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Arthropod Pest Damage to Sugar Beet in England and Wales, 1947-74

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Arthropod Pest Damage to Sugar Beet in England and Wales, 1947–74

R. A. DUNNING

Introduction

The incidence of pest damage to sugar beet in England and Wales was first surveyed, with the help of other Advisory Entomologists, by Petherbridge and Stapley (1935). They recorded general information on the incidence of damage by many pests, but especially by black bean aphid (*Aphis fabae*, Scop.), cutworms (*Agrotis* and *Euxoa* spp.), pygmy beetle (*Atomaria linearis*, Steph.), beet flea beetle (*Chaetocnema concinna*, Marsh.), wireworms (*Agriotes* spp.), millepedes (*Blaniulus guttulatus*, Bosc. and other species) and beet cyst eelworm (*Heterodera schactii*, Schmidt). With the exception of cutworms these are still among our major pest problems. From 1936 to 1946, Petherbridge directed the sugar-beet pest investigations from the School of Agriculture, Cambridge, making annual reports to a Ministry of Agriculture and Fisheries' Sugar Beet Research and Education Committee. For the first half of this decade annual comments were made on the general incidence of the main pests but the work later concentrated on what were then the most damaging pests, beet cyst eelworm and black aphid. Nicotine fumigation to control black aphid was introduced on a commercial scale in 1940; forecasts were made of the probability of attack, based on overwintering egg populations, and records kept of the annual infestation level (Jones & Dunning,1972).

In 1947 F. G. W. Jones instigated a system that ensured regular monthly reports by the British Sugar Corporation Factory Agriculturists on damage by all pests other than green aphids; with major modifications in 1957, it has continued to the present time. The incidence of crop damage by the 32 vertebrate and invertebrate pests of known significance was recorded month by month and season by season to understand better the reasons for epidemics, to monitor the appearance of any new pest problems (nine have been recognised up to the present time, although none are new to the country), and to give a guide to priorities in research work.

Sugar beet suffers from a plethora of pests, many of them minor ones and most varying considerably in the damage they cause from year to year. Enthusiasm for collecting standardised data on the incidence of pests had to be translated into what was practicable for the fieldstaff of the British Sugar Corporation.

This paper records some of the data collected for pest damage other than that due to vertebrates and nematodes, discusses the varying distribution of damage and the differences in incidence within and between seasons, and suggests reasons.

Methods

The crop damage reporting scheme, as organised through the British Sugar Corporation, depended on the ability of the fieldstaff to recognise the pests and/or their damage; to this end, annual short courses were given at Cambridge and, over a period of four years, all fieldmen attended. Courses have been continued in most years up to the present, the primary object being to teach new staff and refresh old staff in the recognition of pests and diseases and their damage.

From 1947 to 1956 BSC Factory Agriculturists made a monthly report on the estimated incidence of pest damage to the sugar-beet crop, April to September inclusive. The

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standard form had columns to record name of pest, dates and localities (usually parish) of damage, acreage lost due to pest damage (whether 'ploughed-up' and resown to sugar beet or other crop, or left bare, was not recorded), and acreage damaged severely, moderately, or slightly; these latter categories were not defined strictly and the reporter used his judgement, the subjectiveness of which is enlarged on below.

The quality of recording was improved from 1957 onwards by supplying printed forms on which all pests were listed, by obtaining monthly reports from each fieldman (150 in 1957 but decreased gradually until only 90 in 1974) rather than a single one from each of the 17 sugar factories, and by categorising three different degrees of crop damage other than complete crop failure, viz.: severe (loss of yield likely), moderate (damage extensive, but loss of yield unlikely) and slight (damaged plants occurring in crop, but no effect on yield).

Each fieldman is responsible today for *c.* 2000–5000 acres (810–2020 ha), depending on the distribution of the contract-grown crops, but from 1947 to 1965 for only about half this acreage; he knows the soils and crop problems of his area well. The fieldmen's best estimate each month of the different categories of pest damage is a subjective but practical record, the shortcomings of which are discussed later.

The raw data is converted into an annual index. A 'month-acre' is defined as one acre damaged during one month. The annual 'month-acre' index is derived from the formula:

$$\text{Acres failed} + \frac{\text{acres severely damaged}}{10} + \frac{\text{acres moderately damaged}}{100} + \frac{\text{acres slightly damaged}}{1000}$$

and is referred to in the text as the Damage Index (April–September for 1947–56 but April–July for 1957–74).

Because the records are for many years, the minor pests are omitted from the tables and figures, brief reference being made to them only in the text.

Results

Common names (Thomas, Janson & Aitken, 1968; Jones & Dunning, 1972) are used throughout the text, being the names used on the field record forms. In the following cases more than one species is involved:

Capsid bugs—*Lygocoris pabulinus* (L.) and *Calocoris norvegicus* (Gmel.) but from 1956 onwards (when damage first identified) also *Lygus rugilipennis* Popp.

Chafer grubs—usually *Melolontha melolontha* (L.) but occasionally *Amphimallon solstitialis* (L.)

Cutworms—*Agrotis segetum* (Schiff.) and *Euxoa nigricans* (L.)

Millepedes—mainly *Blaniulus guttulatus* (Bosc.) and *Brachydesmus superus* Latz. but several other species can be involved

Summer caterpillars—mainly *Plusia gamma* (L.) and *Lacanobia oleracea* (L.)

Wireworms—*Agriotes lineatus* (L.), *A. obscurus* (L.) and *A. sputator* (L.)

1947–56. Acres damaged annually by the nine major arthropod pests are recorded in Appendix Table 1. Damage by minor pests over the ten-year period was, in total: chafer grubs—9 acres failed, 10 acres severely damaged, 88 acres moderately damaged and 1553 acres slightly damaged: capsid bugs—0, 2560, 10 385, 76 651: sand weevil—27, 9, 96, 154: summer caterpillars—0, 0, 2285, 29 520: tortoise beetles—0, 13, 9, 22 919: rosy rustic moth caterpillar—0, 0, 18 and 649. Damage by bibionid larvae, earwig, leafhoppers, red spider mite and slugs was negligible, the latter causing slight damage

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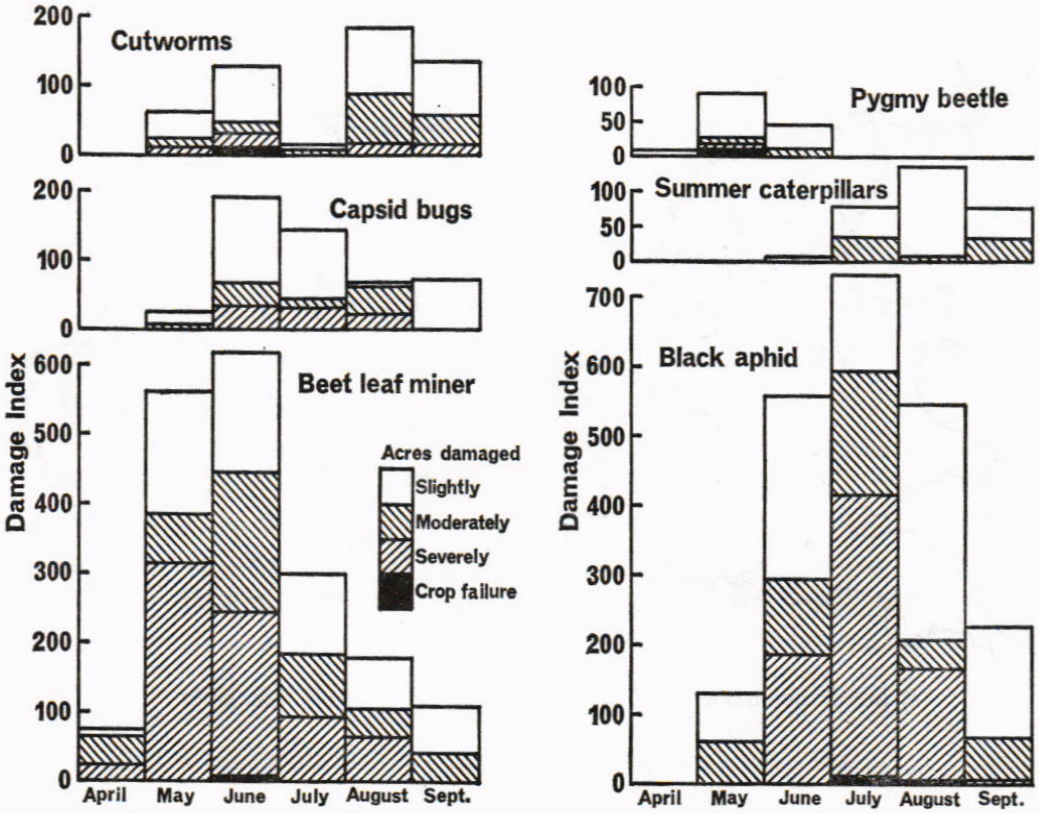

FIG. 1. Mean monthly incidence of damage, April–September, 1947–56.

only in 1951, 1954 and 1956; no damage was reported due to the following pests that have caused damage in subsequent years—diamond-back moth and tortrix moth caterpillars, symphylids and thrips.

The incidence of damage in each of the months April–September is plotted for six pests to illustrate the variety in time and severity of attack (Fig. 1). The histogram for cutworms appears anomalous but this is because two species are involved, of which *A. segetum* is the commonest; it causes mainly minor damage in late summer and autumn but more severe damage the following spring as the caterpillar matures. Capsid bugs and summer caterpillars cause some damage in August and September, and black aphids much more, especially in August. Virtually all crop loss, and all damage by other pests considered in this paper, occurs in April to July.

Fig. 2 illustrates the distribution in England and Wales of cases of significant damage (i.e. crop failure or moderate to severe damage) by four pests in the period 1920–56, chosen because their more recent distribution cannot be shown; two (summer caterpillars and sand weevil) are still fairly common pests in certain localities but are no longer reported on regularly, especially because damage after the end of July is not recorded, and two (chafer grubs and beet carrion beetle) are now rare pests. Sand weevil damage is by far the most localised of the distributions illustrated in Fig. 2; records since 1957 of severe damage, some of it crop failure, have been entirely confined to the Brecklands in the Bury St. Edmunds factory area, but sand weevil damage has been reported occasionally also on sandy soils in the Cantley, Kidderminster and King's Lynn areas (see Fig. 3j for location of sugar factories and area covered). Damage by chafer grubs was scattered, but mainly in east Norfolk; they are now rare pests, reported only from the latter area. Beet carrion beetle has not been known to damage beet for many years but

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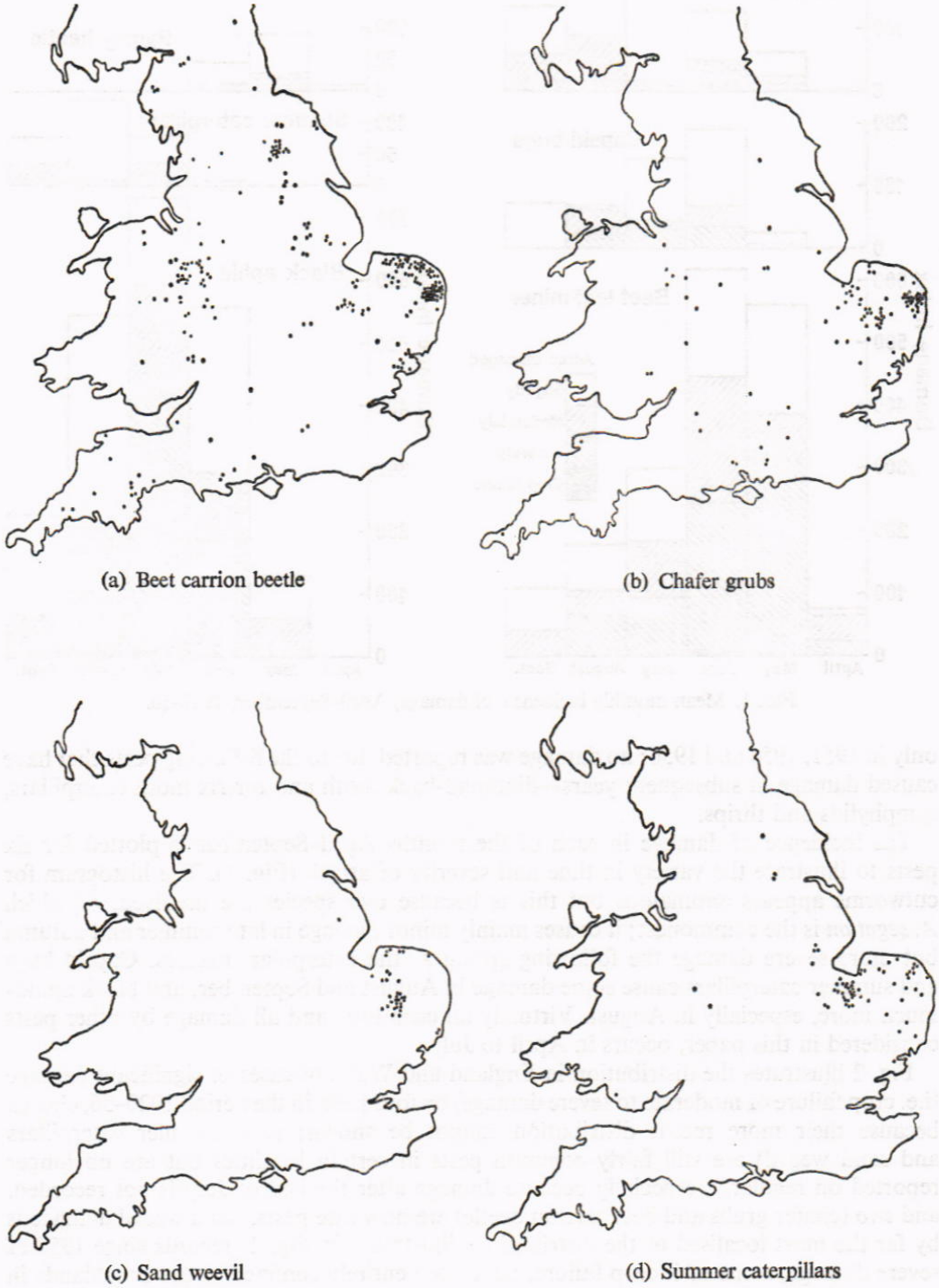

(a) Beet carrion beetle

(b) Chafer grubs

(c) Sand weevil

(d) Summer caterpillars

FIG. 2a–d. Distribution of sites of significant damage (crop failure or moderate to severe damage) by named pests, as reported in Ministry of Agriculture records 1920–56, and by Sugar Factory Agriculturists 1947–56.

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formerly was widespread, especially in north and east Norfolk. Summer caterpillars that defoliate crops in July, August and September caused, and still do cause, most damage in the peat fen regions. The distribution of damage by the other pests is not illustrated; it paralleled the intensity of sugar-beet growing, but wireworm damage was especially prevalent in the Bury St. Edmunds area and pygmy beetle in the peat and silt fen regions.

For seven of the pests for which the acreage damaged is recorded in Appendix Table 1, an average annual damage index has been calculated for the ten-year period and is shown in Fig. 4 together with that for slugs; long term changes in pest status can be compared (see below).

1957–74. From 1957 onwards, to decrease the work load on the BSC staff, recording was discontinued of any damage occurring in August and September; most damage of significance occurs in the period April to July, and pest damage incidence not shown in Fig. 1 all occurs then. As a result of this change the damage recorded for black aphid, cutworms and capsid bugs is slightly less than actually occurred and is, therefore, not directly comparable with that for the previous decade; for summer caterpillars the data is very much less and is not presented below.

Appendix Table 2 gives the acres damaged annually from April to July by the nine major pests in this 18-year period, seven of the pests the same as in the decade 1947–56, with two new ones, slugs and symphylids, replacing beet carrion beetle and cutworms which are relegated to the group of minor pests. Total damage recorded due to the minor pests from 1957 to 1974 was: beet carrion beetle—4 acres failed, 10 acres severely damaged, 59 acres moderately damaged, and 3631 acres slightly damaged (none of significance after 1965): capsid bugs—6, 3178, 26 507, 294 435: chafer grubs—9, 33, 78, 1245 (all in period 1957–65): cutworms—87, 52, 2485, 9435: rosy rustic moth caterpillar—0, 24, 170, 7095 (much more damage occurred in the Cupar area of Scotland): sand weevil—72, 106, 159, 7310: thrips—0, 83, 372, 805 (only in 1957, 1962 and 1970): tortrix moth caterpillars—0, 712, 1156, 80 002 (damage occurred in most years but was especially prevalent in 1959).

The intensity of damage by the nine major pests in the period 1968–73 is shown for each sugar factor area in Fig. 3a–i. The average annual damage index per factory has been corrected for the varying areas of sugar beet grown there over the period (range 14 600 acres in the Nottingham area to 43 200 in the Bury St. Edmunds area—Fig. 3j shows the acres of sugar beet per factory area in 1970 and identifies each area). The annual damage index for eight of these pests over the period 1957 to 1974, in comparison with the average for 1947–56, is given in Fig. 4a–h.

Wireworm damage in 1957–74 (Fig. 4a) was very considerably less than in the previous decade, occurring mainly in the Felsted and Nottingham areas and being virtually absent from the peat and silt fen regions (Fig. 3a). Symphylid damage to sugar-beet seedling roots was first recognised in 1965 and the amount reported seems to be increasing (Appendix Table 2); it occurs mainly in regions with silty soils but several areas report no damage (Fig. 3i). Millepede damage is least prevalent in the south and east of East Anglia (Fig. 3b), but overall seems to be increasing in importance (Fig. 4b). Leatherjacket damage was very largely confined to the two west Midland factory areas (Fig. 3c), and was especially prevalent in 1968 and 1969 (Fig. 4c). Slug damage was particularly prevalent in 1966–69 but was virtually unknown before 1958 (Fig. 4d); most damage occurs in the west Midland areas (Fig. 3d).

With the exception of 1971, beet flea beetle damage has also declined (Fig. 4e), most that occurred being in the Ipswich, Newark, Nottingham and Peterborough factory areas (Fig. 3e). Pygmy beetle damage fluctuated very considerably from year to year but increased on average (Fig. 4f), and was most prevalent in the factory areas around the

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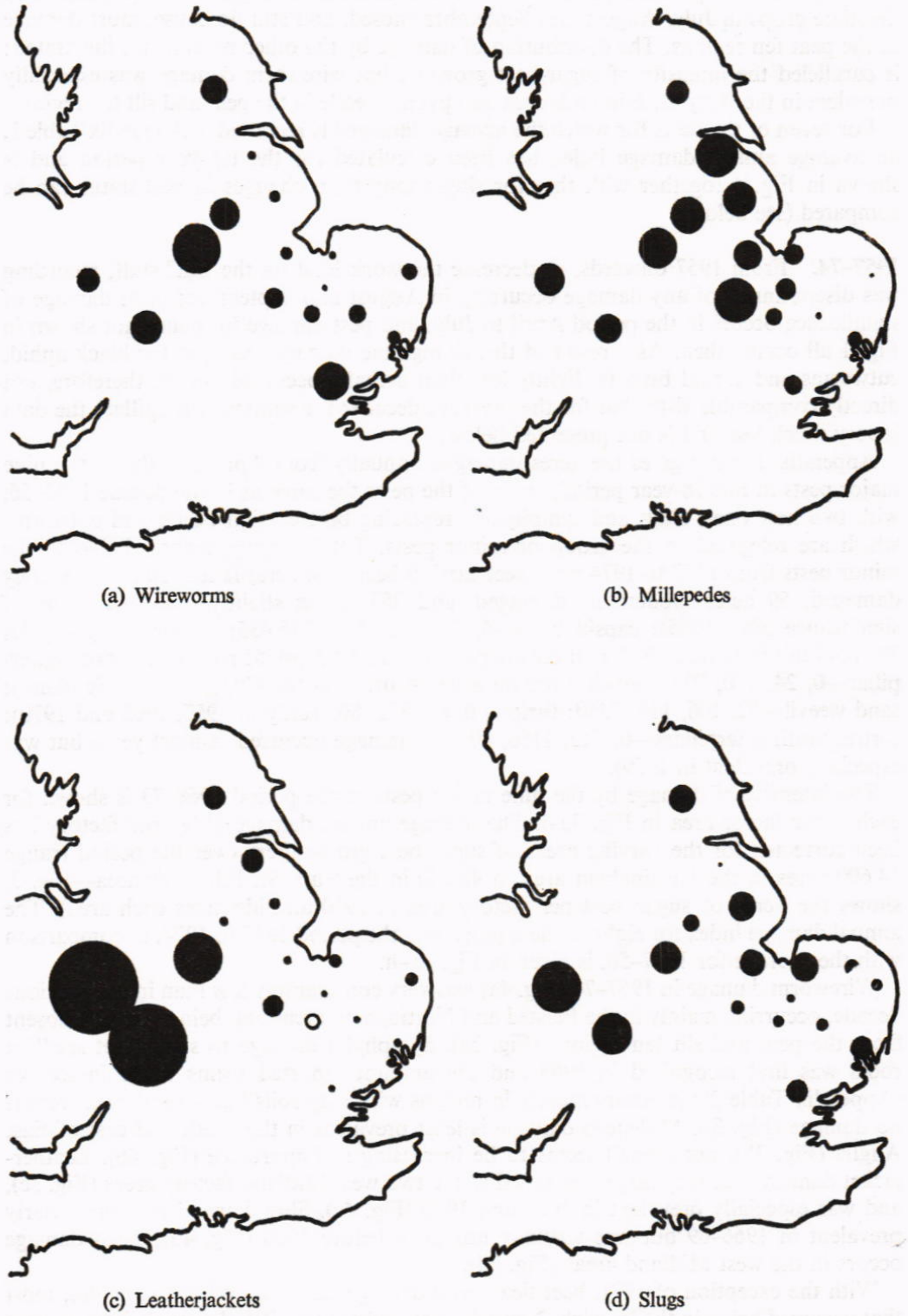

(a) Wireworms (b) Millepedes

(c) Leatherjackets (d) Slugs

FIG. 3a–d. Distribution of pest damage between the 17 sugar factory crop areas. The area of the circle is relative to the mean annual 'month-acre index' (see text) for 1968–73, after correction for the varying acreages of sugar beet grown in the different factory areas (see Fig. 3j).

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(e) Beet flea beetle

(f) Pygmy beetle

(g) Black aphid*

(h) Beet leaf miner

FIG. 3e–g. Distribution of pest damage between the 17 sugar factory crop areas. The area of the circle is relative to the mean annual 'month-acre index' (see text) for 1968–73 after correction for the varying acreages of sugar beet grown in the different factory areas (see Fig. 3j).

* For clarity only part of the circle for sugar factory area 10 (King's Lynn) is shown and that for area 15 (Wissington) is omitted, the latter's damage being intermediate between that for areas 1 and 9.

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(i) Symphylids (j) Sugar beet factory areas

FIG. 3i. Distribution of symphylid damage between the 17 sugar factory crop areas. The area of the circle is relative to the mean annual 'month-acre index' (see text) for 1968–73, after correction for the varying areas of sugar beet in the different factory areas.

FIG. 3j. Acres of sugar beet grown in the 17 sugar factory areas in 1970. 1. Allscott, 2. Bardney, 3. Brigg, 4, Bury St. Edmunds, 5. Cantley, 6. Ely, 7. Felsted, 8. Ipswich, 9. Kidderminster, 10. King's Lynn, 11. Newark, 12. Nottingham, 13. Peterborough, 14. Spalding, 15. Wissington, 16. (and 17). York (and Selby)—these latter two factory areas recently amalgamated.

Wash (Fig. 3f). Black aphid damage also fluctuated considerably, being alternately high and low until 1970 (Fig. 4g—data not shown for 1966 and 1967 because no reports made in July of those years); on average damage has been less in the last seven years (average annual damage index 900) than in the decade 1947 to 1965 (average 3200). It was an important pest in all factory areas, especially King's Lynn, Nottingham and Wissington (Fig. 3g). Damage by beet leaf miner was most prevalent in 1947–56, and has become much less prevalent since 1963 and 1964 (Fig. 4h); most damage occurs in the York area (Fig. 3h).

Other pests were of very minor importance. Diamond-back moth caterpillar damage was prevalent on sugar beet in the eastern factory areas in July 1958 (5040 acres damaged slightly), presumably due to an invasion from Scandinavia or Russia, but has not been reported before or after. Bibionid larvae, earthworms, earwig, tortoise beetles, leaf-hoppers and red spider mite occasionally caused slight damage. Springtails were also reported as minor pests but current research is showing that they are of greater importance.

Discussion

Petherbridge reported on his visit to the beet-growing areas of Europe in 1934 (Petherbridge & Stirrup, 1934) 'sugar beet has been grown on the Continent for nearly a century and a considerable number of pests and diseases have already appeared in the crop. Several of them have become so serious that intensive research work has been carried out'.

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DAMAGE TO SUGAR BEET IN ENGLAND AND WALES, 1947–74

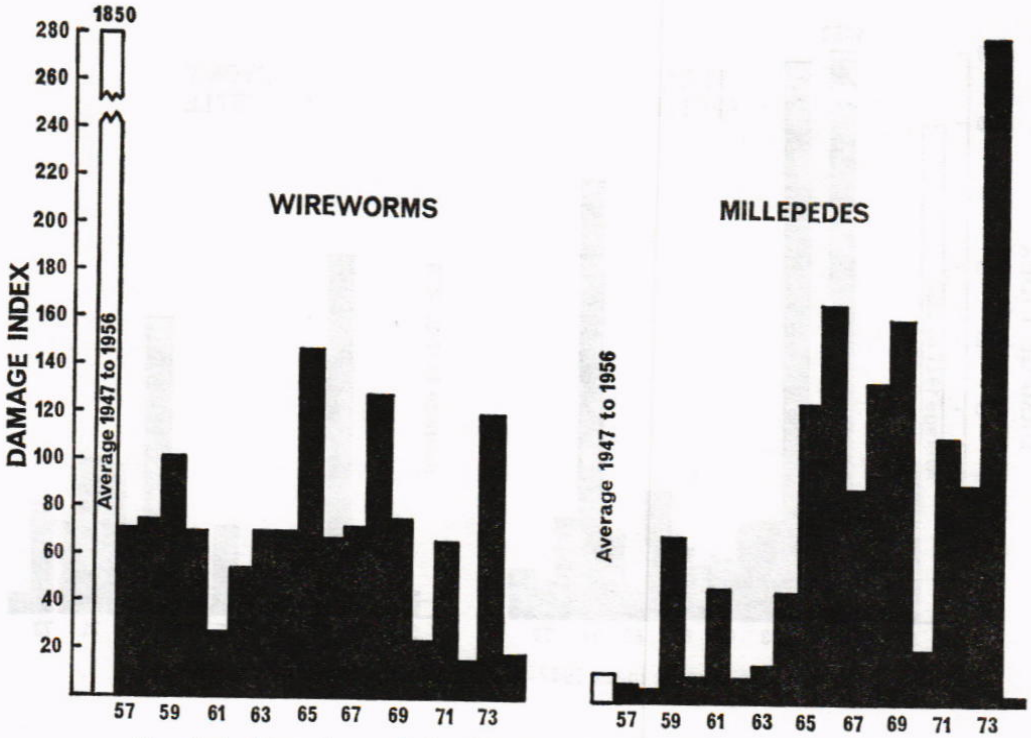

FIG. 4a–b. Mean damage index 1947–56 and annual damage index 1957–74.

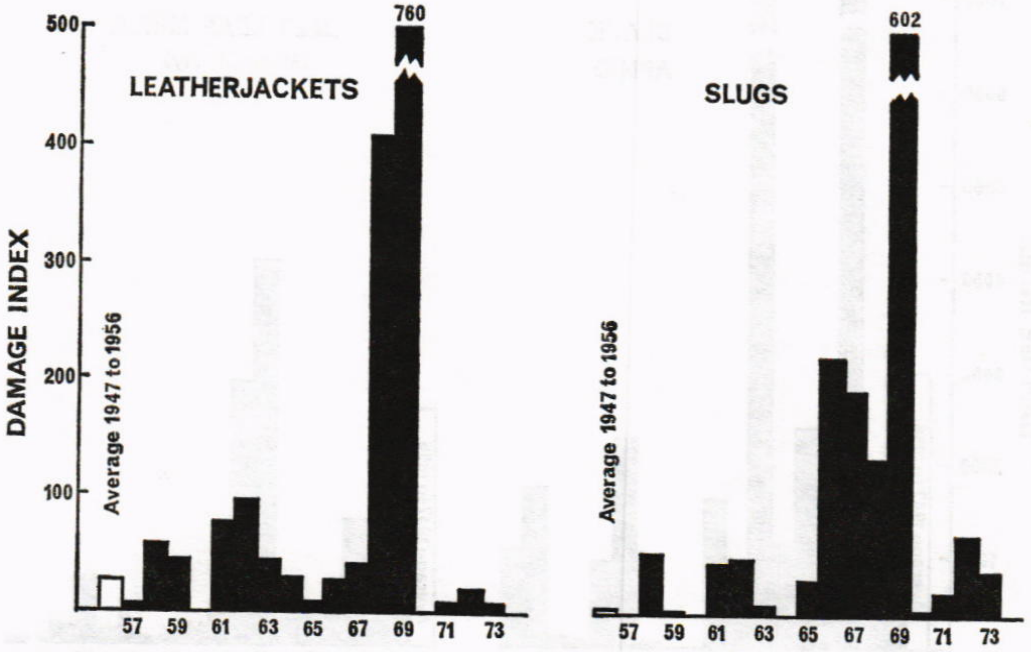

FIG. 4c–d. Mean damage index 1947–56 and annual damage index 1957–74.

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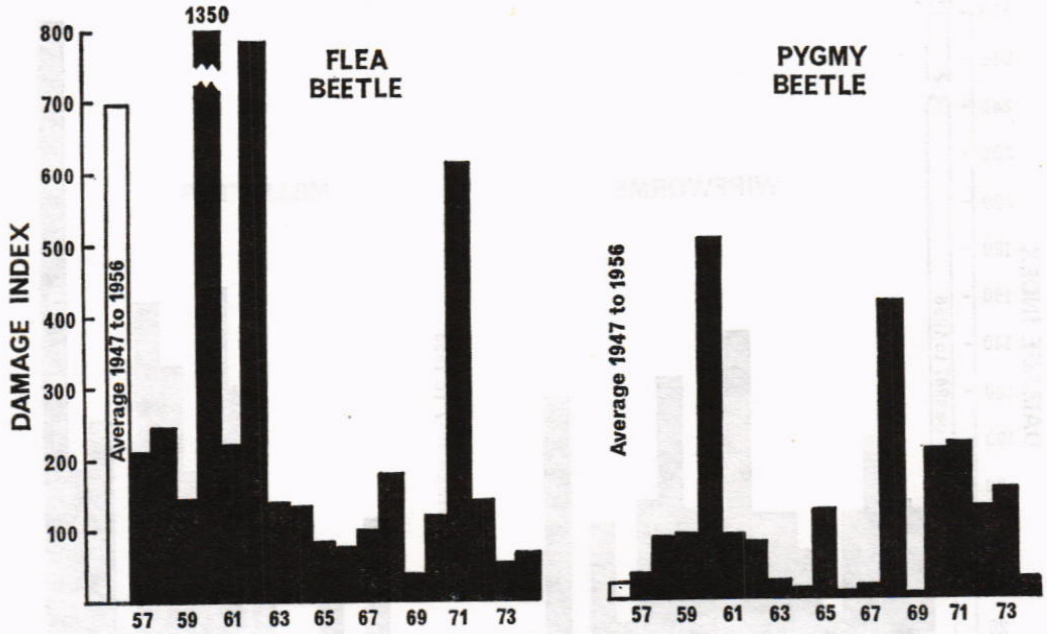

FIG. 4e–f. Mean damage index 1947–56 and annual damage index 1957–74.

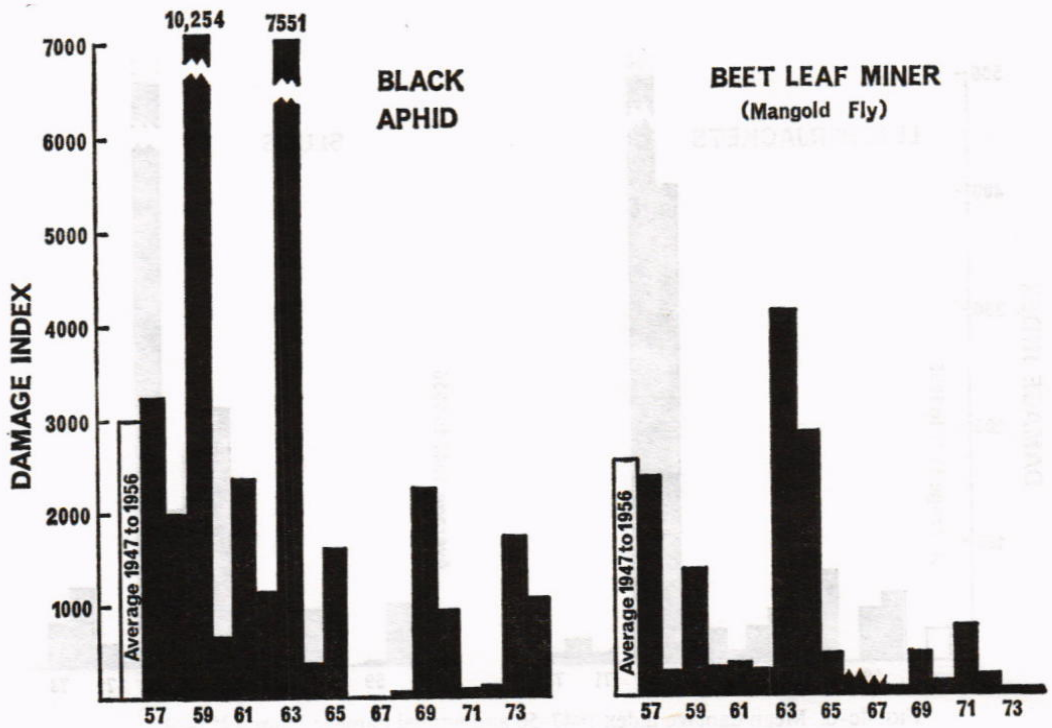

FIG. 4g–h. Mean damage index 1947–56 and annual damage index 1957–74.

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DAMAGE TO SUGAR BEET IN ENGLAND AND WALES, 1947–74

In England and Wales several of the pests recognised on sugar beet in the 1920s and 1930s were well known as pests of mangolds in the 19th century (Curtis, 1860; Ormerod, 1890). However, only about 200 000 acres of mangolds were grown in the 1930s, fairly uniformly distributed throughout the lowland regions. In contrast, sugar beet, introduced in 1920, was concentrated almost exclusively in East Anglia, Lincolnshire, Nottinghamshire, Yorkshire and the West Midlands, and the area grown increased rapidly (viz. 16 000 acres in 1923; 55 000 in 1925; 223 000 in 1927 and 396 000 in 1934). Because of this drastic increase concern was felt that, sooner or later, existing pest problems might increase and new ones appear. Sugar-beet acreage declined to 306 000 in 1937 but increased again soon after and fluctuated only little around 400 000 acres from 1942–63; in the last decade the crop area has increased, and in 1974 was about 465 000 acres. Bickmore and Shaw (1963) illustrated the distribution of sugar beet in 1955, and Fig. 3j does so for 1970. Mangold crop distribution was fairly uniform throughout all arable areas in 1955 (Coppock, 1964); acreage was at a peak of 300 490 in 1944 but then declined to 160 000 in 1956, 38 000 in 1966, and is now very small.

The pest damage survey methods adopted since 1947 were the most practicable for the BSC fieldstaff but the results have some shortcomings. Within-season and between-season data for a particular pest fairly accurately reflect the extent of damage caused, and this can be influenced by factors such as stage of crop and weather condition and not necessarily only by pest numbers; this is an intentional result of the method of reporting. Comparisons between pests may, however, be unreliable because of the widely differing nature of their damage, e.g. a readily visible leaf-feeding pest such as beet leaf miner compared with a hidden soil-inhabiting pest such as the wireworm that feeds only on roots. Very many acres are inevitably reported damaged moderately or slightly by the former pest, whereas most of the minor damage by wireworm goes unnoticed.

Differences in distribution of pest damage. The most intensive beet growing area in 1955 was the Isle of Ely (Bickmore & Shaw, 1963) and probably it still is. Such intensive beet growing has greatly increased the incidence of beet cyst eelworm (Jones & Dunning, 1972) but not of any insect pest damage, with the possible exceptions of summer caterpillars (Fig. 2d) and pygmy beetle (Fig. 3f). The former are non-specific minor pests, but the latter is a major pest specific to *Beta* spp. among crop plants. The only other major and specific pests are beet flea beetle and beet leaf miner; the distribution maps indicate that damage by these two pests is less prevalent in the most intensive beet growing areas. The latter three species all migrate annually in spring from the previous to the current year's crops and the distribution of their damage might have been expected to be influenced by the intensity of cropping.

Other factors such as the soil and soil moisture influence distribution. Sand weevil damage is entirely confined to the sandiest of soils, and chafer grub damage to light soils; black aphid damage is more generally distributed but is most severe on the light soils. Slug damage is most prevalent in the wetter, west Midland areas, and leatherjacket damage is almost entirely confined there. Damage by the beet leaf miner, formerly common throughout the beet growing areas and particularly prevalent in 1954 and 1955 (Dunning, 1956, 1961) is now least damaging in East Anglia; it is suspected that the widespread use of aphicidal sprays each year in this region may be preventing damage appearing and/or overwintering populations building up.

Annual fluctuations in crop damage and long term changes in pest status. Each major pest shows very considerable variation from year to year in the amount of damage caused (Fig. 4a–h); the same seems true of the minor pests but the data gathered on them is less reliable and only epidemic years are considered. The pests' specificity to *Beta* spp.

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varies considerably, as do their life cycles. Most of the non-specific pests are more or less permanently resident in the field (e.g. symphylids, millepedes), or are there as the result of eggs being laid in the previous crop (e.g. leatherjackets, some cutworms). Specific pests, in contrast, migrate each year from the old to the new beet fields.

The fluctuations in incidence of damage are not surprising because they not only involve the well-known fluctuation in numbers of arable crop insect pests but also the seasonal variations in crop growth stage and vigour. An understanding of all the mechanisms involved, so that prediction can be attempted, needs more precise data. That available on pygmy beetle for instance suggests a correlation of extensive damage (Fig. 4) with a dry autumn previously, not with fine weather permitting early migration of beetles as might have been expected (G. W. Hurst, *in litt*). Such an indication provides a necessary basis for study, and more specific data is being gathered currently for pygmy beetle and millepedes.

The severity of damage by wireworms, beet leaf miner, beet flea beetle and black aphid has declined, probably due to the use of insecticides—prophylactic seed treatment for the former, but only spraying when damage threatens for the latter three. Damage by other soil-inhabiting pests, especially millepedes and symphylids, appears to be increasing; it is impossible to determine how much this is due to increased awareness, and how much to the dramatic changes in agronomy of the crop, especially wide spacing of monogerm seed and extensive use of herbicides, that have recently occurred (Hull & Jaggard, 1971). Such changes are implicated in the increased damage to the crop by some birds (Dunning, 1974) and they raise the fear that seedling pest damage by insects will also increase (Dunning, 1971).

Acknowledgements

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DAMAGE TO SUGAR BEET IN ENGLAND AND WALES, 1947–74

APPENDIX TABLE 1

Acres failed, due principally to the pest specified, and total 'month-acres' damaged to differing degrees, April–September, 1947–56

		1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Beet carrion beetle	a*	3	28	—	—	—	—	—	—	—	—
	b	2 319	76	315	35	9	15	—	6	—	—
	c	4 929	1 260	302	74	18	257	—	—	—	50
	d	3 724	3 598	463	528	596	1 025	4	300	—	100
Beet flea beetle	a	63	2 538	50	22	32	125	47	35	—	12
	b	12	21 513	76	51	577	4 549	1 716	595	20	1 564
	c	10	24 381	87	520	1 800	12 086	7 982	6 050	505	2 865
	d	400	17 248	3 300	4 230	8 718	28 332	22 785	29 059	2 782	55 057
Beet leaf miner	a	29	3	10	—	—	4	—	7	35	—
	b	36 407	3 006	26 748	260	1 020	10 997	18 480	65 554	36 970	7 596
	c	63 830	13 030	23 085	8 370	1 207	26 208	25 701	102 210	94 995	35 755
	d	71 008	30 522	77 095	17 934	14 359	70 188	72 605	162 830	150 620	16 176
Black aphid	a	87	—	—	—	—	18	—	—	27	—
	b	73 984	30	39 680	68	28 310	25 730	20	12 900	71 150	—
	c	104 565	139	113 802	60	43 150	56 550	60	34 580	130 750	—
	d	171 099	55 680	221 325	20 275	144 040	117 182	21 399	180 020	232 500	43 042
Cutworms	a	6	19	—	140	1	23	8	8	—	—
	b	236	124	280	448	109	212	—	29	—	45
	c	5 031	389	4 620	774	188	1 587	29	76	1	716
	d	17 629	570	14 582	4 483	7 177	11 881	3 626	1 649	2 948	6 156
Leatherjackets	a	—	2	7	20	48	104	9	16	30	—
	b	—	6	—	23	51	437	20	7	59	—
	c	45	102	1	43	545	885	25	24	50	708
	d	9	30	654	110	47	145	229	27	209	2 635
Millepedes	a	—	61	—	6	10	19	—	3	6	—
	b	—	38	—	7	9	—	5	4	12	—
	c	—	5	—	4	—	12	—	—	—	30
	d	23	115	—	—	50	5	18	4	28	3
Pygmy beetle	a	18	10	13	39	9	1	8	30	23	3
	b	17	8	7	22	3	17	12	87	—	171
	c	—	28	—	69	7	10	18	100	27	436
	d	43	2 068	28	15	2 550	205	602	2 262	1 138	1 235
Wireworms	a	248	9 263	619	2 253	307	256	529	190	82	34
	b	148	35 088	623	4 664	676	151	854	429	18	525
	c	387	16 659	1 778	4 626	1 040	653	948	5 878	1 111	1 082
	d	263	17 038	4 338	4 664	2 589	5 842	1 714	6 598	3 395	3 341

a* = Acres completely damaged (i.e. failed)
b = Severely damaged (loss of yield likely)
c = Moderately damaged (damage extensive but loss of yield unlikely)
d = Slightly damaged (damaged plants occur in crop but no effect on yield)

} 'month-acres' (acres damaged per month, totalled for April–July)

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APPENDIX TABLE 2

Acres failed, due principally to the pest specified, and total 'month-acres' damaged to differing degrees, April–July, 1957–65

Pest		1957	1958	1959	1960	1961	1962	1963	1964	1965
Beet flea beetle	a*	50	38	31	37	40	399	49	49	7
	b	609	1 019	284	8 404	538	2 448	103	59	107
	c	6 244	5 318	5 056	36 865	7 132	7 014	3 745	3 335	2 502
	d	36 465	50 805	27 986	103 304	51 533	69 114	44 238	45 171	38 267
Beet leaf miner	a	16	—	—	—	—	—	—	2	—
	b	12 721	199	7 623	1 560	537	484	28 703	17 061	1 100
	c	87 818	9 870	39 407	5 990	17 510	15 815	95 885	83 441	16 196
	d	214 262	154 886	215 656	84 753	126 973	89 245	305 374	284 113	170 098
Black aphid	a	—	—	—	—	—	—	—	—	—
	b	16 556	10 100	84 708	924	12 093	3 390	51 084	283	8 397
	c	119 779	66 931	136 791	31 732	83 656	45 589	204 537	11 650	43 420
	d	382 235	287 021	415 574	238 343	327 671	334 544	397 523	243 616	325 882
Leatherjackets	a	3	53	35	—	65	73	36	25	—
	b	10	45	37	3	72	136	26	15	55
	c	41	139	214	5	428	729	404	92	50
	d	547	403	3 828	79	926	2 103	1 523	1 016	621
Millepedes	a	5	—	63	7	43	2	3	21	59
	b	15	11	51	4	33	7	115	72	396
	c	—	41	98	130	38	280	162	1 652	2 215
	d	79	2 420	323	1 293	265	3 540	512	1 611	4 546
Pygmy beetle	a	22	62	15	96	8	29	17	6	28
	b	56	44	447	2 833	661	260	—	—	314
	c	132	530	1 292	10 302	735	1 536	168	75	4 160
	d	2 198	2 989	4 889	21 477	7 524	10 583	6 156	4 704	19 457
Slugs	a	—	—	3	—	30	36	5	74	12
	b	—	23	—	—	81	108	10	37	128
	c	—	4 549	—	—	590	323	102	466	176
	d	5	8 274	366	50	820	970	342	592	845
Symphylids	a									—
	b									34
	c									—
	d									103
Wireworms	a	61	49	82	49	20	43	56	64	96
	b	55	147	132	135	36	25	86	24	270
	c	112	514	336	426	270	561	228	89	1 654
	d	3 185	6 065	2 599	1 981	650	2 456	2 155	1 909	6 421

a* = }
b = } As in Appendix Table 1
c = }
d = }

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APPENDIX TABLE 2—continued

Acres failed, due principally to the pest specified, and total 'month-acres' damaged to differing degrees, April–July, 1966–74

Pest		1966†	1967†	1968	1969	1970	1971	1972	1973	1974
Beet flea beetle	a*	6	25	41	—	31	—	—	2	—
	b	25	104	644	15	75	2 818	1 052	150	50
	c	2 939	3 052	3 694	1 530	3 649	21 656	490	784	3 675
	d	32 796	34 933	38 024	16 363	44 526	113 257	25 240	25 773	18 657
Beet leaf miner	a	—	—	—	—	—	—	—	—	—
	b	50	100	—	1 889	476	4 036	432	50	150
	c	4 830	5 312	1 955	15 680	22 028	16 631	5 682	310	1 401
	d	106 947	68 887	64 620	112 162	123 640	155 249	120 657	43 630	40 383
Black aphid	a			—	—	—	—	—	8	—
	b			75	12 901	4 525	—	185	10 240	5 347
	c			447	75 837	30 214	6 560	4 057	55 197	41 751
	d			35 613	219 033	167 181	24 367	47 590	154 355	128 510
Leatherjackets	a	22	40	362	498	—	8	22	—	—
	b	30	20	291	2 210	—	—	—	50	—
	c	34	67	1 324	3 361	100	—	—	60	—
	d	410	561	2 504	7 097	1096	120	135	—	—
Millepedes	a	132	39	97	132	5	80	35	222	—
	b	182	315	214	165	114	225	329	402	26
	c	1 486	1 688	1 124	630	230	624	1 503	923	7
	d	1 781	5 216	5 110	7 562	3 209	3 631	8 670	8 740	1 463
Pygmy beetle	a	—	—	308	—	61	83	37	107	10
	b	—	32	676	—	1 019	674	657	168	25
	c	3	544	2 593	60	3 116	3 919	1 870	1 594	500
	d	3 889	6 116	16 751	2 315	13 574	26 972	7 750	13 049	6 242
Slugs	a	162	80	50	264	—	5	5	28	—
	b	420	716	606	2 348	—	50	522	49	—
	c	1 515	2 741	1 874	8 118	150	630	722	549	—
	d	2 456	13 297	5 968	22 750	1 800	2 265	2 985	1 831	—
Symphylids	a	40	14	42	4	—	15	42	82	10
	b	160	81	55	15	35	14	178	127	—
	c	475	48	397	46	—	228	691	544	15
	d	569	2 198	1 472	1 657	1 488	1 214	4 941	4 588	183
Wireworms	a	61	44	104	68	13	58	6	104	13
	b	17	210	116	39	50	35	80	94	40
	c	245	413	517	130	294	65	285	440	120
	d	1 075	2 714	5 756	2 809	2 248	2 721	2 555	2 193	626

a* = b = c = d = As in Appendix Table 1

† April–June only

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