

EFFICACY OF SOME FUNGICIDES AGAINST LATE BLIGHT OF TOMATO

V. ALEXANDROV

Plant Protection Institute, BG - 2230 Kostinbrod, Bulgaria

Abstract

ALEXANDROV, V., 2011. Efficacy of some fungicides against late blight of tomato. *Bulg. J. Agric. Sci.*, 17: 465-469

The influence of some fungicides, recommended for use in Bulgaria for control of late blight of tomato, was observed in an experiment carried out at PPI-Kostinbrod. The effect of the active substances dimethomorph, cymoxanil, azoxystrobin, famoxadone, chlorothalonil, fenamidone, fosetyl-AL, cupric oxychloride and cupric hydroxide and some major products based on them (Acrobat R, Equation Pro, Quadris, Banco, Verita and Funguran) was studied. A variant with no application of fungicide was used as a control. All tested chemicals except azoxystrobin (Quadris) suppressed the appearance of late blight of tomato. Preventive spraying of plants with fungicides by mid-August was a precondition for significant development of the disease at the end of the vegetation period. The treatment of plants with contact fungicides by the end of August provides good protection of their leaves and fruit until crop harvest. During the period of the study, a strong manifestation of brown leaf spots was observed along with the symptoms of the late blight. This disease was considered to be the second most important one for the crop.

Key words: potato late blight, *Phytophthora infestans*, early blight, tomato, fungicides

Introduction

Potato late blight is one of the most widely spread and economically important diseases of tomatoes in Bulgaria (Bahariev et al., 1988, 1992; Elenkov, 1997; Nakov et al, 2007).

Basically, this disease is controlled with chemicals. Shailbala and Pundhir (2008), Chowdhury and Hitra (2006) and Naskar et al. (2006) have reported the inhibiting effect of mephenoxam and mancozeb combination, a weaker effect of carbendazim and mancozeb and an insignificant effect of cupric hydroxide. Several chemicals, derivatives of chlorothalonil, are more effectiveness for potato

late blight control, compared to copper based products (Hariki, 2006). According to El-Shimy and Tomader (2006), the combination of cymoxanil and famoxadone as well as the independent application of propamocarb hydrochloride, among eight tested fungicides, are most effectiveness for potato late blight control. The substances benthiovalicarb and mancozeb (the fungicide Valbon 72 WG) are more effectiveness in potato late blight control than mancozeb and dimethomorph (Ratajkiewicz and Baranowski, 2007). Duarte et al. (2007) have observed the positive effect from the combination of dimethomorph and chlorothalonil, succeeded by metiram, compared to the combination of metal-

axyl and chlorothalonil, succeeded by metiram.

Our objective was to establish the effectiveness of some of the recommended fungicides for potato late blight control in field conditions in Bulgaria.

Material and Methods

The study was carried out on the experimental field of the Plant Protection Institute, Kostinbrod, in the period 2006 – 2007. The tomato plants were grown according to the standard technology in this area. The trial was started in the conditions of a natural infection background according to the block method in four replications with block dimensions of 20 m². In 2006, the following fungicides were applied on plants of the cultivar Ideal: Acrobat R (dimethomorph and cupric oxychloride), Equation Pro (famoxadone and cymoxanil) and Quadris (azoxystrobin). The first preventive application took place 14 days after planting of the tomato seedlings and the subsequent ones – every 12 – 14 days with the last one on August 14, 2006. In 2007, the following fungicides were applied on cultivars Ideal and Delfin: Banco (chlorothalonil), Verita (fenamidone and fosetyl-AL) and Funguran (cupric hydroxide) with the first treatment one week after seedling planting. The subsequent applications took place every 12 – 14 days and the last one was on August 29, 2007. In both years, the control plants were not treated with any chemicals.

Disease development was reported for each variant in four replications, 25 leaves each. The infection was observed during five phases of tomato

development in 2006: beginning of flowering (July 11), full flowering (July 26), development of fruit (August 15), green (August 30) and picking maturity of fruits (September 15) and in 2007 only in picking maturity of fruits. Student's criterion was used for significance values (Lidanski, 1988).

Results and Discussion

The pathogen of potato late blight – the fungus *Phytophthora infestans* – produces spores in the conditions of a wide temperature range from 3°C to 26°C, the optimal conditions being 18°C – 22°C, and humidity or high relative humidity of 90 – 100% (Mateeva et al., 1985; Bahariev et al., 1988; Nakov et al., 2007).

The data in Table 1 show that there were favorable temperature conditions for the fungus sporulation throughout the whole period of vegetation during both years, with June – August 2006 and May – August 2007 having the closest to the optimal conditions.

In June – August 2006, humidity was within the optimal range for pathogen sporulation. Humidity values in June – July 2007 were lower, hence the lower spreading of the fungus.

The first examination of the treated plants in 2006 showed that they were healthy with an insignificant percentage of potato late blight in the control plants only – 0.74 (Table 2).

The second and third examinations of the treated variants showed potato late blight symptoms within 0.42% - 1.26% on tomato plant leaves. The infection percentage in the control plants

Table 1

Monthly mean temperature (T, °C) and precipitation sum (Q, mm per month) in the region of Kostinbrod

Year	Month											
	April		May		June		July		August		September	
	T	Q	T	Q	T	Q	T	Q	T	Q	T	Q
2006	9.9	33.9	14.6	29.1	16.9	130.3	19.4	56.3	18.9	103.4	15	45.3
2007	10.4	11	16	149.8	19.9	36.8	22.3	7.2			13.4	91.2

Table 2
Attack of tomato plants by late blight

Variant	Stage of observation					
	Beginning of flowering		Fully flowering		Development of fruit	
	healthy leaves, %	infected leaves, %	healthy leaves, %	infected leaves, %	healthy leaves, %	infected leaves, %
Acrobat	100	0	99.58	0.42**	99.4	0.60***
Equation	100	0	99.32	0.68**	98.9	1.10***
Quadris	100	0	99.27	0.73**	98.74	1.26***
Check	99.26	0.74	89.7	10.3	81.1	18.9
Gd		at 0.05=1.98;		at 0.01=2.63;		at 0.001=3.39

Table 3
Attack of tomato plants by diseases in stage green maturity of fruits

Variant	Healthy leaves, %	Infected leaves, %	Including	
			late blight, %	early blight, %
Acrobat	94.2	5.8	1.3***	4.5
Equation	62.5	37.5	4.0***	33.5
Quadris	76.7	23.3	7.7***	15.6
Check	28.3	71.7	47.1	24.6
Gd		at 0.05=1.98;		at 0.01=2.63; at 0.001=3.39

Table 4
Attack of tomato plants by late blight in stage picking maturity of fruits

Variant	Healthy leaves, %	Infected leaves, %	Degree of attack				
			weakly (1-10)	medium (11-25)	strong (26-50)	very strong (up 50)	destroyed leaves
Acrobat	5.8	94.2	61.7	6.7	25	0.8	0
Equation	7.5	92.5	26.7	23.3	30.8	11.7	0
Quadris	0	100	0	0	49	51	0
Check	0	100	0	0	0	88.9	11.1

was the highest, reaching up to 18.9% in the third observation.

Potato late blight infection of the treated variants in green maturity of fruits was low: from 1.3% in plants treated with the fungicide Acrobat to 7.7% for Quadris (Table 3).

Again, control plants were infested to the highest degree – 47.1%. In this stage, brown leaf spots

were detected along with potato late blight. The smallest percentage of leaf spots was found in the plants, treated with Acrobat – 4.5%, it increased to 15.6% in the Quadris treated variant and 24.6% in the control plants and was the highest in Equation treated variants – 33.5%. It was obvious that the fungicides studied were not effectiveness for this disease control.

Table 5
Attack of tomato plants (variety Delfin) by diseases in stage picking maturity of fruits

Variant	Healthy leaves, %	Infected leaves, %	Including	
			late blight, %	early blight, %
Banco	73.15	26.85	3.35***	23.5
Verita WG	69.6	30.4	2.30***	28.1
Funguran OH	63.34	36.66	5.56***	31.1
Check	27	73	31.4	41.6
Gd at 0.05=1.98; at 0.01=2.63; at 0.001=3.39				

Table 6
Attack of tomato plants (variety Ideal) by diseases in stage picking maturity of fruits

Variant	Healthy leaves, %	Infected leaves, %	Including	
			late blight, %	early blight, %
Banco	76.6	23.4	3.8***	19.6
Verita WG	77.6	22.4	2.1***	20.3
Funguran OH	76.4	23.6	4.3***	19.3
Check	35.5	64.5	37.3	27.2
Gd at 0.05=1.98; at 0.01=2.63; at 0.001=3.39				

The infection with potato late blight was the highest during the last record in the stage picking maturity of fruits (Table 4).

Symptoms of the disease were detected to a small degree in Acrobat treated variants on 5.8% of the leaves and in Equation treated plants – on 7.5%. The variant with Acrobat treatment manifested prevalence of leaves with low infection rate – 61.5%, followed by highly infected – 25%, the portion of medium and very highly infected leaves being small – 6.7% and 0.8%, respectively. The treatment with Equation resulted in keeping low, medium and highly infected leaves in close range – 26.7%, 23.3% and 30.8%, respectively, with a smaller degree of very highly infected leaves – 11.7%. The application of Quadris resulted in the prevalence of highly and very highly infected leaves: 49 to 51%. The infection of the leaves of control plants was very high – 89% and 11% of the leaves were already destroyed. Obviously, there was a minor positive effect from Acrobat and Equation application, while there was none

for Quadris treatment and the control.

The interpretation of fungicide effects on potato late blight in 2006 should take into account that the last treatment was done in the middle of August. Plants were left without chemical protection until the end of vegetation. There were considerable precipitations in the period August 26 – 31, 2006, which, given the favorable temperatures, were probably a good prerequisite for intensive sporulation and spreading of the pathogen. A large number of leaves were infected; the disease spread quickly and resulted in leaf destruction and fruit infection. Symptoms of the disease were found on the stems as well in the form of black spots where stems could be broken.

In 2007, the foliage of plants of Delfin variety was slightly infected by potato late blight – 3.35% to 5.56% in the variants, treated with fungicides (Table 5).

In the control plants, this percentage was high and reached 31.4%. Both in fungicide treated variants and the control, the foliage was highly infested

with brown leaf spots – 23.5% to 41.6%.

The infestation with potato late blight of the other variety Ideal was low as well – below 4% in the variants with fungicide treatment (Table 6).

Both this variety and Delfin manifested the highest rate of infected leaves in the control plants – 37.3%. Brown spot infestation was observed in both treated variants and the control. The percentage of brown spot infected leaves was comparatively high regardless of whether fungicides were used or not.

Based on the obtained data, we could assume that the fungicides applied on both varieties did not have any effect on brown leaf spots.

The comparison of potato late blight infestation rate in the variants with fungicide application in both years showed that those tested in 2007 had a stronger inhibiting effect on disease spreading than those tested in 2006.

The termination of preventive fungicide treatment in the middle of August 2006 led to high infestation rates in the later development stages of tomato and preliminary leaf dying. The treatment with chemicals until the end of August in the next year 2007 ensured good preservation of foliage from infestation up to the end of the vegetation period. Therefore, we could recommend that the preventive treatment with fungicides be extended to the end of August, which will be sufficient to preserve the leaves from infestation with potato late blight and obtain stable yields.

In both years, both varieties Delfin and Ideal were highly infested with brown leaf spots along with potato late blight. The considerable infestation with this disease could be related to the ineffectiveness of the tested fungicides.

Conclusions

The tested chemicals suppressed the appearance of late blight in tomato during the period of study. Quadris was an exception as it had no effect.

Preventive plant treatment with fungicides until the end of August had a better plant protection effect from the disease compared to treatment until mid August.

Brown leaf spots on tomato appeared in both years and both varieties Ideal and Delfin; therefore,

the tested products had no effect on the causal agent of the disease.

References

- Bahariev, D., B. Velev and A. Harizanov**, 1988. Plant protection of vegetables. *Zemizdat*, Sofia, 391 pp. (Bg).
- Bahariev, D., B. Velev, S. Stephanov and E. Loginova**, 1992. Diseases, weed and pest on vegetables. *Zemizdat*, Sofia, 339 pp. (Bg).
- Chowdhury, A. K. and P. Hitra**, 2006. Severity of late blight of tomato in terai region of West Bengal and its control. *Environment and Ecology*, **245** (4): 1206-1208.
- Derenko, T.**, 2006. Effective system of potato protection from phytophthorosis during the whole vegetation period, *Kartofel' i ovoshchi*, **5**: 28-29 (Ru).
- Duarte, H. da S. S., L. Zambolium and W. C. Jesus Junior**, 2007. Manejo da queima do tomateiro industrial empregando sistema de previsão. *Summa Phytopathologica*, **33** (4): 328-334 (Br).
- Elenkov, E.**, 1997. Mildew. *Plant Protection*, **7**: 13-15 (Bg).
- El-Shimy, A. O. and G. A. Tomader**, 2006. Efficiency of host resistance and fungicide application for control of potato late blight. *Arab Universities J. of Agr. Sci.*, **14** (2): 743-753.
- Hariki, S.**, 2006. Evaluation of fungicides against potato late blight disease (*Phytophthora infestans*) on susceptible and tolerant potato varieties, *ACIAR Technical Reports Series*, **62**: 66-70.
- Lidanski, T. S.**, 1988. Statistical methods in biology and agriculture. *Zemizdat*, Sofia, 375 pp. (Bg).
- Mateeva, A., B. Braikova and G. Avdjiiski**, 1985. Diseases and pest on potato. *Zemizdat*, Sofia, 101 pp. (Bg).
- Nakov, B., M. Nakova, R. Angelova and R. Andreev**, 2007. Forecasted and signalization of diseases and pest on crop plants. *Publisher IMN-Plovdiv*, 434 pp. (Bg).
- Naskar, I., D. K. Nayak, S. Saha and M. K. Sarkar**, 2006. Bio-efficacy of fungicides of potato and pointed gourd. *J. of Mycopatological Res.*, **44** (2): 297-299.
- Ratajkiewicz, H. and T. Baranowski**, 2007. Skuteczność bentiowalikalbu (Valbon 72 WG) w zwalczaniu macznika rzekomego ogryka i zarazy ziemniaka na pomidorze. *Progress in Plant Protection*, **47** (2): 291-293 (Pl).
- Shailbala, V. and S. Pundhir**, 2008. Fungicide spray schedule for economical management of potato late blight. *Pantnagar J. of Res.*, **6** (1): 114-117.