The Programmed Approach™ to pasture renewal and cropping

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Abstract
Including forage cropping as part of the pasture renewal process can be beneficial; however, too often farmers achieve unsatisfactory results in terms of both crop yield and the re-establishment of new perennial pasture. To be successful with this approach the farmer needs to have a wide range of information on pest and weed control and cropping techniques. This information is vital for the long-term success of a regrassing programme and is taken for granted by those that know, but is often hard for farmers to access. The Programmed Approach™ to pasture renewal incorporating cropping is a package of information that has been gathered together from both field practitioners and scientists to address this need. This information package outlines the important issues that contribute to successful regrassing programmes that are currently being tested on-farm.
Keywords: pasture renewal, cropping, glyphosate, perennial weeds, endophyte, clover establishment

Introduction
Pastures deteriorate as they age. Drought, flooding and poor drainage, disease, pest attack (often resulting from incorrect endophyte selection), lack of adequate soil fertility, pugging, over-grazing and other poor grazing management techniques, all contribute to a decline in the vigour and persistence of sown species. Invasion by less productive grass species and broadleaf weeds must then be combated by regular pasture renewal if farm productivity is to be maintained or improved over time.

The economic benefits of pasture renewal are well documented (Fraser *et al.* 1999; Webby 2004). These benefits arise not only from growing more dry matter per hectare from the new pastures but also from improved forage quality (Woodfield 1999). Examples of improvements in modern cultivars include increased stolon density and nitrogen (N) fixation capacity in white clover and selected (novel) fungal endophytes (e.g. AR1, AR37 and NEA2) in perennial ryegrass that provide insect protection while reducing or eliminating animal health issues (Fletcher 1999), and improved milk production over the wild-type (Standard) endophyte (Bluett *et al.* 2003). Cropping has been introduced into the pasture renewal programme because it provides the opportunity to control perennial weeds and also breaks pest cycles.

Despite the benefits to be gained from pasture renewal, around 50% of New Zealand farmers renew less than 2% of their pastures each year (C. B. Glassey pers. comm.) or do no pasture renewal. While pasture renewal has increased in recent years, many farmers still remain hesitant to engage in the process due to the perceived high risk of failure. Our experience is that some start, but don't continue due to failures resulting from poor advice, lack of knowledge and the taking of short-cuts to reduce time or cost.

The Programmed Approach™ packages current knowledge on pasture renewal and cropping into a programme so farmers can increase their success rate and presumably overall farm productivity and profitability. This programme has been developed in the Waikato and Northland by scientists and experienced field practitioners for use wherever perennial weeds and pasture pests are a problem. It is a pasture renewal programme aimed at ensuring good establishment, productivity and longevity of new perennial pastures.

Benefits and key steps
The Programmed Approach™ begins at least one year before the intended sowing date for the new perennial pasture and involves the following key steps:

Forward planning
Too often the paddock to be renewed is only identified as the contractor arrives. This is far from satisfactory. It is necessary to select the area to be renewed early (say by Christmas), carry out soil tests and apply capital fertiliser and/or lime if required. Pastures should be managed to optimise growth for autumn spray-out. For example, mulch kikuyu swards 3-4 weeks before spray-out to break up stolons and promote new growth, or in the case of browntop dominant swards, reduce seeding by using "Roundup topping".

Multiple glyphosate sprays
A common reason for farmer dissatisfaction with new pasture performance is the rapid reinvasion of the original pasture weeds. Three glyphosate herbicide

sprays (two in succeeding autumns, one in the spring in between) over 12 months should provide excellent control of hard to kill perennial weeds such as couch (*Agropyron repens*), Californian thistle (*Cirsium arvense*), kikuyu (*Pennisetum clandestinum*), Mercer grass (*Paspalum distichum*), Indian doab (*Cynodon dactylon*), browntop (*Agrostis capillaris*) and paspalum (*Paspalum dilatatum*). By starting with the first glyphosate spray in autumn, followed by a second spray in spring (before the summer crop) and the third the next autumn, superior control can be achieved. Rhizomatous and stoloniferous plants (e.g. paspalum and kikuyu) with dormant buds or plants initially covered by dung patches will be controlled by the second and third applications of glyphosate. Another benefit of multiple glyphosate sprays is the ability to control perennial weed reinvasion from seed in the soil seed bank, including ryegrass containing wild-type endophyte. These plants are killed before they seed. This is essential when the goal is to introduce new grass with a novel endophyte or to stop reinvasion of prolific seeding weed grasses into the new pastures.

The first autumn (February/March) application should be a high rate of glyphosate (typically, Roundup TRANSORB® at 4L/ha or G360 glyphosate at 6L/ha) to kill old pasture and a companion herbicide (clopyralid, or tribenuron-methyl) to kill the clovers. Pastures should be sprayed first then grazed three or more days following spraying. Removing clovers in the old pasture and growing non-host crops for 12 months combats nematodes (e.g. clover cyst nematode (*Heterodera trifolii*) and the root-knot nematodes *Meloidogyne hapla* and *M. trifoliophila*) and clover root weevil (*Sitona lepidus*). These pests reduce clover establishment, production, persistence and N fixation. Growing non-host crops such as brassicas, cereals, chicory, maize or ryegrass reduces clover nematode populations (Watson & Mercer 2000) and eliminates clover root weevil from the paddock (P.J. Addison unpublished data). This ensures the vigorous establishment of clovers in new pastures and likely clover dominance for several years (Gerard *et al.* 2009, this volume). Herbage dissections showed 40-50% clover at 18 months after sowing in the ex-maize and ex-turnip paddocks compared to 10-15% where grass/clover was sown after old pasture (Fig. 1). Increased clover content in pastures has been shown to improve animal liveweight gains and milk production (Harris *et al*. 1997).

Slug populations should be assessed (particularly in no-tillage renewal systems) before sowing by placing 6-10 objects (wet sacks, frisbees, boards, half-round posts, etc.) randomly in the paddock for several nights, then check for the presence of slugs. If, on average, 2-3 or more slugs per object are found, then broadcast slug baits before or at sowing.

Winter active crop (annual or Italian ryegrass, cereal)
Sow the winter crop soon after autumn spray-out and always use treated seed to combat pests such as Argentine stem weevil (*Listronotus bonariensis*), black beetle (*Heteronychus arator*) adults and grass grub (*Costelytra zealandica*) which can greatly reduce seedling establishment. Apply N fertiliser to address immobilisation due to the "locking up" of N in organisms that break down the sprayed vegetation. Recent observations indicate that drilling 30-40 kg phosphate/ha with the seed may be just as important as post-emergence N. This is yet to be proven in replicated field trials. In preparation for the summer crop, glyphosate plus organosilicone penetrant should be applied with an insecticide in the mix if brassicas (for springtail control) or cereals (Argentine stem weevil adult control) are to be sown. The autumn-sown ryegrass or cereal can be cut for silage or grazed from 3 days after spraying in spring (observe any insecticide withholding period).

Sow summer crop (brassicas, cereals, chicory or maize)
Assess slug numbers (see above) and apply baits if required before sowing treated seed. Apply sufficient fertiliser (including side-dressing with N) to maximise crop yields without mining soil fertility levels. Best practice agronomic recommendations for brassica cropping were generated during the development of the Programmed Approach™, leading to turnip yield expectations of 12 t DM/ha or more (Eerens & Lane 2004).

Control in-crop weeds and pests
Control of grass weeds (including perennial ryegrass containing wild-type endophyte), broadleaf weeds and pests will help maximise crop yields. As well, controlling the weeds will ensure that seeding does not occur thereby reducing the potential for weeds in the new pasture.

Autumn clean-up spray after the summer crop
Following crop harvest or grazing leave the paddock for 2-3 weeks so any remaining perennial weeds can grow sufficient leaf and for volunteer seeds to germinate and seedlings to emerge. Spray with glyphosate for the third and final time. This is the last opportunity to control any remaining perennial weeds, particularly grass weeds that cannot be selectively controlled in the new pasture.

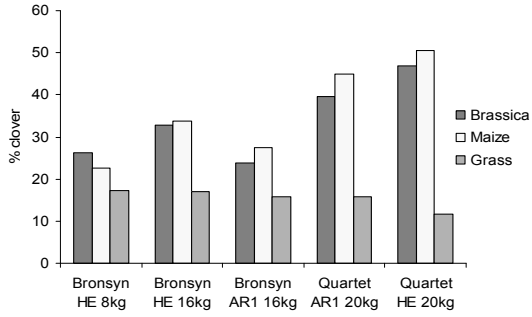
Sow new perennial pasture
Always use insecticide treated seed. Select ryegrass seed with an appropriate endophyte for the pest pressures expected, and ensure endophyte survival in stored seed has been proven with a recent test by checking the purity and germination certificate. This is as important

Table 1 Kikuyu reinvasion (SFF/KAG Project).

	Treatment	No. of sprays	Season of spray*	Peak % kikuyu in late summer / autumn		
				2005	2006	2007
1	Kikuyu pasture	0	-	91	88	88
2	Flat, perennial ryegrass sown	1	A	13	77	(80-90)**
3	Flat, perennial ryegrass sown	2	S, A	7	43	(80-90)
4	Flat, perennial ryegrass sown	3	A,S,A	0	8	0
5	Hill, perennial ryegrass sown	3	A,S,A	0	2	9
6	Hill, tall fescue sown	3	A,S,A	0	17	40

* Season of spray: A = Autumn; S =Spring; ** Assumed, based on visual assessment

Figure 1 Clover establishment after cropping (MAF SFF Project 05/085). HE 8 kg = Bronsyn perennial ryegrass sown at 8 kg/ha etc .



as checking the seed viability (germination percentage). Address any remaining soil fertility or pH issues. Assess slug numbers before sowing and apply baits if required. Graze the new pasture early to promote tillering and encourage clover growth and control newly germinated weeds with appropriate herbicides.

Apply fertiliser to new pasture

Newly sown clovers do not fix N for up to 12 months following sowing. It is therefore critical to apply 150-200 kg N/ha in the first year to overcome this nutrient shortfall. New pasture will be more productive than old pasture and will therefore require higher maintenance fertiliser inputs, usually 1.5–2 times higher. If cultivation has occurred during the program, Olsen P levels will be reduced due to burying of the topsoil.

The Programmed Approach™ has been used to develop pastures on a number of farms. Two examples are given below:

1. Bruce and Julie Paton, Mata, Whangarei

The Programmed Approach™ was utilised to renew the pastures of a recently purchased 100 ha farm, the Leaver Block, adjacent to the home farm that was dominated by kikuyu and produced about 450 kg milksolids/ha in the first year of Paton ownership. After developing 25% of the farm in each of 4 years using the Programmed Approach™, production had increased to over 1000 kg milksolids/ha.

To gather supporting pasture data a number of paddocks were given different treatments and monitored for kikuyu reinvasion over the first 3 years of renewal. There were four assessment cages in each paddock. The treatments included one (autumn), two (spring and autumn) or three sprays (autumn, spring, autumn) of glyphosate. The effectiveness of perennial ryegrass versus tall fescue-based pastures for slowing kikuyu reinvasion was examined as was any differences between the flat, low lying silt loams and the hilly clay soils (Table 1). Results demonstrate that pasture development programs with only one autumn spray or one spring spray followed by a second autumn spray, failed to adequately control kikuyu. The three-spray program, including two autumn sprays, resulted in superior long-term kikuyu control. From experience (P.S.M. Lane unpublished data) control of perennial weeds such as couch, Californian thistle, Mercer grass, Indian doab, browntop and paspalum is also improved by multiple autumn sprays of glyphosate.

2. Phil and Deb Swney, Te Kawa Cross roads, Te Awamutu

A large-scale pasture development program was initiated in February 2006 on a 95 ha dairy farm near Te Awamutu, using the Programmed Approach™. The whole program was carried out without cultivation, using no-tillage techniques. Combinations of Italian ryegrass and turnips have been used before new perennial ryegrass pasture was sown on 10% of the farm, and on a similar area combinations of hybrid ryegrass and chicory have been used spanning two winters before a summer crop and new pasture. Pasture

monitoring is being carried out by DairyNZ. Although the farmer had limited previous experience of forage cropping and no-tillage he was easily able to adopt the cropping and renewal programme with appropriate information and planning.

Summary

The Programmed Approach™ to pasture renewal and cropping contains information that has been known in various sectors of the agricultural community for some time. However, this information has often not been widely known by the farmer/practitioner. The Programmed Approach™ is the result of simply bringing pertinent information together into one easily understood package and making it available to the agricultural community. For the Programmed Approach™ to make an appreciable difference to on-farm feed supply, 8-12% of the farm needs to be renewed each year.

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