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Pests of cultivated plants in Finland

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FOREWORD

The present comprehensive work on the distribution and significance of pests appearing in agricultural crops in Finland is principally based upon the very extensive material compiled since the 1890's, during the entire period of activity of the Department of Pest Investigation of the Agricultural Research Centre. Most of the reports of pest occurrence have been made by individual farmers, but many have also been received from workers in advisory organizations, instructors at agricultural and horticultural schools, and other interested persons. There are also included some details of observations made by researchers of the Department of Pest Investigation.

The publication of this volume is extremely necessary. Primarily, it is needed by Finnish research workers, agricultural schools and advisory organizations, but foreign scientists will also be able to benefit from it. No such comprehensive listing of Finnish crop pests has been made earlier in Finland. In the years until 1927, detailed reports on pest occurrence were made either annually or at intervals of several years; in 1933, Professor UUNIO SAALAS published a university textbook which contained a large part of the data available at that time. However, in later years, partly by reason of insufficient funds, only brief annual reviews have been published. The present volume accordingly fulfils a very urgent need.

Dr. NIILLO A. VAPPULA, the author of this book, has devoted many years to the extremely difficult and demanding task of arranging the rich material for publication. Now that he has completed this extensive compilation, the Department of Pest Investigation is greatly indebted to him for this useful and skilfully-performed work.

Veikko Kanervo

Director, Department of Pest Investigation

Tikkurila, December 1964

AUTHOR'S PREFACE

In preparing the present work I tried to take into consideration all the records mentioned in publications, along with numerous unpublished reports on the occurrence of different pest species on cultivated plants in Finland. In the furtherance of this task, I have made use of the observations and scientific studies made by many investigators in this country.

In the compilation of material and the determination of species, valuable assistance has been rendered by research workers of the Department of Pest Investigation of the Agricultural Research Centre, and I wish to express my sincere thanks to them. I am especially grateful to the Director of the Department, Professor VEIKKO KANERVO, for his able help during the various phases of the work, as well as for his useful advice and additions to the manuscript. I am also indebted to OSMO HEIKINHEIMO, M. A., and MARTTI MARKKULA, Ph. D., both of whom provided data on the pest species relevant to their own special fields. Similarly, I have greatly appreciated the information and suggestions provided by TAHVO KONTUNIEMI, Ph. D., with respect to sawflies.

Thanks are also due to EDVIN RISSER, M. A., for translating the manuscript into English, and to Mr. FRED A. FEWSTER for his valuable help in proof-reading.

During the final phases of this work, I received a grant from the State Research Council for Agriculture and Forestry, to which I tender my sincere thanks.

Niilo A. Vappula

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Introduction

It is probable that insects and other pests have appeared on cultivated plants ever since man began to grow them as crops for his food supply. In view of the great economic importance of these pests, scientific studies were begun rather early, in an attempt to determine the reasons for the damage caused, and to find means for their control. In Finland, research activity concerned with agricultural pests started in the 1700's at Turku Academy, where PEHR KALM (1716—1779) and PEHR ADRIAN GADD (1727—1797), together with their students, carried out studies — which were quite modest by present-day standards — on many pest species. They published their results in the form of academic dissertations. Even at that early time numerous species of pests were known, such as the slug, wireworm, cockchafer, common rustic moth, large white butterfly, antler moth, leatherjacket, frit fly, aphids, and so on. Many methods were proposed for the control of these pests; most of these methods were very primitive, and often quite amusing from our modern viewpoint.

However, systematic pest investigation did not begin in Finland until the beginning of the 1890's. As a result of the great destruction caused by the antler moth in 1881—1886 and 1889—1893, O. M. Reuter made some investigations, initiated and financed by the Finnish Economic Society, on the life habits and occurrence of this pest, together with trials for its control (O. M. REUTER 1892—1894). His investigations were followed by those of Enzio Reuter, who studied harmful insects in addition to the antler moth. The studies of this researcher were initially financed by an annual grant made by the State Board of Agriculture (1894—1898); but from October 1, 1898, and until the year 1912, he served as both State entomologist and director of the Entomology Department of the newly-founded Agricultural-Economic Experiment Station. This institute was associated with the University of Helsinki. The Entomology Department carried out its activities for a number of years in the Agricultural Entomological Laboratory of the University until 1910, when it acquired its own laboratory premises in the Agricultural-Economic Experiment Station at Tikkurila. As successor to Enzio Reuter, Walter M. Linnaniemi was State entomologist until 1924, when agricultural research activity was reorganized and separated from the University. At the same time, the position of State entomologist was discontinued; his former duties were transferred to the Department of Pest Investigation of the present Agricultural Research Centre. KANERVO (1959) has published a historical review of agricultural pest investigation work in Finland during the 60-year period 1898—1958.

Both Reuter and Linnaniemi published the results of their investigations and other records of pest occurrence in their annual reports (E. REUTER 1895, 1897—1899, 1901, 1901 a, 1902—1905, 1908, 1909, 1910, 1912, 1912 a, 1914, 1914 a; LINNANIEMI 1915, 1916, 1920, 1935). The Department of Pest Investigation has also issued reports on the occurrence of pests in the years 1924—1925 and 1926—1927 (HUKKINEN and VAPPULA 1935; HUKKINEN et al. 1936). No extensive accounts have been published since then, but brief summaries relating to the appearance of the most important species have been issued for the periods 1929—1937, 1948 and 1950—1961 (VAPPULA 1930, 1931, 1931 a, 1932, 1932 a, 1933, 1935, 1937, 1938, 1939, 1951, 1952, 1952 a, 1953, 1955 a, 1956, 1957 a, 1958, 1959 b, 1960, 1961, 1962; KANERVO 1948).

Number of pest species and their increase

The previously-mentioned annual reports made by the State entomologists Reuter and Linnaniemi contain much valuable information on the occurrence of pests in Finland, and thus serve as a sound basis for pest investigations in this country. According to the calculations of HUKKINEN (1922, 1923), the numbers of different species mentioned in each year during the period 1894—1916 are as follows:

1894	34 species	1906	28 species
1895—1896	52 „	1907	19 „
1897	41 „	1908	30 „
1898	26 „	1909	30 „
1899	46 „	1910	31 „
1900	51 „	1911	35 „
1901	38 „	1912	38 „
1902	21 „	1913	102 „
1903	29 „	1914	138 „
1904	33 „	1915	205 „
1905	33 „	1916	174 „

In earlier annual reports, the information furnished was based principally on the State entomologists' own investigations and observations, together with the occasional reports received, and consequently the number of species was relatively low, annually amounting to 19—52. After the year 1913, however, there was a considerable increase in numbers, mainly ascribable to the increased efficacy of pest investigation and the collection of data. In order to determine the occurrence of pests and the damage they occasioned, the Department began to make more and more use of questionnaires. In 1915 a network of observers was organized which covered the entire country; at first this consisted of 700—800 persons who provided information on pests, a service which has been maintained to the present time.

In the final state entomologists' report for the period 1917—1923, there is mentioned a total of about 240 species of animals harmful to cultivated plants. In each of the subsequent two extensive reports published under the auspices of the Department of Pest Investigation of the Agricultural Research Centre, and relating to the years 1924—1925 and 1926—1927, about 150 species are listed. In later

years observations and records of 150—200 pest species are received by the Department annually.¹⁾

As research activity in this country has become more effective and intensified, our knowledge of the total number of pest species has become more complete, since recognition is constantly being made of new species, of which many are extremely dangerous and are already found extensively throughout the country. Thus in the five-year period 1913—1917 there was established a total of 177 new species injurious to crops; at that time the total number exceeded 400 different pest species (HUKKINEN, op.cit.). Since then, the number of species has increased from year to year, and simultaneously the accumulating reports have served to furnish a more complete general picture of the distribution and injurious nature of the previously-known species. Some of the new species are ones which originally lived on wild plants and which have only recently begun to damage crops; others have been introduced into this country from abroad through the agency of living plants or parts of plants, or by other means of dispersal.

The list at the end of this volume, which comprises a total of 1060 different species of pest animals, was prepared from data compiled up to the year 1961. The main sources of this list were the published reports of pest occurrence during the period 1894—1927 and other relevant literature, as well as the extensive material received by the Department of Pest Investigation and containing information sent from various parts of the country, along with observations made by the Department's research workers. The pests are divided into the following groups:

I. Insects (<i>Insecta</i>)		
Springtails (<i>Collembola</i>)	4	species
Grasshoppers, etc. (<i>Orthoptera</i>)	2	„
Earwigs (<i>Dermaptera</i>)	1	„
Thrips (<i>Thysanoptera</i>).....	25	„
Plant bugs, aphids, etc. (<i>Hemiptera</i>)	162	„
Beetles (<i>Coleoptera</i>)	146	„
Sawflies, ants, etc. (<i>Hymenoptera</i>)	96	„
True flies (<i>Diptera</i>)	99	„
Butterflies, moths (<i>Lepidoptera</i>)	400	„
		935 species
II. Myriapods (<i>Myriopoda</i>)	6	„
III. Mites (<i>Acarina</i>)	44	„
IV. Crustaceans (<i>Crustacea</i>)	3	„
V. Molluscs (<i>Mollusca</i>)	9	„
VI. Worms (<i>Vermes: Nematoda, Annelida</i>)	8	„
VII. Birds (<i>Aves</i>)	32	„
VIII. Mammals (<i>Mammalia</i>).....	23	„
	Total	1060 species

¹⁾ In addition to the species harmful to crops, many reports have also been received of pests infesting stored products and dwellings, forest pests, etc.

Number of pest species in different parts of Finland

It is natural that the number of different pest species is more abundant in the southern parts of Finland, where crop husbandry is older and more diversified, nature more luxuriant, and the weather milder than in other parts of the country. For this reason, the economic damage caused by crop pests is more substantial in south Finland than, say, in the eastern and northern areas of the country. Against this, it should be realized that the severity of damage is not directly correlated to the number of pest species, since in the northern, climatically-unfavourable regions, relatively few species may cause — at least at certain times — proportionately greater damage than in the south of the country.

The list at the end of this volume (pages 196—225) shows the distribution of pest species in the biogeographical provinces of Finland (see map, p. 226), based upon data obtained up to 1961. Especial emphasis is laid upon the list not indicating the actual geographic distribution of the species as such, but rather their occurrence as crop pests. Many species are distributed much more widely than is shown in the list, but they live and reproduce on wild plants if no suitable cultivated crops are available. In addition, it should be borne in mind that currently very little information is available with respect to the extent of damage caused by certain pests, particularly the less important species. Table 1 shows the numbers of different pest species in the biogeographical provinces in Finland.

As a result of the wars of 1939—1940 and 1941—1944, Finland was forced to relinquish the entire provinces of the Carelian Isthmus (Kk) and Petsamo Lapland (PsL), in which the numbers of pest species were respectively 121 and 5. In addition, the greater part of South Carelia (EK) and Ladoga Carelia (LK) was lost, as well as sections of North Carelia (PK) and Kuusamo (Ks). Reports from these areas are also included in the figures.

On examination of the figures presented in Table 1, it should be remembered that they do not give a completely accurate picture of the distribution of the species as pests of cultivated plants. This is because the southern and western parts of the country, especially Finland Proper (V), Uusimaa (U) and South Häme (EH), have been much more intensively investigated in this respect than have the eastern and northern regions, with the consequence that the figures for the former regions are disproportionately high. On the other hand, in the archipelago of Ahvenanmaa (A) (Åland Islands) studies of pest species are as yet incomplete.

Table 1. Numbers of pest species in Finland by biogeographical provinces

Province	Collembola	Orthoptera	Dermoptera	Thysanoptera	Hemiptera	Coleoptera	Hymenoptera	Diptera	Lepidoptera	Myriopoda	Acarina	Crustacea	Mollusca	Vermes	Aves	Mammalia	Total
Ahvenanmaa (A)	—	—	—	2	25	40	25	16	166	—	23	—	1	1	—	3	302
Finland Proper (V)	3	1	1	15	90	66	40	49	175	—	28	—	3	4	8	5	488
Uusimaa (U)	3	1	—	23	123	84	62	61	249	6	41	3	6	5	14	9	690
South Carelia (EK)	—	—	—	8	37	40	15	30	65	—	18	1	1	1	3	5	224
Satakunta (St)	1	—	—	7	37	39	14	19	49	1	18	2	2	2	6	7	204
South Häme (EH)	1	1	1	19	96	73	41	39	207	2	26	2	4	5	15	8	540
South Savo (ES)	1	—	1	11	51	47	14	28	85	1	15	2	2	2	2	6	268
Ladoga Carelia (LK)	—	—	—	5	23	32	11	15	34	—	12	—	2	—	2	4	140
South Ostrobothnia (EP)	—	—	—	10	41	33	12	21	45	—	13	—	2	—	4	5	186
North Häme (PH)	1	—	—	5	18	30	6	17	31	2	13	—	1	1	4	5	134
North Savo (PS)	—	—	—	7	49	36	11	25	37	1	13	—	1	—	8	3	191
North Carelia (PK)	1	—	1	5	22	34	8	21	38	—	6	—	1	—	2	5	144
Central Ostrobothnia (KP) ..	—	—	—	6	30	32	14	29	41	1	9	—	2	1	5	4	174
Kainuu (Kn)	—	—	—	2	9	22	4	15	14	1	8	—	1	—	1	—	77
North Ostrobothnia (PP)	1	—	—	7	29	27	14	28	28	—	9	—	—	1	3	7	154
Kuusamo (Ks)	—	—	—	3	5	12	4	12	6	—	—	—	—	1	—	2	45
Kemi Lapland (KemL)	—	—	—	2	4	11	2	12	7	—	2	—	—	1	—	2	43
Enontekiö Lapland (EnL)	—	—	—	—	—	3	—	2	2	—	—	—	—	—	—	6	13
Inari Lapland (InL)	—	—	—	1	5	2	—	10	5	—	—	—	—	—	—	1	24

Number of pest species in different crops

In his studies of the pest species to be found on Finnish cultivated plants, HUKKINEN (1922, 1922 a, 1923) presented some data concerning the number of species encountered in different groups of agricultural crops. According to his figures, the numbers of pest species found up to the year 1918 in different crops were as follows: cereals 58, grasses 44, clovers 19, peas 34, beets 16, fibre plants 3, potatoes 26, crucifers 67, vegetables 137, fruit trees 72, berry bushes 57, and ornamental plants 75.

With intensification of the studies relating to pest investigation there has been a corresponding increase in the numbers of destructive species found on cultivated plants. Table 2 presents a summarized tabulation of the species mentioned in the list at the end of this volume. This table, based upon information available up to the year 1961, illustrates the distribution of the various pest species among different crops or groups of crops.

The table makes it apparent that numerous injurious species occur on most of the crops grown in this country, especially as regards cereals, crucifers, fruit trees, berry bushes, as well as ornamental plants and park trees. Only a part of these species is constituted by those which regularly or occasionally cause great destruction to the crops; most of them are less injurious, or appear but rarely. However, experience has shown that species which occur rarely, or which are considered to be unimportant, can suddenly or gradually develop into harmful pests.

The destructiveness of the pests included in the table is divided up, by both animal and plant groups, into three classes: 1) highly destructive species = ***, 2) moderately destructive = ** and 3) slightly destructive = *.

Obviously, it is not possible to draw clear lines of demarcation between these three categories; for example, certain slightly destructive species may bring about rather extensive localized damage. In addition, both Table 2 and the list at the end of this volume include many species which are not as yet known to be significant as crop pests, but whose larvae have on occasion been found to cause injury to the plant concerned. Such species are indicated by the symbol (*).

Table 2. Numbers of pest species in different crops, and their distribution according to destructiveness

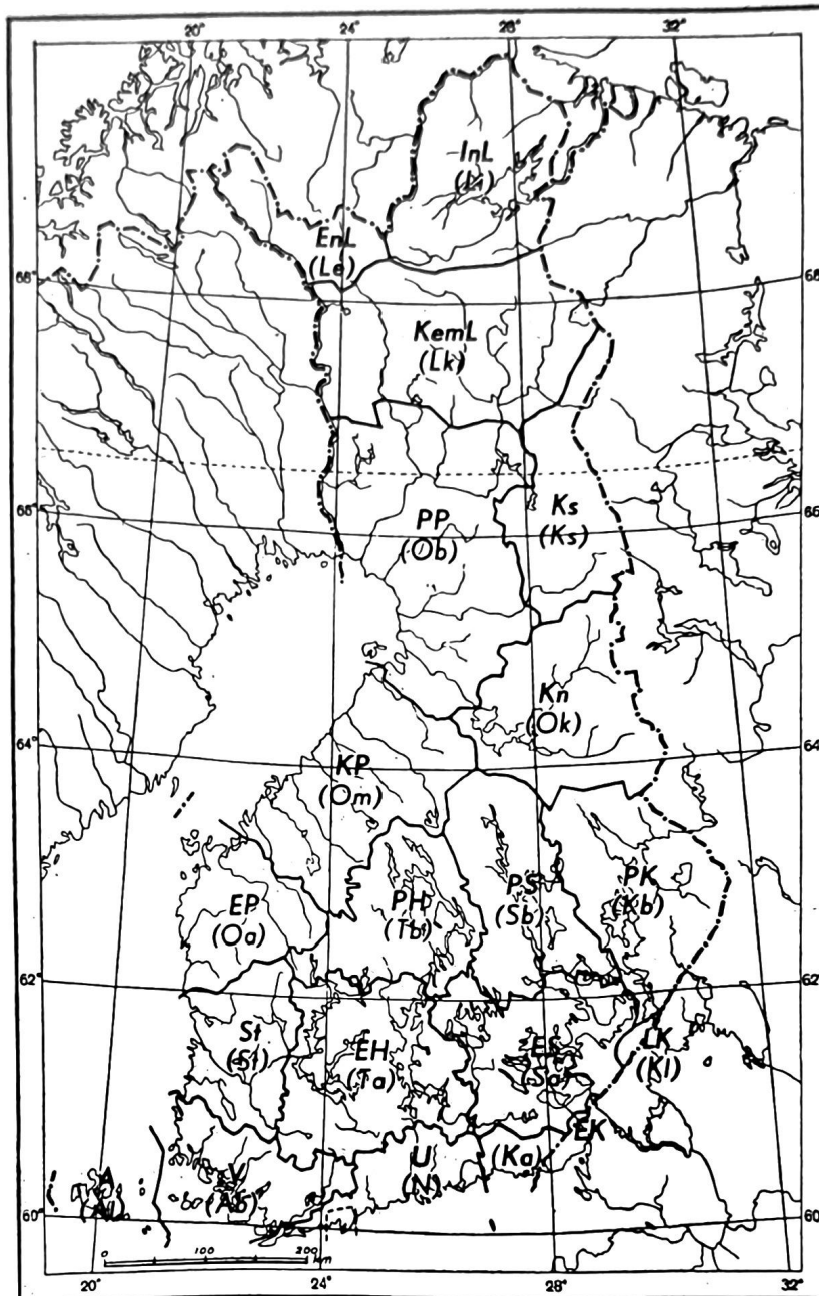
Crops	Collembola	Orthoptera	Dermoptera	Thysanoptera	Hemiptera	Coleoptera	Hymenoptera	Diptera	Lepidoptera	Myriopoda	Acarina	Crustacea	Mollusca	Vermes	Aves	Mammalia	Total	Distribution of species by destructiveness (cf. p. 13)			
																		***	**	*	(*)
Cereals	—	1	—	6	11	19	3	20	11	—	3	—	1	1	13	17	106	23	25	42	16
Gramineous fodder plants..	—	—	—	9	8	11	3	12	31	—	3	—	2	1	—	9	89	18	18	31	22
Peas	—	—	—	1	1	7	—	5	12	—	1	—	1	—	11	1	40	4	8	21	7
Fodder legumes	—	—	—	1	7	21	—	3	34	—	1	—	1	1	1	2	72	5	16	17	34
Potatoes	—	—	1	—	11	6	—	3	9	—	1	—	2	1	6	5	45	6	13	18	8
Beets	1	—	—	1	6	7	—	2	10	—	—	—	—	1	—	2	30	6	8	9	7
Cruciferous root and fodder crops	1	—	—	—	7	16	1	6	20	—	—	—	3	—	4	7	65	18	14	19	14
Cruciferous seed and oil crops	—	—	—	1	5	10	1	7	10	—	—	—	2	—	9	2	47	12	17	15	3
Fibre plants	—	—	—	—	1	3	—	1	3	—	—	—	—	—	1	—	9	—	3	5	1
Hops	—	—	—	—	3	—	—	2	8	—	1	—	—	—	—	—	14	2	2	3	7
Tobacco	—	—	—	—	3	1	—	1	9	—	1	—	1	—	—	1	17	1	2	10	4
Spices and medicinal plants	—	—	—	—	1	2	—	2	4	—	—	—	—	—	—	—	9	—	2	5	2
Osier willows	—	—	—	—	—	1	—	3	3	—	—	—	—	—	—	—	7	—	1	5	1
Field vegetables:																					
Crucifers	—	—	1	—	7	22	2	8	21	—	1	—	4	—	1	3	70	20	13	35	2
Onions	1	—	—	1	—	6	—	9	13	—	3	—	1	—	4	1	39	6	7	16	10
Beans and garden peas..	1	—	—	2	6	8	—	6	7	1	1	—	1	—	4	3	40	5	6	26	3
Cucumbers	1	—	—	1	6	8	1	3	4	—	3	—	2	—	—	3	32	2	5	23	2
Beets	—	—	—	—	4	5	—	1	2	1	—	—	2	—	—	3	19	4	4	9	2
Carrots	—	—	—	—	5	3	1	2	6	—	—	—	3	—	—	5	25	5	8	10	2
Others	—	—	—	1	12	13	1	7	17	—	1	—	3	—	1	3	60	4	6	41	9
Fruit trees	—	—	—	3	24	33	14	2	110	—	9	—	2	—	13	9	219	29	29	104	57
Berry bushes	1	—	—	1	26	29	14	6	79	1	6	—	4	1	16	8	192	22	23	84	63
Ornamental flowers	—	—	—	2	15	25	4	11	55	1	4	—	2	2	—	4	125	4	22	51	48
Ornamental shrubs	—	—	—	1	40	18	28	6	91	—	5	—	2	—	1	5	197	9	21	71	96
Ornamental trees	—	—	—	1	42	30	39	10	172	—	12	—	—	—	—	5	311	10	22	85	194
Greenhouse plants:																					
Tomatoes	1	—	—	—	4	2	1	1	3	—	1	1	—	1	—	1	16	2	4	10	—
Cucumbers	1	—	—	2	3	2	1	—	—	3	3	2	1	1	—	1	20	6	5	8	1
Other vegetables	1	—	—	—	2	1	—	—	—	1	—	1	1	—	—	—	7	—	2	5	6
Ornamental plants	1	1	—	10	23	3	5	5	10	4	10	—	3	3	—	4	82	15	19	42	—
Grape and peach	—	—	—	1	4	—	—	—	—	1	1	—	—	—	—	—	7	1	2	4	—
Mushrooms	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—
Distribution of species by destructiveness	4	2	1	25	162	147	95	99	400	6	44	3	9	8	32	23	1060	114	159	447	340
***	—	—	—	7	26	21	5	14	20	—	10	—	3	1	2	5	—	—	—	—	—
**	—	—	—	7	31	26	12	20	39	2	6	2	1	5	4	3	—	—	—	—	—
*	4	1	1	10	77	78	62	46	105	3	20	1	3	2	25	10	—	—	—	—	—
(*)	—	1	—	1	28	22	16	19	236	1	8	—	2	—	1	5	—	—	—	—	—

APPENDIX

List of cultivated-plant pests and the distribution of injuries caused by them in the biogeographical provinces of Finland (see map, p. 226)

	A	V	U	EK	(KK)	St	EH	ES	LK	EP	PH	PS	PK	KP	Kn	PP	Ks	Kcm	En	In	(Pa)	Class
<i>Plutella porrectella</i> L.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
" <i>maculipennis</i> Curt.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
" <i>annulata</i> Curt.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Ochsenheimeria taurella</i> Schiff.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	(*)
<i>Incurvaria trimaculella</i> H.S. subsp. <i>quadrimaculella</i> Höfn.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Incurvaria rubiella</i> Bjerk.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
" <i>capitella</i> Cl.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
" <i>pecinea</i> Haw.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Heliozela sericiella</i> Haw.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Nepticula pomella</i> Vaugh.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
" <i>aeneella</i> Hein.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
" <i>atricapitella</i> Haw.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
" <i>oxyacanthella</i> Stt.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
" <i>ulmivora</i> Fol.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
" <i>ulmicola</i> Her.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
" <i>marginicolella</i> Stt.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
" <i>subbimaculella</i> Haw.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
" <i>pulverosella</i> Stt.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Eriocrania subpurpurella</i> Haw. subsp. <i>fastuosella</i> Zell.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Myriopoda</i>																						
<i>Polydesmus complanatus</i> L.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Orthomorpha gracilis</i> C. L. Koch ..	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Nopoiulus venustus</i> Meinert	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Cylindrotulus fristus</i> Verh.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
" <i>britannicus</i> Verh.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
? <i>Pachymerium ferrugineum</i> C. L. Koch	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Myriopoda</i>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Arachnoidea</i>																						
<i>Bryobia praetiosa</i> Koch	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Tetranychus urticae</i> Koch	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Eotetranychus tiliarium</i> Hermann ..	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Paratetranychus ununguis</i> Jac.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Metatetranychus ulmi</i> Koch	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•
<i>Tenuipalpus cactorum</i> Oud.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•

	A	V	U	EK (Kk)	St	EH	ES	LK	EP	PH	PS	PK	KP	Ka	Ks	Kem	En	In	(P)	(L)	Chlor
<i>Oxypleurites carinatus</i> Nal.	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	(*)
<i>Nalepella tricerus</i> C.B.	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	(*)
<i>Crustacea</i>																					
<i>Oniscus asellus</i> L.	—	—	×	—	?	×	?	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Porcellio scaber</i> Latr.	—	—	×	×	?	×	?	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Armadillidium vulgare</i> Latr.	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Mollusca</i>																					
<i>Deroceras agreste</i> L.	×	×	×	×	×	×	×	×	×	×	×	×	×	×	—	—	—	—	—	—	•
<i>reticulatum</i> Müll.	—	—	—	—	—	×	—	×	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Limax laevis</i> Müll.	—	×	×	—	—	×	—	×	×	—	—	—	—	—	—	—	—	—	—	—	•
<i>Arión circumscriptus</i> Johnst.	—	×	—	—	—	×	—	—	×	—	—	—	×	—	—	—	—	—	—	—	•
<i>Fruiticola hispida</i> L.	—	—	×	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Succinea putris</i> L.	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Arianta arbustorum</i> L.	—	×	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Oxychilus alliarius</i> Müll., O. sp. ..	—	—	×	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	(*)
? <i>Retinella</i> sp.	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	(*)
<i>Vermes</i>																					
<i>Ditylenchus radicola</i> Greeff	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>dipsaci</i> Kühn	×	×	×	—	—	×	—	—	—	—	—	—	—	—	×	×	—	—	—	—	•
<i>Aphelenchoides fragariae</i> Ritz. Bos. ..	—	—	×	—	×	×	—	—	—	—	—	—	×	—	—	—	—	—	—	—	•
<i>ritzenabosi</i> Schw. ..	—	—	×	—	—	×	×	—	—	×	—	—	—	—	—	—	—	—	—	—	•
<i>Heterodera rostochiensis</i> Woll.	—	×	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>schachtii</i> Schm.	—	×	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Meloidogyne</i> sp.	—	×	×	—	×	×	×	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Enchytraeidae</i>	—	?	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Aves</i>																					
<i>Corvus corone</i> L.	—	×	×	—	×	×	×	×	×	—	—	×	×	—	—	—	—	—	—	—	•
<i>frugilegus</i> L.	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>monedula</i> L.	—	×	×	—	—	×	—	—	—	×	—	—	—	—	—	—	—	—	—	—	•
<i>Pica pica</i> L.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Nucifraga caryocatactes</i> L.	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Garrulus glandarius</i> L.	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Sturnus vulgaris</i> L.	—	—	×	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Chloris chloris</i> L.	—	×	×	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•
<i>Carduelis cannabina</i> L.	—	×	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•



Biogeographical provinces of Finland
(Finnish Zoological-Botanical Society 'Vanamo')

A	Ahvenanmaa	LK	Ladoga Carelia	PP	North Ostrobothnia
V	Finland Proper	EP	South Ostrobothnia	Ks	Kuusamo
U	Uusimaa	PH	North Häme	KemL	Kemi Lapland
EK	South Carelia	PS	North Savo	EnL	Enontekiö Lapland
St	Satakunta	PK	North Carelia	InL	Inari Lapland
EH	South Häme	KP	Central Ostrobothnia		
ES	South Savo	Kn	Kainuu		

Molluscs (*Mollusca*). The grey field slug (*Deroceras agreste* L.), and possibly other related species, are often discoverable on grasses, damaging timothy and meadow fescue as well as other grasses. *Fruticicola hispida* L. was observed in large numbers in the autumn of 1953 on roads, pathways and the edges of fields at Lappeenranta (ES); along field borders there could be counted some hundreds of them in a square metre.

Worms (*Vermes*). The corn eelworm (*Ditylenchus radicola* GREEFF) (cf. p. 27), which is common in barley in north Finland, also lives in the roots of certain grass species, such as meadow foxtail, timothy, meadow grass, and tufted hair grass.

Mammals (*Mammalia*). The common mole (*Talpa europaea* L.) often constitutes a nuisance by reason of its digging tunnels in meadows and hay-fields, and making mounds of earth on the field surface. The mole is to be found throughout south Finland, extending as far as South Ostrobothnia and North Carelia. The Norway lemming (*Lemmus lemmus* L.), which lives in Lapland, causes destruction during what are termed the lemming years. At such times, large hordes of these animals invade fields in the summertime, and eat the grass; in the autumn and winter they attack hay-stacks and barns, destroying the hay stored in them (MUNSTERHJELM 1913, p. 14). The field vole (*Microtus agrestis* L.) is frequently harmful on grasslands, where it feeds on the aerial parts of various grass crops. The continental vole (*Microtus arvalis* PALL.) digs tunnels in the fields, and eats the roots of grasses. In the autumn, voles move to hay-sheds and hay-stacks, causing damage there. Similarly, the water vole (*Arvicola terrestris* L.) often lives in leys and meadows, especially near bodies of water; it occasions damage by eating the growing grass, and forming large mounds of earth on the surface of the fields. Slight damage is brought about by the bank vole (*Clethrionomys glareolus* SCHREB.), to be found throughout Finland, as well as by *Clethrionomys rutilus* PALL., *Clethrionomys rufocanus* SUND., and *Microtus ratticeps* KEYS. & BLAS., all of which are found only in the northern parts of the country (MUNSTERHJELM 1913).

3. Peas

Thrips (*Thysanoptera*). The pea thrips (*Kakothrips robustus* Uz.) appears at times as a very damaging pest as regards field and table peas; it is responsible for withering of the flowers, shrivelling of the terminal parts of the shoots, and discoloration and twisting of the pods. At times of heavy infestation, losses in yield may mount to a figure of 50—75 per cent. Severe damage was reported especially in the years 1915—1916, 1927 and 1945—1946. This species has been found as a pest only in the provinces V, U, St, EH and ES.

Aphids (*Hemiptera, Aphidoidea*). The upper parts of pea shoots, along with the young pods, are sometimes attacked by the pea aphid (*Acyrtosiphon pisum* HARR.), which appears as far north as Kuopio (PS). Only rarely, however, does it cause serious damage. The species was found in abundance on peas at Jokioinen (EH) in the years 1935, 1938 and 1955 (INKILÄ 1960).

1948—1950, 1955—1956 and 1958—1959. Observations made at Jokioinen (EH) showed that the pea moth was exceptionally plentiful in the years 1948 and 1959. In 1948, an average of one-third (32.8 per cent) of the trial pea yields suffered damage as a result of this pest. In 1959, the infested pods in certain pea fields rose to a figure of 37—40 per cent (INKILÄ 1960). Trials showed that early-flowering varieties were more badly damaged than late-flowering ones (INKILÄ 1948).

Mites (Acarina). E. REUTER (1914, p. 8) reported a mild infestation of a »red spider mite» (evidently *Tetranychus urticae* KOCH) on the leaves of field peas at Tikkurila (U).

Molluscs (Mollusca). Slugs (*Deroceras agreste* L., etc.) occasionally cause rather great damage to peas by feeding on their nethermost leaves.

Birds (Aves). The house sparrow (*Passer domesticus* L.), hooded crow (*Corvus corone* L.), jackdaw (*Corvus monedula* L.) and wood pigeon (*Columba palumbus* L.) are often responsible for damage to pea fields, especially when the birds appear in large flocks. They feed on sprouting seeds just after sowing, trample on young seedlings, and later in the summer peck holes in the pods. Other species of pigeons (stock-dove, house pigeon) may also be responsible for this kind of injury. Other species of birds, such as the fieldfare (*Turdus pilaris* L.), continental jay (*Garrulus glandarius* L.), rook (*Corvus frugilegus* L.) and magpie (*Pica pica* L.) are sometimes encountered in pea fields. Mallards (*Anas platyrhynchos* L.) on their migratory flights frequently cause damage to pea fields located near bodies of water (HILLI 1927, 1929; K. E. KIVIRIKKO 1940).

Mammals (Mammalia). Certain voles, such as the continental vole (*Microtus arvalis* PALL.), sometimes injure peas by gnawing the pods.

4. Clover and other fodder legumes

Thrips (Thysanoptera). Seed fields of red and alsike clover are sometimes damaged by *Haplothrips niger* OSB., which live in great numbers in the flower heads, and feed on both the receptacle and the flowers. Mention has often been made of considerable losses in yield caused by this pest, sometimes as much as 25—70 per cent. Nevertheless, the damage inflicted is not easy to distinguish from, say, an absence of fertilization following a lack of pollinating bumble bees. This species, first reported as a pest in Finland in 1913 (LINNANIEMI 1915, p. 6—7), is a common insect in southern and central Finland and has been encountered as far north as Kemi Lapland (Markkula).

Plant bugs, aphids, etc. (Hemiptera). *Halticus apterus* L. has sometimes been found to cause leaf injuries to red clover (KANERVO). At times, large numbers of the sloe bug (*Dolycoris baccarum* L.) have appeared on red and alsike clover at the time the flower heads ripen. They suck the juices from the inflorescence axis and flowers, which makes the flower heads dry (HUKKINEN 1913, p. 173—176; 1913 b, p. 25—28; 1915, p. 6). Less important and sporadic pests of clover are the

(as many as 157 per square metre have been found in places) in the aftermath of clover, where they wholly destroy the leaves, and thus greatly damage the field. Destruction of the field leads to a poor crop in the following year; in addition, animals, especially horses, do not like to feed on pasture infested with larvae. This pest appears to favour red clover, but damage has also been remarked on white and meadow clovers, vetch, and on various grasses (LINNANIEMI and HUKKINEN 1921, p. 9—10, 25). Exceptionally large numbers of larvae appeared in 1914—1917 and 1921, particularly in various parts of the Uusimaa province. Later epidemics occurred in 1926 (Hyvinkää) (U), 1938 (Somero) (EH), 1952 (Somero (EH), Järvenpää (U), Sippola (EK)) and 1953 (Kärkölä) (EH).

Red clover is sometimes rather mildly attacked by the plain yellow twist (*Tortrix paleana* HB.), whose larvae roll and eat the leaves. Similar damage is attributable to the larvae of *Cnephasia virgaureana* TR., which in some years appear in large numbers on red and alsike clover. On one occasion vetch was also infested. Larvae were found in great profusion on red clover in 1954—1955 in many places in south and central Finland, where they were responsible for substantial damage.

At the beginning of the summer, larvae of *Anthrocera meliloti* ESP. and *A. loniceræ* ESP. are found on clover (E. KIVIRIKKO 1941, p. 175; SEPPÄNEN 1954, p. 346), but they cause very little damage. Larvae of *Monima gracilis* FABR. have been observed on red clover (SEPPÄNEN, op.cit., p. 345). Once the writer found many such larvae on lucerne, which they injured severely by twisting the top leaves together (VAPPULA 1943).

According to the data compiled by SEPPÄNEN (1954, p. 345—346), larvae of the additional following species have been found on cultivated clover: *Plebejus idas* L., *Polyommatus icarus* L., *Lasiocampa quercus* L., *Acronycta rumicis* L., *Polia dissimilis* KNOCH, *Monima incerta* HUFN., *Monima opima* HB., *Xylina vetusta* HB. (also on lucerne), *Eumichtis satura* SCHIFF., *Gonospileia glyphica* L., *Eupithecia centaureata* SCHIFF., *Eupithecia satyrata* HB., *Gonodontis bidentata* CL., *Semiothisa clathrata* L., *Ematurga atomaria* L., *Diaphora mendica* CL., *Spilosoma lubricipedium* L., *Phragmatobia fuliginosa* L., *Rhyparia purpurata* L., *Diacrisia sannio* L., and *Arctia caja* L.

Mites (*Acarina*). The hop red spider mite (*Tetranychus urticae* KOCH) is of common occurrence on cultivated clover, especially in the southern parts of the country.

Molluscs (*Mollusca*). Slugs (*Deroceras agreste* L., etc.) appear abundantly at the end of the summer in some years; they invade clover aftermath, and can bring about considerable destruction to the plants.

Worms (*Vermees*). The clover nematode (*Ditylenchus dipsaci* KÜHN) has been found in red clover in Finland in no more than a few localities in the southern region of the country (MARKKULA 1955, p. 165). In at least two cases (in the rural commune of Helsinki (U) 1949—1950 and Padasjoki (EH) 1953) the nematode had been introduced to the fields through the agency of infested seed from Sweden (TINNILÄ 1959, 1960). Thus far, the species has not caused serious damage in this country.

Birds (*Aves*). According to HILLI (1927, p. 127; 1929, p. 42), the wood pigeon (*Columba palumbus* L.) uses cultivated vetch as part of its food supply.

Mammals (*Mammalia*). Voles, especially the continental vole (*Microtus arvalis* PALL.) and the field vole (*Microtus agrestis* L.), prefer to inhabit clover leys, where they often inflict considerable damage by feeding on the roots and aerial parts of red, alsike and white clover.

5. Potatoes

Earwigs (*Dermaptera*). Earwigs (*Forficula auricularia* L.) were once reported to have eaten holes in potato leaves (at Heinola (EH) in 1954).

Plant bugs, aphids, etc. (*Hemiptera*). Plant bugs (*Lygus* spp.) and the common green capsid (*Lygus pabulinus* L.) occur throughout the country, often in potato fields. They prefer to feed on the young leaves, which subsequently become frayed and full of small holes. At times, the damage may be so severe that the tops appear to be withered (HUKKINEN 1913 b, p. 59—60). In two cases¹) *Calocoris fulvomaculatus* DeG. was found to have inflicted the same type of injury on potato foliage. The sloe bug (*Dolycoris baccarum* L.) and the cabbage shield bug (*Eurydema oleraceum* L.) have also sometimes been observed to attack potato plants.

According to data compiled by P. Nuorteva, potato pests include two species of leafhoppers: *Empoasca flavescens* FABR. (at Hattula (EH) and Helsinki (U)) and *E. kontkaneni* Oss. (at Helsinki) (cf. also P. NUORTEVA 1950; 1952 a, p. 29).

Potato plants are further injured by certain species of aphids; Heikinheimo observed the green peach aphid (*Myzus persicae* SULZ.) as well as *Aulacorthum solani* KALT. and *Aphis* sp. to be potato pests in Finland. The direct damage they cause is generally slight, but it is evident that they can be quite harmful as vectors of virus diseases. According to LIRO (1926), *Macrosiphum euphorbiae* Thos (= *M. solanifolii* ASHM.) also spreads potato virus diseases.

Beetles (*Coleoptera*). The foliage of potato plants, especially in north Finland, is frequently attacked by the beet carrion beetle (*Aclypea opaca* L.), which may in some years cause very severe damage. For example, at Petsamo, no longer a part of Finland, it was known to be perhaps the most harmful potato pest; sometimes it was so plentiful in numbers that it destroyed the young plants as they emerged from the soil (PARVELA 1931, p. 55). LINNANIEMI (1935, p. 35) reported that *Longitarsus luridus* SCOP. once slightly injured potato leaves by chewing small notches in them.

The most destructive potato pests in Finland are undoubtedly wireworms (*Elateridae*), which are often found in great numbers in potato fields. They bore into the tubers, and often render them unfit for consumption. Potato fields which are established following leys are especially susceptible to wireworm attacks. So

¹) In one case (at Raahe [KP] in 1918) the species was reported as uncertain (LINNANIEMI 1935, p. 111).

far, it has not been established which species of *Elateridae* is the most injurious to potatoes, but damaging species include *Agriotes obscurus* L., and in Kainuu *Corymbites cupreus* FABR. subsp. *aeruginosus* FABR. as well as possibly *C. melancholicus* FABR. Potato tubers are also attacked by larvae of the cockchafer (*Melolontha hippocastani* FABR.), which have in some cases destroyed more than one half of the yield. In addition, they also cause damage by severing the potato stems at ground level.

True flies (*Diptera*). *Liriomyza solani* MACQ. was found to be a leaf-mining potato pest in the rural commune of Helsinki (U) in 1938, and at Kirkkonummi (U) in 1946 (cf. also FREY 1937, p. 90). Larvae of the lesser bulb flies (*Eumerus tuberculatus* ROND. and *E. strigatus* FALL.) have sometimes been observed to injure the stems of potatoes (e.g. E. REUTER 1897, p. 24), and occasionally they damage the tubers (Kanervo).

Moths (*Lepidoptera*). In epidemic years, larvae of the silver Y moth (*Phytometra gamma* L.) can cause considerable damage to potatoes by eating the leaves. Such damage occurred in some locations in 1922 and 1946. Occasional pests of potato leaves are *Polia oleracea* L. (SEPPÄNEN 1954, p. 369), *Antitype chi* L., *Polia pisi* L.¹⁾ and *Polia persicariae* L.

The stem of the potato plant is frequently damaged by larvae of the rosy rustic moth (*Hydroecia micacea* ESP.), which live inside the stem and make it wither. Destruction caused by this pest has been reported since the year 1906 in various parts of the country, and extending even as far as North Ostrobothnia. In general, damage has been relatively slight, although on occasion appreciable injury has been remarked, especially in small potato fields. Particularly numerous reports of damage were received in the years 1931, 1950—1952, 1955—1956 and 1958—1960.

Larvae of the common dart moth (*Agrotis segetum* SCHIFF.) have at times been observed to injure potatoes by severing the stems at ground level to enable them to feed on the tender top foliage. At times, the tubers are also hollowed out by the larvae (HUKKINEN 1913, p. 157—159; 1913 a). Other closely-related species may also inflict similar damage. In 1943, tubers were reported to have been injured by larvae of *Agrotis ypsilon* ROTT. near Poryoo (U). In 1915 and 1918, larvae attacking potato tubers appeared at Alatornio and Tornio (PP); the species was not positively determined, but was probably *Hepiolus fusconebulosus* DEG. (LINNANIEMI 1920, p. 140; 1935, p. 90; HUKKINEN 1925, p. 71—73). In 1918 especially, the destruction was very great, amounting in certain places to as much as 75 per cent of the potato crop.

Mites (*Acarina*). In a vegetable garden at Helsinki (U), severely infested with hop red spider mites (*Tetranychus urticae* KOCH), potato plants were also found to be injured by these pests. Similarly, mites were plentiful on potato plants in a small plot at Revonlahti (PP) in 1959. E. REUTER (1912, p. 15) mentioned receiving from Sodankylä (KemL) a sample of potato leaves which had been infested with mites.

¹⁾ This species was observed to a certain extent on potato foliage at Jokioinen (EH) in 1959 (INKILÄ 1960).

Birds (*Aves*). Of the different bird species, at least the wood pigeon (*Columba palumbus* L.) can be mentioned as having eaten flax and hemp seeds (HILLI 1927, p. 127; 1929, p. 42).

10. Hops

Aphids, leafhoppers (*Hemiptera*). The hop-damson aphid (*Phorodon humuli* SCHRK) has on occasion appeared in large numbers on the leaves and inflorescences of hops; in the worst cases, it has given rise to the withering and falling of the leaves, along with damage to the cones. By the excretion of honeydew it produces a sticky layer on the surface of the leaves, which can in consequence easily become infected by sooty mould. The species, mentioned for the first time in the annual report of the State entomologist in 1917, has a distribution which extends as far as South Ostrobothnia and North Savo. The two leafhopper species *Helicoptera lapponica* ZETT. and *Hypospadianus torneellus* ZETT. have also been found on hops at Hattula (EH) (P. NUORTEVA 1952 a, p. 19, 25).

True flies (*Diptera*). Leaf mines in hops are caused by three species of leaf-mining flies, all to be found in Finland. *Agromyza igniceps* HEND. was apparently abundant at Revonlahti (KP) in 1945. It was also found at Saltvik in Ahvenanmaa (FREY 1946, p. 18), and at Virolahti (EH). In several other cases, hops were damaged by large numbers of leaf mines, although it was not established whether the causal agent was *Agromyza flaviceps* MEIG. or the chrysanthemum leaf miner (*Phytomyza atricornis* MEIG.). The former species was found by FREY (op.cit.) at Karjaa (V), and by the writer at Tikkurila (U) in 1936.

Butterflies, moths (*Lepidoptera*). The most important pest which injures hop leaves is the buttoned snout moth (*Hyppena rostralis* L.), whose larvae often destroy the leaves so completely that only the petioles and main veins remain. Damage inflicted by this pest has been observed since 1895—1896 in the southern and central parts of the country as far north as Kannus (KP) and Kuhmo (Kn). Larvae of *Vanessa urticae* L. cause similar forms of injury; they make their original habitat on nettles, but move to nearby plantings of hops when the host plant has been consumed and sometimes destroy them completely. Instances of this have been reported from Puumala and Leivonmäki (ES) in 1917 and from Revonlahti (KP) in 1937. Moreover, larvae of *Polygonia c-album* L. have at times been found feeding on hop leaves, for example in the region of Vaasa (EP) (LINGONBLAD 1944, p. 112), Hollola (EH) (HEINÄNEN 1947, p. 11) and Lempäälä (EH) (SALO and SOTAVALTA 1952, p. 95). In addition, larvae of *Pyrameis atalanta* L., *Orgyia antiqua* L., *Acronycta rumicis* L. and *Eupithecia assimidata* DBLD. have been found on hops (SEPPÄNEN 1954, p. 310). Once the writer observed larvae of the European leaf roller (*Cacoecia rosana* L.) inflicting their typical injury on the leaves of hop plants.

Mites (*Acarina*). In some cases, exceedingly large numbers of the hop red spider mite (*Tetranychus urticae* KOCH) have appeared on hops and discoloured the leaves.

11. Spices and medicinal plants

Aphids (*Hemiptera*, *Aphidoidea*). Damage to the inflorescences of fennel occurred at Turku (V) in 1947; the causal agent was apparently *Cavariella aegopodii* SCOP.

Beetles (*Coleoptera*). The green tortoise beetle (*Cassida viridis* L.) was found by the writer at Järvenpää (U) in 1924 and at Tikkurila (U) in 1944 on mint (*Mentha aquatica* and *M. piperita crispata*) as well as on *Melissa officinalis*; larvae ate holes in the leaves, with resultant considerable damage to the plants. *Chrysomela polita* L. damaged the leaves of mint (*Mentha piperita*) at Helsinki (U) in 1943.

True flies (*Diptera*). Mines attributable to the larvae of *Trypeta artemisiae* FABR. were found in the leaves of *Artemisia dracunculus* (LINNANIEMI 1913, p. 85), and mines made by *Philophylla heraclei* L. were encountered in the leaves of common lovage at Turku (V) in 1942.

Butterflies, moths (*Lepidoptera*). Larvae of *Papilio machaon* L. have been observed on caraway, lovage and *Ruta graveolens*, those of *Barathra brassicae* L. on hyssop (*Hyssopus officinalis*) and those of *Dasytopia templi* THNBG on lovage (SEPPÄNEN 1954). In 1956, many larvae of *Depressaria* sp. appeared on a 3-hectare caraway planting at Piikkiö (V); they injured about 50 per cent of the flowers.

12. Tobacco

Plant bugs, aphids (*Hemiptera*). In 1912, the sloe bug (*Dolycoris baccarum* L.) was mentioned as having damaged certain crops, especially tobacco, at Sysmä (EH) (HELLÉN 1913). The cabbage shield bug (*Eurydema oleraceum* L.) has at least on one occasion made a mild appearance on tobacco. In spring 1943, the writer found black aphids on some tobacco plants at Sipoo (U), but the species was not determined. The peach-potato aphid (*Myzus persicae* SULZ.) has also been observed on tobacco (HEIKINHEIMO 1944, p. 4).

Beetles (*Coleoptera*). Wireworms (*Elateridae*) have at times damaged tobacco seedlings. In 1943, severe injury occurred at Sipoo (U), where about 4 hectares of a 10-hectare field were completely destroyed. The wireworms penetrated the stem at ground level, and hollowed out the stem even as far as to the terminal parts of the shoots. As a result the plants were stunted and curved, and had ceased growth.

True flies (*Diptera*). In 1946 the larvae of crane flies (*Tipula* sp.) were reported to have destroyed tobacco seedlings by severing their stems at ground level.

Butterflies, moths (*Lepidoptera*). The most injurious moth species is the cabbage moth (*Barathra brassicae* L.), whose larvae were observed as early as 1911 on tobacco seedlings at Tikkurila (U). During the period 1943—1945,

when tobacco was commonly cultivated in Finland, larvae of this species appeared in many localities; they ate large holes in the leaves, or sometimes even destroyed the entire leaf. In addition to this species, small numbers of the larvae of other moths were also found on tobacco leaves at Tikkurila; these included *Polia oleracea* L., *Polia pisi* L. and *Polia persicariae* L. In 1946 slight damage was caused to tobacco by larvae of the silver Y moth (*Phytometra gamma* L.) (KANERVO 1947, p. 100). Larvae of *Eumichtis bathensis* LUTZ. were discovered on tobacco at Lempäälä (EH) in 1945 (SALO and SOTAVALTA 1952, p. 109). Larvae of *Pieris brassicae* L. and *P. rapae* L. have been observed on Virginia tobacco (SEPPÄNEN 1954, p. 370).

As a tobacco pest larvae of the rosy rustic moth (*Hydroecia micacea* ESP.) have been found twice (at Siilinjärvi (PS) in 1932 and at Tyrvääntö (EH) in 1943); the larvae damaged the plants by hollowing out the roots and lower part of the stems.

Mites (Acarina). The writer once found a light infestation of hop red spider mites (*Tetranychus urticae* KOCH) on home-grown tobacco at Helsinki (U) in 1936.

Molluscs (Mollusca). During the years 1943—1945, slugs (*Deroceras agreste* L.) were responsible for severe damage to tobacco in certain localities; they fed on the basal part of the stem, and made large holes in the lower leaves. A small species of snail was also observed on the leaves of tobacco at Tikkurila (U) (Kanervo).

Mammals (Mammalia). At Laukaa (PH) in 1944, the field vole (*Microtus agrestis* L.) was reported to have damaged tobacco seedlings growing in frames.

13. Osier willows

Beetles (Coleoptera). The brassy willow beetle (*Phyllodecta vitellinae* L.) has sometimes been found to have damaged the leaves of the purple willow.

Sawflies (Hymenoptera). At Mouhijärvi (St) in 1952, sawfly larvae were observed on the terminal shoots of common osier, but the species was not determined.

True flies (Diptera). Globular or knobby-shaped stem galls caused by *Rhabdophaga salicis* SCHRK have been observed several times in the shoots of different species of willow (*Salix purpurea*, *S. purpurea nana* and *S. viminalis*). R. FORSIUS (1927, p. 36) mentioned finding stem galls of *Rhabdophaga dubiosa* KIEFF. (*Rh. dubia* KIEFF.) in *Salix ?purpurea* at Tikkurila (U) in 1924. Curled galls on the edges of the leaves of osier willow due to *Rhabdophaga marginemtorquens* BREMI were found at Helsinki (U) in 1922 (R. FORSIUS 1922; FREY 1925).

Moths (Lepidoptera). Larvae of *Amorpha populi* L. have been observed feeding on the leaves of purple willow at Tikkurila (U). The shoots of osier willow plants at Mouhijärvi (St) were found in 1952 to be infected with leaf rolls produced by the larvae of *Cnephasia virgaureana* TR. Similar injury occurred on purple willow at Hyvinkää (U) in 1945; in this case at least 59 per cent of the leaves — or even more in some plants — were curled by the larva of *Cacoecia rosana* L.

Larvae of *Arctia caja* L. have also been observed on grass onion in Uusimaa (SEPPÄNEN 1954, p. 280).

Mites (*Acarina*). The bulb mite (*Rhizoglyphus echinopus* FUM. & ROB.) has sometimes appeared as a pest in onion cultivations. Its attack results in the plants beginning to decay even in the field, and the onions after harvest may completely spoil. *Eriophyes tulipae* KEIFER is mainly a pest of stored onions. It was found for the first time in Finland at Lepaa (EH) in 1942 (LIRO 1942; 1943, p. 29—31); the damage it inflicted was estimated at about 30 per cent. The species lives principally on the succulent scale leaves, and gives rise to drying of their outer surface. So far, this mite has been found as remotely as North Ostrobothnia (LIRO and ROIVAINEN 1951, p. 140—141). Slight infestations of *Uropoda* (*Urosternella*) *obnoxia* E. REUT. have been observed on onions growing in frames.

Molluscs (*Mollusca*). In severe epidemic years, the grey field slug (*Deroceras agreste* L.), possibly with other related species, has heavily attacked onions, sometimes bringing about complete loss of the crop.

Birds (*Aves*). The hooded crow (*Corvus corone* L.), jackdaw (*Corvus monedula* L.), magpie (*Pica pica* L.) and house sparrow (*Passer domesticus* L.) have sometimes been seen eating onions (HILLI 1927, 1929).

Mammals (*Mammalia*). In some instances, the common mole (*Talpa europaea* L.) has been responsible for great damage by digging tunnels through onion fields; the plants withered and died as a consequence.

C. Beans and garden peas

Springtails (*Collembola*). *Onychiurus armatus* TULLB. was once mentioned (at Vihti (V) in 1904) as having injured beans just after their emergence (E. REUTER 1906 b; 1908, p. 14—15).

Thrips (*Thysanoptera*). Pea thrips (*Kakothrips robustus* Uz.), mentioned for the first time as a pest in Finland in 1906—1907 (E. REUTER 1910, p. 12—13), has from time to time appeared as a destructive pest of both garden and field peas (cf. p. 37). In many cases it has meant losses of 50—60 per cent, and sometimes the entire crop has been almost completely destroyed. The species seems especially to favour sugar peas. In 1936, there was a very severe infestation of *Taeniothrips atratus* HAL. in the flowers of dwarf bean in a Helsinki (U) garden. Most of the flowers were quite full of these thrips, and apparently for this reason were withered (HUKKINEN and SYRJÄNEN 1940, p. 128).

Plant bugs, aphids (*Hemiptera*). *Lygus* bugs have been seen on beans, but with no appreciable injury being caused. The sloe bug (*Dolycoris baccarum* L.) was once reported as abounding on the pods of peas and broad beans, where they inflicted slight damage. The pea aphid (*Acyrtosiphon pisum* HARR.) is relatively common on pea plants, but only rarely does it occur in injurious numbers on the

Agromyza scutellata FALL. However this name has since disappeared from the taxonomy. According to FREY (1946, p. 15), leaf-miners of broad beans include *Liriomyza congesta* BECK., *L. strigata* MEIG. and *Phytomyza atricornis* MEIG., all of occurrence in Finland.

The shoots, flowers and pods of sugar peas and other kinds of garden peas are sometimes severely damaged by larvae of the pea midge (*Contarinia pisi* WINN.) (cf. p. 39). In the region of Helsinki (U), in particular, these larvae have substantially damaged garden peas, principally by curling the leaves of the terminal shoots.

Moths (*Lepidoptera*). Cutworms (*Agrotis* sp.) have at times damaged the seedlings of peas, beans and broad beans by severing the stem at soil level and feeding on the lowermost leaves. In 1934, larvae of *Euxoa obelisca* HB. damaged garden legumes in this manner at Viipuri (EK), and in 1951 larvae of *E. nigricans* L. destroyed peas growing in a frame at Tampere (EH). In the epidemic years 1922 and 1946, the silver Y moth (*Phylometra gamma* L.) was responsible for severe damage to both peas and beans (cf. p. 39), by feeding on the leaves and injuring the flowers and pods. The writer once observed (at Helsinki (U) in 1925) a larva of *Xylina vetusta* HB. eating the leaves of broad beans, and Heikinheimo reported that *Xylina exoleta* L. appeared at Perniö (V) in 1945, where it gave rise to slight injury by feeding on the tips of garden pea shoots. Larvae of *Orgyia antiqua* L. were also found once on broad beans.

The most destructive pest to garden pea seeds is the pea moth (*Laspeyresia nigricana* FABR.), whose larvae often destroy most of the seeds, and at the same time make the pods undesirable for consumption (cf. p. 39).

Mites (*Acarina*). The hop red spider mite (*Tetranychus urticae* KOCH) has occasionally infested runner beans, dwarf beans and sugar peas; runner beans suffer considerably from its depredations.

Myriapods (*Myriopoda*). One myriapod species was once mentioned (at Messukylä (EH) in 1915—1916) as having injured the seeds of sown beans and peas (LINNANIEMI 1920, p. 219). Myriapods were also responsible for severe damage to germinating peas at Kangasala (EH) in 1951.

Molluscs (*Mollusca*). In some epidemic years; grey field slugs (*Deroceras agreste* L.) and other related species, heavily attack garden peas and beans. Slugs have at times appeared in large numbers even at the beginning of the summer, damaging germinating bean seeds, or completely destroying large numbers of seedlings.

Birds (*Aves*). House sparrows (*Passer domesticus* L.) have sometimes proved a nuisance in gardens by breaking open unripe pea pods and eating the seeds. According to data collected by HILLI (1927, 1929), the continental jay (*Garrulus glandarius* L.), fieldfare (*Turdus pilaris* L.) and wood-pigeon (*Columba palumbus* L.) have sometimes been seen feeding on peas and beans.

Mammals (*Mammalia*). The yellow-necked field-mouse (*Apodemus flavicollis* MELCH.) was said by K. E. KIVIRIKKO (1940, p. 61) to have caused damage

by breaking pea pods in gardens. In a similar fashion, the Norway rat (*Rattus norvegicus* ERXL.), when in large numbers, may destroy pea pods (for example, at Korkeasaari in Helsinki (U) in 1943). According to VÄLIKANGAS (1942), bank voles (*Clethrionomys glareolus* SCHREB.) were particularly numerous in 1941—1942 at Sipoo (U), where they gnawed at pea pods, and carried them away to their winter storage places; as a result the yield of one variety of round-seeded pea was reduced by at least 30 per cent. According to MYLLYMÄKI (1959, p. 79), damage attributable to voles (*Arvicolidae*) has also been found on the young shoots of garden pea plants.

D. Cucumbers

Springtails (*Collembola*). The garden springtail (*Bourletiella pruinosa* TULLB.) has at times injured the leaves of cucumber seedlings, both in frames and in outdoor plantings (LINNANIEMI 1920 b, p. 17).

Thrips (*Thysanoptera*). Onion thrips (*Thrips tabaci* LIND.) seriously infested cucumbers in frames at Piikkiö (V) in 1935 (HUKKINEN 1936 a, p. 132).

Plant bugs, aphids (*Hemiptera*). *Lygus* bugs have occasionally appeared in profusion on cucumbers, which they damage, and particularly the young terminal leaves. At Anjala (U) in 1951 and 1952, these pests destroyed 50—75 per cent of the cucumber crop. At Raahe (KP) in 1918, the common green capsid (*Lygus pabulinus* L.) was observed in large numbers together with *Calocoris ?fulvomaculatus* DEG. on cucumbers growing out-of-doors; the plants withered as a result of the infestation. At Tuusula (U) in 1915, larvae and adults of some psyllid (*Psylla* sp.) appeared on the lower surface of the cotyledons of cucumber seedlings which had been transplanted outdoors; the pests caused yellow spots in the leaves. The species was not determined (LINNANIEMI 1920, p. 180—181). Occasionally, small numbers of aphids have been found on the leaves of cucumbers in various parts of the country, but to date it is not known whether these were melon aphids (*Aphis gossypii* GLOV.), as was presumed by LINNANIEMI (1935, p. 121—122). According to E. REUTER (1901, p. 33), aphids severely infested cucumbers, especially those in frames, at Espoo (U) in 1900, with the result that the leaves wilted and shrivelled. The peach-potato aphid (*Myzus persicae* SULZ.) has also been observed on cucumbers (Heikinheimo).

Beetles (*Coleoptera*). Cucumber seedlings growing in frames are sometimes severely attacked by rove beetles (*Trogophloeus pusillus* GRAV.), which make holes in the leaves and fruits. The damage was observed for the first time in Finland near Helsinki (U)¹ in 1906. Subsequently the species has appeared as a destructive pest in the region of Turku (V), Uusimaa (in and near Helsinki, Per-

¹ The cause of the damage was stated by E. REUTER (1909, p. 11) to be *Trogophloeus corticinus* GRAV., but evidently the species was in fact *Tr. pusillus* GRAV. (LINNANIEMI 1915, p. 7).

naja), South Häme (Loppi, Tyrvöntö, Ylöjärvi) and Central Ostrobothnia (Raahe). Once apparently this species attacked the seedlings of melon growing in frames.

The false cabbage flea beetle (*Halitica oleracea* L.) was mentioned by E. REUTER (1901 a, p. 32) as having injured the leaves of cucumbers growing outdoors at Espoo (U) in 1900. *Bembidion quadrimaculatum* L. and *B. lampros* HBST have on a few occasions been reported as damaging cucumber plantings; in one case, the insects fed on the leaves, and perhaps also severed the plant at the root. The beet carrion beetle (*Aclypea opaca* L.) when in large numbers has also injured cucumbers. At Michikkälä (EK) in 1934 *Harpalus pubescens* MÜLL. was seen to have severed cucumber seedlings, and fed on the sown seeds so that no more than the empty hull remained.

Wireworms (*Elateridae*) sometimes inflict considerable damage on cucumbers growing outdoors. In some instances, nearly all of the seedlings were destroyed by the larvae. Larvae of the cockchafer (*Melolontha hippocastani* FABR.) have also appeared in damaging amounts in cucumber beds.

A n t s (*Hymenoptera*, *Formicidae*). Ants often constitute a nuisance by building their nests in cucumber frames or in outdoor beds, with the result that the young seedlings suffer from desiccation.

T r u e f l i e s (*Diptera*). In at least one case, larvae of crane flies, most likely the common crane fly (*Tipula oleracea* L.), have damaged outdoor cucumbers. At Piikkiö (V) in 1937, large numbers of the larvae of *Hylemyia liturata* MEIG. appeared as miners in the stems of cucumbers, destroying 60—70 per cent of the seedlings (VAPPULA 1937 b). Evidently injury attributable to the same species occurred in 1943 at Siilinjärvi (PS) and in 1953 at Kuusisto (V); in the latter case the larvae were reported to have injured germinating seeds, later penetrating the stem and hollowing it out. Tunnel mines have sometimes been found in cucumber leaves. Once, such mines were found by LINNANIEMI (1913, p. 116) to originate in the chrysanthemum leaf miner (*Phytomyza atricornis* MEIG.). Small numbers of the same species appeared in 1946 in the leaves of cucumbers growing in frames at Kirkkonummi (U).

M o t h s (*Lepidoptera*). Cutworms (*Agrotis* sp.) have occasionally appeared in profusion in cucumber beds; in one case they inflicted rather severe injury by severing the seedlings at ground level. Very often, it was not possible to determine which species was responsible. In 1934 at Viipuri (EK), the causal agent was found to be *Euxoa obelisca* Hb., and in 1952 at Rauma (St) *Euxoa tritici* L. was established as the pest. In 1946, larvae of the silver Y moth (*Phytometra gamma* L.) caused rather severe localized damage to cucumbers (KANERVO 1947, p. 99). Larvae of the cabbage moth (*Barathra brassicae* L.) have sometimes been found on squash (SEPÄNEN 1954, p. 376).

M i t e s (*Acarina*). The hop red spider mite (*Tetranychus urticae* KOCH) has at times attacked cucumbers growing outdoors; as a result of their feeding, the leaves become pale and blotched. This pest has on occasion been responsible for

16. Fruit trees

Thrips (*Thysanoptera*). Flower thrips (*Frankliniella intonsa* TRYB.) were encountered in the summer of 1939 at Janakkala (EH) as pests on young apple trees, whose growth they considerably hindered. *Thrips major* Uz. also appeared as a pest of young apple seedlings in 1942 near Hämeenlinna (EH), although the injuries were mild (HUKKINEN, Ann. Report of the Dept. of Pest Invest. 1942). In 1936, rose thrips (*Thrips fuscipennis* HAL.) harmed young leaves and stalks of developing fruit on apple trees at Kalanti (V) and Loppi (EH) (VAPPULA 1938, p. 8).

Plant bugs, aphids, etc. (*Hemiptera*). Capsid bugs are often plentiful on apple, plum and cherry trees; they injure young shoots, and in severe cases the leaves become brown and withered. At times, unripe apples are damaged by these bugs, resulting in pits and brown patches on the surface. Fruit tree pests in Finland include at least Lygus bugs (*Lygus* spp.) and apple capsid bugs (*Plesiocoris rugicollis* FALL.), both of which occur as far as North Ostrobothnia (PP). Occasionally the sloe bug (*Dolycoris baccarum* L.) has appeared in large numbers on apple and pear trees in the spring, feeding on and injuring the young shoots. *Coreus marginatus* L. inflicted similar damage on apple trees at Sipoo (U) in 1898.

One of the most destructive apple tree pests in Finland is the apple sucker (*Psylla mali* SCHMIDBG.)¹⁾, whose larvae penetrate the unfolding buds in the spring and suck juice from them. Later, they inhabit in particular the base of the petiole and the unopened flower buds, causing the desiccation of these parts of the plant. At the end of June, adults are produced, which to some extent injure the leaves and fruits of apple trees. The apple sucker is very common in south and central Finland, where apples are grown, and it has been found as far north as the regions of Oulu (PP), Iisalmi (PS) and Joensuu (PK). At times the destruction it has brought about has been very great; in the worst cases, nearly all the flower buds have dried and become stuck to one another. This pest has also attacked pear trees. Reports have been made of considerable damage being done at least in the years 1915, 1933, 1937—1939, 1948—1950, 1952, 1954, 1959 (KANERVO 1960 a) and 1960. In south Finland (Finland Proper, Uusimaa, South Carelia) small numbers of another psyllid species, *Psylla costalis* FLOR, have been found on apple trees; it winters as an adult, and lays its eggs on the young leaves of opening buds.

Heavy infestations of *Psylla pyrisuga* FÖRST. have appeared in some areas on pear trees. The species has been found at least in Finland Proper (Angelniemi in 1953 and Lohja in 1955) and in Uusimaa (Hyvinkää in 1953, Helsinki in 1956). *Psylla pyri* L. has also been found as a pear tree pest at Parainen (V) (O. M. REUTER 1876, p. 70) and Karjalohja (V) (LINNANIEMI 1915, p. 60) and possibly also at Nauvo (V) (ÅBERG 1938).

¹⁾ LISTO (1930) was the author of an article on the apple sucker in Finland and the damage it inflicts in this country.

the fruit were injured on some of the trees in an orchard. Slight damage has also been observed at Lohja (V) in 1940, at Tikkurila (U) in 1945 and 1947, and at Salo (V) in 1949 (KANERVO). Evidently this species appears at certain times as a significant plum orchard pest in south Finland.

Mites (Acarina). The fruit tree red spider mite (*Metatetranychus ulmi* KOCH) is one of the most destructive pests of fruit trees in this country, injuring apple, plum and bullace trees, and sometimes also pear and cherry trees. The species was first observed in Finland in 1901, when according to E. REUTER (1902, p. 68) it brought about severe injury to plum trees at Parainen (V). In 1917, these mites were plentiful on apple trees at Porvoo (U) and in 1922 on plum trees at Naantali (V) (LINNANIEMI 1935, p. 132). Since 1924, reports of damage by this species have been received annually from various parts of the country and at times the damage has been very great in extent. In 1934 and 1935, it was found as far as Oulu (PP), and in 1954 Heikinheimo saw moderate numbers of mites in an orchard at Simo (PP), apparently the most northerly location in Finland where the fruit tree red spider mite has been found. As most commercial nurseries are infested with mites, this pest has been able to spread to many parts of the country. The mites live in large numbers on the lower surface of the leaves, feeding on them; the result is that the leaves often become brownish-grey, and even fall off prematurely. During the course of the summer, 3—5 generations are produced, dependent on the weather conditions (LISTO et al. 1939, p. 38). Particularly heavy infestations of mites were recorded in the years 1931, 1933, 1934, 1936—1937, 1939 (locally), 1947—1948 (locally), 1952, 1955, 1957 and 1959 (cf. KANERVO 1960 a). In 1955 in particular, the reproduction of mites was profuse; by the autumn, the leaves of apple trees in many orchards had become prematurely brown, thus hindering their photosynthetic activity. Since the 1930's, attention has been paid to control of the fruit tree red spider mite (LISTO 1935 a, 1935 b; LISTO and LISTO 1937; HEIKINHEIMO 1956; KANERVO 1956 a).

The apple gall mite (*Eriophyes malinus* NAL.) is a common pest on apple trees, and produces white or reddish felted galls (which later turn brown) on the under-surface of the leaves. The species, first observed as a pest in this country at Tikkurila (U) in 1911¹), occurs in southern Finland as far as the regions of Laukaa (PH) and Suonenjoki (PS). Its most severe attacks are directed against old trees, but in general it does not inflict serious damage. *Eriophyes mali* NAL. was found as a pest on the leaves of apple trees at Nauvo (V) in 1952.

Injuries brought about by the leaf and bud mite (*Phyllocoptes schlechtendali* NAL.) were first observed in 1926 at Hyvinkää (U), and two years later at Sortavala (LK) (LISTO 1933 a, 1934 a). Subsequently, it has been found in several communities, the northernmost being Revonlahti (KP). The species lives freely on the leaves of apple trees, and when it appears in large numbers may cause the leaves to turn yellow and dry during the summer, thus hindering the growth of the trees. This

¹) According to LINDROTH (LIRO) (1899, p. 18) it was found earlier at Hammarland (A), Suursaari (EK), and Kaukola (LK).

roots, evidently caused almost exclusively by the water vole. The annual losses to fruit and ornamental trees for which voles are responsible are estimated at 100—200 million marks; in exceptional epidemic years such losses may be substantially greater (MYLLYMÄKI 1959).

It has been stated that the red squirrel (*Sciurus vulgaris* L.) carries off apples, pears and other fruits in order to eat their seeds (KORVENKONTIO 1926; RIKALA 1937). In addition, it has been seen feeding on the bark of apple trees, and eating nuts (VARTIO 1946, p. 67, 69). In one case, squirrels were suspected of removing all the buds from the branches of an apple tree (PEKKOLA 1938).

In some instances, elks (*Alces alces* L.) have visited fruit orchards, eating the terminal shoots of the twigs, and breaking branches and even the trunks of the trees (Metsästys ja Kalastus 1950, p. 110; COLLAN 1951). In 1951 at Parainen (V), elks destroyed several thousand marketable fruit tree saplings in a nursery, as well as rootstocks, resulting in damage to the extent of over 2 million marks (COLLAN, op.cit.).

17. Berry bushes

Springtails (*Collembola*). In 1924, springtails, evidently *Sminthurus viridis* LUBB. var. *nigromaculata* TULLB., appeared in large numbers on strawberry leaves in a garden at Tikkurila (U), causing curling of the leaves (HUKKINEN and VAPPULA 1935, p. 14).

Earwigs (*Dermaptera*). At times, rather large numbers of earwigs (*Forficula auricularia* L.) have been found on currant bushes; on one occasion it was stated that they had attacked ripe fruit.

Plant bugs, aphids, etc. (*Hemiptera*). Capsid bugs often infest berry bushes, particularly currants, but also gooseberries, raspberries and strawberries. At the beginning of summer, they feed on growing shoots, of which the young leaves subsequently become brown and dry. Older leaves become wrinkled and discoloured. In the worst cases, the bushes dry almost entirely, and the berries fall to the ground before they have ripened. On occasion, damage has been especially great in North Ostrobothnia, e.g., in 1919 at Oulu, 1930 at Tornio, 1933 at Alatornio and Ylitornio, 1944 at Kemi, 1951 at Tervola and Alatornio, 1954 at Oulu, Tornio, Ylitornio and Rovaniemi, and 1956 at Tornio. The species mentioned in literature as inflicting damage is usually the tarnished plant bug (*Lygus pratensis* L.), but in fact the principal causes of damage to berry bushes are the common green capsid (*Lygus pabulinus* L.) and the apple capsid (*Plesiocoris rugicollis* FALL.). The former was found as early as in 1918—1919 as a pest at Raahe (KP) (LINNANIEMI 1935, p. 111), and the latter on currant bushes in 1931 at Kauhajoki (EP), in 1933 at Alatornio and Ylitornio (PP) (VAPPULA 1935 c) and in 1935 in Helsinki (U) (Vappula)¹).

¹) Currants were further infested with *Calocoris biclavatus* H.S., but this species was evidently less injurious than the apple capsid.

the developing shoots completely. The species is rather common in Finland, but damage was first noted in 1934, when it was extensive in gardens at Kumpula in Helsinki (U) (VAPPULA 1935 c). Since then, serious damage has occurred several times in south Finland, including the region of Tampere (EH). In 1943, this species, together with *Argolamprotes micella* and *Notocelia roborana*, destroyed 40—60 per cent of the raspberry buds and shoots at Hämeenlinna (EH), with the berry yield thereby being reduced by 30—40 per cent (HUKKINEN 1943). Similar cases of destruction were reported in 1938 at Sipoo (U), in 1945 at Uusikaupunki (V), in 1946 at Kotka (EK), in 1948 at Sauvo (V), and in 1952 at Tampere (EH). The buds of raspberry plants, and the shoots emerging from them, are also injured by *Argolamprotes micella* SCHIFF., found as a pest in 1925 at Tikkurila (U) (VAPPULA 1926 b) and in 1943 at Hämeenlinna (EH) (HUKKINEN 1943).

Myriapods (*Myriopoda*). Myriapods have at times inflicted considerable damage on ripe strawberries by eating holes in them. In two cases (at Kirkkonummi (U) and Tyrvääntö (EH) in 1915—1916), slight injury was caused by flattened millipedes (*Polydesmus complanatus* L.) (LINNANIEMI 1920, p. 218—219).

Mites (*Acarina*). A pest especially injurious to berry bushes is the gooseberry red spider mite (*Bryobia praetiosa* KOCH), which feeds on the leaves, causing their discoloration, withering, yellowing, and curling of the edges. The berries are smaller than usual, and fall prematurely. Damage is mainly confined to gooseberry bushes, but is sometimes extended to currant. The gooseberry red spider mite was first observed in this country in 1920 at Tammela (EH), infesting black currant, and has since been found from time to time in the southern and central parts of the country as far as the regions of Vaasa (EP) and Jyväskylä (PH). The hop red spider mite (*Tetranychus urticae* KOCH) has also appeared occasionally as a harmful pest, particularly on the leaves of black currant. However, it usually attacks strawberry and raspberry plants, whose leaves subsequently become yellow and twisted. Such damage has been reported from as far north as North Ostrobothnia.

The most destructive pest of cultivated strawberry is the strawberry mite (*Tarsonemus pallidus* Bks), which mainly lives on young, unexpanded leaves, causing them to become stunted, twisted and brownish in colour. The flowers wither, the fruit is small, and in the worst cases the plants die. The strawberry mite was first found at Parainen (V) in 1902 (E. REUTER 1903, p. 18; 1906 a). In 1904 and 1911 it was encountered at Helsinki (U), and after 1914 many reports told of its appearance in different localities. During the 1940's and 1950's in particular it became commoner, inflicting substantial damage on strawberry plantings.¹⁾ In some cases, it has completely destroyed the entire field. Damage was particularly severe in 1959—1960. In the main the mite has spread through the agency of infested commercial plants. This pest is found in south and central Finland, and has been observed as far north as the region of Tornio (PP).

¹⁾ A detailed description of the strawberry mite and its control has been given by HEIKINHEIMO (1953 a, 1953 b).

by voles, most by the water vole (*Arvicola terrestris* L.) and continental vole (*Microtus arvalis* PALL.), which dig tunnels in the soil and feed on the roots of the plants. During the winter of 1957—1958, water voles killed many blueberry bushes at Piikkiö (V) (HÄRDH 1959, p. 139). VÄLIKANGAS (1942) reported that the bank vole (*Clethrionomys glareolus* SCHREB.) appeared as a garden pest at Sipoo (U), injuring strawberries and other plants. However, the damage inflicted by voles on cultivated berries is not as great as their depredations in orchards.

18. Ornamental flowers grown out of doors

E a r w i g s (*D e r m a p t e r a*). In 1953, the author found that earwigs (*Forficula auricularia* L.) had damaged the flowers and leaves of dahlias at Kuhmalahti (EH), and had caused injury to indoor plants such as *Thunbergia alata*. In 1952, this species was mentioned as a pest of both outdoor and indoor ornamentals at Rääkkylä (PK), and in 1960 it fed on the leaves of ornamental plants at Korppoo (V).

T h r i p s (*T h y s a n o p t e r a*). The chrysanthemum thrips (*Thrips nigropilosus* Uz.) was first observed in Finland at Hyvinkää (U) in 1926, where it severely damaged cornflower (*Centaurea montana*) leaves (HUKKINEN 1927; 1936 a, p. 130). It was assumed that the species had entered the country through the agency of imported plants. Cornflowers were similarly found by HUKKINEN (op.cit.) at Hyvinkää to be infested by cabbage thrips (*Thrips angusticeps* Uz.).

P l a n t b u g s , a p h i d s , e t c . (*H e m i p t e r a*). Plant bugs (*Lygus* spp.) sometimes harm ornamentals, in particular chrysanthemums, dahlias, and China asters, by feeding on their shoots. These pests are particularly noxious on chrysanthemums grown outdoors. They feed on the flower buds, with the result that the flower heads are either lacking or defective and the shoots are malformed. In some cases, entire plantings have been lost in this manner. On one occasion, hollyhocks (*Althaea rosea*) were injured in the same way by plant bugs. During the spring of some years, sloe bugs (*Dolycoris baccarum* L.) have attacked and badly damaged annual and perennial ornamentals, such as the nasturtium, *Nemesia*, squill, phlox, doricum, China aster, *Onopordum*, spiraea, fern and stock. *Coreus marginatus* L. has also been observed on perennials. O. M. REUTER (1880, p. 161; 1881) mentioned the cabbage shield bug (*Eurydema oleraceum* L.) as having completely destroyed newly-set seedlings of stock at many places at Uskela (V) in 1877. Since 1914 in particular, it has on many occasions caused severe damage to stocks, sometimes also to queen stocks, nasturtiums and alpine rockcress, and at times to sweet peas and mignonette.

At times, perennials suffer large infestations of the common froghopper (*Philaenus spumarius* L.), resulting in curling of the leaves and withering of the flower buds. Chrysanthemums and phlox are on occasion severely damaged, with milder injury being inflicted upon the coneflower, solidago, poppy, violet and annual daisy (*Chrysanthemum coronarium* and *Chr. carinatum*).

Myriapods (*Myriopoda*). In 1939, large numbers of myriapods (species undetermined) appeared in partially-decayed tulip bulbs set outdoors at Helsinki (U). They had made holes in the bulbs, and damaged the healthy tissues of the plants.

Mites (*Acarina*). The hop red spider mite (*Tetranychus urticae* KOCH) is occasionally responsible for considerable damage to outdoor ornamentals, resulting in discoloration of the leaves. Severe or moderate injury has been observed on scarlet runner bean, sweet pea, hollyhock, mallow, *Aristolochia clematidis*, hydrangea, dahlia, *Centaurea montana*, coneflower, campanula, lupin, larkspur, columbine, *Astilbe arendsi*, violet, *Physalis alkekengi* and *Cephalaria tatarica*. Mild injury has been remarked as regards poppy (*Papaver nudicaule* and *P. orientale*), snapdragon, morning glory, *Omphalodes verna*, phlox, *Lychnis chalconica*, sunflower and daisy. In 1916, *Uropoda* (*Urosternella*) *obnoxia* E. REUT. damaged a large number of sweet pea plants growing in frames at Turku (V) by severing their stems at ground level (LINNANIEMI 1920, p. 210). On at least one occasion (at Anjala (U) in 1953) bulb mites (*Rhizoglyphus echinopus* FUM.& ROB.) have injured tulip bulbs in outdoor beds.

Phyllocoptes violae NAL., which produces leaf edge galls in violets, was first observed in this country in 1927 at Helsinki (U) (LIRO 1927; 1940, p. 41). It destroyed entire frames of horned violet (*Viola cornuta*), and also damaged ordinary garden violets (*Viola tricolor maxima*) in the rural commune of Helsinki. This pest has also been found at Kauniainen (U) (H. ROIVAINEN 1947, p. 27) and at Espoo (U) in 1949.

Molluscs (*Mollusca*). In some years, when slugs, especially grey field slugs (*Deroceras agreste* L.), are very numerous, they may inflict severe damage on ornamental plants by feeding on their leaves. In particular, they have injured dahlia, gladiolus, *Hosta*, salvia, nasturtium and *Chrysanthemum carinatum*; on occasion, they have destroyed young seedlings even in the cotyledon stage. In 1954, *Arianta arbustorum* L. injured some flower plants at Helsinki (U).

Worms (*Vermes*). In 1946, the author found steam and bulb eelworms (*Ditylenchus dipsaci* KÜHN) in phlox growing in a Helsinki (U) park. The stems of the infested plants were swollen, the leaves had become narrow strips, and the lowermost leaves had turned brown. Such injury was apparent in red-flowered varieties, while white-flowered varieties grown in the same group appeared to be quite healthy. In 1950, a plant sample displaying similar damage was received from Turku (V).

In 1932, enchytraeids (*Enchytraeidae*) were observed in the decayed lower part of primrose (*Primula obconica*) plants growing in frames at Tyrvääntö (EH), and in the soil nearby. These worms were either the primary or at least the secondary cause of the damage (Hukkinen).

Mammals (*Mammalia*). Common moles (*Talpa europaea* L.) have sometimes been (e.g., at Loppi (EH) in 1917) noxious pests in flower beds, where they dig tunnels just under the ground surface, resulting in the collapse and desiccation of the plants. They may also be harmful in plantings where flower bulbs are produced (V. SIIVONEN 1957).

Voles, especially the water vole (*Arvicola terrestris* L.), field vole (*Microtus agrestis* L.) and continental vole (*Microtus arvalis* PALL.), occasionally damage outdoor ornamental plants; they feed on flower bulbs and the roots of perennials, and destroy young seedlings on their emergence from the soil. The water vole and continental vole are particularly voracious eaters of flower bulbs. In 1938, scores of lily bulbs were found in the storage chambers of water voles at Sääksmäki (EH) (K. E. KIVIRIKKO 1940, p. 81). In 1950, water voles destroyed at Korso (U) a great number of tulip and narcissus bulbs which had been buried in the ground; losses amounted to 100 000—150 000 marks (Puutarha-Uutiset 1950, No. 50). At Urjala (EH), field voles were seen to take sown sunflower (*Helianthus annuus*) seeds, along with leaves and shoots of stonecrop (*Sedum ewersii*), from the fields and carry them away (BRANDER 1955 a, p. 66). At Hattula (EH) in 1941 this same pest ate germinating sweet pea seeds in a frame, which meant that sowing had to be repeated four times.

Vole damage has also been observed in chickweed (*Cerastium*), chrysanthemum, bleeding heart (*Dicentra*), *Gypsophila*, iris, primrose, poppy, phlox and violet (MYLLYMÄKI 1959, p. 78).

19. Ornamental shrubs

Thrips (*Thysanoptera*). At Janakkala (EH) in 1945, flower thrips (*Frankliniella intonsa* TRYB.) were present on the flowers of Persian yellow rose and Valamo rose, although no damage was inflicted. In 1934, some thrips species appeared in large numbers on the terminal buds and young leaves of hawthorn at Nurmijärvi (U); as a result considerable withering of these parts of the plants occurred.

Plant bugs, aphids, etc. (*Hemiptera*). Capsids have at times been found as pests of ornamental shrubs. In 1918—1919, the common green capsid (*Lygus pabulinus* L.) appeared together with *Calocoris ?fulvomaculatus* DEG. at Raahe (KP); much damage was done to rose bushes, of which the young leaves withered as a result of the injury, and the older leaves became full of feeding-holes. The tarnished plant bug (*Lygus pratensis* L.) was also partly responsible for the damage inflicted. Capsids have also been seen to injure young shoots of Virginian creeper. *Calocoris biclavatus* H. S. was found by O. M. REUTER (1880, p. 168) on spiraea at Vestanfjärd (V). On one occasion, *Coreus marginatus* L. was observed to injure the leaves of lilac.

In 1935 *Stephanitis oberti* KOL. was found by SAALAS (1936) to be an injurious rhododendron pest at Karjalohja (V). The species, quite common on wild dwarf shrubs in Finland, was in this instance introduced from Germany along with imported rhododendron plants. The damage mainly affected *Rhododendron catawbiense*, of which the leaves had become discoloured, or had completely lost their green colour. The species had not previously been observed with certainty as a pest in

TENGSTRÖM 1948, p. 106). Injury has also been noted on honeysuckle (*Lonicera periclymenum*, *L. caprifolium*), viburnum (*Viburnum opulus pygmaeum*), lilac (*Syringa josikaea*), rose, privet, snowberry, cotoneaster and hawthorn. The species appears as far north as the region of Oulu (PP) (VAPPULA 1933 b). *Argyroploce siderana* TR. was found in 1960 to be a pest of spiraea at Hamina (EK) (TIENSUU 1961). Larvae of *Peronea holmiana* L. were seen on cotoneaster at Föglö (A) (NORDMAN 1943, p. 175). Larvae of *Cnephasia virgaureana* TR. were once remarked on rose, and once on common osier and hawthorn.

NORDMAN (1943, p. 179) reported the discovery of larvae of *Taygete mouffetella* SCHIFF. on honeysuckle at both Föglö (A) and Helsinki (U). The larvae live inside tubular leaf-rolls. Leaf-mines made by larvae of the apple and plum casebearer (*Coleophora serratella* L.) have been found at Helsinki (U) on cotoneaster and *Pera-phyllum* (KANERVA 1925), and in profusion on *Forsythia* in 1925—1927 (HACKMAN 1945, p. 30), as well as on hawthorn at Jyväskylä (PH) in 1951.

The most damaging lilac pest is the lilac leaf-miner (*Caloptilia syringella* FABR.), whose larvae make large blister mines in the leaves and thereby disfigure the appearance of the bushes. In some years, the injury is so extensive that the bushes appear completely brown. The lilac leaf-miner, which produces two larval generations during the summer, is common in south and central Finland; to date, damage has occurred as far north as South Ostrobothnia and North Savo. The round, brown leaf-mines made by *Leucoptera scitella* ZELL. abound on cotoneaster, but are less numerous on hawthorn and june-berry (NORDMAN 1957 b). Larvae of *Hyponomeuta cognatellus* HB. inflicted considerable damage to *Euonymus* in 1919 at Turku (V) and in 1920, 1925 and 1928 at Helsinki (U). Small numbers of larvae of *Hyponomeuta irrorellus* HB. were found on sloe at Föglö (A) (NORDMAN 1943, p. 152). A heavy infestation of *Swammerdamia lutarea* HAW. occurred in 1945 on a hawthorn hedge at Maarianhamina (A); the leaves of the young shoots were so badly injured, that from a distance the hedge appeared grey in colour (NORDMAN 1946). Larvae of *Cerostoma xylostellum* L., which roll the leaves of honeysuckle, abounded on *Lonicera xylostemum*, *L. caprifolium* and *L. sp.* in 1934 and 1942 at Helsinki (U), and in 1945 at Tikkurila (U). *Nepticula oxyacanthella* STT., first found in Finland by KANERVA (1928) at Helsinki (U), produces tunnel mines in the leaves of hawthorn. Such mines were very numerous at Kymi (EK) in 1954 (NORDMAN 1955).

Mites (Acarina). The hop red spider mite (*Tetranychus urticae* KOCH) has brought about severe damage to the following ornamental shrubs in south Finland: *Hydrangea paniculata*, laburnum, roses, shrubby cinquefoil, *Celastrus orbiculata*, *Actinidia*, spiraea, buckthorn (*Rhamnus frangula*, *Rh. alpina*), ampelopsis, dogwood, elder, viburnum and honeysuckle. The fruit tree red spider mite (*Metatetranychus ulmi* KOCH) has at times appeared in large numbers on hawthorn, and in small numbers on cotoneaster and june-berry (LISTO et al. 1939, p. 16). *Eriophyes goniothorax* NAL., which causes erineum in the rolled leaf edges of hawthorn,

has been observed in Ahvenanmaa and Finland Proper (LINDROTH) (LIRO) 1899, p. 18; LIRO and ROIVAINEN 1951, p. 144) and in Hyvinkää commune (U) (Vappula).

Eriophyes aroniae CAN. gives rise to galls in the leaf tissue of cotoneaster; initially, these are yellowish-green, later becoming reddish, and finally dark brown; they appear as small swellings on the upper and lower surfaces of the leaves. The species has been remarked in south Finland as far as South Häme and Ladoga Carelia (LIRO and ROIVAINEN 1951, p. 82). Sloe bushes are infested by *Eriophyes similis* NAL. var. *pruni-spinosae* NAL., which produces bag-shaped galls in the leaves. This pest is common in Ahvenanmaa (op.cit., p. 155).

M o l l u s c s (*M o l l u s c a*). Slugs (*Deroceras agreste* L., etc.) have on occasion eaten the leaves and green shoots of broom (*Cytisus alpinus*) seedlings; they have also injured rose bushes. In 1923, *Fruticicola hispida* L. appeared in large numbers on mock orange at Helsinki (U) (LINNANIEMI 1935, p. 138).

B i r d s (*A v e s*). The bullfinch (*Pyrrhula pyrrhula* L.) has been seen to damage the leaf and flower buds of lilac, hawthorn, june-berry and mock orange in winter, thus retarding the subsequent development of leaves and flowers (SIMBERG 1953; Puutarha 1953, p. 296).

M a m m a l s (*M a m m a l i a*). Field voles (*Microtus agrestis* L.) often damage ornamental shrubs during the winter by gnawing the bark of the stem under the cover of snow up to a height of 10—25 cm from the ground. They attack hawthorn bushes in particular, occasionally destroying hedges for many tens of metres. Voles also injure rose bushes in a similar fashion, and do not even hesitate to feed on prickly-stemmed bushes. Damage attributable to voles has been seen on lilac, dogwood, mock orange, spiraea and elaeagnus. Moreover, MYLLYMÄKI (1959, p. 78) lists 16 species of ornamental shrubs injured by voles in Finland; such injury has occurred in the south and central parts of the country. Other voles, such as the continental vole (*Microtus arvalis* PALL.) and the water vole (*Arvicola terrestris* L.), have contributed to the damage. Furthermore, hares (*Lepus timidus* L. and *L. europaeus* PALL.) may sometimes be harmful to ornamental shrubs (BRANDER 1960).

20. Ornamental trees

T h r i p s (*T h y s a n o p t e r a*). *Thrips calcaratus* Uz. lives on linden leaves, making them brown and curled. The species was first observed at Tuusula (U) in 1915—1916, when it was an injurious pest of park lindens (LINNANIEMI 1920, p. 4—6). In 1932 it appeared profusely at Kuhmoinen (EH) and again in 1936 at Tuusula (U) (HUKKINEN 1936 a, p. 129). Substantial injury to linden seedlings attributable to thrips was found in a nursery at Janakkala (EH) in 1939 (HUKKINEN, Ann. Report Dept. of Pest Invest. 1939), and at Viipuri (EK) (Vappula).

P l a n t b u g s, a p h i d s, e t c. (*H e m i p t e r a*). Occasionally, large numbers of sloe bugs (*Dolycoris baccarum* L.) have been observable on young

found as far as Kokemäki (St), Kuhmalahti (EH), Hartola (EH) and Tohmajärvi (PK). The related species *Tischeria dodonea* STT. was reared from oak leaf mines found at Ruissalo (V) and Ahvenanmaa (NORDMAN 1950 a; BRUUN 1952 b). In addition, the following species have been observed as leaf-miners on oak: *Lithocolletis nicellii* STT. at Turku (V) (BRUUN 1952), *L. cramerella* FABR., *L. quercifoliella* ZELL., *Nepticula atricapitella* HAW., and *N. subbimaculella* HAW. in 1939 at Föglö (A) (NORDMAN 1943, p. 180, 181, 182), *Heliozela sericiella* HAW. at Eckerö (A) (BRUUN 1952) and *Eriocrania subpurpurella* HAW. var. *fastuosella* ZELL. in the region of Turku (V) and at Föglö (A) (SALMIKIVI 1932; NORDMAN 1943, p. 183).

Maple leaves are injured by *Caloptilia (Gracilaria) semifascia* HAW., whose larvae roll the edges of the leaves downwards into loose curls. Such damage was very apparent and abundant at Aulanko near Hämeenlinna (EH) in 1936 and 1939. The species was first reported as new to Finland at Sortavala (LK) in 1938 (KANERVA 1939). — Ash is sometimes infested with *Prays fraxinellus* BJERK., a rather rare species in this country, although it occasioned severe damage at Föglö (A) in 1939 (NORDMAN 1943, p. 140, 181). At times small numbers of mines made by the lilac leaf-miner (*Caloptilia syringella* FABR.) have been observed in ash leaves.

The following species have also been found as leaf-miners on ornamental trees in Finland: *Coleophora hemerobiella* SCOP., on Finnish and Swedish whitebeam in Ahvenanmaa (A) (NORDMAN 1947); *Nepticula marginicolella* STT., on elm at Helsinki (U) (JÄPPINEN 1941; NORDMAN 1950 a), *N. ulmivora* FOL., on smooth-leaved elm at Hattula (EH) in 1952 (TIENSUU 1956); *N. ulmicola* HER., on linden (?) at Eckerö (A) (BRUUN 1952 a); *Phyllocnistis suffusella* ZELL., on balsam poplar at Parainen (V) and Turku (V) (E. REUTER 1904 b, p. 44; KANERVA 1924); *Leucoptera scitella* ZELL., on Finnish and Swedish whitebeam (NORDMAN 1943, p. 181; 1957 a). — *Cerostoma scabrellum* L. has been observed to injure the leaves of Finnish whitebeam (NORDMAN 1943, p. 181).

The larch casebearer moth (*Coleophora laricella* HB.) is a larch pest; its larvae penetrate the needles, and feed on their internal tissues. The injury may continue in the same tree for several years; on occasion, the damage is very severe, and the trees appear to be like injured by frost. The first reports of extensive appearances of this pest date from 1894, when it damaged larches at Helsinki (U) (E. REUTER 1895 b). It reappeared in the same locality in 1914—1915, and injured various species of larch (*Larix sibirica*, *europaea*, *dahurica*, *kurilensis*, *ochotica*, etc.) (LINNANIEMI 1916, p. 46; 1920, p. 122). Subsequent occasions of severe damage have been reported from Tampere (EH) in 1919, Turku (V) in 1925, Tampere and Kangasala (EH) in 1943, many places in west Finland in 1947 (SAALAS 1949, p. 514) and Tikkurila (U) in 1953—1954. The species is found as far north as North Savo and North Carelia (SAALAS, op.cit.).

Mites (Acarina). One of the most injurious linden pests is *Eotetranychus tiliarium* HERMANN, which infests the lower surface of the leaves, often together with the brasswood aphid. Following the injury, the leaves become brownish at the end

of the summer, and may partially wither. Park lindens suffer particularly from mite infestations in dry and warm summers. The species has been found in south and central Finland as far north as North Häme and North Savo. The fruit tree red spider mite (*Metatetranychus ulmi* KOCH) has been noted on the following species of park trees: Finnish whitebeam (quite abundantly), Swedish whitebeam (moderately), *Sorbus hastii*, *S. chrysophylla*, *S. aria* and *S. conradina* (small numbers), *Pyrus malus prunifolia hyvingiensis* (abundantly) and elm, mainly wych elm, (moderately) (LISTO et al. 1939, p. 15—16). In 1928 eggs of *Paratetranychus ununguis* JAC. were found on larch at Tikkurila (U); in 1959, the species infested 3—4-year old spruce trees in a nursery at Parainen (V).

Ornamental trees are often injured by certain gall mites, which live mainly on the leaves of the trees. The commonest species on linden is *Eriophyes leiosoma* NAL., which causes erineum — initially white, yellowish or reddish but finally changing to dark brown — in the leaf surfaces and sometimes in the petioles and inflorescences. The mites live for many years on the same trees, sometimes inflicting visible damage on them. The species is found throughout the whole country as far north as Tornio (PP). *Eriophyes tiliae-nervalis* NAL. makes white, yellowish or reddish erineum along the veins in the upper surface of linden leaves. It has been noted in south Finland on the lower branches and stump sprouts of wild linden trees (LIRO and ROIVAINEN 1951, p. 139). The erineum spots attributable to *Eriophyes exilis* NAL. are located at the vein junctions in the lower surface of the leaves. They have been seen on wild linden at Säkylä (St) (LIRO and ROIVAINEN 1951, p. 143), on park linden at Helsinki (U) in 1943 and Järvenpää (U) in 1959. *Eriophyes lateannulatus* SCHULZE, which makes reddish hornlike galls in the upper surface of the leaves, is quite common in south and central Finland as far north as North Häme and North Savo. *Phytoptus tetratrichus* NAL. lives in the edges of the leaves, which as a result become curled and bleached. The species has been noted at Lammi (EH) and at Kajaani (Kn) in 1958.

Eriophyes platanoideus NAL. produces erineum in the lower leaf surfaces of maple; at times it is very plentiful, and young trees in particular are retarded by the infestation. It is obviously quite common, at least in south Finland. *Eriophyes multistriatus* NAL. lives in pouch-like galls — initially green, later brown — in the upper surface of elm leaves.¹⁾ They have been found in south Finland as far as the regions of Mouhijärvi (St) and Pirkkala (EH) (LINDROTH (LIRO) 1899, p. 14). — *Eriophyes fraxinivorus* NAL. infests the inflorescences of ash, changing them into large, sometimes fist-sized galls, which are initially green but become dark brown and woody at the end of the summer. These galls were first observed in 1907 at Loviisa (U) (E. REUTER 1908 d). During the period 1914—1927, damage was inflicted in many localities in southeastern Finland; in 1927, nearly all of the ash trees growing in the parks of Loviisa (U) were infested (RAINIO 1928). The species

¹⁾ Another species, *Eriophyes brevipunctatus* NAL., has also been found in the galls of the smooth-leaved elm; it is possibly a free-living species (LIRO and ROIVAINEN 1951, p. 87).

21. Greenhouse plants

A. Tomatoes

Springtails (*Collembola*). Springtails have at times been reported to destroy tomato seedlings by completely devouring their cotyledons during the germination stage.

Plant bugs, aphids, etc. (*Hemiptera*). The greenhouse white fly (*Trialeurodes vaporariorum* WESTW.) often appears as a very damaging greenhouse pest, injuring tomatoes, cucumbers and different pot plants. It was first found in 1919 on myrtle, grown indoors at Helsinki (U) (LINNANIEMI 1921). In the same year, it was apparent on greenhouse tomatoes and pelargonium at Vanaja and Janakkala (EH) (LINNANIEMI 1935, p. 116—117). Since then, the greenhouse white fly has rapidly become prevalent in greenhouses throughout the country, as far as Rovaniemi (PP), often inflicting quite substantial damage on plants. It is readily spread from place to place through the agency of infested plant stock. In summer small numbers of this pest have at times been found on tomatoes growing outdoors in the vicinity of greenhouses. — Lily aphids (*Aulacorthum circumflexum* БУКТ.) and solanum aphids (*Aulacorthum solani* KALT.), which live on the underside of tomato leaves, have been found in this country. Both species were noted at Malmi in Helsinki (U) in 1953. Mealybugs (*Pseudococcus* sp.) have also inflicted slight injury on greenhouse tomatoes, for example at Tyrv nt  (EH) in 1932, and at Sammatti (V) in 1960.

Beetles (*Coleoptera*). Wireworms (*Elateridae*), principally *Agriotes obscurus* L. and *Agriotes lineatus* L., are often injurious pests of tomatoes in greenhouses, into which they are carried with infested soil from outside. After planting, the larvae sever the young seedlings just below the soil surface, thus bringing about the death of the plants. They also penetrate the main root or stem of older plants — sometimes even those which have begun to bear fruit — and both retard the growth of the plant and prevent the formation of fruit. On occasion all the plants have died.

Ants (*Hymenoptera, Formicidae*). At times, ants have been observed building nests at the roots of tomato plants in the greenhouse, with withering and even death of the plants as a consequence.

True flies (*Diptera*). The leaves of greenhouse tomatoes are sometimes infested with numerous tunnel mines, which were in at least one case (at Kirkkonummi (U) in 1946) caused by the chrysanthemum leaf-miner (*Phytomyza atricornis* MEIG.). At the same place, small numbers of mines, possibly the work of the same species, were remarked in cucumber leaves.

Moths (*Lepidoptera*). Larvae of the tomato moth (*Polia oleracea* L.) have on a number of occasions inflicted considerable damage on tomatoes by feeding on the leaves, boring holes in the stems, and later attacking the fruit. Since 1940, injury has been noted in Finland Proper, Uusimaa, Satakunta and South H me. Larvae of *Euxoa tritici* L. damaged tomatoes at Yl ne (St) in 1943 by feeding on the stems at night, with the result that they broke (VAPPULA 1945). In 1961, larvae

of the rosy rustic moth (*Hydroecia micacea* ESP.) appeared in tomato plants at Varkaus (PS).

Mites (*Acarina*). On at least one occasion, a heavy infestation of the hop red spider mite (*Tetranychus urticae* KOCH) has been found on the surface of the unripe fruit of greenhouse tomatoes.

Crustaceans (*Crustacea*). In 1948, large numbers of *Armadillidium vulgare* LATR. appeared in a greenhouse at Hanko (U), and inflicted substantial damage on tomato plants. The species had evidently been introduced to the country along with flower bulbs imported from Belgium or Holland (PALMÉN 1950, p. 102).

Worms (*Vermes*). The root knot eelworm (*Meloidogyne* sp.) was first observed in Finland at Tyrvöntö (EH) in 1932 in the roots of greenhouse tomatoes at the Lepaa horticultural school (VAPPULA 1933 c). Since then, it has spread increasingly and become an injurious greenhouse pest throughout south Finland, extending to the regions of Tampere (EH), Mikkeli (ES) and Savonlinna (ES). Enchytraeids (*Enchytraeidae*) have at times been plentiful in the soil of greenhouses. The growers have claimed that they induce wilting of tomato plants, although it is probable that other factors have contributed to this condition.

Mammals (*Mammalia*). Norway rats (*Rattus norvegicus* ERXL.) were once observed feeding on the leaves of tomato seedlings in a greenhouse, where they had eaten all the leaves and even the terminal shoot from one of the plants.

B. Cucumbers

Springtails (*Collembola*). Reports from growers state that springtails have often injured cucumber seedlings during the process of germination by eating the cotyledons before they have completely emerged from the seed. Furthermore, these insects have damaged the fruit and stems of cucumber plants in the greenhouse.

Thrips (*Thysanoptera*). Greenhouse cucumbers are often infested by thrips, which live on the lower surface of the leaves, producing pale, translucent spots in them and in the fruit. At times, the damage has been very serious. The commonest species is probably the onion thrips (*Thrips tabaci* LIND.), found in Uusimaa, South Häme and South Savo. The chrysanthemum thrips (*Thrips nigropilosus* Uz.), first remarked in this country at Hyvinkää (U) in 1926 (cf. p. 141), inflicted considerable damage on greenhouse cucumbers at Jääski (EK) and Tyrvöntö (EH) in 1930 (HUKKINEN 1932).

Plant bugs, aphids, etc. (*Hemiptera*). In 1931, *Halticus apterus* L. injured cucumber leaves in a greenhouse at Tyrvöntö (EH).

At times, the greenhouse white fly (*Trialeurodes vaporariorum* WESTW.) (see p. 163) is a very damaging cucumber pest in greenhouses or frames; it injures the leaves, soiling them and the fruit with its sticky secretion. In severe cases, it completely destroys the plants.

In some instances, aphids attack greenhouse cucumbers, making the leaves curl and wither, and the shoots are deformed. The causal species is evidently the melon aphid (*Aphis gossypii* GLOV.)¹⁾. Damage by aphids has occurred in Uusimaa, South Carelia, South Häme and Central Ostrobothnia. Melons are also occasionally infested by this species. The aphids which attack cucumbers have been established as vectors of the mosaic virus disease of cucumber (RAINIO 1941, p. 18).

B e e t l e s (*Coleoptera*). Wireworms (*Elateridae*) are on occasion destructive pests, particularly as regards young cucumber seedlings; they injure the roots, and at times penetrate the interior of the stem, making the plant wither. In some instances, they have been observed to hollow out the seeds of cucumber. — A species of *Cercyon* was found in the soil of indoor cucumbers at Siuntio (U) in 1939 and near Iisalmi (PS) in 1948. In the first case, the beetle, together with *Uropoda obnoxia*, appeared at the junction between the stem and root, where gummosis was observed, although it is uncertain whether the injury could be ascribed to the insects.

A n t s (*Hymenoptera, Formicidae*). Ants have at times been reported as harming cucumbers, with consequent drying of the plants.

M y r i a p o d s (*Myriopoda*). Several species of myriapods appear in greenhouses; some of them may be so numerous that they injure the plants. The most important pest is perhaps *Orthomorpha (Oxidus) gracilis* C. L. KOCH, first found in Finland in 1900, and subsequently so widespread that today it may well be the commonest myriapod in Finnish greenhouses (PALMÉN 1949, p. 15—16). To date, it has been reported as far north as Haapavesi (KP) and Kuhmo (Kn). Myriapods have been observed to feed on the root collar and even on the fruits, with the result that the plant grows poorly, and the crop is low. In 1949, large numbers of *Cylindroiulus frisius* VERH. and *Pachymerium ferrugineum* C. L. KOCH were found on the roots of melons grown in a greenhouse at Kirkkonummi (U); it was assumed that they were responsible for the wilting of the plants.

M i t e s (*Acarina*). Undoubtedly the most destructive pest of greenhouse cucumbers is the hop red spider mite (*Tetranychus urticae* KOCH), found throughout the whole country in varying degrees of intensity. In some cases, the leaves become brownish or wither completely; on severe infestation, the crop may be almost entirely lost. *Uropoda (Urosternella) obnoxia* E. REUT. (cf. p. 79) often damages the stem base of cucumber plants; young seedlings in particular suffer from their attack. In 1958 at Kaarina (V), *Scheloribates laevigatus* C. L. KOCH (*Oribata lucasi* NIC.) (cf. p. 79) was found injuring the leaves of greenhouse cucumber.

C r u s t a c e a n s (*Crustacea*). Very large numbers of woodlice appear on occasion in greenhouses, where they feed on the leaves and unripe fruit of cucumbers in particular. They are most destructive to young plants, which they sever at ground level, but old fruit-bearing plants may also be damaged. Reports of injury inflicted by woodlice have been received from Uusimaa, South Carelia,

¹⁾ HEIKINHEIMO (1959, p. 35) believes it possible that *Aphis (Aphidula) nasturtii* KALT., or some other related species, may have contributed to the damage inflicted on cucumber.

the Carelian isthmus, Satakunta and South Häme since 1929. The species responsible have been *Porcellio scaber* LATR. and *Oniscus asellus* L. The former species may live outdoors, but evidently the latter is dependent upon man-made conditions of environment (PALMÉN 1946, p. 19, 24). It has been established that the latter species transmits the mosaic virus disease of cucumber (RAINIO 1941, p. 17—19).

Molluscs (*Mollusca*). Slugs (*Deroceras agreste* L.) have at times inflicted harm upon greenhouse cucumbers.

Worms (*Vermes*). Since 1932, root knot eelworms (*Meloidogyne* sp.) (cf. p. 164) have on a number of occasions been responsible for substantial damage to cucumbers, which wilt and in severe cases wither completely.

Mammals (*Mammalia*). The Norway rat (*Rattus norvegicus* ERXL.) has sometimes been observed to eat cucumbers in greenhouses.

C. Other vegetables

Springtails (*Collembola*). In one instance, springtails were reported as having completely devoured the cotyledons of lettuce seedlings.

Aphids (*Hemiptera, Aphidoidea*). The peach-potato aphid (*Myzus persicae* SULZ.) has at times been found on parsley and potatoes grown indoors (HEIKINHEIMO 1944, p. 4). In 1937, *Aulacorthum solani* KALT. appeared on potato, horse-radish and beans grown in a greenhouse at Mikkeli (ES) (HEIKINHEIMO 1945).

Beetles (*Coleoptera*). Wireworms (*Elateridae*) have at times injured greenhouse lettuce.

Myriapods (*Myriopoda*). *Cylindroiulus frisius* VERH. was observed in profusion in a greenhouse at Kuopio (PS) in 1951, where it damaged the roots of some plants, such as parsley.

Crustaceans (*Crustacea*). In 1948, *Armadillidium vulgare* LATR. (cf. p. 164) appeared on cauliflower grown in a greenhouse at Hanko (U) and almost completely destroyed the crop. In the following year, control measures kept them to a minimum, but in 1950 they were again numerous without, however, damaging the plants (PALMÉN 1950, p. 102).

Molluscs (*Mollusca*). In 1954, slugs (*Deroceras agreste* L.) injured cauliflower growing in a greenhouse at Kauhava (KP) and threatened the ruin of the entire crop.

D. Ornamental plants

(in greenhouses and dwellings)

Springtails (*Collembola*). Springtails are often very plentiful in greenhouse soil and in flower pots; their source of food is mainly decaying organic matter. As a rule, they do not appreciably damage mature plants, but they have

of forget-me-not and daisy growing in a greenhouse at Espoo (U), and in 1951 it infested greenhouses at Kuopio (PS), destroying many tulip bulbs; *Cylindroiulus britannicus* VERH. was abundant on the roots of chrysanthemum at Helsinki (U) in 1949, and in the soil of various greenhouse plants at Mikkeli (ES), where it brought about severe damage to the roots of fairy primrose (*Primula malacoides*). In addition, *Nopoiulus venustus* MEINERT was found in greenhouse soil at Hyvinkää (U) in 1949, although no mention was made of possible injury.

Mites (Acarina). One of the most harmful indoor ornamental plant pests is the hop red spider mite (*Tetranychus urticae* KOCH), which infests many different kinds of plants. During the early stages of mite infestation, the leaves become slightly chlorotic, but when the attack is severe, the leaves turn yellow or brown, become covered with webs produced by the mites, and finally wither and die. This pest is most prevalent and injurious as regards roses, but it has also been seen on the following plants: hydrangea, carnation, fuchsia, ivy, *Fatsia*, palms, amaryllis (*Hippeastrum*), laurel (*Laurus*), Japanese euonymus (*Euonymus japonica*), orchids, gardenia, *Zantedeschia*, medeola, passionflower, common fig (*Ficus carica*), Indian rubber fig (*Ficus elastica*), orange (*Citrus*), *Cissus*, Japanese aucuba, hibiscus (*Hibiscus manihot*), *Fatshedera*, asparagus (*Asparagus plumosus nanus*), chrysanthemum, *Mitella diphylla*, *Nelumbo* sp. and *Acalypha hispida*. The hop red spider mite is a common pest on house plants throughout southern and central Finland, and has been found as far north as Alatornio (PP). There are two different colour types in this country, one red, and the other yellowish-green with black spots (HEIKINHEIMO 1956).

Tenuipalpus (Brevipalpus) cactorum OUD. has only once been observed in this country, in 1953 at Kuopio (PS), where it caused brownish spots in cactus plant. Mites evidently belonging to the same genus were observed at Helsinki (U) in 1955; it had made pale blemishes in the leaves of an orchid plant (*Odontoglossum grande*). In 1956, the leaves of anthurium at Joutseno (ES) were injured in a similar fashion.

In 1904, the strawberry mite (*Tarsonemus pallidus* BANKS = *fragariae* ZIMM.) appeared on begonia plants growing in a greenhouse at Helsinki (U). As a consequence of the infestation, many of the shoots had stopped growing even at the bud stage (E. REUTER 1905, p. 23—24, 25; 1906 b, p. 138). In 1952, strawberry mites damaged the top shoots of *Kalanchoë blossfeldiana* and pentstemon at Tyrvántö (EH); the leaves had become brown and twisted (cf. also HEIKINHEIMO 1953 a). On two occasions (at Helsinki (U) in 1953 and 1960) mites of the genus *Tarsonemus* — probably *T. laticeps* HALBERT — were observed in narcissus bulbs. *Uropoda (Urosternella) obnoxia* E. REUT. was once found on seedlings of gloxinia (*Sinningia*).

The bulb mite (*Rhizoglyphus echinopus* FUM. & ROB.) has appeared as a flower bulb pest since 1924, when it was noted in amaryllis bulbs at Tyrvántö (EH) (HUKKINEN 1924, 1926 b). The mites had either attacked the basal, interior part of the stalk, causing it to remain stunted in its growth, or the leaf primordia, preventing the development of the leaves. In this year, and in the two succeeding years, hyacinth, tulip and narcissus bulbs imported from Holland were generally of poor quality,

In 1937, root galls made by the root knot eelworm (*Meloidogyne* sp.) were observed in coleus plants growing at Tyrvääntö (EH). Cyclamen plants were severely damaged by this pest at Nastola (EH) in 1943, at Lahti (EH) in 1948 and at Hämeenlinna (EH) in 1949.

M a m m a l s (*M a m m a l i a*). At Rauma (St) in 1957, voles (*Arvicolidae*) injured roses growing in a greenhouse. Norway rats (*Rattus norvegicus* ERXL.) and house mice (*Mus musculus* L.) damage flower bulbs in storage, and at times during the period of their forcing in greenhouses (V. SIIVONEN 1957). In 1956, common moles (*Talpa europaea* L.) invaded a greenhouse at Kirkkonummi (U), occasioning slight damage to ornamental flowers by digging in the soil near their roots (Myllymäki).

E. Grape and peach

Thrips (*Thysanoptera*). In 1924, rose thrips (*Thrips fuscipennis* HAL.) appeared on peach trees at Vanaja (EH), with consequent desiccation and twisting of the leaves (HUKKINEN 1932 b; HUKKINEN and VAPPULA 1935, p. 16).

Aphids, etc. (*Hemiptera*). The peach-potato aphid (*Myzus persicae* SULZ.) was found on peach trees at Piikkiö (V) and Kuopio (PS) (HEIKINHEIMO 1959, p. 26).

The citrus mealybug (*Pseudococcus citri* RISSO) has on two occasions (at Dragsfjärd (V) in 1944 and at Elimäki (U) in 1945) appeared abundantly on grape vines; it hindered the growth of the plants, and soiled the fruit. In 1948, a severe infestation of mussel scale (*Lepidosaphes ulmi* L.) and brown scale (*Eulecanium corni* BChÉ) occurred on the branches of peach trees at Karjalohja (V). Large numbers of the latter species were also observed on peach trees at Järvenpää (U) in 1949.

Myriapods (*Myriopoda*). In 1912, the roots of grape vines at Köyliö (St) were affected by injury possibly attributable to myriapods (E. REUTER 1914 a, p. 12).

Mites (*Acarina*). The hop red spider mite (*Tetranychus urticae* KOCH) has on many occasions been an injurious pest on both peach trees and grape vines; the leaves of these plants become discoloured as a result of the infestation. Damage has been observed in greenhouses in south Finland extending as far north as the regions of Noormarkku (St), Ruovesi (EH) and Mikkeli (ES).

22. Mushrooms

True flies (*Diptera*). In 1957, large numbers of larvae of *Lycoriella* sp. appeared on cultivated mushrooms at Janakkala (EH). They infested the mycelia of the mushrooms, and brought about so much injury that the yield was reduced by about one-third (Ekbon).