

Fungus diseases of field bean in Finland during 1975–1977

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Abstract. During 1975–1977, studies were carried out on the fungus diseases of field bean and attempts were made to find, through seed-dusting trials, suitable methods for their control. The fungal flora in a total of 43 seed lots containing 140–200 seeds each were determined. In addition, plant samples collected from farms where field beans were under cultivation and field bean cultivar trials in seven localities were analysed.

The weather conditions in the growing seasons of 1975 and 1977 were rather exceptional, the former being dry and warm and the latter rainy and cool. Ripe crops were obtained from the control experiments, in which the seeds of 3–4 field bean cultivars were dusted with thiram and benomyl preparations, only in 1975 and 1976.

Ascochyta fabae Speg. was rare in all the seed samples apart from those from Länsi-Hahkiala, where the degree of infection varied, depending on the cultivar, from 1.3–20%. *Botrytis fabae* Sard. was rare in the seeds, *B. cinerea* Pers. ex Fr. quite common in 1976 and especially in 1977. The frequency of the *Fusarium* fungi were very great on the seeds in 1977, *F. culmorum* (W. G. Sm.) Sacc. and *F. avenaceum* (Fr.) Sacc. being the most common.

A. fabae was quite common in the stand samples collected at Länsi-Hahkiala in 1975 and 1976. The chocolate spot-causing agents, *B. fabae* and *B. cinerea*, were relatively rare in all years except 1977, when some cultivars were heavily infested by *B. cinerea*.

Introduction

Cultivation of the field bean (*Vicia faba* L.) has greatly increased in the Nordic countries since the last decade. Attention has thus been focused on the fungus diseases affecting the cultivation of this plant and on the possibilities of controlling them.

Information about fungus diseases of *V. faba* is available from, for instance, China (YU 1947), Argentina (SPEGAZZINI 1899), the Soviet Union (CHEKALINSKAYA 1963), Iran (KAISER et al. 1967), England (HEWETT 1973) and Norway (SUNDHEIM 1973). The most important pathogens of this plant have been found to be *Ascochyta fabae* Speg., *Botrytis cinerea* Pers. ex Fr. and *B. fabae* Sard. (all causing leaf lesions), the last mentioned one being more damaging than *B. cinerea* (DEVERALL and WOOD 1961, SUNDHEIM 1973).

The cultivation of field bean in Finland is restricted by the length of the growing season. Almost all the foreign cultivars require too long a growing period to be grown under the conditions prevailing in Finland. Breeding work

using old native varieties from Southeast Finland was therefore started in 1969 at Hankkija's experimental station in Anttila (HOVINEN and KIVI 1976). As a result, one improved cultivar is already on the market — the early and small-seeded Mikko. The aim of this study is to determine the species of fungi causing diseases in stands and seeds of field bean under Finnish conditions and their practical importance.

Material and methods

During 1975–77 a seed-dusting experiment was carried out on the Viikki Experimental Farm. The field bean cultivars Mikko and the native variety Pirhonen were grown throughout the duration of the experiments, the Swedish varieties Sving and Primus in 1975 only, and Arla in 1976 and 1977. Dusting was carried out with benomyl and thiram preparations, in 1975 with the latter only. The dusting trial was combined in 1975 with a cultivar trial which included the cultivars Arla, the German Herz Freya and Hankkija lines 70006 and 70028.

When the seeds were checked for healthiness the number of seeds in each lot was found to vary from 140 to 200. Untreated and surface sterilized seeds were used in 1975, but in subsequent years surface sterilized seeds were used almost exclusively. Seed treatment and incubation was carried out using the same methods as described earlier (RUOKOLA and KÖSSI 1977), with slight modifications. The seeds were soaked for 10 min. in NaClO- (1 % chlorine) solution to destroy saprophytic fungi. In addition to cellulose discs, the seeds were also incubated on weak CM- (12 g/l corn meal (Difco) + 300 ppm streptomycin/l) agar (WCMA) to induce growth of the pathogenic fungi. Plant samples were taken from 7 different localities (Fig. 1), most of them, however being from the experimental field of the Institute of Plant Pathology. Sampling took place during different growth stages.

The microbes were isolated from infected parts of the plants using the method described earlier (RUOKOLA and KÖSSI 1977). CMA, PDA (Difco) and Czapec-Dox agar were used as the growth media. Most of the transfers were soaked for one hour in streptomycin solution (300 ppm l) to inhibit bacteria.

Weather conditions

In 1975 the growing season at the southern sites, i.e. Viikki, Tikkurila and Tuusula, was on average very warm with only slight rainfall. The summer was cooler in Länsi-Hahkiala than at the other localities. Total precipitation here during the growing season was lower than normal.

In 1976, the growing season, apart from in May, was cooler than normal. The monthly precipitation sums were also generally lower than normal. The rather heavy rain in Länsi-Hahkiala in July was exceptional.

In 1977, the start of the growing season at Viikki and Tuusula was warmer than normal and less rain than normal fell in Viikki. The rather cool period which started in the middle of the summer continued up until October and precipitation, especially in July, was heavy.

Results

Seed-dusting trials

A combined seed-dusting and cultivar experiment was set up in Viikki in 1975. A total of eight field bean cultivars were used, four in the dusting experiment and four in the cultivar experiment.

Owing to the severe dry period which occurred during the growing season, the early cultivar, Mikko, was harvested already at the beginning of August and the rest during August. Of these, Primus was the latest, its growing period lasting for 103 days. Seed yields were overall rather low, varying from 1 128 to 1 977 kg/ha, which is rather a lot less than the normal yield of 3 000 kg/ha. There were no significant differences between the yields, weight of 1 000 seeds, volume weight and plant density of the dusted and corresponding undusted test units.

The growing season in 1976 was favourable for the development of *Vicia faba* and hence the seed yields of two of the cultivars used in the dusting experiment, Mikko and Pirhonen, were rather good. The seed yields for Mikko ranged from 4 722 to 5 026 kg/ha and for Pirhonen from 4 085 to 4 511 kg/ha. However, no reliable differences as regards yields were found between different treatments. No crop was obtained from Arla owing to the poor germination of the seeds.

The weather conditions prevailing at Viikki in 1977 were unfavourable for the development of field bean since ripened seeds were not obtained from any of the cultivars used in the experiment.

Identifications of the fungi

Seeds

Altogether a total of 43 seed lots comprising 5 040 seeds were analysed. A total of 3 315 fungus determinations were carried out on these seeds, either the species or at least the genus to which the fungi belonged being determined (Table 1).

The fungal species and the frequency of occurrence of certain species of fungi varied considerably depending upon site type, cultivar and experimental year. In the analyses carried out in 1975, the most diverse microflora were found in the seed lots representing the yields obtained in Länsi-Hahkiala and Viikki (Table 2). The most pathogenic fungi, especially *A. fabae*, were found in the samples from Länsi-Hahkiala. It was most common in the native variety — Pirhonen.

Hardly any *A. fabae* or *B. fabae* fungi were found in the sample lots from Viikki in 1976 and 1977 (Table 3). On the other hand, *B. cinerea* and *Fusarium* fungi were exceptionally common in the seed lots in 1977. The *Fusarium* fungi determined from all the seeds were, in order of frequency, as follows: *F. culmorum* (W. G. Sm.) Sacc., *F. avenaceum* (Fr.) Sacc., *F. sambucinum* Fuckel, *F. poae* (Peck) Wollenw., *F. semitectum* Berk. et Rav., and *F. graminearum* Schw.

Table 1. Determined fungi, no. of infected seeds and their percentage out of all seeds investigated.

| Fungus | No. | % |
|---|-------|------|
| Absidia sp. | 1 | 0.02 |
| Acremoniella atra Corda | 19 | 0.4 |
| Alternaria alternata (Fr.) Keissl. | 120 | 2.4 |
| Arthrinium phaeospermum Fuck. | 5 | 0.1 |
| Ascochyta fabae Speg. | 98 | 1.9 |
| Aspergillus spp. | 31 | 0.6 |
| Aureobasidium pullulans (de Bary) Arnaud | 76 | 1.5 |
| Botrytis cinerea Pers. ex Fr. | 177 | 3.5 |
| B. fabae Sard. | 6 | 0.1 |
| Cephalosporium spp. | 6 | 0.1 |
| Chaetomium spp. | 5 | 0.1 |
| Chrysosporium pannorum Link | 93 | 1.8 |
| Cladosporium spp. | 947 | 18.8 |
| Epicoccum nigrum Link | 1 | 0.02 |
| Fusarium spp. | 188 | 3.7 |
| Fusidium sp. | 1 | 0.02 |
| Gliocladium spp. | 4 | 0.1 |
| Mucor spp. | 290 | 5.8 |
| Ostracoderma state of Peziza ostracoderma Korf | 1 | 0.02 |
| Paecilomyces sp. | 1 | 0.02 |
| Penicillium spp. | 583 | 11.6 |
| Phoma spp. | 133 | 2.6 |
| Rhizoctonia sp. | 1 | 0.02 |
| Rhizopus nigricans Ehrenb. | 433 | 8.6 |
| Scopulariopsis brevicaulis (Bain.) Thom | 1 | 0.02 |
| Sordaria fimicola (Roberge) Ces. & de Not. | 1 | 0.02 |
| Trichoderma viride Pers. ex Fr. | 57 | 1.1 |
| Trichothecium roseum Link | 2 | 0.04 |
| Ulocladium consortiale (Thüm.) Simm. | 33 | 0.7 |
| Verticillium tenerum (Nees ex Pers.) Link | 1 | 0.02 |
| Total | 3 315 | |

In 1977, the *Phoma* species, *P. herbarum* Westend and *P. eupyrena* Sacc., were also isolated from very many samples, in one lot of Mikko seeds about 40 % of the seeds were infected with *P. eupyrena*.

When seed lots with germination percentages of less than 20 were excluded, the germination percentage of the seeds varied from 25 to 100. In 1975, germination clearly decreased as the proportion of seeds in the seed lots from different cultivars which were infected with fungi or bacteria increased, $r = -0.718^*$. In 1976, the correlation between germination percentage and the number of bacteria and fungi isolated from the different cultivars was similar to that found the previous year, $r = -0.712^*$. The seed lots, apart from Mikko ones, were 100 % infected in 1977.

Plant samples

Altogether 39 different species of fungi were isolated from the field bean stands, but part of them were classified only at the genus level. The number

Table 2. Germination of *Vicia faba* seeds and microflora isolated from yield during years 1973–1975.

Number of seeds per sample: 1973–1974 40, 1975 120; WCMA medium; untreated seeds and seeds treated with NaClO and streptomycin. Results combined.

| Site, year and cultivar | Germination, % | Microorganisms | | | | | | | | | | | | | |
|----------------------------|----------------|----------------|------------------------|-------------------------|-----------------|----------------------|---------------------|-----------------------------|--------------------------|-------------------|-------------------------|---------------------------|-------------------------|--------------|--------------|
| | | Pathogens: | <i>Ascochyta fabae</i> | <i>Botrytis cinerea</i> | <i>B. fabae</i> | <i>Fusarium</i> spp. | Common saprophytes: | <i>Alternaria alternata</i> | <i>Cladosporium</i> spp. | <i>Mucor</i> spp. | <i>Penicillium</i> spp. | <i>Rhizopus nigricans</i> | Infrequent fungi, total | Unidentified | Fungi, total |
| Anttila 1973 | | | | | | | | | | | | | | | |
| Primus | 43 | | | | | | | | 12 | 18 | 1 | 12 | | 43 | 9 |
| Mikko | 95 | | | | | | 2 | | | 6 | | | | 8 | |
| Herz Freya | 80 | | | | | | | | 2 | 9 | | 4 | | 15 | |
| Hja 70028 | 95 | | | | | | | | 2 | 3 | | 6 | | 11 | |
| Sving | 100 | | | | | | 1 | | | 4 | | 4 | | 9 | |
| Arla | 83 | | | | | | | | | 1 | 1 | 1 | | 3 | |
| Hja 70006 | 88 | | | | | | | 1 | | | | | | 2 | 1 |
| Pirhonen 1974 ... | 60 | 21 | | | | | 2 | | 1 | 13 | | | | 37 | 2 |
| Viikki 1975 | | | | | | | | | | | | | | | |
| Primus | 51 | 1 | 2 | | | | 2 | 13 | | 20 | 71 | 3 | 9 | 121 | 4 |
| Mikko | 95 | | | | | | | 2 | | 6 | 22 | | 2 | 32 | 1 |
| Pirhonen | 83 | 1 | | | | | | | | 2 | 64 | 3 | | 70 | 1 |
| Herz Freya | 46 | 1 | | | | | 11 | 11 | 2 | 15 | 60 | 3 | 16 | 119 | 10 |
| Hja 70028 | 87 | | | | | | 4 | 1 | | 2 | 26 | 3 | | 36 | 1 |
| Sving | 59 | | | | | | 11 | 10 | | 15 | 80 | 5 | 9 | 130 | 6 |
| Arla | 77 | 1 | | | | | 2 | 3 | | 2 | 44 | 2 | 2 | 56 | |
| Hja 70006 | 91 | | | | | | 6 | 11 | | 23 | | 9 | | 49 | 2 |
| Länsi-Hahkiala 1975 | | | | | | | | | | | | | | | |
| Primus | 85 | 4 | 6 | 2 | 1 | | 1 | 11 | 5 | 16 | | 11 | 7 | 64 | 1 |
| Mikko | 67 | 42 | 1 | | 5 | | | 24 | 2 | 22 | | 16 | 17 | 129 | |
| Pirhonen | 64 | 50 | | | 5 | | 2 | | 4 | 23 | 2 | 23 | 53 | 162 | 2 |

of isolates of the most important fungi was 130 (Table 4). In 1975, leaf sample transfers were taken in the proportion of 2.5: 1 to other types of sample (stem, root and pod); in other years the proportion was 3: 2. *Alternaria alternata*, which is considered to be a saprophyte, was frequently found together with pathogens causing spot diseases. Sometimes, however, it also grew as the only fungus transferred from stems or leaf spots.

In 1977, when the weather conditions prevailing during the growing season were rather unfavourable for the ripening of field bean, the condition of the plants in the dusting experiment was estimated at the end of August using the scale 0–5. 0 indicated a healthy plant and 5 a completely infected plant. The following mean values were obtained:

| | Arla | Mikko | Pirhonen |
|---|------|-------|----------|
| | 1.50 | 3.45 | 1.95 |
| Cultivars F 7.21* LSD _{t_{0.05}} | 1.18 | | |

Table 3. Frequency of occurrence of microorganisms in seed crop of dusting experiments at Viikki 1976–1977.

Samples: 100 seeds/test unit, 400/cultivar; WCMA medium, treated with NaClO and streptomycin.

| Year and cultivar | Germination, % | Pathogens: | <i>Ascochyta fabae</i> | <i>Botrytis cinerea</i> | <i>B. fabae</i> | <i>Fusarium</i> spp. | Common saprophytes: | <i>Alternaria alternata</i> | <i>Aureobasidium pultulans</i> | <i>Cladosporium</i> spp. | <i>Mucor</i> spp. | <i>Penicillium</i> spp. | <i>Phoma</i> spp. | <i>Rhizopus nigricans</i> | Infrequent fungi, total | Unidentified | Fungi, total | Bacteria |
|-------------------|----------------|------------|------------------------|-------------------------|-----------------|----------------------|---------------------|-----------------------------|--------------------------------|--------------------------|-------------------|-------------------------|-------------------|---------------------------|-------------------------|--------------|--------------|----------|
| 1976 | | | | | | | | | | | | | | | | | | |
| Mikko | 92 | | 12 | 5 | 18 | 6 | 59 | 1 | 7 | | | | | 5 | 12 | 125 | 25 | |
| Pirhonen | 75 | | 1 | 16 | 2 | 12 | 12 | 21 | 72 | 8 | 13 | | | 4 | 10 | 4 | 175 | 83 |
| 1977 | | | | | | | | | | | | | | | | | | |
| Arla | — | | 40 | 72 | | | 4 | 236 | 98 | 11 | 18 | | | 4 | 3 | 5 | 491 | 400 |
| Mikko | 32 | | 65 | 46 | | | 21 | 43 | 167 | 39 | 10 | 89 | | 1 | 23 | 8 | 512 | 379 |
| Pirhonen | — | | 30 | 32 | | | 4 | 2 | 177 | 79 | 3 | 16 | | 4 | 3 | 5 | 355 | 400 |

Table 4. Most important fungi isolated from field bean stands in 1975–1977.

| Year | No. of isolates | | | | | | | |
|-------------|-----------------|-----------------------------|------------------------|-------------------------|-----------------|---------------------|----------------------|--------------------|
| | No. of samples | <i>Alternaria alternata</i> | <i>Ascochyta fabae</i> | <i>Botrytis cinerea</i> | <i>B. fabae</i> | <i>Botrytis</i> sp. | <i>Fusarium</i> spp. | <i>Pythium</i> sp. |
| 1975 | 60 | 34 | 6 | 14 | 3 | | 4 | |
| 1976 | 50 | 20 | 6 | 10 | 5 | 1 | 21 | 2 |
| 1977 | 20 | 2 | 4 | 1 | 1 | | 11 | |
| Total | 130 | 56 | 16 | 25 | 9 | 1 | 36 | 2 |

Of the three cultivars, Mikko was the most severely infected with *Botrytis* fungi and Arla the least. However, these values do not give a completely reliable picture of the susceptibility of these cultivars to disease, because the soil of the different experimental plots was not sufficiently uniform. Mikko clearly did not grow as well as the other cultivars, thus presumably increasing its disease susceptibility. On the other hand, this cultivar was found to be heavily infected by *Botrytis* fungi at two sites where it was under cultivation, at Tuusula and Sipoo.

The relative proportions of *B. cinerea* and *B. fabae* in the infection of plants in the dusting experiment was determined by randomly selecting one leaf (5–7 leaflets) from each of the experimental plots and placing the leaves on moist filter paper in petri dishes (Ø 13 cm) to induce sporulation. The disease was then partly in the chocolate spot phase and partly in the aggressive phase,

which appeared as large necrotic spots especially along the edges of the leaves. The leaf samples were examined under the microscope after 6–8 days. They were found to be almost completely covered with conidiophores of *B. cinerea*; *B. fabae* was found only occasionally. *B. fabae* occurred, however, in every one of the experimental units where Mikko was grown, almost every one of the Pirhonen ones and on one Arla only. *B. fabae* fungi were also found in the leaf and pod samples taken from sites at Tuusula where field beans were under cultivation. Rather many conidiophores of this fungus developed in these samples.

A. fabae fungus occurred at five different localities. Fungus damage was the greatest at Länsi-Hahkiala in 1975 (cf. Table 2) and 1976 and at Jomala experimental station in Åland where samples were taken only in 1977.

The number of *A. fabae* and *B. fabae* isolates obtained from samples taken at different localities were as follows:

| | Year | <i>Ascochyta fabae</i> | <i>Botrytis fabae</i> |
|----------------------|-----------|------------------------|-----------------------|
| Viikki | 1975–1977 | 6 | 2 |
| Anttila | 1975–1976 | 2 | 4 |
| Länsi-Hahkiala | 1975–1976 | 6 | 3 |
| Tuusula, Riola | 1977 | 1 | 1 |
| Jomala | 1977 | 4 | 0 |

Neither of these fungi were found in the samples taken at Tikkurila in 1975 and 1976, but almost a quarter of all the *Fusarium* isolates were obtained from these samples.

Mildew was found on the leaves of *Primus* cultivars at the end of the growing season in 1975 and proved to be caused by *Erysiphe polygoni* DC. fungus. Other less important fungi which caused spot disease were as follows: *Cercospora cruenta* Sacc., *Helminthosporium sativum* Pamm., King & Bakke, *Phyllosticta viciae* (Lib.) Cooke, *Septoria viciae* Westend and *Stemphylium botryosum* Wallr.

Pathogenicity of the fungi

Ascochyta fabae Speg.

SPEGAZZINI (1899) was the first to isolate *A. fabae* from field beans in Argentiina in 1899. SPRAGUE (1929) showed that the fungus he isolated from field bean was a form of *A. pisi* Lib., which resembles *A. fabae*. According to the literature, *A. pisi*, which is a parasite on pea, can also infect field bean (ANON. 1969). A number of researchers (RATSLAG 1930, BEAUMONT 1950) have named the new fungus *Ascochyta* sp. which is a parasite only on field bean. According to present-day knowledge, there is no doubt that the *Ascochyta* fungus in question is identical to that found by SPEGAZZINI.

The disease occurred at the end of the summer. Small brown spots appeared on the leaves of field bean, which gradually enlarged, turned light grey brown, often circular and were separated from the rest of the leaf tissue by a dark brown margin (Fig. 2 a, b). Black pycnidia were formed in the center of the lesions and during damp weather great masses of conidia escaped from the

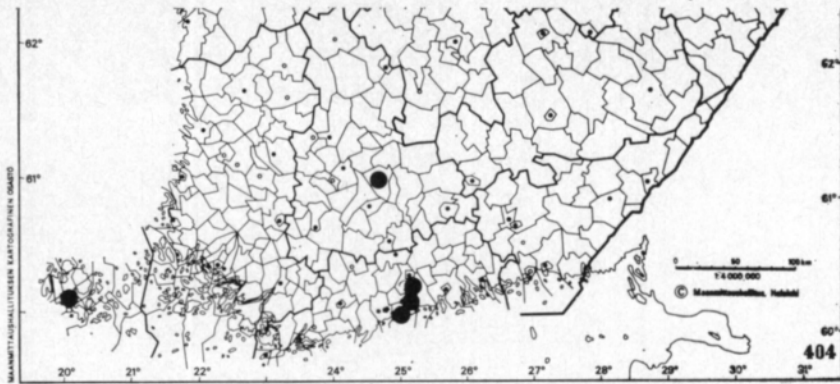


Fig. 1. Geographical origin of the field bean samples.

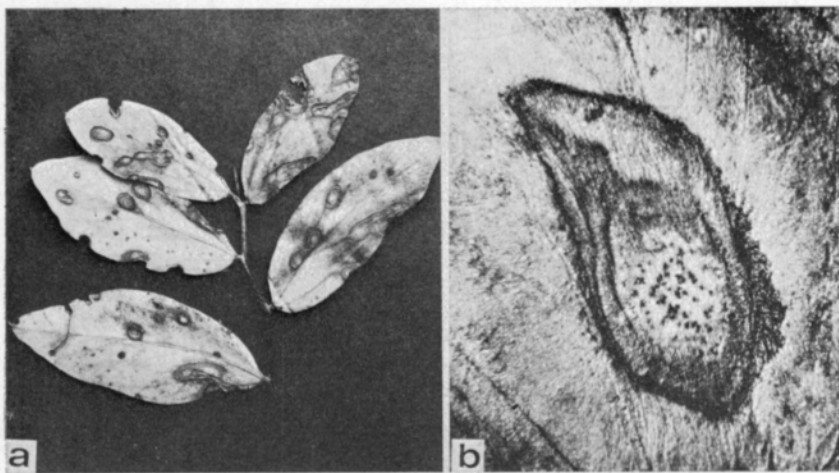


Fig. 2 a. Field bean leaf heavily infected b. Close-up of spot showing pycnidia with *Ascochyta fabae*.

ostioles in the pycnidia causing secondary infection in neighbouring parts of the plant. The field bean pods in Viikki were only slightly infected by the primary infection derived from the infected seed used in sowing. It was slightly more common in Länsi-Hahkiala.

On the germination medium the fungus initially covered the infected seed with a white mycelium which later became slightly pink or olive-green.

On CMA the colonies of *A. fabae* were initially white but turned light olive-green as the mycelium aged. On PDA the mycelium was tinted slightly orange and yellow.

The size (μ) of the pycnidia and conidia of *A. fabae* were as follows:

| | Pycnidia, \emptyset | Conidia, length x breadth | Mean |
|--------------------|-----------------------|---------------------------|------------|
| From seeds | 172-327 | 14-23 x 2.5-4.0 | 16.6 x 3.2 |
| CMA, 30 days | — | 12-19 x 3.0-4.0 | 14.7 x 3.9 |

Botrytis cinerea Pers. ex Fr., *Botrytis fabae* Sard.

SARDINA (1929) was the first to describe *B. fabae* on field bean. PAINE and LACEY had already earlier (1923) isolated this fungus from field bean, but considered it to be a secondary one. They postulated that the actual disease-causing agent was the bacteria *Bacillus lathyri* Manns. & Taubenh. Very many researchers have since published information about the occurrence of *B. fabae* and *B. cinerea* on field bean (e.g. OGILVIE and MUNRO 1947, ÅKERMAN 1955, GERLACH and RUDNICK 1972, SUNDHEIM 1973).

The large numbers of reddish-brown spots, of from one to a few millimeters in diameter, found on the leaves of field bean (Fig. 3 a) and also later on on



Fig. 3 a. Chocolate spots on a field bean leaf.

b. Conidiophore of *Botrytis fabae*. 400 x.

the stem and pods are characteristic of diseases caused by *Botrytis* species. The center of the spots were light brown, the edges dark chocolate brown. These chocolate spots represent the harmless stage of the disease (SUNDHEIM 1973). Under certain conditions favourable to the fungus the disease can develop into the aggressive stage, when the plant may be quickly killed-off. In general, however, growth of the fungus stops at the maturation stage (SODE 1969).

B. fabae produced conidia on the surface of the seeds on the germination media and in pure culture, although only in small numbers (cf. SUNDHEIM 1973). In the leaf spots the conidia developed only after being transferred on to moist filter paper.

The fungus initially formed a hyalin, later brownish, loosely packed mycelium on CMA. The conidiophores produced single-celled, oval, colourless conidia (Fig. 3 b). According to MENZINGER (1966), the shape, size and occurrence of septa in the conidia varies greatly in this fungus.

The size (μ) of the conidia of *Botrytis* species in 30-day old cultures on CMA was:

| | Length x breadth | | Mean |
|-------------------------|------------------|-----|-----------|
| <i>B. fabae</i> | 12-20 | 5-9 | 16 x 6 |
| <i>B. cinerea</i> | 8-12 | 5-7 | 9.7 x 5.7 |

The sclerotia formed by *B. fabae* on CMA were smaller and more irregular than those formed by *B. cinerea*.

Fusarium spp.

F. avenaceum (NOLL 1939) and *F. solani* (Mart.) App. & Wr. emend. Sn. & Hans. (YU and FANG 1948) cause root rot-type damage in field bean, and *F. avenaceum* (YU 1944) and *F. oxysporum* Schl. emend. Sn. & Hans. have been found to cause wilt disease. In general, these disease forms occur together or else root rot alone. No attempt was made in this study to determine which of these two disease forms was present.

A total of 41 *Fusarium* isolates were obtained from the stands of field bean, mainly from the stem, especially the lower part. The isolates were divided into the following species on the basis of the systematic division of BOOTH (1971, 1977).

| | No. of isolates |
|--|-----------------|
| <i>F. avenaceum</i> | 10 |
| <i>F. oxysporum</i> | 10 |
| <i>F. culmorum</i> | 8 |
| <i>F. oxysporum</i> v. <i>redolens</i> | 1 |
| <i>F. sambucinum</i> | 1 |
| <i>F. semitectum</i> | 1 |
| <i>F. solani</i> | 1 |
| <i>F. spp.</i> | 9 |

The relatively abundant occurrence of *F. oxysporum* in the samples, although it was not found at all in the seeds, indicates that *Fusarium* infection has mainly been soil or air-borne infection. *F. oxysporum* occurred most frequently on the base of the stems of yellowish plants, sometimes on the roots. *F. avenaceum* and *F. culmorum* were likewise isolated from the reddish-brown elongated lesions (Fig. 4), which were sometimes surrounded by a violet ring, at the base and also higher up the stem. The leaves of these infested plants were often completely black when sampled in late summer/early autumn.

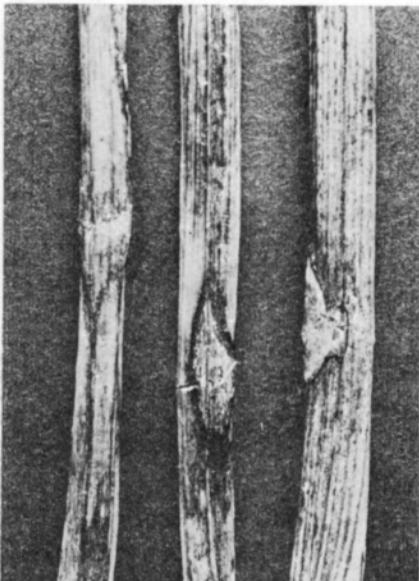


Fig. 4. Spots caused by *Fusarium avenaceum* and *F. culmorum* on the stem of field bean.

Discussion

Spot disease on field bean caused by *A. fabae* is rather dependant on the air humidity (BEAUMONT 1950). The total precipitation during the 1975 and 1976 growing seasons at Länsi-Hahkiala was higher than that recorded at the more southerly localities (Fig. 1). *A. fabae* were also more abundant there than in field bean plants from other places. For instance, the Primus cultivar in Viikki was, owing to the dry period in 1975, only slightly spotted although the seeds used in sowing were severely infected with *A. fabae*. Secondary infection did not take place that year. However, it is interesting to note that even under such dry conditions the fungus was able to infect the plants via the seeds. The over-wintering of *A. fabae* in infected plant residues remaining in the ground does not appear to be possible in Finland (cf. SUNDHEIM 1973).

B. cinerea and *B. fabae* spread in epidemic proportions in the rainy summer of 1977 and caused more damage than *A. fabae*. *Botrytis* species can over-winter both in seeds and in infected decaying plants (SODE and JÖRGENSEN 1974). However, no connection was found between the degree of infection of the seed and the seed crop obtained from them. In fact, according to HARRISON (1978), *B. fabae* originating from the seeds used in sowing can destroy field bean seedlings, but no significant differences have been found under field conditions between the spottiness of plants developed from seeds infected to differing degrees with this fungus. Besides, *B. fabae* was no longer present in 9-month old commercial seed.

In this study seed dusting was not found to have any significant effect on the yield level, which is in good agreement with, for instance, the study carried out in Denmark (NØDDEGAARD and HANSEN 1972). Despite the fact that according to the Danish and other studies (MAUDE et al. 1969) satisfactory results can be obtained in laboratory tests against *A. fabae*, no compound is available at the present time which would give full protection against diseases spread through the seeds used in cultivation. For this reason the use of clean seed is of prime importance.

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Härkäpavun sienitaudit Suomessa vuosina 1975—1977

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Vuosina 1975—1977 suoritettiin tutkimuksia härkäpavun sienitaudeista sekä pyrittiin peitauksokkein selvittämään niiden torjuntaa. Tutkittiin 140—200 siementä käsittävän yhteensä 43 erän sieniflora. Lisäksi analysoitiin kaikkiaan 7:ltä eri paikkakunnalta härkäpavun lajikekokeista ja yksityisiltä viljelyksiltä kerättyjä kasvinäytteitä.

Kasvukaudet 1975 ja 1977 olivat sääsuhteiltaan sangen poikkeuksellisia, edellinen kuiva ja lämmin, jälkimmäinen sateinen ja viileä.

Torjuntakokeista, joissa 3—4 härkäpapulajiketta peitattiin tiraami- ja benomyylivalmis-teilla, saatiin tuleentuneita satoja vain vuosina 1975 ja 1976. Luotettavia eroja peitattujen ja vastaavien peittaamattomien koejäsenten satojen välillä ei tällöin esiintynyt.

V. 1975 tutkituista siemenieristä oli Primus eniten sienten saastuttama, sen jälkeen Pirhonen ja alhaisin saastuneisuusprosentti oli Arlalla. V. 1976 oli Pirhonen Mikkoa saastuneempi sekä sienten että bakteerien suhteen. V. 1977 Arla, Mikko ja Pirhonen olivat 100 %:sti sienten ja bakteerien turmelemia.

Ascochyta fabae Speg. oli harvinainen muissa, paitsi Länsi-Hahkialan siemennäytteissä, joissa saastuneisuusprosentti oli lajikkeesta riippuen 1. 3—20; Pirhonen oli saastunein. *Botrytis fabae* Sard. oli siemenissä harvinainen, *B. cinerea* Pers. ex Fr. melko yleinen 1976 ja varsinkin 1977, jolloin Mikko-lajikkeen siemenistä oli 16 % saastunut. *Fusarium*-lajeista, joita esiintyi siemenissä runsaasti v. 1977, olivat yleisimmät *F. culmorum* (W.G. Sm.) Sacc. ja *F. avenaceum* (Fr.) Sacc.

A. fabae oli sangen yleinen L.-Hahkialan kasvustonäytteissä vv. 1975—1976. Suklaalaikun aiheuttajat *B. fabae* ja *B. cinerea* olivat suhteellisen harvinaisia muina koevuosina paitsi 1977, jolloin *B. cinerea* saastutti voimakkaasti varsinkin Mikko-lajiketta.