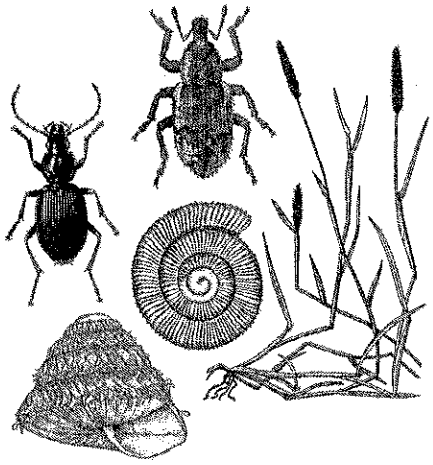
Strategies for maximising pasture establishment in the presence of grass grub, black beetle and porina: Key points to consider in formulating recommendations and advice on establishment of pasture cultivars

Report prepared for Cropmark Seeds Ltd

by Gary M. Barker



G. M. Barker & Research Associates

The Invertebrate Biodiversity Specialists
Working in production agriculture and its interface with biodiversity conservation

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Report. No. 145 September 2014

Overview

High population densities of grass grub, black beetle and porina can lead to failures in pasture establishment. Generally, resistance in seedling ryegrasses is not conferred by endophyte infection (as for example in Barrier U2) as there may be a significant window during which minimal protection is available, due to a lag in endophyte growth and alkaloid production following seedling emergence. What is more, protection afforded by endophytes is not absolute, and insects will attack seedlings and young plants, especially where food is limiting under conditions of high pest densities.

Options for managing this exposure risk in seedling grasses and legumes are twofold:
(i) Reduce pest numbers prior to sowing

This can be achieved by:

a) soil cultivation
b) insecticide application either prior to sowing or with the seed at sowing
c) mob stocking when vulnerable insect stages are at or near the soil surface

(ii) Protection of the seedlings

This can be achieved primarily through the use of insecticidal seed treatment. Pest numbers may be reduced but the primary goal is to afford protection over the vulnerable seedling stage.

Cultivation is highly effective in reducing population densities of soft-bodied macro-invertebrates inclusive of grass grub larvae and pupae, black beetle larvae and pupae, and porina caterpillars.
Cultivation does, however, also have the effect of reducing the inoculum levels of key entopathogenic pathogens (bacteria, viruses, fungi, protozoa) in the soil – both through desiccation of free-living stages of these microorganisms and, more importantly, reduction of insect hosts that are essential to pathogen persistence and transmission. This reduction in entopathogenic pathogen inoculum levels can lead to disruption of natural population regulatory processes and in turn lead to resurgence of pest numbers in subsequent years. This phenomenon is best known for grass grub, but the same principals apply for many soil-dwelling pests. Cultivation may thus enable new pastures to establish but the re-emergence of high pest numbers in succeeding years may lead to significance losses in the agronomic performance of the sown cultivars unless additional pest management strategies are put in place.
Direct drilling is often preferred to cultivation as it allows for more rapid transition from old to new pasture, is less disruptive of soil structure and beneficial organisms, and typically is of lower cost. However, direct drilling (herbicide spraying and drilling) can increase effective pest numbers, as, in the absence of other food, resident insect feeding stages aggregate onto the rows of seedlings.
Over- and under-sowing (i.e. broadcasting or drilling seed, without herbicide suppression or removal of the old pasture) do not increase effective pest numbers, but are of limited agronomic value as establishment of sown cultivars is severely limited by competition from resident plants.

Grass grub

Key points:

- Found throughout New Zealand. Pest in South Waikato southwards to Southland.
- Low number of grubs can lead to poor pasture establishment, unless appropriately managed.
- High numbers of grubs will lead to failed pasture establishment.
- High U2 endophyte in sown seed does not provide protection from grass grub during pasture establishment [alkaloid stores in seed depleted before endophyte begins to growth and produce sufficient lolines].
- Cultivation can greatly reduce grub numbers and allow successful pasture. establishment. Spring cultivation greatly reduces the delicate pupal stage. Repeated autumn surface cultivation can reduce larval numbers.
- Cultivation however disrupts population regulation by natural enemies and will often lead to outbreak numbers in subsequent 2-3 years.
- Direct drilling techniques are often used in grass grub prone areas to maintain more stable diseased populations and damage levels. But be aware that direct drilling (spray and drill) increases effective grub numbers as, in the absence of other food, grubs aggregate onto the rows of seedlings.
- **Action threshold during pasture establishment is about 50-75 grubs/m^2 (2-3 grubs/spade square)** if economic losses are to be avoided. [Action thresholds are at time of autumn sowing. Grub densities should be determined after all ground preparation work is complete].
- If establishing a new pasture into a paddock with grass grub densities at or above the action threshold, use of an insecticide or an appropriate seed treatment (Superstrike; Agricote; Gaucho; Poncho) is highly recommended.
- Seed treatments may not be effective at very high grub numbers, and the use of granular insecticides is likely the better option – Counter, Diazinon 20G, Gesapon, suSCon Green applied to the root zone.
- For ongoing persistence, sow grass cultivar with the appropriate endophyte.
- Grass grub primarily feed in the autumn, but control may be required for spring sowings in areas where grass grub has a two-year cycle.

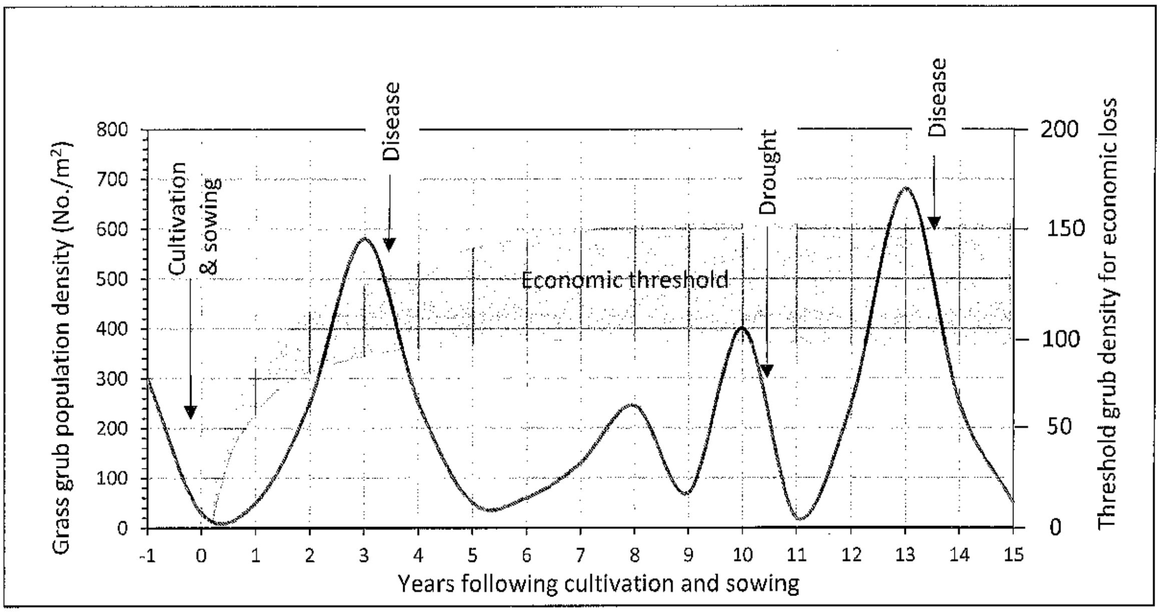

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Figure 1. Cycling pattern of grass grubs in permanent pasture in the years following cultivation and pasture establishment. Population density of grass grub is generally regulated by density dependent processes, especially development of disease outbreaks that are initiated as populations reach high levels. Perturbations to the pasture system, such as cultivation or drought, greatly reduces numbers of grass grub and pathogenic microorganisms in the soil. This perturbation can release grass grub populations from density dependent control by pathogens, and grub numbers build over a number of years, until pathogen numbers rebuild and disease outbreak occurs, or a further perturbation occurs.

Disease is more prevalent in high grass grub populations because (i) the pathogen has had time to build up inoculum levels in the soil, (ii) grubs are under stress because of competition for food, (iii) at high densities grubs are more likely to be involved in 'combat' with contact and injuries leading to increased transmission of pathogens.

Economic thresholds – grass grub densities at which economic losses in the pasture occur – vary with time following cultivation and pasture establishment. Initially, seedlings of the newly sown pasture are highly susceptible to feeding damage by grass grub larvae and accordingly the economic threshold is low. As the pasture plants become more established, the economic threshold increases and then becomes more-or-less stable. Because of differences in farm enterprise type, soil types, sown pasture species, pasture management, and presence of other pests, economic thresholds vary greatly among paddocks within a region. And economic thresholds vary between regions due to differences in climate.

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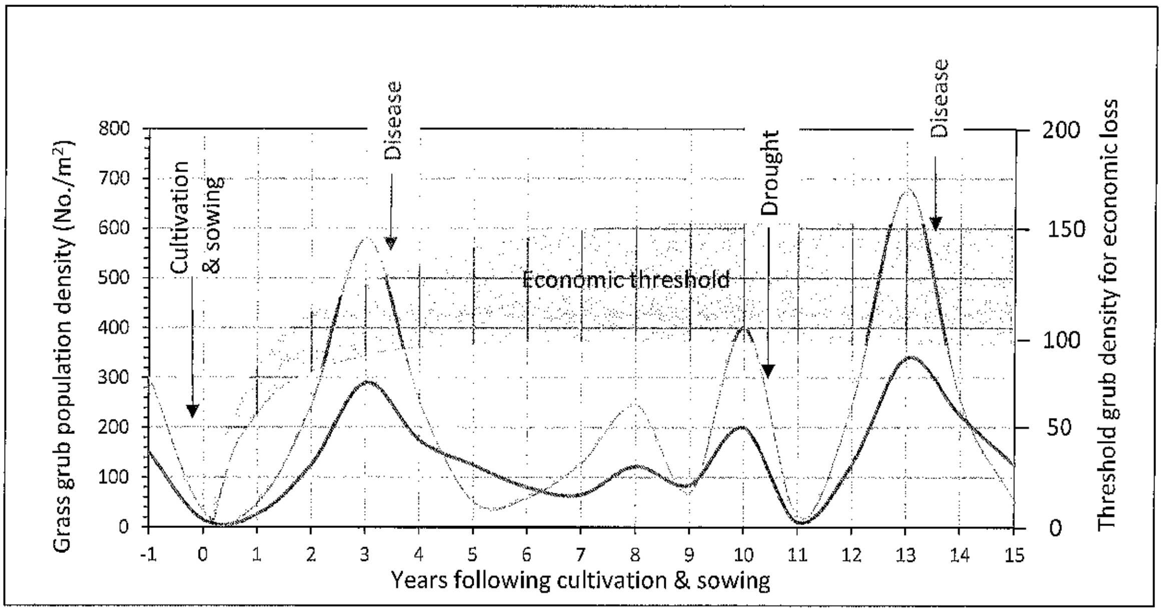

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Figure 2. Possible scenario under pastures sown to Barrier U2. Grass grub population fluctuations may be dampened due to feeding deterrence of lolines from *Epichloë uncinata* endophyte (cf Figure 1). Following sowing into cultivated paddocks, grass grub population increases may not reach economic thresholds. The role of disease as a regulatory factor may become secondary to plant resistance, although the stress in underfed grubs may allow disease to operate at low grub densities.

This scenario needs verification with field trials.

Porina

Key points:

- A species complex, with members found throughout NZ. Pest in Wairarapa, Canterbury, Otago/Southland, Westland, and occasionally in other areas such as Taupo.
- Porina caterpillars damage pasture from late autumn through winter.
- **Action threshold during pasture establishment is about 20-40 caterpillars/m^2** if economic losses are to be avoided.
- Porina can be relatively easily controlled by insecticides. Insect growth regulators should be applied late January-early March; organo-phosphate and synthetic pyrethroids later. If possible apply insecticide to a short pasture.
- Mob stocking in summer can give porina control. Intensively graze pasture to 2-3 cm using high stocking rates (1000 ewes/ha or equivalent) over a few days.
- Cultivation in autumn can effectively control porina by killing the caterpillars.
- For ongoing pasture persistence, sow grass cultivar with the appropriate endophyte.
- While pathogens (especially viruses) have a role in natural regulation of populations, there is only limited evidence for disruption of this regulation by cultivation.

Black beetle

Key points:

- Black beetle is a pest of pastures on free draining soils in the upper North Island.
- Numbers vary widely from year to year, and outbreaks are generally associated with warmer than average conditions, especially in the preceding winters.
- The root feeding larvae are capable of causing severe pasture damage in summer.
- Adults require high carbohydrate stores in their preferred food – grass roots, stolons and rhizomes – to achieve high body fat necessary for high over-wintering survival and spring egg production.
- Adults can rapidly re-infest new pastures by movement from neighbouring pastures. Paspalum, Kikuyu and *Poa annua* are a good food sources for black beetle adults and the presence of these grasses in adjacent areas can indicate a high risk of re-infestation.
- Adult black beetle can decimate new grass sowings in autumn, and seed treatment is recommended (Superstrike; Agricote; Gaucho; Poncho).
- U2 endophyte infection in sown Barrier seed does not provide protection from black beetle during pasture establishment [alkaloid stores in seed depleted before endophyte begins to growth and produce sufficient lolines]
- Break crops, such as brassicas, chicory or maize, can reduce damage potential in pastures. These crops should be maintained free of grass weeds which can support black beetle.
- Monitor black beetle populations from early February. It's important to know numbers before sowing plans are finalised. The action threshold is >15-20/m^2 adult + larvae.
- Cultivate if beetle populations are high. Cultivation significantly reduces numbers by damaging adult beetles and larvae.
- For ongoing persistence, sow grass cultivar with the appropriate endophyte. AR1 is not recommended.
- At present no granular insecticides are available for broadacre control of black beetle.
- While pathogens (especially protozoans) have a role in natural regulation of populations, there is only limited evidence for disruption of this regulation by cultivation.

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