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EFFECTIVENESS OF SOME CHEMICAL STRATEGY PROTECTION OF POTATO AGAINST AN EARLY BLIGHT (*ALTERNARIA SOLANI*)

Jerzy Osowski

Plant Breeding and Acclimatization Institute in Radzików
Department of Potato Protection and Seed Science
76-009 Bonin, Poland
e-mail: j.osowski@wp.pl

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Abstract: In the years 1999–2001, efficiency of plant protection products in control of early blight (*Alternaria solani*) was evaluated in two series of field experiment. There were examined four contact fungicides: propineb (Antracol 70 WP), chlorothalonil (Bravo 500 SC), mancozeb (Dithane M-45 80 WP) and zoxamide + mancozeb (Unikat 75 WG), and two with local penetrant mobility propamocarb-hydrochloride + chlorothalonil (Tatoo C 750 SC) and metalaxyl-M + mancozeb (Ridomil Gold MZ 68 WP). In the series I propineb (Antracol 70 WP) showed the greatest efficacy in early blight control while in the series II mancozeb (Dithane M-45 80 WP) did.

Key words: fungus, *Alternaria solani,* chemical protection

INTRODUCTION

Early blight is a very common disease of potato crops wherever they are grown, however an importance of the disease varies and depends upon regions. Harrison (1974) and Rotem (1981) have considered early blight as the most destructive disease in warm climate, particularly for irrigated potato crops. According to Wnękowski and Błaszczak (1997) early blight is a disease of extensive cultivation of potatoes.

Fungi from *Alternaria* spp. being casual agents of early blight are necrotrophic (Rotem 1966) frequently attacking plants that are stressed by poor nutrition, drought or other pests. Broggio and Ranucci (1991) called these fungus species "weakness pathogens" due to their development cycle that takes place under weather conditions unfavorable to potato plant development. Wnękowski (1971) implied that physiological weakness of plant resulting from translocation of assimilates into developing tubers favored occurrence of the disease. Meanwhile, Kohomoto (1989) classifies *Alternaria* fungi to saprophytic group of organisms i.e. these that can grow on and derives its nourishment from dead or decaying organic matter. According to Wnękowski and Błaszczak (1997) plants expressing virus diseases are also much more susceptible to early blight than nearby healthy plants.

Losses caused by early blight infection are difficult to estimate. Nachmias et al. (1988) based their calculations on numerous trials and reported that in spring time the losses amounted to 22% and in fall to 7%. Mean yield in spring was 50 tons/ha and in fall 30 tons/ha, thus a decrease of yield was 11 tons and 2 tons, respectively.

Sufficient reduction of losses due to pathogen infection can be obtained with correct agricultural measures, cultivation of resistant cultivars and chemical protection. The aim of this work was evaluation of efficacy of some selected fungicides in control of early blight development on potato plants.

MATERIAL AND METHODS

Experiments on efficacy of 6 selected fungicides in control of potato early blight were carried out at 2 localities (Bonin – Zachodniopomorskie province and Stare Olesno – Opolskie province). The field trials were set up in split-plot design on potato cv. Frezja (100 plants in each of 4 replications). Evaluation of fungicides was conducted in 2 series. The series I carried out in the years 1999 and 2000 included propineb (Antracol 70 WP) – 1.8 kg/ha, chlorothalonil (Bravo 500 SC) – 2.0 l/ha, mancozeb (Dithane M-45 80 WP) – 2.0 kg/ha and propamocarb-hydrochloride + chlorothalonil (Tatoo C 750 SC) – 2.0 l/ha. The Series II conducted in the years 1999 and 2001 contained mancozeb (Dithane M – 45 80 WP) – 2.0 kg/ha, propamocarb-hydrochloride + chlorothalonil (Tatoo C 750 SC) – 2.0 l/ha, metalaxyl-M + mancozeb (Ridomil Gold MZ 68 WP) – 2.5 kg/ha and zoxamide + mancozeb (Unikat 75 WG) – 2.0 kg/ha. All spray treatments were applied in 400 l/ha of water. The spraying of plants started along with occurrence of first disease symptoms. Contact products were applied at 7–10 day intervals and local penetrant fungicides at 10–14 day intervals. The disease development rate was evaluated at 10 day intervals according to 9-degree scale (9 – the lowest infection; 1 total plant destruction). Based on collected results there was calculated the disease development rate (ddr) for each treatment according to Van der Plank (1963) equation. Results were subjected to 2-factor analysis of variance.

RESULTS

Series I

Disease development rate for treatments in series I differed significantly (Tab. 1) and depended on applied fungicides, year of evaluation, locality and correlation between year and locality. All tested fungicides provided good control of disease development (ddr within a range from 0.154 to 0.167) compared with a control (ddr=0.194). In analysis of comparison of years of conducted studies ddr was significantly lower in 2000 (0.147). Unfavorable weather conditions for disease development in Bonin effected disease incidence in this year (Fig. 1). In III decade of June and I decade of July there were considerable high rainfalls (36 mm, 34.4 mm, respectively) and low temperatures (16.0°C, 15.0°C, respectively). Thus mean infec-

Table 1. Mean rate of the disease development (series I)

Treatment	Locality	Year		LSD for treatments
		1999	2000	
Control	Bonin	0.210	0.120	0.194 b
	Stare Olesno	0.228	0.219	
Antracol 70 WP	Bonin	0.180	0.086	0.166 a
	Stare Olesno	0.197	0.202	
Bravo 500 SC	Bonin	0.195	0.091	0.167 a
	Stare Olesno	0.188	0.193	
Dithane M-45 80 WP	Bonin	0.166	0.091	0.158 a
	Stare Olesno	0.188	0.185	
Tattoo 750 SC	Bonin	0.164	0.091	0.154 a
	Stare Olesno	0.169	0.193	
LSD (0.01) for years – 0.009		0.189 b	0.147 a	
LSD (0.01) for locality – 0.009				
LSD (0.01) for years and locality – 0.013				

Means followed by the same latter within a column are not significantly different

Table 2. Mean rate of the disease development (series II)

Treatment	Locality	Year		LSD for treatments
		1999	2001	
Control	Bonin	0.210	0.206	0.249 b
	Stare Olesno	0.228	0.350	
Unikat 75 WG	Bonin	0.150	0.176	0.200 a
	Stare Olesno	0.169	0.306	
Ridomil Gold MZ 68 WP	Bonin	0.179	0.198	0.210 a
	Stare Olesno	0.169	0.292	
Dithane M-45 80WP	Bonin	0.166	0.191	0.216 a
	Stare Olesno	0.188	0.318	
Tattoo 750 SC	Bonin	0.164	0.191	0.217 a
	Stare Olesno	0.169	0.345	
LSD (0.01) for years – 0.012		0.179 a	0.257 b	
LSD (0.01) for locality – 0.012				
LSD (0.01) for years and locality – 0.017				

Explanation – see table 1

tion was considerable lower in Bonin than in Stare Olesno (r=0.096; r=0.198, respectively). Comparing locality of trails revealed that ddr was higher in Stare Olesno as mean r was 0.196 (1999y. – 0.198, 2000y. – 0.194) as compared with Bonin where calculated mean r amounted to 0.140 (1999y. – 0.096; 2000y. – 0.183).

Series II

Evaluation of fungicide efficacy conducted in series II provided similar results to series I i.e. statistical depended on differences applied fungicides, year and locality and correlation between locality and year (Tab. 3). There were no differences between particular treatments. The differences were found between a control (0.249)

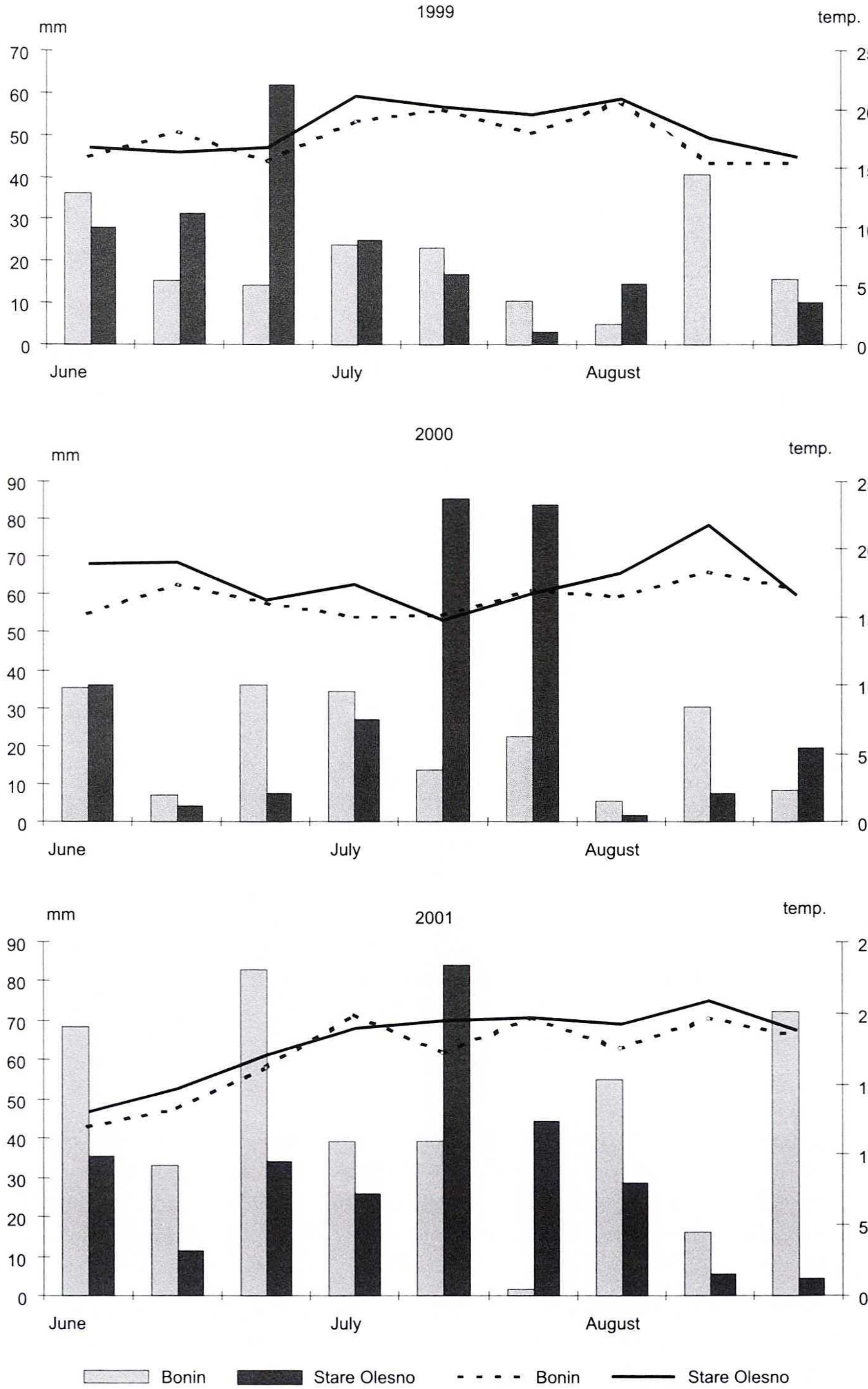

Fig. 1 Weather conditions in Bonin and Stare Olesno in June and July in the years 1999–2001

Table 3. Mean tuber yield increase in Series I and II (compare to untreated control)

Trial	Treatment	% increase of yield	Trial	Treatment	% increase of yield
Series I	control	100.0	Series II	cont rol	100.0
	Propineb	+ 15.1		Zoxamide + mancozeb	+ 32.0
	Chlorothalonil	+ 12.1		Metalaxyl M + mancozeb	+ 23.7
	Mancozeb	+ 15.2		Mancozeb	+ 42.1
	propamocarb-hydrochloride + chlorothalonil	+ 11.0		propamocarb-hydrochloride + chlorothalonil	+ 28.8

and fungicide treatments (range from 0.200 to 0.217). Ddr was significantly lower in 1999 than in 2001 (0.179; 0.257, respectively). The highest disease incidence was recorded in 2001 (0.257) for both series. Similarly to series I ddr was lower in Bonin than in Stare Olesno (0.183; 0.254, respectively). Assessment of correlation between year and locality in 2001 showed statistical differences between disease incidence and evaluated places (Bonin – 0.192; Stare Olesno – 0.322).

Application of fungicides in each series resulted in significant inhibition of disease development as compared to a control. Slower destruction of potato haulm caused yield increase compared to a control (Tab. 3). In series I yield increase was lower (from 11 to 15.2%) than in series II (23.7 and 42.1%) due to slower disease development rate. The highest yield increase was obtained for mancozeb treatment in both Series (15.2 and 42.1%, respectively).

DISCUSSION

In Poland the early blight plays important economical role on some potato cultivars. Its harmfulness results from early occurrence on potato crops and caused losses. Early occurrence and favorable weather conditions for disease development in Poland lead to intensive search for methods of efficient control. Under Polish climatic conditions the disease occurs on average 50–70 days after potato planting (Osowski 2001). In an analyzed period very first symptoms of early blight were recorded 46 days after planting in 2001 while in remaining 52 days after planting. So early occurrence of early blight symptoms was dependent upon weather conditions. According to Dorożkin and Iwaniuk (1979) weather conditions in third decade of June and first decade of July effect time of early blight occurrence. In conducted experiment weather conditions were more favorable for disease development in Stare Olesno than in Bonin. Higher temperatures in June and July and also course of rainfalls more favorable for disease development increased infection pressure of a pathogen. Climatic conditions in Stare Olesno and higher risk of virus infection favored time of early blight occurrence and disease incidence in carried out experiments as well. Plants expressing virus symptoms are also much more susceptible to early blight than nearby healthy plants (Hooker 1980). Dorożkin et al. (1979) indicated that infection with PVY and PLRV particularly favored disease occurrence. Frequent cultivation of potatoes and other susceptible plant species on the same field stimulates quicker time of occurrence of first symptoms (Sthienberg and Fry 1990). Earlier onset of early blight and most rapid development of disease (under favorable weather conditions) resulted in significant reduction of tuber yield. According to Broggio and Ranucci (1991) weather course is one of the most important factors effecting epiphytotic outbreak of early blight. However, disease incidence is also dependent on cultivar resistance (Johanson and Thurston 1990; Pelletier and Fry 1990; Wnękowski and Błaszczak 1997; Osowski 2000a). Very early maturing cultivars are often very susceptible to early blight (Stewart and Bradshaw 1993; Brogio and Ranucci 1991).

There are few measures that help to prevent the occurrence of serious early blight outbreak. Application of fungicides is important in suppressing damage by the early blight however, this method can be expensive and not always efficient (Stewart and Bradshaw 1993; Johnson and Teng 1990). Effectiveness of chemical protection in control of early blight depends on numerous factors. Disease forecasting models for early blight or including early blight control in models for other pests can lead to more effective timing of fungicide application (Pelletier and Fry 1990).

Timing for the first fungicide application is very important factor in efficient chemical protection (Christ 1990; Johnson and Teng 1990). Cultivation of resistant cultivars or cultivars that have a lower susceptibility to early blight can decrease number of applications from 1 treatment per week to 1 per 2 weeks (Sthienberg and Fry 1990). Efficient control depends also on choice of fungicide that can either lessen disease development or totally eradicate casual agent. In tested treatments 4 fungicides with contact mobility and 2 with local penetrant were evaluated. All products provided statistically significant efficiency in control of early blight as compared with a control. The best results were recorded for mancozeb (Dithane M-45 80 WP) and propineb (Antracol 70 WP). Other studies confirm these results (Christ 1990; Guddewar et al. 1992; Osowski 2000b). Time of mancozeb application i.e. before potato flowering probably effected protection efficiency. Christ and Maczuga (1989) also registered the lowest number of leaf damages after mancozeb application at this growth stage.

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POLISH SUMMARY

SKUTECZNOŚĆ CHEMICZNEJ OCHRONY W ZWALCZANIU ALTERNARIOZY ZIEMNIAKA (*ALTERNARIA SOLANI*)

W latach 1999–2001 w dwóch seriach doświadczeń polowych oceniano skuteczność środków ochrony roślin w zwalczaniu alternariozy. Oceniano cztery fungicydy o działaniu powierzchniowym: propineb (Antracol 70 WP), chlorotalonil (Bravo 500 SC), mankozeb (Dithane M-45 80 WP) i zoksamid + mankozeb (Unikat 75 WG) i dwa o działaniu układowym: chlorowodorek propamokarbu + chlorotalonil (Tattoo 750 SC) i metalaksyl-M+mankozeb (Ridomil Gold MZ 68 WP). Spośród testowanych fungicydów największą skuteczność w ograniczaniu rozwoju choroby uzyskano dla propinebu (Antracol 70 WP) w serii pierwszej i mancozebu (Dithane M-45) w serii drugiej.