A COMPARISON OF URBAN AND SUBURBAN OCCURRENCE OF *ERYSIPHALES* WITH SPECIAL EMPHASIS ON DEGREE OF HOST INFECTION

MARIA DYNOWSKA

Department of Botany, Institute of Botany, Pedagogy College,
Żołnierska 14, 10-561 Olsztyn, Poland

(Received: July 12, 1993. Accepted: October 28, 1994)

ABSTRACT

The occurrence of *Erysiphales* in selected regions of Northern Poland was studied in detail between 1981 to 1991. Special attention was paid to the degree of infection of host plants caused by powdery mildew. More species of fungi were found in urban regions, but in several cases the severity of lesions was greater in suburban areas. A hypothesis is put forth that urban environmental pollution inhibits the development of the studied fungi.

KEY WORDS: host plants, immunity, urban pollution, physiological changes, powdery mildew, lesions.

INTRODUCTION

Most of the studies done on *Erysiphales* (powdery mildew) deal with the systematics or phytopathology of these fungi (Kochman 1960, Kućmierz 1967, Madej 1969, 1971, 1972, Sałata and Romaszewska-Sałata 1969, Majewski 1970, 1971, 1972, Mikołajska and Dynowska 1982, Sałata 1985). Only very few studies have addressed ecological aspects related to the intensity of infection by these fungi or compare these indices in urban and suburban areas (Mikołajska 1960, 1974, Orłowski 1961, Majewski 1971, Kućmierz 1973, Durska 1974).

This paper presents the results of long-term observations carried out between 1981-1991 in the cities of Olsztyn, Brodnica, Biała-Piska and Płock and the cities of Olsztyn, Brodnica, Biała-Piska and Płock and the surrounding areas.

MATERIAL AND METHODS

The study was carried out on material obtained from herbarium collections of the Department of Botany, Institute of Botany of the Pedagogy College in Olsztyn and material collected by this author. The lesions on host plants were graded according to a formula given by Dobrozhakova (1966):

$$R = \frac{(a \times b) \times 100}{N \times 4}$$

Where:

- R – disease coefficient in percent (index)
- (a + b) – sum of products obtained by multiplying the number of examined organs of a plant by their given grade of lesion severity
- N – total number of examined plants (or leaves)
- 4 – maximal degree of lesion severity in a fivepoint scale of 0 to 4.

The fungi were identified according to Blumer (1967), Junell (1967) and Sałata (1985); the host plants according to Szafer et al. (1976), updating the nomenclature according to Jasiewicz (1984).

RESULTS

A total of 48 *Erysiphales* species were identified on 112 host species belonging to 35 families. Most of the fungi were found on representatives of following families: *Compositae*, 25 species; *Papilionaceae*, 13; *Labiata*, 11.

The most frequent fungi was *Erysiphae*, 24 species (50%); *Sphaerotheca*, 9 (19%); *Microsphaera* 8 (17%); *Uncinula*, 3 (6%); *Leveillula*, *Phyllactinia* and *Podosphaera*, 1 each (2%). Conidial stages, oidia, (Fig. 1) made up only a small fraction of the observed fungi.

Forty-three species of fungi were isolated from urban areas, 24 from suburban regions. Only these species were taken into account in comparing the severity of infection.

Very distinct differences were found in the degree of infection of host species. The highest coefficient of disease was found in *Cucurbitaceae*, 95%; *Moraceae*, 91.6%; *Plantaginaceae*, 88.5% and *Dipsacaceae*, 80.6%. The lowest in *Valerianaceae*, 10%; *Papaveraceae*, 11.1% and *Graminae*, 25%.

A comparison was also made of the disease coefficients of 4 selected host species that occur in the entire studied area: *Taraxacum officinale*, *Heracleum sphondylium*, *Plantago major* and *Quercus robur* (Fig. 2).

DISCUSSION

Parasitic fungi are a very important link in the biocenosis chain. Their presence in a habitat is primarily dependent on the occurrence of a host there. However, the presence of such

Fig. 1. Percentages of the fungi species studied.

a plant does not necessarily mean that a parasitic fungus will appear on it. Fungi that always or almost always occur with a host plant are very rare. Most often, parasitic fungi are less widespread than their hosts. This is true even in respect to species commonly thought to be ubiquitous.

Majewski (1971) finds various reasons for this fact. A fungus may have greater ecological requirements than its host, or it may not occur, even under favorable conditions, if its host's presence is sporadic.

The results of this study support the view that environmental requirements should always be taken into consideration along with the quality of the environment and the immunological characteristics of both coexisting organisms. An array

of biocenotic factors always acts on the fungus. Among these factors are some that may restrict its occurrence, others may completely inhibit it (Majewski 1971, Kućmierz 1973). A general rule of nature is to maintain the highest possible number of species within one systematic group in two- or multi-specific (preferably symbiotic) sets of species. A change in the external conditions can affect each of the partners in such sets; the weakening of one may strengthen another.

A parasitic fungus has a strong influence on the general character of the processes occurring in plant cells, evoking metabolic changes in a manner favourable for itself (the fungus). The more highly specialized the parasite, the better it is adapted to a particular host's metabolic processes (Rubin, Ar-

Fig. 2. Degree of lesions in urban and suburban regions.

cichowska 1971). This high degree of adaptation that favours the survival and expansion of a species, reduces its adaptability, so that even small changes in the metabolism of a parasite or host can inhibit the parasite from attacking a plant. The unfavourable aspect of this relationship is the ease with which specialized parasites can adapt to resistant varieties of plants. This holds in particular to obligatory parasites, such as the *Erysiphales*.

The results presented in this study show that the representatives of the families attacked by the largest number of powdery mildew species did not show the highest disease coefficient. The severity of infection was only partially dependent on the number of parasitic species the plant was hosting. This conclusion is corroborated by Durska (1974). According to her, the number of attacking parasitic species depends mainly on the distribution of these pathogens, less on the fact if the affected plant is a host for one or many fungi.

Our results show that the severity of infection in *Cucurbitaceae*, *Moraceae* and *Plantaginaceae* was very high, despite the fact that number of attacking species was low. This may point to the low resistance of the hosts and the very good condition of the parasites. Conversely, *Compositae*, *Papilionaceae* and *Labiata*, families whose representatives are attacked by the highest number of powdery mildew species, had much lower disease coefficients. It can be assumed that this is related to these plants' greater resistance.

It was noticed that the studied fungi occurred more intensely in cities than in the suburbs. Their number increased in proportion to the degree of environmental pollution (near-by roads, exhausts, railway tracks, industrial plants). The infection severity, however, did not show a similar pattern. In the cases of *Microspheera aliphitoides* on *Quercus*; *Erysiphae cichoracearum* on *Taraxacum officinale* and *E. heraclei* on *Heracleum sphondylium*, a higher disease index was found in the suburbs. These plant species are probably more sensitive to urban pollution than the remaining studied species. Bevan and Greenhalg (1976) found a similar pattern with *Rhynisma acerinum*. This fungus clearly reacts to the level of sulphur dioxide in the atmosphere. In cities with a high degree of pollution, *Rh. acerinum* rarely occurs and is only slightly pathogenic for its hosts. In addition to lichens, this fungus is considered a natural indicator of air pollution (Vick, Bevan 1976, Chlebicki 1989).

Temperature, humidity, illumination, oxygen supply and carbon dioxide levels are the basic physical factors directly affecting the growth and development of fungi. During spore germination the oxygen demand rises several-fold. Hyphae are not produced in environments lacking oxygen. Inhibition of fungus growth is proportional to the carbon dioxide concentration (Rubin, Arcichowska 1971). The carbon dioxide concentration in an urban environment is much higher than in the suburbs. It can not be excluded that some *Erysiphales* also react with poorer growth to carbon dioxide.

Observations on the influence of environmental factors on the development of pathogenic fungi should take into account the highly adaptable metabolism that is so characteristic for these organisms. Their ability to adjust to changing environmental conditions, resistance to harmful factors, are best illustrated by their synthesis of adaptive enzymes (Rubin, Arcichowska 1971). In cases of very high environmental pollution, these enzymes probably cannot be produced in the same amounts as usual, thus the development of the fungus is impeded.

In summary, more *Erysiphales* species were found in urban areas, but the severity of infection by them was, in several

cases, higher in suburban regions. This observation requires further study, especially physical and chemical studies of the environment and of the changes in the physiology of the host plant, which is the direct breeding site of the fungi.

The problems presented in this study have only been broadly signalized, although the results may shed a little light on the occurrence of *Erysiphales* in the natural environment in Poland, as well as in settings that demonstrate a strong anthropogenic influence.

LITERATURE CITED

- BEVAN R.J., GREENHALG G.N., 1976. *Rytisma acerinum* as biological indicators of pollution. Environ. Pollut. 10: 271-185.
- BLUMER S., 1976. Echte Mehltäupilze (*Erysiphaceae*). VEB Gustav Fischer Verlag Jena: pp. 436.
- CHLEBICKI A., 1989. Test grzybowy. Inst. Bot. PAN, Łowicz Polski 9: 29.
- DOBROZRAKOVA T.L., 1966. Selskochozajstvennaja fitopatologia. Kolos, Leningrad: pp. 380.
- DURSKA B., 1974. Studia nad grzybami pasożytniczymi roślin występujących w litoralu zbiorników wodnych Pojezierza Mazurskiego. Acta Mycol. 10 (1): 73-141.
- JASIEWICZ A., 1984 (1986). Nazwy gatunkowe roślin naczyniowych flory polskiej. Fragm. Flor. et Geobot. 30, Pars 3.
- JUNELL L., 1967. *Erysiphaceae* of Sweden. Symbolae Bot. Uppsala. 19: 1-117.
- KOCHMAN J., 1960. O nowych dla Polski mączniakach prawdziwych. Acta Agrobot. 9: 89-97.
- KUĆMIERZ J., 1967. Materiały do flory grzybów pasożytniczych Polski. Roczn. Nauk.-Dydakt., WSP Kraków 28: 93-107.
- KUĆMIERZ J., 1973. Grzyby pasożytnicze w zbiorowiskach roślinnych Ojcowskiego Parku Narodowego. Ochr. Przyr. 38: 155-212.
- KUĆMIERZ J., 1976. Flora grzybów pasożytniczych Pienin. Fragm. Flor. et Geobot. 22: 377-393.
- MADEJ T., 1969. Mikroflora roślin zielonych ogrodu dendrologicznego w Pszelewicach. Fragm. Flor. et Geobot. 1: 99-110.
- MADEJ T., 1971. Notatki mikologiczne ze Świnoujścia. Fragm. Flor. et Geobot. 3: 413-424.
- MADEJ T., 1972. Materiały do mikoflory miasta Szczecina. Acta Mycol. 8: 35-45.
- MAJEWSKI T., 1970. Przyczynek do flory grzybów pasożytniczych Zachodniego Pomorza. Acta Mycol. 6: 77-94.
- MAJEWSKI T., 1971. Grzyby pasożytnicze Białowieckiego Parku Narodowego na tle mikroflory Polski. Acta Mycol. 7: 299-388.
- MAJEWSKI T., 1972. Rzadkie i nowe dla Polski gatunki *Erysiphaceae*. Acta Mycol. 8: 218-227.
- MIKOŁAJSKA J., 1960. Z badań nad występowaniem i ekologią chorób traw pochodzenia grzybowego. Zesz. Nauk. WSR Olsztyn 10: 403-408.
- MIKOŁAJSKA J., 1974. Badania pojawów grzybów pasożytniczych traw na tle zmian ekologicznych siedliska łąk doliny Łyny. Zesz. Nauk. ART Olsztyn, Rolnictwo 6: 3-50.
- MIKOŁAJSKA J., DYNOWSKA M., 1982 (1986). Materiały do znajomości grzybów pasożytniczych Pojezierza Mazurskiego. I. *Erysiphales*. Acta Mycol. 18: 213-222.
- ORŁOŚ H., 1961. Badania ekologiczne nad mikroflorą niektórych typów lasu w Białowieckim Parku Narodowym. Prace IBL 229: 57-106.
- RUBIN B., ARCICHOWSKA J., 1971. Biochemia i fizjologia odporności roślin. PWRiL Warszawa, pp. 320.
- SALAŁA B., 1985. Grzyby (*Mycota*). Workowce (*Ascomycetes*). Mączniakowe (*Erysiphales*). T. 15, PWN Warszawa, pp. 308.
- SALAŁA B., ROMASZEWSKA-SALAŁA B., 1969. Materiały do znajomości grzybów pasożytniczych Lubelszczyzny. Ann. UMCS 24: 73-86.

SZAFER W., KULCZYŃSKI S., PAWŁOWSKI B., 1976. Rośliny Polskie. PWN Warszawa, pp. 1020.

VICK C.M., BEVAN R.J., 1976. Lichenes and far spot fungus (*Rhytisma acerinum*) as indicators of sulphur dioxide pollution on Yersey side. *Envir. Poll. Liverpool* 11: 203-216.

PORÓWNANIE WYSTĘPOWANIA GRZYBÓW Z RZĘDU *ERYSIPHALES* NA TERENACH MIEJSKICH I POZAMIEJSKICH ZE SZCZEGÓLNYM UWZGLĘDNIENIEM STOPNIA PORĄŻENIA

STRESZCZENIE

W latach 1981-1991 przeprowadzono badania nad występowaniem grzybów z rzędu *Erysiphales* na terenie Olsztyna, Brodnicy, Białej Piskiej, Płocka oraz najbliższych okolicach tych miejscowości. Ogółem zebrano 48 gatunków mączniaków na 112 roślinach należących do 35 rodzin: w miastach – 45 gatunków, poza miastem – 24, 19 gatunków było wspólnych. Zauważono, że badane grzyby w miastach występują z większą intensywnością niż na terenach pozamiejskich, ale indeks choroby w szeregu przypadkach jest wyższy poza miastem. Przypuszcza się, że grzyby reagują na zanieczyszczenia miejskie słabszym rozwojem. Mimo ich ogromnej plastyczności nie potrafią przystosować się.

Stwierdzono, że przedstawiciele roślin żywicielskich atakowanych przez największą liczbę *Erysiphales* nie ulegają porażeniu w najwyższym stopniu przez te grzyby. Stopień porażenia jest tylko częściowo zależny od tego dla ilu gatunków pasożytniczych dana roślina jest żywicielem. Najwyższy wskaźnik choroby był w rodzinie *Cucurbitaceae* – 95% i *Moraceae* – 91.6% oraz *Plantaginaceae* – 80.6%; najniższy w rodzinie *Graminae* – 25%, *Papaveraceae* – 11.1% i *Valerianaceae* – 10%. Najliczniej reprezentowany był rodzaj *Erysiphae* – 24 gatunki, *Sphaerotheca* – 9 gatunków, *Microsphaera* – 8, *Uncinula* – 3, *Leveillula*, *Phyllactinia* i *Podosphaera* – po 1 gatunku. Znikomy procent stanowiły stadia – *Oidium*.

SŁOWA KLUCZOWE: rośliny żywicielskie, stopień porażenia, odporność, zanieczyszczenia miejskie, zmiany fizjologiczne.