

The Grass-grub Problem

By DAVID MILLER, *Cawthron Institute, Nelson.*

DURING this season farmers in some parts of the Dominion have again witnessed one of those disconcerting outbreaks of the grass-grub and its beetle, which, from time to time, have been a feature of New Zealand pastoral activities since the earliest days of settlement.

If one peruses the daily and weekly Press, and the journals devoted to agricultural problems, and even the scientific publications of the seventies and earlier, one finds exactly the same story about the grass-grub as is written in the Press of today.

NATURALLY enough one is justified in asking why more has not been done over all these years to put a period to the depredations of this pest; especially when one finds that other insects, so destructive in the early days, have been controlled (e.g., cottony-cushion scale, codlin moth, woolly aphis, diamond-backed moth, etc.). There are several probable reasons; it is only in comparatively recent times that economic entomology has been developed as a scientific service; the insects that have been checked have been more or less amenable to control; unlike most other crops infested by a pest (such as fruit trees, agricultural and garden crops), pastures are not limited to the confines of a few acres where insect depredations can be total, but cover many square miles of country, and no insect, not even the grass-grub, has at any time threatened the whole of this extensive area of grassland; again, at no time in the history of our researches has there been an adequate staff of entomologists to tackle all major insect problems, or at least to enable a sufficient team to concentrate on any long-term project such as that of the grass-grub.

But even if the problem of grass-grub depredations upon pastures remains unsolved at the moment, the insect has been by no means neglected. Though total action against the insect

cannot be taken, the information we possess enables us to adopt certain control measures, limited as they undoubtedly are. A review of the position might not be out of place.

Grass-grub Habits

There are several species of grass-grubs in New Zealand, all native to the country; of them, it is apparent, at the moment, that only one species, the common grass-grub (*Odontria zealandica*) is the major culprit. A few of the others are certainly destructive, but their influence is much more localised and their outbreaks more sporadic.

While much remains to be ascertained concerning the habits of the common grass-grub, we have a general knowledge of the main features. As a rule, the great droning flights of the beetle at dusk take place during November and early December; during some seasons and in some localities, however, these flights may commence a week or two earlier. When the beetles appear in epidemic force, as has occurred this season, they devour the foliage of all kinds of plants, including some trees; but what interests the farmer is their destruction of cruciferous crops in the seed-leaf stage, which coincides with the beetle flights.

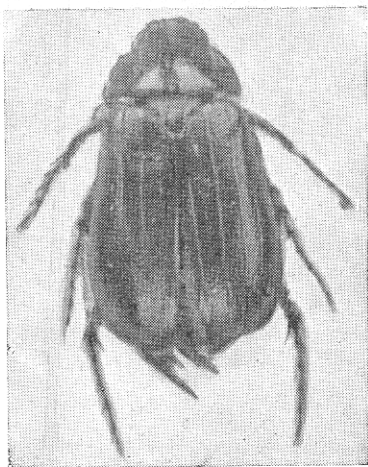
At this time the beetles enter and infest the ground with their eggs; this may occur even in cultivated ground, especially when a crop is present. The insects seem to be more or less gregarious in this habit, if one is to judge from the isolated areas of grub-infested pasture that are so frequently seen. When feeding upon the roots of pasture and other plants the grubs swallow quantities of soil as well as roots, and, working near the surface as they do, they cause the ground to become pulverised and spongy.

By the close of autumn the grubs are well grown. During winter they generally cease feeding, and, according to the severity of the soil climate, descend more or less deeply and there hibernate. With the advent of a rise in spring temperature, the grubs stir themselves and again ascend, continue to feed, and complete their growth. During September and October they reach maturity, cease feeding, and again descend into the soil, where they construct their earthen cells and pupate. This is the chrysalis or dormant stage; but dormant only in so far as feeding and migration are concerned; great changes take place in the pupae, the tissues being recast, as it were, into the form of the adult beetle.

This reconstruction is accomplished at first by only a few pupae; from them emerge the first odd beetles of the season which work their way to the surface by pushing aside the earth with their bulldozer-like heads, and take to the wing. These are the fore-runners of the November flights. Emergences from pupation increase daily until the major flights reach their peak. Early in December the numbers of beetles commence to diminish, until activity practically ceases, except for a comparative few insects that have been late in their pupal transformations. Such is the general cycle of the common grass-grub.

Aspects of Control

Though our present knowledge of the grass-grub problem is insufficient upon which to base a satisfactory approach to universal control, yet certain measures can be adopted to meet some phases of the situation.



Common grass-grub beetle.

1. Control of Beetles. The farmer's concern is to prevent his cruciferous crops, for example, from being devastated by the beetle—under these circumstances the attack is sometimes ascribed to "turnip-fly." It frequently happens that the successful establishment of a crop fails owing to the beetle, except after the very considerable expense of resowing the crop several times. This can be avoided to a great extent by a watch being kept for possible epidemics of beetles, and by taking into consideration their flight period.

Every farmer can tell from the condition of his pastures whether the grub is causing damage of sufficient extent to be noticeable; evidence of such damage will be apparent during March and April, and from this early warning it is but reasonable to conclude that heavy flights of beetles are likely to occur in November, necessitating protective measures at that time. It is evident that all farmers in a district should have a common interest in this, because, though little sign of grub attack, if any, is to be seen on one farm, other farms in the district can be severely infested, whence the developing beetles can travel in all directions; a boundary fence is no safeguard.

On the evidence pointing to an outbreak of beetles, precautionary measures should be taken by sow-

from later grub infestation. This practice might even be of use in the protection of pastures. Sulphur is copiously spread on strips of scrim, which are rolled up and placed in a number of old paint pots. These latter are stood around and about the nursery, and fired at dusk except during stormy weather; the scrim burns throughout the night and the fumes act as an effective deterrent to the beetles. Mr. Buchanan's observations are worth noting. The Tapanui nurseries had been heavily infested by grass-grubs, resulting in very serious losses. For example, in the 1924-25 season 500,000 seedlings were lost, while in the following season the entire crop of 1,500,000 plants was destroyed. The next year the smudges were applied, and not a single one of the 3,500,000 seedlings covering over five acres had been lost in January (at which time the losses formerly occurred); furthermore, no grubs were found during the course of weeding operations. Another point of interest is that the beetle flights at Tapanui commenced early in December, and many beetles were on the wing throughout the summer; this may have been a species other than the common grass-grub (*O. zealandica*), or the later emergence may have been due to local conditions.

Another problem is the protection of strawberry beds. Though entailing a considerable amount of labour, the

beds can be effectively protected during the flight of the beetles by screening them before dusk with scrim stretched on wooden frames. This not only prevents defoliation and damage to the berries, but, by excluding the beetles, also hinders the insects from laying eggs about the roots of the plants, which are thus freed from root damage throughout the season.

The trapping of beetles by means of lights is frequently advocated. A common feature of the Canterbury countryside, during a period of beetle activity, are the bonfires lit to attract and destroy the insects. But this is of little use. Experiments have shown that mainly male beetles are attracted and destroyed; and as there is usually a surplus of males over females, it is largely this surplus that is removed from the competition.

2. Control of Grubs. The influence of grass-grubs on pasture land is twofold; not only are the grass roots destroyed, but also, whilst feeding, the grubs break the normal circulation of moisture about the roots by swallowing the soil with their food and later evacuating it. Against these combined influences grass has difficulty in surviving, and frequently infested turf can be pulled up, or rolled up as one would a carpet. The damage to roots can be partly overcome in stimulating root development and maintaining a vigorous pasture by means of fertilisers; this is a normal phase of proper



Rolling up the turf.



A young turnip crop at Amberley attacked by the "fly."

farm management. On the other hand, the disturbed soil can be compacted by a rolling so as to re-establish the circulation of moisture; but this is an additional and special activity, and by no means always practicable. It should be noted that rolling has no crushing influence on the grubs themselves.

Though all kinds of grasses are subject to grub attack, the attack on some species is much less noticeable than on others. In general it can be said that the more vigorously-growing grasses suffer ill effects less than the weaker or more sluggish types. In regard to the more resistant species, A. H. Cockayne lays special stress on clovers, cocksfoot, and crested dogstail, but draws attention to the value of twitch, yarrow, and *Danthonia pilosa*; on the other hand, perennial ryegrass is a poorly-resistant type. It would seem, therefore, that this aspect requires exploring, and offers possibilities of being at least one of the high-ways along which eventual control will be found.

Another aspect of the problem is that if grass immediately follows cereals, it is recorded that grub infestation is to be expected. The reason

for this is most likely as follows:—Ground in which beetles will lay their eggs need not necessarily be in pasture. The females will be attracted to and lay their eggs in soil of a high humus content, and in this the grubs find ample nourishment for their complete development. For example, a common garden practice is to bury cut grass and even straw; this environment is highly attractive to gravid female beetles and offers an excellent breeding ground for the grass-grubs. Under farming conditions a similar environment is created where a cereal crop has been harvested and the rotting roots of the stubble remain to attract the egg-laying beetles. This suggests another possibility that is worth exploring toward ascertaining what practices should be avoided.

Seasonal cultivation has some value in checking the grass-grub under certain conditions, but it does not offer a solution to the problem of pasture protection. The insect is very sensitive to disturbance during the pupal state, and ploughing at that time (during September and October) causes a destruction of a high percentage.

Though no comprehensive method is yet known by which farm pastures

can be protected from grass-grub invasion, the position in regard to smaller areas is a different matter. Lawns and bowling greens can be "grub-proofed," when the grass is dry, by broadcasting over every 1000 sq. ft. of turf a bushel of screened sand or clean soil with which 5lb. of lead arsenate powder has been thoroughly mixed. The same mixture can be worked into the top soil when a new lawn is being laid down.

Finally, garden plants, being isolated and thus unlike extensive areas of grasses with their dense root masses, can be severely injured by one or two grubs attacking a single plant. Under these conditions some benefit is to be derived by making holes about four inches deep in the soil, near to but not against the plants, pouring in a little carbon bisulphide, and closing up the holes immediately.

Conclusion

The grass-grub is the major insect pest of the country, striking as it does at the pastures of the Dominion upon which our prosperity depends, and no really effective control of the problem as a whole is yet known. A solution of the difficulty will never be found until a sustained and concentrated long-term study is undertaken by a research team of entomologists associated with such others as agrono-

mists and agrostologists. Even then there can be no guarantee that the effort will be crowned by absolute success; but conversely, there remains the obvious guarantee that there never will be a solution without the attempt.

The main objective of the problem is to strike at the grass-grubs in the pastures—to hold them within reasonable bounds, either when they are already in the pastures, or by lessening the chances of the pastures becoming infested. A natural outcome of such an accomplishment would be a corresponding reduction in the depredations of the beetles.

A commencement has been made on this research as a major activity of the entomological service. The problem is a vast one, and no time limit can be placed on it. It entails a study of the life, seasonal, and regional histories of the grass-grub complex in relation to soils, climate, and pasture types and their management; it also necessitates a search for and use of natural enemies and possible insecticides. Whatever the control measures may eventually be, they will be unlikely to centre round one method, but will embrace a combination of methods—perhaps resistant pasture types suited to different soils, pasture management, natural enemies, and possibly insecticides.