A field comparison of strategies for the control of Chilean needle grass in Hawke's Bay

M.W.A. SLAY[1], G.O. EYLES[2] and S.K. BENNIE[3]
[1]AgResearch Poukawa, PO Box 8144, Havelock North
[2]Hawke's Bay Regional Council, P O Box 6006, Napier
[3]Hawke's Bay Regional Council, Waipukurau

Abstract

Management strategies to control Chilean needle grass comprised two re-grassing regimes using the competitive pasture species cocksfoot, combined with lax grazing using sheep or young cattle, no attempted management, and forestry. The presence of Chilean needle grass and cocksfoot densities were assessed by examining 50 mm turf cores taken annually from 1994, and from the forestry site since 1997. There was a strong inverse relationship between Chilean needle grass frequency of occurrence and the sown cocksfoot density. The establishment of cocksfoot and its promotion by lax grazing reduced the frequency of occurrence of Chilean needle grass from 60% in October 1994 to 9% in 1998. Although cocksfoot suppressed Chilean needle grass, eradication appears unlikely or at least a long-time process. In the young pine plantation, Chilean needle grass grew unchecked with 24 and 27% of the cores containing Chilean needle grass in 1997 and 1998 respectively. Under forestry the Chilean needle grass seed bank is likely to develop until canopy closure.

Keywords: Chilean needle grass, cocksfoot, *Dactylis glomerata,* forestry, grazing, *Pinus radiata, Stipa neesiana,* weed control

Introduction

Chilean needle grass (*Stipa neesiana* Trin. & Rupr.) is a perennial tussock-forming grass native to South America, but a plant pest in Hawke's Bay. The grass is one of the most undesirable escapees to contaminate New Zealand pastures and thrives on steep northerly/ north-easterly faces as well as on easy rolling country. Seeds can penetrate through the skin into body muscle resulting in abscesses and downgrading of carcasses (Bourdot & Hurrell 1989). Chilean needle grass was introduced to the Waipawa area, as in other Hawke's Bay areas, approximately 30 years ago via contaminated pasture seed originating from Marlborough. Localised outbreaks are being regularly identified in Hawke's Bay (S.K. Bennie, unpublished data). At Waipawa, about 60 ha of mainly north-easterly facing, steep country are infested. The steep aspects of this area hinder the control of the grass. Once established it is persistent and tenacious. Infestations at the trial sites consisted of numerous dense clumps, some of which had merged to form a continuous sward restricting the growth of other species.

Control of Chilean needle grass seeding using the systemic herbicide 2,2-DPA was commenced in 1988 by the "Noxious Plants Council" (subsequently incorporated into the Hawke's Bay Regional Council). In 1990, resistance to 2,2-DPA was identified at Waipawa (Hartley 1994) necessitating the development of alternative control strategies. In addition, repeated applications of 2,2-DPA detrimentally affected the presence of naturally occurring grasses (local farmers and S.K. Bennie, unpublished data). A series of droughts in Hawke's Bay contributed to the general demise of the pasture at the Waipawa infestation site, which is now, predominantly Chilean needle grass. A proposal developed by AgResearch for the Hawke's Bay Regional Council outlined a programme to prevent regeneration of Chilean needle grass at Waipawa through the introduction of cocksfoot (*Dactylis glomerata*), a competitive pasture species that is adapted to dry environments (Bourdot & Hurrell 1989). This current work included an untreated control area to enable the success or failure of the pasture management strategy and afforestation option to be monitored. The programme began in December 1994. In 1997, a 1-year-old plantation of *Pinus radiata* in the same locality was added to the investigation. The plantation was planted on a steep north-easterly slope infested with Chilean needle grass. This paper reports the results of the programme to date.

Methods

The management systems instigated in October 1994 were:

- Site 1: *Direct drilling and lax grazing*. The existing sward was treated with glyphosate (Roundup) at 1.4 kg ai/ha in November 1994 and at 1 kg ai/ha before drilling. Cocksfoot (Grasslands Wana) seed was direct-drilled into the site at 18 kg/ha on 31 March 1995. Grazing began once the pasture was 10 cm high. Subsequent grazing using sheep or young cattle aimed to maintain the sward height at 8–10 cms.

- Site 2: *Cultivation and lax grazing*. The site was sprayed with glyphosate as in Site 1 and received shallow 5 cm cultivation using a rotary hoe in autumn 1995. Cocksfoot (Grasslands Wana) was roller drilled and harrowed in and re-rolled on 29 March 1995. Grazing began once the pasture was 10 cm high. Subsequent grazing using sheep aimed to maintain the sward height at 8–10 cm. At this site, which is on tractor traversible country, the seedheads of needle grass were mown in spring 1996, 1997 and 1998.
- Site 3: *Control*. No control of Chilean needle grass was attempted. The site was open to grazing by sheep and cattle with no restriction on grazing practice.
- Site 4: *Forestry option*. Trees (*Pinus radiata)* GF 17 were planted at 3 × 3 m spacing in June 1996. Grass was left to grow uncontrolled.

Physical, historical and cultural details of each of the four sites are summarised in Table 1.

The soil type at three of the sites is Waipawa silt loam a soil which has a moderate natural fertility. It is a fairly shallow soil, which dries out in summer and is prone to sheet erosion when wet. The Matapiro sandy loam at Site 2 is associated with rolling hills. The soils have good natural fertility and are prone to drying out in summer. Drainage is slow on most of the soils and impeded by the variable density of the subsoil. At Sites 1 and 2, up to 50 kg nitrogen was applied as urea or ammonium sulphate annually in spring and autumn. At Site 3, 225 kg/ha superphosphate was applied annually.

Pasture composition monitoring

Pasture composition was monitored at all sites by taking 25 50 mm diameter turf cores from each of four areas at each site (100 cores per site) annually in June. The same areas were sampled on each occasion. The numbers of cores containing needle grass, cocksfoot other grasses legumes and weeds were counted. Results are expressed as the percentage of cores containing each species. Numbers of Chilean needle grass seeds on the top surface of the cores were recorded along with the presence of decayed cocksfoot (cocksfoot mat). At Sites 1, 3 and 4, each of the sampling areas was approximately similar in size with an even distribution of Chilean needle grass. At Site 2, the Chilean needle grass infestation consisted of a central locus with a reducing infestation radiating from this. This difference necessitated a weighted sample calculation to account for the different sized areas. The number of cores taken in 1998 was doubled to 50 in each of the four areas (200 per site) at Sites 1 and 2 to compensate for reducing levels of Chilean needle grass. Identification of grasses was made using a microscope (×25).

Results

The proportion of samples containing Chilean needle grass showed a general decline at Sites 1 and 2 where cocksfoot was sown and lax grazing imposed, but consistently high levels were maintained at Site 3, the untreated control site (Figure 1). At Site 4 (forestry) levels remain high (Figure 1) but this treatment has only been in place for 2 years. A decline at sites 1, 3 and 4 was also evident between 1997 and 1998, with the percentage of cores containing Chilean needle grass decreasing marginally. The exception was site 2 that has been mown in spring to control needle grass seed-heads. Here, needle grass increased from 10% to 18%, due mainly to a large increase in Chilean needle grass in the central locus. No needle grass or cocksfoot seedlings were found in the Site 2 cores. In comparison, Site 1 was laxly grazed in spring and cocksfoot and Chilean needle grass was allowed to run to seed. When sampled in June 1998, 28% of cores contained cocksfoot seedlings and 7% of the cores contained needle grass seedlings.

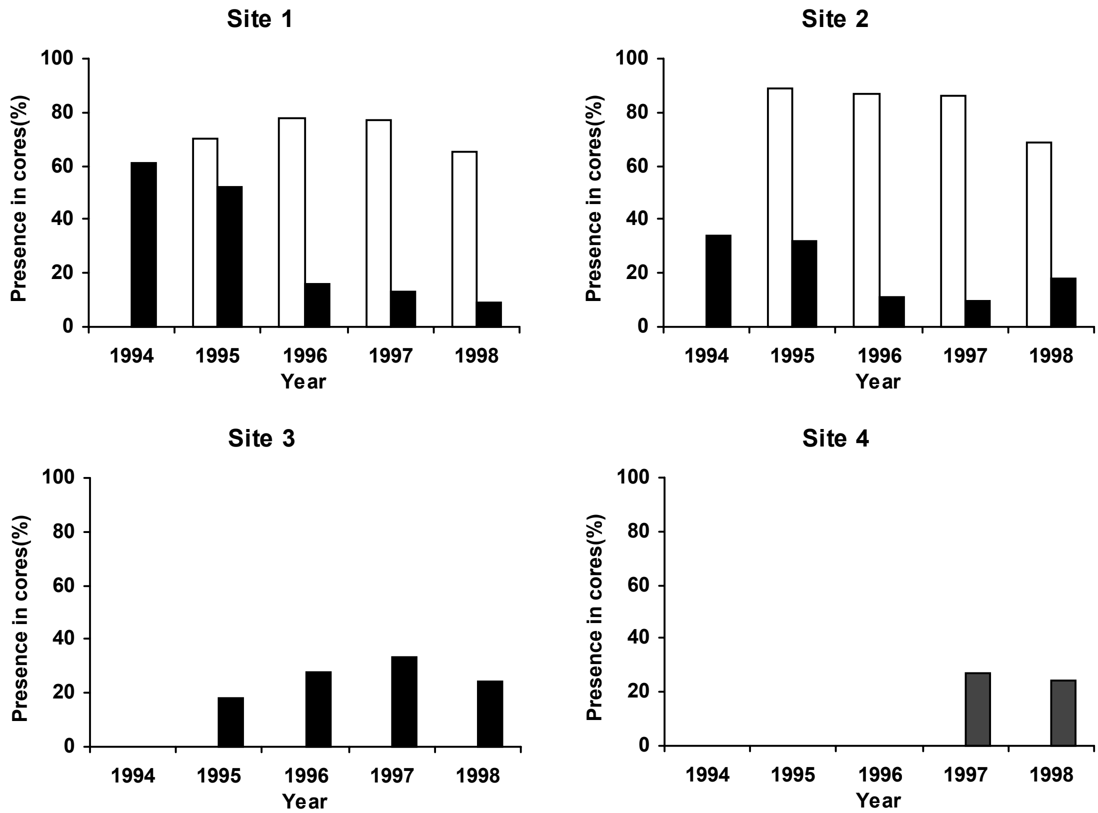
Effects of cocksfoot

Concurrent with the general decline in Chilean needle grass, at Sites 1 and 2 there was a successful maintenance of cocksfoot cover (Figure 1) in most areas of each of the two sites. Though the establishment of cocksfoot at Site 2 was superior to Site 1 following sowing in 1995 (89% vs. 70% presence of cocksfoot respectively), the cocksfoot has apparently declined substantially from 89% in 1995 to 69% in 1998. Furthermore, cocksfoot in

Table 1 Details of the four Waipawa Chilean needle grass sites.

Site	1	2	3	4
Area (m^2)	7000	3500	4000	8000
History	Permanent pasture	Permanent pasture	Permanent pasture	Permanent pasture
Soil Type	Waipawa silt loam	Matapiro sandy loam	Waipawa silt loam	Waipawa silt loam
Aspect	North	North	North	North
Topography	Steep	Easy rolling	Very steep	Steep

Figure 1 Percentage of turf cores with Chilean needle grass (black bars) and cocksfoot (white bars) at sites 1–4 from 1994 to1998.

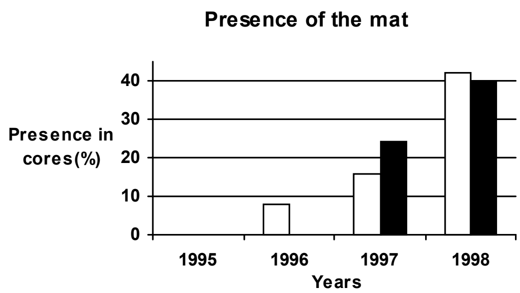


the central locus area of Site 2 has declined from 84% presence in 1997 to 58% in 1998. At site 1, the level declined from 70% in 1995 to 65% in 1998. Cocksfoot also contributed a significant amount of dead plant matter to the base of the sward (cocksfoot mat) (Figure 2).

Effects of forestry

The turf cores averaged 26% presence of Chilean needle grass with 48% of turf cores being bare ground in the 2 years of monitoring. Chilean needle grass was growing to 90 cm. Counts of Chilean needle grass seed on the soil surface on 22 June 1988 averaged 1350 seeds/m^2. The pine trees averaged 1 m in height.

Figure 2 Development of the cocksfoot mat at Site 1 (white bars) and Site 2 (black bars) between 1995 and 1998.



Discussion

The project has demonstrated that the management system of cocksfoot establishment and promotion associated with lax grazing reduced the frequency of occurrence of Chilean needle grass populations at two Waipawa sites.

The sown cocksfoot and lax grazing regimes undertaken contributed to better control of Chilean needle grass. Paradoxically, lax grazing and mowing at Site 2 to control Chilean needle grass seedheads opened up the pasture resulting in an increase of needle grass cover. The management systems used appear to have had important effects at Sites 1 and 2. At Site 1, the management system favoured cocksfoot and needle grass re-seeding, but that used at Site 2 did not. Mowing to remove seedheads provided summer grazing for sheep that would not have been available if the seedheads were present as at Site 1. At Site 1, cocksfoot provided a bank of winter feed that was break fed to control the grazing pressure.

Chilean needle grass occurrence at Site 1 most probably declined because the lax grazing and often rank cover of cocksfoot inhibited the Chilean needle grass at this site. The grazing management at Sites 1 and 2 aimed to encourage a high percentage of cover to shade and inhibit Chilean needle grass. As a result, a high level of dead matter built up in the pasture base (Figure 2). The development of the cocksfoot mat has had apparently, a secondary effect on the control of Chilean needle grass. At Sites 1 and 2, the mat increased between 1997 and 1998 as a result of high levels of decayed cocksfoot caused by the drought and lax grazing. Although the mat is reducing the pasture value for animal production, it probably reduced Chilean needle grass seed germination, though shed seed trapped within the mat was seen to germinate when it was moist.

Perhaps the reason for the decline in cocksfoot density at Site 2 was due in part to the interplant competition within the high initial population of cocksfoot seedlings observed following roller drilling in autumn 1995. This dense population of seedlings probably resulted in the formation of weaker root systems in comparison to the direct drilling where cocksfoot was in rows (Site 1). Additionally, the extreme drought experienced in the 1997/1998 summer may have caused greater stress on the less-developed cocksfoot plants thus reducing their ability to compete with Chilean needle grass.

At the 1998 assessment, the control site (Site 3) had 24% presence of Chilean needle grass, a level relatively unchanged during the study. The level of infestation was higher than at Sites 1 and 2, indicating the value of the management strategies. In the forestry block, needle grass has grown unchecked for 3 years. The plants were robust and formed a complete canopy. While it is too early to see any trends in the control of needle grass under forestry, a feature of this early period of management is the very high load of seed that will be shed over the next 4–5 years. In 1998, higher levels of seed were observed on the turf cores at this site than other sites. It is anticipated that shading from the trees will commence at year 6 with total canopy cover at year 12. This option overcomes the deleterious animal health affects, at least in the short term, by removing stock from the system.

By establishing cocksfoot into Chilean needle grass infested pasture, suppression of the weed has been achieved, but eradication is unlikely given the variable nature of the terrain (e.g., dry knobs), and the high levels of buried seed, which can lead to re-infestation. These results suggest the control of Chilean needle grass might be achieved through strategic management involving the use of competitive pasture species supporting the conclusions of Bourdot & Hurrell (1989). However, management regimes that combine animal production from pasture grasses with needle grass suppression are further areas for applied research.

ACKNOWLEDGEMENTS

The authors are indebted to the Hawke's Bay Regional Council who funded the project and the many people who have made significant contributions, especially the farmers on whose properties the work was conducted, Rachel and the late John Hornblow, Jackie Berrigan, Richard Brown and Alan Gray. Thanks go also to Danny Smith, Chris Korte (now of the Victorian Institute of Dryland Agriculture) for technical advice and to Mark Fisher of AgResearch Poukawa for assistance with compiling this paper.

REFERENCES

Bourdot, G.W.; Hurrell, G.A. 1989. Ingress of *Stipa neesiana* Trin. & Rupr. into swards of *Lolium perenne* L., *Dactylus glomerata* L. and *Phalaris aquatica* L., on a dry, low fertility soil in Marlborough as affected by fertiliser and 2,2-DPA. *New Zealand journal of agricultural science 32*: 317–326.

Hartley, M.J. 1994. Dalapon resistant individuals in a susceptible population of Chilean needle grass. *Proceedings New Zealand Plant Protection conference 47*: 75–79.

Hawke's Bay Regional Council. 1996. Regional plant pest management strategy. 77pp.

■