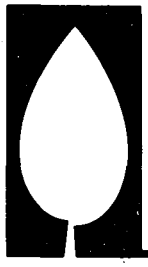
Danish Research Service
for Plant and Soil Science

Plant diseases and pests in Denmark 1981

98th annual report
Compiled by
The Research Centre for Plant Protection

Lyngby 1982



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Content Side

A. PLANT PATHOLOGY INSTITUTE

I. GENERAL SURVEY OF PLANT PATHOLOGY SUBJECTS 1981, H. Rønde Kristensen

In conformity with recent years the versatile activities at the institute have been maintained thanks to the many projects being subsidized by various funds.

Such "extra" money has wholly or partly paid for the following projects:

Establishment of damage thresholds for harmful agents attacking cereals.

Fungal diseases in rape.

Soil-borne seedling pests of beet roots.

Bremia lactuca in lettuce.

Effect on fungal diseases in barley by using mixtures of varieties.

Testing pre-basis material of seed potatoes for *Corynebacterium sepedonicum*.

Establishment of healthy nucleous stocks of horticultural plants and of potatoes.

Testing cucumber varieties for virus resistance.

Methods to obtain virus-free banana plants through tissue culture.

Standard methods for testing pesticides used against rape pests.

Biological control of aphids in greenhouses.

Insecticide resistance in Danish populations of the peach-potato aphid (*Myzus persicae*).

Registration and warning service for pests and diseases of rape.

The ability of pesticides for integration in biological control.

Strangles and root diseases in sugar beets.

Besides the above mentioned projects the Institute of Plant Pathology is dealing with several other important tasks.

The Botanical Department is trying to develop a warning service for fireblight based on meteorological data. Likewise the immuno-fluorescent method for detection of bacterial diseases is being further improved.

Routine work such as testing for resistance against potato wart disease as well as analysis for fungal and bacterial diseases in various horticultural plants has been rather laborious. Routine work at the Zoological Department has comprised testing for the potato cyst nematodes in a great number of soil samples.

This department is furthermore trying to develop the best possible testing methods for insects, nematodes and mites and is also engaged in work on aphid survey in crops of cereals and potatoes. Likewise much work is involved in investigations regarding integrated control of the carrot fly and the cut worm (involving use of feromone traps).

In the Virological Department much emphasis has been laid upon work improving the serological and electron microscopical analysis methods (ELISA and ISEM). Besides these investigations comprehensive work on establishment of virus-free meristeme cultures of potatoes and of various horticultural plants has been carried out.

In connection with this work several investigations regarding long time storage in vitro of gene material has been undertaken.

As in earlier years comprehensive and fruitful collaboration with colleagues in other countries has been achieved in 1981.

The Institute for Plant Pathology was in 1981 visited by colleagues from the following countries: Austria, Bangladesh, Belgium, Brasil, China, Chorea, Dominican Republic, Egypt, England, France, Germany, Greece, Guernsey, Hungary, India, Japan, Liberia, Libya, The Netherlands, Nigeria, Norway, Poland, Sierra Leone, Somali, Sudan, Sweden, Switzerland, Turkey, United States and Yugoslavia.

From The Institute for Plant Pathology 21 scientific workers have undertaken 57 foreign journeys and visited the following countries: Belgium, Columbia, England, Finland, France, Germany, Ireland, The Netherlands, Norway, Sweden and Switzerland.

The plant health control and the production of healthy plants

The Plant Health Board, in which three members represent The

Institute for Plant Pathology has during the year been dealing with several diseases and pest problems in relation to the health control. During 1981 the Plant Protection Service has not registered any invasion nor overwintering of the colorado beetle, so Denmark is still free from this pest.

Dutch elm disease did not show the explosive development which was feared - but the monitoring and survey work will be continued.

The fireblight (Erwinia amylovora) was rather common in 1981 especially in Cotoneaster. Winter barley, which is only allowed to grow under special conditions was doing well in 1981 and a considerable increasing in area with this crop is expected.

The prebasis material of seed potatoes has again in 1981 been tested for potato ring rot by the immuno-fluorescens method and again all the tests were negative.

The new programme for production of healthy seed potatoes (based on meristem culture) is running smoothly and considerable amounts of healthy seed material are now available for further multiplication, which takes place under very strict sanitary demands.

Under the guidance of the Nursery Control Commission (advisory body for the Ministry of Agriculture) the production of healthy nucleous stocks of various horticultural plants has been continued as an efficient - and in many cases - basis supplement to the compulsory health control carried out in all Danish nurseries.

The special station for propagation of elite material delivered from the State Research Stations has now been in operation for about two years and has so far met expectations and is undoubtedly very valuable for Denmarks production of horticultural plants.

The Institute for Plant Pathology has in 1981 been represented in an EEC working group dealing with tissue culture. A survey made by this group shows that in 12 European Countries about 150 laboratories are working on tissue culture comprising about 200 plant genera.

The Danish Plant Health Board as well as the Institute for Plant Pathology are also working in close contact with EPPO, and with several groups and panels established by this organization.

The Institute for Plant Pathology is also represented in FAO´s "Expert Committee on Protection of Plants and Crops".

In a recent meeting in Frankfurt this committee discussed FAO´s "Action programme for improved plant protection in the developing countries" and here faced with problems of a magnitude, incomparable with the domestic ones.

II. Advisory Work

1. Diseases in agricultural plants 1981

Ole Bagger

Cereals and grasses

The wintering of the winter cereals was satisfactory at most places in this country. It was only in low-lying areas temporarily flooded that the winter cereals suffered any damage by water. The winter cereals , the winter wheat as well as the winter rye and the winter barley got, by and large, very well through the wintering, with the exception of low-lying areas covered with sheets of open water.

The wintering of the grass seed crops was likewise satisfactory at most places. However, also here plants were destroyed where their roots had been standing in water for longish periods. The germination of the spring cereals took place in most parts of the country during the first days of April and was, by and large, completed within the first 10 days of April.

Frost injuries. During the whole of April, unusually low temperatures were recorded, affecting the crops, not least the newly germinated spring cereal fields. At several places, temperatures down to $8^{o}C$ below zero were recorded, so that a good deal of newly germinated spring cereals, especially grown in loose soil, which was either ploughed in the spring or after grass, was destroyed by the frost. In connection with the very cool weather there was some sand drift on April 20-22, which further contributed to affect the newly germinated cereal. In spite of the rather severe effect of the night frost, the spring cereal fields, however, soon recovered so there was no question of lasting damage.

Grey speck (manganese deficiency) was observed in winter as well as in spring cereal fields in May-June. At first, the attacks seemed to become serious, but this was prevented by the condi-

tions of growth and by the fairly extensive sprayings with manganese.

Yellow top disease (copper deficiency) was only seen with weak attacks at a few places, in particular in low-lying black soil, i.e. areas predisposed to copper deficiency.

Powdery mildew (Erysiphe graminis) wintered in the winter cereal fields with only weak and insignificant attacks. However, in April were seen rather severe powdery mildew attacks in a few winter wheat fields, especially those to which nitrogen fertilizers had been applied at an early date. In May mildew was observed in most winter wheat fields. The attacks were described as relatively moderate, and it was only at the end of May that the attacks spread considerably, especially in the Vuka variety. In the winter rye fields, for instance in northern Jutland, rather severe mildew attacks were observed in early June. In the spring barley fields, the first powdery mildew pustules appeared about May 11-12. During the whole of May, the attacks remained fairly weak and without any great importance. The weakest attacks were seen in the widely cultivated Welam variety. The most severely attacked varieties were Tron, Gula, and Vega. In June-July, however, the mildew attacks seemed to increase, especially in Jutland. As far as the Islands were concerned, the mildew attacks in the spring barley were recorded as rather weak in June. In July, a slight increase seemed to set in, especially in the barley fields in the Islands. All in all, the powdery mildew attacks in the spring barley fields must be characterized as rather moderate in 1981, because, among other things, the attack only began spreading in earnest after the spring barley having completed its heading period about June 20.

Take-all (Gaeumannomyces graminis) occurred in the winter wheat fields with attacks somewhat weaker than those in the preceding years. In the stubble samples sent in from tests in different parts of the country, the infection percentage was lower, and

severe attacks were seen at a few places only.

In spring barley the attacks were generally weak and without any great importance.

Eyespot (Cercosporella herpotrichoides). In the autumn of 1980 and the spring of 1981, the eyespot fungus had fairly good possibilities of infection during the greater part of the period. The dry weather in early April, however, put an end to the spreading and development of the disease. On the basis of investigations of a great number of winter wheat and winter rye fields, information was sent out on May 8 about eyespot and where found required, control at growth stage 6 in abt. 35 per cent of the winter wheat fields and 30 per cent of the rye fields was carried out. In the winter cereal fields, the attacks of eyespot, however, remained rather moderate. Thus, in August the attacks were described as weak except in a few winter wheat fields where severe attacks occurred. In those cases, it was a question of rather forced rotation of crops.

In the spring barley fields, only weak attacks were observed, and with up to 5 per cent infected plants in the stubble material sent in August; although the attacks were weak, they were, however, found in a far greater number of samples than was the case in 1980.

Leaf stripe of barley (Drechslera graminae) occurred, in 1981, to a very small extent only. An investigation carried through at the Pesticide Institute in June showed that, in 1981, only o.1 per cent of the fields showed attacks of leaf stripe. It is the lowest figure since regular investigation were introduced in 1974.

At the State Seed Testing Station, only 4 infected samples were found out of a total of 4,577 samples of barley tested. In all 4 cases it was a question of less than 0.1 per cent infected plants.

Barley leaf spots (Drechslera teres) were observed with rather widespread attacks in June-July. In 1981, primarily spots of the Drechslera teres type were found in a number of barley fields in Zealand and in Eastern Jutland. It was, in particular, the Welam variety that was attacked by the leaf spot disease at several places.

Further, however, rather widespread attacks of the fungus Helminthosporium sativum were observed. This fungus gives leaf spots that may easily be mistaken for the type of spots that is caused by the barley leaf spot disease. Finally, also attacks of glume blotch (Septoria nodorum) were observed on the barley plants.

Ergot (Claviceps purpurea) was observed in a few rye fields, for instance rye fields, with rather severe attacks.

In several meadow grass fields were, towards the end of June, seen a number of black scurf attacks. It was primarily in the southern parts of Zealand and Lolland-Falster that the attacks were observed.

Loose smut of barley (Ustilago nuda) were observed in certain parts of the country, primarily in the Aramir variety. The attacks were very conspicuous, and at the counting, the attacks were most frequently found in tenths of a per cent. In 1981, however, rather widespread, and sometimes vigorous, attacks were seen, which were counted in per cent. At the National Seed Testing Station, a total of 3,247 barley samples were tested for loose smut. 779 of the samples tested were infected by the disease. In most cases, however, it was a question of weak attacks. Yet, 46 of the samples proved to have an infection percentage of more than 1 per cent of the plant. The Aramir variety was most heavily attacked with an infection average of 0.84 per cent.

Loose smut of wheat (Ustilago tritici) was only found in 18 winter wheat samples out of a total of 789 samples tested. 32 samples of spring wheat were tested, but no infection of loose smut

was found.

Loose smut of oats (Ustilago avenae) was not observed at the testing of a total of 167 oats samples at the National Seed Testing Station.

Bunt of wheat (Tilletia caries) was not observed at the testing of a total of 789 winter wheat samples at the National Seed Testing Station, and no attacks in 32 samples of spring wheat.

Yellow rust (Puccinia striiformis) was observed in early May in a number of winter wheat fields in Lolland-Falster. Here the varieties attacked were Vuka, Anja, and Kraka. Later in the month attacks were also found in Funen and in the eastern parts of Jutland. However, the dry weather in May gave rather poor chances of dissemination of the fungus, and it was not until after the rain came towards the end of May that a vigorous propagation set in. During the last days of May, light spots of yellow rust were observed in the infected fields. In June, the attacks of yellow rust did not seem to spread to any considerable degree. In a few fields, the attacks of yellow rust were observed to spread in July. With the control measures taken in early May and repeated 3-4 weeks later - Bayleton being used - the yellow rust did not develop into any great problem. It was, however, only in a few fields that 2 sprayings were needed. In most cases, the yellow rust remained relatively weak, a single spraying being enough to solve the problem.

Barley rust (Puccinia hordei) was observed with one rather early attack in June. In July, however, barley rust was observed at a few places in the country, mostly characterized as weak.

Brown rust (Puccinia recondita) was seen with only extremely weak attacks in wheat as well as in rye.

Leaf blotch of barley (Rhynchosporium secalis) was observed in July with rather widespread attacks, which, at a few places, were characterized as severe. In Jutland, the attacks were judged to be the most vigorous, for instance in Claudia, the new barley variety. All in all, the attacks of leaf blotch of barley must be characterized as relatively weak in 1981.

Glume blotch of wheat (Septoria nodorum) occured with rather widespread attacks in the moist weather of 1981. In June, the attacks were very widespread, and where, in many winter wheat fields, the leaf spot symptoms could be found. In early June and the beginning of July, increasing attacks could be observed. All in all, however, the attacks were judged to be somewhat weaker than in 1980.

In several barley fields, scattered attacks of the leaf blotch fungus (Septoria nodorum) were observed. Yet the attacks were not judged to cause any great or serious damage. The symptoms were partly concealed by severe attacks of barley leaf spot and Helminthosporium sativum.

Snow mould (Fusarium nivale) occurred in the spring with but few and weak attacks. The snow mould attacks in 1981 were the weakest seen since 1976.

Ear blight (Fusarium spp.) occurred with rather widespread attacks on the newly germinated winter wheat in the autumn of 1981. Several areas were highly infected by Fusarium fungi or other sprout-inhibiting fungi and also by, for instance, glume blotch of wheat.

Snow rot of cereals (Typhula incarnata) was found with only weak attacks in the winter barley fields in the spring. As in previous years, the severe attacks set in primarily in fields with winter barley after winter barley. An assessment of numerous winter barley fields showed that, in general, attacks of snow rot of cereals are only found in 0-2 per cent of infected plants.

Clover, lucerne, peas etc.

The wintering of the leguminous plants in the grass fields was satisfactory, and no great injuries were seen.

Clover rot (Sclerotinia trifoliorum) occurred with but few and weak attacks in the spring. This was the case in the clover seed fields as well as in the grass fields with clover. In October, on the other hand, several attacks on the undersown clover were observed. The attacks were reported as rather widespread, yet as mainly weak.

Verticillium wilt (Verticillium albo-atrum) was in July judged to be without any great importance. Only a few and, as a rule, weak attacks were seen in the lucerne fields.

Grey mould (Botrytis cineria) has, at most places, been a problem in ripening peas. Likewise, chalky seeds were observed at a few places, resulting from attacks of grey mould fungi.

Leaf and pod spot (Ascochyta pisi) was observed with rather widespread attacks in several pea fields, thanks to the moist weather, but also brought about by infected seed from the 1980 harvest.

Beets

The wintering of beets for seed production at the permanent site was extremely satisfactory all over the country. No wintering injuries on seed beets sown on the permanent site were even reported.

The wintering of fodder beets in clamps was, on the other hand, not too good at all places. In several cases, the clamps had been covered too late after the frost set in and, therefore, a good deal of frost injuries occurred. In general, most of the clamps, however, showed heat injuries from being too closely covered in the mild periods.

Precipitation. Due to the ample precipitation in 1981, many beet fields had very poor conditions of growth, especially in Eastern Jutland. The heavy precipitation caused an absolute flooding of large areas over a longish period, whereas other fields were so water-soaked that the beets were now lacking oxygen.

Strangles were observed in a few fields in June. The attacks were, however, characterized as being of a limited extent but rather more widespread than in the preceding years.

Grey speck (manganese deficiency) was, in May-June, characterized as rather widespread, but the attacks were, however, mainly weak.

Heart rot and dry rot (boron deficiency) was of no great importance in 1981 and was only seen with extremely weak attacks.

Magnesium deficiency was, in the late summer months and in the autumn, observed with very moderate attacks only, due to the ample rainfalls.

Yellows (Beta virus 4) appeared in 1981 at a relatively late time. Only in mid-July the first weak symptoms were seen in patches in the beet fields. At end-July, the attacks were still characterized as weak and, as mentioned, with a late start. In August, the attacks of yellows spread somewhat but were still characterized as relatively weak. The most severe attacks were seen in Jutland, whereas the attacks in the Islands were generally weak. All in all, the virus attacks in 1981 must be described as weak in the country as a whole and with late-starting attacks, which, as far as the crop was concerned, were of no great importance.

Black leg (*Phoma beta*, *Pythium spp.* et al.) was seen in May-June -July with very widespread attacks in the beet fields. However, it was primarily the last-sown or the re-sown beets that suffered most. In 1981, the attacks of black leg were the most

severe seen since 1967. It was primarily in Jutland the worst attacks were experienced. Further, it was in the fields where beets were cultivated at a few years' intervals or where beets were even sown after beets or every other year, the greatest damage was seen. 1981 showed plainly that beets shall not be sown too often; at any rate, there ought to be intervals of at least 3-4 years between the growing of beets.

Downy mildew (Peronospora betae) was observed in 1st-year beets with few and weak attacks only.

Leaf spot (Ramularia betae). Attacks of leaf spot were seen in September-October in a number of beet fields, primarily in Falster but also, for instance, in Funen. In Falster, rather severe attacks were observed, in particular in the Primahill variety. There was no doubt that the sources of infection in Lolland-Falster were primarily beet seed fields in the vicinity of the severely attacked first-year sugar beet fields.

Powdery mildew (Erysiphe betae) was, in September, rather widespread in most parts of the country.

Beet rust (Uromyces betae) was observed with weak to moderate attacks late in the summer, especially in the southern parts of the country.

Swedes, rape and other cruciferous crops

The wintering of the winter rape fields was, in general, good, The uneven plant population seen in a good deal of winter rape fields was caused by the poor sowing conditions in August 1980. The germination at that time was very poor and irregular due to the unusually moist weather.

Frost injuries. In April, a few early-sown spring rape fields were, in patches, destroyed by frost, as a rule in connection

with earth drift.

Brown heart (boron deficiency) was only seen in swede fields with few attacks, which, furthermore, were characterized as weak.

Symptoms of magnesium deficiency in swedes were only seen with few and insignificant attacks.

Club root (Plasmodiophora brassicae) occurred in general with weak and insignificant attacks only in the cruciferous crops. However, in a few swede fields were seen rather severe attacks. In the rape fields attacks were observed at a few place, the attacks seemed to have affected the yield.

Downy mildew (Peronospora parasitica) was observed in June in several rape fields. The attacks were primarily found on the oldest leaves and were rather unusual at that time of the year but were due to the moist weather.

Verticillium wilt (Verticillium dahlia) was observed in July in a few winter rape fields, for instance in Hornsherred and at Virumgaard near Lyngby. Verticillium dahlia is a well-known fungus found on various plant species, but in Denmark it is the first time that attacks on winter rape have been observed.

Sclerotinia rot (Sclerotinia sclerotiorum) was, in the moist weather of 1981, a very widespread disease, both in winter and spring rape fields. In most rape fields a few infected plants could be found, but in a good deal of rape fields, primarily where plants susceptible to the fungus were cultivated, severe attacks with more than 20 per cent of the plants being attacked were observed, such attacks having an essentially yield-reducing effect. In control experiments with, for instance, the fungicid called Ronilan, excess yields of 20-25 per cent have been achieved in severely attacked fields.

Canhar (Phoma lingam) was observed in a few winter rape fields scattered all over the country. In a single field in North Zealand was seen a rather widespread attack, which, among other things, prepared the way for attacks of grey mould.

Grey mould (Botrytis cinerea) was seen with rather wide-spread attacks in several rape fields.

Root rot (Phoma betae, Pythium spp., et al.) in swedes was found to a fairly great extent, but not nearly to the same extent as in the beets.

Dark Leaf and Pod Spot (Altenaria brassicae) was found to be rather widespread in both winter and spring rape fields. The most severely attacked spring rape fields proved to be situated quite close to winter rape fields, from where the infection came. Investigations of a great number of spring rape fields all over the country showed that the attacks were exclusively made by Alternaria brassicae where as attacks of Alternaria circinans were not found.

Potatoes

The wintering of potatoes in clamps was satisfactory, but generally with scattered, slight heat injuries. The highly unfavourable weather conditions when the potatoes were lifted affected the storage very much, the moisture of the potatoes causing, for instance, poor airing conditions. Several clamps were, however, also quite flooded on account of the heavy rainfalls towards the end of the year.

The sprouting of the potatoes was everywhere described as satisfactory.

Magnesium deficiency was rather widespread, but the attacks were mainly weak.

Leaf roll (Solanum virus 14) and rugose mosaic (Solanum virus 2 (Y)) were widespread in 1981, the attacks being primarily weak. The attacks in 1981 were judged to be rather more severe than in 1980.

Rattle virus was rather widespread in 1981 due to the moist weather conditions. At most places, however, the attacks were described as relatively weak.

Wet rot (bacteriosis) occurred with rather widespread but mainly weak attacks.

Black leg (Erwinia carotovora var. atroseptica) was seen in June-July with rather widespread and, at some places, severe attacks.

Common scab (Streptomyces scabies) occurred with weak and insignificant attacks only.

Wart disease (Synchytrium endobioticum). In 1981, The National Plant Protection Service received reports of only 3 new attacks, all in Jutland. Immediately after the discovery, the new finds were treated with methyl bromide.

Potato blight (Phytophthora infestans) occurred rather early in 1981 on account of the moist weather. Already in the last days of June, potato blight was observed at a few places scattered over the country. The first warnings against potato blight were sent out on June 15 and repeated on July 6. In spite of the relatively early start of the potato blight attacks and the very moist weather conditions, the properly treated fields showed but weak attacks of late blight on the tubers. It was primarily in gardens and on other small areas where control sprayings had not been carried through in time that destructive attacks were seen.

Black scurf (Rhizoctonia solani) was rather widespread in June, causing missing plants in the rows in a number of potato fields. At the lifting attacks of black scurf on the tubers were observed, rather widespread but primarily weak.

Gangrene (Phoma exigua var. foviata) was observed in the latter half of the storage period but only to a slight extent and thus it was not the great problem in the winter of 1980-81.

Umbelliferous plants

Sclerotinia rot (Sclerotinia sclerotiorum) was found in a number of caraway fields, usually with very severe attacks. In the caraway fields, the attacks were more severe than they were in the rape fields.

2. Pests 1981

Ole Bagger

Cereal and grasses

Cereal nematodes (Heterodera avenae) were without any great importance in 1981, observed with only moderate attacks all over the country. Thus, in May the attacks were judged to be the weakest for the past 5 years.

Rye thrips (Limothrips denticornis) and grain thrips (L. cerealium occurred in July with rather widespread attacks in, primarily, the winter cereal fields. In several spring barley fields, however, aggressive feeding of the thrips on the leaf sheaths could also be seen.

Oat aphids (Rhopalosiphum padi), grain aphids (Sitobion avenae), and rose grain aphids (Metopolophium dirhodum) were observed from mid-June with rather widespread attacks, which, however, at most places were characterized as weak. In June, only a rather sparse propagation was seen in the barley as well as the wheat fields. In the first half of July, a good deal of aphids were found in the cereal fields, but the attacks ceased already in mid-July, so the aphid attacks in cereals in 1981 must be characterized as being without any great importance.

Wireworms (Agriotes spp.) only occurred with weak attacks at a few places in the country. It was primarily in second and third year barley sown after grass that the attacks were rather more severe.

Garden chafers (Phyllopertha horticola). Attack by the garden chafer larvae in, for instance, lawns but also in grass fields were, in the lighter soils in Jutland, observed to a very great extent in September-October. In great parts of Jutland and on several localities, the attacks were severe.

Leaf beetles (Lema lema). In several barley fields all over the country, several attacks by leaf beetle larvae were observed in June. In several fields the attacks were characterized as rather severe.

Rustic Shoulder (Apamea sordens). In the Roskilde district, a number of winter wheat grains in an experimental field were found holed by the larvae.

Crane flies (Tipula paludosa) occurred in the spring with weak attacks only. From Vendsyssel alone were reported severe and at some places early attacks in patches, especially in fields sown after grassland.

Bibionid flies (Bibio hortulanus) practically did not occur in the spring barley fields in 1981.

Diplophus febrilis were observed in lawns in the Brædstrup district with rather widespread attacks. In several cases it was necessary to re-lay the lawns.

Wheat midges (Contarinia tritici) were, in 1981, without any importance thanks to the rather cool and moist weather.

Hessian flies (Mayetiola destructor) occurred with widespread, but everywhere only weak attacks. A few broken straws were seen in the spring barley fields as well as in the winter barley fields.

Saddle gall midges (Haplodiplosis equestris) were without any great importance in 1981 as they were observed with extremely few and weak attacks only.

Frit flies (Oscinella frit) were observed in the winter cereal fields with rather severe and widespread attacks, which, however, did not lead to resowing as it was primarily the question of a

thinning of the plant population. In June, the attacks of the 2nd generation of the frit fly larvae were reported as moderate. True, in oats were seen a good deal of attacks but primarily in late-sown fields. In the autumn, single attacks were seen in the winter cereal fields sown after re-plowed grass or grass seed fields. All in all, however, the attacks must be characterized as relatively moderate.

Gout flies (Chlorops pumilionis) were seen in Djursland with rather severe attacks in a few barley fields. In 1980, attacks likewise occurred on the same localities.

Leaf miners (Hydrellia grisseola). In June, attacks of the leaf miner larvae were seen with rather widespread attacks in winter cereal as well as in spring cereal fields. The attacks were, however, described as being of no importance worth mentioning.

Wheat bulb flies (Hylemya coarctata) were found at a few places in the country with rather severe attacks. They occurred primarily in winter cereal fields sown after peas for canning or ryegrass, and where a thinning of the plant population had taken place. It was especially in wheat fields in southern Funen and on Taasinge sown after peas for canning and harvested in the period from June 7 to June 10, that a considerable thinning took place. Thus, in a few fields about 60-70 per cent of the shoots had been destroyed by attacks of the wheat bulb fly larvae. Even though the seed had been dressed with, for instance, Volaton seed dressing, a vigorous thinning occurred without any particular effect of the preparation.

Slugs (Agriolimax spp.) were observed in September-October with rather widespread attacks, worst in the winter cereal fields after clover or rape.

Rosy Rustic moth (Hydroecia micacea). In May-June, severe attacks, most often in patches, of the larvae were observed in a

few maize fields.

Frit flies (Oscinella frit). In May-June, the attacks in the maize fields of the fritfly larvae were, at most places, characterized as rather moderate and only weak. Attacks of any importance were only seen in a few cases.

Clover, lucerne, peas etc.

Stem nematodes (Ditylenchus dipsaci) were seen with exclusively weak and insignificant attacks.

Pea aphid (Acyrthosiphon pisum) were seen in June with rather widespread attacks in the pea fields. However, the attacks remained on a rather moderate level.

Beets

Beet nematodes (Heterodera schachtii) generally occured with few and weak attacks, which, throughout the country, were characterized as unimportant.

Cabbage thrips (Thrips angusticeps) were seen in the spring with attacks, which, by and large, were weak to moderate only. The attacks of cabbage thrips were, in 1981, judged to be the weakest for many years.

Black bean aphids (Aphis fabae) were observed towards the end of May in several beet fields, for instance in Lolland-Falster, Funen, and Southern Jutland. Investigations of a total of 66 spindle bush localities in April-May showed no wintered black bean aphids. As eastern to southeastern and southerly winds were prevailing in May, it was presumed that the relatively early appearance of black bean aphids in the beet fields was due to migration from the southern parts of our country. This presumption was further corroborated by a re-investigation of some of the spindle bushes investigated, in which there were still no

wintered black bean aphids to be found. In June there was a rather vigorous propagation, and severe attacks were seen in a number of beet fields. The propagation continued in July and even in the first half of August. Only from mid-August the attacks began petering out. The last internal information on aphids sent out on July 29, stated that only 17 per cent of the beet fields investigated were not infested by black bean aphids.

Capsid bugs (Lygus rugulipennis), Lygocoris pabulinus and Calocoris norvegicus) occurred in June with rather widespread attacks, which, locally, were very severe at several places.

Peach potato aphids (Mycus persicae). In the spring of 1981, the number of beet clamps was recorded as 5,400 as of May 15, and 1,200 as of June 1. Thus, the number was fairly moderate and as, furthermore, peach potato aphids were found in only 18 per cent of a total of 208 sprout samples examined, there would presumably be no danger of early, severe attacks by peach potato aphids. As mentioned under Black bean aphids, a number of peach potato aphids were, however, found towards the end of May, apparently coming from far away, from our neighbouring countries to the south. The peach potato aphids, however, showed no considerable propagation, so, in July, the attacks were described as rather widespread, but mainly weak. In August, there were only rather weak attacks of the peach potato aphid, and as far as beet yellows is concerned, the attacks were not very widespread either.

Beet carrion beetles (Blitophaga opaca) were observed in May-June with rather widespread and, at some places, severe attacks, mainly, however, in Jutland. In the islands somewhat more severe attacks have, however, been seen than in the preceding few years when there were hardly any attacks at all. As in previous years, the attacks ceased about mid-June. Towards the end of May, control measures were taken in several beet fields and, as usual, the results were good.

Pygmy mangold beetles (Atomaria linearis) were of no great importance in the spring, and only a few attacks were observed, primarily on Møn and Lolland-Falster.

Mangold flies (Pegomyia hyoscyami). In May, early egg-laying was observed at many places throughout the country. The first larvae were hatched about May 18-20, and control measures were taken at several places because of the small size of the beets. In June, the attacks were likewise described as rather widespread and, at some places, as very severe. In August, the attacks were described as rather widespread and, at some places, as severe. In Lolland-Falster, for instance, rather severe attacks by the 3rd generation of the mangold fly larvae were observed.

Grey field Slugs (Agrilimax spp.). In September, a rather severe attack was seen in the Roskilde district in an undersown beet seed field sown after caraway. In the headland where the previous crop had been cereals, no attack was seen. The attack appeared in patches, especially where the seed bed had been poor due to lumps and, on the whole, a bad soil structure, and there the plants had been completely gnawed off.

Swedes, rape, and other cruciferous crops

Cabbage thrips (Thrips angusticeps) were observed in April in some radish seed fields and in a few spring rape fields. In several cases there were so many thrips that control measures had to be taken.

Cabbage aphids (Brevicoryne brassicae) were seen with rather widespread but only weak attacks in late summer.

Blossom beetles (Meligethes aeneus) occurred with rather widespread attacks, which, at most places, were described as weak only. All in all, the blossom beetles were only seen in winter as well as spring rape fields to a very limited extent.

Flea beetles (Phyllotreta spp.) occurred with single, weak attacks only.

Cabbage seed weevils (Ceutorrhynchus assimilis) were seen in the winter rape fields with weak attacks, which, however, seemed to be rather widespread. In the spring rape fields, the attacks were weak and quite without importance.

Diamond-back moth (Plutella maculipennis) occurred in June with attacks somewhat more severe than in preceding few years. At most places, however, the attacks were characterized as rather weak. In June, however, a rather vigorous propagation took place and at several places, primarily in Jutland, the attacks were rather severe, but towards the end of July they declined somewhat at most places in the country. At a few places, however, rather severe attacks could be seen in August too, and most of swede fields in Jutland were infested.

Cabbage butterflies (Pieris brassicae) and P. rapae) were seen with relatively moderate attacks, which were of no great importance.

Swede gall midges (Contarinia nasturtii) occurred with extremely weak attacks, and from nowhere in the country were reported attacks of any considerable extent.

Brassicae pod midge (Dasyneura brassicae). Warnings against 1st generation were sent out on May 18, and against 2nd generation the warnings were sent out on June 22. In the winter rape fields, the attacks of 1st generation were rather weak whereas the attacks by the 2nd generation of the brassicae pod midge larvae were described as rather widespread but in the main weak. In the spring rape, it was generally a question of very weak attacks only.

Cabbage root flies (Delia brassicae) were seen in June with rather widespread attacks, which, however, were described as weak at most places. Further, attacks were seen in some spring rape fields where the plants fell to the ground because the root collars had been gnawed through by larvae. The attacks in the swede fields in July and August were described as rather moderate. In September-October, the attacks were likewise characterized as rather widespread, however, so that only at a few places the attacks were severe.

Turnip root flies (Delia floralis). On a few localities, for instance in the Give district, the attacks by larvae of turnip root flies were described as rather severe and generally widespread.

Potatoes

Colorado beetles (Leptinotarsa decemlineata) were not observed in 1981.

Cutworms (Agrotis segetum). The flying of the turnip moth was very sparse in 1981, and the ample rainfall in early summer was not favourable to the young larvae; therefore, there were no attacks of any importance in 1981. Thus, in August, the attacks were described as the weakest since the 'Cutworm Year' of 1976. Only locally rather weak attacks were seen at a few places.

Onions

Onion flies (Hylemya antiqua). The attacks of onion flies seemed to be rather widespread. Thus, there were quite a number of attacks in Lammefjorden and in a few fields with severe attacks. Also in Bornholm there was a number of attacks by the larvae.

Caraway

Parsnip Moth (Depressaria nervosa). In a few caraway fields were observed rather severe attacks by the larvae.

Carrots

Carrot flies (Psila rosae). In September-October, the attacks were characterized as rather widespread, primarily, however, with weak attacks.

3. Diseases and pests of horticultural plants 1981

Mogens H. Dahl

Damage by the weather

Frost injuries. Violent destruction of flowers on fruit trees and fruit bushes was observed. However, the injuries varied from one locality to the other. In the night between April 22 and 23, 5°C below zero was measured at a height of 2 metres; the result was not only withering of the styles but whole clusters of flowers were destroyed. In berry and fruit orchards the yield was greatly reduced in 1981 from apple trees and sweet cherry trees as well as from black currant bushes. Later in the season, the milder form of frost injuries was observed in irregular shapes of fruits.

Suffocation of roots was observed in hedges as well as in solitary trees. Heavy, clayey soil was still further reduced in air contents in March due to the unusually heavy rainfalls. Thereby the roots were suffocated - especially where the planting had taken place in the autumn or in early spring. Injuries of the most serious nature - due to the costs of replanting - were found in roadside trees, which are often bought in sizes of 4-5 m in height.

Poor foliation. In many cases, the birches showed poor bursting of buds and, later on, a vigorous withering. Later in the summer, it was observed at a number of places that dormant eyes were developing. Probably the injuries were caused by after-effects of frost and low air contents in the soil.

Spring winds in connection with the cold weather reduced the population of outdoor vegetables and, therefore, many areas had to be resown.

Hailstorm injuries in onions for consumption occurring in end-July opened the gateway to attacks of fungal diseases which could

not be prevented, the frequent rainfalls making the use of tractors and sprayers impossible.

Fungal diseases

Gummy stem blight (Didymella bryoniae). In the preceding year, this disease occurred with a symptom, so far unknown, namely greyish or brownish tissue in the interior of the blossom-end of the fruit. The same injury was seen in 1980 even as early as in May. The disease was controlled through fungicide treatments.

Twig death (Kabatina thujae) caused drastic withering in hedges as well as in solitary thujas in churchyards.

Downy mildew (Peronospora sparsa) was rather widespread. Already in June the disease was observed - in outdoor as well as in glasshouse cultures. Beside numerous small brown spots followed by leaf drop-off, a strong red-colouring of stems and small cracks in the young shoots were also observed. Sprayings with fungicides seemed to have a slight effect only. In glasshouses, the attacks were checked by reducing the air moisture.

Black spot (Diplocarpon rosae) manifested itself already from the beginning of June. Often, the well-known symptoms were not observed; instead, numerous, usually slightly angular, small spots developed on the small leaves, quickly covering the whole lamina without the otherwise so characteristic symptoms.

Grey monilia (Sclerotinia laxa f. mali) was observed in sweet cherries, the berries being brown and soft-rotted. Microscopic examinations confirmed that the injury had been caused by the fungal disease although the pathological picture is normally the withering of flowers.

Apple scab (Ventura inaequalis), which, for many years, the fruit growers have found it fairly easy to control, developed into stupendously severe attacks. Suitable fungicides applied at

normal spraying intervals were absolutely unable to prevent the spreading of the apple scab.

Anthracnose (Gnomonia veneta). As usual, this disease was observed, especially in trees with unbalanced growth. A special point to be noticed in 1981 was the observation of a symptom not previously seen, namely, elongated, brown spots on leaf stalks - often halfway between lamina and leaf base. These attacks resulted in a vigorous leaf-drop from midsummer.

Fusarium avenaceum) in raspberry. In several cases, received plant samples of withered raspberry shoots showed attacks of the above-mentioned fungal disease. The bark of the fruit-bearing branches was loose or missing.

Further, large irregular swellings, dark-brown and covered with white to faintly orange-coloured layers of spores were seen. Apart from the last-mentioned symptom, the pathological picture gave the risk of mistaking the disease for an already terminated attack of pests, for instance Raspberry Stem gall midge (Lasiop tera rubi).

Potato blight (Phytophthora infestans) in tomato fruits. After, in July, this fungal disease had caused the withering of many potato tops, a vigorous spreading of spores to the fruits of outdoor tomatoes took place. Some weeks later when the air moisture was considerably lower, the attacks were seen to stop, but shortly after they set in again and kept on during the remainder of the season.

Early blight (Septoria petroselini) in parsley occurred with constantly increasing force. The commercial growers often wrongly judged the withering of the leaves to be caused by inappropriate use of fertilizers or pesticides.

Leaf spot (Blumeriella jaapii) in cherries. In late summer, sweet cherries as well as sour cherries were badly damaged by the

disease in orchards as well as in nurseries. The leaf drop started in late July and this went on for almost the entire season. Prophylactic sprayings with fungicides (evidently) started too late (which has also been the case in the preceding years) and, consequently, this fungal disease must be included in the regular spraying programme in future.

Powdery mildew (Sphaerotheca macularis) in strawberries. In most commercial cultures, the disease was kept in check during the first half of the season, but it suddenly spread vigorously when the picking was over, among other things because the growers do not, to a sufficient degree, bear the yield of the following year in mind.

White Chrysanthemum rust (Puccinia horiana). Some extremely severe and widespread attacks were observed in glasshouse as well as in outdoor varieties. The frequent showers of rain may have been the reason for the spreading, but in several cases there was greater probability of imported cuttings having been the carriers of the disease, which, due to the very long period of incubation, could not be established at the time of receipt.

Black leg fungi (species of Thielaviopsis, Rhizoctonia, Pythium and Phytophthora) in pot-plant cultures were very often the real cause of the withering of rooted cuttings and plants almost ready for sale. The highly increased use of enriched sphagnum, which have no antagonists, must be considered to be the most important cause thereof - although the greater part of the infectious matter usually came from the table bed (cover mats) which had not been changed after the preceding culture in which the disease had been found - though to a smaller extent.

Bacterial diseases

Pseudomonas corrugata in glasshouse tomatoes, which was found for the first time in this country in 1980, occurred in a few

market gardening cultures in Funen in early summer. At first the attacks were found in a few scattered plants, but some weeks later the disease developed vigorously. As the late summer period was rather cool, a number of tomato growers used a little more heat in the glasshouses, thereby reducing the air moisture, so the bacterial disease again became of secondary importance.

Fire blight (Erwinia amylovora) showed, according to the National Plant Protection Service, an incidence and spreading more serious than ever seen before, compared with the 12 years that have passed since the disease was first demonstrated in Denmark.

The attacks were predominantly observed in hawthorn and apple trees. As for Cotoneaster, the disease was further registered in C. bullatus, C. dielsianus, and C. horizontalis.

Pests

Gastropods (Gastropoda). Many species - big as well as small ones, with or without shells - occurred in enormous numbers during practically the whole season. Not only herbaceous plants, but bushes too, were infested. The damage consisted partly in numerous big holes in the leaves, partly in gnawed-through, soft stems. The destruction occurred in private gardens, parks and cemeteries as well as in market gardening cultures, outdoors and in glasshouses. Control by the use of pesticides was seldom successful and, furthermore, expensive.

Cockchafers and garden chafers (Melolontha melolontha and Phyllopertha horticola). Lawns in gardens and, to a slighter degree, in parks suffered especially severe damage in the form of withering in large patches or even total areas due to root-gnawing by the larvae. Horticultural advisers as well as this institute had, during late summer, daily telephone calls concerning these pests without being able to recommend any suitable control measures.

Common green capsids (Lygocoris pabulinus). Herbaceous as well as ligneous plants were deformed in young leaves and in the tips of the shoots. Often the feeding caused the withering of the growing points.

Mottled umber moths (Erannis defoliaria) were observed in great numbers in some parts of the country; therefore, bushes and trees in shelter belts, woods, and gardens were almost leafless in midsummer. For a great number of years, this pest has led a rather unobtrusive life.

Leaf curling plum aphid (Brachycaudus helichrysi). These aphids caused a good deal of damage to China asters (Callistephus chinensis) arresting the development of the flower buds. Before that, a number of leaves had become deformed with vigorous crumbling and, at the same time, the leaves assumed a red colour.

Cutworms (Scotia segetum). The damage caused by the larvae was quite insignificant - probably because of the frequent rainfalls while the larvae were still quite small, moving about in the above-ground parts of the plants.

Sawfly on birch (Arge pullata). The larvae, which can defoliate even big birch trees, have now been found in a total of 5 localities.

Dock saw flies (Amestegia glabrata). In the orchards there seemed to be a risk that the damage by the larvae might be serious because - after the numerous rainfalls - a very dense weed population had developed, which might easily get to function as a propagation centre. The advisers, however, warned the growers, who then took the necessary steps so the pests made no significant damage.

Brevipalpus obovatus (formerly called Tenuipalpus inornatus) was observed in some glasshouses. The attack, in the form of bronze-

coloured to greyish-brown spots on either the upper or lower sides of the leaves, was seen in, for instance, Aeschynanthus and Kalanchoë.

III. BOTANY DEPARTMENT, Arne Jensen.

1. Experimental work

Bacterial diseases (Ib G. Dinesen)

Potato ring rot (Corynebacterium sepedonicum)

Last years potatoes originating from pre-basic crops were investigated for potato ring rot; and the immunofluorescens method was employed. All the investigated samples were negative, however, in a few samples cross reactions were observed; but both morphology, size and arrangement were different from C. sepedonicum. Isolation of organisms from the samples in question showed a negative result. We have received from abroad some latent infected potato tubers and those are used for the development of a safer testing method.

Fireblight (Erwinia amylovora)

Investigations were continued with special reference to forecasting the disease. Thus in Jutland and Funen observations were carried out concerning the degree af fireblight attack in two hawthorn hedges and in one pear orchard. Those observations will be compared with meteorologic data in order to find out, whether there may be any correlation between the degree af attack and the weather conditions.

Healthy nuclear stock of pot plants

The plant material collected in 1980 concerning Diffenbachia maculata and Kalanchoë blossfeldiana has been tested several times for Erwinia chrysanthemi in the passed year. Bacteria were found in none of the Kalanchoë blossfeldiana clones, on the contrary, a number of Dieffenbachia maculata clones have been withdrawn on account of the presence of bacteria.

The tests are carried out by means of the immunofluorescens method. Towards the end of the year the ELISA method was used as

well. Both Dieffenbachia maculata and Kalanchoë blossfeldiana are expected to be delivered to the Plant propagating Station during 1982.

Pelargonium hortorum is permanently investigated for Xanthomonas pelargonia. With a view to a production of Begonia spp. free from Xanthomonas begoniae a specific serum has been produced. As a test method, immunofluorescens and ELISA will be used.

Fungal diseases

Take-all and eyespot (Gaeumannomyces graminis and Cerosporella herpotrichoides) (H. Schulz)

In 1981, 1124 samples were assessed for take-all disease. In spring barley the level of attack was considerably lower than in 1979 and 1980, while the attack in winter cereals was approximately the same level as in 1980. Eyespot disease was assessed in 1467 samples, of which 343 were sampled in spring with a view to a prognose, a forecast and a spray guidance for winter cereals. Spore catching and weather observations showed, that the chances of contamination were likely in October-November and in the first week of February as well as in all the month of March.

It was assumed that there was a need for control in 35 per cent of the wheat fields, in 30 per cent of the rye fields and in 15 per cent of the winter barley fields; a little less than in 1980. In the control experiments considerable yield increases were obtained especially in rye. In 1981 it appeared that coherence between attack in spring was not in all cases in accordance with the attacks at harvest time and the increases of yields after control treatments.

Sharp eyespot (Rhizoctonia sp.) occurred in most of the winter cereal fields, but only to a small extent in spring barley. In 62 per cent of the investigated barley fields only weak attacks of eyespot were found.

Chemical control of eyespot (H. Schulz)

Spraying with 0.5 kg Benlate per ha in wheat and rye grown continuosly at the experimental stations of Rønhave, Tylstrup and Ødum reduced the attacks considerably; however, only in wheat at Ødum a profitable increase in yield was obtained after treatments.

Other work on root diseases in cereals (H. Schulz)

In small plot experiments with 9 different types of soil and continuous cereal growing a bigger increase of yield has been obtained comparing with 1980.

In spring barley the level of take-all was the same as in 1980, and the yield 5 per cent higher. In winter barley the attack was a little higher and the average yield 22 per cent higher.

In winter rye the attack was at the same level as in 1980 and the yield 3 per cent higher. In winter wheat the attack of take-all was only half as big as it was the previous year and the yield 28 per cent higher. In small plots with continuous barley growing and with spring rape as a post harvest crop one has obtained a yield decrease of 7 per cent.

In a field experiment with an increasing number of years with winter barley the strongest attacks of take-all are found in fields grown with barley from 3 to 7 years, however, at a relatively low level. The eyespot attack is biggest after 2 to 6 years of barley growing, but the first year barley was also relatively heavily attacked. The yields were between 55 and 43 hkg, per hectar.

Threshold studies on mildew in spring barley (Sten Stetter)

In 1980 and in 1981 different experiments with thresholds were carried out concerning different diseases in spring barley. The experiments were especially concerned on mildew. The field experiments were carried out at three sites both years and experiments in a glass-house were also carried out during the winter 1980 to 1981.

The field experiments were assessed for mildew and other leaf diseases twice a week on the most heavily attacked leaf when still green; and spraying was carried out at 5 different levels of attack. Both years were cool and moist and therefore, the mildew attacks were rather moderate, On the contrary late in the growing season of 1981 a considerable attack of different leaf spot fungi occurred at two experiment sites and rust attack at site number 3. At the two experiment sites where leafspot occurred, two treatments were altered, thus instead of spraying with Bayleton and Calixin as planned Ortho Difolatan and Derosal Combi were used.

The increase of yield after spraying against mildew was between - 2.1 to + 7.9 hkg with average for the two years of about 2.0 hkg.

The increase of yield after spraying against rust and leaf fungi cannot be extracted directly from the results, because the sprayings were carried out at a time, where, mildew was found. The assessment of the comprehensive amount of data has not yet been done, therefore, the following results are temporary: Increase of yield from spraying with Bayleton 25 WP and with Calixin shows a positive, exponential correlation with the supplied amount of nitrogen. The correlation between yield in connection with spraying and time of sowing is positive and apparently straight lined. Correlation between increase of yield from spraying and the percentage of mildew-cover can be expressed with a sigmoid curve, whose inclination is rising in the field of per cent mildew-cover of 0.0 to 0.3 on the third leaf and subsequently declining. The temporary results in question as well as the effect of variety, fungicide,previous crop, climate etc. will be incorporated into a model in the microdatamate of the institute.

Leaf and ear-diseases of cereals (Boldt Welling)

Examinations for attack of glume blotch (Septoria nodorum) in wheat was continued; in the beginning of May 103 samples were investigated, but the fungus could not be found. From the begin-

ning of June to the end of July assessments were carried out regularly in selected varieties and in experiments with spraying times. A considerable amount of data has been collected and it will be compared with climate observations in order to obtain a basis for a forecast model. The increases of yield after control treatments in due time were large.

A project recently started in collaboration with the Rønhave Experimental Station concerning barley variety mixtures has illustrated the effect on mildew attacks. Experiments with mixtures of varieties with different basis of resistance showed a weaker attack of mildew than the average single varieties and gave a little higher yield.

As a support for the assessments of mildew attacks a Schwarzbach spore trap was used, but due to the humid weather conditions it could only be used for a short time. There was a good connection between the assessments and the spore catches.

Heavy attacks of leaf spot diseases (especially Drechslera teres) occurred in spring barley in 1981, and in the trial with variety mixtures a spread of infection was observed from Welam, the variety attacked the most. From experiments in buckets with barley artificially infected with leaf blotch (Rhynchosporium secalis) a good effect has been obtained by spraying with Bayleton at incipient attacks.

Winter barley (Boldt Welling)

The area of winter barley was 6000 hectars in 1981. Observations concerning the occurrence of mildew were carried out at 9 sites. In two winter barley fields, perithecia of mildew was found at the base of the plants which is a sign of inefficient spraying, and therefore, considerable attacks of mildew were found in neighbouring spring barley.

In autumn 1981 winter barley was sown in about 18.000 hectors, and most of the seed was dressed with Baytan. After examination in November of plant samples from 43 fields with dressed seed, only a weak attack of mildew was found in one sample.

In experiments with Typhula incarnata in third year winter barley good results have been obtained by Baytan seed dressing and sowing in the second half of September; a considerably poorer effect was obtained after sowing in the beginning of September.

Diseases of grasses (Boldt Welling)

Diseases was investigated in experiments at Roskilde with grass seed. Lawn grasses in the permanent fertilizer-experiment are kept under observation. The diagnosis of diseases was made in 19 grass samples

Strangles and root diseases in sugarbeets (H.A. Jørgensen)

Both root diseases and strangles occurred with unusually severe attacks and especially after late sowing, repeated sowing and also in light soil in connection with rainy weather in May and June. As predominant fungi, Pythium- and Fusarium species were found, whereas Phoma betae only occured in a few cases.

Soil samples from 23 fields and from about 70 other sites with root diseases were analysed and the results compared with information on root diseases, crop rotation and other cultivation conditions. After data processing a correlation was found between increased attacks of root diseases and a restricted crop rotation, a low pH, a low content of clay and a low phosphorus content. The investigation continues in 1982.

Fungus diseases in oilseed rape (Arne Jensen)

As a consequence of the past summer with a great precipitation, heavy attacks of several fungus diseases were found. Sclerotinia sclerotiorum was the most devastating fungus, especially in sites, where growing of rape has predominated. Control experiments by spraying with 0.5 to 1.0 kg Ronilan per ha in the flowering period showed a good effect against S. sclerotiorum in two fields of winter rape and in one of spring rape.

In the seed goods from two of the experimental sites significantly fewer sclerotia were found especially after a treatment with 1.0 kg Ronilan. An investigation of 100 samples of spring rape seeds showed an occurrence of sclerotia of S. sclerotiorum in 35 per cent although chiefly in small quantities.

In a few winter rape fields severe attacks of Phoma lingam were for the first time found in Denmark. In spring rape an attack Verticillum dahliae was found for the first time in 1981; please see under New attacks of fungi.

Late blight (Phytophthora infestans)

A survey of strains in collaboration with the Potato Breeding Station at Vandel and the Plant protection Department at Godthaab, Jutland has been undertaken.

Potato Wart (Synchytrium endobioticum) (H. Mygind)

For the testing of resistance in new cross-breeding varieties, a number of 326 tuber samples from the Breeding Station at Vandel were tested. The testing work is carried out in January, February and March in a glass house, using the Spieckermann's slightly modified compost method.

For the Government Plant Protection Service a check-cultivation in pots has been carried out with soil samples taken out in older potato wart sites, with the purpose of abolishing the blocking of potato growing in older sites (practically all are vegetable gardens). From a total of 32 soil samples only one was positive. The variety "Alma" was used as a susceptible variety.

In the testing for resistance very heavy attacks of potato wart were obtained both in "Alma" and in the new susceptible varieties.

Grey mould (Botrytis cinerea) in tomatoes (H. Mygind)

The recording of data from rather comprehensive investigations in 8 tomato nurseries accomplished in 1979 and 1980 was handed

over to the Data analytic Laboratory. The recordings comprised continuous measurings of the relative humidity (RH), temperature and grey mould attacks with week intervals, further leaf samples were taken for analyses of nutrient elements and sugar content. The analysis results from the leaf samples taken every two weeks as well, the sequence of "Total N" is of great interest, because a too low level of nitrogen normally results in a considerably higher susceptibility. The project is carried out in collaboration with two of the advisers from the Danish Grower's Association with the aim of comparing the nurseries having severe attacks and those which normally have a very low level of grey mould.

Ultimately the results are studied by the working group before the final report can be written. Infection experiments in glass houses were started in 1980 and finished in 1981. The "plots" were as follows: pinching off leaf stalks of 8 week old tomato plants in pots; 48, 14 and 0 hours of drying before a spore suspension was sprayed on the tomato stems with the remaining petiole stumps of about 1 cm. In all the 9 experiments the fungus chiefly attacked stumps with progressive senescent tissues, except in one experiment, where the highest frequency occurred after 0 hours of drying. The "Stump-drying theory" might, therefore, be abandoned, but as expected the stumps are definitely the way of entrance of the disease and further into the main stem, the latter being fatal for the tomato plant.

Healthy nuclear stock of pot plants (H. Mygind)

The Glasshouse Crops Institute, Årslev has forwarded samples of Campanula isophylla, Hedera helix and Ficus pumila nuclear stocks for disease testing. No attacks of vascular fungi have been revealed.

In 40 samples of Hedera clones and in one of Campanula isophylla all plant material originating from nurseries; however, Fusarium oxysporum was found in 9 of the samples. The stock of those plants was discarded.

Plant diseases in water culture and glasshouse crops (H. Mygind and Ib G. Dinesen)

At the Plant Pathology Department of the Royal Veterinary and Agricultural University the project "Microbiological-and-plant -pathological investigations of closed water culture systems with a recirculating nutrient solution" is continued. The project is conducted by a working group of which above mentioned authors are members. The experimental objects are lettuce and Pythium spp..

Downey mildew (Bremia lactucae) in lettuce (K. Thinggaard)

Strains were identified in 14 isolates of downy mildew originating from lettuce nurseries in Funen and Zealand. The frequency of 11 virulens factors (VI - VII) was recorded and the results show that the Bremia in Denmark are not identical to a greater extend with the strains in other countries for instance Sweden and Holland. The lettuce varieties with the resistance R1, R3 and R7 have been cultivated for many years in this country and they give no protection. Varieties with R11 only occurred recently and in addition with the varieties containing R10, R9 and R5, these will be able to provide protection against attack.

Danish lettuce growers have been advised concerning the choice of varieties with a suitable resistance against downy mildew on the basis of above mentioned studies.

Diagnostic work and recording of scientific litterature (H.A. Jørgensen, H. Mygind and Ib G. Dinesen)

In the course of the year the Botany Department has received about 500 plant samples for diagnosis of bacterial and fungal diseases. Like previous investigations mostly horticultural plants were involved, and some of the most frequent fungi are Pythium, Phytophthora, Fusarium, Rhizoctonia and Botrytis. The predominating bacteria were Erwinia amylovora and E. carotovora.

Extensive recordings are made of scientific litterature.

2. New attacks of diseases in 1981 (Arne Jensen)

Verticillium dahliae in oil seed rape

The fungus is known in connection with attacks on a number of cultivated plants, among others tomato and potato, and in the month of August the fungus was found in a field of spring rape at the site "Virumgård" near Lyngby. The symptoms were a partial or a total wilting of the plants in patches of the field. On the stems typical stripes were found of necrotic tissue containing the numerous microsclerotia of the fungus, see the illustration.

A pure culture of the fungus has been obtained but infection experiments have not yet taken place. Symptoms of *Verticillium* wilt were found in two other fields.

Attacks of *Verticillium* have been known for years in Sweden. The importance of the fungus under Danish conditions will be investigated more closely.

IV. VIROLOGY DEPARTMENT, H. Rønde Kristensen

1. Experimental work

The application area for the serological methods - especially ELISA - are under further development and immuno-reagents for this purpose have been produced for several potato viruses.

The relatively new immuno-electron microscopical method, ISEM, has been used with great advantages for a still increasing number of viruses.

Healthy meristeme material from about 40 potato varieties delivered some years ago to the potato foundation is being kept in test tubes in the "meristembank" at the institute.

Investigations regarding the long term storage in vitro under various growth conditions (nutrition, temperature and light) are currently performed.

Research on meristem culture of woody plants has so far comprised 90 species/varieties.

Comprehensive work is also carried out with virus diseases of pot plants and cut flowers.

In order to improve the test methods various experiments regarding special treatment of the indicator plants and various inoculation methods have been performed.

Viruses in Carnations, Chrysanthemum, Kalanchoe and Pelargonium have been eliminated by meristeme culture.

Work to clarify the spread of lettuce veinbanding chlorosis virus and tomato mosaic virus through the nutrient solution in soil-less culture has been continued, and so has work on viruses of pepper and leeks.

Virus diseases of agricultural plants (B. Engsbro)

Tuber formation of potato cuttings in test tubes

Well developed potato cuttings in test tubes placed in darkness and covered in plastic bags to minimize the air exchange began wilting and after a while also began to form small potato tubers.

The best and most starble tuber formation are obtained at 12°C at minimal light and air exchange, but also at 20°C in light and with moderate air exchange small good tubers can be formed in the test tubes.

After one month at 12°C tuber formation was found at 31 per cent, after two months at 69 per cent and after three months at 91 per cent of the plants in test tubes.

After three months 67 per cent of the plants in test tubes had formed one good tuber. 22 per cent two and 4 per cent had formed three or more tubers.

Storage and growth from tubers formed in test tubes

Dormancy of the formed tubers seems to be very short at 12°C.

After storage for one month at 12°C 97 per cent of the tubers sprouted after transfer to new test tubes both at 12°C and 20°C in light. 68 per cent of the tubers gave rise to one sprout, 18 per cent to two, 6 per cent to 3 and 5 per cent gave rise to four, five or six sprouts.

After storage in darkness at 3°C for eight months all 80 tubers representing 16 varieties sprouted. The tubers were placed 2 cm deep in soil outdours, and they all formed good plants. Average yield was 72 g per plant, 14 tubers of which 7 had a diameter of 15 mm or more.

After storage in darkness at 3°C for 14 months 5 tubers of each of 51 varieties were placed in soil in glasshouses. In 32 varieties all tubers sprouted, in fifteen varieties most tubers sprouted and no tubers sprouted in 15 varieties. All together 84per cent of the tubers sprouted, mostly raising one to 3 stems (average 2,2).

Tuber formation at "mini cuttings" in the open and in glasshouses

Tuber formation from "mini cuttings" (well developed test tube plants cut in 1-leaf pieces, and rooted in soil in mist or

moisture chamber are compared for tuber formation from plants raised from tubers and from cuttings taken from well developed plants and rooted in blocks of mineral wool.

In the open the presprouted tubers were planted 30. April and 25. May the "mini cuttings" and the two leaf cuttings were planted.

In the glasshouse both the rooted cuttings and the presprouted tubers were planted the first days of April.

In the open the yield of the "mini cuttings" of the variety Bintje was 49 tubers per m^2 in the size of 30-55 mm from the tuber plants 72 and from the two leaf cuttings 25.

The yield from the variety Kennebec was likewise: 30, 46 and 17 tubers per m^2 in the size of 30-65 mm.

The yield from the stem cuttings consisted in many cases of deformed tubers and are a bad source as planting material, while all tubers from tuber plants and from "mini cuttings" were of a good shape for seed potatoes.

In the glasshouse the yield of tubers from tuber plants was 137 tubers per netto m^2 in the size of 30-45 mm, and from the "mini cuttings" 79 tubers in this size.

Is also the size of 20-30 used the yield of tubers is nearly equal in the size 20-45 mm 208 tubers per netto m^2 from the tuber plants and 205 from the "mini cuttings".

Virus diseases on fruit trees (Arne Thomsen)

Apple meristem-tip culture. The formation of roots in meristem -tip culture of the apple variety 'Rød Graasten' accelerate when plantlets are transmitted from solid toliquid medium containing 1 ppm IBA and 1 per cent of sugar. After 4 days in this medium the plants are transmitted to solid medium without IBA. In 10 days they develop good roots.

Apple rootstocks - meristem-tip culture. Plants with roots are established from meristem-tip culture of the rootstocks EMII and EMIV.

Cherry - meristem-tip culture. By cultivating 'mini cuttings' of the cherry variety 'Stevnsbær' in a medium containing 2-3 ppm BAP a multiplication of 10-20 times of the number of cuttings, was obtained for a period of 6 weeks.

Virus diseases in fruit bushes (Arne Thomsen)

Blackberry - meristem-tip culture. Meristem plants with roots are established from the varieties 'Black Diamond' and 'Thornless'.

Virus diseases in vegetable (N. Paludan)

Tomato mosaic in tomato

Attack of tomato mosaic virus (TomMV) in tomato cultures is no longer of any importance, as virus resitant varieties are mainly used. Vaccination of susceptible tomato plants with attenuated TomMV-vaccine has only been used in a single nursery.

The transmission of TomMV by a recirculated nutrient solution in a soilless system was investigated with tomato plants grown over a period of 10 weeks. Root infections occurred in 4 of 28 plants (14 per cent), while no top infections were shown.

Water melon mosaic in gherkins. In combination with a tolerance test of gherkins a new strain II of the water melon mosaic virus (WMV) was received from Israel (S. Cohen). This virus strain which destroys all existing resistance in gherkins causes local lesions in Chenopodium varieties together with a strong systemic mosaic, vein clearing and deformation in cucumber and squash.

Freeze-dried samples of WMV-strains have shown to be infective for several years, while this was not the case with freezing.

Big vein agent (BVA) in lettuce. The transmission of BVA in combination with the fungus Olpidium brassicae (O.b.) by a recirculated nutrient solution in a soilless system was investigated using lettuce plants.

All the lettuce plants became infected irrespective of the infection period ranging from 4 to 36 days. By repeating this experiment, using the same infector plants, no transmission occurred during the same period of time. Using fresh infector plants (BVA + O.b.) and only a 1 day infection exposing time 1, 3, 8, 16 and 21 days from the start, lettuce became infected after 1, 3 and 8 days only.

Treatment with the surfactant "wetter" 'Teepol' at 20 ppm every 4th did reduce the BVA attack, but could not avoid BVA infection.

Chemical treatments of soil with methylbromid (100 g/m^2) and basamid 60 g/m^2 reduced the BVA attack, but the effect from methylbromid was too short, BVA symptoms were already showing up in the second lettuce crop.

Tobacco mosaic in pepper

Experiments concerning resistance in pepper varieties to different strains of tobacco mosaic virus (TMV) have been carried out. Resistance to the mild TMV-pepper strain, received from Rast in 11 of all together 20 plants.

The variety 'Cadice' showed resistance to both the tomato- and the tobacco TMV-strains, and so did 'E 1104', '19-31', 'Herpa' and 'Rumba'. None of them were resistant to any of the 2 TMV-pepper strain nr. 8 and 11.

A survey of the spread of TMV in Danish pepper culture has continued in 1981, where 16 growers were visited. TMV-attack was shown at 11 growers but only in a very low degree. Cucumber mosaic was shown in 2 samples and TMV in 9. Of these 6 were tomato strains, 1 a tobacco strain and 1 a serious pepper strain, causing systemic infection in capsicum frutescens 'Tabasco'. This is the first report of the pepper strains existance in Danish pepper cultures.

Leek yellow stripe in leek

Experiments with wintering concerning virus tolerant varieties

infected with leek yellow stripe virus (LYSV) have been carried out. In May the saleable number of healthy and LYSV-infected plants were in per cent of total 17 and 10 for 'Ligina', 43 and 33 for 'Ara Platina' and 49 and 21 for 'Sigfried Frost' respectively. The average weight of 5 plants showed a weight reduction for the LYSV-infection at 57, 48 and 50 per cent respectively. The LYSV-infection has a serious effect on wintering leek varieties resulting in fewer saleable plants and reduction in weight.

The most virus tolerant plants have for further breeding purposes been delivered to 4 seed companies.

Shallot plants from the winter tests, comprising 8 growers and 24 group samples, have been tested for the presence of LYSV. The virus was not shown in any of the samples.

Virus diseases in ornamental plants (N. Paludan and A. Thomsen)

Inactivation of carnation viruses. Carnation etched ring- and carnation mottle virus have both been inactivated by meristem-tip culture.

Meristem-tip culture of carnation has been carried out in order to find media, which do not cause a development of vitroficied (water soaked) growth. With 0.7 per cent agar normal growth was achieved in a medium with 1400 mg macroelements pr. litre, while vitrofied growth occurred at 4530 mg macroelements. The concentration of kinetin, ranging from 0.2 to 1 mg/litre, did not have any influence.

Storage of carnation top cuttings in tubes at $1^{o}C$ in darkness has been carried out. Plants were stored 12, 16, 20 and 24 months respectively followed by illumination for 14 days at $12^{o}C$. The average growth was estimated to be 52, 49, 49 and 74 mm, and the possible number of cuttings to be 3.2 - 3.8 - 5.3 and 7.2 respectively. All the plants were green, healthy and with good roots.

Growth control of carnations. Plants were stored at 1°C in darkness for periods up to 2 years. From these plants motherplants were established and uniform cuttings were taken and these grew to approximately 20 cm. All the plants including unstored plants were simular in growth and leaf form.

Elimination of the viroids Chrysanthemum stunt (CDV) and Chrysanthemum chlorotic mottle (CCMV) did not succeed either by the use of very small 0.2 mm meristem-tips (64 plants), or by media containing 'Amantadine' at 0, 50 and 100 mg/litre during a 3.5 to 8 month cultivation period (47 plants).

Infection experiments with Pelargonium virus isolates have shown to be most effective performing dry inoculation with PEG-buffer to young 4 leaves Chenopodium quinoa plants without any previous treatment in darkness.

Cuttings from selected sensitive clones of the variety 'Carefree' top grafted to the infector plants were just as effective, but this method is more labour consuming and more difficult to perform.

Meristem-tip culture of Pelargonium varieties and clones has been carried out using different media, combinations and growth substances. The best growth was achieved using media with a very low content of nitrogen (2000 mg/litre) and 1 mg kinetin together with 0.2 mg IBA/litre. Coconut water is not necessary and the use of gibberelin in combination with NAA caused abnormal growth.

Virus-free plants have been established in 8 different Pelargonium varieties. From a total of 226 established meristem-tip plants, from virus infected Pelargonium plants, 50 per cent were virus-free, 35 per cent virus infected and 18 per cent with genetic alterations irrespectively of the variety.

Storage experiments with Pelargonium cuttings in tubes over a 1 year period at 9°C and with 16 hours illumination have been carried out. Using a medium with a very low content of nitrogen 83 per cent survived as vital plants.

Infection experiments with Dieffenbachia virus isolates have been carried out. Dasheen mosaik virus (DMV) has been sap transmitted to Philodendron and serological reactions appeared with DMV-antiserum by immunodiffusion test and immuno electronmicroscopi.

In healthy looking plants tobacco necrosis virus (TNV) was found once in connection with a sporadic vein clearing. In the meantime TNV was not shown again, and back transmission to Dieffenbachia failed.

Healthy Dieffenbachia plants regarded as improved material were found in commercially grown cultures by careful selection work.

Mosaic symptoms in Kalanchoe have been found in 17 of 24 assessed varieties.

Seed transmission. Seedlings of the variety 'Visur' have shown white rings in the leaves, and developed mosaic symptoms in K. daigremontiana by graftings.

Meristem-tip cultures of Kalanchoe plants have been carried out with a low concentrated medium using 1 mg kinetin and 0.3 mg IAA per litre. From a total of 391 meristem-tips, 64 per cent were established as plants. Of these leaf symptoms developed in 48 per cent of the plants and virus infection shown in 82 per cent by top grafting with K. daigremontiana.

Begonia elatior plants of the varieties 'Nixe' and 'Elfe' have shown vein clearing and rugosed top leaves in the winter months from November to March. Tobacco necrosis virus (strain A) was found once by dry inoculation to Chenopodium quinoa. Meristem-tip

plants have been established in a MS-62 medium with 0.5 mg kinetin and 1 mg IBA per litre.

Deutzia meristem-tip culture

By meristem-tip culture plants with roots of 12 Deutzia magnifica clones are established.

Healthy plants now exist of all 12 clones.

Nuclear stock plants

Material from 29 valuable, virus-free species and varieties of woody ornamentals is now kept at the Plant propagation Station at Lunderskov.

Testing of meristem-tip cultures

527 meristem plants including 16 species of woody ornamental plants, found to be free of virus infection by testing in 1980, have been retested in 1981. Virus infection was found in 7 plants spread over the species Budleia, Hypericum, Sambucus and Tamarix.

In-vitro storage of woody ornamental plants

It has been shown that some meristem cultures survive a longer period at 20°C compared to temperatures at 3°C and 8°C.

Serology (Mogens Christensen)

Preparation of antisera for potato viruses

The following amount of antisera has been prepared. The titers mentioned are the highest ones obtained. 750 ml antiserum to potato virus M, titer 1:8192, 880 ml antiserum to potato virus S, titer 1:2560, 625 ml antiserum to potato virus Y, titer 1:25600, 900 ml antiserum to potato virus X, titer 1:2560.

Some of these antisera are suitable for ELISA.

Diagnosing of potato viruses

In connection with the production of seed potatoes potato virus M, potato virus S and potato virus X has been detected by the agglutination method while potato virus Y and potato leafroll virus were detected with ELISA.

The 5 viruses mentioned above were diagnosed by ELISA in extracts from potato tubers and potato sprouts and also in cuttings grown in vitro.

Relationship between strains of tobacco mosaic viruses (TMV)

Precipitation test in tubers at 37°C showed that an antisera prepared for the tobacco strain of TMV had the same titer both on the tobacco strain and on the tomato strain.

An antiserum prepared for the tomato strain had a much higher titer on the tomato strain than on the tobacco strain.

Neither the antiserum for the tobacco strain nor the antiserum for the tomato strain reacted with the pepper strain.

Delivery of antisera

220 ml of antisera for different potato viruses have been delivered to laboratories both in Denmark and abroad which deal with the production of healthy seed potatoes. In a few cases also immunoreagents to ELISA have been delivered.

Electron microscopy (Jens Begtrup)

During the year 1981, 2480 samples were examined under the electron microscope, 2150 by immunosorbent electron microscope (ISEM).

With the embedding technique 140 examinations were carried out. 58 of the embeddings were the final work of the project "MLO in plants of Denmark".

The figures mentioned above and the great percentage of samples done with ISEM (2150) show the importance, this technique has been developed the later years. We have by now app. 100 different antisera to use in the ISEM work. Experiments to keep

virus suspensions in the refrigerator at 4°C in EM stain (PTA-AM-UA) show that it is possible to keep the serological activity up to ten years. This is valuable information as it is important to keep constant control of the antisera used in EM-laboratory. There is not "up to date" research on stability of antisera stored under "normal ISEM condition" e.g. diluted/undiluted antisera at 4°C in glycerol or added NaN_3 (0.02%). The experiments continue.

The investigation of the validity of virus suspension in EM stain started as a coincidence. A ten year old virus suspension kept in a refrigerator at 4°C for ten years could by ISEM be identified as Tobacco ringspot virus (TobRV) in sap from Arctium lappa. Identification was abandoned 10 years ago as inoculation to test plants failed. Today it can be recognized that A. lappa is a new host for TobRV. The virus is not infective, but the serological reaction to the antisera is caused by the coatprotein.

Among the viruses diagnozed are Dasheen mosaic virus, Barley yellow dwarf virus, Euforbia mosaic virus, Euforbia cryptic virus.

Besides the ISEM-technique the cut squeeze method is still being greatly used.

2. New attacks of virus diseases 1981

Virus infection was detected in the following species:

Begonia elatior (tobacco necrosis virus, strain A)
Dieffenbachia maculata (tobacco necrosis virus, strain A)
Hoya australis (tobacco mosaic virus)
Jasminum polyanthum (cucumber mosaic virus)
Lolium perenne (Cynosorus mottle virus).

V. Zoology Department, J. Jakobsen

1. Experimental work

Potato root nematode (Globodera rostochiensis, G. pallida) (J. Jakobsen)

In 1981 about 11,000 soil samples were investigated for occurrence of potato cyst nematodes. This work is carried out for The Plant Protection Service and the samples came from fields with seed potato, potato for export, from plant nurseries and horticulture.

A special investigation was carried out on Samsø with cooperation between the local farmers organization and The Plant Protection Service.

A total of 1,500 samples from 164 farms were investigated. Among these, 64 farms were found with one or more infested fields. However, even though the potato-growing on these farms was rather intensive, most fields were found with a low number of potato cyst nematodes. This was certainly due to the early lifting of potatoes that is normal practice on Samsø.

The work with testing new potato varieties from The Potato Breeding Station Vandel has been continued and about 3,000 potato-clones have been tested against pathotype Ro-1.

On the basis of a sample of pathotypes PA-2 and PA-3 received from Holland we have now built up a population of these two pathotypes enough to test new potato-varieties against these two pathotypes to a limited extent.

Cereal cyst nematode (Heterodera avenae) (M. Juhl & J. Jakobsen)

The investigation of the influence of winter soil-temperature on the fungi species, that parasitize the nematode cysts has been continued. If the soil temperature does not fall below 5°C the number of cysts parasitized by fungi is twice that compared with cysts in non-heated soil.

Investigation of the importance of certain fungi species that parasitize cyst nematodes has been continued in cooperation with

the IOBC working group. Soil-treatment with the fungicide captafol was included in this work.

In both the years in which treatments have been used the number of nematode-cysts parasitized by fungi in the treated plots have only been half the number compared with untreated plots.

A high number of spores of Verticillium chlamydosporium and Nemathophtora gynophila were found in the untreated plots (M. Juhl).

A long term investigation into the population dynamics of Heterodera avenae in microplots continues at The Experimental Station, Borris. Until 1977 oats, barley and four different grass species were grown and more recently susceptible varieties of oats and barley were also included.

It is interesting to note that in the plots of timothy there was no build up of cereal cyst nematode compared with the other plots, where the number of cereal cyst nematodes were rather high until 1977.

Aphids on cereals and other crops (J. Reitzel & J. Jakobsen)

In connection with a project on damage thresholds of diseases and pests in cereals, development of a new method of estimating population density of aphids has been developed. The method is based on counting the number of aphids on 2 x 100 tillers from each field or plot to find the correlation between the number of infested tillers and the total number of aphids.

The attack of aphids was low in cereals in 1981. Therefore the results from field experiments with use of different pesticides and concentrations against aphids were not significant.

Fields with selected seed potatoes were kept under observation for occurrence of aphids in order to prevent the spread of virus.

The development of semifield pesticide test methods was continued. The method is based on containers covered with nylon -gauze, where the aphids are introduced.

Biological control of aphids in glasshouses (L. Stengård Hansen)

Supported by a 2-year grant from the Danish Agricultural and Veterinary Research Council, L. Stengård Hansen has continued the biological investigations on the aphid midge, Aphidoletes aphidimyza. Furthermore, the aphid midge has been used on a greater scale for aphid control in commercial glasshouses.

Promising results have been obtained with the so-called "open stock"-technique, by means of which the aphid midge is establish in the glasshouse as a preventive measure, early in the growing season. An aphid species specific to leguminous plants (vetch aphid (Megoura viciae)) on broad bean serves as a food source for the aphid midge during the first part of the growing season.

Control of pest insects on non protected vegetable crops (P. Esbjerg)

The development of new trap designs and testing of synthetic pheromone mixtures for the turnip moth has been carried out as part of the research initiative on integrated control supported by the Danish Agricultural and Veterinary Research Council.

The investigation of different pheromone mixtures has lead to a very efficient synthetic pheromone.

The trap design also has an important influence on the cathing efficiency of traps for the turnip moth. The previously used trap, based on a section of pipe has proven much less efficient than a trap with a large opening between a simple roof and bottom construction.

Investigations of the influence of soil moisture on cutworms have been carried out in a glasshouse. When the soil is kept permanently very wet the mortality is increased significantly in particular of first and second instar cutworms. This corresponds very well to the statistically based conclusion that only weak cutworm attacks occur during wet summers.

Development of laboratory methods for investigation of the effect of insecticides on pests in oil-seed rape (Bent Bromand)

In field trials it can be difficult to compare the effect of different insecticides, especially when the population of a specific pest is low.

On the basis of captured blossom beetles (Meligethes aeneus) work has been carried out with different methods. In principle glass-chambers have been used in which the surfaces have been coated with a well defined layer of the pesticide under test. After 24 or 48 hours the number of live and dead beetles was counted.

Instead of glass plates insecticide treated leaves can be used in the chambers. The technique seems very suitable to separate insecticides with different effect against blossom beetles, but further trials are necessary.

From previous investigations of the biology of blossom beetles egg laying have been noticed, which suggests the presence of a 2nd generation of beetles. Systematic investigations of this in 1981 revealed that egglaying started after 3 months at 20°C, 16 hours of light and a relative humidity of 70 15% and a continuous supply of fresh buds and flowers of oil-seed rape. From October to December, on average 2 eggs per female a day were laid.

The larvae from these eggs developed normally and 60% pupated and hatched as fully developed beetles. The development from egg to adult took about 5 weeks.

The results show that it is possible to break the "diapause" in the blossom beetle.

Registration, warning and damage thresholds for pests in oil-seed rape (F. Lind)

The population density of pest is estimated in a considerable number of fields with winter- and spring rape. The investigation is based on a close cooperation with the farmers. The farmers

collect samples from traps, from plants and take soil samples. These samples are sent to the laboratory, where the population density and hence the level of attack are estimated. In this way it is possible to handle a large number of samples.

The attack of pests in rape was relatively low in 1981, so therefore the results from the investigations have been limited.

Insecticide-resistance in peach-potato-aphids, Myzus persicae Sulz (Ole C. Pedersen)

The aim of this project is to determine the distribution and degree of resistance in danish peach-potato-aphids. This is done with the aid of a biochemical test-method, with which it is possible to measure the degree of resistance in single aphids.

The preliminary results from 1981 have demonstrated that very resistant peach-potato-aphids are the most frequent types in glasshouses.

In the open (beet- and potato-fields) weak resistance is the most frequent type found, though more resistant types occur all over the country. There seems to be more resistance in the open in areas where glasshouses are frequent.

Soil inhabiting pests of sugarbeet (Lars Monrad Hansen)

The investigations of collembola and millipeds as seedling pests have continued. This investigation is sponsored by a private committee of sugar-beet growers.

The occurrence of collembola in 1981 was relatively small, but the investigation showed a tendency towards higher numbers on lighter soils with a relatively high content of organic matter.

Investigations with different granulated insecticides showed that in the absence of pests, the number of plants will be lower in treated plots than in untreated plots.

In connection with the investigation in 1981 samples were taken from areas of fields, in which there were a very low number of plants and poor growth. In the samples a high number of

Trichodorus spp. were found - species of nematodes which in England are known to cause great damage in sugarbeet fields.

Methods for testing the effect of pesticides on the predacious mite Phytoseiulus persimilis and the parasitic wasp Encarsia formosa (Lise Samsøe-Petersen)

A laboratory test-method has been developed to test effects of pesticides on the predatory mite. The method has been accepted as an international standard test method by the IOBC working group "Pesticides and beneficial Arthropods". Work on a test method for the parasitic wasp has been started, and it is expected to be completed by the end of 1982.

B. PESTICIDE RESEARCH INSTITUTE, E. Nøddegaard

The institute carries out experiments with pesticides for use in agriculture and horticulture.

The Agricultural Chemicals Approval Scheme

The scheme is carried out in accordance with an agreement between the Ministry of Agriculture and the Danish Agrochemical Association. Registration at the Ministry of Agriculture is voluntary and involves efficacy, only.

Firms submitting pesticides for testing receive confidential information about the results.

When an approval has been granted a certificate is issued given the specifications of the approval. The text of the certificate may be printed on the label of the specific products.

A list of approved products and their uses is published in February each year. A list of additions and amendments is issued in April.

The Agricultural Chemicals Evaluation Scheme

Efficacy is to certain Degree also included in the compulsory registration at the Ministry of Environmental Protection.

Efficacy data is send by the chemical firms to the Environmental Protection Service together with other information needed for registration.

The Environmental Protection Service sends the efficacy data to the Pesticide Institute. After evaluation of the data the Institute reports back to the Environmental Protection Service whether or not the results can be considered sufficient to fullfill the demand for efficacy in connection with registration by the Environmental Protection Service.

The efficacy data required can be from trials carried out either by officiel agencies or by chemicals firms, and need not be from trials carried out in Denmark, but can be from other countries, whose climate and agricultural practises are similar to those of Denmark.

1. Experimental work

Agriculture

Fungal diseases

Seed treatments of cereals (Bent Løschenkohl)

I field experiments 9 compounds have been tested against Stripe smut of rye (Urocystis occulta) and Bunt of wheat (Tilletia caries). Compounds containing carbendazim or a mixture of fuberidazole and Na-N-dimethyldimethiocarbamate gave a good control of the two diseases. Triadimenol and fuberidazole completely controlled stripe smut, but not bunt. Disease level in untreated was 32.2 per cent and 18.3 per cent respectively.

10 compounds have been tested against Leaf stripe of barley (Drechslera graminea). Best control was achieved with prochloraz, nuarimol, Baytan Universal and Baytan Universal IM. Disease level in untreated plots was 10.7-44.6 per cent.

In laboratory- and greenhouse experiments 7 compounds have been tested against seed-borne diseases. Carbendazim, carbendazim+maneb, maneb and Baytan showed good effect against Fusarium spp., although in some trials carbendazim had no effect. Disease level in untreated was 2.7-8.2 per cent. Methoxyethylmercuri Chloride had a good effect against Septoria nodorum, which occurred with 19.7-78.o per cent in untreated.

Epicoccum sp. was controlled with maneb and Na-N-dimethyldithiocarbamate + fuberidazole, whereas Baytan had no effect. Disease level in untreated was 2.8-24.6 per cent.

Alternaria spp. was controlled by all the mentioned compounds except carbendazim. Disease level in untreated was 8.2-43.6 per cent.

In a lot winter wheat, variety Solid, with low germination carbendazim failed to control Fusarium sp. The reason for this is being investigated further.

In 8 field experiments with seed treatments of barley, and in 3 experiments with rye no significant extra-yields were achieved, whereas 3 field experiments with winter wheat in average gave extra-yields of 4.5 hkg/ha for carbendazim, carbendazim+maneb, guazatine and Baytan.

Seed Treatment against powdery mildew (Erysiphe graminis) and rust (Puccinia spp.) in cereals (Bent J. Nielsen)

After seed treatment of winter barley with several systemic fungicides there was in some trials a complete control of powdery mildew (Erysiphe graminis) in the autumn. The effect could be seen in the next spring and summer where there was a delay of the epidemic in the treated plots. In the autumn of 1980 these trials were affected late and only mildly by mildew and there was no carry over of any disease in the treated plots. In other trials with early and more severe infection the untreated plots were heavily infected. The control of mildew in the treated crops was not complete. There was a low level of infection but the treated plots escaped the severe autumn infection and the development of mildew in the following spring was reduced compared to untreated plots.

In wheat and rye the untreated plots were only mildly affected in the autumn of 1980 even where plants had been artificial infected with mildew.

In spring barley seed treatment gave a good control of powdery mildew. The epidemic was delayed and first at heading the disease developed in the treated plots which compared to untreated plots carried little mildew only.

Some trials were severely attacked by brown rust (Puccinia hordei) late in the season after ear emergence. The disease build up rapidly at this time, and beside one fungicide with only a very weak and short effect, there was no control of rust after seed treatment.

The investigations are supported by the Danish Agricultural and Veterinary Research Council.

Eye spot (Cercosporella herpotrichoides) (Knud E. Hansen)

In fields with severe attack 4 experiments have been carried out with spraying at approximately growth stage 6 in winter wheat. Compounds containing benzimidazoles,prochloraz, propiconazole and phenpropemorph partly as single active ingrediens partly in combinations have been tested. The best effect against eye spot has been obtained by carbendazim - and benomyl containing compounds.

In the experiments, smaller attack of mildew (Erysiphe graminis) and severe attack of glume blotch (Septoria nodorum) were registered. Therefore half of the replications were sprayed again about the heading (g.s. 10-10.3).

Spraying with propiconazole and prochloraz compounds gave 10-18 per cent yield increase for 1 spraying at stage 6 and 20-22 per cent for 2 sprayings.

These big increased yields were results of good control of glume blotch more than the control of eye spot. Benzimidazole compounds which controlled eye spot better gave less yield increase for the second spraying.

Glume blotch (Septoria nodorum)

Besides the experiments mentioned above, other experiments with controlling glume blotch have been carried out in winter wheat. Several types of compounds have been tested in experiments combining timing with number of sprayings.

The attack on leaves and ears has been examined as well as the occurrence of the fungi on the harvested grains.

In average the best effect has been obtained by propiconazole, prochloraz and chlorothalonil. Further more these compounds gave a good yield increase. Captafol, Anilazine and combinations of carbendazim and maneb gave a significant yield increase but a weaker control of the disease.

Yellow rust (Puccinia striiformis)

One single experiment has been carried out in winter wheat with heavy attack by yellow rust. Weaker attacks of brown rust (Puccinia recondita)and glume blotch occurred also in the experiment.

Propiconazole, triadimefon, dichlobutrazole and combined compounds of phenpropemorph/carbendazim respectively tridemorph/carbendazim gave good control. Chlorothalonil and oxycarboxin had a weaker effect.

Potato Blight (Phytophthora infestans)

A series of experiments with spraying programmes with the purpose of controlling blight have been started in collaboration with the experimental stations Lundgaard and Tylstrup.The experiments are carried out in 2 varieties with different growth length. The preliminary results showed best effiency by 2 sprayings with metalaxyl combinated with mancozeb. In experiments with compounds containing different types of active ingrediens this compound also gave the best control both against attacks on leaves and tubers.

Pests

Frit fly (Oscinis frit) on corn (Bent Løschenkohl)

Best control was obtained with carbofuran granules and good control with etrimfos and 7 pyrethroids.

Pollen beetle (Meligethes aeneua), Seed weevil (Ceutorrhynchus assimilis), and Brassica pod midge (Dasuneura brassicae) in oil seed rape.

4 experiments were performed in winter rape with methoxychlor, phosalon, parathion-methyl and 8 pyrethroids, together with 4 experiments in spring rape with 2 doses of methoxychlor, phosalon and 4 pyrethroids.

In all the experiments phosalon had the weakest effect against the Pollen beetle, whereas the other compounds all had same effect. In spring rape the effect was depending on the dosage of phosalon,

whereas the other compounds had the same effect both after normal and half dosages.

Against seed weevil there was an inadequately effect of methoxychlor, whereas the other compounds had good effect.

Against brassica pod midge methoxychlor and phosalon had a weaker effect than the pyrethroids.

Potato root nematode (Globodera rostochiensis) (A. Nøhr Rasmussen)

In 1980 a new method of spreading metam-Na was introduced. The spreading is carried out with a special machine which simultaneously applay the compounds and mix the top soil as well as levelling and rolling it.

Using this method 2 experiments were performed in which metam-Na was compared with dazomet. After the spreading was carried out on the 15 of October, however, a heavy rainfall injured the metam-Na, which needs the presence of oxygen to be transformed in the soil. Due to that, the effect of metam-Na was 50 per cent, only which is considerably lower, than under normal conditions, using this method. Dazomet had more than 99 per cent effect.

II. HORTICULTURE (A. Nøhr Rasmussen and E. Schadegg)

Fungal disease

Apple Mildew (Podosphaera leucotricha)

2 experiments were performed to investigate the effect of 18 different compounds, representing all the approved compounds against apple mildew. Fenarimol, binapacryl and the mixed product sulphur-Nitrothal-isopropyl had an acceptable effect in both experiments, whereas the effect of thiophanat-methyl and triadimefon was not satisfactory.

Powdery mildew on roses (Sphaerotheca pannosa)

8 different compounds were investigated against rose mildew. Bitertanol, fenarimol and pyrazophos were effective but also triforin had good effect. The compounds had also satisfactory effect

against black spot of roses, but against this disease triforin had the best effect.

Apple scab (Venturia inaequalis)

Much rain in early summer caused a severe scab infection. The scab was particularly severe in the variety Golden Delicious.

26 different compounds approved against apple scab were investigated. The results showed that thiram and sulphur and a combination of these, together with zineb and ziram, was not sufficiently effective where the degree of infection was high, whereas benomyl, captan, captafol and 4 new compounds had a satisfactory effect against the scab.

Grey mould (Botrytis cinerea) on strawberries

Rainy weather gave good conditions for spreading of grey mould. The spraying took place at 25, 60 and 90 per cent flowering. Mechlozolin was considerably better than the other compounds tested. Thiram was the worst with only 3 per cent effect. Tolylfluanid and mechlozolin gave the greatest yield.

In an experiment with 4 compounds, sprayed as the previous experiment plus on green berries, the best effect was achieved by vinclozolin, whereas the yield was greatest after using tolylfluanid.

Winter moth (Cheimatobia spp.)

An experiment was carried out with 7 pyrethroids and 2 phosphorus compounds. Permethrin and fenvalerate were best. Cypermethrin was not quite as good, but had the same effect as the 2 compounds containing phosphorus.

Apple psyllid (Psylla mali)

6 different pyrethroids have been tested and all of them had an excellent effect against apple psyllid.

Black anthonomus (Anthonomus rubi) on strawberries

Among the compounds tested the pyrethroids (permethrin and cypermethrin) had the best effect, methomyl was less effective.

Moth on strawberries (Acalla comariana)

The experiment was performed in an old strawberry field with heavy attack by moths. Methomyl had the best effect of all the compounds tested. Among the pyrethroids, cypermethrin was better than permethrin.

Glasshouse (A. Nøhr Rasmussen)

Fungal diseases

Stem and fruit rot of tomatoes (Didymella lycopercici)

5 compounds were tested in one experiment. Vinclozolin had good effect, whereas the effect of captan and thiabendazol was less satisfactory. Mechlozolin had the poorest effect.

Grey mould (Botrytis cinerea) on tomatoes

During 1979-81 9 experiments were carried out with 8 different compounds. In average vinclozolin had the best effect, whereas thiabendazol and iprodion had a weaker effect, especially thiabendazol. Wettable powders caused so many spots on the fruits that washing was necessary before sale.

Downy mildew (Bremia lactucae)

In 3 experiments, propamocarb and milfuran were tested by mixing the compound with the soil before planting, and by spraying after planting. Moreover milfuran was sprayed on the top of the soil at the time of sowing. Propamocarb had good effect when applied to the soil before planting, but not by spraying the plants during the growth. Milfuran was effective after all 3 methods of treatment, but after soil treatment at the time of sowing, a growth inhibition was observed.

Pests

Scale insects (Saissetia coffeae)

In 1981, for the first time, insecticides were tested against scale insects on ornamental plants. The experiments showed good possibilities for effective control of scale insects by the insecticides available. Not much difference in effect between the phosphorous compound etrimfos and the pyrethroids was observed.

Glasshouse White fly (Trialeurodes vaporariorum)

In 4 experiments 12 compounds were tested against larvae of the White fly. The synthetic pyrethroids were very effective, methamidophos and etrimfos, however, also had good effect. The effect of mevinphos, heptenophos and thiophanat was not satisfactory

The compounds were tested in normal and half the normal dosages. The effect was weaker by using half dosage,especially against the 2rd and 3rd larvae stages. When normal dosage was used the effect was 100 per cent.

III. New pesticides tested in 1981 (E. Schadegg)

In 1981 the Pesticide Research Institute evaluated, including reference compounds, 80 fungicides, 47 insecticides, 4 of which being granules, and 40 fungicides and 1 insecticid for dressing of cereals, other seeds and potatoes. In total 173 experiments were carried out with 172 compounds, out of which the pesticides mentioned below have been approved by the State Committee on Crop Husbandry.

Fusarium

in spring barley: VIT-Bejdse, Trimidal bejdse 10 S,
Sportak bejdse, Baytan Universal IM.

in winter barley: VIT-Bejdse, Baytan Universal IM.

Eye spot (Cercosporella herpotrichoides)

Benlate DF, BAS 431 07 F,

Glume blotch (Septoria nodorum)

Tilt 250 EC, Tilt Plus, Sportak,

Yellow rust (Puccinia striiformis)

Bayleton 25 WP

Apple scab (Venturia inaqualis)

Baycor 25 WP, Dithane LF, Ronilan flowable.

Grey mould (Botrytis cinerea) on tomatoes

Ronilan flowable, Ronilan,

Glasshouse White fly (Trialeurodes vaporariorum) on ornamental plants and vegetables

Ambush, Cymbush, Decis, Ekamet, Midol Permethrin, PLK-Permethrin, Resbuthrin 20 EC, Ripcord, Sumicidin 20 EC, Tamaron 600 EC,

Peach potato aphid (Myzus persica) on vegetables in glasshouse

Hostaquick, Pirimor G.

Red spider mites (Tetrahynchus urticae)

on ornamental plants: Morestan, Pentac SP, Tamaron 600 EC,

on cucumbers: Morestan,

Vine weevil (Otiorrhynchus sulcatus)

Tamaron 600 EC

Moth on strawberry (Acalla comariana)

Lannate 25 WP

Growth regulators

Cereals: Agro stråforstærker, PLK-Chlormequat, Stabilan extra, Terpal, Tricorta.

Fruit trees: Alar 85.

Ornamental plants in glasshouse: Alar 85, Ethrel 480, Reducymol.

C. PLANT PROTECTION ADVISORY DEPARTMENT, GODTHÅB

by A. From Nielsen

The department was established in 1979 in order to initiate a closer co-operation within plant protection between the National Agricultural Research Council and the National Committee on Crop Husbandry. The main aims are extension service in plant protection and testing pesticides for use in agriculture. This aims are being carried out in close co-operation with the staff from the National Department of Crop Husbandry within this area.

EXPERIMENTAL WORK

Shootflies (Oscinella spp.) in grass (S. Holm)

Chemical control experiments in maize and raigrass show good effect of parathion and permethrin. The main object are to find the need of control in relation to population densities and plant development.

Cereal leaf beetle (Lema spp.) (S. Holm)

The significance of the attach in spring barley is related to development of the plant and the number of larvae. The main factors influencing the population density is temperature and precipitation during migration and at egg and 1.-2. larvae stage. The significance of these factors are examined in order to obtain a better recommendation for control.

Aphis (Rhopalosiphum padi a.o.) in maize (S. Holm)

The occurrence and importance of aphis species in maize is examined in control experiments.

Storage defects and diseases at potatoes (J. Bak Henriksen)

Preheating to 12^{o}C before grading decreased amount of potatoes with superficial damages and with internal blue spots.

Treatment of potatoes with fungicides in 2 litre water at lifting increased often the amount of rotten tubers, if the tubers were wet at the time of treatment.

Varieties for consumption were tested for tendency to greening in light. Great differences occurred. The varieties Gelda, Hansa and Asparges became easily green, while greening occurred much slower at Bintje and Sava.

Diseases in Spring Rape (J Simonsen)

In August 65 rape fields in Jutland were investigated. Clubrot (Plasmodiophora brassicae) was important only in 3 cases. Grey mould (Botrytis cinerea) was widespread, but unimportant. Sclerotinia sclerotiorum occurred in several fields with very low infection rates, except in one case with 70 pct. infected plants. A trial here with vinclozolin applied when 60-70 per cent flowers had opened reduced infection to 1 per cent and raised yield by 35 per cent.

Dark spot (Alternaria brassicae) generally were found at half of the pods. The infection level varied widely, with point 3 as main average within scale 0-10, where 0 = healthy.

Mildew (Erysiphe graminis) in winter barley and adjacent spring barley. (J. Simonsen)

As in previous two years a number of winter barley fields were investigated 2-3 times during May-June to reveal their possible influence on the mildew situation in neighbouring spring barley. Among the 55 localities investigated in South and East Jutland only 2 showed earlier and heavier mildew infection in spring barley due to nearby winter barley.

At several places voluntary plants from earlier years winter barley fields were examined without finding mildew.

Rust was not found in winter barley, but leaf spot fungi occurred at some places, espec. Rhynchosporium secalis.

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