

A N N A L E S A G R I C U L T U R A E F E N N I A E

Maatalouden tutkimuskeskuksen aikakauskirja

1963

Supplementum 2

Vol. 2

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CENTRE

ACTIVITY IN THE YEARS 1959—61

HELSINKI 1963

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Agricultural Research Centre

Activity in the years 1959–1961

The Agricultural Research Centre is an institution of the Finnish government whose main function is research and experimental work in agriculture and related fields. The Research Centre, which is subordinate to the Ministry of Agriculture, was founded in 1908 and reorganized in 1924 and 1957. Its leadership is in the hand of the head director and the governing board, whose members are the directors of the various departments.

Prof. Dr. Pellervo S a a r i n e n was the Head of the Agricultural Research Centre until the year 1960. His successor is Prof. Dr. Jouko V u o r i n e n, address Erottajankatu 15—17, Helsinki. Telephone: 63 20 23.

The Research Centre consists of following nine departments:

1. Department of Soil Science
2. Department of Agricultural Chemistry and Physics
3. Department of Plant Husbandry
4. Department of Plant Breeding
5. Department of Horticulture
6. Department of Plant Pathology
7. Department of Pest Investigation
8. Department of Animal Husbandry
9. Department of Animal Breeding

In addition, the following fourteen experimental stations are a part of the Agricultural Research Centre:

1. Southwest Finland Agricultural Experiment Station
2. Satakunta Agricultural Experiment Station
3. Karelia Agricultural Experiment Station
4. Häme Agricultural Experiment Station
5. Central Finland Agricultural Experiment Station
6. South Savo Agricultural Experiment Station
7. North Savo Agricultural Experiment Station
8. South Ostrobothnia Agricultural Experiment Station
9. Central Ostrobothnia Agricultural Experiment Station
10. North Ostrobothnia Agricultural Experiment Station

11. Polar Circle Agricultural Experiment Station
12. Pasture Experiment Station
13. Frost Research Station
14. Pig Husbandry Experiment Station

Furthermore the following two offices are connected with the Agricultural Research Centre:

1. Bureau for Local Experiments
2. Administrative Bureau

The Administrative Bureau manages the administrative and economic affairs of the Research Centre. It is located in Helsinki, Erottajankatu 15—17. Telephone: Office 63 94 91. The inspection of the research work is managed by Mr. Antti E l o m a a and that of the economic affairs by Mr. Yrjö I i v o n e n.

Department of Soil Science

Address: Meritullinkatu 8, Helsinki

Telephone: Office Helsinki 15 177; Director 62 40 48

The Department of Soil Science was originally organized in 1914 as the Agrogeological Section of the Geological Commission. In 1926 it became an independent institute and in 1933 it was united with the Agricultural Research Centre.

Departmental personnel and their special fields

Prof. Dr. Jouko Vuorinen, director until September 1960 and Dr. Mikko Sillanpää, acting director since 1960; Dr. Paavo Purokoski, soil survey and special agrogeological problems (until June 1959); Dr. Osmo Mäkitie, chief chemist, spectrographic analyses (since July 1961 in Recife, Brasil as FAO expert); Mr. Esko Lakanen, chemist; Mr. Jorma Kivikä, chemist since August 1961; Miss Sylvi Soini, soil survey and special agrogeological problems and statistics; Mr. Raimo Erviö, soil survey and field experiments with trace elements; Miss Leila Urvas, soil survey; Mr. Seppo Hyvärinen, statistics.

The average number of the staff in the department was 24 persons in 1959, 26 in 1960 and 27 in 1961.

Functions of the Department

The Department of Soil Science carries out scientific investigations concerning soil and its use in agriculture.

Work in the years 1959 – 61

Agrogeological soil survey

Soil survey has been in progress in Tampere, Hämeenlinna, Kymenlaakso, Helsinki, Lohja, Riihimäki, Oulu and Rovaniemi districts in the years 1959 – 1961.

In the Tampere district the soil survey work was completed and the maps were printed in the following map (1: 20000; 10000 ha each) areas:

Rämsöö 2123 01*)	Vesilahti 2123 04	Saarikylät 2141 01	Pälkäne 2141 04
Siuro 02	Nokia 05	Kangasala 02	Sahalahti 05
Mahnala 03		Suinula 03	Ponsa 06

Field work was completed in following map areas:

Lempiäniemi 2124 07	Parkkuu 2124 09	Teisko 2124 11
Länsi-Teisko 08	Kämmenniemi 10	Murole 12

Descriptions of the area surveyed have been published for the Tampere—Lempäälä map group (2123 07—12; 60000 ha; VUORINEN, J. 1959. Agrogeol. maps No. 16: 1—85) and for the Nokia—Vesilahti map group (2123 01—06; SILLANPÄÄ, M. 1961. Agrogeol. maps No. 17: 1—95).

In the Hämeenlinna district the following soil maps were printed: Kalvola 2132 01, Sääksmäki 2132 02 and Valkeakoski 2132 03 and the field work was completed in Tyrvöntö 2132 05 and Laitikkala 2132 06 map areas.

In the Kymenlaakso (Kymi River Valley) district the maps of Pernoo 3024 07, Juurikorpi 3024 11 and Inkeroinen 3024 12 were printed and thus the map group of Anjala—Kymi 3024 07—12 was completed.

In the Helsinki district the maps of Hämeenkylä 2043 01 and Malmi 2043 04 were printed completing the map group of Malmi—Tuusula 2043 01—06. In addition the map of Östersundom 2043 07 was printed and field work was completed in Hangelby 2043 10, Nickby 2043 11 and Pornainen 2043 12 map areas.

In the Lohja district field work was completed in Lohja 2041 01 and Koisjärvi 2041 02 map areas.

In the Riihimäki district field work was completed in Rajamäki 2044 01, Hyvinkää 2044 02 and Riihimäki 2044 03 map areas.

In the Oulu district the 6 maps of the Oulu—Liminka group:

Liminka 2444 07	Tupos 3422 04
Oulunsalo 08	Madekoski 05
Oulu 09	Oulujoki 06

were printed and field work was completed in the adjoining areas:

Luohua 2443 07	Mankila 3421 04
Pehkola 08	Temmes 05
Liminganjärvi 09	Tyrnävä 06

*) Index of the General Map of Finland.

In the Rovaniemi district the field work was completed in the following map areas:

Rovaniemi	3612 07	Oikarainen	3612 10	Olkka—Toramoselkä	3612 12
Saarenkylä	08	Olkkejärvi	11		

The Department of Soil Science has taken part in the work of the European Soil Map. Results of these investigations concerning Finnish soils have been presented in the 7th ISSS Congress 1960 (USA) and in the ISSS meeting in Athens 1961.

Special agrogeological investigations

Investigations concerning sulphur-containing acid coastal soils were continued. Over 50,000 hectares of coastal soils were investigated, about 38,000 hectares of which were found to suffer damage from high sulfur content. These soils are very acid and require heavy liming if a reasonable yield is to be obtained. In many cases fertilizing of these soils without liming has not resulted in any substantial increase in yield, whereas with heavy liming the yields have been more than doubled. The extremely beneficial effect of liming on these soils may be mainly due to the precipitation of sulphate ions as gypsum and to the decrease in acidity, but subsequent indirect effects, such as the increased solubility of phosphates, may be partly responsible for the better growth (PUROKOSKI, P. 1959. *Agrogeol.* publ. 72: 1—21; 1959 *Agrogeol.* publ. 74: 1—27; SILLANPÄÄ, M. 1961. *Acta Agric. Scand.* 11: 360—368).

In the investigation of Finnish clay profiles from 88 sites, the properties of various clay types were compared and the effects of particle size distribution, clay minerals, pH and organic matter on the solubility of Ca, K and P were studied (PUROKOSKI, P. 1959. *Acta Agr. Fenn.* 94: 87—100).

Orchard soils of Finland and Central Europe were compared. A detailed description of soil profiles shows especially the natural profile characteristics. Differences between soils from regions of different climatic conditions can be seen in the profiles under comparison (VUORINEN, J. 1959. *Acta Agr. Fenn.* 94: 131—149).

A statistical study on the fertility of soils under various grain and hay crops in Finland was made from a material of 84,525 soil samples. The average fertility levels and pH of the soils was found to be generally highest in wheat fields and lowest in oat fields. The exchangeable calcium and potassium were closely related to pH. The soluble phosphorus content was in good correlation with exchangeable calcium content, whereas its increase with increasing pH was clear only at higher pH levels. The difference in fertility of soils under various crops partly due to the choice of the

farmers, who are aware of the differences in soil requirements of various crops. Other reasons are climatic and geographical factors, especially in the northern parts of Finland, which limit the growing of certain crops to particular soils. (JANHUNEN, M. 1961. *Maatal. ja Koetoim.* 25: 15—29.)

Fixation of phosphorus fertilizer as a function of time was studied in Finnish soils during a period of eight months. The relationship between the amount of applied phosphorus and acid ammonium acetate soluble phosphorus was linear with highly significant correlation. The fixation of applied P seems to be a log-log function of time. The decrease in the solubility of iron and aluminium due to phosphorus fertilizing indicates the formation of insoluble Fe and Al phosphates. The solubility of applied P was significantly higher in the limed than in the unlimed soil, but liming did not significantly affect the solubility of native soil phosphorus. (SILLANPÄÄ, M. 1961 *Agrogeol.* publ. 80: 1—22; 1961 *Acta Agric. Scand.* 11: 360—368.)

The occurrence of trace elements in soils have been studied from sample material collected from local experimental fields around the country and from areas of soil surveying. The average contents of Cu, Co, Ni, Pb and Zn in the arable soils studied were found to be somewhat lower than the amounts reported to exist in soils and in earth crust in general. Mo content on the other hand seems to be a little higher. In mineral soils the contents of trace elements generally increase with decreasing particle size. Partial concentration of trace elements in organic matter of mineral soils was noted, while deficiency of trace elements is most likely to exist in peat soils. (VUORINEN, J. 1960 *Maatal. ja Koetoim.* 14: 24—32; MÄKITIE, O. 1961 *Agrogeol.* publ. 78: 1—25).

Investigations of physical properties of soils

Factors affecting the soil temperature during the growing season were studied in an orchard. The results showed for example that during the warming season (early June) the air temperature fluctuates widely from day to night, but its net increase during the 7-day period was 9° C. During the same period the net increase in the upper soil layer was 7.5° C and at a depth of 75 cm., 4.5° C. During the cooling season a similar pattern was observed. (VUORINEN, J. 1959 *Maatal. ja Koetoim.* 13: 269—274.)

The effects of soil moisture content and air temperature on soil freezing and thawing were studied in laboratory conditions. The time required to freeze or thaw a soil sample was a linear function of soil moisture content and a linear log-log function of the temperature of the surrounding air. In field conditions the indirect effects of those soil properties that determine the moisture-holding properties of soils seem to be of prime importance in influencing the course of the freezing and thawing processes. (SILLANPÄÄ, M. 1961. *J. Sci. Agric. Soc. Finland* 33: 233—239.)

Soil moisture tension was studied in texturally varying Finnish soils. It seems that water in finesand (0.02 — 0.2 mm) and silt (0.002 — 0.02 mm) is well fixed and that especially in finesand the soil moisture tension increases very slowly. (VUORINEN, J. 1960 Trans. 7th Int. Congr. Soil Sci. 1: 91—96.)

Methods for measuring hydraulic conductivity of soils above and below the water table were compared in an experiment field where the depth of the water table could be adjusted. The results obtained with both methods were in relatively good agreement. (SILLANPÄÄ, M. 1959 Acta Agric. Scand. 9: 59—68.)

Relationships between hydraulic conductivity and other physical properties of soils were studied. In spite of wide variation, soil structure seems to be generally well correlated with the conductivity. Correlations with humus content were negligible except in muddy clay and silt soils. With soil texture the correlation was significant only in finesand soils; in finer textured soil the correlations were obscure. (SILLANPÄÄ, M. 1959 Agrogeol. publ. 73: 1—28.)

Studies on soil structure and its determination were continued. The pre-treatment of the samples has an essential effect on the results of aggregate analyses. For example when wetting the samples by direct immersion, aggregation decreased with initial soil moisture content to values of less than half of those obtained from samples in their original field-moist condition or of those wetted with a spray (SILLANPÄÄ, M. 1959 J. Sci. Agric. Soc. Finland 31: 233—239).

The effect of cations on the water stability of aggregates was studied. The results bring out rather distinct differences among the effects of various cations. A cation may also play different roles in different soils. The water stability was a function of the concentration of the treatment solutions (SILLANPÄÄ, M. 1960 J. Sci. Agric. Soc. Finland 32: 211—218).

The effect of freezing and thawing on soil aggregation seems to depend essentially on soil moisture content and on the rate and number of the processes. An essential feature in the results was the distinctly different behavior of aggregates of different sizes and origin (SILLANPÄÄ, M. & WEBBER, L. R. 1961 Can. J. Soil Sci. 41: 182—187; SILLANPÄÄ, M. 1961 Acta Agric. Scand. 11: 87—94).

The relations of soil type, texture and humus content to soil aggregation were studied from a sample of typical Finnish subsoils. Among the soil types, muddy clay showed the greatest and finesand the least tendency to aggregate. An increase in clay content up to 50—60 per cent clay, generally boosted aggregate formation, while the relation between silt content and aggregation was more obscure. Aggregation increased generally with humus content within the range from 0.2 to 5.8 per cent humus. (SILLANPÄÄ, M. 1959 Agrogeol. publ. 75: 1—24.)

Analytical investigations

When studying the sulphur-containing soils a complexometric method for determining sulphates from soil extracts was developed. The total hardness is determined with 0.01 M DCTA, sulphates precipitated with known amounts of 0.01 M BaCl, DCTA is added according to the total hardness and excess Ba backtitrated with 0.01 M EDTA. (PUROKOSKI, P. & LAKANEN, E. 1959 Acta Agric. Scand. 9: 355—360.)

The accuracy of the routine soil testing method used in Finland was studied from a material of 2 316 soil samples. The mean errors calculated on the basis of duplicate determinations were: pH \pm 0.05 pH units, exch. Ca \pm 2.2 — \pm 3.8 %, exch. K \pm 2.5 — \pm 3.9 %, sol. P \pm 3.3 — \pm 21.2 %. The higher values given were for soils of very low nutrient levels. (LAKANEN, E. 1960 Agrogeol.publ. 76: 1—33.)

The extractability of phosphorus by the acid ammonium acetate (pH 4.65) method was studied. The first extraction gives a picture of the status of soluble P in soils and a picture of the P fixing capacity of soils appears in the extraction curve of repeated extractions (MÄKITIE, O. 1960 Acta Agric. Scand. 10: 237—245).

A procedure for chloroform (cont. 8-hydroxyquinoline) extraction of trace nutrients as oxinates from soil extracts was developed. With the procedure reported it is possible to separate the common trace metals from the major soil extract constituents, especially for spectrographic analysis (MÄKITIE, O. 1960 J. Sci. Agric. Soc. Finland 32: 223—228).

When investigating the chelation reactions of trace element reagents 1,2-naphthaquinone-1-monoxime-3,6-disulphonic acid and 1,2-naphthaquinone-2-monoxime-4-sulphonic acids were studied. Several dissociation and stability constants were determined (MÄKITIE, O. 1960 Suomen Kemistilehti 33: 207—209; 1961 Agrogeol.publ. 79: 1—61).

In determining the inorganic components of plants 3 % pyrrolidine dithiocarbamic acid in chloroform was used. The trace elements in chloroform are collected into alumina matrix and analyzed spectrochemically, In and Pd being used as internal standards. The same technique can be used in the analysis of soluble trace elements from soils (LAKANEN, E. 1961 Agrogeol.publ. 77: 1—26).

The investigations published by the Department of Soil Science in the years 1959—1961 are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Department of Agricultural Chemistry and Physics

Address: Tikkurila

Telephone: Office Helsinki 83 12 24; Director 83 13 59

The Department of Agricultural Chemistry and Physics began its activities in the year 1909 as a unit of the Institute of Agricultural and Economic Research which was subordinate to the University of Helsinki. In 1924 the Department became incorporated into the Agricultural Research Centre.

Departmental personnel and their special fields

Prof. Dr. Martti Salonen, director, fertilization trials; Dr. A. Teräs-vuori, chemical analyses; Dr. T. Keränen, chemical analyses, pot trials; Mr. A. Tainio, field trials, trace elements; Mr. G. Larpes, soil tillage; Mr. E. Barkoff, soil analyses; Mrs. H. Tähtinen, pot trials, chemical analyses; Mrs. A.-K. Ruuttunen, chemical analyses. In addition, about 8—10 people have worked in the office and laboratories and 3—4 on the experimental fields.

Functions of the Department

The Department of Agricultural Chemistry and Physics carries out investigations on fertilization, liming, soil improvement and tillage.

Work in the years 1959 - 61

During the three-year period 1959—61 the investigations of the Department continued in their usual manner. The experimental work can be divided into three groups: 1) field trials, 2) pot trials, and 3) laboratory analyses.

1. A small number of the field trials are carried out at the Department of Agricultural Chemistry and Physics at Tikkurila, but most them are located at the permanent experimental fields throughout the country. Yields were harvested from the following number of fields:

	1959	1960	1961
At Tikkurila (total)	33	36	40
At the experimental fields:			
liming trials	9	10	9
liming-fertilization trials	22	22	16
fertilization „	158	171	163
trace element „	51	51	55
trace element-liming „	23	27	23
others	44	36	38
total	340	353	344

2. The following numbers of Mitscherlich pots have been used in pot trials:

	1959	1960	1961
new multi-nutrient fertilizers	160	149	105
problems of potassium fertilization	237	176	—
new phosphorus fertilizers	22	34	80
various nitrogen fertilizers	30	8	83
various liming agents	—	57	57
time of application of P and K fertilizers	—	81	—
plant uptake of phosphorus and potassium from different soils	—	14	78
methods of application of lime and P fertilizers	—	—	21
boron and molybdenum on clover	—	—	111
radioactive phosphorus trials	5	10	12
various preliminary trials	95	20	22
total	549	549	569

3. The following numbers of analyses have been made in the different years:

chemical analyses:

	1959	1960	1961
of soil	2057	4450	3413
of manure	215	330	136
of crops	6499	7602	14426
botanical analyses from leys	1875	1214	2196
various analyses of yield quality	1160	1250	475

As can be seen from these figures, attempts have been made to increase the numbers of chemical analyses of crops during the three-year period in question.

Investigations concerned with soil analyses

As a result of extensive and thorough investigations, a completely new method for determining the calcium state of the soil is presented (TERÄSVUORI, Publ. Finn. State Agr. Res. Board 175, in German). By this method it is possible to get a picture of the total cation-fixing ability of the soil, the amount of fixed metal cations and hydrogen ions as well as the actual pH of the soil. On the basis of this data, the lime need of the soil can be established with greater certainty than before.

In a study concerned with the forms of phosphorus in the soil and the availability of phosphorus applied in fertilizers (Acta Agr. Fenn. 94: 165—199),

a technique was developed which is based on ion exchange columns and particularly on the use on continual extraction. This technique makes it possible to determine the various phosphorus fractions, which have certain definite correlations with the effect of phosphorus fertilization.

It was found in one investigation (J. Sci. Agr. Finl. 23: 179—185) that ultra-frequency sound could accelerate certain slow reactions.

Fertilization and liming investigations

By comparing analyses of farmyard manure made at different time periods, it was found that the nitrogen and phosphorus contents of manure at the present time are considerably higher than in the 1930's (Koetoim. ja käyt. 16: 37, in Finnish).

In studies on various methods of handling of farmyard manure, it was found that the use of various chemical additives, such as superphosphate and calcium cyanamide, does not give profitable results (Koetoim. ja käyt. 17: 21—24, in Finnish).

According to the results of long-term comparative trials, the effect of basic slag is directly dependent upon the acidity of the soil. At a pH of less than 5, basic slag is better than superphosphate (Koetoim. ja käyt. 17: 4, in Finnish).

The effect of potassium present in cement kiln dust obtainable in Finland was found to be the same as that of corresponding amounts in potassium chloride and in ground limestone (Yearb. Agr. Res. Centre XV: 30—39, German summary).

In trials with different kinds of phosphorus fertilizers, it was found that water-soluble phosphorus improved the frost resistance of seedlings (Koetoim. ja käyt. 16: 39, in Finnish).

Pot trials have shown that under Finnish conditions, in certain cases — for example, in the cultivation of vegetables — magnesium applications are necessary (Koetoim. ja käyt. 17: 21, in Finnish).

Pot trials have provided experimental data on the significance of the relative proportions of different nutrients to plant growth (Koetoim. ja käyt. 17: 26, in Finnish).

Field trials conducted at various locations throughout the country have shown that the ploughing of phosphorus fertilizers into the soil buries them too deeply (Yearb. Agr. Res. Centre XIV: 7—15, English summary).

According to the results from field experiments carried out for nearly 30 years with different potassium amounts, it is apparent that the most suitable rate of potassium application on the usual Finnish fields of cereals or leys is 50 kg/ha annually of K_2O on sandy soils, 100 kg/ha on humus soils and as much as 150 kg/ha on peat soils. Potassium fertilization greatly increases the potassium content of hay and cereal straws while at the same time tending to

decrease the phosphorus, calcium and magnesium content (Publ. Finn. State Agr. Res. Board 185, English summary).

In comparing basal and annual applications of phosphorus and potassium on leys, it has been found that — especially on soils deficient in nutrients — annual applications give better results than large basal applications (Yearb. Agr. Res. Centre XIII: 197—203, English summary).

It was established that nitrogen fertilization as such is not harmful to red clover, but that in mixed leys it causes grasses to grow profusely and thus indirectly hinders the growth of clover (Yearb. Agr. Res. Centre XIII: 204—207, English summary).

Both beets and carrots demand sufficiently-limed soil and heavy applications of potassium and boron fertilizing, but beets respond more efficiently to all sorts of fertilization than do carrots (Yearb. Agr. Res. Centre XV: 205—212, English summary).

A rather close correlation was found between the results from copper fertilization trials and the amount of copper chemically determined in the soil (Koetoim. ja käyt. 17: 3, in Finnish).

Trials carried out with trace elements on cereals showed that copper and boron had an effect in reducing the amount of ergot (Koetoim. ja käyt. 18: 39, in Finnish).

According to a trial carried out in laboratory for many years, it is evident that the soil-neutralizing effect of blast furnace slag can be as good as that of ground limestone. No difference upon the humus content of the soil was noted (J. Sci. Agr. Soc. Finl. 33: 194—202, in Finnish and German).

Soil tillage investigations

In spring tillage trials on clay soil, it was found that — especially in the growing of spring wheat — the earliness of sowing was more significant than the depth of the tilled layer of soil. If a shallow depth is used, tillage may be carried out somewhat earlier (Yearb. Agr. Res. Centre XV: 40—45, English summary).

Detailed listings of the investigations published by the Department in the years 1959—61 can be found in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Department of Plant Husbandry

Address: Tikkurila

Telephone: Office Helsinki 83 12 32; Director 83 13 02

The Department of Plant Husbandry was founded at Tikkurila in 1910 as a unit of the Institute of Agricultural and Economic Research. In 1924 it became a department of the newly-founded state Agricultural Research Centre.

Departmental personnel and their special fields

Prof. Dr. Otto Valle, director, seed production of clovers and grasses; Dr. Jaakko Mukula, weed control; Mr. Jarl Wallin, cereals; Dr. Leo Yllö, potatoes and root crops; Miss Sirkka-Liisa Hiivola, herbage crops; Mrs. Marjatta Sarisalo, clover investigations; Mr. Risto Lallukka, weed control.

Functions of the Department

The function of the Department of Plant Husbandry is to study problems and methods of plant production for all the cultivated field crops in Finland.

Work in the years 1959—61

The weather conditions during the growing seasons 1959—61 had an important effect on the yields obtained in these years. In 1959 there was very little rainfall, the weather was sunny and warm, and even at harvest time in August the relative humidity was exceptionally low. As a result, combine harvesting was carried out under ideal conditions, and the quality of the grain was very high. Because of the favourable weather in this summer, there were many pollinating bumblebees in red clover fields, and a record yield of high-quality clover seed was harvested.

The growing seasons in 1960 and 1961 also had favourable weather conditions, with the result that the total yields of all crops in these years averaged 35 % and 26 % greater than the average for the period 1950—59. Characteristic for both of these years was the high temperature during the early part of June. All three growing seasons 1959—61 were free from autumn frosts in most parts of Finland.

In 1960 and 1961 the Department of Plant Husbandry carried out a special investigation on the suitability of combine harvesting of timothy seed. This investigation was concentrated in southern Ostrobothnia, which is the principal area of timothy seed production in Finland. In 1961 another special investi-

gation was begun on the distribution of various weed species throughout Finland.

In 1960 the United States Department of Agriculture awarded a 5-year grant (PL 480) for the project "Evaluation of genetic changes in seed of alsike, red and white clover varieties produced in the United States and Canada". The purpose of the project is to investigate, among other things, the possibilities of seed production of Finnish clover varieties in North America.

The numbers of trials carried out in the year 1961 were as follows:

Cereals and legumes	15
Potatoes and root crops	5
Forage crops	42
Weed control	29
Others	10

Cereals

Trials with cereals have consisted primarily of variety trials on new Finnish (Tammisto, Jokioinen) and foreign improved varieties. The Department also participated in a survey in 1960 on the distribution of cereal, pea and potato varieties in Finland. This survey is carried out every five years and shows the changes in extent of cultivation of these varieties, especially those of cereals.

The main lack of new cereal varieties in Finland concerns winter wheat. The acquisition of new winter wheat varieties depends entirely upon Finnish breeders, since foreign varieties are not sufficiently winter-hardy under Finnish conditions. New varieties of spring wheat are also necessary, since with the increase in wheat self-sufficiency in this country, there is a need for varieties which are early, stiff-strawed, and of superior milling qualities. Two new Finnish varieties of 6-rowed barley have recently been put on the market (Otra, Paavo), but no new 2-rowed malting barley has been developed to replace Balder, which is susceptible to sprouting in the head. Most of the oats cultivated in this country are Finnish varieties from the Tammisto Plant Breeding Station; the Dutch Pendek is the most commonly cultivated of the foreign varieties.

Investigations on combine harvesting of cereals have been continued mainly on the experimental farm at Tikkurila. The growing season in 1959 was especially favourable for these trials.

Potatoes and root crops

Variety trials on potatoes have been terminated for the present. Sugar beet variety trials have been carried out on Swedish (Hilleshög), Dutch (Kuhn), German (Klein Wanzleben) and on American hybrid varieties.

Forage crops

Trials on forage crops have been more extensive than those carried out on other crops and have mainly been concerned with red clover, the most valuable forage crop in Finland. At the Department of Plant Breeding at Jokioinen a tetraploid red clover has been developed; this tetraploid, Jo TPA 1, has been proved to be more resistant to clover rot than the diploid. In 1960 trials were begun at all experimental stations on four red clover varieties: the two diploids Tammisto and Jokioinen and the two tetraploids Jo TPA 1 and the Swedish Ulva. In 1961 a similar series of trials on alsike clover varieties was also started at several experimental stations. The varieties included the diploid alsike Tammisto as well as two tetraploids, Jo TAA 4 from Jokioinen and Tetra from Weibull, Sweden.

Since difficulties are often encountered with in the production of red clover seed, the Department carried out extensive investigations in the years 1959—61 on pollination and seed setting in red clover. These studies were made both at Tikkurila and at various experimental station. It was found that if sufficient numbers of pollinating bumblebees are present, there is no difference in seed setting between the Finnish Jo TPA 1 and the Swedish Ulva, and satisfactory seed yields can be obtained from both of these varieties.

Weed investigations

Weed control investigations have greatly increased during the years 1959—61. In each of these years 40 to 50 herbicides were tested in 25—30 field trials. In attempts to find effective herbicides against MCPA-resistant weed species in cereals, good or satisfactory results were obtained with MCPP, MCPA/TBA, dinoseb amine and dinoseb acetate. In connection with the program of the European Weed Research Council, barbane was tested against wild oats, but it gave very poor results. In control of weeds in root crops and vegetables, good results were obtained with propazine, prometryne, and a mixture of OMU and BiPC. Weeds in fruit orchards and nurseries were effectively controlled by simazine, diuron and amitrol. In trials against couch grass, TCA, dalapon and amitrol were tested. TCA was found to be most effective under Finnish conditions, but on peat soils it did not give good results. Control of horsetail was improved by increasing the rate of MCPA; annual treatment with this herbicide has reduced the re-growth of horsetail.

In 1961 a survey of weeds in spring cereal fields in Finland was begun. This survey has shown that sow thistle (*Sonchus*) is rapidly spreading and becoming a serious problem especially in fields which are combine harvested.

The major investigations published by the Department of Plant Husbandry in the years 1959—61 are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Department of Plant Breeding

Address: Jokioinen

Telephone: Office Forssa 23 041; Director 23 040

The Department of Plant Breeding was founded in 1924 at Tikkurila. In 1928 it was moved to the state-owned Jokioinen estate near the community of Forssa, 79 km from Turku and 117 km from Helsinki. Approximately 40 acres of cultivated fields are in use annually by the Department. The trial fields are located on heavy clay soil, which is a common soil type in the important agricultural region of southwestern Finland.

Departmental personnel and their special fields

Prof. Dr. Vilho A. Pesola, director until 31. 5. 1960, wheat, rye and field pea; Dr. Kalevi Multamäki, acting director 1. 6. 1960 — 31. 12. 1961, herbage plants, polyploids and mutations; Mr. Onni Pohjanheimo, potato and barley (in addition wheat during the period 1. 6. 60 — 28. 2. 61); Mr Oiva Inkilä, oats (in addition rye and field pea during the period 1. 6. 60 — 31. 12. 61); Mr. Olli Rekola 1. 3. 61 — 31. 12. 61, wheat. The numbers of other workers, calculated in terms of full-year working time, were as follows: 13 in 1959, 14 in 1960 and 17 in 1961.

Functions of the Department

The functions of the Department of Plant Breeding are to develop new improved varieties of cultivated crops as well as to carry out fundamental research in the field of plant breeding.

Work in the years 1959—61

The weather conditions at Jokioinen, as elsewhere in Finland, show great variation from year to year. In 1959 the snow cover and ground frost disappeared at the same time in the first week in April. Spring sowing was begun as early as April 27th. The growing season in 1959 was characterized by little rainfall: the total precipitation during the period May—September was only 146 mm or half of the normal (293 mm). The dry conditions clearly hindered the growth and development of the crops, with the result that yields

were lower than normal. On the other hand, because of the favourable harvesting conditions, the quality of many crops was exceptionally high.

In 1960 the snow cover disappeared from the experimental fields on April 15th and the ground frost had completely thawed by April 20th. Spring sowing was begun on May 10th, or two days earlier than normal. During the growing season, rainfall was normal and the temperature was 0.8° C higher than the mean. Yields were in general larger than usual, although heavy rains in the middle of the summer caused sprouting in the heads of some cereal crops.

In 1961 the snow cover left the experimental fields on April 15th and ground frost disappeared on April 19th. Sowing was begun on May 2nd, or 10 days earlier than normal. The favorable conditions of the early part of the growing season accelerated the development of the crops. In July and August, however, heavy rainfall caused lodging of cereals and reduced their quality. In general, yields were very high in this year.

Abiotic factors affecting the overwintering of winter cereals (temperature, snow cover, ground frost, etc.) were relatively favorable during the three winters in question.

The amounts of insect pests and plant diseases varied during the three years. In the summer of 1959 aphids appeared in exceptionally large numbers. Their damage to spring cereals was apparently relatively small; however, aphids occurring on the foliage of potato plants were effective in spreading virus diseases. During the winter 1958—59 field voles caused considerable damage to winter cereal seedlings under the snow.

In 1960 there was relatively little damage by pests to crops in the experimental fields. In the autumn of 1961 voles damaged stands of clover.

Injuries to winter cereals by low temperature parasitic fungi as well as clover rot were observed in varying degrees. Such injuries were generally most severe in foreign varieties, whereas domestic varieties showed only slight fungal damage. In 1960 virus diseases were common in the potato, and in the autumn of the following year 1961 the tops and tubers of potatoes were seriously damaged by late blight.

The average numbers of trial plots used for different crops in the years 1959—61 were as follows:

Crop	no. of plots	Crop	no. of plots
Winter rye	419	Field pea	355
Winter wheat	1 615	Potato	1 382
Spring wheat	1 840	Herbage plants	1 013
Barley	2 246	Polyploids etc.	795
Oats	1 117	Others	32
		Total	10 814

Cereals

Winter rye. The main objective in breeding work on winter rye is to develop varieties in which winterhardiness is combined with a short and sturdy straw. In striving toward this ideal objective, many crosses have been made, especially between Finnish and Swedish varieties. The most promising of these crosses, line Jo 090, derived from King II (Svalöf) × Pekka (Jokioinen), is now being multiplied. Investigations on the correlation between winterhardiness and length of straw are being continued.

Spring rye. Breeding work on spring rye is being made partly with Finnish material and partly with the progeny of crosses obtained from King II winter rye and Finnish spring rye varieties.

Winter wheat. Breeding work is mainly concerned with increasing the reliability of cultivation of this crop. Numerous crossings have been made, and line selection, especially of the variety Vakka, has been carried out. The most promising of these latter lines, which have been proved to be resistant to sprouting in the head, are at present being multiplied. In the frost laboratory, investigations on the factors influencing the winterhardiness of spring wheat are being continued. A practical method has been developed for studying the resistance of winter cereal varieties to snow mould as well as determining the extent of fungal infestation in seed lots.

Winter wheat lines derived from the cross *Agropyrum* × *Triticum* have been obtained from the Soviet Union. These lines have been investigated for their suitability in Finnish cultivation and have also been used as parents for further crosses.

Spring wheat. The principal objectives in the breeding of spring wheat are earliness, strength of straw, as well as satisfactory milling and baking qualities. Since combine harvesting has become more common in Finland, the value of the early variety Apu, developed at the Department of Plant Breeding, has become very apparent. Since Finland is practically self-sufficient in terms of quantity of wheat produced, there is now a large need for spring wheat varieties of a higher quality than those being cultivated at present.

Barley. A very extensive breeding material is available, consisting of both fodder and malting barleys. Endeavours to develop varieties resistant to diseases have mainly been concentrated on the *Ustilago* loose smut. The Department has also been concerned with developing both awnless and huskless barley varieties. In addition, investigations are being carried out to determine the factors which hinder the growth of spring cereals, including barley, in the trial fields of the Department. In connection with these investigations, artificial irrigation trials have been performed.

The high-yielding fodder barley variety Paavo was put on the market in 1960.

Oats. Valuable results in breeding work on oats have been obtained, especially in regard to drought-resistance. This characteristic is very important, since dry conditions in the early summer are a common and detrimental occurrence in Finland.

Field pea

Breeding work has been concentrated mainly on green table peas. One such variety, Riitto, was put on the market in 1961. Special attention in laboratory investigations has been given to the protein content of peas.

Potato

The objectives in potato breeding are numerous and they include, in addition to quantity and quality of yield, resistance to various diseases. The cultivation of virus-free seed potatoes has been commenced. In 1961 two new potato varieties were made commercially available: the table variety Koto and the fodder and industrial variety Teho with its high yield of starch.

Herbage plants

The diploid red clover variety Jokioinen was put on the market in 1961. This variety is leafy, juicy-stemmed, and very resistant to clover rot. Sufficient amounts of seed of the Department's alfalfa variety have been produced in California since the year 1960. The breeding program of the Department includes most of the herbage crops cultivated in Finland.

Polyploids and mutations

Tetraploid rye breeding material includes both Finnish and foreign varieties. In investigations on tetraploid barley, special attention has been paid on reversion to the diploid form. The cross wheat-rye (*Triticale*) represents an attempt to combine the best qualities of both of these species. A four-year grant from the U.S.A. awarded in 1961, has made it possible to carry out breeding of tetraploid red and alsike clover on a large and efficient scale.

Mutations have developed using both irradiation and mutagenic chemicals. The X-ray mutation Balder J, a malting barley, was put on the market in 1960. It is higher-yielding than its parent variety Balder, especially under relatively poor growing conditions.

Results of the major investigations published by the Department of Plant Breeding in the years 1959—61 are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Department of Horticulture

Address: Piikkiö

Telephone: Office Piikkiö 817; Director 812

The Department of Horticulture was founded at Yltöinen governmental estate in 1927 and at present comprises 30 hectares under cultivation and approximately 50 hectares of forest. The nearest city, Turku, is located 23 kilometers away.

Departmental personnel and their special fields

Prof. Dr. Olavi M e u r m a n, director until 1. 10. 1959, acting director 1. 11. 1959 — 30. 4. 1960, then retired after being a director of the institute for 33 years. Pomology, cytogenetics. Prof. Dr. Jaakko S ä k ö, chief researcher until 30. 4. 1960, acting director 1. 5. 1960, director 26. 7. 1960—. Pomology. Prof. Dr. J. E. H å r d h, chief researcher until 31. 5. 1959. Berries, vegetables grown under glass. Dr. Arne R o u s i, acting chief researcher 1. 9. 1960, chief researcher 12. 7. 1961—. Breeding and cytogenetics of berries. Miss Kirsti S a l o k a n g a s, researcher until 30. 10. 1959, acting senior researcher 30. 10. 1959—, senior researcher 27. 2. 1960—. Vegetables. Mr. Tapio K. K a l l i o, researcher 3. 9. 1960—. Outdoor ornamentals, propagation. Miss Kirsti O s a r a, junior researcher until 31. 8. 1961. Vegetables, floriculture. Miss Lea K u r k i, junior researcher 1. 9. 1961—. Floriculture.

Except for the scientific workers mentioned above, the size of the staff was 19 persons in 1959, 20 persons in 1960, and 21 persons in 1961.

Functions of the Department

The Department of Horticulture carries out investigations concerned with the cultivation and breeding of horticultural plants.

Work in the years 1959—1961

The growing season 1959 was considerably drier than normal. A severe frost period occurred at the flowering time of the apple, destroying the yield almost completely. The mean temperature of the winter 1959—60 was ca. 2° C lower than normal, but weather conditions of the following spring and early summer were very favourable. The late fall of 1960 was unusually warm except for

a cold period in November, and the sea was open until the 9th of January 1961. Following a mild winter there was an unusually early and warm spring which made it possible to start the sowing work as early as April 20th. In July and August there was a long rainy period, including a severe storm during which a rainfall of 58.8 mm was recorded, this being the record of the three-year period.

Pomology

The frost hardiness of various apple varieties and rootstocks were studied in laboratory conditions by the exosmosis method. By using this method it was possible to classify the material in certain groups according to their hardiness. Among the rootstocks tested, the Swedish clone A 2 was found clearly more hardy than the Malling-types M II, IV and VII. The seedling stocks of the varieties Antonovka and Sugar Miron showed much better hardiness than those of Bittenfelder, Grahams Jubiläum and Normandie. These results have been checked in a field experiment in which the snow was kept off during winter.

The experiments with apple stembuilders have revealed the great possibility which this method has in improving the overwintering of tender apple varieties in the climatical conditions of Finland. Among the stembuilder varieties tested, Hiberna has proved to be the most promising. In 1960 new experiments were set up at the Department of Horticulture, Piikkiö, and at Häme Experiment Station, Pälkäne, for studying the effect of different stembuilders on the apple variety Lobo.

In the investigations concerning the chemical weed control of apple orchards, simazine and atrazine have given the best results. It was possible to entirely kill a heavy couch grass cover with a treatment of 10–20 kg/ha simazine or atrazine without causing any injuries to apple trees. Mixtures of amitrole and simazine gave a rather fast and long effect on weeds. Monuron 40 kg/ha and dalapon 42.5 kg/ha treatments injured apple trees.

In the years 1958–61 experiments were carried out on the effect of two different temperatures, -1°C and $+4^{\circ}\text{C}$, on the keeping quality of apples. The apple varieties Atlas, Kaneli, Lobo, Wealthy and Åkerö were tested. The ripening of apples progressed much more slowly at the temperature of -1°C than at $+4^{\circ}\text{C}$. At -1°C , cold injuries in apples occurred to some extent, but the total amount of injuries was very small and concerned only the varieties Wealthy and Åkerö. Gloeosporium-rot started to appear later in apples kept at -1°C than in those at $+4^{\circ}\text{C}$. This was due to the fact that the maturing of apples was retarded in the colder storage room.

Among the other research subjects can be mentioned varieties, rootstocks, fertilizing and top soil cultivation in orchard, and the raising of apple trees as hedges and as a spindlebush.

The small fruit investigations have mostly concerned varieties, growing technique, and the fertilizing of strawberry and black currant.

Propagation experiments were carried out in order to find out the value of various kinds of mist control equipment in rooting of cuttings. The use of various kinds of substrates in rooting of cuttings has also been studied.

Breeding activity

Breeding of apple was started in 1958, and has consisted of crossing ca. 3000 flowers annually. The main purpose of the various crosses was to get a hardy progeny.

Breeding of *Rubus idaeus* × *arcticus* was continued. Seedlings were raised mostly from free pollinations of F₁ and from the most promising F₂ individuals. Directed back-crosses and sib-crosses were also made. The main goal in the breeding of this species hybrid was to combine the fine aroma of *R. arcticus* with a productivity which would make a commercial growing of this plant possible. A resistance to viruses or virus-bearing aphids was also strived for. Some F₂ individuals have been propagated in order to find out their suitability for commercial growing.

In black currant, the breeding program was started with mostly inter-varietal crosses, using the Finnish variety Brödtorp as a starting point. Inter-varietal crosses were also made in hexaploid plums, in gooseberries and in strawberries. In strawberry an inbreeding program was started with some varieties as a first step in establishing pure lines for F₁ hybrid breeding.

The American highbush blueberry, *Vaccinium corymbosum* was crossed with a native Finnish strain of *V. uliginosum*. The cross gave vigorous seedlings. The purpose of this cross was to transfer winter hardiness and disease resistance from *V. uliginosum* to *V. corymbosum*.

Vegetable crops

Variety trials

Cabbage. A 3-year trial was carried out to clarify the differences between various strains of the variety Ditmarsker. The results revealed only small differences in the yield, but considerable differences in the earliness of different strains. The earliest strains were Ditmarsker orig. OE and Ditmarsker N:o 84 Vangede.

Cauliflower. In the years 1958—60 a trial was carried out with 11 different strains of the variety Erfurter. Trials were also made with various early and late cauliflower varieties. Altogether 14 varieties were represented. In the group of early varieties, Erfurter N:o 291 AH and Helios OE gave the highest total yields. Among the late varieties, Flora Blanca, Stor svensk W:s/57 and Stor dansk W:s/54 were the highest-yielding.

Brussels Sprouts. In a variety trial 12 varieties were compared, of which the new Japanese F₁ hybrid Jade, the early-yielding Kvik OE and the Toftø variety Tidlig dvärg were found to be the most recommendable.

Broccoli. In the variety trial, De Cicco was found to be the earliest, whereas Greenia OJO and Waltham N:o 29 CS gave the highest yields. Also the suitability of different varieties for deep-freezing was studied.

Red beet. Main attention was given to the suitability for canning purposes. Among the varieties with spherically-shaped roots Rubia OJO and Sigma OE were found to be the best ones, among the ones with cylindrically-shaped roots, the Danish variety Formanova LD was the most recommendable for growing.

Garden pea. In the variety trials during 1959—61, 20 varieties in all have been studied. In addition to the amount of yield, the suitability of different varieties for deep-freezing has been studied, most attention being paid to the taste, colour and firmness of the seeds. When the taste of the frozen peas was judged, Marrowärt lav N:o 59110 AH, Sigyn/58 W and Perfected Freezer were found to be the best.

Greenhouse cucumber. New F₁ hybrid varieties were compared with the variety Butcher's W:s/57, which was used as a standard. Although the F₁ varieties did not differ much in their total yield, they differed considerably in the earliness and quality of the yield. The earliest of the varieties studied was the Swedish Hammenhög variety Final. The Weibull variety Arla showed the best quality.

Greenhouse tomato. A variety trial, including new F₁ hybrid varieties, revealed that all F₁ varieties were earlier yielding than the standard variety Potentat AH 8. Most of the F₁ varieties also gave a higher total yield than the standard. On the other hand, the fruit quality in some of the F₁ varieties was inferior, the fruits being small, furrowed, and irregularly shaped in many cases.

Cultural experiments

Broccoli. The effect of planting distance on yield was studied. Of the five different planting distances used, the densest one gave the best results, the seedlings being planted in quadruple rows, at distances of 20 × 40 cm.

Cauliflower. Various pot types were compared in rearing cauliflower seedlings. The new Finn pots proved to be equivalent to the imported Jiffy-pots.

Greenhouse tomato. To promote fertilization of tomato flowers, various mechanical means to help shedding of pollen, as well as hormone sprays, were experimented with. Mechanical vibrating with a "trostriller" gave the best results.

Floriculture

Greenhouse flowers

The program of the Department of Horticulture will be expanded to include also the most important commercial flowers grow under glass, and therefore new greenhouses and storage rooms suitable for experimental purposes in floriculture are outlined. In the autumn of 1961 trials with forcing of tulip, especially of sports of cv. 'Bartigon' were started. The influence of time of planting, and the influence of forcing time on flowering was followed. With *Iris Hollandica* cv. 'Wedgwood' the influence of different treatments of bulbs on flowering was experimented. Work was concentrated around the time of flowering of carnations, tulips and Dutch irises, and the culture technique of *Asparagus* and *Adiantum* species grown as cut greens.

Outdoor ornamentals

Factors influencing thriving and particularly overwintering of woody ornamentals have been studied. In an experiment on 68 varieties of outdoor roses, their value for cultivation was studied.

Results of the major investigations published by the Department of Horticulture in the years 1959—61 are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Department of Plant Pathology

Address: Tikkurila

Telephone: Office Helsinki 83 12 58; Director 83 14 19

The Department of Plant Pathology was founded at Tikkurila in 1911 as a unit of the Institute of Agricultural and Economic Research. In 1924 it became a Department of the newly-founded state Agricultural Research Centre.

Departmental personnel and their special fields

Prof. Dr. E. A. J a m a l a i n e n, director, overwintering of plants; Dr. Miss Annikki L i n n a s a l m i, vegetable and root crops; Mr. Aarre Y l i m ä k i, clover and potatoes; Mr. Klaus A u r a, inspector of plant protection; Mrs. Eeva T a p i o, berries and ornamental plants; Mr. Pentti T a l v i a, fruit trees and storage of plants; Dr. Martti M a r k k u l a, inspector of plant protectants; Miss Katri I k ä h e i m o, spring cereals; Mr. Pekka K ö p p ä, extension work in plant protection.

Functions of the Department

The Department of Plant Pathology carries out investigations on plant diseases and methods for their control. In addition, the Department is responsible with the Plant Protection Act and for inspection of plant protection chemicals in accordance with the Act concerning plant protection substances.

Occurrence of plant diseases in the years 1959—61

Low temperature parasitic fungi have caused great losses in annual yields, especially in regions of heavy snow cover in central, eastern and northern Finland. Exceptionally severe damage was caused to timothy fields in Lapland during the winter 1960/61, and losses in hay yield were estimated to be 17.5 million kilograms. Foot rot diseases of spring wheat have steadily become more apparent and harmful during recent years in the southern and western regions of the country. The loose smut disease (*Ustilago tritici*) has appeared extensively in fields of the spring wheat variety, Apu. In 1961 barley was often found infected with ergot (*Claviceps purpurea*). In the same year the occurrence

of oat sterile dwarf virus and wheat striate mosaic virus was frequently observed. In many places in central Finland clover rot (*Sclerotinia trifoliorum*) has caused the disappearance of clover from leys. The damage caused by this disease was especially large throughout the whole country in the autumn of 1961.

In the summer of 1960 virus diseases caused injuries to potato fields. During the latter part of summer 1961 rainy weather resulted in extensive damage by potato blight (*Phytophthora infestans*). A total of 32 fields were reported to be infected with potato wart (*Synchytrium endobioticum*). The onion (*Allium cepa*) suffered considerably from onion yellow dwarf virus in some areas in southern Finland. In certain regions club root (*Plasmodiophora brassicae*) greatly hindered the growth of cabbage and swede. Frosts in the spring of 1959 injured the leaves of apple trees in many orchards. In the years 1960 and 1961 apple scab (*Venturia inaequalis*) seriously infected susceptible apple varieties. Brown rot (*Sclerotinia fructigena*) has annually caused considerable damage to certain fruit orchards. Virus diseases of raspberry have hindered the growth of the canes and resulted in large losses in yield. Tomatoes grown under glass have generally been infected with virus diseases, and in some places much damage has occurred. Imported tulip bulbs have often been found to be injured by unduly high temperatures during storage or transportation.

Work in the years 1959—61

Numerous trials and experiments have been carried out in the field, in greenhouses and in the laboratory.

A total of 1308 samples of diseased plants sent by farmers were examined by the Department and the farmers given advisory aid.

Test to determine the effectiveness of plant protectants were carried out on 189 compounds. Of these, 47 were approved during the years 1959—61.

Inspection of imported and exported plant materials in accordance with the Plant Protection Act was carried out at various ports. Likewise, nurseries were inspected and measures taken to control the potato wart disease.

Research workers from the Department gave a total of 47 lectures and courses concerning plant protection measures. An instructor in extension work, acting in cooperation with agricultural and horticultural organizations, was in charge of instructional and advisory activities in the field of plant protection.

Main results of studies in the years 1959—61

Extensive trials have been carried out in various parts of the country of low temperature parasitic fungi. Good results have been obtained with winter rye, winter wheat and clover when the stands were treated with fungicides during the latter part of the autumn. In some trials it was found that certain

winter-resistant Finnish varieties of winter rye had become susceptible to snow mould, a phenomenon apparently due to the fact that these varieties had become crossed with other susceptible varieties (JAMALAINEN, E. A. 1961: The problem of purity of rye varieties in the light of overwintering studies. Year-book of the Agricultural Research Centre XV: 95—100).

The variations in overwintering of winter turnip rape from year to year have been found to be due to injuries from water, from winter frosts during winters of light snow cover, and from low temperature parasitic fungi in winters of abundant snow. The latter group of injuries can be prevented by treating the stands of winter turnip rape with PCNB fungicides during late autumn (JAMALAINEN, E. A. & HAAVISTO, M. 1959: Tests on the control of low temperature parasitic fungi in winter turnip rape by treatment of stands with fungicides. J. Scient. Agric. Soc. Finl. 31: 38—44). In coniferous nurseries extensive damage to spruce seedling was caused by *Herpotrichia nigra* and to pine seedlings by *Phacidium infestans*. Trials showed that these diseases can be controlled by PCNB treatment in late autumn (JAMALAINEN, E. A. 1961: Damage by low temperature parasitic fungi in coniferous nurseries and its chemical control. Silva Fenn. 108: 1—15.)

The frequent severe frost damage to fruit orchards in Finland is due to cool and rainy autumns, during which sudden and severe frosts are common. Under such conditions fruit trees as well as other susceptible woody plants have not been able to become winter-hardened (JAMALAINEN, E. A.: Vinterskador som begränsande faktor vid fruktodling i Finland. Nord. jordbr. forskn., suppl. I, 1960: 294—297.)

As a result of heavy damage to oats in this country in the years 1954—56, cereal virus studies were begun in order to determine the reason for the damage. The studies showed in 1959 that the bird cherry aphid (*Rhopalosiphum padi*) was able to transmit the barley yellow dwarf virus and the leafhopper (*Calligypona pellucida*), the wheat striate mosaic virus (IKÄHEIMO, K. 1962: Two cereal virus diseases in Finland. J. Scient. Agric. Soc. Finl. 32: 62—70.) In the following year 1960 it was found that the leafhopper was also able to spread the oat sterile dwarf virus (IKÄHEIMO, K. 1961: A virus disease of oats in Finland similar to oat sterile-dwarf. J. Scient. Agric. Soc. Finl. 33: 81—87).

It has been shown in preliminary studies of raspberry viruses that virus diseases constitute the principal reason for the poor yield of raspberries in Finland as in many other countries (TAPIO, E. 1961: Virus diseases on raspberry. Publ. Finn. State Agric. Res. Board 184: 1—21). The following are the most common raspberry virus diseases in Finland: raspberry vein chlorosis, raspberry vein banding, raspberry yellows, and raspberry mosaic caused by different viruses. Vectors of raspberry viruses are common in Finland, the aphids *Amphorophora rubi* (= *Nectarosiphon idaei*) and *Aphidula* (*Aphis*, *Doralis*) *idaei* occurring throughout the whole country and the leafhopper *Macropsis fuscula* occurring in the southern and central parts.

Studies on vegetatively reproducing onions have been concerned with the effect of storage temperature on inflorescence initiation, bulbing and final flowering. It was found, among other things, that both low temperatures (0° C and below) and high temperatures (above 20° C) during storage prevented inflorescence initiation and delayed bulbing in set onions.

Gloeosporium album and *G. perennans* were determined to be the most important causal agents of apple rot during storage in 20 apple varieties from 17 localities in Finland. All of the apple varieties investigated were found to be susceptible to *Gloeosporium* rot, although there were distinct differences in the susceptibility of certain varieties to one or another of the two species (TALVIA, P. 1960: Various species of *Gloeosporium* in stored apples in Finland. J. Scient. Agric. Soc. Finl. 32: 239—246).

Results of the major investigations published by the Department of Plant Pathology in the years 1959—61 are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Department of Pest Investigation

Address: Tikkurila

Telephone: Office Helsinki 83 12 03; Director 83 12 74

The Department of Pest Investigation was founded in 1898. It was originally located at the agricultural entomological laboratory of the University of Helsinki until 1910, at which time it obtained its own laboratory along with the Institute of Agricultural and Economical Research, at present located at Tikkurila. It remained as a unit of the University until 1924, at which time it became a separate department of the Agricultural Research Centre.

Departmental personnel and their special fields

Prof. Dr. Veikko Kanervo, director, various fields of pest investigation; Dr. Niilo Vappula, horticultural pests; Mr. Osmo Heikinheimo, cereal pests, leafhoppers and aphids; Mr. Svante Ekholm, inspection of plant protectants; Dr. Martti Markkula, pests of clover and other legumes, inspection of plant protectants; Miss Katri Tiittanen, pests of cereals and root crops; Mrs. Anna-Liisa Varis, pests of vegetables and root crops; Mr. Pehr Ekblom, pests of wooden structures, dwellings and storehouses; Mr. Aulis Tinnilä (1959—60), nematodes, inspection of plant protectants; Mr. Mikko Raatikainen, cereal pests; Mr. Arvo Myllymäki, rodents; Mr. Pekka Köppä, advisor in plant protection in cooperation with the Department of Plant Pathology; Mr. Osmo Roivainen (1960—61), nematodes.

Functions of the Department

The Department of Pest Investigation carries out investigations on insects and other animals causing damage to cultivated plants, stored products and wooden structures, and performs field tests concerned with the control of these pests. In addition, the Department inspects plant protectants in accordance with the regulations of the State Plant Protection Act, as well as carrying out advisory and educational work in the field of plant pest control.

Work in the years 1959—61

The principal biological investigations and control trials carried out in 1959, 1960 and 1961 are presented in the following table:

	Biological investigation			Control trials					
				in the field			in the laboratory		
	1959	1960	1961	1959	1960	1961	1959	1960	1961
1. Pest of cereals	3	2	3	6	—	1	—	—	—
2. „ „ herbage plants	4	3	3	3	5	4	2	4	—
3. „ „ vegetables and root crops	2	1	1	19	22	26	14	9	16
4. „ „ oil crops	—	—	—	3	—	4	6	2	8
5. „ „ fruit trees	—	—	—	8	2	9	2	—	—
6. „ „ berries	—	1	1	6	6	3	1	2	3
7. „ „ greenhouses	—	—	—	3	10	20	—	—	—
8. „ „ dwellings warehouses, farm buildings	—	—	—	5	5	2	7	6	3
9. Rodents	1	1	1	7	5	3	—	—	—
Total	10	8	9	60	55	72	32	23	30

Official tests in accordance with the Plant Protection Act were made in 1959 on 120 compounds (35 species of test insects), in 1960 on 126 compounds (39 species of test insects), and in 1961 on 120 compounds (47 species of test insects). — The Department made health inspections in 1959 on 108 lots, in 1960 on 124 lots and in 1961 on 150 lots of plant material for export, as well as examined sugar beet fields in Denmark intended for production of sugar beet in Finland.

A total of 86 publications in 1959, 99 publications in 1960 and 70 publications in 1961 were made by members of the Department, of which about one-fifth were scientific papers.

Occurrence of plant pests

In 1959 the most damaging pests occurring on cultivated plants were the following: on cereals *Rhopalosiphon padi*, *Oscinella frit* and *Frankliniella tenuicornis*; on clover *Apion apricans* and *Apion assimile*; on peas *Laspeyresia nigricana*; on cabbage, swede and turnip *Hylemyia brassicae* and *H. floralis*; on sugar beet *Lygus rugulipennis* L. spp., *Aphis fabae* and *Pegomyia hyoscyami*; on onion *Hylemyia antiqua* and *Eumerus* sp.; on fruit trees *Metatetranychus ulmi* and *Argyresthia pruniella*; on berry bushes *Incurvaria capitella*, *Eriophyes ribis*, *Aphididae* and *Tarsonemus pallidus*.

In 1960 pest damage was somewhat less severe than in the previous year. The following pest species caused the most injury: on vegetables and root crops *Hylemyia brassicae*, *H. floralis*, *Chaetocnema concinna*, *Aclypea opaca*, *Lygus rugulipennis* L. sp., *Pegomyia hyoscyami*; on onions *Hylemyia antiqua* and *Eumerus* sp.; on turnip rape *Meligethes aeneus*; on fruit trees *Laspeyresia pomonella* and *Argyresthia conjugella*; on berry bushes *Incurvaria capitella* and *Eriophyes ribis*.

In 1961 the most damaging species were: on cereals *Rhopalosiphon padi* and *Calligypona pellucida*; on peas *Sitona lineata* and *Laspeyresia nigricana*; on vegetables and root crops *Hylemyia brassicae*, *H. floralis*, *Aclypea opaca* and

Pegomya hyoscyami; on turnip rape *Meligethus aeneus* and *Ceuthorrhynchus assimilis*; on fruit trees *Metatetranychus ulmi* and *Laspeyresia pomonella*; on berry bushes *Incurvaria capitella* and *Eriophyes ribis*.

Main research results in the years 1959—1961

Cereal pests. In 1959 and 1960 the damage caused by the leafhopper (*Calligypona pellucida* Fabr.) was light, but in 1961 severe injury again occurred. Investigations on the biology of this species have been concerned especially with its host plants and population dynamics. The effect of crop rotation on the abundance of leafhoppers was studied on 13—17 different farms; it was found that continued and intensive establishment of timothy leys with spring cereal nurse crops promoted the increase of leafhoppers. Studies were also made on the natural enemies of leafhoppers and on the effect of climatic factors. These investigations have shown that the damage caused by the leafhopper in Finland is mainly due to its transmission of the oat sterile dwarf virus disease and to a lesser extent the wheat striate mosaic virus; in addition, the toxic effect of the saliva of the insect also can cause injury. Two other species of leafhopper (*C. sordidula* and *C. obscurella*) were found to transmit viruses of oats. The results have in part been published (RAATIKAINEN, M. & TINNILÄ, A. 1959; RAATIKAINEN, M. 1960).

In control trials on the frit fly (*Oscinella frit*) in winter rye, good results were obtained on the larvae when granulated pyrazinyl phosphorothioate and forate were spread on the soil and tilled in to a depth of 5—6 cm just before sowing. Some of these results have been published (TIITTANEN, K. 1959).

In 1959 the bird-cherry aphid was a very injurious pest especially on oats and barley (RAATIKAINEN, M. and TINNILÄ, A. 1960). Complete control of this pest was obtained by spraying with parathion, malathion or methyl demeton, and good results were also acquired with other preparations.

Pests of red clover and other legumes. Investigations were completed on the biology of *Sitona* species (MARKKULA, M. 1960), including the effect of ecological factors on its oviposition (MARKKULA, M. & ROIVAINEN, O. 1961) and a detailed analysis of the species of *Sitona* on field legumes (MARKKULA, M. & KÖPPÄ, P. 1960). During the years 1959—61 an extensive investigation was undertaken throughout the entire country on the abundance and distribution of red clover seed pests. Preliminary results from the first year's research were published (MARKKULA, M. 1959), and also experimental data from the year 1936 were analyzed (MARKKULA, M. & VALLE, O. 1959). Studies on the biology of the seed pests *Phytonomus meles*, *Apion trifoli* and *Coleophora deauratella* were completed. The results of the latter species were published (MARKKULA, M. & MYLLYMÄKI, S. 1960). *Dasyneura gentnerii* was established as being a new seed pest of white clover. Control trials of seed pests were continued.

The clover stem nematode (*Ditylenchus dipsaci*) was found at several new localities in South Finland. Extensive trials have been carried out to determine the resistance of different clover varieties and strains to nematodes. Several control trials against this pest have also been successfully performed.

Pest of vegetables and root crops. Control trials of the cabbage root fly were continued by insecticide treatment of seeds and seedlings. Seed treatment with compounds containing chlorinated hydrocarbons gave protection to cabbage seedlings in frames and during the early part of their growth on the field, but the effect stopped by the middle of the summer. Very good results were achieved by dipping the roots of seedlings in a 2.5 % solution of dieldrin. Trials indicated that seed encrustation with lindane-thiram could be recommended for crucifer forage crops such as swede, turnip, etc. This treatment, however, did not provide protection against larvae appearing at the end of the summer (TIITTANEN, K. 1959; VARIS, A.-L. 1960; TIITTANEN, K. & VARIS, A.-L. 1961 a and b).

Pests of onions (*Hylemyia antiqua*, *Eumerus tuberculatus* and *E. strigatus*) were found to be most satisfactorily controlled by preparations of aldrin or dieldrin, either used as seed treatment or in the form of dipping solutions for onion sets. Even after six years of use, there was no evidence of larval resistance to these compounds. The carrot fly (*Psila rosae*) was effectively controlled by seed treatment with lindane-thiram preparations; this treatment can be recommended for carrots to be consumed in the autumn or winter. Part of the results have been published (KANERVO, V. 1959).

In control trials of the mangold fly (*Pegomyia hyoscyami*) good results were obtained by spraying with the new compounds mercaptofos, dimecron, alkylphosphonate and dimethoate. Granular phosphorothioate and forate were effective when used at the first appearance of the flies.

Pests of fruit trees. The best control of the fruit three red spider mite (*Metatetranychus ulmi*) was achieved when combined preparations, especially malathion + fenison or malathion + keltan, were sprayed at the beginning of August.

Investigations on voles (*Microtus agrestis*, *M. arvalis* and *Arvicola terrestris*) were concerned with variations in numbers of voles, their reproduction, mutual competition and choice of food plants. It was found that the *Microtus* species were definitely selective in their choice of available food plants. Even a relatively small vole population can cause an appreciable decrease in the protein yield of leys, since they preferably feed on plant parts of high in protein. The different vole species were found to be competitors in the trial ley field consisting of red clover and four grass species. Part of the results have been published. (MYLLYMÄKI, A. 1959).

Results of the major investigations published by the Department of Pest Investigation in the years 1959—61 are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Department of Animal Husbandry

Address: Tikkurila

Telephone: Office Helsinki 83 13 08; Director 83 20 25

The Department of Animal Husbandry was founded at Helsinki in 1923, and in 1925 it was transferred to its present location at Tikkurila.

Departmental personnel and their special fields

Prof. Dr. Orvo Ring, director 1959—1960, nutritional chemistry; Prof. Paavo Kajanoja 1960—61 (†); Dr. Mrs. Irja Uotila, animal management and feeding; Mr. Martti Lampila, nutritional physiology and microbiology; Mr. Olli Tuomisto (1959), Mr. Henrik Furstenborg (1959—1960), Mr. Jaakko Mäkelä (1960—1961), Mrs. Eeva Larpes (1959—), Mr. Tuomo Kiiskinen (1961—) and Miss Maija-Liisa Syvälahti (1961—), animal management and feeding.

Functions of the Department

The Department of Animal Husbandry carries out investigations concerning animal management and feeding. Digestibility trials, some of the feeding trials, as well as chemical and bacteriological analyses are performed in the departmental laboratories, whereas the remainder of the feeding trials as well as other trials are carried out on large farms, such as the State agricultural school farms and experimental stations. The activities of the Department have been somewhat hampered by numerous changes in personnel.

Work in the years 1959—61

The following projects were under investigation by the Department between 1959—61:

1. Micro-organisms of the rumen and their action in decomposition.
2. Production of silage in towers and trench silos.
3. The need for supplementary forage for dairy cattle during the grazing season.
4. Mineral nutrition of grazing cattle.
5. Effect of horsetail (*Equisetum palustre*) on the health and milk production of cattle.

6. The use of whey concentrate as cattle fodder.
7. Production of beef.
8. The relation between intensity of feeding and milk production.
9. Alkali-treated straw.
10. Feeding trials on poultry.
11. Comparative feeding trials on mink (in cooperation with the Fur Breeders' Association).

Micro-organisms of the rumen

One of the subjects of investigation on the micro-organisms of the rumen and their activity concerned the synthesis of protein. In these studies it has been found that the concentration of ammonium in the rumen is closely dependent upon the ammonium content of the silage, especially in the case of silage treated with ammonium bisulphate. Investigations have also been made on the ammonium content of the rumen during the grazing season. (Published in English in J. Sci. Agr. Soc. Finl. 1960, 32: 169—175.)

Silage

In June 1959 a mixture of clover-timothy (dry matter 21.2 %; crude protein in dry matter 18.1 %) was ensilaged by four different methods: AIV acid, AIV salt (ammonium bisulphate), Calcifor-salt (calcium formate + sodium nitrite) as well as untreated (no preservative). Results were as follows:

	pH	NH ₃ -N % of total N	Butyric acid
AIV acid	3.75 — 4.05	4.2 — 5.6	0
AIV salt	3.90 — 4.10	22 — 34	0
Calcifor-salt	4.00 — 4.15	4.7 — 7.7	0
Untreated	4.45 — 4.75	13.4 — 14.0	0

In June 1960 a similar trial was performed on clover-timothy having 15.0 % dry matter and 16.5 % crude protein in the dry matter. Results of this trial were as follows:

	pH	NH ₃ -N % of total N	Butyric acid
AIV acid	3.10 — 3.75	2.3 — 2.7	0
AIV salt	3.77 — 3.97	22 — 25	0
Calcifor-salt	4.00 — 4.25	6.4 — 6.5	0
Untreated	4.45 — 5.25	12.0 — 17.5	0 — 0.35 %

In the autumn of 1959 three methods were used to ensilage sugar beet tops in a trench silo: at one end 20 tons of AIV salt silage were made, at the other end 20 tons of Calcifor silage, and in the center 20 tons of untreated silage. The pH of all the silages was under 4.0 and no butyric acid was formed.

In the autumn of 1960 AIV salt (1.25 kg/ 100 kg) was used in a trench silo to preserve clover-timothy aftermath in two forms: in one end of the silo was the usual mown aftermath and in the other end the aftermath was crushed. Both forms of silage succeeded well; the pH of both was below 4.0 and they were eagerly eaten by the cattle.

Mineral nutrition of grazing cattle

Results of these studies have been published in J. Sci. Agr. Soc. Finl. 1959, 31: 149—161 (English summary).

The use of whey concentrate as cattle fodder

In Finland over 200 million kilograms of whey are obtained annually as a by-product in cheese manufacture. Since not all of it can be fed as such to domestic animals and since it cannot be stored, the artificial drying of whey, principally into the form of a powdered concentrate, has been begun in recent years. Investigations have shown that powdered whey concentrate is a good fodder for milk cows and can be used at a rate of 2 kg daily per animal. The feed value of whey is 1.25 feed units per kg of dry matter.

Production of beef

Trials on beef production were begun in the autumn of 1960. In one trial there were 12 male calves from each of five Ayrshire bulls or a total of 60 calves. Half of these were given concentrated feeding and were slaughtered as fattened calves at the average age of 153 days. The remaining half were fed on a less concentrated diet and were slaughtered at the age of about 1 ½ years.

In the second beef production trial there were 20 male calves of Ayrshire cattle and 20 of Finnish cattle. After one year 5 Ayrshire and 4 Finnish yearling bulls were slaughtered. Five additional Ayrshire and four Finnish cattle bulls were given concentrated feeding for 3 months before slaughtering, and the remaining 20 bulls were slaughtered at the age of two years. (Results are published in the yearbook of the Agricultural Research Centre 1962, XVI: 179—194.)

Alkali-treated straw

Attempts were made in these trials to develop a method where by a smaller amount of alkali and water is required than in the Beckman method. Alkali-treated straw which was ensilaged with AIV salt was found to be more palatable than that prepared without the salt. Its palatability was approximately the same as that of silage prepared from grass.

Feeding trials on poultry

Feeding trials on poultry have been principally concerned with determining the effects of various feeds and management practices on the growth of chicks and on the egg production of laying hens. In 1961 trials on broilers were begun; in these trials, comparisons were made between the breeds White Leghorn and White Rock as well as their crosses. (Results are published in the yearbook of the Agricultural Research Centre 1962, XVI: 195—205.)

Feeding trials on mink

In the mink feeding trials various feed mixtures have been used consisting of different kinds of frozen fish and slaughter wastes as well as fish preserved with different preservative agents. In addition, trials have been made with fresh bone meal and animal fats.

The major investigations published by the Department of Animal Husbandry in the years 1959—61 are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Department of Animal Breeding

Address: Tikkurila

Telephone: Office Helsinki 83 19 01; Director 83 12 44

The Department of Animal Breeding was founded at Helsinki in 1923 and was transferred in 1925 to its present site at Tikkurila.

Departmental personnel and their special fields

Prof. Dr. Viljo Vainikainen, director, various fields of animal breeding; Dr. Mikko Varo, various fields of animal breeding; Mr. Kalle Majala, poultry, blood group investigations; Mrs. Hilikka Ruohomäki, small domestic animals; Mr. Antti Säisä (3/4 year), small domestic animals.

Functions of the Department

The Department of Animal Breeding carries out investigations concerned with the breeding of farm animals.

Work in the years 1959—61

The following investigations were in progress by the Department in the years 1959—61:

I. Cattle

1. Mechanical progeny testing of bulls.
2. The use of average yield results in calculating relative bull breeding values.
3. The significance of elimination of daughters in bull progeny groups.
4. Protein content of milk.
5. Investigations on beef cattle.

II. Horses

1. The dependability of horse draught trials.

III. Sheep

1. Crossing of Lincoln and native breeds of sheep.

IV. Pigs

1. Reasons for variations in thickness of back fat.
2. Investigations on the inheritability of various characteristics of pigs.

V. Poultry

1. Possibilities of breeding poultry for viability.

VI. Blood group investigations

Carried out since April 1961 on a grant from the U.S.A.

Cattle

Using the punch card system, daughter evaluations (based on the results from at least 10 daughters) were made on 2210 bulls in the recording year 1957/58, on 3151 bulls in the year 1958/59, and on 2557 bulls in the year 1959/60.

The use of average yield results in calculating relative bull breeding values. Acta Agr. Fenn. 94, 19.

The standard method used by the Department of Animal Breeding for evaluating bulls, in which the average yield results are used to obtain the relative production of progeny groups, was found to be the most suitable method under Finnish conditions for determining the value of bulls.

The significance of elimination of daughters in bull progeny groups. Publications of the Finnish State Agricultural Research Board No. 179.

The experimental material consisted of 4, 5, and 6 year old daughter groups of 47 Ayrshire bulls from the recording years 1955/56 — 1957/58. Between the 4th and the 5th years of age, an average of 10.1 % of the progeny of the entire experimental material were naturally eliminated, and between the 5th and the 6th years an average of 13.8 %. The correlation of elimination percentage calculated for the bulls was $+ 0.380 \pm 0.125$ and shows that natural elimination was generally continually more vigorous for some of the progeny groups whereas for other groups it was generally weaker. The relative production of the vigorously eliminated progeny groups was poorer than that of the more weakly eliminated groups. The differences were statistically significant.

The protein content of milk in the cows investigated was not found to change significantly as the age of the animals increased. It was found that the percentage amounts of the various constituents of milk were greatly dependent upon inherited factors.

At the present time there is no satisfactory method of milk protein content determination which would be suitable for cattle raisers. The determination of

milk dry matter, however, could successfully be carried out on a large scale.

Investigations on beef production were begun in the autumn of 1960. On the basis of preliminary trials it was found that there were apparent differences in the pattern of growth among the progeny of different bulls. Such differences in growth, however, become apparent only when the feeding corresponds to the appetite and the growth pattern of the animals. Variances in the external conditions during the early phases of growth hindered to some extent this short-time trial.

Horses

The dependability of horse draught trial (Acta Agr. Fenn. 94, 18). On the basis of the internal correlation between fathers, the inheritability of the draught trial results of the sons was calculated to be 0.14 for 4 year old horses and 0.24 for 5 years old horses. The average result of 0.18 corresponds to the previous value of 0.17.

Sheep

Crossing trials which were begun in 1956 between the Lincoln breed and the native Finnish breed have been continued. The purpose of these trials is to study the effect of the crossings on the quantity and quality of the wool and meat. Special attention was paid to the numbers of lambs. Because of the small amount of experimental material, the dependability of the results has suffered to some extent. However, an increase in the quantity of wool of the crosses became evident. This trial is being continued in the F₂ generation in order to study heterosis and variations.

Pigs

In 1959 investigations were begun at the Pig Husbandry Experiment Station in order to determine the reasons for variations in thickness of back fat. The share of inherited factors in this variable was found to be 58 % in male piglets and 73 % in female piglets, or an average of nearly 66 %.

The Department has collected data on punch cards from all the strain trials at the Pig Husbandry Experiment Station since the year 1926. The data consisted of both individual progeny results and average results from different groups, the latter of which were analyzed factorially. A total of 18 different tests were used on the trial groups, and as a result three factors were determined: 1. Fat factor, measured in the region of the shoulder; 2. growth factor, determined by the live weight of the animal; and 3. muscular or form factor, determined by the thickness of the back fat. The correlation of the combined variables between the results of the best tests and all the other tests was 0.72.

Poultry

Investigations are being continued on the possibilities of breeding poultry for viability and productive ability.

Blood group investigations

The principal work in the blood group investigations up to the present time has been concerned with the preparation of test serums. Fourteen specific serums were obtained as well as several valuable crude serums. In addition, a successful start was made in collecting blood samples for heredity studies. The latter studies have been restricted mainly to developing plans for the experimental work.

Results of the major investigations published by the Department of Animal Breeding in the years 1959—61 are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Southwest Finland Agricultural Experiment Station

Address: Hietämäki

Telephone: Turku 50 913

In 1927 a plant husbandry and horticultural experiment station was founded at Piikkiö and in 1935 it became the horticultural station of the Agricultural Research Centre. A number of plant husbandry trials were carried out at the station until the year 1956. During the years 1955—58 temporary field trials were carried out in southwest Finland, and in 1959 the present agricultural experiment station was established at Mietoinen. The station is situated 33 km from the nearest city, Turku, and is a latitude of 60° 38' N.

The station comprises 60 hectares of cultivated land, 33 hectares forest and 17 hectares of another type, or a total area of 110 hectares. The predominant soil types are heavy clay and muddy clay.

Personnel

The directorship of the station was held by Mr. Osmo Perttula between 1. 1. — 30. 6. 1959 and by Mr. Jaakko Köylijärvi between 1. 7. 1959 — 31. 12. 1961.

Fields of investigation

In the field of agricultural physics the station is primarily concerned with problems of tillage of clay soils. Cultivation of cereals and seed production of herbage crops also make up an important share of the investigations of the station. Meat production trials include raising trials of calves in which different breeds and feeding practices are compared.

Work in the years 1959—61

Since the station was established in 1959, the experimental work in this years was carried out under deficient conditions. Among other deficiencies, all the fields were drained by a poor system of open ditches, the buildings were in poor condition, and there was a lack of suitable equipment. This during the years 1959—61 the station was in the phase of establishment and organization.

By the year 1961 a satisfactory amount of machinery and equipment had been obtained. Underground drainage was begun in 1959 and has been continued annually; at the present time one-third of the fields have underground drains. Extensive repairs of the buildings have been made, with the result that the station has adequate office and laboratory space, threshing facilities, and a special barn for trials on raising of beef cattle. Thus the external material conditions for carrying out experimental work have been considerably improved during the years 1959—61.

The following numbers of trials have been carried out at the station:

	1959	1960	1961
soil improvement and fertilization trials	19	17	27
soil tillage trials	1	2	3
cultivation technique trials	2	6	13
variety trials	17	21	23
plant disease trials	4	3	3
insect pest trials	1	1	2
Total	44	50	71

In the years 1960—61 endeavours were made to begin trials concerned with the special fields of investigation of this station. Three soil tillage trials, for example, were in progress in 1961. Cereal cultivation trials have been concerned primarily with nitrogen fertilization, weed control and comparisons of different varieties. Seed production trials of cocksfoot have also been started.

In 1960 the first group of Ayrshire and Finnish breed calves was procured; they were used for trials on meat production. In the following year a second group of calves was obtained for further trials. Feeding trials have been carried out according to a plan provided by the Department of Animal Husbandry.

A new method for harvesting cereals on the trial plots was put into use in 1961. The stands of cereals were left until they had reached the stage of ripeness for combine harvesting. They were then cut with a mowing machine mounted on a small tractor to which was attached a sheet-metal box for collecting the grain. The grain was transported in sacks to the threshing room and threshed immediately. This method corresponds closely to combine harvesting and makes it possible to perform observations on the cereal stands during the latter phases of their ripening as well as to determine the moisture content and the extent of sprouting in the heads.

Principal results

Since most of the experimental series were not begun until 1960, only few final results have so far been obtained. However, some trials were started

already in the years 1955—58 or even earlier at Piikkiö, and from these it is possible to draw reliable conclusions and compile reports.

Fertilization trials

During the years 1955—61 a total of 15 trials were carried out in southwestern Finland on the application of varying amounts of nitrogen on grass-dominated leys. The amounts used were 0, 50, 100, 150 and 200 kg N per hectare, applied in the form of ammonium nitrate (25 % N). The results clearly showed that under the conditions in southwestern Finland 100 kg/ha N is a suitable rate for grass leys, but that larger amounts of nitrogen only rarely give profitable yield increases. In those cases where clover grew in the ley, its share was decreased by nitrogen application. The crude protein content of the hay was definitely increased by large dressings of nitrogen. When an amount of 100 kg/ha or more of nitrogen was applied in the spring, it was found in the years 1960—61 to cause an increase also in the yield of the aftermath.

Cultivation technique trials

Most of the cultivation technique trials were not begun until 1960, and thus few results have as yet been published. However, chemical weed control trials have given practical results. It was found that all of the chemicals used in these trials gave profitable yield increases. Compounds of MCPA proved to be suitable general herbicides in cereal fields. Scentless mayweed was effectively controlled by preparations containing 2,4-D or MCPP. Galium was eradicated by sprays of MCPP or MCPA + TBA and *Stellaria media* by MCPP sprays. According to these trials, MCPB herbicides can safely be used in leys containing clover.

Variety trials

Of the winter cereals generally only domestic varieties have been found to be sufficiently reliable and winter hardy under the conditions in southwestern Finland. On the basis of the trials carried out at this station, recommended rye varieties are Pekka and Visa and winter wheat varieties Varma, Vakka and Antti. In areas well suited for winter wheat cultivation, the high-yielding and very strong-strawed Swedish varieties Ertus and Odin can also be recommended.

Among spring wheat varieties the Norwegian Norröna was found to be undemanding and earlyripening, yet high-yielding. Its deficiencies are a rather weak straw and a low protein content. The cultivation of this variety has rapidly increased in Finland in recent years. The Swedish variety Svenno is high-yielding, demanding and strong-strawed, but it ripens late. It can be

successfully grown in southwestern Finland on fertile fields in good condition. The variety Touko from Jokioinen has also proved to be a valuable spring wheat variety. It gives high yields, has a strong straw and is earlier and less demanding than Svenno. The most early variety Apu has likewise given satisfactory results in these trials.

In variety trials on barley, Balder and its mutation Balder J developed at Jokioinen were found to be suitable malting barley varieties. Among the other two-rowed varieties the Swedish Ingrid and Foma gave slightly higher yields, but an insufficient number of trial results have been obtained from these varieties. The new variety Paavo from Jokioinen is a suitable forage barley, and likewise Otra from Tammisto has given good results, being higher-yielding than its predecessor Tammi.

The oat variety Sisu has been the highest-yielding of all the varieties tested, and especially on clay soils it has produced superior yields. The strong-strawed Dutch variety Pendek has given good results on muddy clay soil, but on heavy clay soil and especially in dry years it has not grown so well. Of the new lines Ta 5794 appears to be a very promising variety of oats.

According to potato variety trials, the following old varieties can be recommended for cultivation in southwestern Finland: Ostbote, Alfa, Aquila and Olympia. Of the new varieties, Lori and Amyla from Germany as well as Record from Holland can be recommended. On the other hand, Koto and Teho, developed at Jokioinen, appear to be less suitable for southwestern Finland. In the trials carried out in 1960—61 the Dutch variety Barima gave a very high and early yield. Not until 2—3 weeks later did the varieties Jaakko and Siikli give an adequate yield at the early lifting. Virus diseases were found to reduce the yields of certain susceptible potato varieties considerably.

Publications of results from trials carried out at the Southwest Finland Experiment Station during the years 1959—61 can be found in the year-books of the Agricultural Research Centre, numbers XIV, XV and XVI.

Satakunta Agricultural Experiment Station

Address: Peipohja

Telephone: Kokemäki 63 420

The Satakunta Agricultural Experiment Station was founded in 1929. It is situated at a latitude of 61° 17' N. and a longitude of 22° 14' E. The total area of the station is 123 hectares, of which 34 is cultivated land. The principal soil types are sand and silt.

Personnel

The director of the station is Mr. Pentti Teittinen. In addition, six technical workers are employed.

Fields of investigation

Special fields of investigation include studies on cereals, ley crops and sugar beets. In connection with such projects, honeybees are also studied in the near future.

Work in the years 1959—61

During this three-year period a total of 87 field trials were successfully carried out. They can be grouped as follows:

Soil improvement and fertilization	37
Tillage	1
Cultivation technique	9
Variety trials	27
Plant disease control	8
Pest control	1
Others	4

In a six-year sugar beet fertilization trial (1947—59) the highest yields were obtained by applications of 1200 kg/ha nitrate of lime, 1500 kg/ha superphosphate and 900 kg/ha 40% potassium chloride. When heavy applications of nitrogen were made on sugar beets, the yields of cereals in the following

year were increased. Further, if this cereal was a nurse crop for clover-grass ley, the effect of the nitrogen was seen in a decrease in the clover content of the ley (Maatal. ja koetoim. XV: 213—222).

In trials begun in 1946 on the establishment and annual fertilization of clover-dominant leys, it was found that nitrogen caused yield increases in the ley but that only the amount of timothy had risen while that of the clover had decreased. The greatest depression in amount of clover was produced by 40 tons/ha of farmyard manure given to the nurse crop as well as 20 kg/ha nitrogen (Koetoim. ja käyt. 16: 1).

Soil fertility analyses of the station fields were last performed in 1959. Because of the present high fertility state of the fields, applications of phosphorus or potassium do not generally give yield increases.

The use of sand (200 m³/ha) to melt the snow cover in 1960 resulted in a yield increase of sugar beets amounting to 10 0/0, even though the treated area was not ready for spring sowing before the untreated (Acta agr. fenn. 98: 132—133).

Moisture analyses of cereal grains during the period of ripening showed that there were no essential differences in the changes in moisture content in comparison to those occurring in South Finland, with the exception that these changes took place later. Therefore, the growing time of cereal varieties grown in Satakunta should be about one week shorter than that of the varieties cultivated in the southern regions of the country (Koetoim. ja käyt. 18: 27).

In studies on bumblebee occurrence carried out in the years 1959—61 the species *Bombus distinguendus* was found to be most common. The seed yield of clover varied in correlation to the number of bumblebees.

According to results from variety trials, the following cereal varieties are recommended for cultivation in the region of the station: rye: Toivo, Pekka and Visa; winter wheat: Varma, Vakka and Antti; spring wheat: Norröna, Apu, Tammi and Diamond; barley: Balder, Oтра and Paavo; oats: Eho, Kyrö, Pendek and Sisu.

Control trials against low-temperature parasitic fungi in winter wheat and red clover were carried out during the three years of this report, but they did not give definite results because of the lack of fungi. In the eastern parts of the province, however, where the snow cover is heavy, such fungi were very abundant in winter cereals in the spring of 1961 (Koetoim. ja käyt. 19: 16).

In 1961 an investigation was started in order to compare non-drained and underdrained fields. In the spring the non-drained field was ready for sowing one week later than the drained field. In the autumn the ground of the non-drained field was so soft that it was impossible to use harvesting equipment on it. The yield from both fields was found to be approximately the same.

The most important publications by the station are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Karelia Agricultural Experiment Station

Address: Anjala

Telephone: Anjala 107

The Karelia Agricultural Experiment Station was founded in 1931 in the Antrea parish, but because of territorial cessions as a result of the war it was transferred in 1945 to its present site at Anjala. The station is located near the city of Kotka about 1 km west of the Kymijoki River and is at a latitude of 60° 42' N. A total of 82 hectares belong to the station, of which about 38 hectares are on cultivated land. The main soil types of the fields are very heavy clay and silty clay.

Personnel

The director of the station during the 1959—61 has been Mr. H. Meurman. The number of other workers each year has been about 7.

Fields of investigation

In addition to investigations related to practical farming in the local region, the station also carries out trials concerned primarily with clay soil farming and grain cultivation.

Work in the years 1959—61

In 1959 spring sowings were begun earlier than usual. Overwintering crops survived the winter well. The eather conditions during the growing season favoured cereal crops, but drought in the late summer considerably hindered the growth of potatoes and root crops.

In 1960 sowing was begun at the normal time in the beginning of May. The summer was very rainy, but since it was warm all grains ripened at the usual time. All crops gave good yields in this year, some producing all-time record yields.

In 1961 overwintering crops were in good condition, and spring sowings were begun on April 25 or much earlier than usual. Drought in the early summer hindered the growth of crops, and rainy conditions in the late summer made harvesting very difficult. The yields of spring cereals were very low.

About 50 trials have been carried out every year at the station. The following table lists the trials in the years 1959—61 according to groups.

	1959	1960	1961
Soil improvement and fertilization	21	21	22
Tillage	3	5	6
Cultivation technique	12	10	12
Varieties	8	9	10
Plant diseases	4	1	4
Insect pests	—	1	2
Total	48	47	56

Soil improvement trials

In 1958 soil improvement trials were started for the first time at the station. The use of various soil improvement agents was found to be advantageous on silty clay soil. In particular peat gave very good results, but sand was also good in several cases.

Fertilization trials

Nitrogen fertilization on clay soils was found to be indispensable and economically profitable. Since nitrogen when applied to cereal nurse causes a reduction in the amount of clover in the newly-established ley, trials have been carried out in order to establish the optimum nitrogen rate. It was found that about 100 kg/ha is the maximum amount which can be applied without hindering the growth of clover.

The use of boron applications on red clover seed fields proved to be very satisfactory, causing an average increase of 33 % in the seed yields.

Tillage trials

Endeavours have been made in recent years to increase the number of tillage trials, since there are still many unsettled questions about tilling clay soils. A shallow (6—9 cm) spring tillage has given good results, since it enables the soil to be worked early in the spring and preserves soil moisture. Other trials have compared the effects of the spike harrow and disc harrow and have investigated methods of suitable spring cultivation of fields which were not ploughed in the autumn.

Cultivation technique trials

Trials with green fodder crops showed that a mixture of peas and oats was the only which gives satisfactory results on clay soil.

The sowing rate of the nurse crop (spring wheat) had only a very small influence on the yield of the following year's ley.

Seed yields of red clover, especially of tetraploid, have generally been very low under the conditions at the station; this is due to the scarcity of pollinating bees. Only in the exceptionally favorable year of 1959, was a good seed yield obtained, and in this year a second-year field of Jo TPA 1 yielded 207 kg/ha. Tetraploid alsike clover, on the other hand, can be expected to give larger seed yields.

In row distance trials with winter turnip rape, it was found that a distance of 22.5 cm gave much better results than 45 cm. The ridge-furrow method of sowing did not prove to be of any benefit.

Variety trials

In variety trials on winter wheat the new lines Ta a 5333 and Ta b 2598 appeared to be very promising, but additional experimental results are needed. On the other hand Diana overwintered very poorly.

Among the spring wheat varieties, Apu has been included in the trials for 9 years and has given a mean relative yield of 105. Norröna has been in the trials for 6 years with a mean relative figure of 102. During the same 6-year period, Apu gave a figure of only 100 and is thus slightly lower-yielding than Norröna. The latter variety, however, is no longer as high-yielding as it appeared to be in the early years. Both of these varieties are early and thus would be well suited for cultivation in the region of the station, but they are unfortunately susceptible to lodging. In addition, Apu is readily infected by smut diseases and has a low hectoliter weight. Norröna's drawback is its low protein content which makes it poorly suited for milling purposes. Among the new lines Ta 4693 is high-yielding but late, and Ta 2136 is early, stiff-strawed but gives lower yields than Timantti, as does also Jo 05616.

The new barley variety Balder J is very similar to the original Balder but gives slightly higher yields. The two-rowed Foma which has been tested for only 3 years has been found to be resistant to lodging, but it is later than Balder and also has given 5 % lower yields. During 6 years of trial Otra has a mean relative yield of 93; it is thus higher-yielding than Tammi and its straw is slightly more sturdy. Paavo has been tested for 5 years, yielding 103 on average. It is an especially abundant-yielding, early many-rowed variety with a rather strong straw and is well suited as a nurse crop especially on clay soils.

Variety trials on oats have shown that the Dutch variety Pendek gives poor yields on clay soil (similar to those of Tammi) but that on humus soil it is slightly higher-yielding than Tammi. Blenda and Blixt closely resemble Eho, so there is no reason for putting them into general cultivation. Kyrö

has given lower yields than Tammi. The new line Jo 0721 has been found to be especially resistant to lodging.

The pea variety Riitto gives high yields and can be recommended for cultivation to replace Sinikka, since it is an earlier variety than the latter. Likewise, the early line Jo 03745 produces abundant yields.

Among the winter turnip rape varieties tested, the varieties Lembke, Duro and Rapido II were found to overwinter poorly.

Jokioinen red clover is resistant to clover rot but is clearly lower-yielding than Tammisto. High yields have been obtained from the tetraploids Ulva and Jo TPA 1. The foreign varieties Perm and Altaswede overwintered poorly.

On the basis of the variety trials carried out at the station, the following varieties can be recommended for cultivation in the near by region:

Winter rye:	Toivo, Ensi
Winter wheat:	Varma, Antti
Spring wheat:	Timantti II, Touko, Apu
Barley:	Balder, Balder J, Paavo, Otra
Oats:	Sisu L, Marne, Eho, Pendek, Tammi
Pea:	Riitto, Kalle
Winter turnip rape:	Rapido I
Red clover:	Tammisto, Jokioinen

In control trials against clover rot PCNB has sometimes given good results, but the method must be further developed.

Publications made by the Karelia Agricultural Experiment Station during the years 1959—61 are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Häme Agricultural Experiment Station

Address: Pälkäne

Telephone: Pälkäne 2214

The Häme Agricultural Experiment Station was founded in 1925. Since the year 1927 it has been situated near the shores of the Mallasvesi Lake 4 km from the village of Pälkäne and 38 km from the city of Tampere. Its latitude is 61° 20' N. and elevation 100 meters above sea level. The station has a total area of about 168 hectares, including about 66 hectares of cultivated land, 4 hectares of garden and orchard, 79 hectares of forest and 19 hectares of unused land. The predominant soil types on the cultivated area are silty soil 17 hectares, fine sand 46 hectares and Carex peat soil 3.3 hectares.

Personnel

The director of the station is Mr. Mauri T a k a l a and the chief assistant is Miss Helmi L i n n o m ä k i .

Fields of investigation

The principal duties of the station are to carry out variety trials on different cultivated crops and to make investigations on fruit tree growing. In addition, control trials against winter parasitic fungi and herbage crop trials make up an important share of the research program of the station.

Work in the years 1959—61

The three-year period 1959—61 was characterized by generally favorable weather conditions. In 1959 spring sowings were begun as early as the last week in April, in 1960 at the normal time (May 9) and in 1961 on the 2nd of May. In 1960 and 1961 heavy rains occurred in July and August, making harvest work difficult and decreasing the quality of the yields of hay and grain. In general, weather and growing conditions were favorable during these years.

Results

In variety trials on winter wheat the line Ta 5333 appears to be the most promising. Although its straw is not especially strong, it is less susceptible to sprouting in the head than the sturdy-strawed Vakka.

Spring wheat variety trials showed Norröna and Nora to be the highest-yielding, but their baking qualities are too poor to satisfy the requirements of the milling industry. The best variety has been the strong-strawed Svenno, although its growing time especially in unfavorable summers, is too long.

Among the barley varieties tested, the Swedish malting barley Sv 2102 has been found to be very promising.

In herbage plant trials the tetraploid red clover varieties Jo TPA 1 and Ulva have been found to be high-yielding and especially winterhardy, but their seed yield is low. Jokioinen red clover (Jo 37) is more winterhardy than Tammisto, but its forage yield has been less than that of the latter variety. The local red clover strain Myttäälä is similar to Tammisto in its yield and winterhardiness.

Among the apple varieties tested, the highest-yielding was found to be the Canadian Lobo. This variety bears early and gives an abundant and high-quality yield. However, it is susceptible to apple scab and its winterhardiness is only moderately good, but when grafted onto an intermediate stem it apparently is able to survive the winters satisfactorily in the southern parts of the province. The most reliable apple variety in the province is Canel.

Publications made by the Häme Agricultural Experiment Station during the years 1959—61 are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Central Finland Agricultural Experiment Station

Address: Kuusa

Telephone: Kuusa 179

The Central Finland Agricultural Experiment Station was founded in 1951. There is no actual station farm, but instead the trials are carried out on private farms throughout the region of operation of the station, which comprises the province of Central Finland. Main trial location, Laukaa, is situated at a latitude of 62° 27' N. and a longitude of 25° 55' E. The main soil types in the region are fine sand silt, moraine and peat; clay soils exist only in the southern areas of the region.

Personnel

The director of the station is Dr. Pentti Hänninen. In addition, two technical assistants are employed.

Fields of investigation

Red clover seed production, bumblebee studies, investigations on overwintering problems, as well as special projects in cooperation with other institutions have been carried out.

Work in the years 1959—61

Red clover seed production

Special emphasis has been given to the effect of boron fertilization. The entire region of operation of the station was found to be deficient in boron. In order to obtain satisfactory seed yields of red clover, regular applications of boron are indispensable. In several trials this trace element has increased the seed yield many times; the average increase in red clover seed yield due to boron fertilization (total of 104 trials) has been as high as 40%. — In recent years tetraploid red clover seed trials have given highly promising results.

Bumblebee studies

The region was found to have a large population of bumblebees. The most important species occurring in red clover are *Bombus lucorum*, a nearly 100%

robbing species, and *B. agrorum*, a very efficient pollinator. Other species (for example *B. hortorum*) are considerably less numerous than the above-mentioned two.

Overwintering problems

Since the region has a thick snow cover in the winter, low-temperature parasitic fungi are common and injurious. Fungicide trials have been concentrated on winter wheat, which is cultivated very rarely in the region because of the severe winter injury. Very promising results have been obtained with both PCNB and PMA compounds. *Fusarium nivale*, for example, has been nearly completely controlled with these chemicals. *Typhula* sp. is more difficult to control, but even its damage has been clearly reduced by treatment with these fungicides. *Sclerotinia borealis* is not as important in the region as the first two fungi, but in some years it has occurred rather abundantly. PCNB controls it effectively, whereas PMA has only a slight control or none at all. The good results with fungicidal treatment of winter wheat give hopes that the cultivation of this crop can be increased in Central Finland.

Clover rot (*Sclerotinia trifoliorum*) occurs in many years throughout the area frequently, causing very severe damage on red clover. The controlling effect of PCNB products has been highly satisfactory.

Other investigations

Investigations in cooperation with other institutions have been concentrated on problems of fertilization. The most important trials have concerned phosphorous fertilization, for example, the effects of superphosphate and fine-ground rock phosphate. In certain trials on grasses both of these fertilizers gave equally large yield increases, but it was found that superphosphate increased the phosphorus content of the yield considerably more than the rock phosphate. It was also established that phosphorous fertilization (in particular superphosphate) appreciably increased the winter hardiness of winter rye; this was due at least partly to the increased resistance of the seedlings to *Fusarium nivale* as a result of the phosphorus application.

Publications of the station are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

South Savo Agricultural Experiment Station

Address: Karila, Mikkeli

Telephone: Mikkeli 11 564

The South Savo Agricultural Experiment Station was founded in 1919. It is situated at a latitude of 61° 40' N. and a longitude of 27° 10' E. The area of the station comprises 95.5 hectares, of which 42.6 are under cultivation. The main soil types are moraine (9 ha), sand and silt (29 ha) and peat (4 ha).

Personnel

The directorship of the station has been held by Mr. Erkki Huokuna.

Fields of investigation

Experiments included increase in seed potatoes, pasture investigations and clover seed production.

Work in the years 1959—61

An average of 45 trials and investigations have been carried out annually at the station, most of which are planned by the various departments of the Agricultural Research Centre.

Fertilization trials

Trials with farmyard manure have shown that the yield increases from cattle manure have been as great as those obtained with corresponding amounts of nutrients in the form of chemical fertilizers. In trace element trials, boron has been found to be indispensable for root crops and clover seed fields. Several trials have been carried out on the time and rate of application of nitrogen dressings, especially on ley crops. The effect of different forms of nitrogen in delaying ripening of cereals has also been studied, and no difference was found between the various types of nitrogen fertilizers employed.

Cultivation technique trials

The oldest of these are trials on establishment of leys with cereal nurse crops. Early broadcast sowing or drill-sowing at the usual time were found to give

much more dependable results than broadcast sowing late or at the normal time. — Investigations have also been in progress on seed production of red clover. There are abundant pollinating bumblebees in the region of the station, and they are to a great extent responsible for the large seed yields obtained even from tetraploid red clover (300 kg/ha).

Variety trials

Trials with spring cereals, red clover and potatoes have been extensive, whereas those with winter cereals, turnip rape and ley grass have been more limited.

Plant disease trials

Plant diseases, especially winter parasitic fungi, are common in this region of abundant snow. In certain years treatment of the stands in the autumn with fungicides has resulted in considerable yield increases.

Pasture trials are at present in a preliminary stage.

Publications of the station are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

North Savo Agricultural Experiment Station

Address: Maaninka

Telephone: Maaninka 62

The North Savo Agricultural Experiment Station was founded in 1930. It is situated at a latitude of 63° 09' N. and a longitude of 27° 20' E. Total area of the station is 243 hectares, of which 87 is cultivated land. The main soil types are fine sand and peat.

Personnel

The director of the station is Mr. Martti Salmi, assistant Miss Annikki Ryyänen.

Fields of investigation

Fodder production is carried out with the aim of obtaining well-balanced feeding of cattle. Plant husbandry is concentrated on leys, red clover, fodder roots, potatoes and rye. Horticultural investigations are made mainly on berries and the Paradise apple hybrid.

Work in the years 1959—61

The most important results from investigations in the years 1959—61 were as follows:

Nitrogen fertilization was found to have a large influence on both the quantity of yield and the content of crude protein of ley fodder crops. — Tetraploid red clover proved to be more resistant to clover rot than diploid, but its seed formation is poorer than that of the diploid. A tetraploid seed field gave yields of 169 kg/ha in 1960 and 195 kg/ha in 1961. Since the numbers of pollinating bumblebees vary considerably from place to place, the seed yield of clover likewise can vary greatly between different fields on the same farm. On small areas, seed yields as high as 500—600 kg/ha of tetraploid red clover have been obtained. It appears possible that tetraploid red clover can give a seed yield in three consecutive years.

Animal husbandry investigations have been concerned with the raising of calves. Ayrshire calves increased in weight at an average of 700 grams per day. At the age of seven months their average weight was 186 kg (cow calves

177 kg and steer calves 198 kg). At the age of a year and a half the corresponding weights were 343 and 359 kg on the average. The weight of steer calves on the pasture increased 884 g/day without concentrates. At slaughter, the carcasses of these animals have been usually placed in class I.

Publications made by the North Savo Agricultural Experiment Station during the years 1959—61 are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

South Ostrobothnia Agricultural Experiment Station

Address: Pelma

Telephone: Ylistaro 53

The South Ostrobothnia Agricultural Experiment Station was founded in 1927 in the commune of Ylistaro ($62^{\circ}55'$ N.lat., $22^{\circ}30'$ E.long., elev. 26 meters). The area served by the station includes the province of Vaasa exclusive of its northernmost parts. The main soil type at the station is a highly acid, sulfur-containing muddy clay, covered with a thin layer of humus or peat.

Personnel

The directorship of the station has been held by Mr. Teemu Honkavaara. The number of technical personnel at the station is 10—20.

Fields of investigation

Investigations on the cultivability, fertility and improvement of acid soils; crop variety problems; experimental cultivations of breeding material; timothy and clover seed production; frost damage and frost control; apicultural studies; cooperative investigations together with other institutions.

Work in the years 1959—61

Liming trials

Studies have been made on the calcium requirement of the exceptionally acid soils prevailing in the coastal areas as well as procedures for eliminating the acid salts from these soils. Investigations have also been carried out on liming and other aspects associated with the spreading of acid soil on to the surface of the ground in connection with digging drainage ditches. Long-term field experiments (the oldest of which was begun in 1928) have been continued on the combined effects of calcium and different soil nutrients as well as on the after-effect of liming.

Variety trials

New varieties and lines have been tested with special emphasis on their growth under the conditions prevailing at the station and their response toward soil acidity.

Frost research

The occurrence of summer frosts and the damage caused by them were studied especially in the unusually dry summer of 1959. Although the average temperature of the growing season 1959 was higher than normal, frequent spring and summer frosts occurring even during the warmest part of the summer caused considerable injury to the crops.

Apicultural studies

Apicultural observations have been made at the station since 1938 under the supervision of the Beekeepers Association. The station maintains a scale-colony that has been in continuous operation for longer than any other in the country. These long-term observations give a good picture of the suitability of the area near the station for beekeeping.

Cooperative investigations

In cooperation with other institutions, the following problems have been studied: fertilization, forage production, plant protection, cultivation of fruits, berries, vegetables and ornamental plants, agricultural techniques and drainage.

Publications made by the station are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Central Ostrobothnia Agricultural Experiment Station

Address: Kaattari, Kannus

Telephone: Toholampi 88

The Central Ostrobothnia Agricultural Experiment Station was founded in 1952. It is situated at a latitude of 63° 45' N. and a longitude of 24° 20' E. There is no actual station farm, but instead the trials are carried out on private farms throughout the province of Central Ostrobothnia, for example, in 7 different communes in the year 1961. The soil types represented by these trials were: fine sand 72 %, silt 6 %, peat 18 % and mud 4 %.

Personnel

In the year 1959 Mr. Lauri Toivola was the station director for 4 months, Mr. Hannu Perho for 2 months and Mr. Osmo Perttula for 6 months, the latter also holding this post for the years 1960—61.

Fields of investigation

Since forage production is predominant in the region of operation of the station, special attention is given to the following:

- fertilization and liming of leys
- establishment of timothy seed fields
- pest control in timothy seed fields
- variety trials on root crops
- clover strain trials
- early types of cereal crops
- control of low-temperature parasitic fungi

Work in the years 1959—61

The following numbers of different kinds of trials were carried out by the station in the years 1959—1961:

	1959	1960	1961
soil improvement and fertilization trials	23	29	23
variety trials	3	4	9
plant disease trials	10	16	10
pest control trials	—	—	2
Total	37	56	51

Publications made by the station in the years 1959—61 consisted of 18 articles in the local newspapers.

North Ostrobothnia Agricultural Experiment Station

Address: Ruukki

Telephone: Ruukki 2010

The North Ostrobothnia Agricultural Experiment Station was founded in 1924 on the Greus estate in the parish of Revonlahti. It is situated at a latitude of 64° 40' N. and is 45 meters above sea level. The nearest railroad station is Ruukki, 4 km away, and the nearest city, Oulu, is approximately 50 km to the north. The total area of the station is 345 hectares, of which 77 hectares are cultivated land and about 223 hectares forest. Approximately half of the cultivated land is on fine sand soil and half on peat soil.

Personnel

The directorship of the station has been held by Mr. Olavi Anttinen. At the beginning of 1959 Mr. Jaakko Köylijärvi was the research agronomist, his successor being Mr. Paavo Simojoki.

Fields of investigation

Research studies at the station have dealt primarily with problems of soil improvement and fertilization on peatland as well as various questions related to leys and forage crops.

Work in the years 1959—61

The following numbers of trials were carried out by the station during the years 1959—61:

	1959	1960	1961
Soil improvement and fertilization	27	25	27
Fertilization and cultivation technique	10	5	5
Cultivation technique	13	12	14
Varieties	16	18	21
Plant disease control	8	5	4
Insect pest control	—	—	2
Horticulture	6	6	5
Total	80	71	78

A large share of the trials are long-term trials in progress for many years on the same location. The oldest of these were begun as early as the 1920's.

Soil improvement and fertilization trials have included the following: fertilization and improvement of Sphagnum peatland, fertilization and clay applications on Carex peatland, liming and fertilization on Carex peat soil, the effect of different amounts of fertilizers on various crops, comparisons of different multiple fertilizers, time of nitrogen application, comparisons of domestic phosphate and superphosphate.

In the group of combined fertilization and cultivation technique trials, the following can be mentioned: seed mixture and nitrogen dressing of pasture, establishment and nitrogen application of timothy leys, establishment of timothy seed fields and their nitrogen fertilization, and seed rate of nurse crops with varying amounts of multiple fertilizer.

Cultivation technique trials have dealt with various green fodder crops and their seed mixtures, thinning of turnip, seed rates of fodder pea and Italian ryegrass, the use of barley and Italian ryegrass as nurse crops, pasture seed mixtures and weed control methods.

Variety trials have been carried out on barley, oats, pea, potato, fodder turnip, red clover, timothy, and Italian ryegrass. In addition, different species of grassland crops have been tested.

In the control of plant diseases, trials have been made on the control of low temperature parasitic fungi on clover and winter wheat. Likewise control trials against the cabbage maggot were also carried out.

Horticultural investigations have been concerned principally with variety trials of berry bushes.

In addition to its regular program of research work, the station also carries out practical farming and applies to it the results obtained from the trials. In this region of northern Finland, agriculture is based on cattle raising, primarily for milk production, and as a result plant husbandry is concentrated on the production of fodder. Breeding of both cattle and pigs is carried out at the station.

Publications made by the station are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Polar Circle Agricultural Experiment Station

Address: Apukka, Rovaniemi

Telephone: Office Rovaniemi 8317; Director 8320

The Polar Circle Agricultural Experiment Station was founded in 1938 at the Apukka farm 18 km north of the city of Rovaniemi. Its latitude is $66^{\circ} 35' N$. and its altitude 103 meters above sea level.

The total area of the station is 975 hectares, of which 65 hectares are cultivated land. Eight hectares are located on mineral soil and 57 on peat soil.

Personnel

Dr. Aimo I s o t a l o, director, forage crops and domestic animals; Dr. Leo Y l l ö (1959—60), herbage and green fodder crops; Mr. Vesa R a n t a n e n (1960—), herbage crops and winter parasitic fungi; Mr. Reimar V o g e l, cereals, potato, green fodder crops, plant breeding; Mr. Eero V i r t a n i e m i, vegetables, berries, ornamental plants.

The number of other workers has varied from 10 to 15.

Fields of investigation

The principal function of the station is to investigate the factors related to successful agricultural practice under the conditions in northern Finland. Work in the field of plant husbandry has been concentrated mainly on forage production and includes investigations on leys, green fodder crops, potato, root crops and barley. Breeding work is concerned principally with potato and barley. Horticultural investigations are made on the cultivation of vegetables and berries in the open field as well as hothouse growing of vegetables and flowers. Studies on domestic animals include sheep and reindeer in addition to cattle.

Work in the years 1959—61

Every year about 115—120 different trials are carried out at the station, and in addition 15—20 trials are made on various private farms throughout Lapland. Further, certain trials are carried out at the observation farms. The experimental work of the station can be divided into the following groups:

Soil improvement and fertilization trials

The effect of sand and lime as soil improvement agents on peat soil and the influence of the major mineral elements on crop yields. Trials began in 1950—51.

The effect of varying amounts of nitrogen, potassium and phosphorus on the yields of leys and the nutrient content of the crops. Trials began in 1952—53.

The effect of varying and in particular excessive amounts of nitrogen on the protein content and fodder value of grass crops.

The effect of multiple fertilizers, especially Oulu Y-fertilizer, when used as top dressings on leys. Trials began in 1958—59.

Comparative trials on sulfur-free and sulfur-containing fertilizers with the view to determine the mobilization of this element in peat soil and the effect of sulfur when applied in the form of fertilizer. Trials began in 1959.

Trace element trials on peat soil, were begun in 1955 and 1961.

Drainage investigations on peat soil

The objective of these trials is to determine the best means of draining peat soils under northern Finnish conditions. Comparisons are made between open ditches and underground drains as well as between different depths of ditches and distances between them. These trials were begun in the years 1954—56.

Cultivation technique investigations

Ley establishment trials, the purpose of which is to determine the effects of nurse crop, seed mixture, date and rate of seeding, sowing method, row distance and other factors on the success of ley establishment under northern Finnish conditions. Trials were begun in the years 1956—61.

Yield quality investigations, concerning the effects of varying fertilization and cultivation techniques on the quantity, quality and fodder value of hay fields and pasture. Trials were begun in 1954.

Seed production investigations dealing principally with methods and conditions of timothy seed production. Trials were begun in 1954.

Pasture investigations under northern Finnish conditions, including trials on establishment, fertilization and suitable crops varieties for pasture. Trials were begun in 1954.

Forage crop studies concerned with determining the best crops suited for green fodder in northern Finland, their fertilization and method of cultivation.

Investigation on the factors affecting the overwintering and yield of rye; began in 1961.

Weed control trials using both chemicals and cultivation techniques.

Variety trials

Cereal trials concerning the conditions for growing different cereal species and varieties in northern Finland. Attention has principally been given to barley.

Potato trials in which the factors affecting the yield and the quality of early varieties of potato have been studied.

Herbage trials including different species, varieties and strains of grasses and clovers on hay fields and pastures.

Plant disease investigations

Trials dealing with overwintering problems of ley crops have been carried out both with chemical agents and with various cultivation techniques for the control of plant diseases. Trials were begun in 1956.

Insect pest investigations

Trials have been carried out with different insecticides and methods for controlling insect pests under the conditions in northern Finland. Trials were begun in 1957.

Horticultural investigations

Berry-growing investigations have been concerned with the possibilities and methods of cultivating strawberries, raspberries and currants in northern Finland. Trials were begun in 1954.

Vegetable and crop trials have been carried out under outdoor conditions since the year 1954.

Trials in the greenhouse and in glass frames have been made in order to determine the conditions for cultivating tomatoes, cucumbers, various vegetables and flowers under glass in northern Finland. Trials were begun in frames in 1956 and in the greenhouse in 1958.

Out-of-door ornamental trials have been carried out with certain trees and shrubs as well as with annual and perennial flowers. The first plantings were made in 1956 and have subsequently been renewed and supplemented.

Investigations on domestic animals

Trials have been carried out on the forage consumption and milk production of different cattle races as well as on the possibilities of raising cattle for slaughter in northern Finland. The comparative trials on milk cattle were begun in 1959 and those on cattle for slaughter in 1955.

Sheep trials have been concerned with determining the possibilities of meat and wool production with domestic sheep breeds. Trials were begun in 1961.

Reindeer trials have been carried out since 1961 in order to study the problem of winter feeding of reindeer as well as to determine their damage to cultivated fields.

Other investigations

Plant breeding work, which is carried out in cooperation with the Department of Plant Breeding, has been concentrated mainly on barley and potato.

Laboratory analyses have been performed principally on fodder samples. They include determinations of crude and digestible protein, sugar, ash, fiber, as well as nutrient minerals such as phosphorus, potassium, calcium, magnesium, etc.

The use of various preservative agents has been studied on vegetables and root crops in storage.

Regular observations are made on temperature, evaporation, precipitation, snow cover, ground frost, as well as on plant phenological phenomena.

Trials are also carried out outside the experiment station on private farms; most of these have been potato variety trials at Inari, located in northern Lapland at a latitude of over 69 degrees.

Publications made by the Polar Circle Experiment Station during the years 1959—61 are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Pasture Experiment Station

Address: Mouhijärvi

Telephone: Vammala 8131

The Pasture Experiment Station was founded in 1933 at Mouhijärvi which is located in the province of Satakunta about 40 km west of the city of Tampere at a latitude of 61° 31' N. The area of the station comprises 396 hectares, of which 77.6 hectares are cultivated land. The principal soil types are clay silt and fine sand.

Personnel

The director of the station is Mr. Tauno L a i n e.

Fields of investigation

This station specializes in carrying out trials concerned with pasture cultivation and management.

Work in the years 1959—61

Every year the station carries out 50—60 trials, most of which are mown at the stage of pasturing. These trials are confirmed by others in which the pasture is actually grazed by animals. Because of the long duration of the trials, the experimental program of the station is extensive and diversified, and because of variations in weather conditions, the same types of trials are made over many consecutive years.

Fertilization trials

Long-term phosphorus fertilization trials which were terminated in 1958 showed that the application of phosphorus on clay soils has no marked effect in increasing the yields of pasture. An annual amount of 200 kg/ha suffices. Nitrogen, on the other hand, is considerably more effective. In recent years the duration and total effect of nitrogen fertilization has been specially studied at various times of application during trials.

Seed mixture trials

In previous years many seed mixture and seed rate trials were carried out; these are being continued but on a smaller scale. The best results have been obtained by simple mixtures containing large amounts of meadow fescue and cocksfoot. Seed mixtures of cocksfoot are especially well suited to pastures on clay soils. Seed rate trials have been carried out in recent years with the two above-mentioned grass species.

Grassland establishment trials

Since the establishment of pastures often fails on clay soils because of dry conditions, a number of experiments have been carried out on this problem. They include nurse crop trials (different species and seed rates), fertilization trials (farmyard manure and artificial fertilizers) and sowing method trials (nurse crop before and after the grass; drill sown and broadcast sown).

Other pasture trials

In sheep-grazing trials comparisons have been made between short- and long-term pastures as well as between paddock and strip grazing. In cattle-grazing trials, meadow fescue-dominated and cocksfoot-dominated pastures were compared in their effect on milk production. On trials which were mown, studies were made on the time between mowings and the height of the stubble, and its effect on the yield of the pasture. In addition, variety trials are being carried out on meadow fescue, cocksfoot and clover.

Hay field trials

These trials have been concerned primarily with the effect of nitrogen fertilization on fields with abundant and with little clover as well as the effect of the stubble height on the hay yield and aftermath growth. Nitrogen fertilization trials have been carried out on grass fields containing a large proportion of awnless brome grass; the object of these studies was to establish long-term awnless brome grass-dominated grasslands on those soil types which are not suitable for other grass species.

Publications made by the Pasture Experiment Station during the years 1959—61 are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Frost Research Station

Address: Pelsonsuo

Telephone: Veneheitto 17/25

The Frost Research Station was founded in 1951. It is situated in northern Finland 85 km southeast of the city of Oulu at a latitude of $64^{\circ} 31' N$. and altitude of 115 meters. Its area of operation comprises 14 000 hectares of the Pelso peatland area and it works in cooperation with the Pelso prison which has as its disposal 538 hectares of cultivated land and about 5 500 hectares of other state-owned land. The experimental fields of the station are located on a 47-hectare area consisting of mesotrophic Bryales Carex peat.

Personnel

The station director is Dr. Arvi Valmari. Other research workers included 2 people in 1959—60 and 3 in 1961.

Fields of investigation

The special fields of investigation of this station are agricultural meteorology, particularly the problem of frost, as well as related plant husbandry studies.

Work in the years 1959—61

Weather conditions

The winter of 1958/59 was mild and the spring of 1959 was warm and drier than normal. In regard to temperature, summer 1959 was slightly warmer than normal but very dry, with the result that the daily amplitude in temperature was large and frosts occurred so frequently that 1959 is considered as a particularly severe frost year. The autumn was characterized by normal temperature and dry conditions. The region most severely affected by frosts was Ostrobothnia, the eastern area of which includes Pelso. Barley and potato failed nearly completely at Pelso because of the frosts. Under these conditions the significance of the form of terrain, cultivation techniques and special frost prevention methods were clearly apparent.

The winter of 1959/60 was cold, the spring of 1960 warm and dry, and the summer warm and — with the exception of July — rainy. Autumn was cool

and very dry, and the first autumn frost was recorded on August 30th. Under these weather conditions many crops gave record yields at Pelso in this year.

The winter of 1960/61 was mild, but since there was little snow, especially in the early part of the winter, the soil froze to a great depth. Red and alsike clovers which had been sown in 1960 succumbed during the winter, apparently as a result of the ground frost, since clover rot did not occur. The spring of 1961 was cool and rather dry, the summer was rainy and slightly warmer than usual, and the autumn was dry and rather cool. The first frost came on September 5th. Because of the abundant rainfall during the summer, valuable observations were made on the drainage trials and on the effect of soil moisture in preventing frost. A record yield of barley was obtained, but this was evidently due more to lime applications than to the weather conditions.

Field experiments

The following numbers of field trials were carried out in the years 1959—1961:

	1959	1960	1961
Soil improvement and fertilization	12	14	4
Soil tillage	—	1	2
Cultivation technique	1	2	3
Varieties	2	3	1
Plant diseases	1	—	—
Drainage	—	3	5
Others	1	3	2
Total	17	26	17

Since the station has extensive areas of land at its disposal, it has carried out a great number of large-area trials. In 1961 the total area of trials was 10.04 hectares and the largest single trial, of which the entire yield was weighed, comprised an area of 6.76 hectares. Since the year 1960 most of the cereal trials have been harvested by combine harvester. In connection with the field trials, physical analyses of the soil and microclimatic measurements have been made, and differences in the rate of cereal ripening have been studied by means of moisture determinations.

Fertilization trials have shown that the application of artificial fertilizers does not have a sufficiently beneficial effect on the frost-resistance of crops to be recommended in amounts greater than those normally applied. Nitrogen fertilization was found to improve the frost-resistance of potatoes in the autumn, an effect due partly to the more favorable microclimate of the leafy foliage. Further trials have confirmed the fact that under the trial conditions at this station, normal nitrogen fertilization does not increase the susceptibility of spring cereals to frost. Excessive soil acidity was found to delay

grain ripening considerably. As much as a 14-day difference in ripening of barley was observed in 1960.

Soil tillage trials have continually shown the beneficial effect of soil rolling on peatland upon grain ripening and yield.

In the years 1960—61 comparisons were made between pure stands of barley and oats as well as a 1:1 mixture of them. Ripening was determined by means of moisture content determinations, and minimum temperatures were measured at different heights in the stands. The objective of these investigations was to see whether the mixed barley-oat stand was more resistant to frost than the pure stands. No significant difference, however, was observed.

Drainage trials begun in 1959 on the depth of and distance between wooden underground drains as well as on the mole-tunnel technique of underground drainage did not show any individual differences by the year 1961 in the depth of ground water or in the bearing capacity of the soil. Differences noted in the yields were not reliable. In 1961 the first yield of rye was obtained from a trial in which the open ditches on an area 60—80 meters wide were filled, whereas the control plots contained open ditches at distances of 20 meters. No differences between the two were found. The principal conclusion obtained from all the drainage trials is that if the main ditches enclosing the field are sufficiently large (their depth at the end of the area being 110—170 cm) and if the water from melting snow is able to flow freely into the main ditches, then the type of drainage within the field is of relatively little importance even on peatland.

The station is at present constructing a damming trial in which the ground water will be at levels 30, 60 and 90 cm below the surface of the soil. In this trial the effect of the depth of ground water will be studied by means of micrometeorological, biological and soil physical observations.

Frost control by water spraying has been attempted every year on potatoes during the period of spring and autumn frosts. In many cases frost damage has been prevented in spite of temperatures of -6 to -7° C. The time of beginning the water treatment can be delayed until the first leaves begin to stiffen, and thus possible damages from an excessive amount of water may be avoided. Even when too little water is used, frost damage is often decreased. Attention has been given to the reasons for the lack in uniformity of the efficiency of the treatment.

Investigations on cold-resistance of plants

An investigation on the frost resistance of red clover has shown that the seed of Finnish red clover is not damaged even by the most severe frosts if its 1000-seed weight is 1.5 grams or above (normal = 1.5 — 2.0 g). Small seeds are injured by frost in direct relation to their smallness, and thus frost may considerably reduce the seed yield of red clover.

Meteorological investigations

The geographical occurrence of frost has been investigated by taking daily minimum temperature measurements in different districts and at different points of the terrain. The thermometers are placed at the upper level of a ley stand. Measurements have been made in the vicinity of the station at Pelso, in the province of Kainuu to the East, and in the province of Central Ostrobothnia to the West. The numbers of measuring points and thermometers used for these minimum temperature measurements and also for other microclimate measurements were as follows:

	1960	1961
Pelso		
Measuring points	28	38
Thermometers	50	94
Kainuu		
Locations	9	16
Thermometers	29	43
Central Ostrobothnia		
Locations	—	12
Thermometers	—	29
Total no. of thermometers	<hr/> 79	<hr/> 166

The above investigation has shown that the differences in mean minimum temperature which occur at different points of the terrain are relatively stable. If the results are calculated as mean values for approximately 15-day periods, these differences are nearly equal during the whole growing season. Thus the tendency for frost occurrence at a given location can be determined also during periods of no frost by comparing the minimum temperature values with, for example, those obtained at permanent observation stations. On a relatively flat terrain such as that found in Ostrobothnia, the configuration of the terrain was found to have an important influence on the occurrence of frost.

The major investigations published by the Frost Research Station are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

Pig Husbandry Experiment Station

Address: Tikkurila

Telephone: Office Helsinki 83 13 63

The Pig Husbandry Experiment Station was founded at Tikkurila in 1926. The area of the station comprises 12 hectares, of which 11 are cultivated land.

Personnel

In addition to the director of the station, Mr Johannes Partanen, there are 5 other workers.

Fields of investigation

At the experiment station pig progeny testing and feeding trials with slaughter pigs have been carried out.

Work in the years 1959—1961

Pig progeny tests were made on 110 groups in 1959, on 121 in 1960 and on 116 in 1961. About a quarter of the groups tested were of the native breed and three-quarters of the Large White breed.

The average results of the pig progeny tests were as follows:

	Native breed			White Large breed		
	1959	1960	1961	1959	1960	1961
Growth (grams/day)	722	699	712	710	696	708
Ratio of live weight to food consumption (food units/kg)	3.29	3.27	3.15	3.20	3.18	3.10
Back fat thickness (cm)	3.7	3.5	3.12	3.4	3.3	2.98
Carcass length (cm)	93.3	95.0	96.6	93.3	93.9	94.2

Slaughter pig feeding trials. The consumption of ground swede as compared with non-ground swede was investigated in these trials. In addition grassmeal, preserved fishfood and dried whey were considered for their suitability as food for slaughter pigs. The relation between daily food unit consumption and the results of growth as well as food utilization was studied.

Bureau for Local Experiments

Address: Erottajankatu 15—17, Helsinki
Telephone: Office 14 813; Director 53 783

The Bureau for local field experiments began its activities in 1922 as a unit of the production section of the Ministry of Agriculture. In 1923 it was transferred to the Agricultural Research Centre, of which it has been a part up to the present time.

Personnel and their special fields

Mr. F. T e n n b e r g, director, fertilization investigations; Miss Helvi M a r j a n e n, variety trials and plant protection investigations; Mr. H. P e r h o, plant husbandry in general. The Bureau also has an office staff of about 12 as well as 4—5 storehouse workers. In addition, in the years 1960—61 an agronomist was employed for special studies.

Functions of the Bureau

The functions of the Bureau for local field experiments are — in cooperation with various agricultural advisory organizations — to carry out field trials at private farms, offer practical advice to farmers, and perform research work on the basis of results obtained in practice. These activities are arranged so that the agricultural advisory organizations manage the practical matters in carrying out the trials (selection of trial fields, sowing, observations, harvest, reports), while the Bureau plans the trials and supplies seed, fertilizers and other necessary equipment. The Bureau also supervises the trials and is responsible for the calculation and publication of the results. In planning the trials, special emphasis is given to current, practical problems and to the requests of the advisory organizations.

Work in the years 1959—61

During the three years 1959—61 the following numbers of different groups of local trials were carried out:

Year	Fertilization and liming	Species and variety trials	Ley establishment and forage crops	Plant protection	Vegetables	Total
1959	1345	332	153	83	210	2123
1960	1266	322	151	56	289	2084
1961	1214	287	169	94	233	1997
Total	3825	941	473	233	732	6204
%	61.7	15.2	7.6	3.7	11.8	

The number of trials performed annually is around two thousand, of which fertilization trials make up about 60—70 %. The latter group of experiments are carried out according to 40—50 different plans which include varying rates of fertilizer on different kinds of crops. In the most frequent experiments the effect of the three major nutrient elements are studied separately. The second most important group of experiments has been with varying rates of fertilizers. The distribution of the fertilization trials according to crops is as follows:

Cultivated leys	51.9 %	Potato	2.3 %
Green fodder	0.5 „	Sugar beet	3.7 „
Oats	14.9 „	Other roots	8.3 „
Barley	7.3 „	Forage crops	2.8 „
Spring wheat	5.7 „	Mixed grains + other	1.0 „

Variety trials have been carried out mainly with spring cereals. These have numbered about 160—180 annually, of which an average of 45 % were with oats, 31 % with barley and 24 % with spring wheat. There have been about 20 trials every year with winter cereals and 120—160 variety trials on potatoes.

Plant protection trials have been principally concerned with weed control in spring cereals. — Trials on vegetable crops have included comparative trials with different cabbage varieties, onion strains as well as different kinds of root crops.

Results

Fertilization investigations have been concerned with studying the effects of different fertilizers in various regions, on different soil types and under different conditions in general, taking into consideration annual fluctuations caused by weather conditions. Results of investigations on the effect of phosphorous fertilizers on crop yields have been published (TENNBERG 1960). In these studies it was found that phosphorous fertilization generally gave larger yield increases in the 1940's, at which time its use was relatively small, whereas in the 1950's when phosphorous was abundantly applied, its effect was relatively weak. It was calculated that the use of phosphorous fertilizers in the 1950's resulted in average yield increases throughout the whole country of about 15 %.

Considering that the results obtained from the local experiments are used as a basis for general economic calculations in order to show the effect of fertilization, it is important that the experimental material should be as representative as possible. In a study concerned with this problem, it was found that the local experiments are situated on farms of varying size in nearly the same proportion as the distribution of different-sized farms according to statistics of the Ministry of Agriculture (PERHO 1960).

When granular fertilizers first came on the market in 1958, it was thought that because of their slower solubility, they would be less efficient than the corresponding finely-ground fertilizers. In the years 1957—58 the Bureau for Local Experiments arranged a total of 34 comparative trials between these two forms of multi-nutrient fertilizer. Results showed that the granular fertilizer gave on an average better results than the finely-ground fertilizer (PERHO 1959).

In 1959—61 a study was made on the yields of different oat varieties based on trials carried out in the years 1923—1959. From all the varieties tested, selection was made from 13 new, presently-cultivated varieties as well as 12 older varieties. The relative yield values of the new varieties were as follows: Golden Rain II (2616 kg/ha; control variety) = 100, Sisu 109, Marne 107, Pendek 105, Sol II 104, Juha 104, Blenda 103, Blixt 102, Nip 102, Eho 100, Orion III 99, Tammi 95 and Kyrö 92. Their other qualities were also noted, in so far as information about them was available from the reports given by agricultural advisors (MARJANEN, HELVI. English summary: Productivity of oat varieties in local experiments, 1923—1959. Valt. maatal. koet. julk. 190: 1—125.)

In 46 spring wheat variety trials carried out in 1956—58, in which the yield of Norröna in comparison to other varieties was studied, this variety proved to give yields 19 % greater than those of Diamond (MARJANEN 1959).

A total of 394 weed-control trials with MCPA were carried out up to the year 1961. On the basis of these results, investigations have been made to determine the time effect of treatment on crop yield.

The major investigations published by the Bureau for Local Experiments are listed in the yearbooks of the Agricultural Research Centre, numbers XIV, XV and XVI.

