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Tasmanian grass grub - a significant threat to pastoral farming in dryland regions

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ABSTRACT

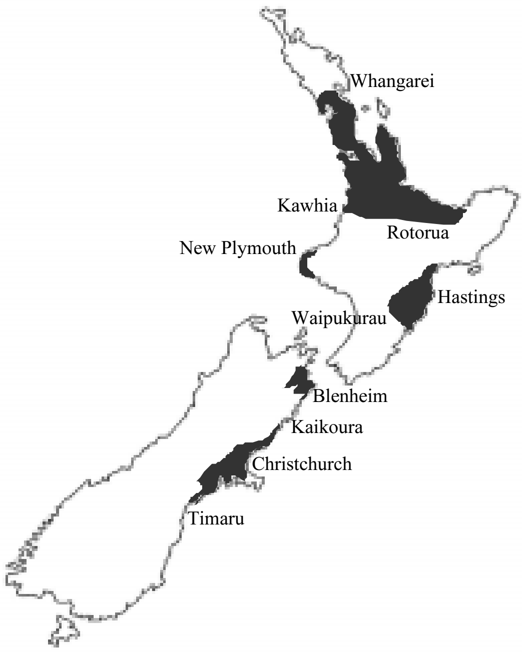
Tasmanian grass grub, first recorded in Canterbury in 1920, is now well established in several areas of New Zealand. The adult beetles fly in January and lay their eggs in the soil after mating. After hatching, the larvae live in the soil and construct vertical tunnels from which they emerge at night to feed on and denude pasture plants. The effects of this pest on pasture were estimated by measuring pasture with larval densities ranging from 21-574 m^2. Larval infestation significantly reduced pasture mass in a linear fashion by around 5% per 100 larvae. For example, at one site from July to September, pasture mass Y = -0.816X + 1852, R+ = 0.3; where Y = pasture mass (kg DM per ha) and X = larvae per m^2. Losses in stock carrying capacities have been estimated to vary between 0.5 and 5 stock units per hectare depending on the farm carrying capacity and larval damage to pasture, resulting in losses of up to $315 per hectare.

Keywords: Tasmanian grass grub; pasture damage; production losses.

INTRODUCTION

Tasmanian grass grub (*Acrossidius tasmaniae.* Hope), native to southeastern Australia, was first recorded in Canterbury in 1920 (Kelsey, 1970). The current distribution (Figure 1) now encompasses areas in Canterbury, Marlborough, Taranaki, Hawke's Bay and a wide area of the northern North Island (R.J. Townsend and B.E. Willoughby, pers. comm). Larvae are very similar in size and shape to the New Zealand grass grub (*Costelytra zealandica*), except for a darker almost black head and bluish-white body and they are generally more active when disturbed than native grass grub.

FIGURE 1: Present distribution of Tasmanian grass grub in New Zealand. The place names approximate the limits of the infestation.



The adult beetles emerge from the soil between mid-January and late March and fly en masse some fifteen minutes after sunset and at dawn providing wind is minimal (<7.5 kph) and ambient temperature >14.5°C and fly initially with the wind and are attracted to light. After laying their first batch of eggs (>35) the beetles fly up-wind attracted to sources of dung on which they feed, such as at stock camps, gate-ways, and shelterbelts, and search for an easy entry into the soil to lay a second batch (>20), hatching within 4-5 weeks (Maelzer, 1961a). After hatching, 1st instar larvae may take 4-6 weeks to migrate to the surface, construct shallow vertical tunnels and feed on organic matter, maturing to the 3rd instar stage within 4-5 weeks (Carne 1956; Maelzer, 1961b). Larvae surface at night to feed on pasture, with initial populations as high as 7500 per m^2 in Australia and 3000 per m^2 in Hawke's Bay, resulting in severe pasture damage until combat between larvae significantly reduces numbers (Carne, 1956; Slay, 1998). By November the larvae, having discarded their gut contents and having a creamy yellow appearance from accumulated fat, construct an earthen cell in the soil in which to live for the next 3-4 month in a state of diapause. A remarkable feature of this pest is this period of diapause, enabling the population to be synchronised at metamorphosis around mid-December. The insect is sensitive to climatic factors, especially moisture, with emergence, flight patterns, larval development, feeding and survival affected by excessive rainfall and/or drought.

In Hawke's Bay, the pest has been associated with yellow brown loam and recent alluvial soils; its initial infestation area was immediately west of Hastings. However, recent severe droughts may have contributed to its spread with a 1995 survey indicating that Tasmanian grass grub was established over 86,090 hectares to the south and west of Hastings as far as Waipawa, with an estimated loss in productivity of 67,160 s.u. (Slay, 1995). In August 1996, two years after one of the driest years on record, Tasmanian grass grub was found at Tikokino in central Hawke's Bay and by 1999 it had spread east to Porangahau and south to Ormondville affecting a further 60,000 hectares (Table 1). Different climatic zones within Hawke's Bay have contributed to differences in the way populations mature. For example, in central Hawke's Bay with its cool moist early autumn, the grubs mature earlier compared to the drier early autumn at Maraekakaho, west of Hastings. Pasture damage can be found in whole paddocks or selective areas and, especially in hill country, is largely confined to the tops and northerly sides of ridges. In flat country around Tikokino, the pest appeared initially to establish under the

TABLE 1: Areas of Hawke's Bay affected by Tasmanian grass grub in 1995 and 2000 and an estimate of the resultant loss in animal productivity. *Damage was defined as severe (major proportion of the farm affected and whole paddocks damaged by larval densities of 500->2000m²), moderate (some whole paddocks affected and localized, 0.5-1.0 ha damage in others by 500->2000m² larvae), or localized (<500m² larvae mainly in hill country usually localized and following ridges). The reduction in stock units was estimated by farmers.

Year	District	Damage*	Area Ha	Reduction in productivity s.u per ha	Total s.u.
1995	Ngatarawa Triangle	Severe	1,000	5.0	5,000
	Ngatarawa/Maraekakaho	Moderate	8.380	1.8	15,080
	Mangatahi District	Moderate	3,910	1.8	7,040
	Crownthorpe	Severe/moderate	2,200	1.8	3,960
	Puketapu	Localised	600	1.8	1,080
	Hill Country	Localised	70,000	0.5	35,000
2000					
	Tikokino	Severe/moderate	2000	1.5	3000
	Takapau-Ormondville	Localised	20,000	0.5	10,000
	Waipukurau/to coast	Localised	50,000	0.5	20,000
	Total		148,090		100,160

numerous shelter belts then moved out to encompass whole paddocks. In hill country east of Waipukurau its rapid spread is considered to be due to 'ridge hopping' as beetles fly from ridge to ridge attracted to stock camps, enabling the pest to proliferate through the district quickly. Almost uniquely, the northerly and southerly slopes provide an ideal habitat for the survival of the pest, with beetles laying eggs in the moist southerly aspect and larvae migrating to the northerly aspect. Land disturbed by Tasmanian grass grub is susceptible to establishment of thistles, reducing pasture production and encouraging further weed and pest infestation establishment (M.W.A. Slay, unpublished observations).

Given the significant increase in area now occupied by the pest in the Hawke's Bay, and the damage sustained by pasture, this paper seeks to quantify the losses in pasture production from Tasmanian grass grub larvae and relate it to farm gross margins.

MATERIALS AND METHODS

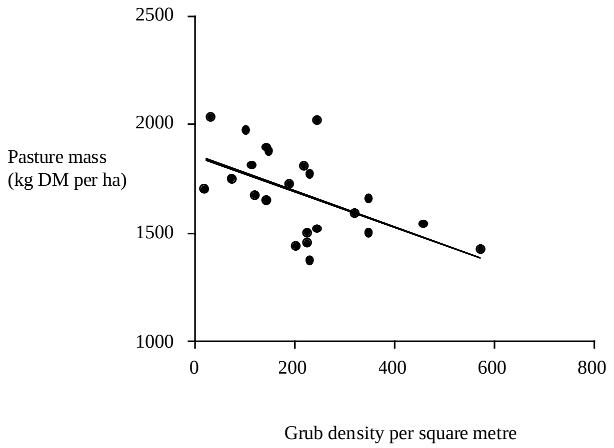
Two insecticides were applied to a population of Tasmanian grass grub larvae (range 500-1275 larvae per m^2) infestation on a site on a Maraekakaho farm. There were four replicates in a randomised block design with the following treatments: control (no insecticide), fenitrothion (1200 and 900 g/ha - Caterkill® 1000, Nufarm Ltd.) and alpha-cypermethrin (10, 15 and 20 g/ha – Fastac, 100EC – BASF NZ Ltd.). All insecticides were applied in 250 litres of water per hectare on 10 May 1996 to 40 m^2 plots. Larval density was re-assessed 28 days later (7 June) in 18, 10cm cores per plot. On July 25, pasture on the plots was trimmed to 3cm and fenced to exclude stock. Pasture mass was estimated from three, 45cm strips per plot on 16 September and the yield calculated and correlated with the pest densities. The data was analysed by regression analysis. The financial effects of Tasmanian grass grub infestation on farm production were estimated according to Garnham & Barlow (1993). The value of lost production was calculated as the current farm gross margin (GM; P. Tither, pers. comm.) x larval population (per m^2) x 0.0005 (the coefficient of the relationship between Tasmanian grass grub density and pasture loss). Two larval populations (300 and 700 larvae per m^2) and two farm businesses were compared (a sheep and a deer farming enterprise).

RESULTS

Insecticide application produced a range (21-574 per m^2) of grub densities and resulted in pasture recovery and increased growth within six days of treatment. Pasture mass decreased as grub density increased (Figure 2) such that $Y = -0.82X + 1852$ $R^2 = 0.30$; df 22; $P = 0.01$ where X = larvae per m^2, Y = pasture mass (kg DM per ha). This relationship indicated that for every 100 larvae, there was a loss of 82 kg DM per ha or about a 5% (range 4.4-5.7%) loss in pasture per 100 larvae. Thus 5% was used as the coefficient in the calculation of the production losses.

Given larval populations of 300 and 700 per m^2 for the sheep and beef hill country farm business and a gross margin of $420 per ha, then the estimated production loss due to Tasmanian grass grub would be $63 and $147 per ha respectively. Since only 8% of the farm was affected by an average of 300 larvae per m+, the net loss was $2,268. Similarly, for the deer farm with a gross margin of $900,

FIGURE 2: The relationship between Tasmanian grass grub densities and pasture production at a site in Hawke's Bay during spring.



the losses would be \$135 and \$315 per ha respectively for 300 and 700 larvae per m+ and as 27% of the farm was affected by an average of 700 larvae per m+, the net loss was \$25,515. This level of infestation significantly impacts on gross margins.

DISCUSSION

This study suggests that Tasmanian grass grub affected pasture production with an estimated loss of 5% pasture dry matter production for every 100 grubs present in the soil from the onset of damage in March/April to November. Furthermore, pasture damage may result in potential losses in farm production of between \$62-315, depending upon the level of infestation and the farm enterprise. A recent informal survey of eight Hawke's Bay farms with Tasmanian grass grub infestation, suggested between 8 and 33% of hill and flat country, respectively, was moderately to severely affected (M.W.A. Slay, unpublished data). On some farms with a uniform soil type that favour Tasmanian grass grub, >70% of the farm can be under attack from moderate to severe densities of Tasmanian grass grub, effectively halving the stock carrying capacities between April and October, the critical pasture growth period in Hawke's Bay. Given that this insect pest is now well established in dryland regions, and its distribution appears to be increasing in the cooler/wetter southerly area of Hawke's Bay region, it poses a serious threat to livestock farming.

While these effects are significant, it is important to acknowledge that the results have been produced at only one site, and at one time of the year. While similar losses in pasture production and stock carrying capacity have been observed through the Hawke's Bay, these losses may vary throughout the year. For example, an average infestation of 400 grubs per m^2 may result in a 20% loss in pasture production in September, but only an 8% loss in January as pastures recover during spring (B.E. Willoughby and M.W.A. Slay, unpublished data). Similarly, the technique of using insecticides to induce a range of grub densities, while having the advantage of keeping the study at a single site, may have affected pasture production independently of grub density or may fully reflect the variation in natural populations. Nevertheless, the relationship between grub density and pasture production does provide a simple predictive equation based on the relationship between pest density, % pasture loss and the farm/paddock gross margin, albeit based on studies of the control of grass grub and porina caterpillar (Barlow, 1985; Van Toor & Dodds, 1994). Given the variation in pasture loss (Figure 2) and therefore farm production, with any given population of larvae, these results merely provide an estimate upon which individual farmers can begin to assess their management options. There are other factors that may require inclusion, such as the beneficial effects of Tasmanian grass grubs tilling the soil, and differences in the tolerances of pasture species

In conclusion, Tasmanian grass grub is a severe threat to livestock farming on light soils and in dryland regions. Whilst reasonable levels of control can be achieved with insecticides, the most appropriate means and optimum times for managing Tasmanian grass grub have yet to be fully determined. Those affected will need to decide on control options to avoid the losses in productivity associated with the exceptionally high initial larval densities in early autumn, damage from which will become apparent in late autumn and winter.

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