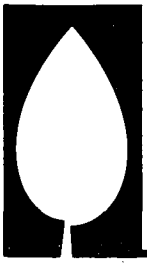
Danish Research Service
for Plant and Soil Science

Plant diseases and pests in Denmark 1982

99th annual report
Compiled by
The Research Centre for Plant Protection

Lyngby 1983



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Content Side

A. PLANT PATHOLOGY INSTITUTE

I. DIRECTORY

Director of Institute: H. Rønde Kristensen

Botany Department

Head: Arne Jensen

Scientific staff:

Lone Buchwaldt:
Diseases of oil seed rape and other seed crops.

Ib G. Dinesen:
Bacterial diseases of glasshouse crops, fruit trees and potatoes.

Arne Jensen:
Storage diseases of vegetables, Verticillium wilt and cereal diseases.

Karen Bolding Jørgensen
Diseases of sour cherries.

Henrik Albert Jørgensen:
Diagnostics of fungi, diseases of horticultural crops and root rot of sugarbeets, Dutch elm disease, registration of scientific literature.

Hemming Mygind:
Fungus diseases of glasshouse crops and nursery plants, potato wart, testing for resistance, diagnostic work especially root pathogenic fungi.

Hellfried Schulz (part time)
Root and foot rot of cereals; take-all decline.

Virology Department

Head: H. Rønde Kristensen

Scientific staff:

Jens Begtrup:

Elektronmicroscopy of viruses and MLO.

Mogens Christensen:

Purification and serology of plant viruses.

Bent Engsbro:

Viruses of agricultural plants.

Production of healthy nuclear stocks of potatoes.

Niels Paludan:

Viruses of vegetables and ornamental plants (herbaceous).

Production of healthy nuclear stocks.

Arne Thomsen:

Viruses of fruit trees, soft fruits and woody ornamental plants.

Production of healthy plants.

Zoology Department

Head: Jørgen Jakobsen

Scientific staff

Bent Bromand:

Development of standard Laboratory methods to test the effect of insecticides on pests.

Peter Esbjerg:

Insect pheromones and cutworm population dynamics.

Lars Monrad Hansen:

Soilborne pests on beets and potatoes.

Lise Stengård Hansen:
Biological and integrated control of pests on glasshouse crops.

Jørgen Jakobsen:
Plant parasitic nematodes.

Mogens Juhl:
Natural enemies of cyst-forming nematodes.

Fritjof Lind
Pests on oil seed rape.

Ole Carsten Pedersen:
The occurrence of insecticide resistant populations of Myzus persicae in Denmark.

Jørgen Reitzel:
Aphid population dynamics, particularly on potato and cereal crops.

Lise Samsøe-Petersen:
Methods of testing side effects of pesticides on beneficial arthropods.

Advisory Service

Ole Bagger.
Pests and diseases of agricultural plants.

H. Schulz (part time):
Pests and diseases of agricultural plants.

Lars A. Hobolth:
Pests and diseases of horticultural plants.

II. GENERAL SURVEY OF PLANT PATHOLOGY SUBJECTS 1982, H. Rønde Kristensen

A total staff of 63 persons were employed in this institute in 1982.

10 voluntary workers and 8 students have participated for some time in the work of the institute.

The testing work, at the Botany Department, for potato ring rot (Corynebacterium sepedonicum) has increased considerably. Investigations on the relation between outbreak of fireblight (Erwinia amylovora) and climatic conditions were continued.

Extension of the warning systems and work on determination of threshhold values for various fungus diseases of cereals has also been continued.

Special research projects have been dealing with fungus diseases of rape and damping of and root rots of beet roots, while another project has concentrated on clarification of sour cherry disorders.

Work on phloem-living fungi has been performed in connection with the establishment of healthy nuclear stocks of various pot plants.

The nematological work at the Zoology Department has comprised of routine analysis for potato cyst nematodes in a large number of soil samples and testing for nematode resistance in new potato hybrides.

A search for new patotypes in populations of potato cyst nematodes has been carried out in collaboration with the plant protection service.

Various counting methods regarding aphids in cereals and potatoes have been investigated. Work on insecticide resistance in populations of peach aphids has been continued as so have the research projects dealing with biological control of some glasshouse pests and the projects dealing with rape pests and soil -borne pests in beet roots.

The development of methods for the determination of the effect of insecticide on beneficial fauna has also continued.

At the Virology Department over 2500 electronmicroscopical analysis have been carried out, 75 per cent of them by implementing the ISEM method.

In serological analysis the ELISA method has now become an integrated part of the work.

Several investigations have been carried out in connection with "the potato meristem programme", to determine the effect of meristem size and meristem growth, under various growing conditions, upon virus elimination. Research on long term storage in vitro of gene material has been continued.

Establishment of nuclear stocks of various horticultural plants has also been continued and has comprised varieties of apples, plums, cherries, raspberries and several pot plant species.

Dr. Bhagyalaksmi Prasad from Mysore University, India has carried out post graduate studies on establishment of virus-free meristem cultures of banana.

During 1982 the Institute for Plant Pathology was visited by colleagues from the following countries:
Bangladesh, Brazil, Chechoslovakia, Columbia, Cuba, England, Finland, Hungary, India, Indonesia, Iran, Kenya, Korea, Libya, Morocco, Mauritius, Nepal, The Netherlands, Norway, Pakistan, Phillipines, Sierra Leone, Somalia, The Sudan, Sweden, Taiwan, Tanzania, Thailand and The USA.

21 scientific workers from the Institute for Plant Pathology have during 1982, undertaken 39 foreign journeys and visited the following countries:
Belgium, Canada, Chechoslovakia, England, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxemburg, The Netherlands, Norway, Scotland, Sweden, Switzerland and The USA.

Plant health control and the production of healthy plants

For several years the Danish Plant Health Board has been dealing with special problems arrising from potato ring rot, potato cyst nematodes, colorado beetles, potato viruses, dutch elm diseases, fireblight and winter barley.

Potato ring rot was found in several cases and although the disease so far has had no influence on the domestic potato production, it has been hampering export possibilities. As a consequence testing by the immunofluorescence method has been considerably increased.

The new programme for seed potatoes (based on meristem culture) aimed towards total erradication of potato ring rot is progressing rapidly and in the near future it should be possible to totally replace the seed potatoes in current use with "meristem potatoes".

While the potato cyst nematodes do not present any real problem in the Danish production of seed potatoes, numerous cases of infestation were found in imported lots of early potatoes for consumption.

Small invasions of the colorado beetle took place in 1982, but they were all dealt with successfully.

Dutch elm disease is not yet a really serious problem. Hopefully the disease can remain suppressed at low level, if the recommended control measures are followed.

The attacks of fireblight were relatively moderate in 1982. Infected hawthorns are still an important source of infection.

The obligatory health control of horticultural plants was carried out in approximately 2500 establishments in 1982 the total number of inspections being almost 7000.

The nursery Control Commission forwarded over the year 49 proposals for new projects regarding establishment of nuclear stocks of various horticultural plants. The Institute for Plant Pathology is involved in work on several of these projects.

As in former years the Plant Health Board and the Institute for Plant Pathology have had a successful collaboration with EPPO; Denmark is represented in several working parties and

on panels of this organization, which contributes an important factor to European cooperation on Plant Protection.

In September Denmark hosted the Nordic Plant Protection Conference, which took place in Roskilde with 155 participants contributing 104 papers.

In October The Seed Pathology Institute organized an International Symposium on Seed pathology. The symposium was attended by 120 participants from 38 countries.

III. ADVISORY WORK

1. Diseases in agricultural plants 1982

Ole Bagger

Cereals and grasses

Overwintering of winter crops was not completely satisfactory, due to the long period in which the ground was covered with snow. There was an added problem in the middle of the winter, when there was a thaw followed by rapid freezing. Assessment of winter survival has been made since 1959 and the 1981/82 winter led to the poorest survival rate of rye on record. A number of rye crops had to be ploughed in due to poor stands of plants in the spring. Winter barley crops overwintered relatively well, although in fields where there had been winter barley within the last few years there was snow rot (Typhula incarnata) damage. Winter wheat survived better than rye and barley. It was only where snow lay particularly thickly - near hedges etc. - that there was some degree of winter kill.

Grey speck (manganese deficiency) was a widespread problem in may but damage was generally described as only moderately serious. In june there was widespread manganese deficiency in spring crops.

Powdery mildew (Erysiphe graminis) occurred in mild attacks in winter wheat. Damage was judged to be moderate in most situations. Likewise, there was only mild attack in rye crops. Despite widespread attack in spring barley crops, damage was rather limited. Generally, there was considerably less damage in 1982 than in the previous year. There was a greater mildew problem in the southern part of the country, although this was still rather limited.

Take-all (Gaeumannomyces graminis) was widespread in winter wheat, although there was only moderate damage as a result. In fields

where cereals have been grown too frequently, severe attacks were recorded.

Eyespot (Cercosporella herpotrichoides) attack in winter wheat was somewhat more widespread in 1982 than in the previous year. This resulted in severe damage to winter wheat crops. This was the same situation as for crops of winter rye.

Leaf-stripe (Drechslera graminea) occurred only rarely in 1982. The disease was seen in only a few places.

Net blotch (Drechslera teres) was seen in June in a few fields of the barley variety Welam, in situations where it followed a previous crop of Welam and where there had not been any ploughing between the two crops. Generally, attack was much weaker than in 1981 and 1982.

Loose smut (Ustilago nuda) was locally widespread in spring barley crops. In several fields there were heavy attacks.

Yellow rust of wheat (Puccinia striiformis) was seen in July in widespread attacks in winter wheat crops. In particular the varieties Vuka and Anja suffered and to a lesser extent the variety Kraka. The first symptoms of yellow rust were seen on the islands of Lolland and Falster in may, but weather conditions temporarily halted the spread of the disease. By the end of May the disease started to spread rapidly, and control measures were taken many places in the form of spraying with Triademefon ("Bayleton"). This gave good results.

Brown rust of wheat (Puccinia recondita) was identified in July and August on the islands of Lolland and Falster in a few crops of the winter wheat variety Kraka. In October quite a lot of brown rust was seen in early sown crops of Kraka.

Brown rust of barley (Puccinia hordei) was only seen in a few fields, where damage was insignificant.

Leaf blotch of barley (Rhynchosporium secalis) was not a problem in 1982.

Glume blotch (Septoria nodorum) occurred in widespread attacks in several winter wheat crops. Damage was judged to be somewhat less than in 1981 and 1980. Attack started rather late in 1982 - some 10-14 days later than in 1981. It was not until it had rained again in the last week of June and the first week of July after a previous dry spell that attack was found.

Snow mould (Fusarium nivale) occurred in early spring causing widespread damage, which was worst in winter rye. Damage was worse in the northern parts of the country than in the southern parts. In the latter areas, the problem was mainly confined to along hedgerows and boundry fences, where snow lay thicker and longer, giving better conditions for snow mould to cause damage.

Seedling blight (Fusarium spp.) occurred in only a few cases in rather mild attacks. Winter crops were harvested in favourable conditions most places in the country, which meant that there was little chance for the development of the Fusarium fungus in the new crop of winter wheat sown in the autumn 1982.

Snow rot (Typhula incarnata) was seen in winter barley in the spring in quite widespread attacks. The worst cases occurred, where there had been two or three successive crops of winter barley. Seed dressing with Triademenol ("Baytan") did not provide adequate protection against snow rot.

Legumes

Overwintering of forage legumes was reasonable despite the hard winter.

Clover rot (Sclerotinia trifoliorum) occurred in the spring in rather limited attacks. In October clover rot was seen in red clover fields, especially in the denser crops.

Grey mould (Botrytis cineria) was observed in a number of pea crops in June. The attack developed rapidly in the wet weather of June, and there was no chance to spray against the attack.

Beet

Overwintering of beet crops for seed was generally satisfactory. There were only patches in a few fields, where plants died as a result of the winter. Survival of clamped beet was especially good and much better than 1980/81. Some clamps, covered with plastic were so well covered that they suffered due to too high temperatures leading to a good deal of sprouting.

Speckled yellows (manganese deficiency) was common in June, but with relatively little damage to follow.

Magnesium deficiency was a relatively limited and unimportant problem in 1982.

Heart rot/dry rot (boron deficency) was of little importance in 1982. There were only a few cases of mild deficiency problems.

Virus yellows (Beta virus 4). The first symptoms of this problem were found in the middle of July. By the end of the month damage was still considered to be relatively moderate as a result of rather mild attack. In August and September there continued to be a relatively mild attack, but there was fairly wideapread damage. Damage in 1982 was somewhat more severe than in recent years.

Damping-off and seedling blight caused by (Phoma betae and Pythium spp.), a state often called black leg or root rot, was widely seen in the spring months of May and June. Generally there were only mild attacks, although heavier attacks were observed in re-sown crops. Damage was, however, much less widespread than in 1981. The worst attacks were, as usual, seen where beet has been grown too frequently in a rotation.

Downy mildew (Peronospora betae) was not a problem in 1982 and was only seen in a few cases. These were only mild attacks.

Leaf spot (Ramularia betae) was observed in a single field on the island of Falster in September.

Powdery mildew (Erysiphe graminis) was widespread towards the end of the growing season as a result of the warm, dry weather. The attack was not such that a yield increase was obtained as a result of control measures.

Beet rust (Uromyces betae) occurred in sporadic attacks at the end of the growing season.

Swedes, oil-seed rape and other cruciferous crops

Overwintering of oil-seed rape was generally good with reduced plant stands only occurring in a few places.

Downy mildew (Peronospora parasitica) was seen in the beginning of June in widespread attacks. It was especially the lower leaves of spring rape that suffered. Damage was seen in many parts of the country.

Club root (Plasmodium brassicae) occurred in relatively mild, unimportant attacks in 1982. This included spring oil-seed rape crops too. Generally damage was described as less than in recent

Stem rot (Sclerotinia sclerotiorum) was only seen to a limited extent in 1982 and there was much less damage than in 1981.

Grey mould (Botrytis cineria) was not a problem in 1982.

Canker (Phoma lingam) was identified in crops of winter oilseed rape only where rape had been grown too frequently in the rotation. Damage is still judged to be of little significance to rape growers.

Dark leaf and pod spot (Alternaria spp.) was present in extremely mild attacks in both winter and spring oil-seed rape crops.

Potatoes

Winter survival of potatoes in clamps was satisfactory throughout the country.

Sprouting of seed potatoes was satisfactory.

Frost. A number of potato crops were hit by frost in June. It was especially early crops that were set back, in some cases by at least three weeks.

Tobacco rattle virus was seen in a few places. It was a little more common than in 1981.

Wet rot (Bacteriosis) was not important in 1982. Damage was much more limited than in more recent years.

Blackleg (Erwinia carotovora var. atroseptica) occurred in the spring in mild attacks of little importance.

Common scab (Streptomyces scabies) was present in mild attacks which were quite widespread.

Powdery scab (Spongospora subterranea) was present in quite severe attacks of a number of potato lots, especially of the variety Hansa.

Potato wart disease (Synchytrium endobioticum) was not discovered in any new outbreaks. The State Plant Protection Service reported the existence of twenty wart disease localities left in Denmark.

Potato Blight (Phytophthora infestans) was not a problem in 1982. The first blight-warning was issued on the 30th June, but damage did not develop seriously due to the dry weather. In July blight was only seen in the beginning of the month, whilst development of the diease was checked by the dry weather in the rest of the month. Blight of tubers occurred only to a very limited extent. Most fields were as good as free from potato blight.

Black scurf (Rhizoctonia solani) occurred in the spring, but only in mild attacks of little importance. Similarly, there was only limited evidence of attack on tubers in the autumn.

Gangrene (Phoma exigua) was only present in a few mild attacks in the spring.

Poppies

Root rot. Quite severe attacks of root rot were seen in a number of poppy fields. In many cases a lime deficiency was shown in the fields concerned.

2. Pests 1982

Ole Bagger

Cereals and grasses

Cereal cyst nematode (Heterodera avenae) was without any great importance in the spring. Only a few weak attacks were recorded and in june the attack was judged to be the weakest for many years.

Grain thrips (Limothrips cerealium) and Rye thrips (L. denticornis) occurred in widespread infestations in may and june. In many winter crops evidence of thrips feeding was easily seen in that the leaf-sheath under the flag-leaf was completely yellow. Upon opening one of the leaf-sheaths, both black adults and the greenish nymphs could be found.

Bird-cherry aphid (Rhopalosiphum padi) and Grain aphid (Sitobion avenae) were commonly found in the southern and western parts of the country during june and july. Infestations were found in both winter and spring sown crops. The attack was heavy enough, especially in the southern part of the country, for 1982 to be called "an aphid year", although it was not as extreme as in the very dry year of 1976.

Wireworms (Agriotes spp.) occurred only occasionally in 1982 and only in rather weak infestations.

Leatherjackets (Tipula paludosa) occurred quite extensively in april and may, but produced relatively weak attacks.

March fly (Bibio hortulans) reduced the stand of plants in a few early sown crops of spring barley, where they followed a crop of beet which had received farm-yard manure.

Dilophus febrilis was rather widespread, and larvae damage was found in numerous cereal crops, where they followed a crop of grass. Dilophus febrilis, which has two generations a year, was more widespread than Bibio hortulans.

Saddle gall midge (Haplodiplosis equestris) was without any great importance in 1982, as was the case in the previous year. Only in a very few places were there heavy attacks.

Frit fly (Oscinella frit) occurred in only weak to moderate infestations. There was also relatively little migration. Infestation in the spring was widespread in winter crops, but resulted in little damage. Grass crops for conservation suffered only moderate attacks by the second generation. Similarly the third generation led to only moderate attacks in winter crops in October. The attacks were widespread with relatively little resultant damage.

Gout fly (Chlorops pumilions) was seen in a few isolated cases in early sown crops of barley.

Wheat bulb fly (Delia coarctata) was seen in the early spring in one single spring barley field.

Slugs (Agriolimax spp.) were quite widespread during the autumn in winter crops. In addition, there was a certain amount of damage to grass-seed crops, although this was judged to be less than in autumn 1981.

Legumes

Stem nematode (Ditylenchus dipsaci) caused insignificant damage.

Pea aphid (Acyrthosiphon pisum) infestations were quite heavy in several pea fields. The attack spread somewhat in July.

Clover seed weevils (Apion spp.) occurred rarely and caused very little damage.

Pea and Bean weevils (Sitona spp.) occurred in September in newly undersown crops relatively frequently. However, there was little resultant damage.

Beet

Beet cyst nematode (Heterodera schachtii) was generally insignificant in 1982.

Cabbage thrips (Thrips angusticeps) did not occur in the spring to any great extent. In May 1982, damage was judged to be weakest since 1966.

Black bean aphid (Aphis fabae). In a investigation of 100 spindle tree localities, on various Danish islands during the spring of 1982, over-wintered black bean aphids were found at 69 per cent of the localities. This was the highest number since 1957. Hence, there were considerable infestations of beet fields in the southern parts of the country during the last few days of May. There were abundant infestations of beet fields right through June. Despite the relatively cool weather in June there was considerable multiplication and a rapid build up in aphid numbers and by the end of June 73 per cent of the fields investigated were infested. Of these fields 54 per cent were judged to be heavily infested, ie. more than 25 aphids per 50 plants. In July infestations remained widespread and damage often heavy. Towards the end of the month there was a drastic reduction in attack so that in August black bean aphids were of little importance in beet fields.

Peach potato aphid (Myzus persicae). Samples were taken from 159 beet clamps in the spring and in 21 per cent of them peach potato aphids were found. In addition, there were only a few remaining beet clamps by the 15 May and 1 June so that a heavy infestation

of peach potato aphid was not expected. Therefore, a high incidence of virus yellows was not anticipated. However, migration did occur and there was a considerable build up in numbers in June. By the end of the month peach potato aphids were found in 42 per cent of the 250 fields that were examined throughout the country. Hence, there was a heavy infestation in July. Although it died out towards the end of the month, the attack was described as the heaviest for many years.

Tortrix months (Cnephasia spp.) were widespread in May and June. In many places larvae were seen to spin leaves together. Tortrix moth larvae were also found in other crops. Control in beet was attempted with various chemicals without particular success.

Beet carrion beetle (Blitophaga opaca) occurred relatively infrequently in May and June. Both in 1980 and in 1981, they were fairly widespread so that in comparison they were much less common in 1982.

Pygmy beetle (Atomaria linearis) caused little damage of any importance in 1982.

Beet leaf miner (Pegomyia hyoscyami) laid many eggs on beet plants during the last few days of May. The infestation was widespread and seen in most parts of the country. It was not, however, as heavy as in 1981. As a result of good growing conditions the beet plants grew quickly and this meant that the beet leaf miner attack was of little consequence. In June there was only a moderate infestation and in August it was generally described as extremely weak.

Nutmeg moth (Dicestra trifolii) and Cabbage moth (Mamestra brassicae) occurred in August in considerable numbers in several beet fields, where they made holes in the leaves as a result of their feeding. In some fields the plants were totally defoliated

so that only the stalks remained. However, the attack died off once it started to rain again.

Swedes, Oil-seed rape and other cruciferous crops

Cabbage thrips (Thrips angusticeps) occurred only rarely in 1982 in rape crops and the damage level was judged, in the spring, to be the lowest for many years.

Cabbage aphid (Brevicoryne brassicae) occurred rather widely in July, but the infestation was judged to be relatively moderate in August and September.

Blossom beetle (Meligethes aeneus) infestations were very weak in the early summer of 1982. It was only in late sown spring oil-seed rape crops that there were, here and there, signs of rather heavy damage in June.

Tortrix moth (Cnephasis spp.) larvae were widespread in several different crops in June. In rape crops leaves were spun together by the larvae. Occasionally fields were seen with up to 10 per cent of the plants suffering from attack.

Sand weevil (Cneorrhinus assimilis) was seen in one swede field in the north of Jutland, where there was a heavy but patchy attack.

Seed weevil (Ceutorrhynchus assimilis) caused a little damage in the early summer. Attack in winter rape was judged to be moderate, whilst spring rape crops were more or less unaffected.

Stem weevil (Ceutorrhynchus quadridens) was identified in a considerable number of spring oil-seed rape crops throughout the country. Stem weevils were somewhat more widespread than seed weevils. Holes made by larvae when they left the plant were seen in many rape fields in August. However, damage by stem weevils

does not usually affect yield.

Diamond back moth (Plutella maculipennis) only occurred in rather weak infestations in 1982, which contrasted to 1981, when there were widespread infestations causing severe damage.

Cabbage white butterflies (Pieris brassicae and P. rapae) were widespread in August and September, but caused relatively little damage.

Swede gall midge (Contarinia nasturtii) was identified in June in crops of winter oil-seed rape. Sucking during feeding on the leaf-stalks caused so-called withch's-broom. However, damage was judged to be insignificant.

Brassica pod midge (Dasyneura brassicae) started to fly towards the end of May. Warnings about the 1st generation were sent out on the 21st May and on the 21st June warnings were sent out about the 2nd generation. The infestation of winter rape crops was judged to be weak and caused little damage. In a few fields, where control measures were ineffective, widespread and severe damage could be found. There was little damage in spring rape crops.

Cabbage root-fly (Delia brassicae) was fairly widespread in June, although damage to swede and spring rape crops was described as relatively weak. Cabbage crops, especially in private gardens, were widely attacked, as were crops of chinese cabbage.

Potatoes

Potato cyst nematode (Heterodera rostochiensis) damage was seen in June 1982 and was a little more serious than usual in Denmark, although it was still rather limited. Damage was primarily seen in private gardens where there is a greater tendency to grow potatoes too frequently on the same piece of ground.

Turnip cutworm (Agrotis segetum) occurred in weak infestations in the main. In October damage was judged to be slightly greater than in recent years, but still rather low in intensity.

Colorado beetle (Leptinotarsa decemlineata). In June 6 reports of this pest were made to the State Plant Protection Service. All of these were found on the island of Als or in west Jutland. In July larvae were found on 3 occasions in southern Jutland and once on the easterly island of Bornholm. In August Colorado beetles were found at 7 localities - mainly on the islands of Langeland, Lolland and Ærø. In September 7 beetles were found in a potato field in southern Jutland where there had been found beetles earlier in the year.

Carrots

Carrot fly (Psila rosae). In September damage was judged to be slight and of little importance. It was only in private gardens that more widespread damage was found. Damage is nearly always greater in warm sheltered spots - typical of gardens.

3. Diseases and pests of horticultural plants 1982

Lars A. Hobolth

Climatic damages

Frost damage. From the time when the first buds started to open in the spring until early summer, there was evidence of considerable frost damage on many woody crop species. This damage resulted mainly from the abrupt change in weather which occurred in the beginning of December 1981. The temperature felt, in the course of a couple of days, from between 5 and 10°C to minus 20°C.

In orchards there was similar damage to that which occurred in nurseries, but there was considerable variation in the degree of damage according to variety. The apple varieties Mutzu, Grå-sten, Golden Delicious and Belle de Boskoop suffered more than others. Damage to soft fruit was first recorded at a late stage of growth, when blackcurrants were swelling up. An examination of the bushes showed that the cambium layer was dark in colour. The recording of late damage was most likely due to the high evaporation rate that occurrred during the summer's first spell of warm weather, in May.

Heat damage. As a result of the second heat wave, in July and the first 10 days of August, many glasshouse crops were damaged. This was due to the fact that it was impossible to keep temperatures down under the glasshouse curtains used for short-day treatments. In outdoor crops there was poor head formation due to conditions of drought resulting from inadequate irrigation capacity.

Tip-burn. Early crops of outdoor lettuce suffered considerable from tip-burn due to stress during growth. Furthermore, many crops showed symptoms of nutrient deficiency resulting from stress conditions.

Fungal diseases

Damping-off and seedling blights (Pythium spp. and Phytophtora spp.) have caused considerable damage in many glasshouse crops; the more important ones being cucumber, tomato, pepper and various pot-plants. Attack was more prevalent in tomato and cucumber crops grown in an inactive growth medium. Such materials do not contain agents antagonistic to these fungi. In pot-plants, where a standard soil medium was used, attack was often connected to high salt-concentration or too much water in the soil mass so that the roots suffered from a partial lack of oxygen.

Leathery rot (Phytophthora cactorum) was identified in strawberries. The fungus typically causes a brown coloured dry rot of the fruit. According to information from growers it must be acknowledged that the fungus has been present for several years.

Downy mildew (Peronospora brassicae) was common in all brassica crops during the first part of the growing season. A change of weather generally enabled crops to grow away from the disease, although some late brassica crops suffered further attack.

Coral spot (Nectria cinnabaria) caused considerable damage in orchards where trees were already weakened by the two foregoing winters.

Apple canker (Nectria galligena). Attack of apple canker has been increasing in recent years. It is now quite common to find trees with canker damage in orchards.

Anthracnose (Pseuopeziza ribis) has caused premature leaf-fall in susceptible varieties.

Rose powdery mildew (Sphaerotheca pannosa) was recorded relatively early in the year on crops of roses. As a result of the high degree of variation between day and night temperatures powdery mildew was present over a long period.

Cherry leaf spot (Blumeriella jaapii) is still quite important in many orchards. In some years it has caused premature leaf-fall with poor subsequent bud development.

White Chrysanthemum rust (Puccinia horiana) was present in several crops in 1982, after not being seen for some years. According to the existing literature the race of fungus concerned is resistant to the chemicals presently available.

Leek rust (Puccinia porri) was found in several fields of chives, where the top of the plants were spoilt by the rust-red spores.

Fusarial wilt (Fusarium oxysporum) destroyed several crops of freesia. Plants were weakened by the very high temperatures.

Snow mould (Fusarium nivale) inflicted widespread damage to lawns, where the fungus had good conditions for growth under the insulating blanket of snow.

Grey mould (Botrytis cineria) damage occurred in many market gardens. An added reason for the extent of the attack of grey mould was the nature of some of the measures used by growers to reduce oil use. They often led to a substantial increase in relative humidity, favouring the growth of this fungus. IN addition there was severe attack of grey mould in strawberries especially in the beginning of the season.

Pests

Spittle bug (Philaenus spumarius) caused a certain amount of unpleasantness for strawberry pickers, when they got their hands covered in spittle. The pickers had to wash their hands of nymphal spittle before picking could continue.

Aphids (Aphididae) were found in nearly all crops during the long periods when the weather favoured a build up in their numbers.

Root aphids (Pemphigue spp.) gave considerable problems in lettuce crops. An attack always lengthens the crops' growing period, if indeed the attack doesn't ruin the crop completely.

Garden chafer (Phyllopertha horticola) larvae caused very extensive damage to areas of grass in mid-Jutland, where many lawns have had to be re-lain as a result of garden chafer attack.

Sawfly on birch (Arge pullata). Sawfly attack, which can defoliate even large trees, spread further north-west - attack was recorded just south of Rold Skov in the northerly part of Jutland.

Strawberry Tortrix moth (Acleris comariana) was found in quite a few commercial strawberry crops, especially where insecticides were not used at the correct time in relation to the moth's stage of development.

Winter moth (Operophthera brumata) larvae attacking buds was not reported in commercial plantations, although there were several reports of heavy infestations in private gardens.

Cabbage root-fly (Delia brassicae) was an important pest in crops of late chinese-cabbage, where both roots and leafstalks (petioles) suffered attack. In some instances there was thought to be a build-up of cabbage root-fly in fields of spring oil-seed rape.

Fruit-tree red spider mite (Panonychus ulmi) started to be a problem already in the early spring and with the long dry periods became quite serious in several areas.

Red spider mite (Tetranychus urticae) infestations were heavy in many glasshouse-crops. IN addition, favourable weather conditions gave rise to red spider mite attacks in some outdoor crops.

IV. BOTANY DEPARTMENT, Arne Jensen

Experimental work

Bacterial diseases (Ib G. Dinesen)

Potato ring rot (Corynebacterium sepedonicum)

A total of 465 clones of potatoes from pre-basic crops in 1982 were tested by the immunofluorescence method. All the investigated samples were negative. Experiments on the best methods for extraction of the bacteria from infested tubers showed that large amounts are obtained by shaking pieces of heel-ends in water for 16 hours; in that way also the best microscopy picture is obtained.

An EEC project has been carried out, concerning comparison of the immunofluorescence method and the eggplant test. At the end of the year a test of the seed potatoes for export was initiated.

Fireblight (Erwinia amylovora)

As in 1981, investigations on the possibility of using meteorological observations in a warning system have been carried out.

The results showed a good correlation between predicted and observed attacks. In 1982 fireblight was of much smaller significance than in 1981.

Healthy nuclear stock of pot plants

Out of 9 cultivars of Diffenbachia maculata collected in 1980, 6 cultivars were sent to the Plant propagating station after testing for Erwinia chrysanthemi by the use of the immunofluorescens method.

During the year, testing for E. chrysanthemi has been continued in Kalanchoe blossfeldiana.

In Pelargonium hortonum the nuclear stock has been renewed

after testing for Xanthomonas pelargonii. Hedera helix has been tested for Xanthomonas hederae.

Fungal diseases

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

In 1982, 1241 samples were assessed for take-all disease. A small increase was found in spring barley but not in wintercereals, where moderate to severe attacks usually are found in fields with bad cropping systems. Eyespot was assessed in the same number of samples, of which 324 also were assessed in the spring with a view to making a prognosis and forecasting for spraying in wintercereals. Spore catches and weather observations showed that spore dispersal was likely in October-November and from the middle of February to the beginning of April. It was assumed that there was a need for control in 50 per cent of the wheat-fields, 40 per cent of the rye and 10 per cent of the winterbarley fields. In the summer it was found that eyespot was more severe than in 1981 in wheat and rye but in winterbarley attack was only of importance in 5 per cent of the fields. In 78 per cent of spring barley fields weak attacks were found.

In continuous growing of winterwheat, rye and winterbarley at 3 stations, chemical control reduced disease but a profitable yield increase was obtained in only one wheat experiment.

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

In small plot experiments with 9 different types of soil and continuous cereal growing the yield of the wintercereals was higher than in 1981 and the attacks of take-all generally lower. In spring barley both the yield and the attack were lower than in 1981.

In small plot experiments with continuous spring barley growing and with spring rape as a post harvest crop, a yield increase of 8 per cent was obtained.

A severe attack of Typhula incarnata ruined an experiment with increasing number of years of winterbarleys.

Threshold studies on leaf diseases in spring barley (Sten Stetter)

During the years 1980-82 a number of experiments were carried out in the field and growth chambers with the aim of finding threshold values for the control of leaf diseases, especially mildew. Field experiments were also carried out using different chemical control regimes. The experiments were observed twice a week using different methods for evalutation. One of the methods enabled farmers to decide whether to apply a fungicide or not by counting the number of attacked plants. For rust and leaf spot diseases, it seems more difficult to find a good method. The results are used in working out a computerbased model, which calculates the probability of an economic yield increase by spraying with fungicides. The model will be tested in 1983 in about 60 fields and experimental plots.

Leaf and ear-diseases of cereals (Boldt Welling)

Two years experiments with mechanical mixtures of spring barley varieties have been carried out at two experimental stations. The results show that in mixtures with different resistance genes for mildew, less disease is found than in the average of the pure components. Mildew has been assessed both visually and collected by using a Schwarzback spore trap. The mixture gave a yield increase of 0.15-0.25 tonnes per hectar compared with the average of the pure components. The value of mixing was reduced by the use of a single spray with Bayleton. Glume blotch (Septoria nodorum) in winterwheat has been observed for two years with a view to working out a warning system. Observations have been done in experiments with different timing of fungicide sprays. So far no reliable method has been found and perhaps it is not possible.

Net- and spot blotch (Drechslera teres) in barley occurred widely but not so severe as in 1980 and 1981. Experiments with chemical control in 6 different spring barley varieties showed a considerable effect of spraying with Tilt (propiconazol), especially in the most susceptible variety Welam.

Winter barley (Boldt Welling)

The area of winter barley was 18,000 hectares in 1982. A survey of 43 fields in March showed a very low level of mildew and a few attacks by Drechslera teres and rust. A species of Ascochyta was found in nearly all samples. The same fields were inspected in April-May and severe attacks of mildew were found in a few fields because of too late spraying. A few cases of mildew spreading to spring barley were observed. It is obligatory to register all winter barley fields and to treat twice either as a seed treatment with Baytan or spraying in the autumn followed by an early spraying in the spring. Winterdamage was of no significance.

Because of the high yield of winter barley in 1982, more than 64,000 hectares were sown in 1982. A survey in November showed that mildew could be found in 77 out of 78 inspected fields. Nearly all seed lots were treated with Baytan (triadimenol) but the weather was very favourable for mildew development and the fungicide was not able to control the disease.

Diseases of grasses (Boldt Welling)

Except for diagnostic work very little was done in 1982.

Strangles and root diseases in sugarbeets (H.A. Jørgensen og Niels U. Mikkelsen)

Damping off, root rot and strangles occurred to a much lesser extent than in 1981. Pythium sp. was the dominant fungus in relation to root rot and Aphanomyces cochlioides was found for the first time in Denmark was found. Soil samples from areas in 41

fields with diseased and healthy plants were analysed (texture, pH etc.) and compared with information about rotations, fertilizers, sowing time etc. As was expected, root rot occurred most frequently, where pH was relatively low and where sugarbeets were grown frequently in the rotation. The investigation will be finished in 1983.

Diseases in oil seed rape (Lone Buchwaldt)

In 1982 the fungus diseases in both spring- and winter rape were of very little importance due to the rather dry weather conditions and the fact that most of the spring rape was sown on "new land".

In a few fields, Sclerotinia sclerotiorum was found with 5-10 per cent attacked plants. In winterrape grown in a close rotation, attack by Phoma lingam was found but it only had a moderate effect on yield. No attack has so far been found in spring rape. In a couple of fields attack by Verticillum dahliae was found.

A warning system for Sclerotinia sclerotiorum is under development and in 1982 farmers were advised to use a minimum of chemical control.

Experiments concerning the best time for chemical control with vinclozolin (Ronilan) showed that the best criteria was the start of apothecia formation and full flowering.

Preliminary testing of rape varieties for resistance to Plasmodiophora brassicae, Sclerotinia sclerotiorum and Peronospora parasitica showed differences, which might be of value.

Potato blight (Phytophthora infestans) (Hanne Gürtler)

Different races were identified in 25 isolates and following virulence factors were found: 1, 3, 4, 5, 7, 10 and 11.

It was discovered that isolates of the fungus on potato leaves could tolerate storage at approximately 30°C until 12 months.

Potato wart (Synchytrium endobioticum) (H. Mygind)

329 tuber samples were tested for resistance. As usual a slightly modified Spieckermann compost method was used. The test is being repeated for three years, and the results showed this year that 7 per cent were susceptible in the first year, 1.1 per cent in the second and 0 in the third year.

For the Government Plant Protection Service, a check cultivation in pots has been carried out with soil samples taken from 2 older wart localities and a new one treated with Dazomet (Basamid). No attack was found on the susceptible variety "Alma" in any of the samples, except in soil from the new locality taken before chemical treatment. In an experiment at Lyngby very promising results were found with Dazomet.

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

The data from previously mentioned registrations of grey mould in relation to glasshouse climate and plant analysis have finally been treated at the Data Analytical Laboratory. Unfortunately no clear correlations could be found between RH, level of essential minerals and sugar content in the leaves. A final attempt will be done in order to clarify the reasons for the great differences in attacks found in the different tomato crops.

Two experiments have been carried out in collaboration with the Institute for Pesticide Research. The fungicides to be tested were applied 10 days before artificial inoculation. 10 leaves were cut from each plant leaving a stump of 1 cm, then a spore suspension (approximately 50,000 spores/ml) was sprayed on the plants which was kept under high humidity for 8-10 days. The results were extremely satisfactory with severe attacks on the control plants and some attacks after compounds with unsufficient prophylactic effect. The most promising compound was 0.15 per cent vinclozolin (Ronilan).

Healthy nuclear stock of pot plants (H. Mygind)

Campanula isophylla was the first pot plant of which healthy nuclear stock had been delivered to the Glasshouse Crop Research Institute in June 1978. Since then, yearly testings have proved that progenies from these plants have been free from wilt disease, caused by Fusarium tabacinum. In 1982 attack was found in 5 of the 14 clones and it has now been decided to use meristem plants each year to replace the nuclear stock plants and thus to avoid reinfection.

Hedera helix and Ficus pumila have been tested regularly and no vascular infecting fungi have been found in the nuclear stocks.

Red core (Phytophthora fragaria) in strawberries (H.A. Jørgensen)

This disease has so far not been found in Denmark. An investigation has been started to clarify if the pathogen does occur. "Duncan's test" has been chosen as a test method. This is based on the use of trap plants (Fragaria vesca). Diseased plants and pure cultures of the fungi were imported from Sweden & UK in order to gain experience of the technique.

Downy mildew (Bremia lactucae) in lettuce (Kirsten Thinggaard)

In 1982 only slight attacks were observed in glasshouse grown lettuce. A total of 37 cultivars of lettuce have been tested for resistance and good resistance has been found in the Cv. nr. 2535 RZ, Diamant, Hema and Marcia. The cultivars of iceberg lettuce showed poor resistance.

Diagnostic work (H.A. Jørgensen, H. Mygind and Ib G. Dinesen)

In the course of the year the Botany Department has received 583 plant samples for diagnosis of bacterial and fungal diseases. Mostly horticultural plants were involved and some of the most frequent fungi were Pythium, Phytophthora, Fusarium, Rhizoctonia and Botrytis. The predominant bacteria were Corynebacterium sepedonicum, Erwinia chrysanthemi and Pseudomonas marginalis.

V. VIROLOGY DEPARTMENT, H. Rønde Kristensen

1. Experimental work

The diagnostic work at the department has been further developed and this has made it possible to apply the very sensitive diagnostic methods ELISA and ISEM for routine analysis of several viruses.

These methods are now being used in a project in which the serological relationship between certain viruses in the Luteovirus group (potato leaf roll virus, barley yellow dwarf virus, mild beet yellows virus and beet western yellows virus) is being studied.

By means of ELISA barley yellow dwarf virus has been detected in oat, barley, cocksfoot and ryegrass.

The presence of tomato ringspot virus (originating from Pelargonium) in Petunia spp. and Nicotiana spp. has been shown by both the ELISA and gel diffusion methods.

The potato meristem programme is progressing according to schedule although some varieties have been exposed to attack by potato virus Y, disclosed by greenhouse control combined with ELISA tests.

Investigations regarding an apparently seed-borne virus in lilac have been initiated. Further work has been performed concerning Prunus ringspot virus and little cherry in cherries.

By meristeme culture nuclear stocks of various horticultural plants such as apples, plums, raspberries, Begonia, Campanula, Chrysanthemum, Dieffenbachia, Euphorbia, Kalanchoe and Pelargonium have been established.

The trials to clarify the possible spread of viruses through the nutrient solution in soil-less culture have been terminated.

The patogenicity of various strains of tobacco mosaic virus and the resistance in cucumber towards various strains of water melon mosaic virus have been analysed.

Virus diseases of agricultural plants (B. Engsbro)

Susceptibility of transplanted potato plants to aphid-borne virus diseases

Trials were carried out at four sites without any known source of infection. Two types of healthy plants were used: 1) plants made from cuttings in blocks of mineral wool and transplanted in the open, 2) plants derived from tubers. Both sets of plants escaped virus disease even though a strong attack of aphids was observed.

At a fifth site where diseased plants were found scattered in the surrounding field approximately 50 per cent of both sets of plants were attacked by potato virus 4, but only a few were attacked by potato leaf roll.

Elimination of potato leaf roll by meristem culture

By using different sizes of meristem tips taken from buds on potato stems infected by potato leaf roll, it was shown that cultures derived from meristems with one, two or three primordia were free of potato leaf roll. Only a few of the cultures made from larger meristem tips and none of the cultures made from full buds were free of the disease.

Storage of potato cuttings in test tubes

Investigations on storage of potato cuttings in test tubes have shown that storage is almost 100 per cent successful for 1-2 month at $3^{\circ}C$ in darkness.

Approximately 75 per cent of the plants survived and were suitable for further growth after being transferred to light at $20^{\circ}C$ after storage for 3-6 months, 35 per cent after 9 months, 10 per cent after 15 months, 3 per cent after 2 year and 1 per cent after 3 year of storage.

Leaf cuttings made from small plants of different origin

Compared to mini cuttings made from test tube plants which make a virtually even plant mass for transplanting, mini cuttings

made from small plants started in soil in glasshouses usually make stronger but much more uneven plants.

This dissimilarity is caused by different starting times, of up to 14 days, of growth from the cuttings and is probably due to the decomposition of some hormones. For use at at planned time these plants are not as good as plants made from test tube plants where the problem is of little importance.

When transplanted to boxes in glasshouses the plants made from cuttings from small plants yielded less of the smaller tubers (20-30 mm) and slightly more of the larger sizes (more than 30 mm) than the plants made from test tube plants. The total yield was 200-220 tubers more than 20 mm per m^2.

Number of plantlets for optimum tuber production in glasshouse

For optimizing the number of useful tubers it is of importance to start with the right number of plantlets.

Trials have shown that this number greatly depends on the ability of the variety to create tubers.

The best results from varieties setting many tubers were obtained using 10 plantlets per m^2. For varities with less tuber setting 15-25 plantlets must be used per m^2 and for varieties setting only a few tubers at least 25 plantlets per m^2 must be used.

These results are obtained when only half of the space is used for planting and the other half for gangway.

Virus diseases in fruit trees (Arne Thomsen)

Apple meristem tip culture.

By cultivating minicuttings of the apple variety 'Red Gravenstein' in a medium containing 2 p.p.m. BAP a multiplication rate of 15 was obtained for a period of 7 weeks.

Apple root stocks meristem tip culture.

Plants with roots are established from meristem tip culture of the apple root stocks EMIX.

Storage in vitro of mini cuttings from the apple root stocks A_2.
Experiments using mini-cuttings in test tubes at 26°C and with 16 hours illumination have been carried out. In a medium without gibberellin 65 per cent have survived for one year as vital plants.

Mosaic free apple meristem tip culture.

In 1979 16 meristem tip cultures were established from the apple root stock EMII with apple mosaic virus. Tests carried out in 1982 showed no mosaic infection in 11 plants, which had survived.

Plum, meristem tip culture.

Meristem tip cultures of the plum variety 'Italian prune' with roots have been established.

To prevent oxydation the meristem were cut in an atmosphere of nitrogene. The root development was established in a medium of low nutriment containing 1 p.p.m. IBA.

Quince, meristem tip culture.

Meristem tip cultures with roots have been established from material of the Quince variety 'Quince C'. The root development was established in a medium of low nutriment level containing 1 p.p.m. IBA.

Virus diseases in fruit bushes (Arne Thomsen)

Black currents, meristem tip culture

Meristem tip cultures with roots have been established from the Black current varieties 'Amos Black', 'Baldwin' and 'Øjebyn'. Normal growth was achieved in a medium containing 1400 mg macro-

elements per litre, while yellow and stunted growth occurred at 4530 mg per litre of macroelements. The concentration of BAP was 0.1 mg/l, IBA 0.1 mg/l and agar 7 g/l.

Mycoplasma like organisms (MLO) (Arne Thomsen)

Detection of MLO in Denmark.

Investigations have shown that the pathogens most are widespread in wild plants. Mycoplasma-like organisms are found to be present in 21 plant species of which the most important cultured plant species are Apple, Chrysanthemum, Clover, Rubus and Strawberry.

Experimental transmission of Mycoplasma like organisms from wild plants to Fragaria

Through Vinca rosea mycoplasma like organisms from Circium arvense are transmitted to Fragaria Senga Sengana. Mycoplasma like organisms were found by use of electronmicroscope in the strawberry flowers after 8 months of incubation.

Virus diseases on forest trees (Arne Thomsen)

Populus, meristem tip culture

In 1978 15 meristem tip cultures were established from Populus candicans with populus mosaic virus. Tests carried out in 1982 showed no virus infection in 11 of the plants.

Virus diseases in vegetables (N. Paludan)

Tomato mosaic in tomatoes. The transmission of tomato mosaic virus (TomMV) by a recirculated nutrient solution in a soilless system has been continued. Leaf contact between healthy and infected tomato plants did not occur, whilst contact occurred between healthy and infected roots. Leaf and root samples were tested for TomMV-infections after 2, 3, 5, 7 and 10 weeks of culture. The average of 2 experiments comprising 56 plants was calculated, and infection per cent for the leaf samples was determined to be 0, 0, 4, 7 and 7 respectively, and for the root

samples to be 0, 4, 21, 29 and 68 per cent.

Virus strains from collected isolates of tobacco mosaic virus (TMV) have been diagnosed with the aid of indicator plants and serology. The ELISA method was used with antisera against the TMV-strains: tomato, tobacco, pepper 8 and pepper 11.

In the case of vegetables all tomato isolates were tomato strains of TMV, and all the tobacco isolates were tobacco strains of TMV. As regards pepper isolates the following TMV-strains were diagnosed: tomato strains, a compound of tomato and tobacco strains, pepper-8 strains and a pepper-11 strain.

In the case of ornamentals with isolates from 17 different genera, tomato strains, tobacco strains and a compound of tomato and tobacco strains were diagnosed. Some other isolates could not be diagnosed by serology, but these TMV-strains only caused latent infections in tobacco plants, as a contrast to the tomato and tobacco strains.

The pathogenity of TMV-strains has furthermore been determined by Pelhams differential lines of the tomato variety 'Craigella' with different genes and gene combinations. The Swedish TMV-resistant variety 'Ida' was also used.

The tomato strains of TMV showed to be the most infective ones infecting all the tested differential plants, resulting in development of mosaic, necrosis or latent infection.

The tobacco strains of TMV have only occasionally been infective mainly causing latent infection. The TMV-strain from Kalanchoe has, meanwhile, been infective on 4 out of 7 of the differential plants used.

The pepper strain-8 of TMV has not been infective at all, and the pepper strain-11 has only caused latent infection in 2 differential plants.

Homozygous lines of 'Craigella' with the gene $Tm\text{-}2^2$ and the combination of Tm-1 and Tm-2nv have shown the highest degree of TMV-resistance. The variety 'Ida' has also shown this high degree of resistance.

Tobacco necrosis in green beans. The transmission of tobacco necrosis virus (TNV) by a recirculated nutrient solution in a soilless system has, in combination with the fungus Olpidium brassicae, been investigated, using the systemic virus strain stipple streak.

TMV-infected beans with O. brassicae spores in the roots were used as infector plants. Bean indicator plants were exposed to TNV-infection for 24 hours. Groups of plants were placed in the nutrient solution for increasing number of days from the start of the experiment. Leaf and root samples were tested for TNV-infection 3 weeks later.

Provisional investigations have shown a TNV-transmission to the indicator plants up to 21 days from the start of the experiment.

Big vein agent (BVA) in lettuce

The transmission of BVA in combination with the fungus Olpidium brassicae by a recirculated nutrient solution in a soilless system has been continued using lettuce plants.

Plants with BVA-symptoms and O. brassicae spores in the roots were used as infector plants. Groups of 90 lettuce seedlings in the seed leaf stage were exposed to BVA infection for 8 hours, 1-4 days from the start of the stage. The surfactant 'Teepol' was added to the nutrient solution in the concentration 0,20 and 40 ppm.

After an isolated cultivation and symptom registration, the BVA-infection per cent was determined to be 45, 23 and 12 respectively.

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

Begonia elatior. Established meristem plants have been without symptom over a 1-year period, while the original plants constantly have constantly shown a vein clearing in the leaves.

Campanula isophylla. Storage experiment, over a period of 1 year at 6 different temperatures, has been carried out with a white

flowering variety in a modified MS-62 medium comprising 2 mg kinetin pr. litre. The lowest temperature at 1°C in darkness gave the best result with 80 per cent normal, pale plants, which developed into green plants after a short time at 20°C and 16 hours illumination being suitable for propagation or potting.

Growth and flowering control from 5 storage temperatures showed that all plants developed normally. Growth control of cuttings from plants stored for 1 year at 1, 3, 6 and 9°C resulted in 92, 67, 5 and 13 per cent established plants respectively.

Water soaked growth can be changed to normal growth by increasing the agar concentration from 0.7 per cent to between 1 and 1.3 per cent in combination with a weak medium.

Chrysanthemum indicum. Meristem cultures in media comprising 1400 and 4500 mg macro elements per litre and 0.7 per cent agar, have caused a development of 75 and 25 per cent normal plants respectively. Water soaked growth has been changed into normal growth, by the use of an increasing agar concentration, this being 1.6 per cent or more, to achieve 75 per cent normal plants.

Inactivation of the Chrysanthemum viroids stunt (CVS) and chlorotic mottle (CCMV) has successfully been carried out by meristems from plants grown at 5°C over a period of 4 and 8 months. CSV was inactivated in 67 and 73 per cent and CCMV in 22 and 49 per cent of the plants respectively.

Dianthus caryophyllus. Water soaked growth, which often occurs in meristem cultures with 0.7 per cent agar, can be changed into normal growth by the use of a weak medium and a agar concentration of 1 to 1.6 per cent.

Euphorbia pulcherrima. Infection experiments with Poinsettia mosaic (PMV) and Poinsettia cryptic virus (PCV) have been carried out on different Euphorbia species (liquid nitrogen) and Nicotiana benthamiana (dry inoculation). In the last case only, symptoms such as vein spots and mosaic were developed. PMV was shown

later on serologically (ISEM), but not PCV in contrast. The tomato strain of tobacco mosaic virus (TMV) was shown in plants showing retarded growth.

Meristem cultures have been established in the MS-62 medium comprising 0.2 mg benzylaminopurin and 2 mg indolyl acetic acid per litre.

Inactivation of PMV and PCV has been achieved in 5 of 12 tested meristem plants.

Kalanchoe blossfeldiana. By infection experiments (dry inoculation) to Chenopodium quinoa, the tobacco strain of TMV was shown in the variety 'Golden melody'.

Inactivation of virus has been successfully carried out with a single virus isolate, existing of bacille formed and carla liked particles. Of 12 meristem plants, 4 have remained without symptoms in the test plant K. daigremontiana after 4 repeated graftings.

Successfully storing has been achieved with Kalanchoe plants in tubes over a 1-year period at 9°C and with 16 hours illumination. Lower temperatures caused water soaked or chlorofylless plants.

Pelargonium hortorum. Infection experiments with Pelargonium flower break and tomato ringspot virus (TOMRV) from Pelargonium using young Chenopodium quinoa plants and dry inoculation, were carried out in the months 2, 5, 8, 9, 10, 11 and 12. Both viruses were shown each time at all the tests.

Inactivation of TomRV in clones of Pelargonium has been carried out using heat treatment at 34°C in a 2 month period previous to the cutting of meristems. From heat treated and untreated plants 95 and 13 per cent healthy plants were established respectively.

Meristem tip culture of Daphne mezérium

Examination of different pH levels showed the most harmonious plant growth in medium at pH 5.5. The maximum multiplication effect was obtained from 1 ppm of BAP. The root development was established in a medium containing 0.5 I.B.A. per litre. So far no virus test of the meristem plants of Daphne has been carried out.

Deutzia, meristem tip culture

In 1982 mutations causing narrow leaves and others causing yellow sections on the leaves were seen among healthy Deutzia magnifica, established by meristem tipculture in 1980.

Storage of Deutzia magnifica in vitro

Cuttings with roots in test tubes have survived 12 month of storage at 20°C and light for 16 hours. From these cultures mother plants for further multiplication have been etablished in soil in glasshouse.

Seed transmission of virus in Syringa vulgaris

Seedlings of Syringa vulgaris have shown mosaic and rings in the leaves of 5 per cent of the plants from two seed lots.

Nuclear stock plants

Material from the following valuable species of woody ornamentals have been investigated and found to be free of virus infection: Aroniamelanocarpa, Cotoneaster pseudorubens, Deutzia magnifica, 'Ebur-nea', Malus baccata, Physocarpus sp., Salix repens and Rosa 'Bi-to'.

Serologi (Mogens Christensen)

Beet Yellows

Using the ELISA technique and with immunoreactents to beet western yellows virus (BWYV) (produced by Boehringer, Mannheim) and to potato leafroll virus (PLV) (produced by Inotech Schwitzerland) investigations concerning relationship between beet mild yellows virus (BMYV) and BWYV and PLV have been performed.

20 isolates of BMYV collected by symptoms all over the country were examined together with experimentally infected beetroots with the above mentioned immunoreactents.

All the isolates gave positive reactions with the BWYV reactents and negative reactions with the PLV reactents. It is concluded that the collected isolates of BMYV are closely related to BWYV, but not related to PLV.

Barley yellow dwarf virus by ELISA and with immunoreactents from Inotech this virus has been detected in barley, oat, cocksfoot and rye grass.

Potato leafroll virus PLV

ELISA immunoreactents to PLV from Boehringer (Germany) and from Inotech (Switzerland) have been compared.

The reactents from Boehringer gave very specific reactions. The extinctions measured at 405 mm being higher than 0.6 for PLV infected potato leaves and lower than 0.01 for healthy potato leaves.

Reactents received from Inotech 1981 gave extinctions higher than 2.0 for both PLV infected and healthy potato leaves, while reactens received from Inotech 1980 reacted specifically to PLV although somewhat weaker than the reactents from Boehringer.

Potato virus M, S, X and Y. Immunoreactents to be used in ELISA have been prepared from antisera produced at the virological department. In comparison to immunoreactents from Inotech, Swit-

zerland the reactents produced by ourselves showed to be the best as they gave hardly any unspecific reactions, when they were used in dilution 1:5000. The reactents from Inotech gave considerable unspecific reactions.

Identification of strains of tobacco mosaic virus TMV using the ELISA technique.

ELISA immunoreactents were prepared to the following TMV strains: One tobacco strain TobMV, one tomato strain TomV and two pepper strains PepMV. Antisera to the two PepMV were kindly provided by dr. D.Z. Maat, Wageningen, while antisera to TobMV and TomMV were produced by T. Steepy at the virological department in 1967.

In ELISA the immunoreactents to PebMV and TomV reacted specifically with the homologous virus strains, while the TobMV reactents gave unspecific reactions.

61 TMV isolates from 20 different plantspecies have been collected over a number of years.

In ELiSA and with the above mentioned reactents we found 34 isolates belonging to the TomMV strain, 9 to the TobMV strain, 8 to the PebMV strain, 2 isolates were double infected with TobMV and TomMV and 8 isolates could not be identified with certainty.

Tomato ringspot virus (TomRV) is widespread in a number of varieties of Pelargonium. It has been tried to diagnose TomRV both with antisera prepared at the institute and antisera received from other institutes.

By geldifussion and by ELISA TomRV was easily detected in experimentally infected Petunia hybrida and Nicotiana clevelandii, while it was impossible to detect the virus in 5 varieties of Pelargonium, due to unspecific reactions with sap from virus free Pelargonium.

Delivery of antisera.

Antisera to potato virus M, S, X and Y corresponding to 400.000 tests have been delivered to institutes in Denmark and the other

Nordic countries. ELISA immureactents to 4 viruses have also been prepared and used in the routine testing of seed potatoes.

Electronmicroscopy (J. Begtrup)

During 1982, 2320 samples were examined in the electronmicroscope mostly with ISEM technique.

The embedding procedure was almost cancelled due to shortage of labour. However, 25 important embeddings were finished as a part of the testing work.

The investigation of storage of virus samples ("Virusbank") in PTA as a control in ISEM work is now a part of the ISEM work. At present there is control for app. half of the antisera we have (130).

We have carried out a comparison between ELISA and ISEM on seed and their seed borne viruses. This is done together with The Danish Government Institute of Seed Pathology for Developing Countries (L. Lange), Institute of Microbiology, Academia Sinica, Peking (Tien Po) and EM -LAB here at the Plant Protection Center, Dep. of Virology in Lyngby (J. Begtrup). We have also cooperated with the Royal Agricultural University Institute of Zoology on insect viruses (L. Øgaard), H.C. Hansens Lab. on phage and others.

Amongst new ISEM-diagnosis in the lab in 1982 we can mention: Prunus ringspot virus (PNRV), Helenium S-virus (HelSV), alfalfa mosaic virus (A1MV), Hydrangea ringspot virus (HRSV) and Pelargonium flower break virus (PelFBV).

2. New attacks of virus diseases 1982 (N. Paludan and A. Thomsen)

Virus infection was detected in the following species:

Aeschynanthus hildebrandii	(Tobacco mosaic virus)
Allium ascalonicum	(Tobacco necrosis virus, strain A)
Brassica pekinensis	(Tobacco rattle virus) (Beet Western yellows virus)
Cucumis sativus	(Arabis mosaic virus)
Cytisus præcox	(Raspberry ringspot virus)
Euphorbia pulcherrima	(Tobacco mosaic virus, tomato strain)
Ficus elastica	(Tobacco mosaic virus, tomato strain)
Heliopsis scabra	(Helenium virus S)
Iris 'Wedgewood'	(Tobacco mosaic virus, tomato strain)
Kalanchoe blossfeldiana	(Tobacco mosaic virus, tomato strain)
Sempervivum sp.	(Sphaerical particles)
Yucca elephantipes	(Flexible threads, 750 nm)

MLO infection detected in the following species:

Carduus crispus
Herniaria glabra
Melandrium sp.
Monarda didyma
Scabiosa columbaria

VI. ZOOLOGY DEPARTMENT, J. Jakobsen

Experimental work

Potato cyst nematode (Globodera rostochiensis, G. pallida) (J. Jakobsen and L. Monrad Hansen)

Identification of pathotypes of potato cyst nematodes (PCN) collected from infected private gardens

About 3,000 private gardens were investigated. Of the potato plants that were lifted some 600 were found to have cysts on the roots indicating infection.

Soil samples from the infected gardens were tested in glasshouses by growing an Ro-1 resistant variety in pots of the soil under test. Four replicates were made from each soil sample.

After 12 weeks the roots were examined for newly developed cysts. In about 30 samples new cysts were found. Second stage larvae from these cysts were then measured for stylet- and tail-length to identify G. rostochiensis and G. pallida. G. pallida was found in two samples, the others were G. rostochiensis.

Further tests will be carried out to identify the pathotypes of the populations from the 30 samples.

These preliminary results are the first evidence of other pathotypes of PCN than Ro-1 in Denmark excluding the Faroe Islands.

Early lifting of potatoes as a method to prevent a build-up of Potato Cyst Nematodes (J. Jakobsen and L. Monrad Hansen)

Production of early potatoes is concentrated in certain areas of Denmark. One of the main areas of production is the island of Samsoe. Very often early potatoes are grown in the same field year after year. Therefore, experiments were carried out to show whether early lifting might prevent a build-up of PCN.

The results from the experiments show that the population density of PCN will be kept down if the potatoes are lifted not later than 12 weeks after planting.

Testing new potato crosses for resistance to pathotypes of potato cyst nematodes (J. Jakobsen)

2,000 potatotubers were tested for resistance to pathotype Ro-1 and 500 tubers for resistance to both pathotype PA-2 and PA-3 for the potato breeding station at Vandel.

Examination of soil samples from seed potato fields and other fields (J. Jakobsen)

This routine work is carried out for The State Plant Protection Service. A total number of 12,000 soil samples were investigated for occurrence of PCN. About 80 per cent of the samples came from seed potato fields. Among these samples 0.6 per cent were found to be infected with PCN.

Cereal Cyst Nematodes (CCN) (Heterodera avenae)
Nematode-parasitizing fungi (M. Juhl)

The investigation of the influence of winter soil-temperature on nematode-parasitizing fungi was continued. This experiment was started in 1976, and since then the population density of CCN has been reduced by 50 per cent in heat-treated microplots compared with the density in the non-heated microplots. The number of eggs parasitized by fungi in the heat-treated plots was twice the number in the untreated microplots.

Verticillium chlamydosporium was the dominating species among the fungi found in the eggs. Treatment with the fungicide captafol also influenced the reproduction rate of CCN. The treatment resulted in a reproduction rate twice that of the control. The explanation may be that the treatment reduced the number of parasitizing fungi. The dominating fungi species were V. chlamydosporium and Nemathophtora gynophila. The following species were also found: Acremonium sclerotigenum, Arthrobotrys oligospora, Fusarium proliferatum, F. oxysporum, Plectosphaerella cumerina, Tilletiopsis like fungus, Verticillium catenulatum, V. obovatum.

Identification of the species was kindly carried out by Dr. Walter Gams, Baarn. This experiment was carried out in connection with a working group under IOBC.

Population dynamics of CCN (J. Jakobsen)

The microplot experiment set up in 1968 has been continued. During ten years susceptible barley and oat varieties have been grown in the plots. The population density of CCN rose significantly from 1981 to 1982 in all plots.

Despite great variation in the density of CCN from plot to plot, there was no correlation between the density and the yield. The favourable growing conditions may possibly provide an explanation. The experiment will be continued. CCN were regularly found in soil samples from the Borris research station "Borris" - even in samples from fields with a crop rotation designed to limit a build-up of CCN. These results tend to show that the conditions for build-up of CCN were good in 1983, at least at "Borris", and were supported by results from microplot experiments.

Occurrence of cereal cyst nematodes in soil samples from sugar beet fields

In connection with the survey of soil inhabiting pests in sugarbeet fields, the soil samples were examined for cyst forming nematodes, including CCN. The occurrence of CCN in these soil samples was remarkably low, the reason probably being that the samples were taken in fields with a more varied crop rotation. Only 20 per cent contained more than 1,000 eggs per kg soil.

Beet cyst nematode (Heterodera schachtii) (L. Monrad Hansen, J. Jakobsen & M. Juhl)

Soil samples from approximately 300 fields all over the country were investigated. Only 52 per cent of these samples contained beet cyst nematodes, and none of them contained more than 1,000 eggs per kg soil. The result of this investigation confirms

earlier investigations which have shown that beet cyst nematodes are seldom a problem - and then mainly on light soils with an intense beet production.

Control of beet cyst nematode

The investigation was carried out for the "Maribo" research station. Soil samples from a trial with Metam-Na and Shell DD to control beet cyst nematodes were investigated. When the experiment was established in 1981, approx. 20,000 eggs per kg soil were found.

After harvest the nematode population was reduced to 4,000 per kg soil in the treated plots. A yield increase from 18 to 50 per cent in treated compared to untreated plots was obtained.

An experiment with formalin treatment of the soil was made in a nematode infected area, where only sugarbeet had been grown for a number of years. Treatment caused a considerable increase on nematode-population (26 x) compared to untreated (2 x). Percentage of parasitized eggs was in treated plots 8 compared to 26 in untreated plots.

Soil-inhabiting pests of sugarbeet (L. Monrad Hansen)

The investigations included control experiments, development of forecasting methods and survey of the extent of soil-inhabiting pests.

Field experiments with granulated insecticides

The results from field experiments at 4 localities agreed with earlier results. If no soil-inhabiting pests are present, treatment with granulated insecticides tends to reduce the number of plants.

According to existing results damage thresholds for collembola is about 8-12 collembola per plant in the sensitive part of the growing period.

In two of the control experiments, where there were 0 to 15 collembola per plant, an average yield increase of 7 per cent was obtained compared to untreated plots when sown on 4 April. Sowing on 26 April gave a 12-per-cent yield increase.

Forecasting

The possibilities for examining soil samples in order to establish the necessity for treatment with granulated insecticides are good.

If less than 10 collembola are found in samples taken in the autumn, the use of granulated insecticides cannot be expected to be profitable.

Survey

About 500 sugarbeet growers were asked to co-operate in a survey of the occurrence of soil-inhabiting pests. Just over half of these took part in the investigation, which included information about crop rotation, etc., plus examination of soil samples from sugarbeet fields.

The soil samples were examined for occurrence of symphylids, millipedes, mangold beetles, wireworms, collembola and plant parasitic nematodes.

The presence of these pests was moderate - less than 5 per cent of the samples contained pests to such an extent that control should be considered.

Aphids in cereals

Counts of aphids on spring barley and winter wheat were carried out in preparation for a nation-wide registration program of aphids in cereals. The results show a reasonable correlation between tillers with aphids and the average number of aphids per tiller, when there are 1 to 6 aphids per tiller.

This registration method is easy and fairly precise and thus very suitable in practice for an assessment of whether the density of aphids necessitates treatment with insecticide. The damage

threshold for aphids is between 1 and 6 aphids per tiller as mentioned above.

Suitability of various winter wheat varieties as host plant for aphids (J. Reitzel)

As a part of a major European IOBC investigation, counts of aphids in two wheat varieties, Bounty and Maris Huntsman, were carried out.

The counts were spread throughout June and July and showed, as expected, that the build-up on Bounty was considerably less than on Maris Huntsman. In spite of this difference the build-up of aphids on Bounty was so extensive that control was necessary.

Semifield method for determination of the effect of insecticides on aphids in cereals (J. Jakobsen)

The development of a method based on plants grown in containers covered with net was continued.

Aphids were set out before and after treatment with insecticides. Numbers were assessed one week after treatment. Grain yield and thousand-grain-weight were measured. The results from 1982 show that plant-growth is still not uniform enough to register with a degree of certainty the effect of treatments. In relation to the build-up of aphids, the compounds fenitrothion, pirimicarb and metyl-parathion showed a significantly better effect than cypermethrin, etrimfos and ethiofencarb.

However, due to the lack of uniformity of growth, the results should be looked upon with reservations.

Registration of aphids in areas with seed potatoes (J. Reitzel)

The winged summer generation of several aphids are the most important carriers of leaf roll virus and virus Y. Therefore it is of vital importance that haulm destruction is conducted before risk of infection gets too great.

From 8 June to 27 July the occurrence of aphids was assessed by means of traps in 14 areas with seed potatoes as well as at the research stations at "Rønhave", "Højer", "Borris" and "Ødum".

The number of aphids caught increased dramatically from week 27 to week 28, which indicated the necessity of haulm destruction by the end of July. The number of aphids caught and the occurrence of different species varied from locality to locality. Whether the main reason for this variation is that only one trap was set up at each locality will be checked in 1983.

Pests in oil-seed rape (F. Lind)

The experiments and investigations have included pests in both winter and spring rape.

The investigations in winter rape have included the cabbage seed weevil (Ceutorrhynchus assimilis) and the brassica pod midge (Dasyneura brassicae). The cabbage seed weevil is the subject of investigations to determine the correllation between density of weevils and resulting damages on the rape plants.

The results showed that direct damage, measured in loss of seed is relatively low. Thus a continuous attack of e.g. 1 weevil per plant during the flowering period resulted in a grain loss of approximately 1 per cent.

Parallel to this, a nation-wide survey of damage to winter rape crops caused by the seed weevil and the pod midge was carried out. The extent of damage was established on the basis of plant samples sent in by farmers. On the basis of samples from 28 localities an average of 11.5 per cent of pods were found to be attacked by seed weevil and 8.0 per cent attacked by pod midge. Figures for 1981 were 17 per cent and 2,7 per cent respectively.

The survey also includes a registration of population density and flight periods of the brassica pod midge.

The investigations in spring rape were concentrated on damage caused by the blossom beetle (Meligethes spp.).

Damage threshold experiments were carried out under controlled conditions. The main purpose of these investigations was to com-

bine various cultivation practices with varying pest densities and time of attack.

In one part of the test, blossom beetles were set out on oil -seed rape plants at 10 different stages of flower development.

The results showed that the bud stage was especially sensitive to attack.

The same method was used in a screening test with 5 different spring rape varieties. Here the aim was to investigate the ability of various spring rape varieties to compensate for pest attack. The varieties were selected according to their content of erucid acid and glucosinolate.

An examination of the effect of synthetic pyrethroides on blossom beetles was made. The test included chemicals whose active ingredients are permethrin, cypermethrin and methoxychlor, -cypermethrin in the concentrations 1:1, 1:2 and 1:4. The primary aim was a detection of an effect which goes further than the period in which the pyrethroides are acutely toxic.

On the basis of this material it is possible to prove a statistically reliable effect for 8-16 days dependent on compound and concentration.

In co-operation with several spring rape growers a survey of the occurrence of pests in this crop was carried out. The methods used in this investigation correspond to those of the survey of winter rape. The results show neither a decreasing nor an increasing tendency to pests attacks, compared to a corresponding investi gation in 1981. In 1982 0-7 per cent of pods were found to be attacked by cabbage seed weevil and 0-3 per cent by brassica pod midge.

Monitoring and forecasting of pests on non-protected vegetable crops (P. Esbjerg)

Work from the previous years testing of components of synthetic turnip moth pheromone was so advanced that it was possible to work with a 1:1:1 standard mixture of the components cis-5-dece-

nylacetate, cis-7-dodecenylacetate and cis-9-tetradecenylacetate. This mixture was used at a rate of 100 micrograms for each capsule in various trials - for instance in the final testing of 6 trap types intended for the turnip moth.

This trap test was part of the project: "Integrated pest control", which was finished 1982.

The experiments with synthetic pheromone confirmed the results from earlier tests with live females as bait. It is most important for high catch that the traps are open for approach from any side.

With assistance from The Agro-meteorology Service pheromone trap catches were analysed and compared with the climatic data during the catch period. The influence of climate could not be statistically related to catch, due to the limited data. Measurements of various climatic factors have been made during the latest 3 years at 3 localities using a Norwegian battery-driven AAnderaa weather station, which records data every 10 minutes.

Investigations of the influence of soil humidity on cutworms were continued. This was done in glasshouse using an improved test setup, where even newly hatched cutworms could be kept confined. A carrot top was the source of food and a well-defined heap of sandy soil was used - in which they could bury themselves. These investigations clearly showed that wet soil is an important mortality factor for small larvae. The observations also showed that wet soil forces them to give up their usual pattern of behaviour, i.e. burying themselves in the soil, and instead staying more permanently on the plant leaves.

Experiments with 3 pesticides against cutworms showed that the effect of the pesticides depended on the size of the cutworms. The effect was the same when the larvae came in contact with insecticide residue on plastic as in the case of direct exposure to the insecticide.

Development of standard test methods for laboratory tests of insecticides (Bent Bromand)

A continuous breeding of harmful insects is an essential part of the development of standard test methods. Therefore, in connection with the test method development, breeding of blossom beetles, Meligethes aeneus, was continued in 1982.

During November and December adult blossom beetles were reared from eggs laid in September by captured blossom beetles. Mortality, however, was high during their development, thus only about 4 per cent of the eggs developed into adults.

Blossom beetles captured in the late summer, "hibernated" under conditions that imitate their natural hibernation. In January 1983 the "hibernation" was stopped by moving them to a temperature of 22°C. The beetles began their egg laying 15 days later. The eggs developed normally until the pupal stage, but the apparently healthy pupae did not hatch.

Test method development

Laboratory tests of the effect of the insecticides permethrin, cypermethrin, fenvalerat and deltamethrin on blossom beetles was continued. Captured blossom beetles were used for the test - in May-June from the hibernated generation, in July-August both from the hibernated and from the new generation and from September only from the new generation. This dissimilarity of test material is undesirable but necessary until a breeding method for blossom beetles has been developed.

The same test setup as in 1981 was used, i.e. ventilated glass -cells which during the exposure time - 24 hours - are kept at 20°C and 16 hours of light. The surfaces of the glasscells were coated with pesticide in concentrations varying from 0.016 to 0.00002 per cent of active ingredient, i.e. 1/64 to 4/1 of the normal dose.

The results from the experiments are shown in table 1.

Table 1. Per cent dead blossom beetles after 24 hours' exposure to 4 synthetic pyrethroides.

Concentration: Compound	Control	1/64	1/32	1/16	1/8	1/4	1/2	1/1	2/1	4/1
Permethrin	0.6			5.6	11.5	28.8	37.4	72.3	82.2	
Cypermethrin	4.9	6.7	14.6	14.1	20.0	33.6	55.0	92.6		
Fenvalerat	0.5			3.8	10.8	13.3	27.2	36.6	50.6	83.5
Deltamethrin	4.7	7.5	22.3	32.8	63.7	79.8	91.3	100.0	100.0	

A few experiments with seed weevil and flea-beetle were carried out using the same test method and the same synthetic pyrethroides. The results are shown in tables 2 and 3.

Table 2. Per cent dead seed weevils after 24 hours' exposure to 3 synthetic pyrethroides.

Concentration: Compound	Control	1/8	1/4	1/2	1/1
Permethrin	2.5	47.5	65.0	95.0	97.5
Cypermethrin	0	100.0	100.0	100.0	100.0
Deltamethrin	31.5	100.0	100.0	100.0	100.0

Table 3. Per cent dead flea-beetles after 24 hours' exposure to 3 synthetic pyrethroides.

Concentration: Compound	Control	1/32	1/16	1/8	1/4	1/2	1/1	2/1	4/1
Permethrin	0		3.3	0			4.8	16.2	
Fenvalerat	0				0	0	13.6	40.0	88.6
Deltamethrin	0	13.0	33.3	47.1	70.8	83.0			

Biological control of aphids in glasshouses (L. Stengård Hansen)
The investigations on the biology of the aphid midge, Aphidoletes aphidimyza were completed. The investigations were concentrated on the influence of temperature on the midge development. The experiments were carried out at the temperatures of 10°, 15°, 20°, 25° and 30°C and showed a maximum development at 20° and 25°C. Predation investigations (tests on the eating capacity of the larvae) showed a maximum predation capacity at 20°C, i.e. the aphid midge may be expected to be most efficient at temperatures of approx. 20°C.

In addition to this, an investigation was made as to whether temperature influences the induction of diapause. At 20°C diapause is induced at a day length of 15.5 hours. An increase of temperature to 25°C prevented induction of diapause, even at a day length of 10 hours.

In 1982 control experiments were carried out in 13 glasshouses with pepper (8,000 m^2) and in 4 glasshouses with ornamental plants (Hedera, myrtle) (2,400m^2). In each place control was established with "open rearing units by means of which the aphid midge was introduced early in the growing season.

Control experiments using this technique gave positive results, but some adjustments of the method are still required in order to secure a better balance between the populations of vetch aphids and aphid midges in the establishment phase. If the aphid midge is established in the glasshouse at the beginning of the growing season the chance for a good control is high.

The method is probably suitable not only for pepper-cultures but for many ornamental plants as well.

Development of test methods for investigation of the influence of chemical compounds on natural enemies of pests (L. Samsøe -Petersen)
Parasitic wasp (Encarsia formosa):

A method for testing the effects of pesticides on the parasitic wasp, Encarsia formosa, has been developed. This parasitic wasp is used by a majority of tomato-growers for control of white

flies. The growers who use biological control need information about pesticides that are harmless towards the beneficial insects when chemical control for other problems is required.

The method has been developed by using beans as host for the white flies, but it has not been possible to keep all of these leaves fresh during the whole test period. Therefore Hedera helix, Thunbergia alata and cotyledonous leaves of cucumbers are now used.

Rove beetle (Aleochara bilineata):

Biological control using beneficial insects as in glasshouse crops, is not used in field crops in Denmark.

However, many naturally occurring species are known to be of great importance for reduction of pest populations. For example: ladybirds, hoverflies and lacewings who all feed on aphids; ground beetles who feed on eggs, larvae and adults of many pest species and rove beetles among which some are both predators and parasites.

As is well known, these naturally occurring beneficial insects are not always able to keep the pest populations below damage threshold levels. But they are often able to reduce the need for chemical treatments. Therefore a choice of chemicals that do not have an adverse effect on these beneficial insects is desirable.

In the light of this the Environmental Protection Service has initiated the development of a method to investigate of the effect of chemical compounds on beneficial insects in field crops. At present a method to investigate of the effect of pesticides on the rove beetle Aleochara bilineata is in process. This rove beetle is a predator as well as a parasite, the adults feeding on a wide range of prey, while the larvae are parasites on fly pupae - primarily on onion flies and cabbage root flies.

In 1982 the work has included the establishment of laboratory cultures of onion flies and rove beetles as well as preliminary experiments with on adult rove beetles and with eggs and larvae.

Two experimental setups are used as it is impossible to predict whether the newly hatched larvae (that are to seek out pupae) or the adults (that are very active) will be most sensitive to pesticides.

Insecticide resistance in peach potato aphids. (PPA)
(O.C. Pedersen)

In 1981 and 1982 investigations were carried out on insecticide resistance in PPA in glasshouses and outdoors. By means of a biochemical test method it is possible to measure resistance in this pest. The resistance is due to increased content of a certain enzyme in the aphids. This enzyme is able to decompose or adsorb most generally used aphicides. This applies to phosphorous compounds, carbamates and synthetic pyrethroides. As a result of this method it is possible to classify individual PPA in one of six categories of resistance. The results show that PPA in glasshouses are normally moderately to highly resistant. There is a clear connection between previous chemicals control and level of resistance. Only in glasshouses, where spraying is not used at all, most of the insects are sensitive or only slightly resistant.

The field samples show a lower level of resistance than in glasshouses. In 1981 the sensitive and weakly resistant insects dominated the samples tested. The higher resistance variants appeared sporadically all over the country. In 1982 the situation was slightly different. The weakly resistant types dominated the samples tested, with the other categories of resistance (including sensitive) occurring only occasionally. However, the increase of the average resistance level from 1981 to 1982 may be due to the differences in reproduction and migration conditions.

B. PESTICIDE RESEARCH INSTITUTE

The institute conducts experiments with pesticides for use on agricultural and horticultural crops.

I. DIRECTORY

Director: E. Nøddegaard

Scientific straff:

Knud E. Hansen and B. Løschenkohl
Fungicides and insecticides for Agricultural Crops.

A. Nøhr Rasmussen:
Fungicides and insecticides for Glasshouse and Nurseri crops.

A. Nøhr Rasmussen and E. Schadegg:
Fungicides and insecticides in Orchard and Busch crops.

E. Schadegg:
Documentation, Statistics, Secretariat, List of Approved Products.

Bent J. Nielsen:
Control of Powdery Meldew and Rust Diseases in Cereal by Seed Treatment in the Autumn (Project paid By Funds).

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 giving the specifications of the approval. The text of the certificate may be printed on the label of the specific product.

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 a certain degree also included in the compulsory registration at the Ministry of Environmental Protection.

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

The Enviromental 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 fullfil 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 offical agencies or by chemical firms and need not be from trials in Denmark, but can be from other countries where the climate and agricultural practises are similar to those of Denmark.

II. AGRICULTURE (Knud E. Hansen, B. Løschenkohl and Bent J. Nielsen)

Fungal diseases

Spraying against stem and leaf diseases in cereal (Knud E. Hansen)

Eyespot (Cercosporella herpotrichoides). The experimental work comparing benzimidazoles with prochloraz and propiconaxole in winter wheat was continued in 1982.

Contrary to ealier years carbendazim and benomyl had a poor effect against the eyespot. The effectivity did not increase after combination with procholoraz or propiconazole.

In spite of 38.6 per cent of the straw being attacked by eyespot at harwest time the yield was high. It is concluded that the attack did not have an influence on the growth and therefore only small yield increases have been obtained by the experiment.

Glume blotch (Septoria nodorum) in winter wheat. The attacks have generally been weaker in the experiments in 1982 than in the previous years.

In general there has been no difference in the effectivity of the tested compounds prochloraz, propiconazole, chlorothalonil and a combination of triadimefon with captafol.

In one of the experiments heavy attack by yellow rust occurred therefore spraying with the above mentioned combined compound or propiconazole was carried out and this resulted in a large increase in yield.

Propiconazole and prochloraz and combinations of these with carbendazim have been compared in 1 or 2 sprayings in 4 experiments. The 1st. spraying was carried out concerning control of eyespot, while the 2nd. spraying was based on later attack by glume blotch about stage 9-10.1 (Feekes scale).

The 1st. spraying for the control of eyespot and attack by glume blotch gave a yield increase of 2.9-5.4 hkg per ha. The 2nd. spraying increased the yield further by 2.1-3.0 hkg per ha.

Net spot blotch (Drechslera teres) in spring barley. Some experiments have been carried out comparing chlorothalonil, prochloraz, propiconazole, triadimefon and pyrazophos.

The best effect on the attack and on the yield has been obtained by propiconazole and prochloraz. The other compounds had a weaker efficacy especially in experiment with heavy attack.

Besides the typical symptoms of necrosis a heavy clorosis occurred followed by leaves dying quickly.

Compounds with good efficacy delayed the ripening effectively and thereby increased the yield.

Seed treatment of cereals (B. Løschenkohl)

Stripe smut (Urocystis occulta) of rye and bunt (Tilletia caries) of wheat. 11 compounds were tested in field experiments. Compounds containing carbendazim and the compound Campogran controlled the two diseases well. Baytan Universal completely controlled stripe smut, but had a low effect against bunt. Disease level in control was 11.3 p.c and 16.1 p.c. respectively.

Leaf stripe (Drechslera graminea) of barley. 11 compounds were tested. All compounds, including compounds with imazalil, nuarimol, prochloraz and Baytan bejdse IM had a good effect. Disease level in control was 10.7-21.5 p.c.

Glume blotch (Septoria nodorum) of rye. 10 compounds were tested in field experiments. There was no response to the treatment. 70 p.c. of the grain was infected with Septoria nodorum.

In a field experiment with winther barley seed treatment with 10 compounds had no effect on the emergence. Wintering was good after all compounds. In control the percentage of the emergence and wintering was 93.1 and 88.7 respectively.

Loose smut (Ustilago nuda) of barley. Cillus Vitavax 75 and Baytan Universal gave good results, whilst the effect of the other compounds was not as good.

Net spot blotch (Drechslera teres) in barley. In 2 field and 3 glasshouse experiments 16 compounds were tested. In the field experiments no attacks or response to treatment on emergence occurred.

Disease level of the seed was 89.3 p.c. and 32.3 p.c. respectively. In the glasshouse experiments no attacks occurred but as a result of physiological changes in the plants atypical symptoms were seen after treatment with Baytan Universal, Baytan bejdse IM and Trimidal bejdse 10 S.

In experiments with coated seeds of sugarbeets, seed treatment of peas and spring rape no attacks of pests or root diseases occurred.

Snow mould fungus (Gerlachia nivales). Resistance of the snow mould fungus to carbendazim was tested in 39 samples of winter wheat. Widespread resistance of seedborn snow mould fungus was found in all samples. As a result the approval for all compounds containing pure carbendazim was cancelled.

This resistance will be studied more closely in a projekt financed by the Danish Agricultural and Veterinary Research Council.

Stalk break (Sclerotinia sclerotiorum) in rape. 7 spraying compounds were tested in 2 experiments with winter rape and in 2 with spring rape. Attack occurred in one experiment with winter rape, 29.0 p.c. in control. Ronilan, Sumisclex 50 WP and BAS 436 00 F reduced the attack to 2-3 p.c. and gave 6.6-7.8 p.c. and 15.3 p.c. increase of yield respectively. BAS 435 00 F had a beneficial influence on the condition of the crop.

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

Powdery mildew (Erysiphe graminis.) The investigations were carried out as in 1980-81. In most of the field trials with winter barley powdery mildew occurred only sporadically in autumn 1981.

Under these conditions the ontrol was complete without any carry-over of mildew.

Where the crop was artificially inoculated infection occurred in the treated plots during the autumn but to a lower degree than in control. In these trials there was a carry-over of mildew and an early epidemic development in the spring.

Only in one trial with early and well developed plants in combination with an early and severe attack of mildew was there a high level of infection. A considerable amount of mildew survived the winter on the treated plants and early in March 1982 an epidemic developed.

In spring barley seed treatment controlled an early epidemic development of mildew well, but later in the season susceptible cultivars were attacked to some degree.

Mildew on winter wheat and rye occurred at only a very low level in autumn 1981.

Brown rust (Puccinia hordei). Weak attacks were observed in the autumn. Where the plants had been artificially inoculated in the autumn the control was not complete and survival at the rust through the winter could been seen.

As a conclusion of the field investigations it appears that mildew and rust can be controlled in the autumn after seed treatment, but that the control is incomplete under conditions where the crop is sown early and severely attacked by mildew.

In the trials the best control was attained after seed treatment with triadimenol (30 g a.i. per 100 kg).

Yellow rust (Puccinia striiformis) on wheat and brown rust (P. recondita) on rye occurred only at a very low level in the trials.

Pests

Blossom beetles (Meligethes aeneus) and cabbage seed weevils (Ceutorrhynchus assimilis) in rape (Knud E. Hansen

The experimental work, testing pyrethroids has been continued in 1982. From the average of a great number of trials it has been concluded that pyrethroids have a better and longer effectiveness against Brassica seed weevils than methoxychlor, fenitrothion and phosalon. The efficacy of all compounds against Blossom beetles was alike with the exception of phosalon which had a weaker effect.

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

Fungal diseases

Apple scab (Venturia inaequalis). In 1982 evaluation of the 26 compounds against apple scab, which were evaluated also in 1981, was carried out. Representing all types of compounds. As in 1981 the attack of scab was severe.

The results from the separate years were in agreement with each other, excepting benomyl, which in 1981 had the best effect but in 1982 the poorest.

In both years maneb, bitertanol, captan, dithianon, fenarimol and mancozeb had the best effect closely followed by captan/captafol, captan/chinomethionat and captan/thiram. In 1982 the level of russeting was low but compared to control most compounds caused much russeting in Golden Delicious. Only sulphur/thiram, thiram, sulphur and captan/thiram caused less russeting than the control.

The least russeting was caused by the compound Topas C 50 WP which is not yet on the market.

Apple powdery mildew (Podosphaera leucotricha). Evaluation of the compounds approved in 1981 was carried out. However, no attack of mildew occurred.

Storage test of apples. All compounds against apple scab tested in 1981 were included in the storage test. Captan and thiram approved for control of Gloeosporium proved to be the most effective. Liquid formulations of captan were more effective than wettable powders. Benomyl had a weaker effect. Bitertanol and fenarimol were as effective as the approved compounds and they also controlled storage scab well. However, the maneb were the most effective compounds against storage scab.

Grey mould (Botrytis cinerea) on raspberries. The attack of grey mould was very weak. Tolylfluanid had the best effect and gave the highest yield.

Grey mould (Botrytis cinerea) on black currants. The attack of grey mould was fairly weak. Tolylfluanid had the best effect, while iprodion gave the highest yield.

Grey mould (Botrytis cinerea) on strawberries. The attack of grey mould was very strong, thus the yield in control was only 8.4 kg of berries per 100 m^2 . The best compound tested was certainly BAS 6403 (mechlozolin) which had an effect of 82 p.c. and a yield of 102 kg berries per 100 m^2, followed by tolylfluanid. Iprodion and benomyl had a very weak effect.

Pests

Fruit tree red spider mites (Panonychus ulmi). 2 experiments concerning control of fruit tree red spider mites were carried out. 3 compounds Fenom P 425 EC, NC 21314 and Oleo-Supracid sprayed at five per cent hatching of the winter eggs, had an excellent effect. Sumicidin 10 FW, Danitol 10 FW and Cropotex sprayed at 80-100 per cent hatching of the winter eggs, had an acceptable effect.

The attack of red spider mites was very strong, on average, 20-30 living mites were found on each leaf in the untreated plots.

Green apple aphids (Aphis poma). The attack was strong, on average 140 aphids were found on each leaf. The best effect was obtained with Oleo-Supracid, both in the recommended and half the recommended dosage.

Raspberry weevils (Anthonomus rubi) on strawberries. A good effect was obtained with Sumicidin 10 FW and Ripcord. Ekalux Powder had a somewhat poorer effect, however, it was better than azinphos-methyl which had a poor effect.

Moth on strawberries (Acalla comariana). In the control living larvae were found in 38 p.c. of the spun together leaves. Ekalux Powder, Sumicidin 10 FW and Ripcord reduced the attack to 14, 16 and 20 p.c. respectively.

Glasshouse (A. Nøhr Rasmussen)

Fungal diseases

White rust of Chrysanthemum (Pyccinia horiana). In 1982 rust was found in serveral nurseries where cuttings were imported from the Netherlands. It was impossible to control the fungus satisfactorily with oxycarboxin, the fungicide normally used.

In the laboratory healthy plants were infected with an isolate (A) of P. horiana which was collected in glasshouses where oxycarboxin had no effect. This isolate was compared with an isolate (B) collected from plants growing in the open where oxycarboxin had an excellent effect.

Spraying with benodanil, bitertanol, oxycarboxin, propaconazol and triforine took place when the first pustules were noticed and repeated 10 days later.

None of the compounds worked 100 per cent effectively against isolate A. The best effects were obtained with propiconazol, triforine and bitertanol, whereas the effects of benodanil and oxycarboxin were very poor. All compounds worked 100 per cent effectively against isolate B with the exception of benodanil which gave 80 per cent effect only.

Gummy stem blight (Mycosphaerella meloni). 3 compounds were tested in one experiment. In relation to untreated plants the effect of iprodion was 93 per cent, but only 19 per cent from vinclozolin. Fenarimol damaged the plants and was therefore taken out of the experiment.

Pests

Scale insect (Saissetia coffeae). The experiments concerned with the testing of insecticides against scale insects on ornamental plants were continued in 1982. Until now 16 different compounds have been tested in normal and half the dosages.

Best effects were obtained with acephate, aldicarb, axinphos-methyl, methamidophos, methomyl and mevinphos, irrespective of the dosage tested. Heptenophos and diazinon had a poor effect.

Among the pyrethroids, permethrin and fenvalerate gave good results, whereas the effect was weaker after spraying with flucythrinate and fenpropathrin.

Glasshouse red spider mites (Tetranychus urticae). In Acalypha hispedae 3 experiments were carried out. 7 compounds were tested in normal and half the normal dosage compared with a normal dosage of dienochlor. Fenpropathrin, flubenzimine, methamidophos and thiophanox had the same effect as dienochlor, irrespective of the dosage. Also, 3,6-bis (2-cholorophenyl) 1,2,4,5-tetrazine had a good effect, whereas the effect of fenvalerate and permethrin was unsatisfactory.

Pine root aphid (Prociphilius pini). Pine growing in containers may be attacked by Pine root aphid. They do not damage the plants, but they cause problems if the plants are to be exported.

In an attempt to use the repellent properties of the pyrethroids 2 experiments were performed. In the period May 5th. to September 9th. 10 sprayings with permethrin and fenvalerate were carried out, but in relation to untreated plants no effect was obtained. On the other hand 3 applications with thiophanox gave 100 per cent effect.

IV. New pesticides tested in 1982 (E. Schadegg)

In 1982 the Pesticide Research Institute evaluated a total of 183 compounds, including reference compounds, in 171 experiments. 86 fungicides and 52 insecticides 3 of which were granules. 38 fungicides and 4 insecticides for seed treatment of cereals, other seeds and potatoes. The pesticides mentioned below have been approved by the State Committee on Crop Husbandry.

Net spot blotch (*Drechslera teres*) in barley.
Sportak 45 EC, Tilt 250 EC

Fusarium in spring barley.
Panoctine extra

Eyespot (*Cercosporella herpotrichoides*) in vinter barley.
Sportak PF

Powdery mildew (*Erysiphe graminis*) in cereals.
Corbel, Sportak 45 EC, Tilt 250 EC

Powdery mildew (*Erysiphe graminis*) in winter barley.
Baytan bejdse IM, Baytan Universal

Loose smut (*Ustilago nuda*) of barley.
Baytan bejdse IM, Cillus Vitavax 75

Loose smut (*Ustilago avena*) of oats.
Cillus Vitavax 75

Leaf stripe (*Drechslera graminea*) of spring barley.
Panoctine extra

Apple scab (*Venturia inaequalis*)
Topas C 50 WP

Peach potato aphid (Myzus persicae) on ornamental plants in glasshouses.

Dacamox 10 G

Peach potato aphid (Mysuz persicae) on ornamental plants and vegetables in glasshouses.

Cybolt, Danitol 10 FW, Decis, Ripcord

Wintermoth (Cheimatobia spp.)

KVK Permetrin

Fruit tree red spider mites (Panonychus ulmi).

Danitol 10 FW

Blossom beetle (Meligethes aeneus).

Fenom 200 EC, Sumicidin 10 FW, WL 85871

Strawberry Blossom weevil (Anthonomus rubi)

Ripcord

Leaf rollers (Tortricidae).

KVK Permetrin

Glasshouses white fly (Trialeurodes vaporaiorum) on ornamental plants and vegetables in glasshouses.

Cybolt, Danitol 10 FW

Brassica pod midge (Dasyneura brassicae).

Fenom 200 EC, Sumicidin 10 FW, WL 85871

Seed weevil (Ceutorrhynchus assimilis).

Fenom 200 EC, Sumicidin 10 FW, WL 85871

Fungus gnat (root) maggot (Sciara spp.) on ornamental plants in glasshouses.

Volaton granulat

Red spider mite (Tetrahynchus urticae) on ornamental plants in glasshouses.

Dacamox 10 G

Red spider mite (Tetrahynchus urticae) on ornamental plants and vegetables in glasshouses.

Danitol 10 FW

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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 on service in plant protection and testing pesticides for use in agriculture. These 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 in grass (S. Holm)

Investigations show that Oscinella frit and O. pucilla are the most injurious species in crops of ryegrass. The population of O. pucilla is found to be relatively constant in fields with perennial grasses, whereas O. frit migrates and is found in all grass fields.

Experiments show that there is often a great need for control of these flies especially in ryegrass fields grown for cutting.

Warning for potato late blight (S. Holm)

Negative prognosis, which is the general method, was compared with scheduling fungicide application with blitecast. The negative prognosis released a warning for the beginning and epidemic

development on June 30. and July 19. respectively. The Blitecaster recommended the first spraying on July 3. and 3 additional sprayings in the season.

Resistance of potato late blight to metalaxyl (S. Holm)

Thirty five isolates collected from different metalaxyl-treated potato fields were tested in the laboratory. Four isolates showed a slight degree of insensitivity to 1/4 of normal field rate. After two weeks the laboratory test showed normal sensitivity of isolates collected from the same fields.

Observations in winter barley, 1982 (J. Simonsen & K. Cortes)

As in previous years a number of winter barley fields were studied during April and May. Control measurements carried out in the autumn either by spraying or seed treatment clearly demonstrated the effect on mildew carry over. Several isolates of mildew tested showed normal sensitivity to triadimenol. Seed treatment with triadimenol had no visible effect on Typhula incarnata in fields with high infection pressure.

Control of black scurf on potatoes (J. Bak Henriksen)

Fungicides and methods of treatment against black scurf (Rhizoctonia solani were tested at planting.

The seed tubers were treated in the potato planter either by powdering with Tecto 5P (thiabendazol) 100 g per 100 kg, or by spraying with TBZ 30 (thiabendazol) 50 ml per 100 kg, Tecto L 45 (thiabendazol) 33 ml per 100 kg and TOG (thiabendazol + 8-hydroxyquinoline) 50 ml per 100 kg. The sprayings were carried out with a U.V. sprayer mounted on the planter. All treatments reduced the attack on the young sprouts. There was no significant difference between spraying and powdering.

Fysiological age of potatoes (J. Bak Henriksen)

The sprouting dormancy and incubation period have been measured in several potato varieties.

The period of dormancy and incubation was very different in 1980/81. However, the order of the varieties has been rather constant.

Internal black spot on potato (J. Bak Henriksen)

Internal black spot reduced the quality of several potato lots in the storage season 1981-82. The dry matter content was determined in the top end, the middle of the tuber and the stolon end. It was found to be 2-3 per cent higher in the stolon end than in the top end.

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