JOURNAL OF PLANT PROTECTION RESEARCH
Vol. 44, No. 3 (2004)

EARLY BLIGHT (*ALTERNARIA* SPP.) IN POTATO CROPS IN POLAND AND RESULTS OF CHEMICAL PROTECTION

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Accepted: November 5, 2004

Abstract: In the years 2000–2003 under Polish climatic conditions early blight occurred at different level of incidence on over 90.6% of surveyed fields. Time of disease appearance in different regions was closely related to climatic conditions. On average, early blight appeared on potato plants 59.3 days after planting, earlier than late blight.
In the years 2001–2003, efficacy of six selected fungicides in early blight control was examined in field conditions. Experiments carried out in the Department of Potato Protection and Seed Science of Plant Breeding and Acclimatization Institute. Field trials located in two sites – at Bonin and Stare Olesno revealed much slower development of early blight on these fields where chemical protection was applied as compared to untreated control. Efficacy of plant protection program carried out in Bonin over three years varied from 40% to 63.9%. Effectiveness of selected products was higher in Stare Olesno at higher infection pressure, and ranged from 49.8% to 66.6%. However, efficiency of chemical protection in early blight suppressing is not as satisfactory as in late blight control. In field experiments good control of early blight resulted in tuber yield increase. In Bonin yield increase varied from 5.5 to 24.2% and in Stare Olesno from 12.2 to 34.4%.

Key words: potato, early blight, chemical control

INTRODUCTION

Early blight occurs commonly worldwide on potato crops, particularly in regions with high temperature and humidity. The causal agents of the disease are fungi from *Alternaria* genus: *Alternaria alternata* and *Alternaria solani*. Their occurrence is estimated jointly. High temperature (optimum 25–26°C for *A. alternata* and 26–27°C for *A. solani*) (Dorożkin and Biel'skaja 1979), alternating dry and high humidity periods create environmental conditions that are conducive to infection and disease outbreak.

Each element of good agricultural protection that enhances condition of plants (e.g. foliar fertilization) increases plant resistance to a pathogen (Fry 1994). Nevertheless, chemical protection of potato cultivars very sensitive to early blight infection remains a basic problem.

The goal of investigations conducted in the years 2000–2003 in the Department of Potato Protection and Seed Sciences of Plant Breeding and Acclimatization Institute in Bonin was the evaluation of early blight occurrence on potato crops under Polish climatic conditions and estimation of efficacy of selected fungicides applied in control of the disease in field conditions.

MATERIAL AND METHODS

In the years 2000–2003 in cooperation with the Plant Health and Seed Inspection Service the evaluation of early blight occurrence on potato crops was carried out throughout Poland. Annual observations on disease appearance and the time of first symptoms were performed on 34–36 potato fields of various cultivars and then the collected results were analyzed in Bonin.

In the years 2001–2003, efficacy of selected fungicides in early blight control was examined in field conditions. Field trials were performed in 2 sites differing in climatic conditions (Bonin – in northern Poland and Stare Olesno – in southern Poland). A randomized complete block design with 4 replications was used for the experiment. Each plot measured 30 m^2. Estimation of fungicide efficiency to control early blight was performed on cv. Frezja and since 2003 on cv. Bard (both susceptible to the disease). Chemical protection began at first symptoms of necrosis observed on plants. Usually 2–3 applications were performed depending upon pathogen pressure. To eliminate the influence of *Phytophthora infestans* infection on crop defoliation additional protection program was applied two weeks after last experimental treatment. All experimental plots (including control) were treated with fungicides recommended for late blight control.

The following fungicides were investigated:

– contact fungicides: chlorothalonil (Bravo 500 SC) at the dose of 2.0 l/ha, mancozeb (Dithane M-45 80WP), zoxamide + mancozeb (Unikat 75 WG), both at the dose of 2.0 kg/ha and propineb (Antracol 70 WP) at the dose of 1.8 kg/ha
– systemic fungicides: metalaxyl-M + mancozeb (Ridomil Gold MZ 68 WP) at the dose of 2.0 kg/ha and propamocarb-hydrochloride + chlorothalonil (Tattoo C 750 SC) at the dose of 2.0 l/ha

The accepted criteria for fungicide effectiveness assessment were:

– the percentage of haulm destruction two – three weeks after the last spraying,
– early blight development rate (according to Van der Plank, 1963),
– tuber yield.

The results were analyzed in a 2-factorial ANOVA, the factors being years of experiments and a fungicide applied. For statistical analyses data were converted according to the formula of Bliss.

RESULTS

In the years 2000–2003 under Polish climatic conditions early blight (EB) occurred at different level of incidence on average 90.3% of surveyed fields (Tab. 1). Time of the disease appearance in different regions was closely related to climatic conditions. In Poland, early blight usually occurs at the end of May or the beginning of June. On average, early blight appeared on potato plants 59.3 days after planting. The earliest, recorded EB infection in the season was observed 32–36 days after planting.

Table 1. Occurrence of early blight on potato crops in Poland

Year	Number of surveyed fields	% of fields with EB	Dates of the first recorded outbreaks of EB in potato	The earliest recorded EB infections in season (DAP*)	Average appearance of EB (DAP*)
2000	56	91.1	31.05.	36	57
2001	50	94.0	01.06.	32	61
2002	64	90.6	20.05.	34	56
2003	34	85.3	24.06.	33	63
$\sum$ / x	202	90.3		33.8	59.3

* DAP – days after planting

Considerable differences were recorded in timing of disease occurrence and incidence on control in Bonin and Stare Olesno (Tab. 2). Early blight incidence was distinctly lower over 4 years in Bonin (northern Poland). In general, pathogen infection on control plots did not exceed 50%. The year 2001 was an exception as the disease occurred early and destruction of control plants was 83.9%. In Stare Olesno plant infection was higher each year and ranged from 64.1% in 2000 to 96.9% in 2001.

Table 2. Early blight occurrence and incidence on control plots in field trials

Year	Bonin			Stare Olesno		
	Date of planting	Date of EB appearance	Disease severity (%)	Date of planting	Date of EB appearance	Disease severity (%)
2000	28.04.	15.06.	46.3	05.05.	24.06.	64.1
2001	04.05.	15.06.	83.9	14.05.	01.07.	96.9
2002	23.04.	10.06.	46.3	25.04.	07.06.	90.5
2003	08.05.	24.06.	47.8	13.05.	01.07.	86.1
Mean			56.1			84.4

The years 2000–2003 varied in meteorological conditions and this affected the appearance and development of early blight (Figs. 1, 2). A course of temperatures from June to August was very similar in Bonin and Stare Olesno. The exception was the year 2000, when mean July temperature was lower than temperature in other years. Considerable differences were observed in rainfall, particularly in June and July. Unnatural high rainfall was recorded in Bonin in the growing season of 2001.

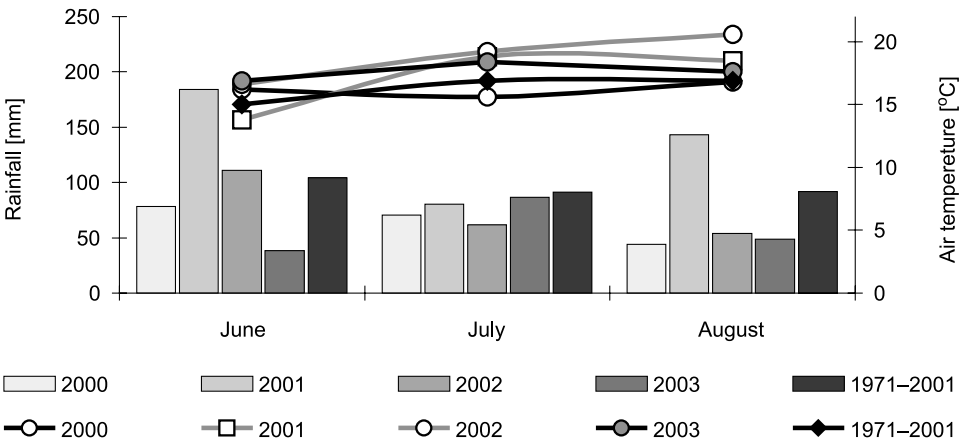

Fig. 1. Meteorological conditions in Bonin in the years 2000–2003 (June, July and August) as compared to long-term mean from 1971–2001

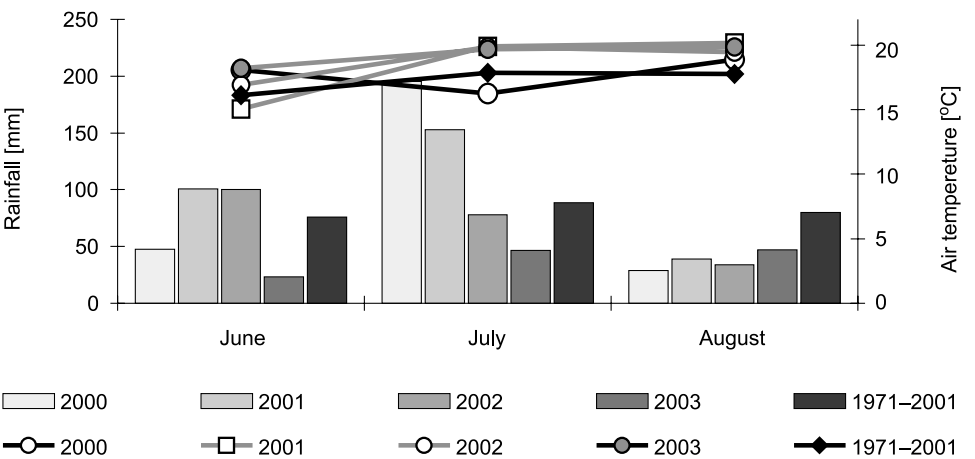

Fig. 2. Meteorological conditions in Stare Olesno in the years 2000–2003 (June, July and August) as compared to long-term mean from 1971–2001

Sum of rainfall from June to August was 407.6 mm and it was considerable higher than a mean from last 20 years from the same period (287.3 mm). The year 2003 turned to be the driest (173.4 mm). In Stare Olesno, sum of rainfall for the period from June to August was also higher (292.7 mm) than long-term mean (244.7 mm); the differences were not as significant as in Bonin. However, in 2003 rainfall was much lower in the growing season (117.4 mm).

It seems that rainfall in June and July mostly affected a rate of early blight occurrence on potato crop (Tab. 3). This correlation was more apparent in Bonin. In 2002 in Stare Olesno unusual early blight occurrence was recorded. The disease was recorded early despite rainfall on an average level (43 days after potato planting).

Table 3. Rainfall in the growing season and rate of early blight occurrence

Year	Bonin			Stare Olesno		
	Rainfall VI–VII (mm)	Rainfall VII–VIII (mm)	EB appearance (DAP)*	Rainfall VI–VII (mm)	Rainfall VII–VIII (mm)	EB appearance (DAP)*
2000	148.9	192.8	48	243.9	271.5	50
2001	264.4	407.6	42	253.6	292.7	48
2002	172.7	226.9	48	178.1	212.2	43
2003	124.8	173.4	47	70.1	117.4	49
1971–2001	195.5	287.3	X=46.3	164.5	244.7	X=47.5

* DAP – days after planting

Field trials conducted in the years 2001–2003 proved usefulness of examined fungicides in control of early blight. The conducted trials showed that all fungicides suppressed the early blight development as compared to the untreated control (Fig. 3).

Fungicide protection influenced significantly the disease development rate as compared to control (Tab. 4). The highest influence on inhibition of early blight development rate was observed after application of mixture of zoxamide+MZB, both in Bonin and in Stare Olesno. Efficacy of plant protection programs carried out in Bonin over three years varied from 42.4% to 56.1%. Tendency of higher effectiveness of selected products was observed in Stare Olesno, at higher infection pressure, and it ranged from 44.2% to 66.8%. No significant differences were found between particular fungicides in their effectiveness.

Table 4. Efficacy of selected fungicides on inhibition of early blight development

Fungicide	The early blight development rate						Efficacy of early blight inhibition – % (mean of 2001–2003)	
	BONIN			ST.OLESNO				
	year			year				
	2001	2002	2003	2001	2002	2003		
control	0.206	0.199	0.200	0.350	0.169	0.297	–	–
propineb	–	0.149	0.146	–	0.168	0.118	52.0	55.0
mancozeb	0.191	0.163	0.154	0.318	0.132	0.128	49.3	63.8
zoxamide + MZB	0.176	0.136	0.134	0.306	0.157	0.116	56.1	66.2
chlorothalonil	–	0.151	0.154	–	0.144	0.153	42.4	44.2
procamocarb + CTL	0.191	0.157	0.154	0.345	0.144	0.153	43.3	60.6
metalaxyl M + MZB	0.198	0.162	0.162	0.292	0.120	0.141	51.4	66.8
LSD	n.s.	0.024	0.040	0.031	0.033	0.038	25.1	27.8

Early haulm destruction by development of pathogens affects the amount of yield. The trials conducted in Bonin and Stare Olesno proved that yields from plots protected against early blight were significantly higher than from control plots (Fig. 4). In Bonin, during three years, tuber yield increase varied from 5.5% for chlorothalonil to 24.2% for mancozeb. In Stare Olesno, yield increase was higher and varied from 12.2% for chlorothalonil to 34.4% for a mixture of zoxamide and mancozeb.

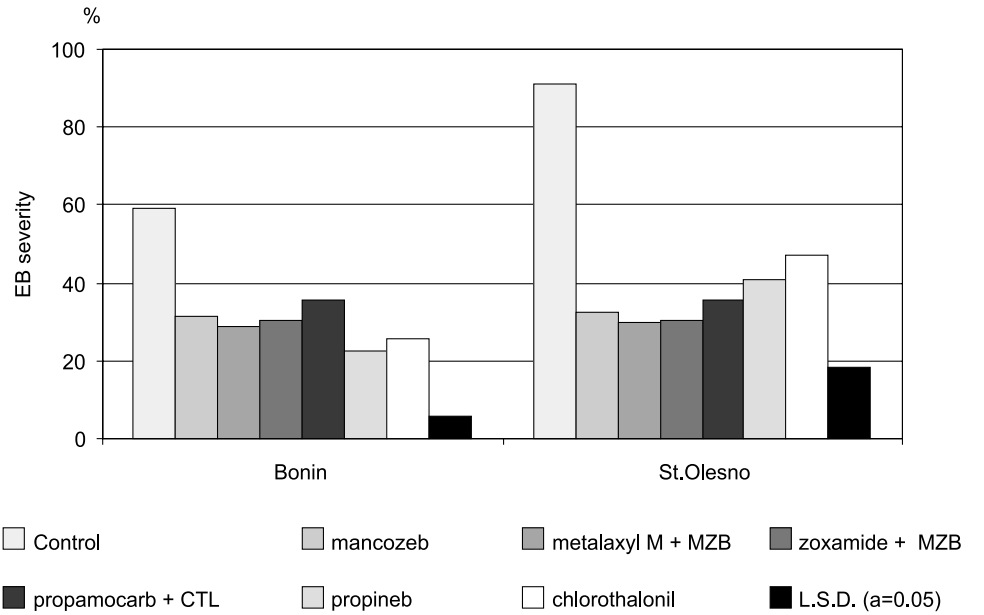

Fig. 3. Efficacy of selected fungicides in early blight control (mean from 2001–2003)

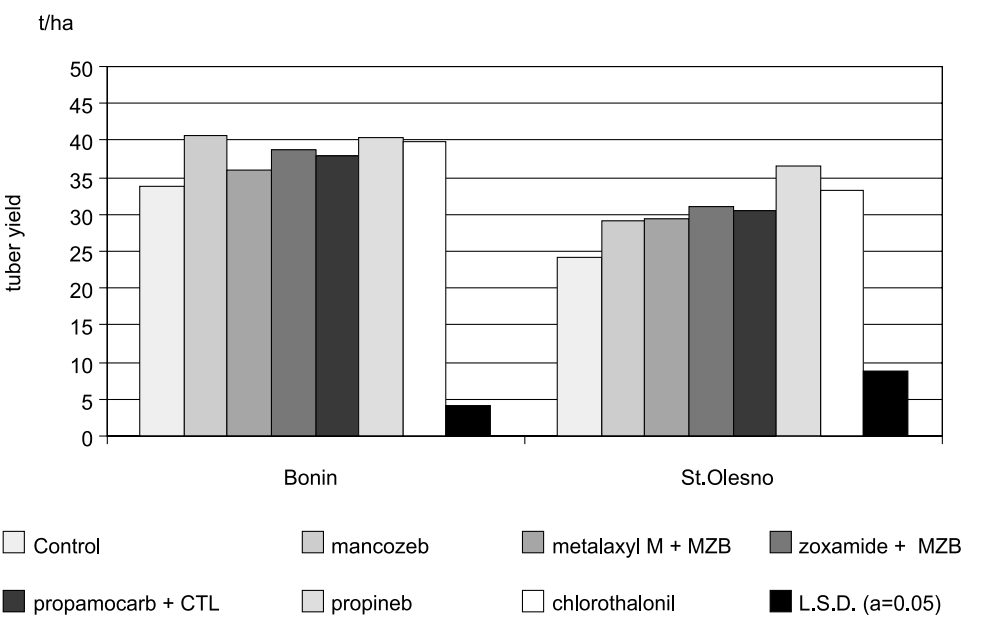

Fig. 4. Yield increase on plots protected with selected fungicides as compared with control (mean from 2001–2003)

DISCUSSION

Surveys carried out in the years 2000–2003 all over Poland, revealed that early blight occurrence on potato crop is common in most production areas in Poland. Inspections performed on 202 potato fields revealed early blight occurrence on 90.6% of examined fields. On average, early blight appeared on potato plants 60 days after planting and this brings a conclusion that under Polish climatic conditions early blight occurs earlier than late blight on potato crops. These results confirm earlier records on common occurrence of early blight and regional differences in disease incidence (Kapsa and Osowski 1996; 2003). The results obtained from control plots in Bonin and Stare Olesno show great differences in timing of first symptoms of early blight in successive years. Consequently years varied in rainfall abundance during the growing season, particularly in June and July. It seems that this was a factor most seriously affecting the occurrence of early blight in Bonin and Stare Olesno. According to Dorożkin and Iwaniuk (1979) the time of occurrence of early blight depends upon meteorological conditions in third decade of June and first decade of July.

Disease incidence also varied in both localities. Every year pathogen pressure was considerably higher in Stare Olesno (southern Poland) than in Bonin. Mean plant infection incidence on control plots in Stare Olesno amounted to 84.4% while in Bonin it was 56.1%. A larger destruction of plants caused by early blight in southern Poland resulted not only from climatic conditions. In this area climatic conditions also favour a greater infection pressure of viruses. Virus infections increased additionally early blight pressure under Stare Olesno conditions. Potato plants infected with some viruses are more susceptible to early blight infection (Wnękowski and Błaszczak 1997).

Chemical protection is one of the methods applied in early blight management programs, particularly in protection of susceptible potato cultivars. Due to the increasing problem of early blight on potato crops, potato management programs should also consider effectiveness of fungicides included in control of this disease.

All examined products provided efficacy at a similar level i.e. 40.0%–63.9% in Bonin and 49.8%–66.6% in Stare Olesno. A good control of early blight resulted in tuber yield increase. In Bonin yield increase varied from 5.5 to 24.2% and in Stare Olesno from 12.2 to 34.4%. Control of early blight is of economic importance. Unsatisfactory efficacy of some fungicides in early blight control in Bonin in the years 2001–2003 could be a result of using less efficient products and also their late application. Protection of potato plants against early blight started at first symptoms appearance. The casual agent of early blight attacks plants that are weaker or older (Rotem 1966) so first symptoms of the disease might be overlooked due to abundant foliage development. Hence, there is a necessity to develop a model of monitoring early blight development and systems of forecasting that would allow to determine more precisely the time of first treatment.

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POLISH SUMMARY

ALTERNARIOZA (*ALTERNARIA* SPP.) NA PLANTACJACH ZIEMNIAKA W POLSCE I WYNIKI CHEMICZNEJ OCHRONY

W latach 2000–2003, w warunkach meteorologicznych Polski, alternarioza wystąpiła w różnym nasileniu na średnio 90,3% obserwowanych pól odmian ziemniaka o różnej odporności na alternariozę. Termin wystąpienia choroby był ściśle związany z warunkami klimatycznymi. Przeciętnie, alternarioza pojawiała się na roślinach ziemniaka 59,3 dni po sadzeniu, wcześniej niż zaraza.

W latach 2001–2003, w warunkach polowych badano skuteczność sześciu wybranych fungicydów w zwalczaniu alternariozy. Doświadczenia polowe wykonano w Zakładzie Nasiennictwa i Ochrony Ziemniaka Instytutu Hodowli i Aklimatyzacji Roślin. Doświadczenie wykonane w dwóch miejscowościach: w Boninie i Starym Oleśnie wykazało znacznie wolniejszy rozwój alternariozy na poletkach chronionych fungicydami w porównaniu z nietraktowaną kontrolą. Skuteczność różnych wariantów ochrony ziemniaka zastosowanych w Boninie w ciągu trzech lat wahała się od 42,4% do 56,1%. Skuteczność testowanych środków była wyższa w Starym Oleśnie, w warunkach wyższej presji infekcyjnej patogena i wahała się od 44,2% do 66.8%. Skuteczność ochrony chemicznej w zwalczaniu alternariozy nie jest jednak tak zadawalająca jak skuteczność zwalczania zarazy ziemniaka. W doświadczeniach polowych dobra skuteczność zwalczania alternariozy warunkowała wzrost plonu bulw. W Boninie wzrost plonu wahał się w granicach od 5,5 do 24,2% a w Starym Oleśnie od 12,2 do 34,4%.