

## BEHAVIOR OF VINCLOZOLIN AND PROCYMDIONE IN GREENHOUSE GROWN TOMATO AND CUCUMBER

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### SUMMARY

The residual behavior of vinclozolin and procymidone, used for the control of *Botrytis cinerea* disease, was studied on greenhouse grown tomato and cucumber. Found residue concentrations depended mostly on the species of treated vegetables, time of picking (harvest), size of fruits and mode of chemical application. The concentration of residues found in cucumber fruits 7 days after application of fungicides were nearly the same as that in tomato 14 days after last application. Big and ripe tomato fruits contain less residues than the small and green ones. Washed and peeled cucumber fruits had a rather big loss of the residues. If applied in the form of vaporation pills vinclozolin residue concentration was lower in all the sampled fruits in comparison with the WP formulation.

### RIASSUNTO

RESIDUI DI VINCLOZOLIN E PROCIMIDONE SU ZUCCHINE E POMODORI COLTIVATI IN SERRA

L' stato studiato il comportamento residuale di vinclozolin e procimidone, usati per il controllo della *Botrytis cinerea*, su pomodori e zucchine allevati in serra. La quantità di residui riscontrata è risultata dipendere principalmente dalle specie vegetali, dal tempo della raccolta, dalla dimensione dei frutti e dalle modalità di applicazione dei principi attivi. L'entità dei residui riscontrata sulle zucchine a 7 giorni dall'ultimo trattamento è stata dello stesso ordine di grandezza di quella riscontrata a 14 giorni su pomodori. L'entità dei residui è risultata maggiore in pomodori piccoli verdi che non in quelli grossi e maturi. Il lavaggio e la sbuccatura delle zucchine porta ad una grossa diminuzione di residui. Residui minori si sono trovati per il vinclozolin distribuito a mezzo di tavolette fumogene che non con il formulato in polvere bagnabile.

### INTRODUCTION

The growing of vegetables has got a rather long tradition in Croatia owing to its favorable agroecological conditions.

Particularly important is the greenhouse growing of vegetables because it supplies the market with fresh vegetables, especially demanded during the

winter period. It is well known that at that time the human nutrition is generally poor in vitamins. Tomato and cucumber are the most frequently grown vegetables in the greenhouse capacities of "ORHIDEJA" at Magadenovac. Until now experiences have showed that one of the most hazardous and almost always commonly present disease in this generated by *Botrytis cinerea* Pers. Fr., i.e. grey mould agent. Damages caused by this parasite reflect in decline of yield by 20-40%, whereas under the microclimatic conditions favoring the parasite development, the whole crop could be destroyed in only 48-72 hours.

The vegetables grown in the "ORHIDEJA" greenhouse have been so far protected by repeated application of botriticide fungicides. Since greenhouse tomato and cucumber have the prolonged time of harvest (which can take two thirds of their growth period), use of fungicide is subject to restriction. On the other hand, the degradation time of the applied fungicides is rather long (usually longer than 30 days), so that under the greenhouse conditions it is hard to wait for them so long to be degraded. It often happens that the grown vegetable come early into the stage of technological maturity, leading to high levels of residue concentrations in the fruits, which is legally unacceptable.

We are nowadays aware that the movement for protection of health and environment is very strong. One of the ways of our contribution to it is to try to reduce the use of chemicals in plant protection, i.e. to produce the food with as low content of pesticides as possible. Therefore, the objective of this study was to determine the residues content of the studied fungicides in greenhouse grown tomato and cucumber fruits at their standard use.

#### MATERIALS AND METHODS

The experiments were set up 1987 and 1989 in the "ORHIDEJA" greenhouse capacities at Magadenovac and the fungicides were applied in completely randomized block design in 4 replications. The size of the basis plot was 41 sq.m. Four tomato plants covered 1 sq.m. (Holland hybrid CARMELLO), as well as 4 cucumber ones (Holland Qinecian hybrid). The fungicides vinclozolin (Ronilan WP, at concentration of 0.06 and 0.1%, Rooktablet 25% of pure vinclozolin, vaporation pills) and procymidone (Sumilex WP 50 at a conc. of 0.06 and 0.1%) were applied to control *Botrytis cinerea* during our study. The applied fungicides were sprayed by portable spraying device "SOLO" with 10 l of fungicide solution for an area of basic plot, 41 sq.m. respectively.

The vaporation pills were applied as follows: a tablet containing pure vinclozolin 25% was placed in bed of the crops and ignited so that is quickly turned into gas. One tablet is sufficient for 100 cubic meters of glasshouse, which makes 5.5 g of pure vinclozolin.

In 1987 the studied fungicides were applied on November 19 and 26, whereas the fruits harvested for sampling, i.e. analysis, 7 and 14 days after last treatments. In 1989 the crops were treated on May 16 and June 6, the fruits being harvested for analysis as follows:

**TOMATO:** 14 days after last treatment both ripe (commercial) and green fruits (4-5 days prior to usual harvest for market); 24 days after treatment both big (20-25 dag) and small fruits (10-15 dag) were harvested. It was taken 1 kg of

fruits per sample, namely 1 kg for cucumber. The analyses were carried out on the second day after harvest.

**CUCUMBER:** 14 and 24 days after last fungicides application both big and small fruits were harvested. Residues in cucumber were determined in fruits left as picked, a part of them was washed and another peeled.

The analysis of residue concentrations of the applied fungicides was done in the laboratory of the Faculty of Agriculture in Zagreb, by the method which was 1974 suggested by the BASF, HEINS & LOCKER (1975). This method is based on the determination of a.i. of residues and fungicide metabolites, firstly by their translation transfer into 3,5 dichloraniline and then by their derivatization using chloroacetylchloride.

## RESULTS AND DISCUSSION

Residue values of the studied fungicides are shown in Tables 1, 2 and 3 for tomato, in Tables 4 and 5 for cucumber respectively.

Table 1. Vinclozolin and procymidone residues detected 1987 in greenhouse grown tomato fruits

Fungicide	Conc. %	Residues (mg/kg) days after spraying	
		7	14
Vinclozolin	0.06	5.16	4.02
Vinclozolin	0.10	4.91	3.78
Procymidone	0.06	3.37	2.20
Procymidone	0.10	4.12	3.19
Rooktablet-vinclozolin		1.79	1.24

Table 2. Vinclozolin and procymidone residues detected 1989 in greenhouse grown tomato fruits (14 days after treatment)

Fungicide	Conc. %	Residues (mg/kg)	
		I	II
Vinclozolin	0.06	2.25	2.63
Vinclozolin	0.10	2.98	3.54
Procymidone	0.06	2.17	2.86
Procymidone	0.10	3.25	2.17
Rooktablet-vinclozolin		1.32	1.32

I ripe fruits of orange colour-commercial

II early harvest (4-5 days prior to usual harvest for the market, i.e. sale)

Table 3. Vinclozolin and procymidone residues detected 1989 in greenhouse grown tomato fruits (24 days after treatment)

Fungicide	Conc. %	Residues (mg/kg)	
		I	II
Vinclozolin	0.06	1.36	2.44
Vinclozolin	0.10	1.99	2.81
Procymidone	0.06	1.58	2.63
Procymidone	0.10	1.48	1.67
Rooktablet- vinclozolin		0.95	1.05

I big fruits (20-25 dag)

II small fruits (10-15 dag)

The results in tables show that the tend of residue concentrations in the fruits of tomato depended on the half-life of fungicide, the number of days from the last treatment till harvest respectively and even more on the size of fruits. The residue concentrations depended also on the leaf area, which more or less covers the fruits. In all the cases the lowest residue concentrations were found with Rooktablet treatment.

According to our results the residue concentrations are higher in winter tomato crop such as was in 1987, than in the spring one of 1989. MELKEBEKE et al. (1980) reported also that the half-life of vinclozolin in winter greenhouse lettuce is longer than that of the early autumn.

Therefore we consider that fungicide degradation time of 14 days in the crop for the winter tomato is not safe (allowed legal limit is 3 mg/kg, "Glasnik zaštite bilja" 1993\*) and should be prolonged to 28 days.

It is believed that the residue concentration in cucumbers is lower due to fast development of fruits. However, it is far more important weather the fruits are washed, peeled or analysed as harvested. The results in Table 4 show a loss of the residues of the tested fungicides by 12-22% after washing the fruits. After peeling the fruits the fungicide residues were lost even more, by 79-87% respectively.

Table 4. Vinclozolin and procymidone residues detected 1987 in greenhouse grown cucumber

Fungicide	Conc. %	Residue (mg/kg)		Days after planting	
		7	14	7 (I)	7 (II)
Vinclozolin	0.06	2.36	1.97	-	-
Vinclozolin	0.10	2.61	1.85	2.03	-
Procymidone	0.06	2.29	1.20	2.03	-
Procymidone	0.10	2.27	1.31	-	0,48
Rooktable- vinclozolin		1.74	0.59	-	0,23

7 (I) cucumber fruits washed prior to analysis

7 (II) cucumber fruits peeled prior to analysis

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The growth stage of cucumber at the time of its protection from disease is very important fact. Since small cucumbers are used for pickling without peeling, caution in use of fungicide is justifiable. Table 5 shows the results of residue concentrations detected in cucumber fruits of different sizes.

Table 5. Vinclozolin and procymidone residues detected 1987 in greenhouse grown cucumber (14 days after last treatment)

Fungicide	Conc. %	Residue (mg/kg)	
		I	II
Vinclozolin	0.06	0.89	1.07
Vinclozolin	0.10	1.69	1.93
Procymidone	0.06	1.34	1.70
Procymidone	0.10	1.18	2.06
Rooktablet- vinclozolin		0.65	0.65

I bigger fruits (technologically ripe for harvest)

II smaller fruits (early harvest)

The obtained results show a surprisingly slow decrease of fungicide residues. It is namely expected that the residues of contact chemical decrease faster in order to comply with the intensive development of fruits. That means that vinclozolin and procymidone have a poor to moderate systemic effect. HISADA (1985) reported in his study on Procymidone effect against *Botrytis cinerea* that there was a possibility of its systemic effect. However, in spite of possible systemic effect of vinclozolin and procymidone fungicides we consider that there will be no hazard if the greenhouse grown cucumber is used for food peeled. Nevertheless, application of the studied fungicides to treat young, i.e. green, cucumber fruits assigned for processing is not acceptable.

## CONCLUSIONS

On the basis of the results on behavior of the studied fungicides, the following conclusions can be drawn:

The values of vinclozolin and procymidone concentrations depended on species of the treated vegetables, mode of fungicide application, size of fruits, their stage of maturity and mode of consumption.

The level of residue concentration found with greenhouse grown cucumber 7 days after last treatment is about the same as that detected in greenhouse grown tomato 14 days after last treatment.

The concentration of fungicide residues detected with winter tomato fruits were higher than that of spring crop. Detected levels of fungicide residues were lower in ripe and bigger fruits than that of green and smaller ones.

Fungicide residues were lost by an rate of 12-22% when the cucumber fruits were washed, while peeling them even by 79-87%. Therefore, one to two repeated treatments are allowed holding to the degradation time of 14 days and that also only in case the fruits will be peeled before consumed.

The residue contents in cucumber fruits assigned both for industrial and home processing (pickling) were higher than legally limited (3 mg/kg). For growing of such cucumbers the studied fungicides must most be used.

If vinclozolin was applied in the form of vaporation pills the detected residues were in all cases lower by 35-65% in comparison with the WP formulation. However, the decrease of residues concentration was significantly slower.

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