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COMPOSITION OF WEED FLORA IN SPRING CEREALS IN FINLAND

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INTRODUCTION

The development of selective chemical weed control has created a need for more information on weeds in agriculture. In order to choose the correct herbicides, it is necessary to know the kind of weeds as well as the distribution, abundance and relative significance of the various weed species. Long term use of selective chemicals brings about changes in weed populations (RADEMACHER 1967), and so do other alterations in agricultural practices (ÅBERG 1957, GRANSTRÖM 1962, FRYER and EVANS 1968). It is of importance to know the trends of these changes as well as the role of the various factors involved.

Anticipating the above situation, the great Norvegian pioneer KORSMO (1925) assembled comprehensive data in his book *Weeds in Modern Agriculture*. Since then, studies on the distribution and abundance of farm land weeds have been conducted in several countries. The works published by BOLIN (1922), GRANSTRÖM and ALMGÅRD (1955) and GRANSTRÖM (1956, 1962) in Sweden, FERDINANDSEN (1918), FREDERIKSEN et al. (1950) and MIKKELSEN and LAURSEN (1966) in Denmark, de VRIES (1959) in the Netherlands, and ALEX (1966) in Canada, should be mentioned in this connection.

In Finland, the first regional study on weeds in agriculture was conducted by HILLI (1948). His study was based on a questionnaire which was distributed to the local agricultural advisers. How far the opinions of these persons reflected the true situation was of course open to interpretation. A more reliable study concerning the botanical composition of leys for hay was conducted by PAATELA (1953 b) whose assistants, mostly graduates, were expressly trained to make visual botanical analyses. Some local weed surveys have also been conducted in cereals (LINKOLA 1916—21, JALAS and JUUSELA 1959, BORG 1964, M. RAATIKAINEN and T. RAATIKAINEN 1964). In addition, the general distribution of plants in Finland and other Fennoscandian areas has been presented in the handbooks of LAGERBERG et al. (1938—40) and HULTÉN (1950).

In the early 1960's, the Department of Plant Husbandry of the Agricultural Research Centre was requested to carry out a country-wide weed survey in field crops. As a first step a survey in spring cereals was conducted in 1961—64. The present paper is an account of this survey and is devoted to the distribution, frequency and plant numbers of the various weed species as well as to some factors affecting the weed populations. The significance and weights of weeds will be discussed later. Some preliminary information on the results has already been made available to the farmers and agricultural advisory personnel (MUKULA et al. 1962—64, LALLUKKA 1963, MUKULA 1964, T. RAATIKAINEN 1965, M. RAATIKAINEN et al. 1967).

MATERIALS AND METHODS

At the time of the present survey, spring cereals were grown on approximately 0.95 million ha or 35 % of the total field area in Finland. They were commonly sown in rotation with grassland crops, mainly red clover-timothy leys (52 %), winter cereals (5 %), potato and root crops (4 %), and summer fallow (2 %). The fields were mostly drained with open ditches

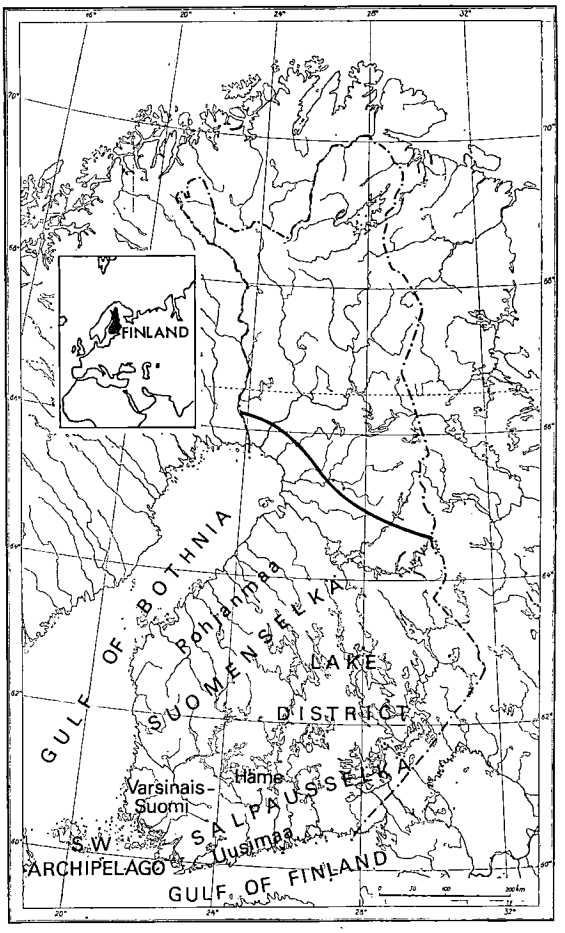

Fig. 1. Boundary and geographical names of main area (97 %) of spring cereal cultivation in Finland.

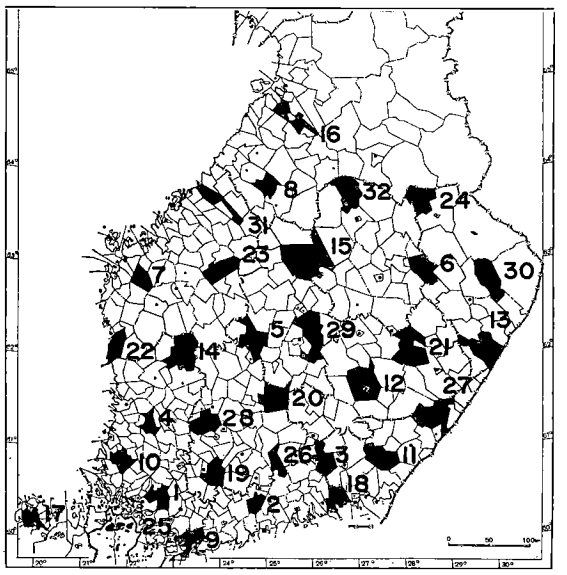

Fig. 2. Localities surveyed in 1961—64 (cf. Table 1).

crossing parallel with the fields 10—20 metres apart. The level of mechanization was relatively high including combine harvesting and chemical weed control.

About 97 % of the spring cereal fields were situated in southern and central parts of the country, distributed over an area of 200 000 km² and divided into 250 000 farms. The length of the thermal growing season (5. . .5°C) in that area is 145—180 days with an average temperature of 11.5—13°C. The sum of the effective temperatures is 1 000—1 300 °C and the average monthly precipitation during the growing season 35—80 mm.

In order to find a workable method of surveying the above area, an extensive preliminary study was conducted in 1961. The actual survey was executed in 1962—64 and was based on the experiences obtained in the preliminary study.

Localities

To save time and travelling costs, the survey was concentrated into relatively compact »localities». Thirty-two localities were selected on the map at approximately even distances within the main area where spring cereals were normally grown. Each locality consisted of one to three parishes, covered a land area of 400—1 750 km² and represented a field area of 3 500—22 000 ha, of which 1 000—8 500 ha were under spring cereals. The localities were divided to form four groups, one group being examined each year. The geographical names referred to in the text are shown in Fig. 1, the distribution of the localities in Fig. 2 and the respective names of the localities in Table 1. Some regional bias occurred in 1961 due to the southwesterly situation of the localities.

Farms

The local agricultural adviser was requested to assist in selecting 30 representative farms in each

Table 1. Localities and number of fields surveyed in 1961—64

Year		Locality	Number of fields
1961	1	Lieto—Paimio—Tarvasjoki.	53
	2	Nurmijärvi	80
	3	Iitti	60
	4	Kokemäki	57
	5	Keuruu	126
	6	Kaavi	70
	7	Laihia	71
	8	Nivala	105
	1— 8		622
1962	9	Pohja—Tenhola	66
	10	Laitila	55
	11	Luumäki	107
	12	Mikkelin mlk.	85
	13	Kitee	85
	14	Kihniö—Parkano	115
	15	Keitele—Viitasaari	100
	16	Liminka	99
	9—16		712
1963	17	Jomala—Finström—Hammarland	57
	18	Pyhtää—Ruotsinpyhtää	62
	19	Tammela	93
	20	Kuhmoinen	94
	21	Rantasalmi—Kangaslampi	86
	22	Lapväärtti—Siipyy	79
	23	Alajärvi	93
	24	Valtimo	100
	17—24		664
1964	25	Korppoo—Nauvo	67
	26	Koski Hl.—Kärkölä	75
	27	Ruokolahti	104
	28	Lempäälä—Pirkkala—Vesilahti	102
	29	Laukaa—Toivakka	79
	30	Eno	88
	31	Kälviä	100
	32	Vieremä	97
	25—32		712
	1—32		2 710
	9—32		2 088

locality for the survey. Each farmer was then requested to provide the following information regarding his farm:

- total field area
- area of spring cereals
- number of spring cereal fields

Farms of various sizes were represented. The percentage numbers of large and medium-sized farms were, however, higher than the corresponding averages for the entire country (cf. p. 101).

Fields

Ecologically field boundaries form a barrier to the spread of weeds. It was, therefore, logical to use the »field» as one of the basic units in the survey. The term field was defined as consisting of a uniform land area growing a single crop and having been subjected to uniform agricultural practices during recent years.

All the spring cereal fields were examined on each farm, except when the number of fields exceeded five (six in 1961). The total number of fields examined in the preliminary study was 880 and in the actual survey 2 548. The sowing time of the spring cereals varied from April 29 to June 4. The average size of the fields was 1.1 ha.

The following information on each field was requested from the farmers:

- area of the field (ha)
- drainage system (open ditched, deep drained, undrained)
- moisture conditions of the soil (dry, medium dry, wet)
- use of combine-harvester on the field during the last ten years (0, 1—3, 4—6, 7—9 times)
- previous crop (fallow, ley, winter cereal, spring cereal, potato or root crop, other)
- ploughing (in the autumn, in the spring, not ploughed)
- use of farmyard manure after the preceding crop (yes, no)
- species of spring cereal (oats, barley, wheat, mixed)
- clover and/or grasses undersown (yes, no)
- use of herbicides on the field during the last ten years (0, 1—3, 4—6, 7—9 times)
- use of herbicides during the current year (yes, no)
- herbicide used during the current year (MCPA, other)

The use of MCPA in spring cereal fields was fairly frequent in South and southwestern Finland and occasional in Central Finland during the years 1961—64 (Fig. 48, p. 100). Several fields had already been sprayed before the examination. The fields where the herbicide had affected the weeds to such an extent that it was impossible to obtain reliable counts were disqualified in processing the data. The total number of the accepted fields was 622 in 1961 and 2 088 in

Fig. 3. Sampling circle of 0.25 m² used for counting the number of weeds.

1962—64. The average number of the accepted fields per locality was 87 varying from 55 to 115 in the actual survey (Table 1).

Sampling units

Sampling units of various sizes, shapes and numbers were studied in the preliminary survey in 1961. On the basis of the experiences obtained it was decided to use a circle of 0.25 m² for counting the number of plants or shoots and for harvesting the samples of vegetation. The apparatus employed was a ring made of heavy steel wire (Fig. 3). It was divided into two sections and marked in the centre.

Personnel

A team of two qualified persons with a university degree in botany or agronomy or at least two years' experience in weed research, conducted the survey in each locality. Training courses were organized to familiarize the persons with the methods of the survey and to make certain that they were capable of identifying the plant species.

The following persons conducted the field surveys in the localities specified by numbers (cf. p. 63) within the brackets: Heikki Forsman (14), Marjatta Haapanen (8), Anja Honkanen (22, 28), Matti Ilmén (19), Riitta Ilmén (19), Eevi Kervinen (2, 9, 17), Edvin Kinnunen (13, 30), Esa Kotanen (27), Risto Lallukka (16, 24, 30), Chira Lönnberg (26), Veikko Makkonen (13), Simo Marttila (5, 12, 20, 29), Jaakko Mukula (3, 13), Ahti Mäkinen (4, 14), Irma Mäkinen (4, 22, 28), Raija Mänty (11, 21), Heikki Niinimäki (3, 16, 32), Kirsti Nurminen (11, 21, 25), Teuvo Nyberg (1), Seija Oksanen (2, 9, 17, 25), Hannu Pirttilä (6), Irmeli Pirttilä (6), Mikko Raatikainen (7, 15, 23, 31), Raija Raatikainen (23), Terttu Raatikainen (7, 15, 31), Teuvo Riipinen (5, 12, 20, 29), Esko Ruuttunen (8), Jorma Rönty (24, 32), Ilona Taarna (10, 18), Jorma Taarna (1, 10, 18), Leena Virtanen (27) ja Marja Visa (26).

Sampling procedures

Each team had a car to facilitate moving from one farm to another. The survey was conducted between June 25 and July 18, i.e. at a time when most of the weeds had emerged, but only a few had withered.[1]) In each locality the survey period was limited to two weeks and was gradually moved forward by a week from the southern to the northern localities. The following visual observations were made on each field during the survey:

- soil type (sand or fine sand, clay, humus or peat)
- density of the cereal stand (sparse with scattered open gaps, thin, dense, very dense)
- percentage of area covered by weeds (—5, 6—10, 11—20, 21—30, 31—40, 41—50, 51—60, 61—70, 71—80, 81—90, 91—100)
- the effect of the herbicidal treatment (good, moderate, weak, none)

All the weed species found in the field were listed. In addition, four random samplings were made for counting the number of plants or, in the case of perennial species, the number of shoots. The term shoot was defined as consisting

[1]) In certain localities some of the fields were re-surveyed for harvesting samples of vegetation at the actual harvest time, between August 10 and August 30. In addition, samples of the vegetation of ditches and verges, of the fauna of spring cereals and of the soil were taken in certain cases for specials purposes. The data of these samplings will be published elsewhere.

of an aerial stem branched below the surface of the soil. In the counts, 41 weeds (27 in the preliminary survey) were specified by species or genera and others by »other broad-leaved» weeds or »other grasses». The former group included both dicotyledonous plants, horsetails and brackens and the latter monocotyledonous plants. The edges of fields and ditches, to a width of 1 m, were not examined.

Statistical analyses

The figures of the four subsamplings of a field were summed, then entered onto punch cards together with other information on the field and finally computerized.

The effects of the number of fields on the number of species were studied in material obtained partly in the preliminary study and partly in the actual survey.

The number of fields needed to reach the 95 % confidence limit in the averages of the plant numbers was examined in the preliminary study by using the conventional t-tests (SNEDECOR 1965, p. 60). Owing to the asymmetry of the distributions, they tended to overestimate the significances (cf. COCHRAN 1963, p. 41). On the other hand, the low numbers of plants per unit area (m^2) made it impossible in certain cases to get correct results by using the square root transformation method recommended by GREIGH-SMITH (1964, p. 31).

The average plant numbers of the 41 counted species were submitted to analyses of variance to determine the significance of the annual variation. The effects of some other factors were studied by using factorial and χ^2 analyses. The significance was expressed by conventional symbols as follows: *** $P < 0.001$, ** $0.001 < P < 0.01$ and * $P < 0.05$.

Terminology and nomenclature

In processing the data the term f r e q u e n c y was adopted to express percentage frequency per field rather than per sampling unit. The Finnish classification of frequency established by NORRLIN (1870) and complemented with numerical values by NYSTRÖM (1937) was followed.

The counted broad-leaved species were classified according to the susceptibility to MCPA on the basis of foreign and domestic investigations (OSVALD and ÅBERG 1952, SMIDT 1954, LÄHDE et al. 1955, PETERSEN 1960, VIDME 1961) and given the following symbols: S = susceptible, MS = moderately susceptible, MR = moderately resistant, R = resistant. In statistical consideration the percentages of the »expected» control were as follows: S = 91—100 %, MS = 71—90, MR = 41—70 %, R = 0—40 %.

The word d e n s i t y was adopted to denote the number of plants or shoots per unit area (m^2) and c o v e r to express the percentage of ground area covered by plants.

The species and genera of weeds were referred to by their botanical names. In the text s p e c i e s usually denotes all types of taxon, i.e. actual species, genera or a group of species. The taxonomic nomenclature of LID (1963) was used with the following exceptions: *Elytrigia repens* was replaced by *Agropyron repens* (L). PB. and *Matricaria inodora* by *Tripleurospermum inodorum* (L.) Schultz. For winter turnip rape the name *Brassica rapa* L. was used.

At the time of the survey some of the weeds were too young to be identified by species. *Galeopsis*, *Lamium* and *Potentilla* were determined by genera only. Similarly, *Matricaria recutita*, *Tripleurospermum inodorum* and *T. maritimum* were grouped together to form a taxon, which apparently often also included *M. matricarioides*. *Galium vaillantii* and *G. aparine*, *Rumex acetosa*, *R. acetocella* and *R. tenuifolius* as well as *Rumex longifolius* and *R. crispus* were also grouped together, respectively. Other taxa, not regularly determined by species, are referred to mostly by genera, in Table 3 (p. 68) and in Chapter 1.

Discussion

The plant counting method employed has been widely used in field experiments on cereals (e.g. PAVLYCHENKO and HARRINGTON 1934, RADEMA-

CHER 1950, GRANSTRÖM 1962, MUKULA and KÖYLIJÄRVI 1965), but only by GRANSTRÖM and ALMGÅRD (1955) and GRANSTRÖM (1956) in large scale weed surveys. The number of plants does not necessarily reflect the significance or competitive value of the weeds. The latter aspect should be evaluated by measuring the size, leaf area, ground cover, or weight of the plants in various stages of growth (HARPER 1960). The level of infestation, on the other hand, could be more exactly evaluated by counting the number of viable seeds in the soil (BRENCHELEY and WARINGTON 1930—36, ROBINSON 1949, DUNHAM et al. 1958).

The number of emerged plants, however, correlates with the number of seeds and, correspondingly, reflects their abundance (CHEPIL 1946). The counting of plants is far less laborious than the counting of seeds and also less laborious than the weighing of plants. It is also more exact than the various visual estimations of the vegetation. It can be repeated in exactly the same way after a great number of years without running the risk of different observers estimating the vegetation subjectively. In fact, the plant counting method employed in this survey makes it possible to follow the trends of changes in weed infestations not only over extensive regions but also during prolonged periods of time.

In order to evaluate the significance of the weeds, the picture obtained by the plant counting method can, of course, be complemented by weight analyses or other evaluations of the biomass of the vegetation.

RESULTS AND DISCUSSION

The effect of the number of fields on the number of species is shown in Fig. 4, and the minimum number of fields needed to reach the 95 % confidence limit in the averages of the plant numbers is shown in Table 2. Because of the asymmetry of the distributions the latter analyses should be interpreted with certain reservations. Nevertheless, the figures reveal that the composition of the weed flora of the surveyed spring cereal fields was relatively homogenic, and both the quantitative and qualitative aspects of the populations could have been adequately described

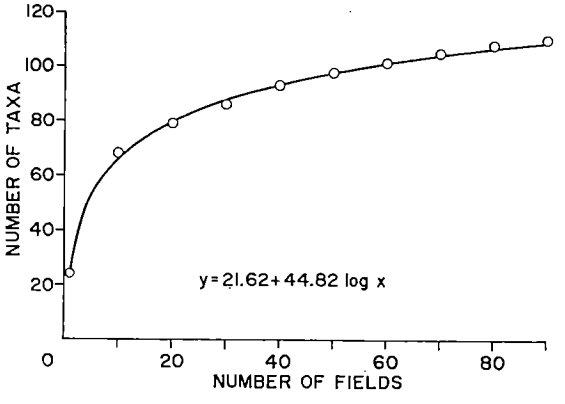

Fig. 4. Effect of number of fields on the number of weed species (taxa). Averages of 12 localities.

Table 2. Minimum number of fields (n) needed to reach 95 % confidence limit in the averages of the number of plants/m² ($\bar{x}$). Preliminary study in Keuruu, 1961

Species	$\bar{x}$	n
Agropyron repens	11	41
Capsella bursa-pastoris	.5	52
Chenopodium album	7	16
Cirsium arvense	.2	57
Equisetum arvense	2	22
Equisetum palustre	.2	366
Equisetum silvaticum	.1	108
Erysimum cheiranthoides	8	7
Fumaria officinalis	2	30
Galeopsis spp.	42	4
Galium vaillantii[a]	2	73
Gnaphalium spp.	10	23
Lamium spp.	.0	357
Lapsana communis	2	19
Myosotis spp.	3	18
Polygonum aviculare	.6	31
Polygonum convolvulus	1	16
Polygonum lapathifolium	5	14
Raphanus raphanistrum	3	33
Sonchus arvensis	2	28
Spergula arvensis	35	11
Stachys palustris	.2	215
Stellaria media	19	11
Thlaspi arvense	.2	159
Tripleurospermum indorum[b]	3	30
Tussilago farfara	.0	175
Viola arvensis[c]	21	6

[a] = incl. *G. aparine*
[b] = incl. *Matricaria recutita*
[c] = incl. *V. tricolor*

by examining 87 (55—115) fields per locality and by counting the plant numbers of the most abundant weed species.

The frequencies of the species are shown in Table 3 (p. 68) as percentages of the localities and the years (1962—64). The numbers of the species (taxa) are given at the foot of the table. Both should be regarded as minimum figures because the species may not have always been found on the field.

The average plant numbers on all the fields (densities) are shown in Table 4 (p. 74) as averages of the localities and the years. The material of the preliminary study (1961) is also included in this table. The significances of the annual variation are shown by symbols as are the susceptibilities of the species to MCPA.

The average plant numbers on the infested fields are shown in Table 5 (p. 76). These figures tend to overestimate the true situation on account of the low percentage frequencies.

The average plant numbers on all the fields are classified according to the species of spring cereal, type of soil, moisture conditions, and preceding crops in Table 6 (p. 77) as averages of the entire material of the actual survey. This table also includes the significance symbols of the χ^2 analyses. The effects of several other factors as well as various interactions are briefly referred to in the text.

1. Distribution of species

The total number of species listed from the 2088 fields during the years 1962—64 was 304. The average number of species per locality was 103 (Table 3). The number of species in the localities varied considerably. Some of the differences resulted from the varying number of fields surveyed per locality and from the varying accomplishments of the teams. Actual regional differences between the localities seem, however, to be a reality.

The highest numbers of species were recorded in southwestern and southern Finland, where the growing season is longest and several kinds of agricultural management is practised. Relatively rich flora was also found in areas of hill farming, mainly in East Finland, and in the northern part of the Lake District, where the fields lay either on hills with mineral soil or in valleys with humus or peat soil. Such fields were usually small, surrounded by woods or swamps. They were also stony which made them difficult to cultivate. Apparently all these factors contributed to the richness of the flora. In flat and marshy Pohjanmaa, with fields subjected to simple hay-and-cereal rotation, the number of species was small, except in the northernmost locality (16), where several coastal and northern species were found.

The most common species and their average frequencies were as follows:

Annuals

Galeopsis spp.	94
Chenopodium album	92
Spergula arvensis	88
Stellaria media	85
Viola arvensis incl. *V. tricolor*	80
Erysimum cheiranthoides	74
Polygonum lapathifolium	73
Myosotis spp.	60
Polygonum convolvulus	60
Lapsana communis	49

Perennials

Ranunculus repens	74
Achillea millefolium	69
Rumex spp. sorrels	61
Agropyron repens	47
Equisetum arvense	44
Vicia cracca	43
Achillea ptarmica	43
Cirsium arvense	37
Trifolium spp. excl. *T. pratense*	37
Taraxacum spp.	35

The distribution of the percentage frequencies was as follows:

Frequency %	Number of species (taxa) Annuals	Biennials	Perennials	Total
— 2	44	5	150	199
3— 4	3	1	15	19
5— 8	3	1	13	17
9—16	4	0	5	9
17—32	5	0	9	14
33—64	8	0	9	17
65—	7	0	2	9

Table 3. Percentage frequencies of weed species (taxa) found on spring cereal fields.
Localities (9—32) surveyed in 1962—64. For the numbers of the localities cf. Table 1 (p. 63) and Fig. 2 (p. 62)

Taxon \ Year / Locality	1962								1963								1964								1962	1963	1964	1962—64
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32				
Achillea millefolium	78	29	69	65	98	73	83	59	53	80	71	76	41	59	72	85	55	76	79	75	63	75	48	86	69	67	70	68.7
A. ptarmica	48	33	52	32	34	51	65	46	36	62	69	39	22	70	50	33	55	35	44	24	19	47	24	39	45	48	36	42.9
Aegopodium podagraria	12	—	2	9	9	3	—	—	—	3	5	33	8	—	—	—	—	7	8	18	—	3	—	—	4	6	5	5.0
Agropyron repens	75	38	54	59	89	10	64	58	94	45	35	44	71	33	47	8	72	37	62	11	23	49	40	19	56	47	39	47.4
Agrostis spp.	—	2	3	—	62	11	34	—	2	—	13	—	—	—	29	4	—	—	—	—	—	20	23	—	14	6	5	6.3
A. canina	—	—	—	—	—	3	5	—	—	—	—	—	—	—	11	—	—	—	—	—	—	—	4	—	1	1	1	1.0
A. tenuis	—	2	2	—	—	16	25	25	—	18	—	—	—	4	48	18	—	1	9	—	—	7	13	26	9	11	7	8.9
Alchemilla vulgaris coll.	2	—	8	3	9	5	21	—	2	—	1	1	9	—	1	12	—	1	9	—	1	23	2	12	6	3	6	5.1
Alnus incana	—	—	—	—	1	—	2	2	—	—	—	—	—	—	1	2	—	—	—	—	—	—	—	—	1	0	—	0.3
Alopecurus spp.	—	—	—	—	1	—	—	—	—	—	—	—	—	1	2	—	—	—	—	—	—	1	—	—	0	0	0	0.2
A. aequalis	—	—	—	—	2	12	5	2	—	5	2	—	—	33	14	—	—	—	3	—	—	—	4	—	3	7	1	3.4
A. geniculatus	3	11	—	—	—	4	—	52	—	3	2	—	—	—	27	—	—	—	—	—	—	2	13	1	9	4	2	4.9
A. pratensis	—	4	1	—	1	—	5	—	—	—	10	—	—	—	2	—	—	—	2	1	—	2	9	—	1	2	2	1.5
Anchusa arvensis	2	—	—	—	1	—	—	—	12	—	—	—	—	—	—	—	3	1	3	—	—	—	—	—	0	2	1	0.9
Angelica silvestris	2	6	—	—	16	3	6	7	—	8	1	—	6	1	—	3	—	3	—	2	—	7	—	6	5	2	2	3.2
Anthemis arvensis	2	4	—	—	—	—	—	—	—	5	—	—	—	—	—	—	3	—	—	1	—	—	—	—	1	1	1	0.6
A. tinctoria	2	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0	—	—	0.1
Anthoxanthum odoratum	2	—	2	—	29	—	18	—	—	—	—	—	—	1	2	9	—	—	2	—	—	16	1	3	6	2	3	3.5
Anthriscus silvestris	3	13	—	5	26	14	9	6	2	8	9	9	6	—	—	1	1	1	5	15	1	9	2	1	10	4	4	6.1
Apera spica-venti	—	6	2	—	—	—	2	—	—	—	—	—	—	—	2	—	—	—	2	—	—	1	—	—	1	0	0	0.6
Arabidopsis thaliana	—	—	—	—	4	2	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	—	0.3
Artemisia vulgaris	5	4	10	2	8	2	2	—	—	—	—	4	7	—	—	—	—	3	2	11	3	—	—	—	4	1	2	2.6
Athyrium filix-femina	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	0	—	0	0.1
Barbarea vulgaris	—	—	—	—	1	—	10	1	—	—	—	3	6	—	2	4	—	1	—	2	—	—	—	5	2	2	1	1.5
B. stricta	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	2	—	0	0	0.1
Betula spp.	—	—	—	—	1	—	4	—	—	—	2	—	—	—	1	—	—	—	2	1	—	—	4	3	1	0	1	0.8
B. nana	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0	—	—	0.1
B. pubescens	—	—	—	—	—	—	8	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	2	—	0	0.7
B. verrucosa	—	—	—	—	1	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	0.2
Bidens tripartita	12	6	6	—	1	—	—	1	5	11	4	1	—	4	—	—	18	1	4	3	1	—	—	—	3	3	3	3.3
Brassica spp.	—	—	1	—	1	—	5	—	—	—	26	2	—	1	3	—	—	—	—	—	—	—	9	—	1	4	1	2.0
B. campestris	3	—	1	2	2	7	1	12	—	—	2	—	—	6	2	7	—	9	—	26	9	14	—	2	4	2	8	4.4
B. napus	—	—	—	—	2	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	0	0.3
B. rapa	—	2	—	—	2	—	1	1	—	—	—	—	—	—	3	—	—	—	—	—	—	—	3	—	1	0	0	0.5
Bromus secalinus	—	—	—	—	—	—	3	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	0	0	—	0.2
Calamagrostis spp.	—	—	—	—	2	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0	1	—	0.3
C. arundinacea	—	—	—	—	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	0	0.4
Calluna vulgaris	—	—	—	—	—	—	1	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	0	0	—	0.1
Caltha palustris	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	0	0.2
Campanula glomerata	—	2	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0	—	—	0.1
C. patula	3	2	3	—	14	15	17	1	—	6	10	2	9	1	5	6	—	—	7	—	5	12	—	4	7	5	4	5.1
C. rotundifolia	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	1	1	0	0	0.3

Taxon \ Locality / Year	1962								1963								1964								1962	1963	1964	1962—64
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32				
Capsella bursa-pastoris	35	64	30	36	66	27	54	1	23	15	51	50	37	18	10	27	21	17	30	46	32	42	22	23	39	29	29	32.4
Cardaminopsis suecica	—	—	—	—	—	—	1	—	—	—	—	—	1	1	—	1	—	—	—	—	—	—	—	1	0	0	0	0.2
Carduus crispus	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	3	0	—	1	0.3
Carex spp.	—	—	—	—	1	1	11	2	—	—	1	—	—	—	18	6	—	—	—	—	—	3	—	—	2	3	0	1.8
C. canescens	—	—	1	—	—	4	13	1	—	—	1	—	—	—	—	—	—	—	2	—	—	—	1	2	2	0	1	1.0
C. leporina	—	—	1	—	—	—	3	—	—	—	2	—	—	—	1	—	—	—	—	—	—	5	—	1	1	0	1	0.5
C. nigra	—	—	—	—	—	2	5	4	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	3	1	0	1	0.7
Carum carvi	—	6	—	—	1	1	4	5	—	5	2	—	—	—	3	4	1	1	—	—	—	3	4	—	2	2	1	1.7
Centaurea cyanus	6	9	36	16	33	8	16	—	26	11	23	6	15	—	3	—	31	7	20	15	5	2	1	—	16	11	10	12.0
C. jacea	—	2	—	—	4	—	—	—	—	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	0.4
C. scabiosa	—	—	—	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	0	0	—	0.1
Cerastium caespitosum	6	7	4	4	25	30	67	44	11	3	10	2	36	3	40	64	6	4	9	13	13	24	43	66	23	21	22	22.3
Chamaenerion angustifolium	2	4	11	11	33	42	38	17	2	15	16	7	17	9	38	29	3	8	8	4	16	11	20	36	20	17	13	16.5
Chenopodium album	100	96	88	81	93	73	86	96	100	92	98	91	90	95	97	82	76	98	95	99	91	91	98	94	89	93	93	91.7
C. polyspermum	11	11	—	—	—	—	—	—	—	3	—	3	—	—	—	—	—	8	—	25	—	—	—	—	3	1	4	2.5
Chrysanthemum leucanthemum	—	26	4	6	22	7	15	—	—	13	12	2	7	3	4	10	10	1	6	1	1	18	1	7	10	6	6	7.3
C. vulgare	—	—	1	—	—	—	2	1	—	—	—	3	—	1	—	—	—	1	—	—	1	—	1	1	1	1	1	0.5
Cirsium arvense	78	49	37	34	59	14	19	2	57	57	57	59	31	14	4	7	60	45	40	81	23	33	11	19	37	36	39	37.1
C. heterophyllum	—	—	1	2	13	6	17	4	—	2	3	6	5	4	1	17	—	4	3	—	4	5	3	15	5	5	4	4.8
C. palustre	—	2	1	—	6	1	16	—	—	2	3	5	2	—	9	—	—	—	5	—	5	9	—	5	3	3	3	3.0
Comarum palustre	—	—	—	—	—	1	—	2	—	—	—	—	—	1	—	1	3	—	1	—	1	—	4	2	0	0	1	0.7
Convolvulus arvensis	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	0	0	0.1
Crepis tectorum	—	4	—	6	19	—	1	3	—	—	2	—	—	—	—	—	—	—	7	—	—	—	4	—	4	0	1	1.9
Dactylis glomerata	—	2	2	—	27	—	—	—	—	2	1	—	—	—	2	—	1	—	5	—	—	16	—	—	4	1	3	2.4
Deschampsia caespitosa	3	19	28	1	21	24	68	72	20	5	27	2	—	15	47	54	6	1	21	—	6	28	51	34	30	21	18	23.0
D. flexuosa	—	—	—	—	6	—	3	1	—	—	—	—	—	20	—	5	—	—	—	—	—	2	—	1	1	3	0	1.6
Dryopteris spinulosa	—	—	—	—	—	—	5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	—	0	0.3
Epilobium spp.	—	—	2	—	1	1	—	—	—	—	1	10	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	0.6
E. palustre	—	—	1	—	—	—	15	2	—	—	—	—	—	—	9	12	—	—	1	—	—	15	4	10	2	3	4	2.9
E. montanum	—	—	—	6	—	1	2	—	—	—	—	—	—	—	1	—	—	—	—	—	—	2	—	—	1	0	0	0.5
Equisetum arvense	88	36	45	24	47	47	49	60	75	66	66	43	42	37	40	12	84	29	41	50	24	15	17	24	50	48	36	44.2
E. fluviatile	—	—	1	—	—	—	5	—	—	—	—	—	—	—	1	—	—	1	3	—	—	—	—	2	1	0	1	0.5
E. palustre	3	0	3	2	20	7	16	1	2	3	0	5	0	3	2	3	6	4	2	1	9	5	0	15	7	2	5	4.7
E. silvaticum	29	11	30	18	22	50	40	3	0	35	8	56	24	10	20	32	7	25	28	32	37	14	1	34	25	23	22	23.6
Eriophorum angustifolium	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	0	—	0	0.1
E. vaginatum	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0	—	—	0.1
Erodium cicutarium	—	—	2	—	1	—	—	—	—	—	—	—	2	—	—	—	—	—	7	—	—	—	—	—	0	0	1	0.5
Erophila verna	—	—	1	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	0.3
Erysimum cheiranthoides	91	84	67	78	93	72	72	51	60	85	93	90	91	61	70	47	66	86	67	82	84	75	45	57	76	75	70	73.6
Festuca spp.	—	—	—	—	—	2	—	1	—	—	—	—	—	—	2	5	—	1	—	—	5	—	3	—	0	1	1	0.8
F. ovina	—	—	—	—	—	1	4	—	—	—	1	—	—	—	3	—	—	1	—	—	—	—	—	—	1	1	0	0.4
F. pratensis	—	4	—	—	—	—	4	4	—	3	1	—	—	—	3	11	1	—	—	—	1	11	1	1	2	2	2	1.9
F. rubra	—	2	6	—	—	3	22	15	—	2	—	—	—	—	40	13	—	1	2	—	—	1	21	5	6	7	4	5.5
Filipendula ulmaria	2	2	12	8	21	3	24	23	12	5	12	9	5	3	2	8	1	4	11	3	6	11	4	18	12	7	7	8.7
Fumaria officinalis	72	40	50	42	79	19	32	0	40	22	47	77	37	23	12	19	27	44	54	91	53	49	7	13	42	35	42	40.0

Table 3. (cont.)

Taxon \ Year / Locality	1962								1963								1964								1962	1963	1964	1962—64
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32				
Galeopsis spp.	94	100	98	94	100	100	89	97	51	97	100	100	97	100	99	82	84	95	94	97	95	93	97	90	97	91	93	93.5
Galium spp.	—	—	—	—	—	—	—	—	—	—	5	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	0	0.3
G. boreale	—	2	—	—	2	—	—	—	—	—	2	—	—	—	—	—	1	—	—	1	—	—	—	—	1	0	0	0.3
G. mollugo	—	—	—	—	—	—	—	—	—	3	2	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	0	0.3
G. palustre	—	2	2	—	6	6	12	19	—	—	—	11	7	13	13	5	1	3	3	—	1	13	10	10	6	6	5	5.7
G. uliginosum	—	—	7	1	18	3	24	—	—	—	3	—	9	—	22	3	—	—	5	1	5	5	10	2	7	5	4	4.9
G. verum	—	2	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0	0	—	0.
G. vaillantii [a]	25	45	21	28	54	4	14	7	42	20	18	38	15	4	1	6	55	9	32	39	18	14	12	5	25	18	23	21.9
Geranium silvaticum	—	—	—	—	6	3	4	—	2	—	—	1	—	—	—	9	—	—	1	1	—	3	—	20	2	2	3	2.1
Geum rivale	—	—	3	—	2	3	9	—	2	—	2	1	—	—	—	—	—	—	—	—	—	5	—	5	2	1	1	1.3
Glechoma hederacea	—	—	1	1	—	—	1	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	0	—	0	0.2
Gnaphalium uliginosum	26	38	53	16	41	72	39	74	36	17	40	56	47	41	65	24	15	25	33	14	46	13	43	38	45	41	28	38.0
Heracleum sphondylium	—	15	—	—	8	1	—	—	2	—	—	1	—	—	—	—	—	1	—	3	—	—	—	—	3	0	1	1.3
Hieracium spp.	2	—	1	4	18	5	—	6	2	3	8	3	—	3	—	—	—	—	6	1	—	—	—	27	5	2	4	3.7
H. pilosella	—	—	—	—	6	—	14	—	—	—	—	—	—	—	3	6	—	—	1	—	3	—	—	2	3	1	1	1.5
H. umbellatum	—	—	2	—	8	1	12	21	—	2	—	—	1	1	—	12	—	—	—	1	—	18	2	3	6	2	3	3.5
Hypericum maculatum	2	—	—	—	4	1	1	—	2	5	—	—	—	—	—	1	—	—	1	—	—	1	—	—	1	1	0	0.8
Juncus spp.	—	—	—	5	—	1	7	1	—	—	—	6	—	—	—	—	—	—	—	—	1	1	—	—	2	1	0	0.9
J. bufonius	2	—	21	7	—	12	25	41	9	—	1	—	—	9	13	2	—	5	10	1	—	6	27	—	14	4	6	8.0
J. filiformis	—	—	3	—	—	1	4	—	—	2	1	—	—	—	3	—	—	—	2	—	—	—	3	1	1	1	1	0.8
Knautia arvensis	—	—	2	8	52	—	1	—	—	—	—	5	8	—	—	—	—	1	3	—	—	34	—	—	8	2	5	4.8
Lamium spp.	40	9	7	5	5	0	0	0	55	8	4	22	1	5	1	0	42	2	14	29	6	2	0	1	8	12	12	10.8
Lapsana communis	86	51	90	84	74	5	18	0	81	71	63	83	83	0	1	2	72	70	75	70	73	30	2	0	51	48	49	49.3
Lathyrus pratensis	18	5	12	6	16	13	11	0	17	32	24	12	23	18	2	3	7	16	14	25	13	25	0	8	10	16	14	13.3
Leontodon autumnalis	18	7	27	18	21	28	46	70	2	31	24	24	36	24	49	47	15	10	0	28	23	28	29	72	29	30	26	28.2
Linaria vulgaris	2	—	—	1	5	1	—	—	—	29	—	—	—	—	—	—	—	—	1	23	—	5	—	—	1	4	4	2.8
Lithospermum arvense	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	0	—	0	0.2
Lolium perenne	—	2	—	—	—	—	1	—	—	2	—	—	—	—	1	—	—	—	1	—	—	—	—	—	0	0	0	0.3
Luzula spp.	—	—	—	—	—	—	22	—	—	1	—	—	—	1	24	—	—	—	—	—	—	—	—	—	3	3	—	2.0
L. multiflora	—	2	—	—	—	9	9	9	—	—	—	—	—	—	1	1	—	—	—	—	—	—	14	2	4	0	2	2.0
L. pallescens	—	—	—	—	1	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	0.2
L. pilosa	—	2	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	0	0	—	0.2
Lychnis flos-cuculi	—	2	2	—	1	—	—	1	—	—	3	—	—	1	—	—	—	—	1	—	—	—	—	—	1	1	0	0.5
Lysimachia vulgaris	—	2	3	2	12	1	1	1	5	3	—	—	19	—	—	—	1	—	21	—	—	1	—	—	3	3	3	3.0
Lythrum salicaria	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	0	0	1	0.3
Maianthemum bifolium	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	0	0	—	0.1
Matricaria matricarioides	9	7	2	1	2	—	16	11	16	3	13	16	9	19	24	12	6	7	—	1	6	7	49	—	6	14	10	9.8
Melandrium album	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	0	—	0	0.1
M. rubrum	—	—	—	—	1	1	2	—	—	—	—	—	—	—	—	2	—	—	—	—	—	1	—	1	1	0	0	0.3
Mentha arvensis	12	—	14	6	1	19	1	1	4	3	8	—	2	—	1	—	21	9	11	6	3	5	2	6	7	2	8	5.6
Menyanthes trifoliata	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	0	—	0	0.2
Myosotis spp.	62	56	81	78	98	53	72	27	72	31	49	87	78	59	26	45	43	58	64	64	84	78	33	46	66	56	59	60.2
Myosurus minimus	—	2	—	1	—	1	1	2	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	1	—	0	0.4
Peucedanum palustre	—	—	1	—	—	—	1	5	—	—	2	—	—	3	—	—	—	—	—	—	—	—	2	1	1	1	0	0.6
Phleum pratense	5	16	17	—	49	37	73	59	37	13	28	3	—	4	68	51	9	—	23	6	25	51	50	37	32	26	25	27.6

Taxon \ Year / Locality	1962								1963								1964								1962	1963	1964	1962—64
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32				
Phragmites communis	3	—	—	—	—	—	—	3	4	3	—	—	—	—	—	—	7	—	—	—	—	1	—	—	1	1	1	0.9
Picea abies	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	0	0	—	0.1
Pimpinella saxifraga	—	—	1	1	8	1	1	—	—	2	1	—	—	3	—	—	—	—	2	1	—	2	—	—	2	1	1	1.0
Pinus silvestris	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0	—	—	0.1
Pisum spp.	—	—	—	—	—	1	—	2	5	—	6	—	1	—	—	—	—	—	1	—	—	3	1	1	0	2	1	0.9
Plantago major	31	44	13	14	29	20	39	27	19	25	31	27	21	8	11	36	40	17	16	23	22	16	18	36	27	22	24	24.3
Poa spp.	—	—	3	—	9	9	48	2	—	—	26	11	—	1	13	5	—	—	—	1	22	5	45	—	9	7	9	8.3
P. annua	—	6	1	—	1	17	5	—	—	—	1	—	—	3	5	12	—	1	1	—	—	—	3	3	4	3	1	2.5
P. palustris	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	3	—	—	—	0	0	0.2
P. pratensis coll.	12	38	8	1	26	20	44	61	18	10	6	—	—	19	69	56	3	—	4	—	—	17	31	34	26	22	11	19.9
P. trivialis	5	15	11	—	15	—	5	7	—	6	—	—	—	—	—	11	—	—	2	—	—	14	3	12	7	2	4	4.4
Polygonum amphibium	—	4	—	—	—	—	5	—	5	3	—	—	—	—	1	—	3	—	—	—	—	—	—	9	1	1	2	1.3
P. aviculare	37	56	32	25	39	33	54	94	58	35	40	49	14	63	73	34	22	33	21	28	27	33	72	24	46	46	33	41.8
P. convolvulus	78	82	50	67	78	21	62	73	91	57	73	76	43	53	35	35	61	33	72	80	49	65	51	35	64	58	56	59.2
P. hydropiper	2	—	38	—	8	—	—	1	—	3	15	—	28	—	—	—	10	—	17	—	—	5	—	—	6	6	4	5.3
P. lapathifolium	78	56	78	72	89	83	78	92	81	75	71	78	62	95	95	63	46	68	90	28	62	81	81	55	78	78	64	73.2
P. viviparum	—	—	—	—	4	1	3	12	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	2	3	0	0	1.0
Populus tremula	—	—	—	—	—	1	2	1	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	1	0	—	0.3
Potentilla spp.	28	15	13	24	22	7	25	23	25	12	36	12	34	11	39	1	28	14	20	14	24	22	14	1	20	21	17	19.3
P. anserina	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	0	—	1	0.2
P. erecta	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	8	—	—	—	—	1	—	0	1	0.4
P. norvegica	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	2	—	—	—	1	—	—	0	0	0.2
Prunella vulgaris	3	—	8	4	20	2	20	—	—	5	8	10	8	—	3	26	—	8	11	—	3	18	2	14	7	8	7	7.2
Pteridium aquilinum	—	—	—	—	—	—	—	—	2	2	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	1	0	0.3
Ranunculus acris	2	4	7	—	19	2	21	37	4	—	9	2	5	1	5	16	—	—	12	—	5	11	9	24	12	5	8	8.1
R. auricomus	—	—	4	—	12	—	8	9	—	—	4	—	6	—	—	10	—	—	7	—	—	11	3	12	4	3	4	3.6
R. flammula	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	0	—	0	0.2
R. repens	63	73	82	62	80	98	86	97	28	55	57	77	56	89	89	94	49	66	68	71	71	72	90	92	80	68	72	73.5
Raphanus raphanistrum	65	44	52	64	85	51	51	20	0	62	60	54	62	24	17	24	37	42	75	40	41	67	16	24	54	38	43	44.9
R. sativus	—	—	—	—	—	—	—	—	—	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0	—	0.1
Rhinanthus minor	—	—	1	—	1	2	6	3	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	2	0	0	0.6
R. serotinus	—	—	1	—	1	1	—	—	—	—	—	—	—	1	2	—	—	—	—	—	—	2	—	—	0	0	0	0.3
Rorippa islandica	—	—	—	—	6	2	8	15	—	3	5	—	—	25	37	4	—	—	8	1	1	12	8	20	4	9	6	6.5
Rubus arcticus	—	—	—	—	—	—	12	22	—	—	1	—	—	1	2	11	—	—	—	2	1	5	6	11	4	2	3	3.1
R. chamaemorus	—	2	—	—	—	1	2	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	0	—	0.3
R. idaeus	2	—	—	—	1	—	2	—	2	5	1	—	—	—	—	—	—	—	—	—	—	—	1	—	1	1	0	0.6
R. saxatilis	—	—	—	—	1	1	3	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	0	0.4
Rumex spp. sorrels	18	42	63	61	92	91	89	97	23	49	56	49	79	80	90	82	27	30	58	21	46	68	80	82	69	64	52	61.4
Rumex spp. docks	18	35	10	26	38	42	38	48	8	12	30	24	9	33	27	47	13	6	10	19	28	33	33	22	32	24	21	25.4
Sagina nodosa	—	—	—	—	—	1	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0	1	—	0.2
S. procumbens	2	7	27	8	25	39	32	2	7	—	10	20	23	10	22	—	1	16	10	1	15	7	27	13	18	12	11	13.5
Salix spp.	—	—	—	—	2	—	4	11	—	—	3	—	—	—	1	7	—	—	—	—	—	6	1	8	2	1	2	1.8
S. caprea	—	—	—	—	—	—	2	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	0	0	—	0.1
S. myrsinifolia	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	—	0	0.1
S. phylicifolia	—	—	—	—	1	4	11	22	—	—	—	—	—	—	10	—	—	—	—	—	—	—	1	7	5	1	1	2.3

Table 3. (cont.)

Taxon \ Year / Locality	1962								1963								1964								1962	1963	1964	1962—64
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32				
S. repens	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	0	—	0	0.1
Scirpus silvaticus	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	0	0	0.1
Scleranthus annuus	—	4	2	—	8	1	1	—	—	—	9	9	—	—	—	—	1	—	—	7	3	2	—	—	2	2	2	2.0
Scrophularia nodosa	—	—	—	—	—	—	—	—	—	3	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	0.2
Scutellaria galericulata	2	2	—	2	—	3	1	8	—	2	2	—	—	—	1	—	—	—	4	2	—	2	—	2	2	1	1	1.4
Secale cereale	—	—	—	—	14	3	16	6	—	—	—	—	—	—	5	—	—	—	1	—	—	7	2	—	5	1	1	2.3
Senecio vulgaris	5	4	—	1	1	—	1	13	2	3	—	1	—	—	4	5	6	4	3	1	—	—	—	9	3	2	3	2.6
Silene cucubalus	—	—	—	1	20	—	—	—	2	5	5	4	—	—	—	2	1	1	1	1	1	12	—	—	3	2	2	2.3
Solanum tuberosum	3	2	3	—	14	7	9	1	—	2	5	1	3	—	12	7	—	—	2	—	—	17	3	2	5	4	3	3.9
Solidago virgaurea	2	—	—	—	—	1	1	3	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	4	1	0	1	0.6
Sonchus arvensis	72	67	53	24	25	27	8	34	60	45	78	37	27	5	0	5	63	54	50	75	35	10	0	12	39	32	37	36.1
S. oleraceus	2	—	—	—	—	—	—	—	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0	1	—	0.3
Spergula arvensis	97	87	92	84	81	96	91	88	83	89	86	100	91	99	94	70	82	87	90	88	80	84	83	85	90	89	85	88.0
S. rubra	—	—	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	0	0	—	0.1
Stachys palustris	23	0	10	5	4	1	0	6	6	52	12	3	1	0	0	1	0	4	1	15	0	1	0	9	6	9	4	6.4
Stellaria graminea	—	—	—	—	7	10	20	9	—	2	4	—	—	3	15	2	—	—	—	—	—	2	—	5	6	3	1	3.3
S. longifolia	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	—	0	0.1
S. media	92	93	73	75	94	65	86	92	92	77	88	96	76	80	81	94	70	76	89	83	92	89	95	94	84	86	86	85.0
S. palustris	—	—	—	—	—	—	1	3	—	2	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	0	—	0.3
Taraxacum spp.	57	35	22	38	59	25	47	30	13	54	58	26	36	32	8	38	22	17	38	55	27	48	14	40	39	33	33	35.0
Thlaspi arvense	37	45	15	11	38	23	23	26	68	8	44	50	13	22	12	2	45	12	20	54	10	7	22	8	27	27	22	25.6
Trientalis europaea	—	—	—	1	—	—	—	6	2	—	—	—	—	—	—	2	—	—	—	1	—	—	—	—	1	1	0	0.5
Trifolium spp.[b]	27	15	37	27	31	13	72	66	9	69	42	35	30	41	71	63	13	50	18	32	11	23	47	43	36	45	30	36.9
T. pratense	31	20	21	12	20	12	63	22	30	8	35	17	9	5	13	18	12	7	10	8	20	20	53	12	25	17	18	19.9
Triglochin palustre	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	0	—	0	0.1
Tripleurospermum inodorum[c]	46	68	56	62	40	42	63	87	64	41	29	42	42	59	35	64	48	34	16	55	43	41	31	51	58	47	40	48.3
Tussilago farfara	31	11	7	2	13	8	4	0	25	17	40	32	17	1	1	13	12	33	13	27	11	8	0	12	10	18	15	14.1
Urtica spp.	—	4	—	1	4	—	—	—	—	2	—	2	—	1	—	—	—	—	—	—	—	—	—	—	1	1	—	0.6
U. dioica	—	4	2	1	4	1	14	8	5	3	3	—	—	4	2	2	1	—	21	1	4	1	7	1	4	2	2	2.9
U. urens	—	—	4	1	1	1	2	1	5	—	—	—	—	3	—	—	1	—	1	1	—	—	—	—	1	1	0	0.9
Vaccinium myrtillus	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	0	0	0	0.1
V. vitis-idaea	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	0	0	0	0.1
Valeriana spp.	—	—	—	1	—	—	—	19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	0.8
V. sambucifolia	—	—	—	—	—	—	1	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	0.2
V. officinalis	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	0	—	0	0.1
Veronica spp.	—	—	—	—	1	—	1	—	4	—	1	2	3	1	—	—	—	—	—	—	—	—	—	—	0	1	—	0.5
V. arvensis	—	4	2	—	1	—	1	—	—	—	—	—	—	—	—	—	—	1	—	2	—	—	—	—	1	—	0	0.5
V. chamaedrys	—	2	4	7	11	7	13	2	2	2	4	1	—	1	1	—	—	1	—	3	8	9	3	12	6	1	5	3.9
V. officinalis	—	—	1	—	9	—	3	—	—	—	1	1	—	1	—	2	—	—	1	2	—	—	—	—	2	1	0	0.9
V. scutellata	—	—	—	—	—	3	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	0	0.2
V. serpyllifolia	5	7	3	2	—	43	55	2	—	2	2	5	—	5	30	29	—	3	4	—	4	7	15	10	15	9	5	9.7
Vicia angustifolia	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	5	—	—	—	—	—	—	0	1	0.3
V. cracca	66	24	50	44	85	30	21	65	26	65	66	40	33	39	15	29	40	53	52	57	11	68	9	49	48	39	42	43.2
V. hirsuta	12	42	29	36	54	24	48	0	13	15	55	78	45	25	4	0	42	3	61	16	30	13	18	10	31	29	24	28.0
V. sativa	11	6	3	—	—	—	1	—	5	3	1	—	10	—	—	—	—	—	—	—	—	—	—	—	3	2	—	1.7

Taxon \ Year / Locality	1962								1963								1964								1962	1963	1964	1962—64
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32				
V. sepium	5	4	1	—	26	—	3	—	2	—	6	2	20	—	—	2	—	—	7	1	1	8	—	6	5	4	3	3.9
Viola arvensis[d]	95	91	92	78	98	72	73	32	96	83	88	99	86	67	74	50	90	92	82	96	95	66	46	80	79	80	81	80.0
V. palustris	—	—	7	9	14	16	37	27	—	—	8	2	7	14	28	17	—	4	6	4	11	19	34	32	14	10	14	12.3
V. montana	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	0	0.2
Viscaria vulgaris	—	4	—	—	1	—	—	—	—	3	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	0	0	0.4
No. of taxa	86	104	108	82	135	118	168	125	93	105	111	84	75	82	107	109	80	79	116	90	81	115	101	119				284

[a] = incl. *G. aparine* [b] = excl. *T. pratensis* [c] = incl. *Matricaria recutita* [d] incl. *V. tricolor*

Frequencies of the species found in one locality ( ) only:

(9) *Chaenorrhinum minus* 2, *Stellaria holostea* 2, *Veronica polita* 2
(10) *Arrhenatherum pubescens* 2, *Carex magellanica* 2, *Chenopodium urbicum* 2, *Filipendula vulgaris* 2, *Juncus compressus* 2, *Lathyrus montanus* 2
(11) *Centaurea phrygia* 1
(12) *Pyrola* sp. 1
(13) *Dryopteris* sp. 5, *Erigeron acre* 1, *Galium trifidum 2*, *Plantago lanceolata* 2, *Veronica verna* 1
(14) *Fragaria vesca* 1, *Poa nemoralis* 14
(15) *Alisma plantago-aquatica* 2, *Avena fatua* 1, *Calamagrostis canescens* 1, *C. purpurea* 1, *Carex limosa* 1, *C. pallescens* 2, *Chamaedaphne calyculata* 1, *Dryopteris linnaeana* 2, *Oxycoccus quadripetalus* 1, *Petasites frigidus* 1, *Prunus padus* 1, *Ribes rubrum* 1, *Salix cinerea* 1, *Sparganium* sp. 1, *Vaccinium uliginosum* 1
(16) *Carex caespitosa* 2, *Cornus suecica* 3, *Juncus alpinus* 1, *Lathyrus palustris* 9, *Ranunculus sceleratus* 1, *Thalictrum flavum* 5, *Trollius europaeus* 1
(17) *Allium oleraceum* 2, *Arenaria serpyllifolia* 2, *Briza media* 2, *Geranium pusillum* 2, *Hypochoeris maculata* 2, *Paris quadrifolia* 2, *Plantago media* 2, *Sinapis arvensis* 58, *Veronica agrestis* 21, *V. opaca* 12
(18) *Beta vulgaris* 3, *Rosa dumalis* 2, *Sorbus aucuparia* 2
(20) *Veronica longifolia* 1
(24) *Antennaria dioica* 1, *Cardamine pratensis* 1, *Lupinus* sp. 1
(25) *Euphorbia helioscopia* 1, *Juncus effusus* 1, *Lotus corniculatus* 1
(27) *Bromus inermis* 1, *Glyceria fluitans* 1
(28) *Atriplex patula* 7, *Euphorbia* sp. 1, *Vicia faba* 1
(29) *Solanum dulcamara* 1
(30) *Arctium tomentosum* 1, *Dianthus deltoides* 1, *Equisetum hiemale* 2, *Euphrasia* sp. 1, *Rhamnus frangula* 1
(31) *Salix lapponum* 1
(32) *Callitriche* sp. 1, *Carex brunnescens* 1, *Matteuccia struthiopteris* 1

Table 4. Average number of plants/m² on all the fields. Localities (1—32) surveyed in 1961—64.

Taxon \ Year / Locality	Category [e]	1961								1962							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Achillea millefolium	MR	..	..	..	..	..	..	..	..	7	.1	8	8	12	4	6	.4
A. ptarmica	MS	..	..	..	..	..	..	..	..	2	2	6	1	3	4	15	3
Agropyron repens	R	1	6	15	8	11	9	15	5	23	34	18	41	96	5	42	29
Capsella bursa-pastoris	S	1	4	2	.6	.5	.1	.1	.1	1	5	3	3	4	.6	7	—
Chenopodium album	S	46	48	39	11	7	15	17	13	71	124	26	29	27	16	40	80
Cirsium arvense	S	4	2	3	.6	.2	2	.4	.4	2	2	1	1	1	.2	1	—
Equisetum arvense	S	2	.8	3	5	2	1	2	2	4	3	3	1	1	4	5	4
E. palustre	S	.2	.1	.8	—	.0	.0	—	.0	—	—	.0	.1	.2	.2	2	.1
E. silvaticum	S	.2	.1	.4	.2	.1	1	.1	.2	.0	.3	.9	.6	.5	1	.9	.0
Erysimum cheiranthoides	S	17	23	25	15	8	10	5	8	32	32	19	28	25	22	36	7
Fumaria officinalis	MR	6	26	13	1	2	2	.3	.6	4	3	4	3	7	1	5	—
Galeopsis spp.	S	70	81	100	47	40	95	92	56	38	66	156	82	167	114	101	86
Galium vaillantii [a]	R	3	2	4	.2	2	.5	2	1	3	9	2	2	10	.1	.3	.1
Gnaphalium uliginosum	S	.4	4	12	5	11	2	7	45	5	5	27	6	10	50	21	100
Lamium spp.	R	3	5	1	.1	.0	.1	.4	—	10	.3	.5	.7	—	—	—	—
Lapsana communis	R	6	16	35	3	2	9	—	.0	25	19	44	41	36	.1	2	—
Lathyrus pratensis	MS	..	..	..	..	..	..	..	..	.2	—	.4	.4	.1	.1	.2	—
Leontodon autumnalis	MS	..	..	..	..	..	..	..	..	.3	.0	1	.7	.4	.5	1	6
Myosotis spp.	R	5	6	6	6	3	4	1	10	5	18	14	18	20	5	32	4
Plantago major	MS	..	..	..	..	..	..	..	..	.4	.4	.1	.1	.0	.1	.4	.9
Polygonum aviculare	MR	.3	.9	2	.7	.6	1	1	2	.6	6	1	1	.8	.5	2	31
P. convolvulus	MR	5	7	7	1	1	3	3	3	3	4	3	7	5	.4	4	4
P. lapathifolium	MR	2	5	8	4	5	7	6	21	4	4	13	16	15	18	16	41
Potentilla spp.	MS	..	..	..	..	..	..	..	..	.9	.4	.2	1	.2	—	2	.1
Ranunculus repens	MS	..	..	..	..	..	..	..	..	1	1	17	5	18	11	27	23
Raphanus raphanistrum	S	6	1	11	2	3	6	1	.2	3	3	9	10	10	3	5	.8
Rumex spp. sorrels	MS	..	..	..	..	..	..	..	..	.1	1	9	14	17	14	26	21
Rumex spp. docks	MS	..	..	..	..	..	..	..	..	—	.0	.0	2	.3	.0	.1	.1
Sonchus arvensis	MS	25	21	18	8	2	4	1	—	11	4	6	3	5	1	.4	3
Spergula arvensis	MS	19	18	54	34	38	49	106	31	56	43	76	54	33	91	147	147
Stachys palustris	MR	.2	1	5	.1	.2	.0	—	.0	.2	—	.5	.2	.1	.1	—	—
Stellaria media	MR	64	66	39	24	21	31	19	26	65	149	50	81	49	26	59	149
Taraxacum spp.	MR	..	..	..	..	..	..	..	..	.2	.2	.4	1	.8	.1	.9	.9
Thlaspi arvense	S	5	3	3	2	.2	.2	2	5	.7	9	.6	2	6	.3	3	10
Trifolium pratense	MR	..	..	..	..	..	..	..	..	2	.6	.7	1	.2	.0	.1	.2
T. spp. [b]	MS	..	..	..	..	..	..	..	..	.8	4	2	.7	.6	.6	3	1
Tripleurospermum inodorum [c]	MR	13	7	4	2	3	1	.4	11	2	2	8	4	3	.6	8	26
Tussilago farfara	R	.0	.7	.8	.1	.0	—	—	—	.0	.1	.2	—	.4	.0	.1	—
Vicia cracca	S	..	..	..	..	..	..	..	..	2	.1	2	2	3	.5	.3	1
V. hirsuta	S	..	..	..	..	..	..	..	..	.1	3	1	.9	1	.4	1	—
Viola arvensis [d]	R	70	55	105	70	22	32	36	58	45	102	100	59	82	38	40	7
Other broad-leaved	..	..	..	..	..	..	..	..	..	4	4	18	22	15	10	58	8
Other grasses	..	..	..	..	..	..	..	..	..	.1	7	6	4	8	5	114	19
Other broad-leaved and grasses	..	42	36	51	19	27	49	84	48	.	.	.	.	.	.	.	.
Total	..	416	446	567	270	212	334	402	347	435	671	658	557	694	448	835	814

[a] = incl. *G. aparine* [b] = excl. *T. pratense* [c] = incl. *Matricaria recutita* [d] = incl. *V. tricolor* [e] = susceptibility to MCPA; S = susceptible; MS = moderately susceptible; MR = moderately resistant; R = resistant [f] = significance symbols of the annual variation.

For the numbers of the localities cf. Table 1 (p. 63) and Fig. 2 (p. 62)

1963								1964														Annual variation t
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	1961	1962	1963	1964	1961—64	1962—64	
1	3	4	6	2	1	.4	3	4	5	6	7	4	7	.4	3	..	6	3	4	.	4	*
1	4	5	1	3	4	6	.6	5	3	5	2	1	5	.4	1	..	5	3	3	.	3	
59	26	10	11	44	8	41	2	22	11	26	2	6	16	21	10	9	36	27	14	21	25	*
1	.1	3	2	3	.4	1	.3	.7	.4	1	2	1	1	2	3	1	3	1	2	2	2	
78	32	40	16	52	46	82	33	23	50	65	93	82	81	209	44	24	52	48	81	51	60	*
1	.6	1	1	2	.2	.1	.0	2	.8	1	1	.3	.7	.5	.1	2	1	.8	.8	1	.9	
6	3	3	1	2	1	3	.4	8	.8	2	.7	1	.4	1	2	2	3	3	2	2	3	
—	.0	—	.2	—	.0	—	—	.0	.0	—	—	.3	.0	—	.6	.1	.4	.0	.1	.2	.2	
—	.1	—	.6	.8	—	.0	.1	.0	.1	.6	.3	.7	.5	—	.7	.3	.6	.2	.4	.3	.4	
13	12	22	18	36	10	17	3	5	17	14	13	18	10	14	7	14	25	17	12	17	18	*
.7	.5	3	7	1	2	.2	.7	2	1	15	45	7	4	1	.6	6	3	2	10	5	5	
3	49	31	77	69	86	102	35	19	49	50	33	45	62	49	36	73	101	57	43	68	67	**
3	.5	2	4	1	.2	.0	.0	7	.2	3	2	.5	.3	.4	.1	2	3	1	2	2	2	
23	.3	21	9	23	7	61	2	.6	3	16	4	13	5	29	7	11	28	20	10	17	19	
4	.1	.1	3	.0	.5	.0	—	7	.0	.5	9	.1	—	—	—	1	1	1	2	1	2	
11	25	7	27	26	—	.0	.0	11	15	41	11	24	6	.0	—	9	21	12	13	11	16	*
.5	.6	.5	.2	1	.3	.0	.1	.1	.4	.3	.2	.1	.9	—	.0	..	.2	.4	.3	.	.3	
.1	.7	.2	1	2	.7	1	.4	.4	.1	—	.8	1	.5	.4	4	..	1	.8	.9	.	1	
5	1	2	6	24	8	2	7	1	7	10	5	19	9	32	3	5	15	7	11	9	11	
.2	.2	.7	.8	1	.1	.2	.4	1	.6	.7	.7	.1	.1	.3	.3	..	.3	.5	.5	.	.4	
1	.4	.6	1	.4	5	5	.5	.5	1	.7	.5	.7	.6	9	.5	1	5	2	2	2	3	
3	.9	2	2	3	2	.9	.5	2	.8	5	3	3	2	1	.6	4	4	2	2	3	3	
18	7	6	22	7	22	42	2	12	4	43	3	19	20	22	3	7	16	16	16	14	16	
.7	.4	1	.1	2	.1	2	.0	3	.2	.7	.4	1	.4	.6	—	..	.6	.8	.8	.	.7	
.4	2	1	10	10	23	26	15	1	4	16	6	8	19	31	16	..	13	11	13	.	12	
—	.9	2	4	7	.0	.0	.1	1	2	10	1	3	9	.0	.3	4	5	2	3	4	4	*
1	3	14	3	11	16	14	9	.9	2	6	1	9	9	55	12	..	13	9	12	.	11	
—	.0	.0	.3	.1	.2	.2	.0	.0	.0	.0	.0	.1	.0	.1	.0	..	.3	.0	.0	.	.1	
5	8	11	2	2	.3	—	—	4	8	11	5	4	1	—	.8	10	4	4	4	5	4	
60	58	101	64	48	91	178	13	53	100	189	86	121	35	180	53	44	81	78	102	76	87	*
.2	7	2	.1	.2	—	—	—	—	.2	—	.5	—	—	—	.5	.8	.1	1	.1	1	.5	
27	47	25	64	81	35	66	106	13	27	84	66	162	120	238	194	36	79	58	113	71	83	*
3	2	.8	.3	2	.2	.1	.3	.1	.2	1	.7	.3	3	.1	.3	..	.6	1	.7	.	.8	
19	—	6	8	2	21	2	.1	3	.9	8	23	.3	.3	8	.4	2	4	7	6	5	6	
2	.2	.8	.2	.1	.1	.0	—	.4	.9	.2	.6	4	.1	.1	.1	..	.6	.4	.8	.	.6	
.2	5	2	1	2	.1	3	3	.4	4	.6	2	.5	.3	1	1	..	2	2	1	.	2	
4	.3	1	2	15	1	.2	2	2	1	.8	5	2	2	2	2	5	7	3	2	4	4	
.4	2	1	.5	1	.0	—	—	.0	.5	1	.2	.6	—	—	.0	.2	.1	.6	.3	.3	.3	*
.4	2	1	.2	2	.4	.5	.9	1	1	1	2	.1	1	.1	.7	..	2	.9	1	.	1	
.2	.2	1	2	3	.2	.0	—	5	.1	3	.2	.6	.1	.4	.1	..	1	.9	1	.	1	
27	50	23	37	42	15	16	18	48	42	41	78	67	9	32	19	56	59	29	42	46	43	*
16	3	10	7	21	4	15	9	11	6	7	7	6	17	26	23	..	17	11	13	.	14	
2	.7	6	.8	22	6	65	5	.5	3	2	3	3	2	31	8	..	21	14	7	.	13	
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	44	.	.	.	.	.	
401	359	374	423	577	418	753	272	281	373	688	526	639	460	998	458	373	641	458	555	439	550	**

Table 5. Average number of plants/m² on the infested fields. Localities (9—32) surveyed in 1962—64.
For the numbers of the localities cf. Table 1 (p. 63) and Fig. 2 (p. 62)

Taxon	1962								1963								1964								1962	1963	1964	1962—64
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32				
Achillea millefolium	9	.5	11	13	12	6	8	.7	3	4	5	8	4	2	.8	4	7	7	7	9	6	9	.9	4	8	4	6	6
A. ptarmica	3	6	12	4	9	8	22	7	3	7	7	3	12	6	10	2	9	8	10	9	7	11	2	3	9	6	7	8
Agropyron repens	31	88	34	71	107	56	66	50	64	58	28	24	62	23	87	22	31	29	42	18	27	33	52	54	63	46	36	48
Capsella bursa-pastoris	3	7	9	8	7	2	12	—	5	.6	6	4	7	2	10	1	3	2	5	4	5	2	9	14	6	4	6	5
Chenopodium album	71	128	30	35	30	21	47	83	78	34	41	17	58	48	85	40	30	51	68	94	90	90	213	47	56	50	85	64
Cirsium arvense	3	3	3	4	3	1	6	—	2	1	2	2	5	2	3	.3	3	2	2	2	1	2	5	.5	3	2	2	2
Equisetum arvense	4	7	6	5	3	9	11	7	8	5	5	3	4	3	7	3	9	3	6	1	4	2	7	9	7	4	5	5
E. palustre	—	—	1	4	.8	3	15	7	—	2	—	4	—	1	—	—	.8	.5	—	—	3	1	—	4	4	.9	1	2
E. silvaticum	.2	3	3	3	2	3	2	.7	—	.4	—	1	3	—	.1	.3	.4	.6	2	1	2	3	—	2	2	.6	1	1
Erysimum cheiranthoides	35	39	28	36	27	31	50	13	21	14	23	20	39	17	25	6	8	20	21	16	22	14	31	12	32	21	18	24
Fumaria officinalis	5	7	7	8	9	6	15	—	2	2	7	9	4	10	1	4	7	2	28	49	13	8	19	4	7	5	16	9
Galeopsis spp.	41	66	159	87	167	114	113	89	7	51	31	77	71	86	103	43	23	52	53	34	48	67	51	41	105	59	46	70
Galium vaillantii[a]	10	19	7	9	18	2	2	1	8	2	10	9	7	4	2	.5	13	2	8	6	3	3	3	3	9	5	5	6
Gnaphalium uliginosum	21	14	51	34	25	70	55	134	65	2	54	16	49	17	94	6	4	12	47	29	30	43	68	19	51	38	32	40
Lamium spp.	24	4	7	15	—	—	—	—	8	1	3	14	1	9	2	—	16	1	3	32	2	—	—	—	6	5	7	6
Lapsana communis	29	37	49	49	49	3	13	—	13	35	11	33	32	—	1	2	15	21	54	15	33	19	.5	—	29	16	20	21
Lathyrus pratensis	.8	—	3	8	.4	.6	2	—	3	2	2	2	5	2	2	2	2	3	2	1	.6	4	—	.4	2	3	2	2
Leontodon autumnalis	2	.3	5	4	2	2	3	9	3	2	1	5	6	3	2	.9	3	.9	—	3	6	2	1	5	3	3	3	3
Myosotis spp.	8	31	17	23	21	9	45	15	6	5	.5	7	31	14	8	15	3	13	15	8	22	12	96	6	21	11	22	18
Plantago major	1	.8	1	.8	.1	.3	1	3	1	.8	2	3	5	.7	2	1	3	4	4	3	.6	.6	1	.7	1	2	2	2
Polygonum aviculare	2	11	3	5	2	2	3	33	2	1	2	3	3	8	7	1	2	3	3	2	3	2	12	2	8	3	4	5
P. convolvulus	4	5	6	11	7	2	6	5	3	2	3	3	6	3	2	1	4	3	7	4	5	3	2	2	6	3	4	4
P. lapathifolium	6	6	16	22	17	21	20	45	22	9	8	29	12	23	44	3	27	6	48	11	30	25	28	6	19	19	23	20
Potentilla spp.	3	3	1	5	.9	—	9	.4	3	3	3	.8	6	.6	4	3	10	2	3	3	5	2	4	—	3	3	4	3
Ranunculus repens	2	2	21	8	22	11	32	24	1	4	2	13	18	26	29	15	2	6	23	8	11	27	34	18	15	14	16	15
Raphanus raphanistrum	4	7	17	16	12	5	10	4	—	1	4	6	12	.1	.2	.2	3	4	13	4	8	13	.1	1	9	3	6	6
Rumex spp. sorrels	.5	3	14	23	19	16	30	22	4	5	24	7	14	20	15	11	3	5	10	5	19	13	69	15	16	13	17	15
Rumex spp. docks	—	.1	.5	7	.7	.1	.2	.1	—	.3	.1	1	.6	.5	.6	—	.2	.5	.3	.2	.3	.1	.2	—	1	.4	.2	.6
Sonchus arvensis	15	7	12	11	20	4	5	10	9	17	14	4	7	7	—	—	6	14	22	7	12	11	—	6	11	7	10	9
Spergula arvensis	57	49	82	65	40	95	162	168	72	65	118	64	53	92	190	19	65	115	208	97	151	42	217	63	90	84	120	98
Stachys palustris	.9	—	5	4	2	9	—	—	4	14	13	3	14	—	—	—	—	5	—	3	—	—	—	5	3	6	2	3
Stellaria media	70	161	68	108	52	40	69	162	29	62	28	66	107	44	99	113	19	36	94	79	175	135	251	207	91	69	125	95
Taraxacum spp.	.3	.5	2	3	1	.5	2	3	20	5	1	1	7	.6	.9	.7	.6	1	3	1	1	5	.4	.7	2	5	2	3
Thlaspi arvense	2	20	4	17	15	1	13	38	29	—	14	16	15	97	26	6	8	7	41	44	3	4	35	4	14	25	18	19
Trifolium pratense	5	3	3	12	.8	.2	.2	1	5	2	2	1	.8	1	.3	—	3	13	2	7	18	.5	.2	1	3	2	6	3
Trifolium spp.[b]	5	14	6	6	2	2	4	2	2	11	3	6	5	2	5	5	3	8	3	7	5	1	2	3	5	5	4	5
Tripleurospermum inodorum[c]	4	4	14	9	4	2	12	30	6	.9	3	4	26	2	.8	2	5	3	5	10	5	4	6	3	10	6	5	7
Tussilago farfara	.2	.5	2	—	3	.3	3	—	1	10	3	2	7	1	—	—	.3	2	8	.7	5	—	—	.3	1	3	2	2
Vicia cracca	3	.6	5	5	4	2	1	2	2	3	2	.4	5	1	3	3	3	2	3	3	1	2	1	1	3	2	2	2
V. hirsuta	.8	7	4	2	2	2	2	—	2	1	2	3	6	.9	.3	—	13	3	4	1	2	.6	2	1	2	2	3	3
Viola arvensis[d]	47	112	108	76	84	53	55	21	28	60	26	37	48	23	21	36	53	46	50	81	71	14	69	23	70	35	51	52
Other broad-leaved	7	9	20	35	15	10	62	9	20	6	10	9	24	5	19	12	19	8	10	8	12	23	31	24	21	13	17	17
Other grasses	1	20	10	36	9	7	125	20	14	6	11	5	36	10	79	9	5	9	8	13	11	7	41	10	29	21	13	21

[a] = incl. *G. aparine* [b] = excl. *T. pratense* [c] = incl. *Matricaria recutita* [d] = incl. *V. tricolor*

Table 6. Average number of plants/m² on all the fields. Material of 1962—64 classified according to the spring cereal species, type of soil, moisture conditions in the soil, and preceding crop

Taxon	Type of soil				Moisture conditions				Preceding crop					Present crop			
	Sand or fine sand	Clay	Humus & peat	Significance[e]	Dry	Medium	Wet	Significance[e]	Ley	Winter cereal	Spring cereal	Potato & roots	Significance[e]	Oats	Barley	Wheat	Significance[e]
Achillea millefolium	4.9	3.6	4.4		5.8	4.3	3.3		5.7	6.5	3.9	1.7		4.8	4.0	4.5	*
A. ptarmica	2.3	2.2	6.2	***	2.4	3.3	7.4	***	5.9	1.9	3.4	0.4	***	5.3	1.9	2.7	***
Agropyron repens	33.3	13.4	19.6	***	38.0	21.8	14.7	***	25.5	35.2	24.6	11.0	**	19.1	25.3	29.4	**
Capsella bursa-pastoris	2.9	1.3	1.1	***	2.6	2.0	0.5	***	1.5	4.0	1.7	2.5	***	1.3	2.0	3.2	**
Chenopodium album	73.6	66.5	34.1	***	74.4	58.8	35.5	***	32.2	63.3	54.8	137.8	***	41.2	73.0	75.7	***
Cirsium arvense	0.8	1.1	0.8	***	1.3	0.8	0.7	**	0.5	0.7	1.1	0.8	***	0.8	0.7	1.4	***
Equisetum arvense	2.9	2.3	2.0	***	2.6	2.5	2.1		1.6	2.4	2.9	2.9	*	2.1	2.2	2.8	*
E. palustre	0.1	0.1	0.5	***	0.0	0.1	1.1	***	0.2	0.1	0.1	0.0		0.3	0.2	0.1	***
E. silvaticum	0.6	0.2	0.3		0.4	0.5	0.2		0.3	0.5	0.4	0.5		0.4	0.3	0.5	
Erysimum cheiranthoides	19.8	16.5	15.8	***	16.3	18.1	14.4		15.6	16.4	19.8	14.4	***	15.8	16.3	24.8	***
Fumaria officinalis	3.0	12.2	3.2	***	11.6	4.7	0.5	***	4.1	6.1	6.0	5.9	***	3.9	6.0	7.4	***
Galeopsis spp.	78.5	40.0	80.2	***	51.5	77.2	56.4	***	58.9	85.9	75.4	67.2	***	67.7	68.2	75.7	**
Galium vaillantii[a]	1.2	2.4	2.1	*	3.2	1.6	1.3	***	0.3	0.8	2.4	3.7	***	1.7	1.3	2.6	**
Gnaphalium uliginosum	23.6	10.2	23.1	***	10.8	18.6	46.3	***	29.0	13.1	19.7	9.7	*	26.2	20.1	10.0	
Lamium spp.	0.2	4.1	0.7	***	2.1	1.3	0.5	***	0.6	0.2	1.9	2.1	***	1.4	0.9	1.7	***
Lapsana communis	14.7	14.2	16.2	***	19.3	15.0	9.4	***	8.5	16.3	19.5	13.0	***	13.4	11.7	22.4	***
Lathyrus pratensis	0.2	0.3	0.3		0.5	0.2	0.5	*	0.3	0.3	0.3	0.1		0.4	0.2	0.2	**
Leontodon autumnalis	1.4	0.7	1.0		0.4	1.3	0.9	**	2.0	1.0	0.8	0.3	***	1.5	0.9	0.7	*
Myosotis spp.	17.0	5.9	6.8	***	14.3	11.1	4.5	***	8.3	15.5	11.2	12.9	***	7.5	11.2	17.7	***
Plantago major	0.4	0.5	0.4	*	0.3	0.4	0.5		0.4	0.8	0.4	0.2		0.4	0.3	0.6	
Polygonum aviculare	4.7	1.3	2.0	***	1.2	3.4	3.7	***	5.4	3.4	2.0	1.6	**	3.5	2.5	2.7	
P. convolvulus	2.9	2.4	2.1	**	4.0	2.4	1.3	***	2.0	2.9	2.6	3.2	***	2.1	2.4	3.6	***
P. lapathifolium	11.8	6.3	29.7	***	5.7	15.2	42.6	***	20.2	16.3	15.0	10.2	**	21.1	13.1	10.4	**
Potentilla spp.	0.3	0.4	1.4	***	0.3	0.6	1.3		0.8	0.6	0.6	0.8		1.0	0.5	0.4	***
Ranunculus repens	10.9	4.1	22.8	***	4.5	13.1	24.4	***	21.7	12.1	10.2	4.4	***	16.3	12.2	6.7	***
Raphanus raphanistrum	5.4	1.2	3.1	***	3.4	3.9	1.5		2.5	4.8	4.0	4.2	**	2.9	4.2	4.5	*
Rumex spp. sorrels	11.6	2.2	19.9	***	10.2	10.9	23.4	***	19.9	17.8	8.0	4.0	***	17.0	9.5	5.4	***
Rumex spp. docks	0.1	0.0	0.2		0.1	0.1	0.2		0.1	0.4	0.1	0.1	***	0.1	0.2	0.1	
Sonchus arvensis	2.5	6.9	3.5	***	6.4	3.6	2.4	***	1.3	1.8	5.8	3.8	***	2.5	4.0	6.8	***
Spergula arvensis	84.9	46.0	130.0	***	72.3	84.7	172.4	***	66.0	90.3	117.0	56.1	***	106.6	85.0	57.9	*
Stachys palustris	0.1	0.8	0.5	***	0.1	0.4	0.5		0.1	0.2	0.7	0.3	***	0.3	0.3	0.9	
Stellaria media	104.2	59.4	71.6	***	75.7	81.9	92.5		31.1	41.6	74.9	272.6	***	58.5	107.4	88.5	***
Taraxacum spp.	0.9	0.9	0.4	**	0.8	0.7	0.9		1.2	1.1	0.6	0.3	***	0.8	0.6	1.0	
Thlaspi arvense	4.1	9.9	3.6	***	9.7	4.8	2.4	***	5.2	7.2	5.7	3.8	**	3.6	6.1	7.6	***
Trifolium pratense	0.5	0.6	0.5		0.7	0.5	0.6	**	0.3	0.4	0.8	0.1		0.6	0.5	0.6	***
Trifolium spp.[b]	1.6	2.0	1.6	*	1.6	1.7	1.7		2.4	1.1	1.6	0.8	***	1.5	1.4	2.7	***
Tripleurospermum inodorum[c]	6.4	2.6	2.2	***	2.1	4.2	6.7		3.5	7.2	3.8	4.7	***	4.7	3.6	4.1	**
Tussilago farfara	0.3	0.4	0.4	***	0.2	0.4	0.4		0.2	0.0	0.6	0.1	***	0.4	0.4	0.3	
Vicia cracca	0.9	1.2	1.4	*	1.0	1.1	1.4		1.1	1.1	1.4	0.5		1.2	0.9	1.2	
V. hirsuta	0.9	1.2	0.8		1.9	0.8	0.4	***	0.6	0.7	1.1	1.6	**	0.8	0.7	1.7	**
Viola arvensis[d]	45.0	49.6	33.6	***	55.3	42.2	24.5	***	30.9	56.4	50.2	29.6	***	37.5	40.5	56.3	***
Other broad-leaved	13.8	5.8	21.2	***	6.7	14.4	24.9	***	15.2	23.2	12.5	10.5	***	17.7	12.6	10.5	***
Other grasses	17.0	3.1	20.4	***	6.4	14.8	24.7	***	27.7	16.1	7.1	13.2	***	16.1	12.5	15.8	**
Total	609	403	584	***	527	545	687	*	457	576	572	703	***	531	562	570	**

[a] = incl. *G. aparine* [b] = excl. *T. pratense* [c] = incl. *Matricaria recutita* [d] = incl. *V. tricolor* [e] = significance symbols of the χ^2 analyses

On an average, the annuals were more frequent than the perennials. Some of the perennials were typical arable land weeds, such as *Agropyron repens*, *Cirsium arvense* and *Sonchus arvensis*, with a great capacity of vegetative propagation. The great majority, however, were typical grassland weeds, apparently as a result of the inclusion of leys in the crop rotation system. Ley was the preceding crop for 28 % of the spring cereals in this material. The ploughing of the sod, particularly on humus or stony soil, is not thorough enough to prevent some perennial grassland weeds from persisting in the following arable crop. Furthermore, the open ditches and the small size of the fields encouraged the perennial species typical of closed vegetation to spread from the verges into the fields.

The average total number of weeds was 550/m² on all the fields surveyed in 1962—64. This total density varied according to the locality (F 2.51*, d.f. 7 and 21). The largest numbers were recorded in northern Pohjanmaa, in southeastern Finland, and in areas in between, while the smallest numbers were found in southwestern and northeastern localities (Table 4, Fig. 5).

The weeds grew well in all the localities, best of all, however, in southwestern and southern Finland where the growing season is longest. In the northeasterly localities many of the fields were young and the weeds thus not yet abundant. In the southwesterly localities the low numbers of plants may have been due, at least in part, to the long-term use of herbicides (cf. p. 100), but also to the low precipitation during the spring and early summer.

The proportion of the 27 species counted in the preliminary study (1961) was only 88 % of the total number of weeds. The number of the counted species was, therefore, increased up to 41 in the actual survey (1962—64) so that 95 % of the plants became counted by species. Probably most of the species of agricultural importance in spring cereals were amongst these 41 counted species.

Among the most abundant individual species the average plant numbers were as follows:

Annuals	Average No. of plants/m²	Percentage from the total No.
Spergula arvensis	87	15.8
Stellaria media	83	15.1
Galeopsis spp.	67	12.2
Chenopodium album	60	10.9
Viola arvensis incl. *V. tricolor*	43	7.8
Gnaphalium uliginosum	19	3.5
Erysimum cheiranthoides	18	3.3
Lapsana communis	16	2.9
Polygonum convolvulus	16	2.9
Myosotis spp.	11	2.0
Perennials		
Agropyron repens	25	4.5
Ranunculus repens	12	2.2
Rumex spp. sorrels	11	2.0
Sonchus arvensis	4	0.7
Achillea millefolium	4	0.7
Achillea ptarmica	3	0.5
Equisetum arvense	3	0.5
Leontodon autumnalis	1	0.2
Vicia cracca	1	0.2
Cirsium arvense	< 1	0.2

The distribution of the average plant numbers of the counted 41 species was as follows:

No. of plants/m²	Number of species (taxa) Annuals	Perennials	Total
— 2	6	12	18
3— 4	4	4	8
5— 8	2	0	2
9—16	3	2	5
17—32	2	1	3
33—64	2	0	2
65—	3	0	3

On an average, the annuals were more abundant than the perennials.

According to the susceptibility to MCPA the counted broad-leaved species divided as follows (S = susceptible, MS = moderately susceptible, MR = moderately resistant, R = resistant):

	S	MS	MR	R
Number of species (taxa)	13	11	8	8
Number of plants	183	121	111	93

About 36 % of the plants belonging to the counted broad-leaved species were susceptible, 24 % were moderately susceptible, 22 % moderately resistant and 18 % resistant. The proportion of the susceptible species was greatest in Pohjanmaa and smallest in Southwest and South-

east Finland. The average »expected» control (cf. p. 65) of the above species was 69 % varying from 55 to 75 in different localities (Fig. 49). MUKULA and KÖYLIJÄRVI (1965) have reported 61 % control in 28 field experiments conducted in 1961—64. Both studies prove that the use of MCPA for the control of broad-leaved weeds in spring cereals is justified. However, the need of new herbicides with different selectivities to complement the effects of MCPA seems very evident, particularly in view of the regional variation in the composition of the weed flora.

The number of plants on all the fields correlated positively with the frequency level of the species, i.e. the most frequent species were usually the most abundant. Significant differences were, however, found in the ratio of the density to the frequency with different species. Certain perennials, in particular, despite their low frequency level, tended to increase rapidly once the field had become infested.

On an average, the number of plants on the infested fields was twice that on all the fields (Tables 4 and 6). Naturally, this difference correlated negatively with the level of the percentage frequency and was more conspicuous in the perennials than in the annuals.

A detailed account of the distribution, frequencies and plant numbers of the 41 counted taxa are given in the following pages and maps (Figs. 6—46). The account is furnished with comments on 9 relatively frequent or otherwise important species belonging to the uncounted groups of the »other broad-leaved» weeds or »other grasses».

Achillea millefolium Tables 3—6, Fig. 6

Perennial; found in open, cleared habitats on fairly dry soil; occasionally also on rocks, shores and in woods, where it often remains sterile. On crop land this species grows mostly along banks of open ditches, in grasses, and in winter cereals. In leys for hay it is the eleventh species in order of abundance and occurs on 57% of the leys (PAATELA 1953 b). It is distributed throughout the country but perhaps more common in the south than in the north.

In spring cereals the species was frequent or very frequent, occurring on 69 % of the fields. The average density of shoots was 4/m² on all the fields and 6/m² on the infested fields. The shoot numbers were highest in southeastern Finland, in Kitee (13) as high as 12/m² as an average of all the fields. Also in Häme and southern Varsinais-Suomi the shoot numbers were above the average for the country, whereas in Pohjanmaa the density of the shoots was low. This species thrived on all kinds of soils, but grew abundantly on very small farms in moraine and sandy areas, in open ditched or undrained fields. The shoots often escaped ploughing and appeared in abundance in spring cereals after leys or winter cereals. The average density of shoots was highest in 1962, i.e. after the fairly warm summer of 1961.

Achillea ptarmica Tables 3—6, Fig. 7

Perennial; found in open, cleared habitats on moister soil and along shores. On crop land this species grows especially along ditch banks and in grasses. According to PAATELA (1953 b) its frequency in leys for hay is 9 %. It is distributed throughout the country, but more common in the south than in the north.

In spring cereals the species was fairly frequent, occurring on 43 % of the fields. The average number of shoots was 3/m² on all the fields or slightly less than that of *A. millefolium*. On the infested fields, however, the shoots were more numerous than those of *A. millefolium* and reached an average density of 8/m². The shoot numbers were highest in the localities of the watershed areas, in Keitele—Viitasaari (15) as high as 15/m² on all the fields, and in the southwestern Archipelago (25).

This species grew most abundantly in wet fields with an open ditched drainage system, and in humus soil. The most common crop on such fields was timothy. The species survived ploughing and appeared in abundance in spring cereal crops, usually oats, grown after a timothy ley.

Agropyron repens Tables 3—6, Fig. 8

Perennial, rhizomatous; restricted species in commercial seed; found in open, cleared habitats, certain races also on shores. On crop land the species is frequent on all kinds of crops as well as on ditch banks and field verges. In leys for hay it has been the twelfth species in order of abundance (PAATELA 1953 b), but the degree of infestation is increasing (MUKULA et al. 1967). It is more frequent in the south than in the north.

In spring cereals the species was fairly frequent. It occurred on at least 47 % of the fields. The young shoots were probably not always differentiated from the spring cereals. Consequently, the recorded frequency remained low in some localities. The average density of shoots was 25/m² on all the fields and 48/m² on the infested fields. The density was highest in the hilly region of southeastern Finland, in Kitee (13) as high as 96/m², along the southwestern coast area, in Jomala—Finström

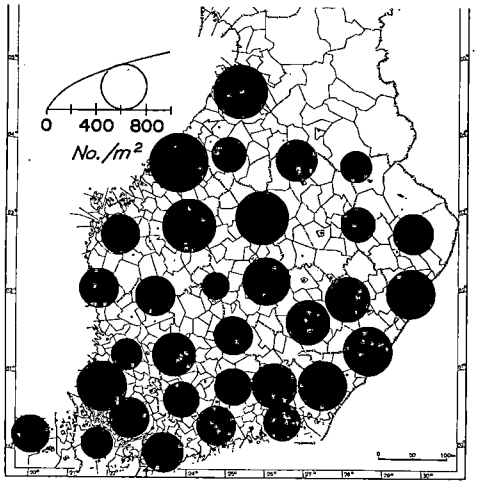

Fig. 5. Total number of weeds

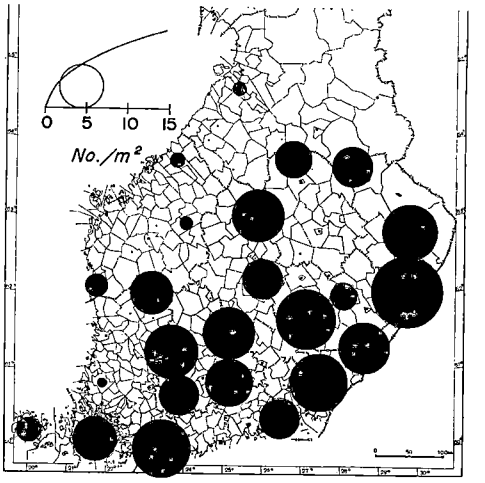

Fig. 6. *Achillea millefolium*

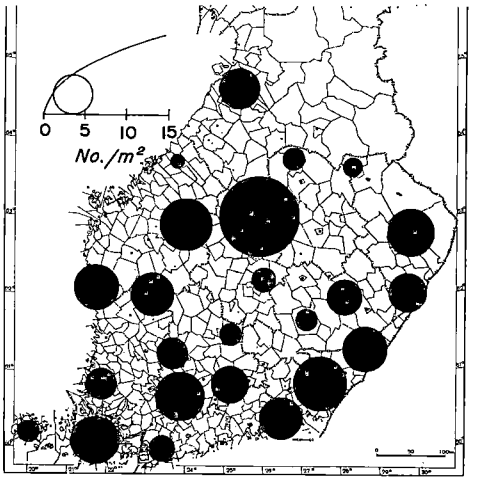

Fig. 7. *Achillea ptarmica*

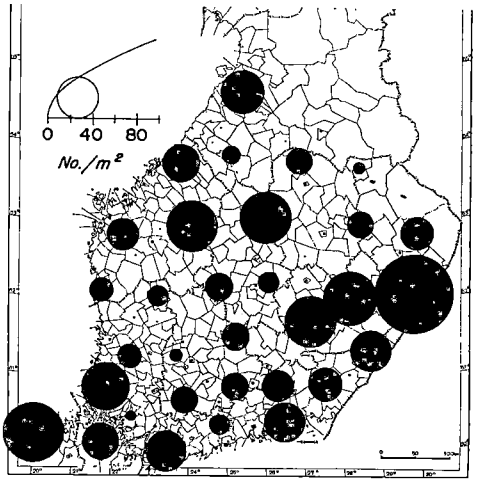

Fig. 8. *Agropyron repens*

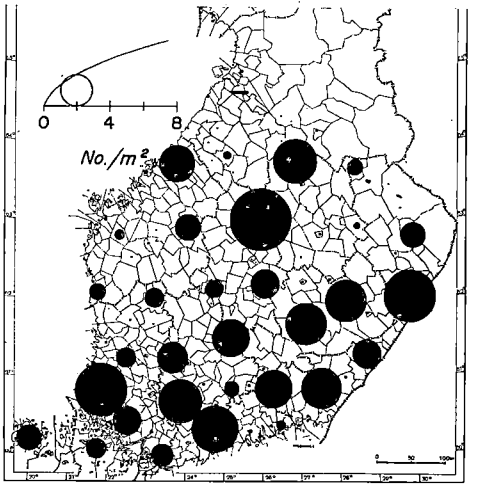

Fig. 9. *Capsella bursa-pastoris*

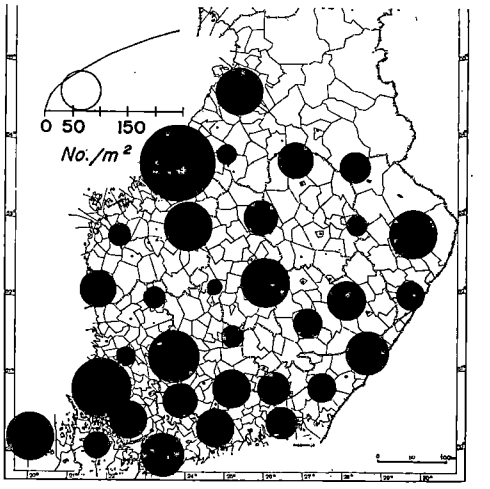

Fig. 10. *Chenopodium album*

—Hammarland (17), and in the central part of the Suomenselkä area. The species was most abundant in fields with dry, sandy or humus rich mineral soil. Such fields were often stony and undrained, and lay along slopes. Also in deep drained fields the shoots grew abundantly. The rhizomes survived ploughing and cultivation. The number of shoots, however, was low in the spring cereal crops grown after potatoes. The density was highest in wheat and barley. The use of herbicides against broad-leaved weeds apparently promoted its competitive ability. The average density was highest in 1962 and lowest in 1964.

Agrostis spp. Table 3

Perennials; found on both cropped and uncropped land, particularly in grasses. According to PAATELA (1953 b) *Agrostis* spp. occurs on 32 % of the leys for hay.

In spring cereals the most frequent and abundant species was *A. tenuis*. Other species were *A. canina*, *A. stolonifera* and *A. gigantea*. In some localities the species were not specified and, in the case of sterile plants, even the genus was often neglected. The average recorded frequency of *Agrostis* was 10 %. The plants were most frequent and abundant in the areas where the proportion of leys in crop rotation was great and, particularly, in post-ley spring cereal crops.

Avena fatua Table 3

Annual, prohibited species in commercial seed of all crops; found in cereals, row crops and waste places in several localities, particularly in southwestern and southern Finland and in southern Pohjanmaa (HILLI 1959).

The timing of the survey was too early to differentiate this species from spring cereals. It probably was fairly rare.

Capsella bursa-pastoris Tables 3—6, Fig. 9

Annual or winter annual, polymorphic; found in open, cleared habitats in unclosed vegetation. On crop land this species grows in cereals, row crops, gardens and also in gaps of grasses. It is distributed throughout the country.

In spring cereals this species was fairly frequent, occurring in 32 % of the fields. Because of the late emergence and minute size of the plants, they may not always have been found or identified. In some localities the species appeared only as scattered specimens, and in the northermost area, in Liminka (16), it was very rare. The average density was 2 plants/m^2 on all the fields and 5/m^2 on the infested fields. The order of density was fairly high in southern and southeastern Finland. The highest densities, however, 15 plants/m^2, were recorded in the Keitele—Viitasaari (15) area of Central Finland. In Pohjanmaa and the southwestern Archipelago the plant numbers were low. The species thrived in dry, sandy and moraine soils, commonly sown with wheat and grew most abundantly after winter cereals.

Centaurea cyanus Table 3

Annual or winter annual; restricted species in commercial seed of herbage crops; found in cultivated or otherwise exposed soil and waste places. On crop land this species grows most commonly in winter cereals and winter rape. It also occurs in spring cereals and first-year grasses. It has become less common after the second World War. At present it is fairly rare though occasionally abundant in South and Central Finland. It is very rare in North Finland.

In spring cereals the species was fairly rare, occurring on 12 % of the fields. It was most frequent in southern and southeastern parts of the country. The plant numbers were usually low, but increased slightly in 1962. The preceding weather conditions — the humid period at the time of the seed ripening in 1961, and the cool and humid spring in 1962 — may have promoted the seed germination.

Cerastium caespitosum Table 3

Perennial, polymorphic; found in both closed and unclosed vegetations, usually in open places; common in leys and older lawns; distributed throughout the country.

In spring cereals the species was scattered and occurred in 22 % of the fields. In the north it was fairly frequent or frequent. In South Finland it was rare. It often survived ploughing, persisting in the post-ley spring cereal crops, particularly in humus and peat soils.

Chamaenerion angustifolium Table 3

Perennial; found in wood clearings, along roadsides, shore banks and field edges; also in forests where it usually remains sterile; common in most parts of the country.

In spring cereals the species was fairly rare, occurring on 17 % of the fields. It was rare in the southern localities, and fairly frequent in the northern localities and in the Suomenselkä area, where it is also known to grow commonly in the forests (KUJALA 1964). The number of shoots was usually low, except near the ditches. Because of the tall size of the shoots they may, despite the low number, constitute a serious competition to the crops.

Chenopodium album Tables 3—6, Fig. 10

Annual, polymorphic; found on cultivated or otherwise exposed soil. On crop land this species is most abundant in row crops, such as potatoes, root crops and vegetables, as well as in spring cereals. Stunted

plants are also found in sparse grasses during the first year. The species is widely distributed throughout the agricultural area of Finland.

In spring cereals the species was very frequent in all the localities and occurred on 92 % of the fields. Only *Galeopsis* spp. exceeded it in frequency. The average plant number on all the fields was 60/m². The highest numbers were recorded in the southwestern localities and from there towards the northeast, i.e. in areas of rich soils. In the watershed areas with less fertile soils the plant numbers were low. The species grew abundantly in fields with dry, sandy or clay soil, where combine harvesters had frequently been used. It was scanty in fields which had often been sprayed with MCPA. The application of farmyard manure seemed to increase its abundance. The number of plants was highest in the spring cereal crops grown after potato or root crops, and lowest after a fallow or ley. In oats the plant numbers were lower than in other cereals. The average density was highest in 1964 and lowest in 1961, i.e. after a warm and rainy spring.

Cirsium arvense Tables 3—6, Fig. 11

Perennial, found in fields and gardens, along roadsides, around habitations and along shores in unclosed vegetation. On crop land this species grows particularly in cereals and row crops, less abundantly in grasses. Its frequency in leys for hay is 14 % (PAATELA 1953 b). It is distributed throughout the actual spring cereal zone but is rare or absent in North Finland.

In spring cereals this species was fairly frequent, occurring on 37 % of the fields. It was frequent in South Finland but rare or fairly rare in the northern localities. The average number of shoots was 0.9/m² on all the fields and 2/m² on the infested fields. The numbers were highest in southwestern Finland, in Lieto—Paimio —Tarvasjoki (1) as high as 4/m². The species grew most abundantly in fields with dry clay soil. It apparently thrived in spring cereals, increasing in abundance when several spring cereal crops were successively grown in a field. The shoot numbers were low after ley, potato or root crops as well as after a fallow. The annual variation of density was not statistically significant.

Deschampsia caespitosa Table 3

Perennial; found in open, cleared habitats, both in closed and unclosed vegetations, also in woods where it often remains sterile. On crop land this species grows along ditch banks and field edges and in older grasses. According to PAATELA (1953 b), it occurs on 42 % of the leys for hay, and in abundance it ranks third after the crop species *Phleum pratense* and *Trifolium pratense*. It is very common in most parts of the country.

In spring cereals the species was scattered, occurring on 22 % of the fields. It was fairly rare in the southern but frequent in the northern localities, where humus and peat soils are common and leys were grown old. The tufted plants tended to survive ploughing, particularly in peat soil, and were not easily destroyed by cultivation.

Equisetum arvense Tables 3—6, Fig. 12

Perennial; found in various open or half-open habitats, such as fields, roadsides, railways, shores and also in damp woods, less abundant in the Suomenselkä area (KUJALA 1964). On crop land this species grows particularly along ditch banks and field edges but also in proper fields. According to PAATELA (1953 b), it occurs on 17 % of the leys for hay. It is distributed throughout the country.

In spring cereals the species was fairly frequent and occurred on 44 % of the fields. It was most frequent in southwestern Finland. The average density of shoots was 3/m² on all the fields and 5/m² on the infested fields. The numbers were highest in the southwestern localities, in Korppoo—Nauvo (25) as high as 8/m² on all the fields. The lowest numbers were recorded in the Lake District. The regional variation of abundance differed from that on woodland and peatland (cf. KUJALA 1964). The species grew abundantly on sandy and clay soils. The rhizomes, surviving the ploughing and cultivation, produced aerial shoots both after arable crops and leys. Annual variation of density was not found.

Equisetum palustre Tables 3—6, Fig. 13

Perennial, poisonous to cattle; found in meso-eutrophic swamps and damp woods; does not disappear when the land is cleared for cultivation. According to PAATELA (1953 b), the species occurs on less than 1 % of the leys for hay. It is distributed throughout the country, but more frequent in the north than in the south (UOTILA 1956, KUJALA 1964).

In spring cereals the species was rare, occurring only on 5 % of the fields. Because of the late emergence of the shoots, the actual degree of infestation may be higher. The average density of shoots was 0.2/m² on all the fields and 2/m² on the infested fields. The highest shoot numbers, 2/m² on all the fields and 15/m² on the infested fields, were recorded in Keitele—Viitasaari (15). The species thrived in fields with moist or wet humus soil, commonly sown with oats, and in fields with an open ditched drainage system. The shoots grew most abundantly along the banks of ditches.

Equisetum silvaticum Tables 3—6, Fig. 14

Perennial; found in damp woods, fens and bogs and in various cleared habitats. On crop land this species grows along edges of fields and also in proper fields.

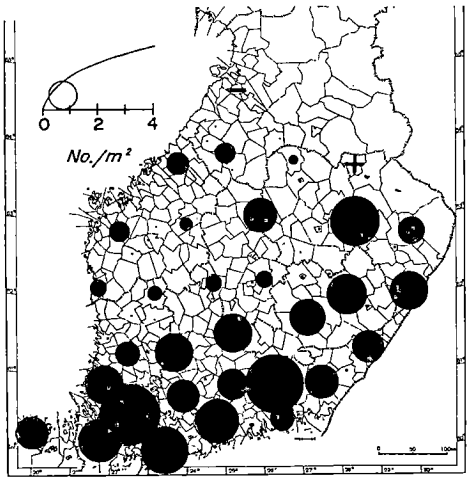

Fig. 11. *Cirsium arvense*

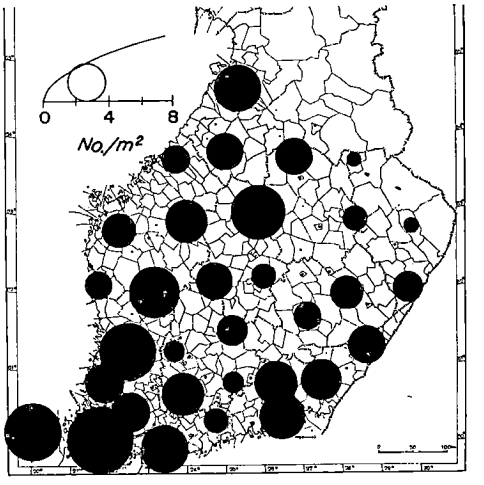

Fig. 12. *Equisetum arvense*

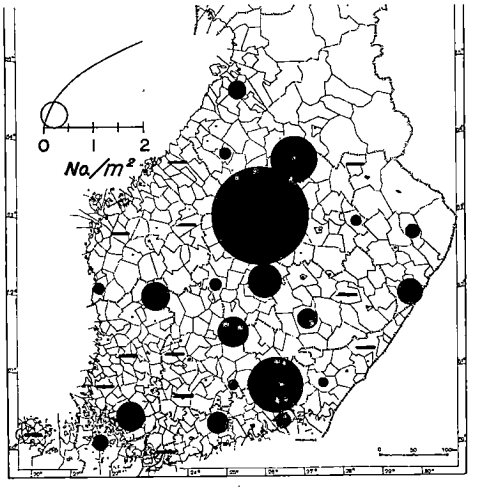

Fig. 13. *Equisetum palustre*

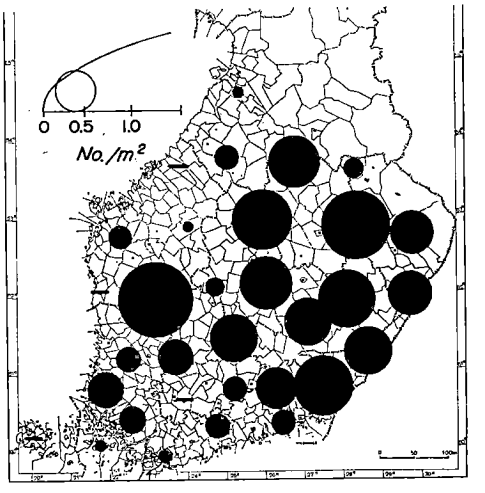

Fig. 14. *Equisetum silvaticum*

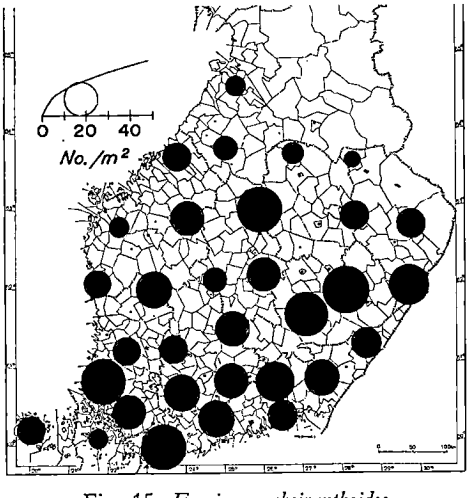

Fig. 15. *Erysimum cheiranthoides*

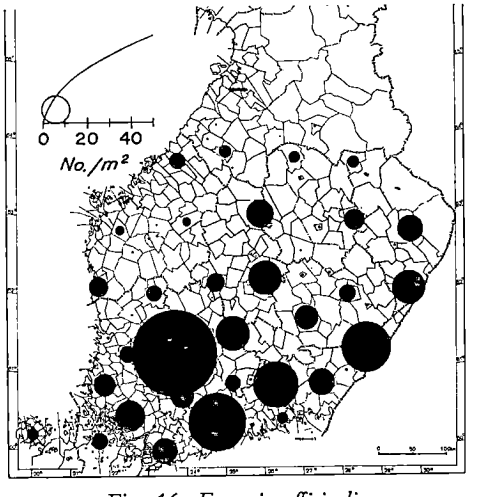

Fig. 16. *Fumaria officinalis*

According to PAATELA (1953 b), it occurs on 6 % of the leys for hay. It is distributed throughout the country.

In spring cereals the species was scattered and occurred on 24 % of the fields. Along the coasts it was fairly rare or rare. The average density of shoots was 0.4/m² on all the fields and 1/m² on the infested fields. The shoot numbers were highest in the Lake District and in Kihniö —Parkano (14). The species was eurytopic but appeared to grow most abundantly in fields with sandy or moraine soil. The rhizomes survived ploughing and cultivation. The shoots grew most abundantly along ditch banks.

Erysimum cheiranthoides Tables 3—6, Fig. 15

Annual or winter annual; found on cultivated or otherwise exposed soil. The name race is common in South and Central Finland, while the biennial subspecies *altum* Ahti occurs in grasslands in North Finland.

In spring cereals the species was very frequent, occurring on 74 % of the fields, except in the northern localities where it was only frequent. The average plant number was 18/m² on all the fields and 24/m² on the infested fields. This small-sized species was probably not always noticed, which is indicated also by the average number for the infested fields. The plant numbers were highest in Varsinais-Suomi and South Finland and also in the Lake District. The plants grew abundantly in fields with sandy soil and after a spring cereal crop or a fallow. Being susceptible to MCPA, the plants were reduced in numbers in the fields which had been sprayed often. The average density was highest after the cool and rainy spring in 1962 and lowest in 1964.

Fumaria officinalis Tables 3—6, Fig. 16

Annual, associated with fertile soil; found in gardens, in cereals and row crops and in waste places.

In spring cereals the species was fairly frequent, occurring on 40 % of the fields. In some southern parts of the Lake District it was very frequent whereas in the localities farthest north it was rare or fairly rare. The average density of plants was 5/m² on all the fields and 9/m² on the infested fields. The plant numbers were high in Häme and on the southern side of Salpausselkä but low along the western coast, in the southwestern Archipelago, Suomenselkä and in the northeastern localities. The species grew abundantly in dry fields with rich, less acid clay or sandy soil. Such fields were most commonly sown with wheat. Lower densities were recorded after a ley than after a spring cereal.

Galeopsis spp. Tables 3—6, Fig. 17

Annuals; found in cereals and row crops, gardens, newly-sown lawns, gaps of established grasses and in various habitats on exposed soil. In spring cereals the most common species is *G. bifida*, *G. speciosa* comes second and *G. tetrahit* third. The two first mentioned species are distributed throughout the country becoming less common toward the north. *G. tetrahit* is most common in the south.

Galeopsis ssp. was very frequent and occurred on 94 % of the spring cereal fields. This was the highest recorded frequency during the survey. The average density of plants was 67/m² on all the fields and 70/m² on the infested fields. The numbers were lowest in the Archipelago and in the southwestern part of the mainland, where herbicides had been used for the longest time, and also in the northern localities. *Galeopsis* grew abundantly in all kinds of soils, but the highest numbers were recorded in humus rich and sandy fields with medium moisture conditions. The three species were differentiated in a few localities, and *G. speciosa* was found to grow in richer soils containing less organic matter than *G. bifida*. The plants were most abundant in fields which had often been sown with spring cereals and harvested with a combine. The lowest densities were recorded when the preceding crop was a ley. The average plant numbers were highest in wheat. Considerable annual variation was found in the density figures. The maximum averages were recorded after the cool and rainy spring in 1962.

Galium vaillantii, incl. *G. aparine* Tables 3—6, Fig. 18

Annual or winter annual; *G. vaillantii* is found in cereals, row crops and waste places. It is distributed throughout the country but more common in the south than in the north. *G. aparine* grows in seashore thickets, occasionally in waste places, cereals and row crops.

Nearly all the plants found in the spring cereals were *G. vaillantii*. Rare specimens of *G. aparine* may have occurred in the southwestern localities. *G. vaillantii* grew scatteredly, occurring on 22 % of the spring cereal fields. In the south the plants were fairly frequent, but in the north rare. The average density of plants was 2/m² on all the fields and 6/m² on the infested fields. The density was highest within a zone about 200 km wide across the southernmost part of Finland and in dry, clay soil. The plants were abundant after potato and root crops but scanty after a ley. Being resistant to MCPA, the species appeared to increase in fields which had often been sprayed. The annual variation of density was low and not statistically significant.

Gnaphalium uliginosum Tables 3—6, Fig. 19

Annual; found in unclosed vegetation of various damp habitats. On crop land this species grows in cereals, in gaps of grasses and also on ditch banks. It is fairly common in South and Central Finland, but becomes scarcer towards the north and is entirely absent in the most northern

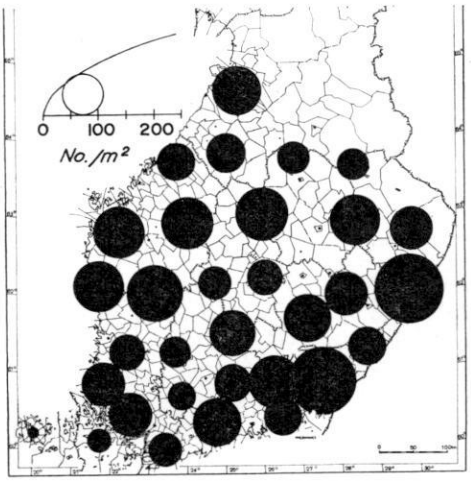

Fig. 17. *Galeopsis* spp.

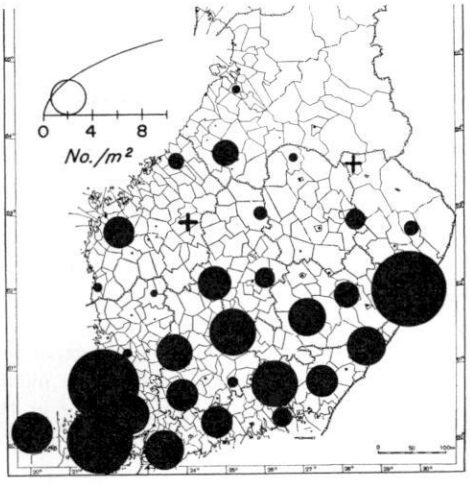

Fig. 18. *Galium vaillantii* incl. *G. aparine*

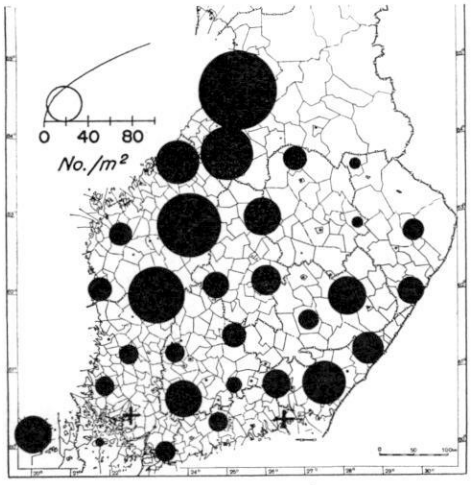

Fig. 19. *Gnaphalium uliginosum*

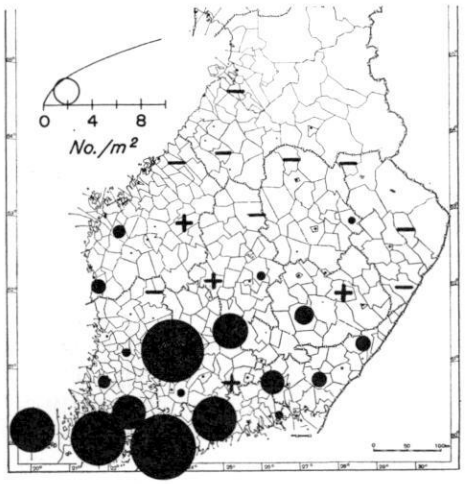

Fig. 20. *Lamium* spp.

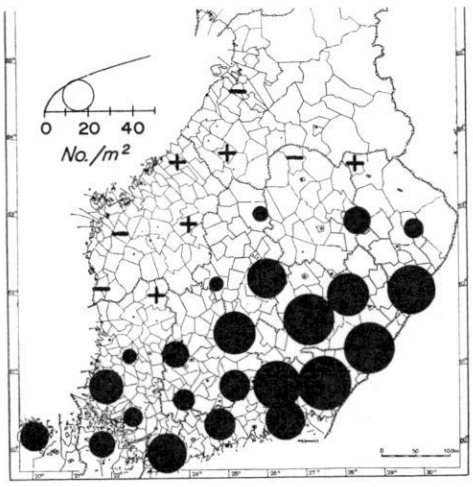

Fig. 21. *Lapsana communis*

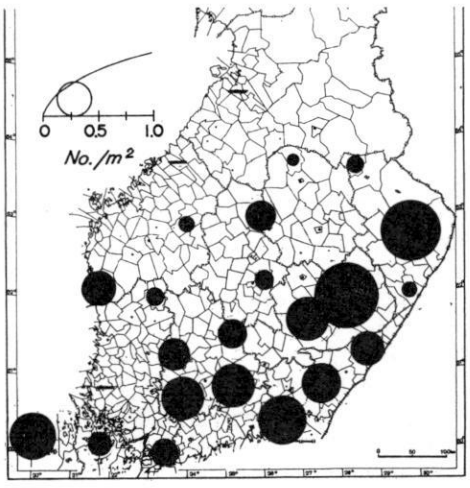

Fig. 22. *Lathyrus pratensis*

part of the country. Because of the minute size of the plants, the species has hardly any significance as a weed.

In spring cereals the species was fairly frequent, occurring on 38 % of the fields. The average density of plants was 19/m² on all the fields and 40/m² on the infested fields. It grew most abundantly in Pohjanmaa, but sparsely in the closest vicinity to the coast, which is normally affected by spring drought. The density was highest in fields with moist humus or sandy soil. Such fields were often drained with open ditches and commonly sown with oats or barley after a ley or a spring cereal crop. Due to the excess moisture, the sowing time was usually late resulting in delayed development of the crop and the weeds. The plant numbers were highest after the cool and rainy spring in 1962. The annual variation of density, however, did not prove statistically significant.

Lamium spp. Tables 3—6, Fig. 20

Annuals or winter annuals; found in habitats similar to those of *Fumaria officinalis*. In spring cereals the most common species are *L. purpureum* and *L. hybridum*. Their relative proportions vary locally. Both grow in the main area of spring cereals but are more common in the south than in the north. *L. amplexicaule* is occasionally found in southern Finland.

Lamium ssp. was fairly rare in spring cereals, occurring on 11 % of the fields. In the northern localities it was very rare although it did occur in all localities. The average density of plants was 2/m² on all the fields and 6/m² on the infested fields. The plant numbers were highest in southwestern Finland, in dry clay areas and particularly in fields with rich soil. In the preceding years such fields had often been sown with root crops, potatoes or spring cereals. Being resistant to MCPA the species appeared to increase in the fields which had often been sprayed. No annual variation of density was found.

Lapsana communis Tables 3—6, Fig. 21

Annual or winter annual; found in habitats similar to those of *Capsella bursa-pastoris*. The species has probably increased in abundance during the 20th century. It is fairly common in South Finland, rare or absent in North Finland.

In spring cereals the species was fairly frequent and occurred on 49 % of the fields. In southeastern and southern Finland it was very frequent, but in the northwestern and northern localities very rare or rare. The average number of plants was 16/m² on all the fields and 21/m² on the infested fields. The density was highest in southeastern Finland, in Luumäki (11) 44/m², and lowest in the northwest and north, where the density figures approached or reached zero in certain localities. This species grew well in all kinds of soil. In the areas with high frequency, the plants were most abundant in dry, undrained, sloping fields with moraine or fairly organic soil. The plant numbers were reduced after a ley but increased after a spring cereal crop. This species is resistant to MCPA, and the density, accordingly, increased in the fields which had often been sprayed. The average density was highest in wheat and in the year 1962.

Lathyrus pratensis Tables 3—6, Fig. 22

Perennial; found in meadows and particularly in habitats cleared by man, occasionally in damp deciduous woods. According to PAATELA (1953 b), this species occurs in 9 % of the leys for hay. It is common in South Finland and rare in North Finland.

In spring cereals the species was fairly rare and occurred on 13 % of the fields. In southeastern and southern Finland it was scattered, but in the northwestern localities rare or very rare. The average number of shoots was 0.3/m² on all the fields and 2/m² on the infested fields. The numbers were highest in southeastern and southern Finland and very low towards the west from the Suomenselkä area. The species flourished on soils rich in humus. The abundance was lowest in fields ploughed annually. The annual variation of density was not statistically significant.

Leontodon autumnalis Tables 3—6, Fig. 23

Perennial, polymorphic; found in dry meadows and particularly in habitats cleared by man, often also on shores. According to PAATELA (1953 b), the species occurs in 4 % of the leys for hay. It is fairly common in most parts of the country.

In spring cereals the species was scattered, occurring on 28 % of the fields. In the northern localities it was frequent or fairly frequent, but grew more rare towards the southwest. In Jomala—Finström—Hammarland (17) it was rare. The average number of plants was 1/m² on all the fields and 3/m² on the infested fields. The highest plant numbers were recorded in the northernmost localities and the lowest numbers in southwestern Finland. The species thrived in mineral soil, but it grew also in humus and peat soils with medium moisture conditions. After inadequate cultivation it could remain in the spring cereal crop grown after a ley or a winter cereal. The plants grew abundantly along ditch banks but occurred also in proper fields between the ditches. They were most abundant in oats and barley.

Myosotis spp. Tables 3—6, Fig. 24

Annuals or winter annuals. *M. arvensis* is the most common species found in spring cereals. *M. scorpioides*, *M. caespitosa* and *M. stricta* occasionally grow among it. *M. arvensis* is found in similar habitats as *Tripleurospermum inodorum*, *Viola arvensis* and *Capsella*. According to PAA-

TELA (1953 b), *Myosotis* spp. grows in 4 % of the leys for hay. It is fairly common in South and Central Finland but less common in North Finland.

Myosotis spp. was frequent in spring cereals, occurring on 60 % of the fields. The average density was 11/m² on all the fields and 18/m² on the infested fields. The plant numbers were highest in southeastern Finland and from there along a belt towards the northwest amounting to 32 plants/m² in Keitele—Viitasaari (15). *Myosotis* grew abundantly in dry fields with moraine or sandy soil. The plant numbers were increased after a winter cereal or potato crop but decreased after a ley. *Myosotis* is resistant to MCPA and seemed to have increased in the fields which had been sprayed often. The application of farmyard manure also appeared to increase its abundance. Alike with *Lapsana communis*, the lowest averages were recorded in 1961 and the highest in 1962. The annual variation of density was not, however, statistically significant.

Phleum pratense Table 3

Perennial; grown as a major crop plant in leys for hay. Accordingly to PAATELA (1953 b) it occurs on 95 % of the fields. It also grows commonly along ditch and field edges and in other similar places; distributed throughout the country.

About 35 % of the surveyed spring cereal fields were undersown with this species. Only the older, established plants, often escaped from the preceding ley, and the seedlings in not-undersown fields, were recorded as weeds. Such plants occurred on 28 % of the fields. The frequency was lowest in the south and highest in the northern and eastern localities.

Plantago major Tables 3—6, Fig. 25

Perennial, polymorphic; found in yards, lawns, gardens, along roadsides and shores, also in fields near habitations; common in populated areas in nearly the whole country.

In spring cereals the species was scattered and occurred on 24 % of the fields. The average of plants was 0.4/m² on all the fields and 2/m² on the infested fields. The plant numbers were highest in certain localities in southern Finland and also in Liminka (16). The species grew most abundantly in clay and sandy soils and after cereals or a ley. The annual variation of density was very small.

Poa pratensis coll. Table 3

Perennials; found in both cultivated and uncultivated habitats. On crop land this species grows especially in grasses, but also in other crops. In leys for hay it occurs on 56 % of the fields and is the fifth species in abundance (PAATELA 1953 b). It is distributed throughout the country.

In spring cereals the most common taxon of this group was *P. pratensis* s. str. Other taxa were *P. angustifolia* and *P. irrigata*. Some missidentified *P. trivialis* and *P. nemoralis* may have been included in this group. On the other hand, some *P. pratensis* were recorded as *Poa* spp.

Poa pratensis coll. was scattered in spring cereals and occurred in at least 20 % of the fields. It was as frequent in the southern as in the northern localities. The plants thrived particularly in mineral soils and emerged abundantly in spring cereal crops grown after winter cereals or leys.

Polygonum aviculare Tables 3—6, Fig. 26

Annual, polymorphic; found in unclosed vegetation on uncropped land, cereals and row crops, occasionally in gaps of grasses; common almost throughout the country.

In spring cereals the species was fairly frequent, occurring on 42 % of the fields. It was most frequent in western Finland. The average density of plants was 3/m² on all the fields and 5/m² on the infested fields. The highest plant numbers were recorded in western Finland, especially in Liminka (16), where the average density was 31/m². The species grew abundantly in post-ley spring cereals and in moist peat and sandy soils. The annual variation of density was low and statistically insignificant.

Polygonum convolvulus Tables 3—6, Fig. 27

Annual; found in cereals and row crops, occasionally in grasses, around habitations and in unclosed vegetation along traffic routes. The species is distributed throughout the country, but very rare in the north.

In spring cereals the species was frequent, occurring on 59 % of the fields. It was very frequent in southwestern Finland and fairly frequent in the northern localities and along the Suomenselkä area. The average density was 3/m² on all the fields and 4/m² on the infested fields. The plant numbers were highest in southern and southeastern Finland amounting to 7 plants/m² in some localities. The density maximum of 11 plants/m² on the infested fields was recorded in Mikkeli mlk (12). The lowest numbers were recorded in the northeastern localities and along the Suomenselkä area. The species grew abundantly in dry sandy and clay soils. The density appeared to be small after leys but high after potatoes and root crops. The fields where this species grew abundantly had usually been given farmyard manure which contained viable seeds. Such fields were most commonly sown with wheat. The highest average densities were recorded in 1961 and 1962. The annual variation of density was almost significant.

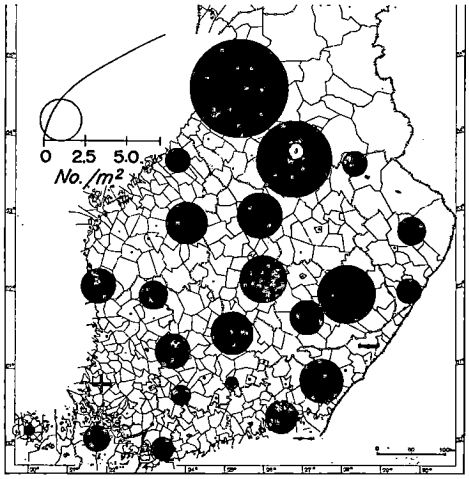

Fig. 23. *Leontodon autumnalis*

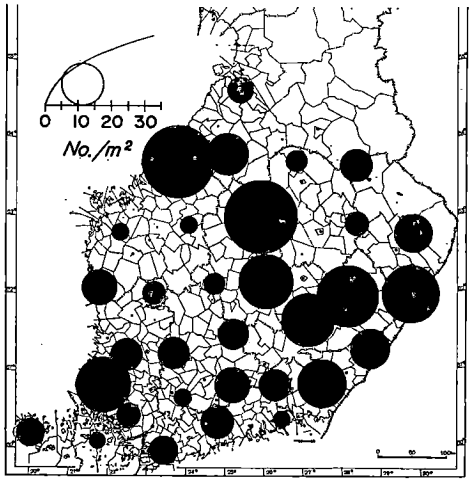

Fig. 24. *Myosotis* spp.

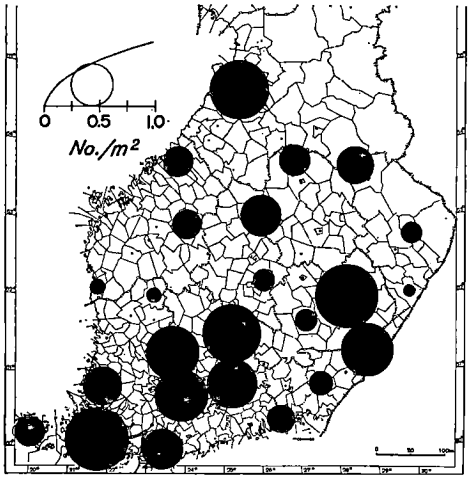

Fig. 25. *Plantago major*

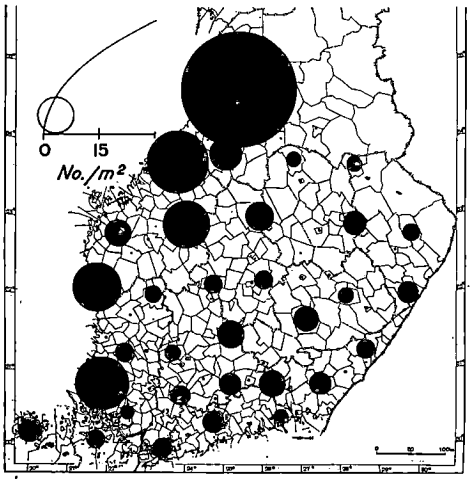

Fig. 26. *Polygonum aviculare*

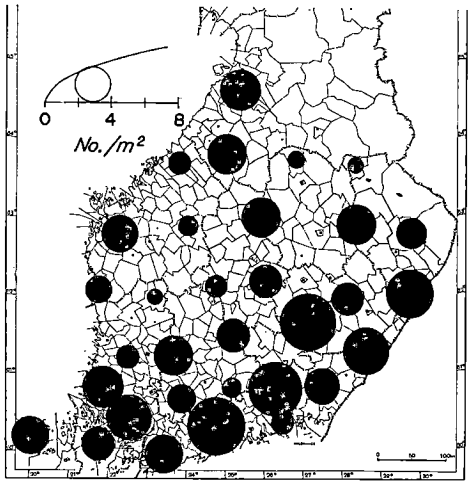

Fig. 27. *Polygonum convolvulus*

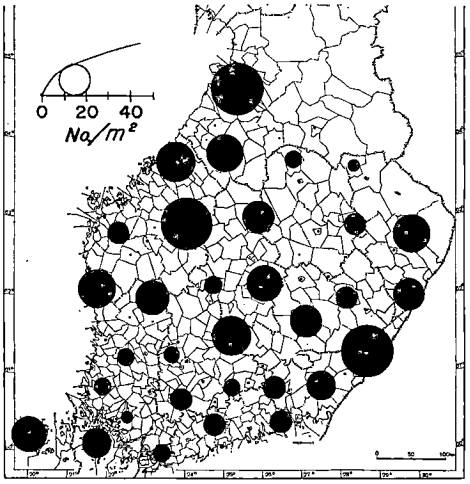

Fig. 28. *Polygonum lapathifolium*

Polygonum lapathifolium Tables 3—6, Fig. 28

Annual, polymorphic; found especially in cereals and row crops, also in gardens and in habitats on disturbed or exposed soil. The species is distributed throughout the country, most common in Central and South Finland, least common in North Finland.

The material found in spring cereals included some erroneously identified plants of *P. hydropiper* and possibly a few specimens of other closely related species. The plants were frequent in southwestern and southern Finland and very frequent further north. The average frequency was 73 %. The average density was 16 plants/m² on all the fields and 20/m² on the infested fields. Lower plant numbers were recorded in southern and southwestern Finland and in the northeastern localities. In the area in between, the plant numbers were higher reaching a maximum of 43/m² in Ruokolahti (27). The species was most abundant in wet fields with less fertile and acid humus or peat soil. The fields usually had open ditches, were far away from the farmstead and had been given only commercial fertilizers. The most common spring cereal crops was oats, usually grown after a ley. The annual variation of density was slight and statistically insignificant.

Potentilla spp. Tables 3—6, Fig. 29

Annuals or perennials. The most common species in spring cereals are *P. norvegica*, *P. erecta* and *P. anserina*. All of them are distributed throughout most of the country. *P. norvegica* is found in disturbed or otherwise exposed soil such as along roadsides and in cereals and row crops, whereas *P. erecta* and *P. anserina* are typical inhabitants of closed vegetation.

Potentilla spp. was scattered, occurring on 19 % of the fields. The average density of plants was 0.7/m² on all the fields and 3/m² on the infested fields. The plant numbers were high in the interior of Central Finland and especially in southwestern Finland reaching a maximum of 10/m² on the infested fields in Korppoo—Nauvo (25). The plants grew well in wet fields with humus soil, commonly sown with oats. The perennial species appeared to favour the post-ley spring cereal crops while *P. norvegica* was abundant after potatoes and root crops. No annual variation of density was found.

Ranunculus repens Tables 3—6, Fig. 30

Perennial, polymorphic; found in leys and meadows, along ditch banks, roadsides, watercourses and in damp woods, also in cereals and root crops. According to PAATELA (1953 b), it grows in 49 % of the leys for hay and ranks tenth in abundance. It is distributed throughout the country but seems to be more common in the north than in the south. The material of this survey may have included some erroneously identified specimens of *R. acris* and *R. auricomus*.

In spring cereals the species was frequent in southwestern and southern Finland and very frequent elsewhere, occurring on 74 % of the fields. The average density of plants was 12/m² on all the fields and 15/m² on the infested fields. The plant numbers were lowest in southwestern and southern Finland and highest in localities where leys constituted a major part in crop rotation, in Keitele—Viitasaari (15) as high as 27/m². The species thrived in open ditched fields with humus and moraine soils, where oats and barley were mostly grown. The annual variation of density was negligible.

Raphanus raphanistrum Tables 3—6, Fig. 31

Annual, restricted species in commercial seed of cereals; found in cereals and row crops, also along roadsides, in transported soil used for seedbed preparation in establishing lawns, etc.; common in South and Central F nland, very rare in North Finland.

In spring cereals the species was scattered in western Finland, frequent in southeastern Finland and fairly frequent elsewhere occurring on 45 % of the fields. The average density of plants was 4/m² on all the fields and 6/m² on the infested fields. The highest plant numbers, 9—11/m², were recorded in southeastern Finland, the lowest in the northwestern and western localities. The species grew abundantly on moraine soil, commonly sown with barley or wheat. The plant numbers were often reduced in post-ley spring cereals. The average density of plants was lowest in 1963, probably partly due to regional bias, i.e. one locality only was situated in the area where the species thrived.

Rumex spp. (sorrels) Tables 3—6, Fig. 32

Two perennial polymorphic species, *R. acetosella* (incl. *R. tenuifolius*) and *R. acetosa* are worth mentioning. They are found in fields, along ditch banks, also in open, cleared habitats on cultivated land and rocks. *R. acetosella* prefers drier soil than *R. acetosa*. Both are commonly distributed throughout the country. According to PAATELA (1953 b), *R. acetosella* occurs in 47 % and *R. acetosa* in 35 % of the leys for hay.

In spring cereals sorrels were frequent and occurred on 61 % of the fields. In the southwestern localities they were only scattered, in South Finland and in the southern part of Central Finland they were frequent, while in Pohjanmaa, the northern part of Central Finland as well as in East Finland they were very frequent. The average density of plants was 11/m² on all the fields and 15/m² on the infested fields. The plant numbers were low in southwestern and southern Finland and high in East Finland and especially in Pohjanmaa, in Kälviä (31) as high as 55/m². Sorrels thrived particularly in moist but also in drier, open ditched fields with less fertile humus

or sandy soil. The cropping system in such fields included frequent leys. The application of farmyard manure appeared to increase the plant numbers. The density was highest in spring cereal crops, usually oats, grown after a ley or winter rye. Annual variation of density was not found.

Rumex spp. (docks) Tables 3—6, Fig. 33

Perennials. The most common species, *R. longifolius* and *R. crispus*, are restricted in commercial seed of herbage crops. Both are found in open, cleared habitats and along shores. According to PAATELA (1953 b), *R. longifolius* and *R. crispus* occur on 9 % of the leys for hay. The former species is distributed throughout the country, the latter is confined to South and Central Finland.

In spring cereals *R. longifolius* occurred most abundantly, though there was also some *R. crispus* and, very rarely *R. aquaticus*. The plants were scattered and occurred in 25 % of the fields. The average density was only 0.1/m² on all the fields and 0.6/m² on the infested fields. The plant number was highest in the Lake District, in Mikkeli mlk. (12) as high as 2/m². The docks appeared to avoid clay soil and grew most abundantly after winter cereals and leys. The annual variation of density was not statistically significant.

Sagina procumbens Table 3

Winter annual or perennial; found in unclosed vegetation in both cultivated and uncultivated soil, e.g. in cereals and row crops; common in South and Central Finland, less common in North Finland.

In spring cereals this species was fairly rare and occurred on 14 % of the fields. It was more frequent in the Lake District and in Pohjanmaa, less frequent in southwestern and southern Finland and also in the northernmost localities. Because of the tiny size of the plants, they were hardly significant as weeds.

Sonchus arvensis Tables 3—6, Fig. 34

Perennial, polymorphic; found in fields, particularly in cereals and row crops, around habitations, special races also on seashores. According to PAATELA (1953 b), this species occurs in 2 % of the leys for hay. It is distributed in South and Central Finland and in the southern part of North Finland, but is more common in the south than in the north. The less common *S. asper* has sometimes erroneously been included in this species in some southwestern and southern localities.

In spring cereals the species was fairly frequent, occurring on 36 % of the fields. It was frequent in the southwestern localities, very frequent in southwestern Häme, but rare or very rare in the Suomenselkä area and in the northwestern localities. The average density of plants was 4/m² on all the fields and 9/m² on the infested fields. The plant numbers were highest in southwestern, southern and southeastern Finland. The density maximum of 25/m² was recorded in Lieto—Paimio—Tarvasjoki (1). Fairly high plant numbers were also found in the Lake District, whereas in Suomenselkä and Pohjanmaa the numbers were low. The species was most abundant in the fields with dry clay soil, particularly when continuous spring cereal cropping was practised. The fields in the main area of occurrence were mostly deep drained and commonly sown with wheat. Combine harvesting appeared to increase the species. The average density was highest in 1961. This difference probably resulted from the location of the surveyed areas.

Spergula arvensis Tables 3—6, Fig. 35

Annual; found mainly in cereals and row crops, occasionally in gaps of grasses and in various habitats on exposed soil; commonly distributed throughout the country.

In spring cereals the species was third in frequency after *Galeopsis* spp. and *Chenopodium album*. It was very frequent in nearly all the localities and most frequent in Pohjanmaa and the Suomenselkä area. The average density of plants was higher than with any other species, 87/m² on all the fields and 98/m² on the infested fields. The species grew abundantly in the localities with acid soil, e.g. in Pohjanmaa and Suomenselkä, and in Ruokolahti (27), where the density maximum of 189/m² on all the fields was recorded. In the northeastern and southwestern localities the density was lower. The minimum average, 13 plants/m² on all the fields, was recorded in Valtimo (24). In similarity with *Polygonum lapathifolium*, the species grew abundantly in wet, open ditched fields with acid, less fertile soil. The spring cereal crop in such fields was usually oats, and the sowing time was late, resulting in delayed development of the crop. Apparently the poor competitive ability of the crop permitted abundant growth of *S. arvensis*. The plant numbers were higher in the spring cereal crops grown after cereals than after a ley. The annual variation of abundance was similar to that of *Chenopodium album* (p. 81) and *Stellaria media* (p. 92) and was probably influenced by the same factors. Significant annual variation of density was found. The highest averages were recorded in 1964.

Stachys palustris Tables 3—6, Fig. 36

Perennial; found in fields and gardens and on shore banks; more abundant in cereals and row crops than in leys. According to PAATELA (1953 b), the species occurs on less than 1 % of the leys for hay. It is fairly common in South Finland, sporadic in Central Finland and absent in North Finland.

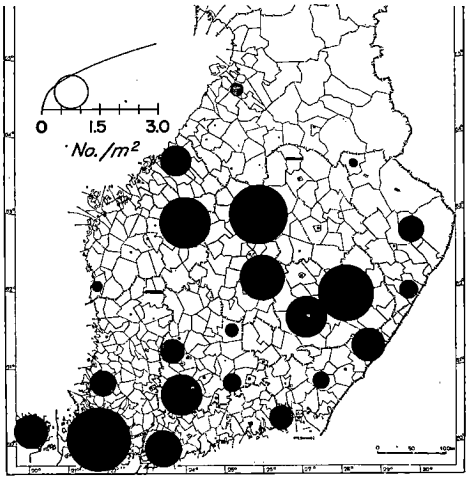

Fig. 29. *Potentilla* spp.

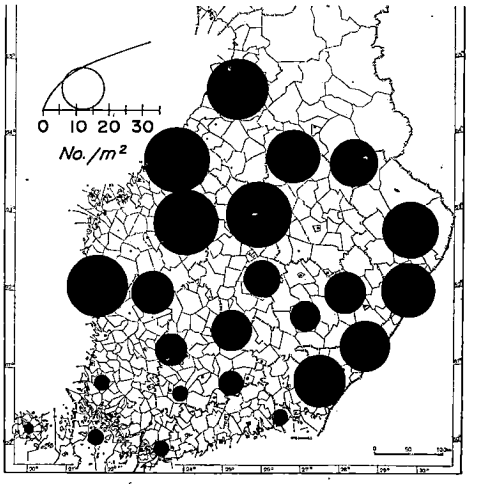

Fig. 30. *Ranunculus repens*

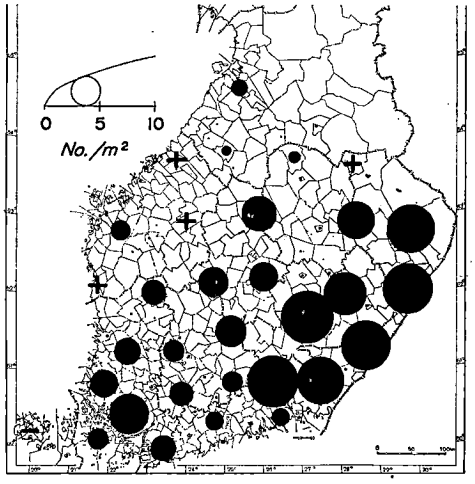

Fig. 31. *Raphanus raphanistrum*

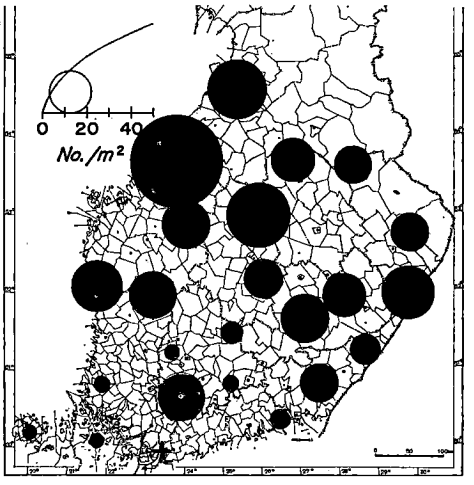

Fig. 32. *Rumex* spp. sorrels

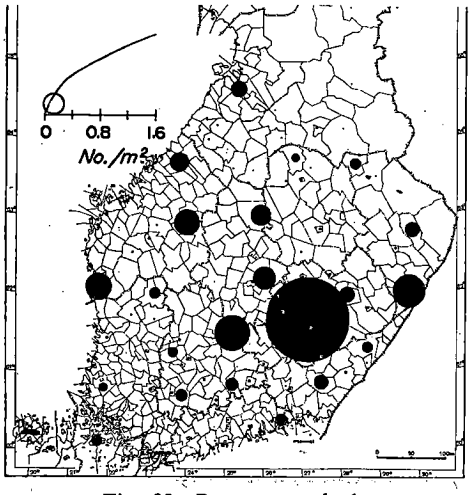

Fig. 33. *Rumex* spp. docks

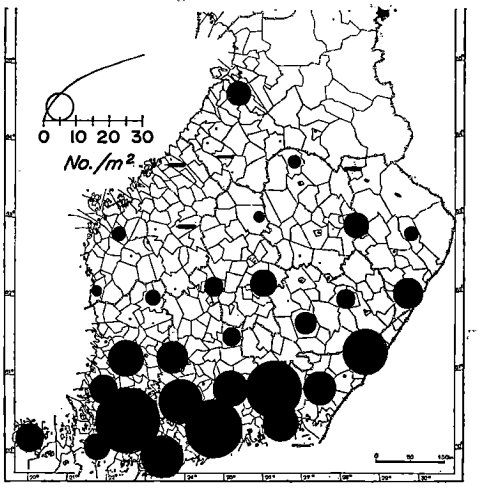

Fig. 34. *Sonchus arvensis*

In spring cereals the species was rare and occurred on 6 % of the fields. In eastern Uusimaa (Kymenlaakso) it was frequent, in some other southern localities fairly rare, and in Pohjanmaa it was very rare. The average density of plants was 0.5/m² on all the fields and 3/m² on the infested fields. The highest plant numbers, 7/m² on all the fields and 14/m² on the infested fields, were recorded in Pyhtää—Ruotsinpyhtää (18). The species grew abundantly in fields with clay or humus soil which were usually wet. The plant numbers were higher in the spring cereal crops grown after spring cereals than after leys. The annual variation of density was not statistically significant.

Stellaria media Tables 3—6, Fig. 37

Annual, rarely overwintering in Finland; found in cereals, row crops, gardens, lawns, gaps of leys and in unclosed vegetation on uncropped land; commonly distributed throughout the country in populated or agricultural areas.

In spring cereals the species was very frequent and occurred on 85 % of the fields. The average density of plants was 83/m² on all the fields and 95/m² on the infested fields. The plant numbers were high in the northernmost and eastern localities. The lowest plant numbers were recorded in the localities of the watershed areas and in the southeastern Archipelago. The species thrived in wet moraine and sandy soils, where barley and wheat were mostly grown. It occurred most abundantly when the spring cereal crop was grown after potatoes or root crops and most sparsely after leys. The application of farmyard manure appeared to increase the infestation. The annual variation of density was significant. The highest averages were recorded in 1964 and the lowest in 1961 and 1963.

Taraxacum spp. Tables 3—6, Fig. 38

Perennials. According to SÅLTIN (1965), 422 species of *Taraxacum* are known in Finland. They grow in leys, lawns, meadows, gardens, along ditch banks, roadsides, field edges, etc. in populated or agricultural areas. According to PAATELA (1953 b), *Taraxacum* occurs in 41 % of the leys for hay and is the ninth taxon in abundance. *Taraxacum*s are distributed throughout the country. They are very common in southwestern, southern and southeastern Finland, less common further north.

In spring cereals *Taraxacum*s were fairly frequent occurring on 35 % of the fields. Along the coast area of the Gulf of Finland and in southwestern Häme they were frequent. In Suomenselkä, Pohjanmaa and in the southwestern Archipelago they were scattered and elsewhere fairly frequent. The average density of plants was 0.8/m² on all the fields and 3/m² on the infested fields. The plant numbers were highest in southeastern and southwestern Finland and in southwestern Häme. The maximum average of 20 plants/m² on the infested fields was recorded in Jomala—Finström—Hammarland (17) and the lowest in Pohjanmaa. *Taraxacum*s grew abundantly on mineral soils, increased in number after leys and winter cereals and decreased after potatoes and root crops.

Thlaspi arvense Tables 3—6, Fig. 39

Annual or winter annual; found in cereals and row crops, occasionally in grasses, around habitations and along roadsides. According to PAATELA (1953 b), the species occurs in less than 1 % of the leys for hay. It is fairly common in South and Central Finland and in at least part of North Finland. *T. alpestre* is occasionally found amongst *T. arvense* in South and Central Finland.

In spring cereals the species was fairly frequent in southwestern Finland and southwestern Häme, scattered in Uusimaa, Pohjanmaa and the southwestern part of the Lake District. It was fairly rare in East Finland and in other parts of the Lake District. The average density of plants was 6/m² on all the fields and 19/m² on the infested fields. The plants thrived in dry mineral soils where wheat was often the crop. The annual variation in density was not significant.

Trifolium pratense Tables 3—6, Fig. 40

Perennial, polymorphic; grown as a major crop plant in the leys together with timothy in South and Central Finland. According to PAATELA (1953 b), this species occurs on 86 % of the leys for hay. It is often also found in meadowlike vegetation on uncropped land.

In spring cereals red clover was commonly undersown, and the sown seedlings were not regarded as weeds. Only the older, established plants as well as seedlings on the not undersown fields were recorded as weeds. They grew scatteredly, occurring on 20 % of the fields. The average density of plants was 0.6/m² on all the fields and 3/m² on the infested fields. The plant numbers were highest in southwestern and southern Finland and in the southern part of central Finland. As a weed red clover thrived in mineral soils. The plant numbers were low after potatoes and root crops. The annual variation in density was not statistically significant.

Trifolium spp., excl. *T. pratense* Tables 3—6, Fig. 41

Perennials. The most common species are *T. repens* and *T. hybridum*. Other species worth mentioning are *T. medium* and *T. spadiceum*. *T. repens* is found in lawns, meadows, gardens, roadsides, field edges, etc. in agricultural or inhabited areas. It has often been grown as a crop plant in pastures and also in lawns. According to PAATELA (1953 b), its frequency in the leys for hay is 22 %. *T. hybridum* is sometimes grown as a crop plant in the

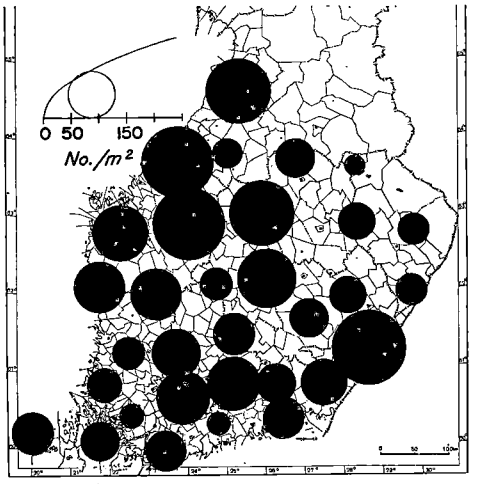

Fig. 35. *Spergula arvensis*

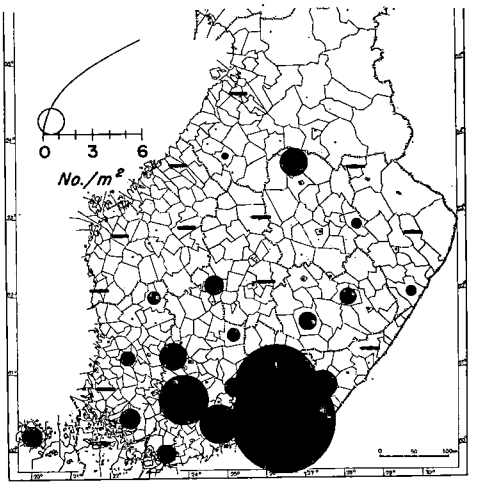

Fig. 36. *Stachys palustris*

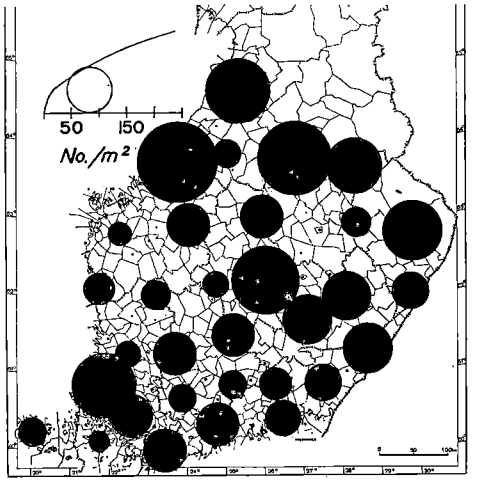

Fig. 37. *Stellaria media*

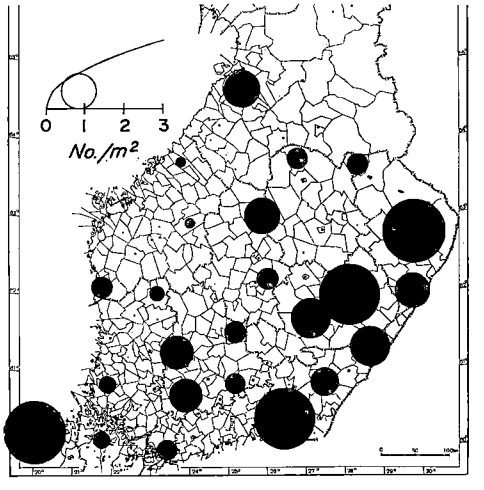

Fig. 38. *Taraxacum* spp.

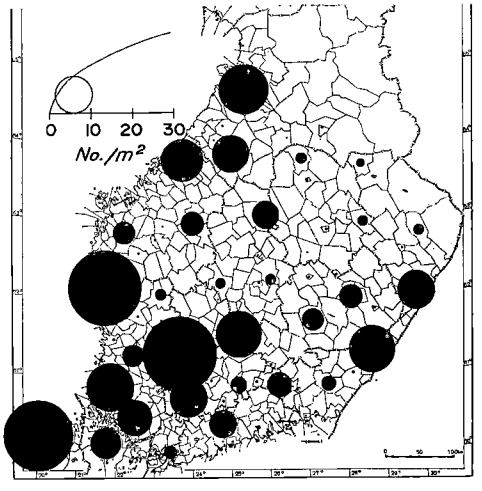

Fig. 39. *Thlaspi arvenses*

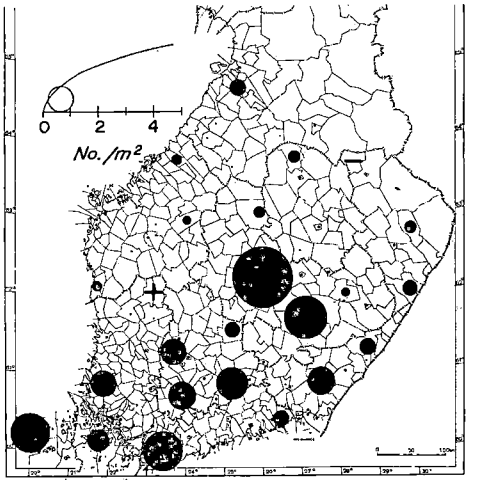

Fig. 40. *Trifolium pratense*

leys for hay having an average frequency of 25 % (PAATELA 1953 b).

In spring cereals mainly *T. repens* of this group occurred. E.g. in Laihia (7) and Kälviä (23) only *T. hybridum* was found in addition to *T. repens*, and the frequencies of *T. hydridum* were as low as 1 and 6 %, respectively. On an average, *Trifolium* spp. appeared to be fairly frequent occurring on 37 % of the fields. In some southern and southeastern localities the shoots were only scattered but in the northernmost localities they were frequent. The average density of shoots was 2/m² on all the fields and 5/m² on the infested fields. The shoot numbers were highest in the interior of South Finland and in the northern localities, lowest in the southwestern localities and in the southern part of Central Finland. The plants thrived particularly in fields with clay soil and appeared abundantly in post-ley spring cereals, which was often wheat. The annual variation of density was negligible.

Tripleurospermum inodorum, incl. *Matricaria recutita* Tables 3—6, Fig. 42

Annual or winter annual; restricted species in commercial seed of herbage crops; found mostly in cereals, winter rape, leys and pastures, also around habitations and along roadsides. According to PAATELA (1953 b), the species occurs on 19 % of the leys for hay. It is more common in South and Central Finland than in North Finland. In southern areas *M. recutita* also occurs.

In spring cereals *T. inodorum* was the most common species. *M. recutita* was sometimes found in southwestern Finland. Some *M. matricarioides* may have been erroneously included in this group, and in the northern localities *T. maritimum*, likewise (HÄMET-AHTI 1967). The average frequency of plants was 48 %. The plants were frequent in southeastern Finland and from there along a zone extending northwest, as well as in the southern part of the coast along the Gulf of Bothnia. Elsewhere they were fairly frequent. The average density of plants was 4/m² on all the fields and 7/m² on the infested fields. The plant numbers were highest in southern and southeastern Finland and from there along a zone extending northeast, reaching the maximum average of 26/m² on all the fields in Liminka (16). The plants thrived in moraine and sandy soils and after winter cereals. The density was high in the fields which had often been combine harvested or sprayed with herbicides. The annual variation of density was not statistically significant.

Tussilago farfara Tables 3—6, Fig. 43

Perennial; found in moist waste places, along ditchbanks, watercourses and roadsides, in deciduous forests on fertile soil and in swamps; very rare in northern Finland.

In spring cereals the species was scattered in southwestern Finland, very rare in Pohjanmaa and fairly rare elsewhere, showing an average frequency of 14 %. The average density of shoots was 0.3/m² on all the fields and 2/m² on the infested fields. The numbers of shoots were high in southeastern and southern Finland. The maximum averages of shoots, 2/m² on all the fields and 10/m² on the infested fields, were recorded in Pyhtää—Ruotsinpyhtää (18). The species withstood ploughing and thrived in moist clay and humus soils. The annual variation of density was not significant.

Vicia cracca Tables 3—6, Fig. 44

Perennial; found in cleared habitats, meadowlike vegetation, ditch banks, cereals and grasses. According to PAATELA (1953 b), it occurs on 26 % of the leys for hay. It is more common in the south than in the north.

In spring cereals the species showed an average frequency of 43 %. It was frequent in many localities in southern and southeastern Finland. In the northern part of the Lake District, in Pohjanmaa and in some southwestern localities (10, 17) it was scattered. The average density of shoots was 1/m² on all the fields and 2/m² on the infested fields. The highest shoot numbers were recorded in southeastern and southern Finland. The species thrived in clay and particularly in humus rich clay soils. The shoot numbers were reduced after potatoes, root crops and a fallow. The annual variation of density was not significant.

Vicia hirsuta Tables 3—6, Fig. 45

Annual; found in unclosed vegetation on cultivated or otherwise exposed soil, particularly in cereals; very rare in northern Finland.

In spring cereals this species was scattered, occurring on 28 % of the fields. It was fairly frequent in the southern part of the Lake District and in southwestern Finland. Along the coast area of the Gulf of Finland and in the northern part of the Lake District it was fairly rare, and in the northernmost localities very rare. The average density of plants was 1/m² on all the fields and 3/m² on the infested fields. The species grew abundantly in fields with dry soil. On such fields wheat was often the spring cereal species, and potatoes, root crops or wheat were the most common preceding crops. The annual variation of density was not significant.

Viola arvensis, incl. *V. tricolor* Tables 3—6, Fig. 46

Annuals or winter annuals. *V. arvensis* is a very common weed in cereals and row crops. It is also found in first-year leys, in winter rape and around habitations in cultivated or otherwise exposed but not trampled soil. It is more common in the south than in the north. *V. tricolor*

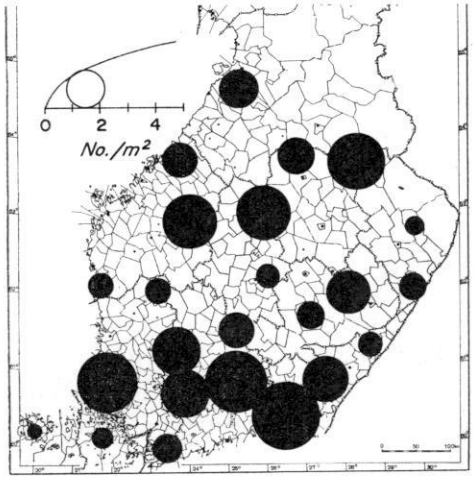

Fig. 41. *Trifolium* spp. excl. *T. pratense*

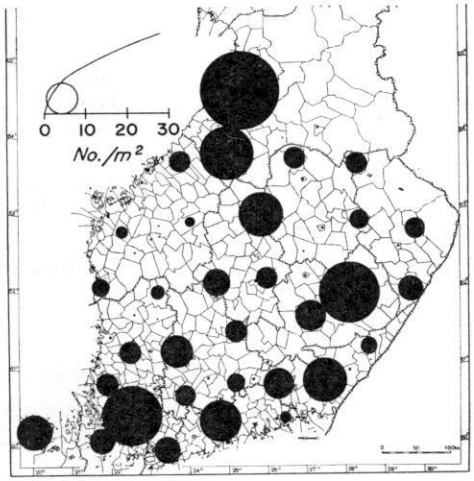

Fig. 42. *Tripleurospermum inodorum* incl. *Matricaria recutita*

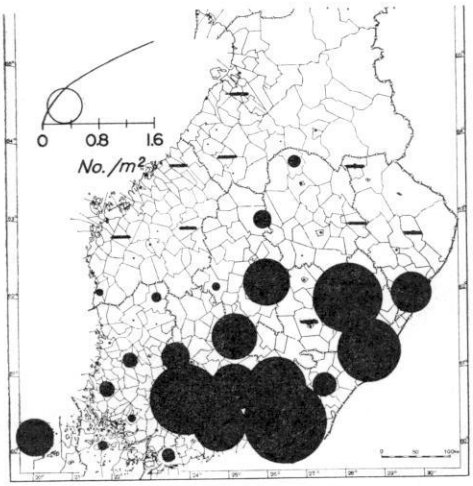

Fig. 43. *Tussilago farfara*

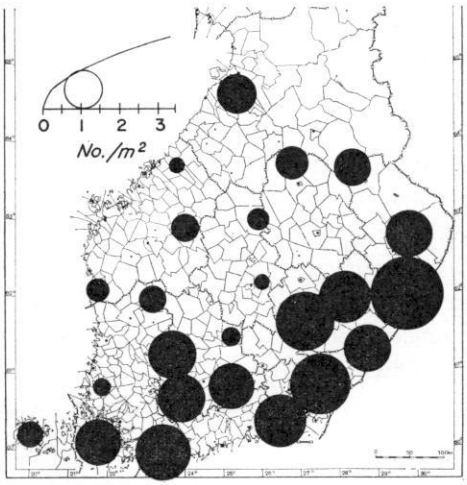

Fig. 44. *Vicia cracca*

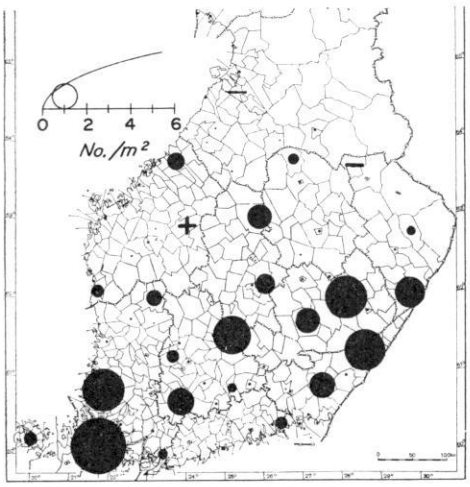

Fig. 45. *Vicia hirsuta*

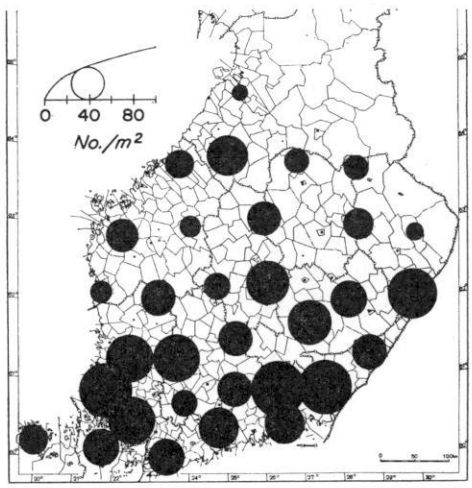

Fig. 46. *Viola arvensis* incl. *V. tricolor*

grows on rocks, occasionally on leys, very seldom in annual crops. *V. tricolor* is more southern than *V. arvensis*.

In spring cereals only *V. arvensis* was recorded. It was the fifth species in frequency and occurred on 80 % of the fields. The plants were very frequent in South Finland, frequent in the Suomenselkä area and fairly frequent in the northernmost localities. The average density of plants was 43/m² on all the fields and 52/m² on the infested fields. The species grew mainly on dry soils and was most abundant in wheat. The plant numbers were reduced in the spring cereal crops grown after potatoes, root crops or a ley. Combine harvesting seemed to increase the abundance. The annual variation of density was not significant.

2. Factors affecting weed species

Species of spring cereal

The material comprised 884 fields sown with oats, 693 fields sown with barley, 435 sown with wheat and 87 fields of mixed cereal. The proportion of barley fields was largest in the northern localities and the Suomenselkä region where they made up almost one half of the surveyed fields. The proportion of wheat was largest in the southern localities, about one third of the surveyed fields, while the proportion of oat fields was approximately equal in all the areas. Oats were grown mostly on humus or peat soil, wheat on mineral soils, while barley was given all types of soil.

The average total number of weeds/m² was largest in wheat and smallest in oats (Table 6). Differences were established in the densities of many individual species. Although the plant cover of the cereals varied already in the early summer, the differences in this respect were not yet important (cf. p. 100) and apparently could not have brought about the above variation. The variation was more likely due to edaphic factors and the nature of the agricultural practices. The weeds growing on wheat fields were annual and perennial species that favoured dryish clay or sand soils, and they grew in abundance particularly after cereals and potato or root crops. The weeds on the oat fields, were perennial and annual species that favoured moist peat or sand soils. They were abundant particularly after leys. The barley fields exhibited the intermediate type of weed flora.

Type of soil

The material comprised 891 fields with sandy soil, 514 with clay soil and 690 fields with humus or peat soil. The fields with clay soil were mainly in southwestern and southern Finland, while the sandy fields were situated in the other parts of the country. Most of the fields with peat soil were in Pohjanmaa and within a zone that extended from Pohjanmaa to southeastern Finland.

The total number of plants was highest in sand soils and lowest in clay soils, particularly when clay soils were situated in the coastal regions which often suffered from spring droughts (Table 6).

The species of weeds that were frequent in spring cereals thrived in all types of soils, but there were marked differences in the abundancies (Table 6), as was to be expected judging by the foreign investigations (e.g. BUCHLI 1936, ELLENBERG 1950, REHDER 1959, GRANSTRÖM 1962). The results also complement the picture obtained in special Finnish studies (PAATELA 1953 b, JALAS and JUUSELA 1959, BORG 1964, M. RAATIKAINEN and T. RAATIKAINEN 1964).

The number of species typical for sandy soils was small. *Myosotis arvensis* may be included into this group. The species that were most abundant in clay soils were, among others, *Fumaria officinalis*, *Lamium* spp., *Sonchus arvensis* and *Thlaspi arvense*, while *Achillea ptarmica*, *Equisetum palustre*, *Polygonum lapathifolium*, *Ranunculus repens* and *Spergula arvensis* were most abundant in humus soils. This preference was not necessarily based on the primary effect of the soil type on the species. For example certain perennials often occurred in greater abundance on humus soils owing to the fact that these soils had been given to leys more often, and the perennial grassland weeds had remained, occurring subsequently in spring cereals. This was due particularly to the ploughing which on humus soils had not been as thorough as on mineral soils. Humus soils were

often also moister than mineral soils, and species that required moisture tended to prefer them to the dryer mineral soils.

Moisture conditions

The material included 336 dry fields, 1 533 medium dry ones and 208 wet fields. The majority of the dry fields lay on the coasts, in the southwest, southeast and in the watershed localities, the medium dry fields were mostly in the interior and the wet fields in western and central Finland.

Among the species whose abundance was recorded, about equal numbers favoured dry and wet fields (Table 6). In general, the results confirmed the findings of TÜXEN (1954), JALAS and JUUSELA (1959). In fields where the moisture of the soils was very high, the cereals showed poor development, while the number of weeds had increased.

The type of soil and the moisture conditions are often coupled together in the fields. According to the factorial analyses they constituted a factor with a very strong effect on the number of weeds. A group of species that particularly favoured moist humus soil included *Spergula arvensis*, *Ranunculus repens*, *Polygonum lapathifolium* and *Equisetum palustre*. The same tendency, though less marked, was shown by *Achillea ptarmica*, *Gnaphalium uliginosum* and the sorrels. A contrasting group favouring dry mineral soils included *Fumaria officinalis*, *Lamium* spp., *Viola arvensis*, *Sonchus arvensis* and *Capsella bursa-pastoris*.

The preceding crop

The material included the following preceding crops to spring cereals: fallow 25 fields, ley 589, winter cereal 196, spring cereal 986, potato or root crops 258, and others 42 fields. In the northeastern and northwestern localities ley was the most common preceding crop while spring cereal became more common towards the southern localities. Winter cereal and potato or root crops were evenly distributed. Fallow occurred in the interior.

Ley as a preceding crop increased the numbers of certain broad-leaved perennials, such as *Achillea millefolium*, *A. ptarmica*, *Leontodon autumnalis*, *Ranunculus repens*, *Rumex* spp. (sorrels), *Taraxacum* spp., *Trifolium repens* and of several grasses, e.g. *Deschampsia caespitosa* (Table 6). Some annuals had also increased, probably due to the disappearing of the dormancy of seeds during the ley period.

The effects of leys on the occurrence of perennial grassland weeds in the following spring cereal crops were more conspicuous than was to be expected on the basis of earlier studies (e.g. GRANSTRÖM 1962). They were probably influenced, not only by the inadequate ploughing or cultivation but also by the relatively long age (3—7 years) and high weed content of the Finnish leys (cf. PAATELA 1953 b).

After winter cereals winter annual species were abundant, such as *Lapsana communis*, *Myosotis arvensis* and *Tripleurospermum inodorum*, as well as some perennials, e.g. *Taraxacum* spp. and the docks. When successive spring cereals were grown, annuals or facultative annuals flourished, e.g. *Erysimum cheiranthoides*, *Galeopsis* spp., *Lamium* spp. and *Spergula arvensis*. Of the perennials, *Cirsium arvense* and *Sonchus arvensis*, which persisted ploughing and tilling and had a great capacity of vegetative regeneration, were conspicuous in continuous spring cereal cropping. Potato and root crops considerably increased the plant numbers of *Stellaria media* and *Chenopodium album* and to some degree also, of *Galium vaillantii* and *Lamium* spp. Fallowing tended to reduce the amounts of perennial weeds, particularly of *Agropyron repens*. The numbers of *Erysimum cheiranthoides* appeared to have increased after fallowing. Perhaps the aeration of the soil, resulting from frequent tillage of the fallow, had reduced the dormancy of the seeds (cf. CHEPIL 1946).

Ditching

It is estimated that 92 % of the fields in Finland need drainage, and the open ditch drainage system is the most common. The ditches cross the fields 10—20 m apart (Fig. 47) and total 700

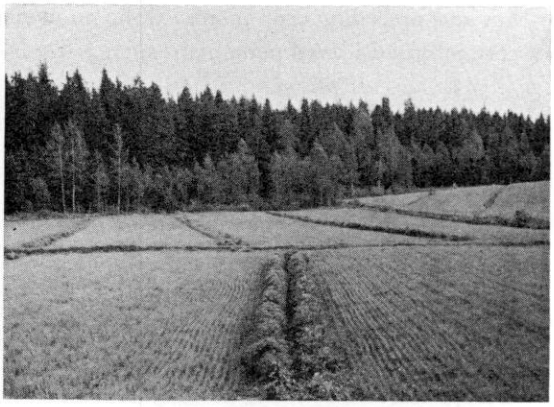

Fig. 47. Open ditch drainage system is dominant feature in Finnish agricultural landscape. Ditches cross the fields 10—20 m apart and substantially contribute to the spread of weeds.

—800 m per hectare, considerably promoting the spread of weeds in the fields (Hilli 1949, M. Raatikainen and T. Raatikainen 1964).

In the present material there were 1 394 open ditched, 313 deep drained and 391 undrained fields. Open ditched fields were more common in the northwestern, deep drained in the southwestern and undrained fields in the eastern localities. Along the sides of the ditches the following perennials, among others, were found: *Achillea millefolium*, *A. ptarmica*, *Agropyron repens*, *Agrostis tenuis*, *Chamaenerion angustifolium*, *Deschampsia caespitosa*, *Equisetum arvense*, *E. palustre*, *E. silvaticum*, *Leontodon autumnalis*, *Ranunculus repens*, *Rumex acetosa*, *R. acetosella*, *Taraxacum* spp., and *Trifolium repens*. Many of these species tended to spread from the uncultivated verges into the actual cultivated field.

Ploughing

The material included 1 907 fields ploughed in the autumn and 137 fields ploughed in the spring. In addition, there were 28 fields sown without ploughing. The method of cultivation for seed bed preparation was not recorded.

The time of ploughing did not affect the numbers of the annual weeds, and the effects on the perennials were irregular. Apparently, adequate ploughing in the spring prevented the development of the perennials, while inadequate spring ploughing promoted it when compared with the autumn ploughing.

On unploughed fields the perennials developed with more than normal speed. The numbers of shoots, however, were smaller. This apparently resulted from the good management of the previous crop, which, in the case of unploughed fields, was usually a potato or root crop.

Farmyard manure

During the year of the survey, farmyard manure had been used on 857 fields, while 1 230 fields were not manured. In the northern and northeastern localities the proportion of the manured fields was more than 50 %, in the southern and southeastern regions it was considerably less.

Chenopodium album, *Myosotis arvensis*, *Polygonum convolvulus*, *Stellaria media* and the sorrels showed higher plant numbers or the manured than on the unmanured fields. It seemed likely that a considerable number of seeds of these weeds had been transported to the fields in the contaminated farmyard manure. The results obtained are in agreement with Korsmo's (1935) findings.

Undersowing for grassland crops

The grassland crops in Finland are mainly leys for hay, and the area of newly sown leys has been 300 000 ha annually. According to Paatela (1953 a), spring cereal was the nurse crop in 72 % of the leys in this area. The areal percentage of the herbage species sown was as follows: timothy 97, red clover 82, alsike clover 2.9, meadow fesque 0.6, cocksfoot 0.3, and other species 0.4. The percentage weights of seeds sown were: timothy 71 %, red clover 28 %, and others 1 %. According to Jokela (1965, 1966), the commercial timothy seed produced in 1963 contained 9 800 weed seeds per kg, on an average. The corresponding figure for red clover was 3 450. According to Hilli (1961), the farmers' own timothy seed contained 33 550 and red clover 19 550 weed seeds per kg in 1955—56. Since 25—30 kg/ha of the timothy-red clover seed mixture was

normally sown, each hectare received 0.1—1 million weed seeds which correspond to 10—100 weed seeds/m².

The material for the present survey included 796 undersown fields and 1 305 fields that had not received herbage seed. The undersown spring cereals were common in Pohjanmaa, the northern part of the Lake District and in northeastern localities where over half of the fields had received herbage seed. In South Finland 28 % of the fields were undersown.

In the undersown spring cereals the seedlings of *Stellaria media*, *Tripleurospermum inodorum*, *Myosotis* spp., *Ranunculus repens*, and the sorrels were more in evidence than in fields not intended for ley. This may have been partly due to the seeds being carried to the field with the contaminated herbage seed and partly because the soil of the fields where leys were being established contained seeds of the above species already in abundant quantities. Among the emerged seedlings of the herbage crops it was difficult to distinguish the weeds, and the recorded numbers of weeds remained smaller than they were in reality. The presence of the undersown plants may also have increased the competition (cf. BULA, SMITH and MILLER 1954). As a result, the numbers of e.g. *Spergula arvensis* and *Galeopsis* spp. seemed to have remained smaller on undersown fields than on fields not sown for leys.

Combine harvesting

The large-scale use of combines for harvesting the spring cereal crops began in Finland in the early 1950's. Soon the method was common in southwestern and southern Finland and spread gradually towards the north and east. With a combine the harvesting takes place about a fortnight later than with older equipment. This gives the weeds a longer period to develop mature seeds which readily shatter on the ground. By using a combine, more weed seeds are discarded back to the field in the process of harvesting the cereal crop. On the other hand, the cutting level with a combine is higher. Therefore, it leaves more uncut weeds in the fields. Several changes have also resulted in agricultural management with the use of combines.

In the material surveyed, 1 495 fields had not been combined during the past ten years and very few fields before that time. On 424 fields a combine had been used 1—3 times, on 143 fields 4—6 times and on 36 fields 7—9 times. The plant numbers of *Sonchus arvensis*, *Chenopodium album*, *Galeopsis* spp., and *Tripleurospermum inodorum* were considerably larger on the frequently combined fields. The differences in the total number of weeds were irregular. The results obtained are in agreement with the data from the earlier studies showing that the long-term use of a combine-harvester will bring about changes in the composition of the weed flora (PETZOLT 1959, AAMISEPP et al. 1967).

Chemical weed control

Since the early 1950's MCPA has been almost the sole herbicide used for weed control. In 1961 only 17 % of the spring cereal fields had been sprayed, during the years under survey the use of MCPA spread considerably, and in 1964 32 % of the spring cereal area was treated (MUKULA and RUUTTUNEN 1969). The use of MCPA was most common in southwestern and southern Finland, while in the northeastern and northern regions it was rare (Fig. 48).

In the present material 1 505 of the fields had not been sprayed during the preceding ten years, on 448 fields MCPA had been used 1—3 times, on 106 fields 4—6 times and on 26 fields 7—9 times before the year of the survey.

It appeared that the use of MCPA in previous years had brought about a decrease in the plant numbers of susceptible species, such as *Chenopodium album*, *Erysimum cheiranthoides* and *Galeopsis* spp. On the other hand, increased plant numbers of the resistant species, e.g. *Agropyron repens*, *Galium vaillantii*, *Lamium* spp., *Lapsana communis*, *Myosotis arvensis* and *Tripleurospermum inodorum*, were recorded. The results are in agreement with those obtained in the long-term German experiments (RADEMACHER 1967) and reveal

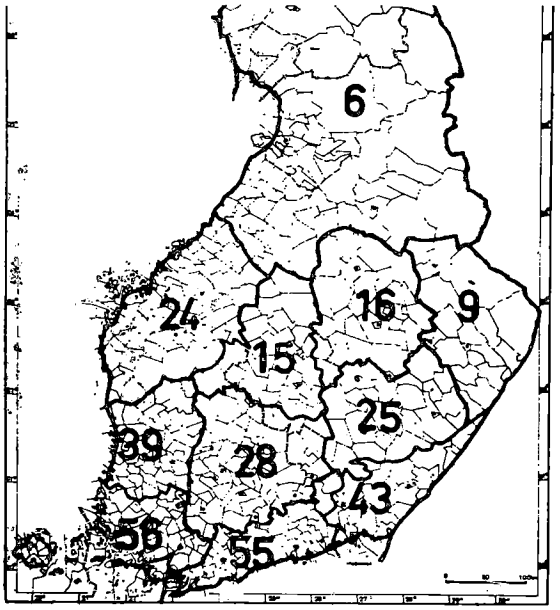

Fig. 48. Percentage area of spring cereals sprayed with MCPA in 1964 (MUKULA and RUUTTUNEN 1969).

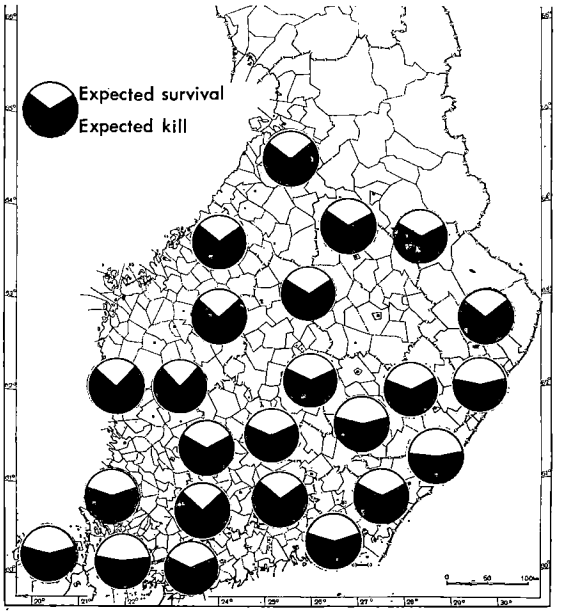

Fig. 49. Expected effects of MCPA on plant numbers of the counted broad-leaved species. Localities surveyed in 1962—64.

the need for new herbicides with different selectivities.

The number of fields sprayed in the year of the survey was 680, and in 460 fields MCPA had already affected the weeds to such an extent that it was not possible to identify the plants or to obtain reliable counts. On the other hand, the timing of the survey was too early to estimate the actual control. In consequence, the 460 fields were disqualified in the data processing. The average »expected» effects of MCPA, calculated on the basis of the composition of the weed flora, were already discussed on p. 78. The regional variation of the expected control is shown in Fig. 49. It can be seen that the proportion of MCPA resistant broad-leaved weeds is highest in southwestern and southeastern Finland. However, the need for new herbicides with different selectivities seems evident in all parts of the country.

Plant cover of cereals

The competition between the cereal stand and the weeds has been widely studied in various countries (e.g. PAVLYCHENKO and HARRINGTON 1934, BLACKMAN 1936, MANN and BARNES 1945—50, RADEMACHER 1950, BLEASDALE 1960, GRANSTRÖM 1962). In the present material the estimated ground covers of the cereals were as follows:

Cover %	Number of fields	Number of weeds/m²
0— 9	171	547
10—19	464	609
20—29	439	579
30—39	379	556
40—49	266	542
50—59	204	482
60—	179	460

As a result of the competition from the cereals, the number of weeds correlated negatively with the percentage ground cover of cereals, except in the lowest cover class. The latter fields were usually sown late, consequently the weeds had not yet emerged in abundance.

Owing to the early timing of the survey, the effects of the competition were relatively small. It should, however, be pointed out that the num-

ber of plants is by no means a satisfactory measure of the competition (HARPER 1960).

Plant cover of weeds

At the time of the survey, the weeds covered about one third of the ground in the fields. The cover was somewhat smaller in the northern and southwestern localities that are close to the sea.

The plant numbers of the individual species were, with the exception of sorrels, in positive correlation to the total weed cover. In other words, in fields with abundant growth of weeds there were usually great numbers of plants of all species. This seems to prove that the competition among weeds had not yet significantly decreased the number of plants of any species.

Size of farm

The size classes of the farms compared with the number of weeds were as follows:

Size class	Field area, ha	No. of fields	No. of weeds/m²
Very small	2— 4	111	469
Small	5— 9	618	545
Medium size	10—24	1 025	575
Large	25—49	268	539
Very large	50—	78	470

The relative number of farms in the various size classes differed from the average in the country being higher on the side of the large farms. The largest surveyed farms were in southwestern and southern Finland, the smallest in northeastern and eastern Finland and in the southwestern Archipelago.

The weeds that were most abundant on very small farms were *Achillea millefolium*, *Galium vaillantii* and *Lapsana communis*, on small farms, *Agropyron repens*, *Equisetum arvense*, *Myosotis* spp., and *Stellaria media*, on medium size farms, *Ranunculus repens* and *Rumex* spp. (docks), on large farms, *Chenopodium album*, *Galeopsis* spp., *Polygonum lapathifolium* and *Spergula arvensis*, and on very large farms, *Equisetum palustre*, *Erysimum cheiranthoides*, *Gnaphalium uliginosum*, *Potentilla* spp., and *Sonchus arvensis*.

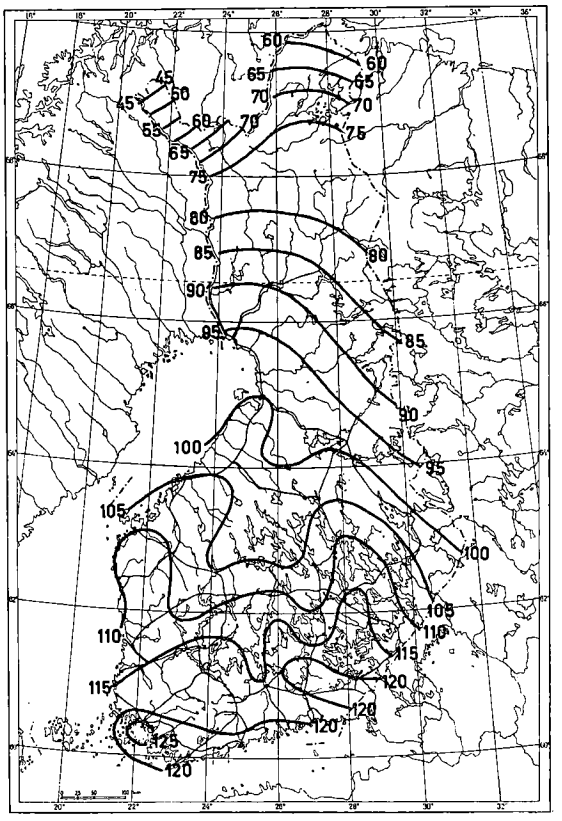

Fig. 50. Length of thermal summer in days (KOLKKI 1966).

The above differences in the composition of the weed flora on farms of different sizes had probably resulted from several differences in agricultural management, such as drainage system, crop rotation, machinery, equipment, etc.

Climate and weather

Finland is the most northerly agricultural country in the world, and her thermal conditions determine the limits of the spring cereal production as well as the nature of crop rotations (MEAD 1953). The average temperature of the growing season is only 11.5—13°C in the main area of the spring cereal cultivation. The length of the growing season (5 . . . 5 °C) varies from 145 to 180 days and that of the thermal summer (10 . . . 10 °C) from 95 to 120 days (Fig. 50) in the north—south direction. Several weed species

do not thrive in the north. Consequently, the number of weed species considerably declines from the south to the north.

The monthly precipitation during the growing season varies from 35 to 80 mm and is lower early in the season than in the autumn. Particularly low figures are recorded during the spring and early summer in southwestern Finland and along the western coast (KOLKKI 1966). The continental-maritime factors of the climate result in some further variation directing from the west to the east.

The climatic factors affect the regional variation in the composition of the weed flora and will be further discussed in Chapter 3. The annual variation in the plant numbers is, at least in part caused by the differing weather conditions. In certain cases the effects of the weather conditions may also be regional or even local. In order to even out the effects of occasional weather fluctuations, the survey was extended to last over a period of four years.

In respect of annual variation, the highest total number of weeds occurred in 1962 and the lowest in 1961. Several species contributed to this difference. In 1962 e.g. *Galeopsis* spp., *Agropyron repens*, *Viola arvensis*, *Lapsana communis*, *Gnaphalium uliginosum*, *Stellaria media* and *Erysimum cheiranthoides* occurred in more than average abundance, while in 1961 *Stellaria media*, *Spergula arvensis*, *Chenopodium album*, *Agropyron repens*, *Polygonum lapathifolium*, *Gnaphalium uliginosum* and *Myosotis* spp. showed reduced plant numbers (Table 4).

In 1962 the spring and early summer were cooler and more rainy than the average in most parts of the country. In such conditions the cultivation for seed bed preparation was difficult and the sowing took place later than normally. The seed was sown partly in wet and cold soil, the germination was slow, and the night frosts at the turn of May-June slowed down the growth of cereals. On the west coast, however, the moisture conditions were reversed, particularly in June, and the crops suffered from drought in some localities (10, 14). In both cases, the result was thin and uneven cereal stands. The weeds flourished in these conditions and were able to compete with the cereals on better than average terms.

In 1961 the sowing season (May) was normal. The following June was warm and rainy, particularly in the western part of the country where this season is normally too dry. In these conditions the cereals germinated, emerged and grew rapidly developing shadowing stands, which reduced the emergence of weeds. On the other hand, a regional bias resulting from the southwesterly situation of the localities surveyed in 1961 must also have affected the averages of the plant numbers, and these two effects could not be satisfactorily differentiated from each other.

3. Phytogeographical division

The regional variation in the composition of the weed flora on spring cereals in Finland suggests a floristic division. The following proposal (Fig. 51) is mainly based on the differences in the plant numbers of the species listed in Table 4 (p. 74) and to some extent the frequencies of the species listed in Table 3 (p. 68). The surveyed area is divided into three zones and two of the zones is further subdivided into sections.

Zone 1 — Southwestern Archipelago

In this zone the weed flora and the abundance of the different weed species differed considerably from the flora and the abundance in the other zones. Many of the southernly species, such as *Sinapis arvensis*, *Veronica opaca*, *V. agrestis*, *Convolvulus arvensis*, *Plantago media*, *Allium oleraceum* and *Anchusa arvensis*, occured in this zone. On the other hand, several species which were abundant on the mainland, such as *Galeopsis* spp., *Erysimum cheiranthoides*, *Trifolium repens*, *Equisetum silvaticum*, *Raphanus raphanistrum*, *Fumaria officinalis*, *Viola arvensis* and *Stellaria media*, were here less abundant.

The factors contributing to the formation of the zone are mainly climatic, edaphic, agricultural and historical. The length of the growing

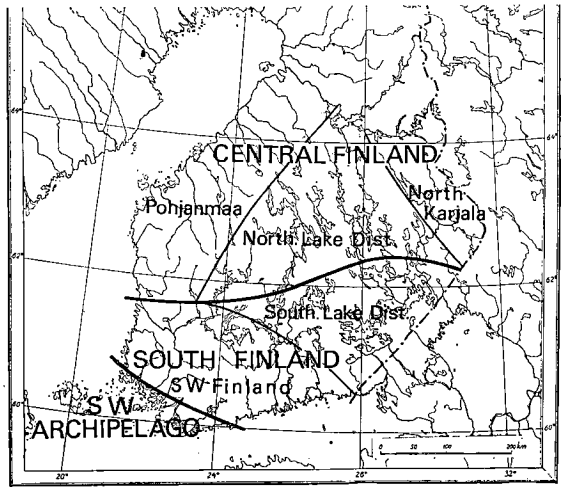

Fig. 51. Proposed phytogeographical division.

season in this area is over 175 days and the sum of the effective temperature is relatively high, about 1 300°C (KOLKKI 1966). Sandy and clay soils predominate, and the fertility of the soil is good. According to KURKI (1963), the average pH degree of the soil is 5.6—6.6, and the content of the exchangeable calcium as high as 9.6—33.9 tons/ha ($CaCO_3$). The cultivation season is the longest in Finland, 210—220 days (CAJANDER 1922). The proportion of leys in the field area is variable, and that of spring cereals, particularly wheat and oats, is large, about 40 %.

Zone 2 — South Finland

In this zone annual and perennial arable land weeds were abundant. *Viola arvensis*, *Fumaria officinalis*, *Galium vaillantii*, *Raphanus raphanistrum*, *Lapsana communis*, *Plantago major*, *Cirsium arvense* and *Sonchus arvensis* should be mentioned among others. Only some grassland weeds or inhabitants of closed vegetation, such as *Taraxacum* spp. and *Vicia cracca*, were copious. Many annuals were MCPA resistant and the perennials persisted ploughing. Most of them favoured clay or sandy soils.

The factors contributing to the formation of the zone are climatic, edaphic and agricultural. The length of the thermal summer in this area is at least 110 days and the sum of the effective temperature 1 150—1 300°C (KOLKKI 1966). The pH degree of the soil is 5.4—5.7, the average content of the exchangeable calcium 8—12 tons/ha and of the exchangeable potash 600—1 200 kg/ha (KURKI 1963). The length of the cultivation season is 180—210 days (CAJANDER 1922).

Section A — Southwest Finland

In this section relatively eutrophic species, which avoided acid soil, were found. Many of them thrived on mineral soils. Some, e.g. the *Lamium*s, favoured areas of old habitations and old cultivations. This section was the most important area of the *Trifolium pratense* leys, while in this section red clover also occurred most abundantly as a weed in spring cereals. Perennial grassland weeds, such as *Ranunculus repens*, *Leontodon autumnalis* and *Rumex* spp. (sorrels) were scarce.

The section forms the more maritime part of the zone (cf. LAAKSONEN 1958). Clay and sandy soils predominate, and less than 5 % of the soils are peat (KURKI 1963). The content of the exchangeable calcium is in many places relatively high, 10—12 tons/ha, and the content of the exchangeable potash is usually 800—1 200 kg/ha (KURKI 1963). The copper content of the soil is higher in this area than anywhere else. The length of the cultivation season is 190—210 days (CAJANDER 1922). The proportion of leys is small, less than 50 % of the field area. The number of combine harvesters per hectare is the highest in the country, and the use of herbicides is most common (MUKULA and RUUTTUNEN 1969).

Section B — Southern Lake District

In this section *Tussilago farfara* was common, and other species that prefer dry, sandy soils, such as *Agropyron repens*, *Lapsana communis* and *Raphanus raphanistrum*, grew also abundantly. Species favouring more southwestern and fertile areas, e.g. the *Lamium*s, *Chenopodium album* and *Sonchus arvensis*, were less frequent than in the western section. Several perennial grassland

weeds, such as *Ranunculus repens*, *Leontodon autumnalis* and *Rumex* spp. (sorrels), were fairly abundant.

This section forms the more continental part of the zone. Moraine soils predominate, while 10—30 % of the soils are peat (KURKI 1963). The contents of the exchangeable calcium and potash are lower than in the western section, as is also the content of copper. The length of the cultivation season is 180—190 days (CAJANDER 1922).

Zone 3 — Central Finland

In this zone several perennial grassland weeds, such as *Deschampsia caespitosa*, *Ranunculus repens*, *Leontodon autumnalis* and *Rumex* spp. (sorrels) grew abundantly in spring cereals. *Taraxacum* spp. and *Vicia cracca*, however, were sparse, and likewise several arable land weeds, e.g. *Viola arvensis*, *Fumaria officinalis*, *Galium vaillantii*, *Raphanus raphanistrum*, *Lapsana communis*, *Plantago major*, *Cirsium arvense* and *Sonchus arvensis*.

The length of the thermal summer in this zone is 95—110 days and the sum of the effective temperature during the growing season is 1 000—1 150°C (KOLKKI 1966). Sandy and peat soils predominate, the pH degree is usually low, 5.2—5.5, the content of the exchangeable calcium 4—8 tons/ha and that of potash 400—600 kg/ha (KURKI 1963). The length of the cultivation season is only 160—180 days (CAJANDER 1922). Leys are the chief crop comprising 55—70 % of the field area (AARIO 1966, p. 136).

Section A — Pohjanmaa

This section differed most from the others and could, in fact, belong to the zone lying immediately north of this one. However, since there was no material from further north, the section was included in Zone 3. Typical weeds in this section were the perennial grassland weeds, such as *Ranunculus repens*, *Deschampsia caespitosa*, *Rumex* spp. (sorrels) and *Equisetum arvense*. The annual weeds that preferred moist and acid soils, e.g. *Spergula arvensis*, *Gnaphalium uliginosum* and *Polygonum lapathifolium*, were also abundant as were *Polygonum aviculare* and *Thlaspi arvense*. The southern and southeastern annuals and perennials, which were common in Zone 2, were rare.

This section is the most maritime part of Central Finland. It is fairly flat and marshy. Sandy soils predominate in most localities and usually comprise 40—60 % of the field area (KURKI 1963). Peat soils are also more common here than in the other sections of the zone, their relative proportions in various localities ranging from 10 to 60 % of the field area. The soils are more acid, the content of the exchangeable calcium is lower, and the proportion of leys is higher than in the other sections of the zone.

Section B — Northern Lake District

Some species of Zone 2 (South Finland), such as *Tussilago farfara*, *Sonchus arvensis*, *Capsella bursa-pastoris* and *Trifolium pratense*, were not as rare in this section as in the other sections of this zone. On the other hand, the boundary line against Zone 2 was distinct.

The sum of the effective temperature in the section is somewhat higher than in the other sections of the zone (KOLKKI 1966), and a greater proportion of the fields consists of mineral soils.

Section C — North Karjala

The weed flora of this section resembled that of the Northern Lake District, except certain southern species which were less prevalent. On the other hand, some southeastern and south—southeastern species, such as *Raphanus raphanistrum*, *Vicia cracca* and *Achillea millefolium*, were relatively abundant, particularly in the southern part of the section. The weed flora of this section displayed some features of the flora of the watershed area of Suomenselkä, which lies between Pohjanmaa and the Northern Lake District. However, as stated above, the limited material did not permit the establishment of a zone situated further north of Central Finland.

The section of North Karjala is the most continental area of Finland. Sand, fine sand and peat soils are common here (KURKI 1963).

Discussion

The proposed floristic division is based mainly on the plant numbers (densities) of the species. It bears considerable resemblance to e.g. the zonal division of forest vegetation by KALELA (1961), the zonal division of peatland vegetation by RUUHIJÄRVI (1960) and EUROLA (1962), and the proposal for vegetation zones and sections presented by AHTI, HÄMET-AHTI and JALAS (1968). The southwestern zone has practically the same boundary in all the divisions. The chief difference between the present proposal and the earlier divisions lies in the boundary between the zones of South Finland and Central Finland. RUUHIJÄRVI (1960), KALELA (1961) and AHTI et al. (1968) include the chief part of the Pohjanmaa and North Karjala sections in a zone lying immediately north of Central Finland. On the other hand, the Northern Lake District is included in South Finland. It would seem logigal to accept the existence of the Northern Zone also on the basis of the weed flora. The present material is, however, too limited to support such a separation.

On the basis of the distribution of trees, HULT (1896), and on the basis of the rock vegetation, JALAS (1961), have divided the area of South and Central Finland with a boundary line running from west to east. The boundary defined by JALAS (1961) is, according to him, mainly edaphic, and it runs somewhat to the south of the southern boundary of the Central Finland zone proposed in this survey.

The governing factors in the defining of the zones presented here seem to be the temperature zones from the south to the north, distinguishable by the length of the growing season, and particularly by temperature sum of that part of the growing season which is available to the weeds in spring cereals. This period is best illustrated by the thermal summer (Fig. 50). Zones running in similar directions may also be laid down as based on the acidity and fertility of the soil. These factors also change distinctively at the boundary between South Finland and Central Finland. It seems apparent that these factors determine the crops for cultivation in each zone as well as the crop rotation system. Consequently, the zonal division of the weed flora is directly or indirectly determined by the thermal, edaphic and agricultural factors (PESOLA 1941).

The forest vegetation zone of South Finland has not been divided into sections (KALELA 1961). The corresponding peatland zone has been divided (EUROLA 1962), but the boundaries of the sections do not entirely follow the boundaries of the present survey. However, the division by e.g. KUJALA (1964), based on forest and peatland flora, does have a section almost similar to that of Southwest Finland.

The division of the zones into sections is evidently dictated chiefly by maritime-continental factors although edaphic factors and agricultural practices seem also to play a part in this division.

The proposed floristic division based on the plant numbers and frequencies of weeds is almost the same as the climatic division presented by AARIO (1966), in which Finland is divided into zones chiefly on the basis of temperature factors, and each zone is subdivided into sections chiefly on the basis of maritime and continental factors.

An extension of the zonal division outside the borders of Finland would also be worth consideration. The weed flora in North Sweden (GRANSTRÖM 1956) bears a considerable resemblance to the flora on the corresponding latitude in Finland, and in the weed flora of Norway (VIDME 1959) and South Sweden (GRANSTRÖM 1962) many features occurring in southwestern Finland are likewise to be found. Similar features exist also in the weed flora of Estonia, which the present authors have had a chance to inspect in connection with occasional visits. In Denmark (MIKKELSEN and LAURSEN 1966) the weed flora already differs considerably from that of South Finland. On the other hand, it has similarities with the weed flora in Skåne, South Sweden. In Western and Central Europe it is possible to find many of the weeds that grow in Finland, the abundances are, however, in a different class and include a number of species that do not thrive in Finland.

SUMMARY

A country-wide weed survey was conducted on spring cereals in Finland and comprised a preliminary study in 1961 and the actual survey in 1962—64. A total of 2 710 fields were examined in 32 localities distributed throughout the actual spring cereal area. The survey was executed in the middle of the growing season and included evalutions of the distribution, frequency and plant numbers of weed species. A circular sampling unit of 0.25 m^2 was used in counting the plant numbers. The following results were obtained in the actual survey:

1. The number of weed species found on the surveyed spring cereal fields was 304. The largest numbers of species were recorded in Southwest and South Finland and the lowest in Pohjanmaa.

2. The most common annual species and their percentage frequencies per field were as follows: *Galeopsis* spp. 94, *Chenopodium album* 92, *Spergula arvensis* 88, *Stellaria media* 85, *Viola arvensis* (incl. *V. tricolor*) 80, *Erysimum cheiranthoides* 74, *Polygonum lapathifolium* 73, *Myosotis* spp. 60, *Polygonum convolvulus* 60 and *Lapsana communis* 49.

3. Among the most common perennial species the percentage frequencies were: *Ranunculus repens* 74, *Achillea millefolium* 69, *Rumex* spp. (sorrels) 61, *Agropyron repens* 47, *Equisetum arvense* 44, *Vicia cracca* 43, *Achillea ptarmica* 43, *Cirsium arvense* 37, *Trifolium* spp. (excl. *T. pratense*) 37 and *Taraxacum* spp. 35.

4. The average total number of weed plants was 550/m^2. The largest numbers were recorded in northern Pohjanmaa, in southeastern Finland and in areas in between, while the smallest numbers were recorded in southwestern and northeastern localities.

5. Among the most abundant annuals the average plant numbers/m^2 were: *Spergula arvensis* 87, *Stellaria media* 83, *Galeopsis* spp. 67, *Chenopodium album* 60, *Viola arvensis* (incl. *V. tricolor*) 43, *Gnaphalium uliginosum* 19, *Erysimum cheiranthoides* 18, *Lapsana communis* 16, *Polygonum convolvulus* 16 and *Myosotis* spp. 11.

6. Among the most abundant perennials the average plant numbers/m^2 were: *Agropyron repens* 25, *Ranunculus repens* 12, *Rumex* spp. (sorrels) 11, *Sonchus arvensis* 4, *Achillea millefolium* 4, *Achillea ptarmica* 3, *Equisetum arvense* 3, *Leontodon autumnalis* 1, *Vicia cracca* 1 and *Cirsium arvense* 0.9.

7. The type of soil and moisture conditions in the soil had a strong influence on the composition of the weed flora. Among the agricultural factors, the preceding crops, or crop rotation in general, played a governing role. The application of contaminated farmyard manure and undersowing with contaminated seed of herbage crops as well as the combine harvesting method significantly increased the plant numbers of certain species, while the long-term use of MCPA decreased the proportion of the susceptible species but increased the proportion of the resistant species.

8. Considering the average composition of weed flora in regard to the susceptibility to MCPA as well as the long-term effects of this herbicide, the future use of MCPA for weed control in spring cereals was considered justified. However, the need of new herbicides with different selectivity to complement the effects of MCPA seems very evident.

9. On the basis of the plant numbers and frequencies of the weeds the surveyed area was divided into zones and sections. The differences between the eastwesterly directed zones were considered to have been caused chiefly by conditions of temperature, while edaphic and agricultural factors also played a role. The differences between the south—north directed sections were obviously governed by continetal and maritime factors as well as edaphic and agricultural ones.

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SELOSTUS

Kevätviljapeltojen rikkakasvit ja niiden runsaus

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Suomen peltojen rikkakasvilajistosta ja lajien runsaussuhteista on ollut vain rajoitetusti tietoja. Laajennettaessa rikkakasvien kemiallista torjuntaa 1950-luvulla tuli yksityiskohtaisempien tietojen tarve ajankohtaiseksi. Puutteen poistamiseksi aloitettiin Kasvinviljelylaitoksen toimesta vuonna 1961 peltoviljelyksillä esiintyvien rikkakasvien levinneisyyden ja runsauden selvittäminen. Ensimmäisenä otettiin tutkittavaksi kevätviljapeltojen rikkakasvit.

Alustava esitutkimus suoritettiin 1961 ja varsinainen tutkimus 1962—64. Kunakin vuonna tutkittiin kahdeksan 1—3 pitäjän suuruista aluetta kesäkuun 25. — heinäkuun 18. päivien välisenä aikana. Tutkimusalueet jakaantuivat tasaisesti suurimmalle osalle kevätviljojen säännöllistä viljelyaluetta (taulukko 1, s. 63 ja kuva 2, s. 62). Kullakin tutkimusalueella työskenteli kahden hengen työryhmä, joka selvitti noin kahden viikon aikana keskimäärin 87 (55—115) kevätviljapellon rikkakasvilajiston (taulukko 3, s. 68). Lisäksi määritettiin kullakin pellolla 41 lajin tai lajiryhmän (taksonin) kasvutiheys neljältä 0.25 m^2:n suuruiselta näytealalta (taulukko 4, s. 74, kuvat 6—46). Rikkakasvien runsauteen vaikuttaneista tekijöistä kerättiin yksityiskohtaisia tietoja. Tutkittuja peltoja oli varsinaisessa aineistossa 2 088 ja koko aineistossa, esitutkimus mukaan luettuna, 2 710.

Tutkituilta kevätviljapelloilta löydettiin kaikkiaan 304 rikkakasvilajia. Eniten lajeja oli Lounais-Suomen pelloilla ja vähiten Pohjanmaalla. Näytealoilta laskettiin kaikkiaan noin 1 500 000 rikkakasvin tainta tai versoa. Keskimäärin niitä oli 550 kpl/m^2. Taimien ja versojen kasvutiheys oli suurin Pohjanmaalla ja Kaakkois-Suomessa sekä niiden välisellä alueella ja pienin Lounais-Suomessa ja Koillis-Suomessa (kuva 5).

Yleisimmät kertarikkakasvit ja niiden esiintymisen yleisyys laskettuna prosentteina tutkittujen peltolohkojen lukumäärästä olivat seuraavat: pillikkeet 94, jauhosavikka 92, peltohatikka 88, pihatähtimö 85, pelto-orvokki 80, peltoukonnauris 74, ukon tatar 73, lemmikit 60, kiertotatar 60 ja linnunkaali 49.

Yleisimmät kestorikkakasvit ja niiden yleisyysprosentit olivat: rönsyleinikki 74, sian kärsämö 69, suolaheinät 61, juolavehnä 47, peltokorte 44, hiiren virna 43, ojakärsämö 43, pelto-ohdake 37, apilat 37 ja voikukka 35.

Runsaimmat kertarikkakasvit ja niiden taimien keskimääräiset kasvutiheydet kpl/m^2 olivat: peltohatikka 87, pihatähtimö 83, pillikkeet 67, jauhosavikka 60, pelto-orvokki 43, peltojäkkärä 19, peltoukonnauris 18, linnunkaali 16, kiertotatar 16 ja lemmikit 11.

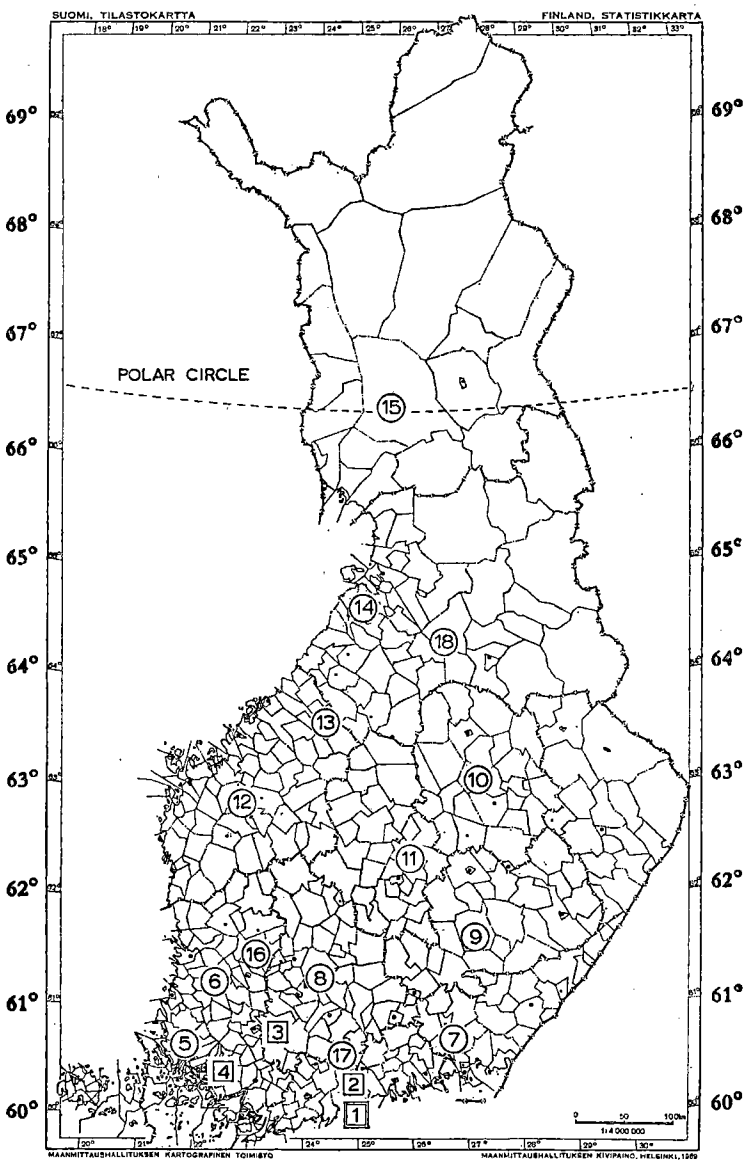
Runsaimmat kestorikkakasvit ja niiden versojen keskimääräiset kasvutiheydet kpl/m^2 olivat: juolavehnä 25, rönsyleinikki 12, suolaheinät 11, peltovalvatti 4, sian kärsämö 4, ojakärsämö 3, peltokorte 3, syysmaitiainen 1, hiiren virna 1 ja pelto-ohdake 0.9.

Maalajilla ja maan kosteussuhteilla todettiin olleen voimakas vaikutus rikkakasvilajiston koostumukseen (taulukko 6, s. 77). Viljelyteknillisistä tekijöistä oli esikasvin ja viljelykierron vaikutus hallitseva. Rikkasiemenpitoinen karjanlanta ja kevätviljaan kylvetty nurmikasvien siemen sekä leikkuupuinti lisäsivät tiettyjen rikkakasvilajien runsautta. Torjunta-aineena yleisesti käytetty MCPA puolestaan vaikutti vähentävästi tälle aineelle herkkien lajien, mutta lisäävästi sitä kestävien lajien runsauteen.

Huomioonottaen kevätviljapeltojen rikkakasvilajiston koostumuksen ja eri lajien herkkyyden MCPA:lle sekä tämän torjunta-aineen jatkuvan käytön vaikutuksen lajiston kokoonpanoon, näyttää MCPA:n käyttö perustellulta kaikissa osissa maata (kuva 49, s. 100). Valikoivaisuudeltaan MCPA:sta poikkeavien torjunta-aineiden tarve on kuitenkin selvä.

Rikkakasvilajien runsauksien ja levinneisyyden perusteella laadittiin kasvimaantieteellinen aluejako (kuva 51, s. 103), jossa kevätviljojen säännöllisen viljelyn alue jaettiin rikkakasvilajiston perusteella kolmeen vyöhykkeeseen ja kaksi näistä vyöhykkeistä lohkoiksi. Syinä vyöhykkeiden erilaiseen rikkakasvilajistoon ovat lähinnä lämpötilatekijät, mutta myös edafiset ja viljelytekniset tekijät. Vyöhykkeiden jakaantumisen lohkoiksi määrännevät pääasiallisesti mereisyys-mantercisuustekijät, mutta ilmeisesti myös edafisilla ja viljelyteknillisillä tekijöillä on merkitystä.

Tutkimuksen tuloksista on jo aikaisemmin julkaistu neuvontatarkoituksiin eräitä selvityksiä (MUKULA et al. 1962—64, LALLUKKA 1963, MUKULA 1964, T. RAATIKAINEN 1965, M. RAATIKAINEN et al. 1967). Ilmeisesti aineiston jatkokäsittely tulee vielä vastaisuudessakin tarjoamaan mahdollisuuksia monien käytännön ongelmien selvittämiseen. Huomioonottaen viljelymenetelmien muuttumisen vaikutuksen rikkakasvilajistoon olisi kuitenkin tärkeätä tulevaisuudessa toistaa tämä tutkimus tarkoituksenmukaisin väliajoin.



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