JOURNAL OF PLANT PROTECTION RESEARCH
Vol. 47, No. 4 (2007)

EFFECT OF CLIMATIC CONDITIONS ON INFECTION PRESSURE OF *PHYTOPHTHORA INFESTANS* AND HARMFULNESS OF THE PATHOGEN TO POTATO CROPS

*Józefa Kapsa**

Plant Breeding and Acclimatization Institute, Radzikow
Department of Potato Protection and Seed Science, Bonin
76-009 Bonin 3, Poland

Received: August 12, 2007
Accepted: September 27, 2007

Abstract: In the recent years earlier appearance of late blight on potato crops and the increase of infection pressure of *Phytophthora infestans* has been observed due to the changes in its population. The occurrence of *P. infestans* on potato plants at early plant growth stages points to the possibility of existence of other infection sources such as infected seed tubers or volunteer plants and their increasing role in the disease epidemiology. These changes have led to late blight epidemics developing earlier and more severely than previously and changes in the occurrence and development of first symptoms of *P. infestans* infection on potato plants. In the years 1997–2006, field studies were conducted at the Plant Breeding and Acclimatization Institute of Bonin with the emphasis on comparison of time of the occurrence and incidence level of late blight of potato. The criteria for pathogen infection pressure assessment were assumed to be the percentage of haulm destruction at the end of growing season and area under the disease progress curve (AUDPC), the late blight development rate defining the increase of destruction of above ground plant parts in unit time and also tuber yield and its healthiness. The observations carried out at Bonin revealed that both time of occurrence and severity of late blight differed and were dependent upon meteorological conditions and upon the year. Late blight occurred the earliest at Bonin in 2001 (42 days after planting). The time of occurrence of late blight depends upon rainfall in May and June. A very high infection rate of the pathogen was observed, particularly in 2006 (0.517) and in 2004 (0.400) despite late time of late blight appearance in the season. In these years AUDPC on the unprotected cultivar was 0.071 and 0.508, respectively.

The 10 years of observations conducted at Bonin revealed that the yield and occurrence of tuber late blight depended mostly upon meteorological conditions in particular years.

Key words: potato, late blight, changes of pathogen, infection pressure

*Corresponding address:
jkapsa@wp.pl

INTRODUCTION

Among all pests, plant pathogens causing serious diseases affect significantly the size of yields and play an essential role in agricultural production. Each arable crop has its own particular pathogen, which occurs more frequently than others; only its efficient control can provide the best conditions for high and healthy yield. Plant protection aiming at prevention of pest occurrence and suppression of disease development faces various problems for instance, pathogen variability often is affected by biological and environmental factors.

The most frequently occurring pathogen causing a serious disease in potato crops is – *Phytophthora infestans* Mont. de Bary (fungus-like organism from *Chromista*), a species that undergoes frequent genetic changes. The disease is known as late blight (LB). Worldwide average losses on unprotected fields in tuber yield due to LB are 70% (Hoffman and Schmutterer 1983) and with early disease outbreak even 100% (Fry 1994). In Poland yield losses resulting from *P. infestans* infection are estimated in a range of 20–25% (Pietkiewicz 1989). In the years 1999–2003 the yield losses were higher and ranged from 22 to 57% (Kapsa 2004).

Recent observations showed the increase in infection potential of *P. infestans* caused by genetic changes in pathogen population and higher infection pressure all over the world (Fry *et al*. 1993; Sujkowski *et al.* 1994, 1996; Drenth 1994; Turkensteen *et al*. 1996). Currently late blight is more dangerous to potato production than in the past and its control is more difficult. Genetic changes within pathogen population represent the major challenge in the efficient disease control. In addition they raise the question whether available now computer based systems of warning and forecasting are reliable, particularly those developed from results collected prior to the occurrence of new pathogen populations (Hansen *et al.* 2003).

It is essential to monitor changes in *P. infestans* population and their consequences such as earlier disease outbreak, higher disease incidence, increase of pathogen pathogenicity and changes in development of first disease symptoms.

The objective of the research projects carried out in the years 1997–2006 was the monitoring of disease occurrence and its development on experimental plots. The results were analyzed to find out a relationship of disease development and weather during the growing season. In addition tuber yield and their health conditions were evaluated in correlation to disease incidence.

MATERIALS AND METHODS

In the years 1997–2006 studies on infection pressure of *P. infestans* and late blight development and their correlation to meteorological conditions were carried out in the Plant Breeding and Aclimatization Institute, Department of Potato Protection and Seed Science, Bonin. The observations were conducted in unprotected experimental plots, in four replications on susceptible potato cultivars: Atol, Rywal and Irga, respectively in the years 1997–1999, 2000–2003 and 2004–2006. The criteria to evaluate the infection pressure were as follows:

- date of first occurrence of LB in the growing season (days after planting),
- maximum degree of plant damage by LB in %,
- rate of disease development calculated as infection regression index within time =

increase of haulm destruction in unit time according to Van der Plank (1963),
- date of critical destruction of 50% haulm (days after planting),
- AUDPC = the area under the disease progress curve,
- tuber yield in tons per ha based on a harvest from two middle rows,
- tuber infection by *P. infestans* evaluated 4 weeks after harvest and storage under standard conditions (weight of infected tubers in %).

In addition to conducted research projects, LB occurrence on potato stems was monitored with cooperation of the National Inspectorates of Plant Health. Annual survey was performed on 51–158 fields in all potato cultivation regions in Poland. Data were collected and analyzed in Bonin.

RESULTS AND DISCUSSION

Detailed observations on the occurrence and development of LB carried out on the experimental plots in Bonin over the last decade allowed either the determination or confirmation of the correlation between pathogen infection pressure and environmental conditions. Meteorological conditions and first LB occurrence varied in the years of conducted studies (Table 1).

Table 1. Time of potato late blight appearance at Bonin in the years 1997–2006

Years	Date of planting	Meteorological conditions (IV–IX)		Time of LB appearance	
		mean temp. [°C]	rainfall [mm]	Bonin	in trials
1997	08.05.	13.7	310.2	26.06.	04.07.
1998	08.05.	14.3	627.2	09.07.	18.07.
1999	28.04.	14.8	370.9	24.06.	21.07.
2000	28.04.	14.3	319.5	17.07.	18.07.
2001	04.05.	13.9	707.6	15.06.	02.07.
2002	23.04.	15.4	399.1	26.06.	15.07.
2003	08.05.	14.5	288.0	14.07.	01.08.
2004	06.05.	13.6	402.6	28.06.	13.07.
2005	10.05.	14.0	330.6	25.06.	25.07.
2006	29.04.	15.0	514.4	27.06.	18.08.
Mean		14.4	427.0		

LB – late blight

Meteorological data showed that four vegetation seasons (1999, 2002, 2003 and 2006) out of a total of 10 years of data collection had a mean air temperature measured at 2 m height higher than a mean 10-year temperature by 0.1–1.0°C. The mean temperatures in remaining growing seasons were lower. The highest mean temperature was recorded in 2002 (15.4°C) and the lowest in 2004 (13.6°C). There was no relation between the highest and the lowest temperatures and earlier or later disease occurrence. Also mean growing season temperatures had no impact on a date of LB appearance on potato crops.

Among different meteorological factors precipitation affects the most occurrence of LB. The records from Bonin area indicate that the sum of precipitation higher than the sum of precipitation over a decade could be found only in 1998, 2001 and 2006 (627.2, 707.6 and 514.4 mm, respectively). The years with higher rainfall varied; only in 2001 the field monitoring revealed earlier occurrence of LB in a monitored location (June 15) and on experimental plots (July 2). In 1998 there was no such a correlation. An unusual situation was observed in 2006 when early single occurrence of LB was recorded in Bonin (June 27) but on the experimental plots the disease was identified as late as August 18. Analyses of data from a decade showed that it was the latest LB occurrence in Bonin region.

Detailed analysis of a precipitation course during a growing season indicates that early disease appearance on potato plants is correlated most frequently with high rainfall in May and/or June (Fig. 1, Table 2).

Table 2. Time of late blight appearance in correlation to rainfall at Bonin in the years 1997–2006

Year	Time of LB appearance (DAP)		Precipitation during growing season [mm]						
	at Bonin	in trials	IV	V	VI	VII	VIII	IX	Σ
1997	49	57	24.7	92.5	37.2	61.8	12.1	81.9	310.2
1998	62	71	71.3	73.3	134.4	135.7	121.0	91.5	627.2
1999	57	84	74.4	68.0	65.3	57.3	61.3	44.6	370.9
2000	80	81	33.7	29.3	78.2	70.7	43.9	63.7	319.5
2001	42	59	62.6	40.8	184.2	80.2	143.2	196.2	707.6
2002	64	83	25.8	69.8	110.8	61.9	54.2	76.6	399.1
2003	67	85	31.2	32.6	38.4	86.4	48.6	50.8	288.0
2004	53	68	40.8	85.4	74.6	93.4	57.2	51.2	402.6
2005	46	76	10.8	86.8	30.6	96.4	74.6	31.4	330.6
2006	59	111	66.2	69.8	68.6	21.2	233.2	55.4	514.4
Mean	57.9	77.5	44.2	64.8	82.2	76.5	84.9	74.3	427.0

LB – late blight; DAP – days after planting

The earliest occurrence of LB at Bonin experimental plots was recorded in 1997 (49 days after planting), 2001 (42 after planting) and 2005 (46 days after planting). The rainfalls in May/June were the most abundant in these years. As mentioned above the year 2001 was the best to prove such a relation. The latest appearance of LB was recorded in 2000 (80 days after planting) and 2003 (after 67 days). In both years the rainfalls were low in May and June.

The observations of LB in Bonin area in the years 1997–2006 show that meteorological conditions conducive for pathogen development affect not only first disease

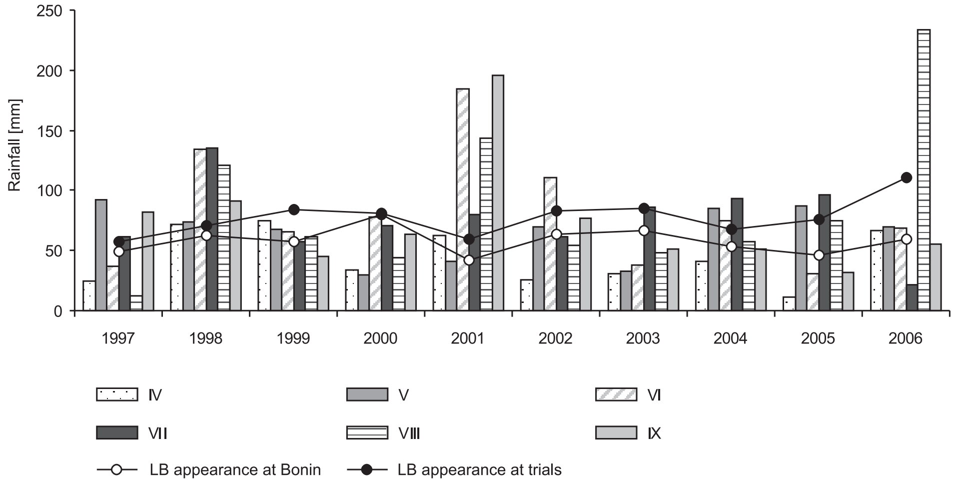

Fig. 1. Distribution of rainfall in 1997–2007 and time of late blight appearance (LB – late blight)

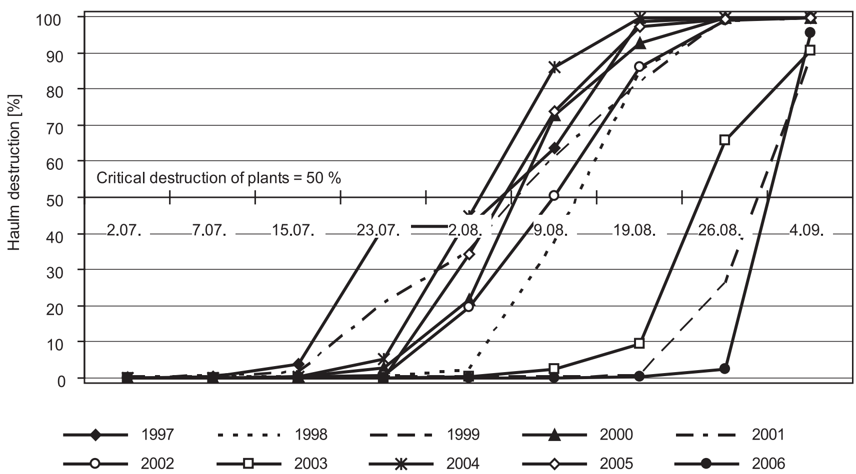

Fig. 2. Late blight development on untreated experimental plots at Bonin, in 1997–2006

occurrence on plants but also disease development during a growing season. In most seasons the most intense disease development on unprotected experimental plots was observed from mid-July to the end of August (Fig. 2).

In 1999 and 2003 severe disease progress was delayed by almost a month. It began in mid-August and lasted to the beginning of September. The year 2006 was atypical. First symptoms of LB on experimental plots were found very late (111 days after planting). Its development was abrupt, the infection of plants increased from 2.5% to 95.3% within just several days (from Aug. 22 to Sept. 4).

Biological factors represent another element affecting the disease development. An increase in infection potential of *P. infestans* caused by genetic changes in the pathogen population and higher infection pressure were observed all over the world over last years (Drenth1994; Duvauchell and Lherbier 1996; Zarzycka and Sobkowiak 1997; Brurberg *et al.* 1999; Flier and Turkensten 1999; Hermansen *et al.* 2000; Kapsa 2004). These changes resulted in an earlier outbreak of LB and higher disease rate despite conditions not always favouring infection occurrence. There may be sources of inoculum such as discarded potatoes from the previous season and self-sown tubers (warmer winters support overwintering). The earlier epidemic occurrence of LB might be also related to plant infections caused by oospores (Hermansen and Amundsen 1996; Andersson *et al.* 1998; Filer and Turkensteen 1999).

The date of infection plays an important role in disease development. Earlier or later disease appearance in Bonin area showed no significant correlation with rate development of disease calculated as an increase of haulm destruction in a unit time (Table 3). The correlation index was $r_{a=0.05} = 0.54$. Despite a late infection suggesting low infection pressure of the pathogen, the disease rate development was very high and the crop was destroyed within few or several days, an example of this occurred 2006.

Table 3. Evaluation criteria of late blight development on unprotected experimental plots during growing season

Year	Time of LB appearance (DAP)	Time of haulm destruction (DAP)		Plant infestation [%]	Rate of LB development	AUDPC
		> 50%	> 90%			
1997	57	83	129	99.6	0.234	0.530
1998	71	98	147	99.8	0.237	0.361
1999	84	136	179	88.5	0.197	0.109
2000	81	106	137	99.8	0.259	0.447
2001	59	87	140	99.8	0.226	0.463
2002	83	109	152	98.9	0.239	0.403
2003	85	103	141	90.7	0.210	0.162
2004	68	84	114	99.8	0.400	0.508
2005	76	82	100	99.8	0.296	0.467
2006	111	123	140	95.3	0.517	0.071
Mean	77.5	101.1	137.9	97.2	0.282	0.352
Correlation coeffcient		–0.36	–0.62		+0.54	–0.80

LB – late blight; DAP – days after planting
AUDPC – area under the disease progress curve

Significant correlation was recorded between date of LB appearance and AUDPC ($r_{a=0.01} = -0.80$). At earlier occurrence of LB on potato plants AUDPC was higher.

Another important factor reflecting the disease development is the date of haulm destruction of 50%. Large (1952) already demonstrated that at haulm destruction in a range 50–70% the assimilation processes ceased and thus tuber yield was lower. Therefore the critical date of haulm destruction in 50% is a very important element in description of pathogen infection pressure during a growing season (Fig. 2). Based on 10-year data it was found that the correlation between disease occurrence in a field and date of haulm destruction in 50% is statistically insignificant ($r_{a=0.05} = -0.36$) (Table 3). The end of tuber production is more related to temperature and precipitation.

Generally speaking meteorological elements and their course during a growing season are the basic elements affecting the occurrence of disease in the field and variability of infection pressure of *P. infestans*. High humidity required for pathogen development needs to be correlated not only with appropriate temperature but also with the character of pathogen growth and host plants as well. The first LB infections developing on plant stems were found to be as stem late blight. This form of LB was recognized on 80.5% potato fields in 1997 and 29.4% in 2006 (Table 4).

Table 4. Incidence of stem blight on potato crops in Poland in the years 1997–2006

Year	Number of monitored fields	Percentage of crops with stem blight symptoms
1997	149	80.5
1998	158	65.2
1999	76	72.4
2000	56	58.9
2001	51	68.6
2002	64	73.4
2003	34	35.3
2004	17	47.1
2005	21	47.6
2006	17	29.4
Σ/Mean	643	57.8

LB development on stems begins on stem tips, petioles and different parts of stems. Severely infected stems frequently break and plants are quickly destroyed. Defoliated plant stems covered with white mycelium and abundant sporulation of a pathogen might be observed at high humidity (Kapsa 2001). There are no data about the dissemination of stem late blight in other European regions. Some evidence shows that stem late blight can be more frequently identified in potato crops (Shattock 1988; Dowley and O'Sullivan 1995; Rowe 1996).

LB occurrence and development affects size and condition of tuber yield; it is of no importance which type of LB is present. In the years 1997–2006 mean tuber yield from untreated plots was 33.0 t/ha (Table 5). The range of tuber yield in examined years was from 16.5 t/ha (1997) to 46.7 t/ha (2002). There was no correlation between LB rate development and tuber yield size. For instance, in 2001 and 2004 LB development rate varied and was 0.226 and 0.400 respectively; however the harvested tuber yields were similar to the mean decade yield (33.3 and 36.5 t/ha respectively).

Table 5. Potato yield and health of tubers harvested from unprotected experimental plots

Year	Time of LB appearance (DAP)	Rate of LB development	Tuber yield [t/ha]	Tuber late blight % ww
1997	57	0.234	16.5	0.6
1998	71	0.237	26.4	19.5
1999	84	0.197	30.6	1.0
2000	81	0.259	40.2	8.6
2001	59	0.226	33.3	11.7
2002	83	0.239	46.8	0.1
2003	85	0.210	42.1	21.8
2004	68	0.400	36.5	5.8
2005	76	0.296	31.4	1.3
2006	111	0.517	25.9	14.8
Mean	77.5	0.282	33.0	8.5

LB – late blight; DAP – days after planting

It is essential to remember that in potato production the meteorological conditions and in particular precipitation during the growing season play an important role in tuber formation. It must be also remembered that the amount of rainfall affects more the size of the yield than pathogens infecting potato plants, especially when the disease occurs late in the season.

However, the presence of pathogen is the critical factor in health of tubers. Scale of tubers with LB symptoms varied in particular years. As previously noted there was no correlation between timing of LB appearance and rate of tuber infection. In the years with a very late occurrence of the disease (2006, 2003 and 1999) there was high number of infected tubers (2003 and 2006). The highest infection of tubers was recorded in 2003 (21.8%), 1998 (19.5%) and 2006 (14.8%). High incidence of LB on tubers was related with high rainfall in August and September. A very high tuber infection in 2003 might be correlated with pathogen virulence. These results indicate that in spite of time of disease occurrence, potato crops should be protected until the end of growing season.

In contrast to the results just presented, there are years referred to as "late blight years" with a very early LB occurrence (for instance 1997) and the pathogen pressure so high that the plants get destroyed very early (2005 season) but the tuber infection is low (0.6% and 1.3%, respectively). This happens very rapidly. The disease develops very quickly due to high infection pressure and in consequence, unprotected plants die and thus there is no source of pathogen inoculum.

Based on long-term 10-year observations it can be stated that there are several factors affecting time of disease occurrence in the field, disease rate development, tuber yield size and health of tubers. These factors are biological (inoculum source, pathogen infection pressure and virulence), environmental (meteorological elements particularly a course of precipitation during a growing season) and host plant features, i.e. vegetative propagation cloning. Due to high genetic variability of the pathogen and lack of apparent criteria of infection pressure evaluation and correlation between host plant growth and meteorological conditions it is critical to monitor *P. infestans* development on standard cultivars in plots for correct protection against late blight.

REFERENCES

Andersson B., Sandström M., Strömberg E. 1998. Indications of soil borne inoculum of *Phytophthora infestans*. Potato Res. 41: 305–310.

Brurberg M.B., Hannukkala A., Hermansen A. 1999. Genetic variability of *Phytophthora infestans* in Norway and Finland as revealed by mating type and fingerprint probe RG57. Mycol. Res. 103: 1609–1615.

Dowley L.J., O'Sullivan E. 1995. Potato Late Blight Control. Technical Manual. Teagasc, Agriculture and Food Development Authority, 29 pp.

Drenth A. 1994. Molecular Genetics Evidence for a New Sexually Reproducing Population of *Phytophthora infestans* in Europe. Ph.D. Thesis, Wageningen, The Netherlands, 150 pp.

Duvauchelle S., Lherbier V. 1996. *Phytophthora infestans* evolution for the last fifteen years. 13th Triennial Conference of EAPR, Veldhoven, The Netherlands: 350–351.

Flier W.G., Turkensteen L.J. 1999**.** Foliar aggressiveness of *Phytophthora infestans* in three potato growing regions in the Netherlands. Eur. J. Plant Pathol. 105 (4): 381–388.

Fry W.E. 1994. Role of early and late blight suppression in potato pest management. p. 166–177. In: "Advances in Potato Pest Biology and Management" (G.W. Zehnder, M.L. Powelson, R.K. Jansson, K.V. Raman, eds.). The APS Press, St. Paul.

Fry W.E., Goodwin S.B., Dyer A.T., Matuszak J.M.,Drenth A., Tooley P.W., Sujkowski L.J., Ko YJ., Cohen B.A., Spielman L.J., Deahl K.L., Inglis D.A., Sandlan K.P. 1993. Historical and recent migrations of *Phytophthora infestans* chronology, pathways and implications. Plant Dis. 77: 653–661.

Hansen J.G., Lassen P., Koppel M., Valskyte A., Turka I., Kapsa J. 2003. Web-blight – regional late blight monitoring and variety resistance information on Internet. J. Plant Prot. Res. 43: 263–273.

Hermansen A., Amundsen T. 1996. Mating types of *Phytophthora infestans* in selected fields in Norway in 1995. 13th Triennial Conference of EAPR, Veldhoven, The Netherlands: 270–271.

Hermansen A., Hannukkala A., Naerstad R.H., Brurberg M.B. 2000. Variation in populations of *Phytophthora infestans* in Finland and Norway: mating type, metalaxyl resistance and virulence phenotype. Plant Pathol. 49 (1): 11–22.

Hoffman G.M., Schmutterer H.O. 1983. Parasitäre Krankheiten und Schädlinge an landwirtschaftlichen Kulturpflanzen. Verlag Eugen Ulmer. Stuttgart.

Kapsa J. 2001. Zaraza (*Phytophthora infestans* /Mont./de Bary) występująca na łodygach ziemniaka. Monogr. i Rozpr. Nauk. 11. IHAR Radzików, 108 pp.

Kapsa 2004. Zmiany stanu zagrożenia i ochrony plantacji ziemniaka przed zarazą (*P.infestans*) w Polsce na tle krajów europejskich. Prog. Plant Protection/Post. Ochr. Roślin 44: 129–137.

Large E.C. 1952. The interpretation of progress curves for potato blight and other plant diseases. Plant Pathol. 1: 109–117.

Pietkiewicz J.B. 1989. Zwalczanie zarazy ziemniaka. Instrukcja Upowszechnieniowa 1/89. Instytut Ziemniaka, Bonin, 20 pp.

Rowe R.C. 1996. Late blight biology – understanding the enemy. p.1–6. In: "Proceeding. 1996 Washington Potato Conference and Trade Show" (M.L. Powelson, R.K. Jansson, K.V. Raman, eds.). The APS Press, St. Paul.

Shattock R.C. 1988. *Phytophthora infestans* (Mont.) de Bary. p. 202–204. In: "European Handbook of Plant Diseases" (I.M. Smith, J. Dunez, R.A. Lelliott, D.H. Phillips, S.A. Archer, eds.). Blackwell Scientific Publications.

Sujkowski L.S., Goodwin S.B., Dyer A.T., Fry W.E. 1994. Increased genotipic diversity via migration and possible occurrence of sexual reproduction of *Phytophthora infestans* in Poland. Phytopathology 84: 201–207.

Sujkowski L.S., Goodwin S.B., Fry W.E. 1996. Changes in specific virulence in Polish populations of *Phytophthora infestans*: 1985–1991. Eur. J. Plant Pathol. 102: 555–561.

Turkensteen L.J., Flier W.G., Van Baarlen P. 1996. Evidence for sexual reproduction of *Phytophthora infestans* in an allotment garden complex in the Netherlands. 13th Triennial Conference of EAPR, Veldhoven, The Netherlands: 356–357.

Van der Plank J.E. 1963. Plant Disease: Epidemics and Control. Academic Press, New York, 349 pp.

Zarzycka H., Sobkowiak S. 1997. Ocena zmian zachodzących w polskiej populacji *Phytophthora infestans* (Mont.) de Bary. Biul. Inst. Ziemn. 48 (I): 125–135.

POLISH SUMMARY

WPŁYW WARUNKÓW KLIMATYCZNYCH NA ZMIENNĄ PRESJĘ INFEKCYJNĄ *PHYTOPHTHORA INFESTANS* I JEJ SZKODLIWOŚĆ NA PLANTACJACH ZIEMNIAKA

W ciągu ostatnich lat w całym świecie obserwuje się zwiększenie potencjału infekcyjnego *Phytophthora infestans*, spowodowane genetycznymi zmianami składu populacji patogena. Występowanie *P. infestans* na roślinach ziemniaka we wczesnym stadium ich rozwoju wskazuje na możliwość występowania innych źródeł infekcji takich jak chore sadzeniaki i samosiewy i wzrastającą ich rolę w epidemiologii choroby. Zmiany te prowadzą do wcześniejszego rozwoju epidemii, większego niż poprzednio nasilenia choroby, oraz zmian w rozwoju pierwszych objawów infekcji *P. infestans* na roślinach ziemniaka.

W latach 1997–2006 w Zakładzie Nasiennictwa i Ochrony Ziemniaka IHAR w Boninie prowadzono ścisłe badania nad presją infekcyjną *P. infestans* i rozwojem zarazy ziemniaka w zależności od warunków meteorologicznych. Jako kryterium oceny presji infekcyjnej patogena przyjęto procent zniszczenia naci przez zarazę pod koniec okresu wegetacji i powierzchnię pod krzywą postępu choroby w czasie (AUDPC) oraz tempo rozwoju zarazy, obliczane jako przyrost zniszczenia naci w jednostce czasu, a także wysokość plonu bulw i jego zdrowotność.

Obserwacje wykonane w Boninie wykazały, ze zarówno termin wystąpienia choroby jak i jej nasilenie różniły się w zależności od warunków meteorologicznych jak i roku. Najwcześniejsze występowanie zarazy w Boninie obserwowano w 2001 roku (42 dni po sadzeniu). Termin wystąpienia choroby zależał od ilości opadów w maju i czerwcu. Bardzo wysokie tempo rozwoju patogena obserwowano szczególnie w latach 2006 (0,517) i w 2004 (0,400), niezależnie od późnego terminu wystąpienia choroby w sezonie. W tych latach AUDPC na niechronionej kontroli wynosiło odpowiednio 0,071 i 0,508.

Dziesięcioletnie obserwacje prowadzone w Boninie wykazały, że wysokość plonu i występowanie zarazy bulw zależy przede wszystkim od układu warunków meteorologicznych w sezonie.