Soybean diseases in Poland

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Abstract

Field observations on the occurrence of soybean diseases were undertaken in the southern and central regions of Poland in the period 1976-1980. Most prevalent were foliage diseases caused by Peronospora manshurica, Pseudomonas syringae pv. glycinea and soybean mosaic virus (SMV). Sclerotinia sclerotiorum and Ascochyta sojae cola were reported as pathogens of local importance. The following pathogenic fungi: Botrytis cinerea, Fusarium culmorum, F. oxysporum and Rhizoctonia solani were also isolated from soybean.

INTRODUCTION

Fungi are the most numerous soybean pathogens (Sinclair and Shurtleff, 1975). Among them Peronospora manshurica (Naum.) Syd. et Gaum. is of an economic importance in some cultivation regions. Downy mildew caused by this fungus has been reported from Romania (Rosca, 1975), Yugoslavia (Acimovic, 1976) and North America (Hildebrand and Koch, 1951; Dunleavy, 1971). The pathogens which might be of great local importance were Sclerotinia sclerotiorum (Lib.) de Bary and Ascochyta sojae cola Abramov. Sclerotinia stem rot occurred often in Romania (Hulea et al., 1973) and France (Signoret et al., 1976) while ascochyta blight was commonly noted in Germany (Frandsen, 1953) and Hungary (Toth and Kovics, 1978).

The bacterium Pseudomonas syringae pv. glycinea (Coerper) Young, Dye and Wilkie causing bacterial blight of soybean was observed quite often in the north regions of the United States (Daft and Leben, 1972), Soviet Union (Klykov, 1963), France (Signoret et al., 1976) and Austria (Zwatz, 1979).

Of several soybean virus diseases which have been reported (Muraveva, 1968; Sinclair and Shurtleff, 1975), soybean mosaic caused by soybean
mosaic virus <SMV> occurs most often and is of the greatest economic importance. Symptoms of this disease were described by many investigators <Gardner and Kendrick, 1921; Sinclair and Shurtleff, 1975>.

Soybean is a new crop in Poland which has been recently introduced for cultivation by plant breeders. The objective of this observation was to determine the soybean pathogens in our country as well as the severity of the occurring diseases.

MATERIAL AND METHODS

Field observations on disease occurrence were done on 2-3-week-old seedlings and on plants in stages of blooming and pod formation. Records were made when the symptoms were most pronounced at the time of the highest pathogens population development. Occurrence of soybean diseases on experimental plots and on production fields was estimated in the south-east <districts of Zamość, Rzeszów, Przemyśl, Tarnobrzesz>, south-west <districts of Opole, Wrocław> and in central Poland <district of Warsaw>.

Pathogens were identified in the fields on the basis of disease symptoms. A more detailed description was prepared in the laboratory. Fungi were identified by considering the structure of the mycelium and their sporulation <the following keys were used: Abramov, 1931; Arx von, 1974; Booth, 1971; Gänzmann, 1923, Purdy, 1955>.

Bacteria were identified by the following tests: Gram stain, growth on Kado's D4 medium for Pseudomonas spp. <Kado and Heskett, 1970>, fluorescein production on King B agar, levan formation, hypersensitive reaction on tobacco <Lelliott et al., 1966>.

The virus was identified on the basis of symptoms which occurred on soybeans, the reaction of indicator host plants, host range and physical properties. Chenopodium quinoa and Chenopodium album were used as indicator host plants. Biological tests were carried out in the greenhouse by mechanical sap inoculations with the use of carborundum.

The pathogenicity of collected fungi, bacteria and virus isolates was confirmed in greenhouse tests.

The severity of downy mildew and bacterial blight was calculated according to the modified INTSOY disease index, as follows: 0 — no symptoms; 1 — a few small spots on about 5% of plants; 2 — a few spots on max. 25% of plants; 3 — some small spots on all plants or more extensive merging lesions on about 50% of plants; 4 — numerous spots differing in size, coalescing, often necrotic on about 75% of plants; 5 — symptoms as in 4 but on all plants. The incidence of soybean mosaic in the field was given as per cent of infected plants. Plants showing typical symptoms of soybean mosaic were considered to be infected.
RESULTS

Soybean seedling blight, so far, is of minor importance in Poland (Table 1). Among the causal agents more prevalent were *Fusarium culmorum* and *Ascochyta sojaecola* while *Fusarium oxysporum* and *Rhizoctonia solani* appeared quite seldom.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Year of observation</th>
</tr>
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<tbody>
<tr>
<td>Downy mildew</td>
<td>8/15*</td>
</tr>
<tr>
<td>Ascochyta blight</td>
<td>15/15</td>
</tr>
<tr>
<td>Sclerotinia stem rot</td>
<td>7/15</td>
</tr>
<tr>
<td>Gray mold</td>
<td>15/15</td>
</tr>
<tr>
<td>Fusarium seedling blight</td>
<td>0/15</td>
</tr>
<tr>
<td>Rhizoctonia damping-off</td>
<td>0/15</td>
</tr>
<tr>
<td>Bacterial blight</td>
<td>15/15</td>
</tr>
<tr>
<td>Soybean mosaic</td>
<td>15/15</td>
</tr>
</tbody>
</table>

*8/15 disease was observed on 8 of 15 fields.*

Some fungal diseases on older plants occurred commonly (Table 1). Downy mildew caused by *Peronospora manshurica* appeared usually on soybean in the beginning of July. Further development and intensity of disease depended first of all on the air humidity in the consecutive years and in different locations (Table 2). However, severe downy mildew development was usually observed in the last

<table>
<thead>
<tr>
<th>Location and district</th>
<th>Year</th>
<th>Varieties and line (A)</th>
<th>Varieties and line (B)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Acme</td>
<td>Ajma</td>
</tr>
<tr>
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<td>1977</td>
<td>3.5</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>1978</td>
<td>4.5</td>
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</tr>
<tr>
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<td>1979</td>
<td>2.75</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>1980</td>
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</tr>
<tr>
<td></td>
<td>1977</td>
<td>–</td>
<td>3.5</td>
</tr>
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<td>3.0</td>
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<td>1980</td>
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<td>1.75</td>
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<tr>
<td></td>
<td>1977</td>
<td>3.3</td>
<td>0</td>
</tr>
<tr>
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<td>1978</td>
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<td>0.25</td>
</tr>
<tr>
<td>Przemyśl</td>
<td>1979</td>
<td>2.0</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>3.25</td>
<td>2.25</td>
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</table>
ten days of August during cool nights accompanied by a longlasting dew on the foliage. In circumstances of high disease severity numerous, pale green spots of secondary infection were produced on the leaves next to brown necrotic lesions. On the lower leaf surface spots were covered with grayish conidiophores (Figs. 1, 2). On soybean seeds mycelium and oospores of *Peronospora manshurica* were noted.

![Image of leaf with mildew symptoms](image)

*Fig. 1, 2. Diversity of downy mildew symptoms on the soybean leaves*

*Ascochyta sojaecola* could affect leaves, petioles, stems and pods of soybean. Spots on leaves appeared first on the lower part of the plant where the fungus had favourable humidity conditions for infections (Fig. 3). On young leaves single, round, brown, often with darker margin spots were produced. On older yellowish leaves spots were more numerous. Symptoms on stems occurred as brown
elongated streaks. The lesions were covered later with dark pycnidia of the causal fungus. Symptoms of ascochyta blight on pods were diversified; from small spots to browning of intact poorly developed pods (Fig. 4). *Ascochyta* blight disease developed best on plants from the midseason to maturity of the crop. At that time the disease could commonly occur (Table 1). As the consequence of stem branchings infection, dying of side stem was observed (Fig. 5).

Fig. 3. Ascochyta blight on stem

Fig. 4. Ascochyta spots on the soybean leaves
Sclerotinia stem rot caused by *Sclerotinia sclerotiorum* was reported only from some fields (Table 1). The fungus commonly attacked the lower part of the stem which became soon rotten. Brownish lesions were covered next with cottony whitish mycelium encrusted with black sclerotia (Fig. 6). Soybean plants were killed prematurely as the results of infection.

*Botrytis cinerea* the causal fungus of gray mold was locally noted usually on soybean stems in wet seasons on a high density plantation. The fungus especially affected plants in the maturity period.

Bacterial blight symptoms appeared first on cotyledons. Then, depending on an air moisture *Pseudomonas syringae* pv. *glycinea* could be at once carried onto the developing leaves or the bacteria were able to survive on cotyledons. Spots on leaves first small, yellow, angular, watersoaked soon became brown (Fig. 7). The
spots frequently conglomerated and necrotic tissue dropped or was torn away giving the leaves a ragged appearance (Fig. 8). Similar spots and also dark brown streaks appeared on pods (Fig. 9). Bacterial blight of soybean of different intensity was noted even in the same region according to the air humidity and temperature (Table 2).

Fig. 7. Symptoms of bacterial blight on soybean leaves

Fig. 8. Effect of infection by Pseudomonas glycinea on soybean leaves
Of soybean virus diseases only soybean mosaic caused by SMV was found in Poland. This disease was common everywhere but its incidence was always very low (Table 3). During four years the tested varieties and lines showed infection, ranging between zero and 5.45%, although mostly infection was lower than 1% of infected plants.

Table 3

Soybean infection by soybean mosaic virus during 1977-1980 (per cent of infected plants)

<table>
<thead>
<tr>
<th>Location and district</th>
<th>Year</th>
<th>Varieties and line</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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<td></td>
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<td></td>
<td>1978</td>
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</tr>
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<td>Jankowice</td>
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</table>

Disease symptoms, which occurred in the field (Fig. 10), were similar to typical symptoms produced by SMV. The leaves of diseased plants were mottled, puckered, distorted, asymmetric, stunted and often curled downwards at the
margins. Some diseased plants were stunted with shortened petioles and internodes. Generally a reduction in the number and size of pods and seeds occurred. Some infected plants produced seeds with mottled seed coats. As maturity approached, the leaves of infected plants remained greener longer than those of healthy plants. Mosaic symptoms were best seen during the blooming stage of soybean. In Poland this period is recorded from the end of June to the beginning of August.

Fig.10. Symptoms of soybean mosaic on leaves

DISCUSSION

In Poland like in the other countries of moderate climate, characterized by heavy rainfalls, most prevalent are foliage diseases such as downy mildew, bacterial blight and soybean mosaic (Hildebrand, 1948; Mikhailenko, 1965). Diseases characteristic for intensive soybean plantations were mostly caused by soil pathogens like Phytophthora magasperma f. sp. glycinea Kuan and Erwin, Rhizoctonia solani Keuhn, Cephalosporium gregatum Allin. and Chamberl., Macrophomina phaseolina (Tassi) Goid (Sinclair and Shurtleff, 1975). Since soybean is a new crop in our country, so far grown on a small area, the soil pathogens do not seem to be of any importance for a long time.

Ascochyta blight reported very seldom from some countries (Abramov, 1931; Frandsen, 1953; Toth and Kovics, 1978) was widespread on soybean in Poland. Nevertheless, this disease was not so dangerous as downy mildew because Ascochyta sojaecola attacked older, maturing plants. On the other hand, downy mildew seems to be an important disease on soybean since Peronospora
manshurica appeared on young plants and usually with high intensity. The two former diseases could be treated as common, while sclerotinia stem rot was a typically local disease. Sclerotinia sclerotiorum was a fungus of wide host-range plants and survived in the soil over the next seasons, thus the forecrop determined the soybean damage and yield losses. One of the widespread fungi causing soybean pod and stem blight has been Phomopsis sojae Leh. The disease was of economic value in the United States of America (Kmetz et al., 1978; Hepperly and Sinclair, 1978), Brazil (Bölkán et al., 1976) and Soviet Union (Zhukovskaya, 1977). In these regions the pathogen commonly reduced seed germination and seedling emergence, whereas in Poland it was found only once on seeds.

Pseudomonas syringae pv. glycinea was the only bacterial pathogen noted on soybean in Poland, another one Xanthomonas phaseoli var. sojensis (Hedges) Starr and Burkholder developed best in warmer regions (Khare et al., 1971; Polanco, 1974; Bakaeva, 1975).

Soybean mosaic caused by SMV as in other countries (Muraveva, 1969; Murayama and Han, 1971; Signoret et al., 1976; Irwin and Goodman, 1980) is also common in Poland but its incidence is low. One of the reasons for the low incidence of this disease could have been the low degree of SMV transmission by soybean seeds. It was found in Poland that only 0.2% of soybean seeds transmitted this virus. In Japan (Takahashi et al., 1974) the rate of seed transmission varied from zero to 76%. In the southern United States (Demske and Harris, 1974) seed transmission was found to be only 1% or less. The percentage of virus-infected seeds to a large extent determines the incidence of soybean mosaic, because systemically infected plants which arise from infected seeds are a primary source of infection.

Because SMV is found everywhere and it is transmitted by soybean seeds, easily in a nonpersistent manner by aphids and mechanically by sap, so soybean mosaic may become a dangerous soybean virus disease in Poland.

In the future with an increased area of cultivation there may appear within the country other soybean diseases of economic importance.

REFERENCES


Występowanie chorób soi w Polsce

Streszczenie