stored at 4 and 20°C. For strawberries, no losses for captan residues on storage at -20°C for 3 months were reported (Ritcey et al. 1984).

The above results seem to show that captan and folpet do not undergo substantial chemical chahnge on plant surfaces and only a very small amount appears to enter fruit cuticles. Reduction should be mainly due to dilution and mechanical removal.

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REFERENCES

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

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

CNPPA (1986) Utilizações do captafol, captana e folpet em Portugal. PPA(CEE)-02/86. Ed. CNPPA, Oeiras, Portugal

EEC (1976) Directive du conseil concernant la fixation des teneurs maximales pour les résidus de pesticides sur et dans les fruits et légumes. Journal Officiel des Communautés Européenes, nº L340/26

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 DGPPA, Oeiras, Portugal

FAO/WHO (1984) Evaluation of some pesticide residues in food, Joint Meeting on Pesticide Residues 84: 61- 78

Koivistainen P, Karinpää A, Könönen M and Roine P (1965) Magnitude and stability of captan residues in fresh and preserved plant products. J Agric Food Chem, 13:468-473

Northover J, Frank R and Braun HE (1986) Dissipation of captan residues from cherry and peach fruits, J Agric Food Chem, 34:525-529

Ritcey G, Frank R, Mc Even FL and Braun HE (1984) Captan residues on strawberries and estimates of exposure to pickers. FAO/WHO,JMPR, 84:61-87

Robalo JC (1980) Estudos de degradação de resíduos de fungicidas ditiocarbamatos em culturas de estufa. Relatório de tirocino, realizado na Direcção Geral de Protecção da Produção Agrícola, Oeiras, Portugal

Tainha A e Rosa Cunha (1984) estudo de resíduos em tomate de estufa. PPA(TR)-9/82 Ed CNPPA, Oeiras, Portugal

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