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COSTS OF SOME WEEDS OF DAIRY PASTURE AND THEIR CONTROL

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Abstract

Scotch thistle and ragwort are weeds of dairy pastures and are commonly controlled with broadcast herbicides. Information on the growth habits of populations of these weeds was used to estimate seasonal pasture shading and recovery of populations following herbicide application. These data were then integrated by a computer model to provide estimates of the effects of the weeds on milkfat production The economics of using broadcast herbicides for controlling these weeds could then be calculated, taking into account possible harmful effects of some herbicides on pasture clover content. Assuming that lost pasture production is directly proportional to the area covered by weeds, control of Scotch thistle is economic when populations reach one flowering plant per $6m^2$, using MCPB for control in spring. Ragwort is also economic to control but, because its control is difficult with pasture-selective herbicides, much higher populations can be tolerated In this work, no account is taken of the poisonous nature of ragwort.

Keywords: Scotch thistle, ragwort, MCPB, 2,4-D. weed economics, dairy production, *Cirsium vulgare, Senecio jacobaea,* dairy model.

INTRODUCTION

In 1984, New Zealand farmers spent about $8 million on pasture herbicides. In spite of this, there is very little information on the economic returns from pasture herbicide applications, especially in dairying. Hartley and Thomson (1982) have worked on the economic effects of Californian thistle (*Cirsium arvense)* in pastures grazed by dairy replacement stock. The evidence suggests that quite high weed populations could be tolerated before they were worth treating, especially if clover damaging herbicides such as 2,4-D or MCPA were used.

Doyle *et al.* (1984), adopting a modelling approach to the economics of controlling docks (*Rumex* spp.) in pasture, concluded that the discounted long-term benefits of controlling docks with asulam exceeded costs if the docks initially covered more than 5% of the ground. Their conclusions were sensitive to the response of docks to asulam, and to the apparent feeding value of docks.

Our approach uses data on the sizes of individual weeds and of weed populations in different seasons with and without herbicidal control, to model their effects on dairy production. The effects of Scotch thistle (*Cirsium vulgare*) and ragwort (*Senecio jacobaea)* are examined here, but data are available to extend the principles to examining the effects of other pasture weeds.

METHODS

Weed Parameters

First, general premises are that lost pasture production due to weeds is directly proportional to cover of Scotch thistle or ragwort, and that unsprayed weed populations remain constant from year to year, with no fluctuations due to pasture management, pasture growth or climate. Sprayed populations recover as in Fig. 1.

Second, seasonal patterns of thistle cover, and patterns of recovery after spraying shown in Fig. la are based on life cycle information (Forcella and Wood 1986), the assumption that seedling emergence is reduced by 70% in the absence of flowering plants (based on Lee and Hamrick 1983), and on the size distribution of thistles in a paddock near Palmerston North (Popay unpubl. data).

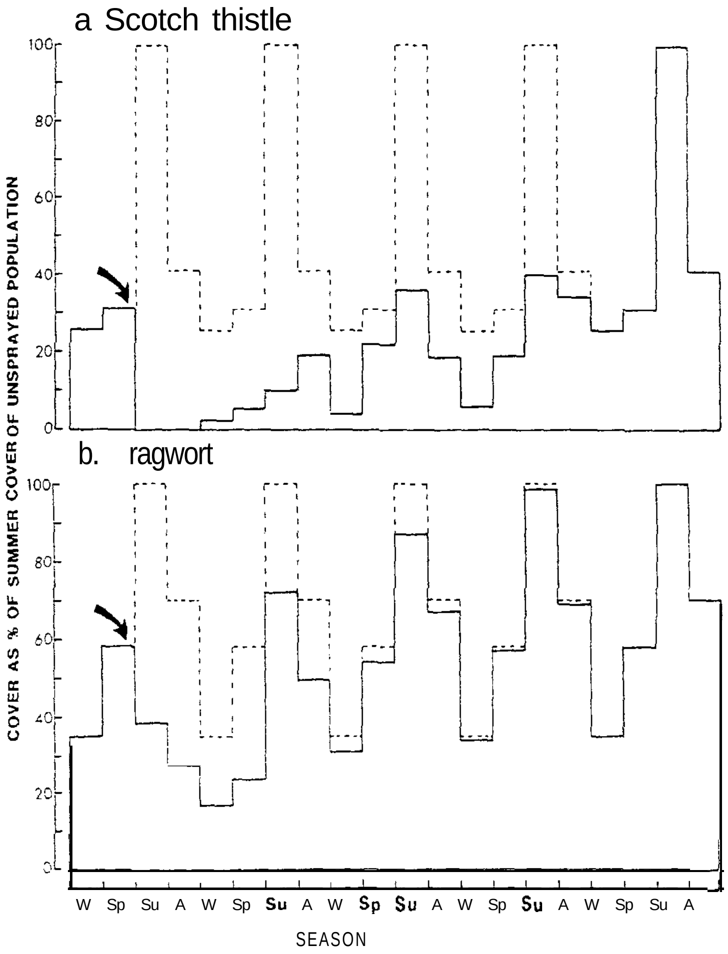

Figure 1: Estimated seasonal patterns of cover of Scotch thistle and ragwort when not sprayed (dotted lines) or after a single spray (solid lines) with MCPB (Scotch thistle) or 2.4-D (ragwort). Arrow shows date of spraying

Scotch thistle, growing in pasture, always acts as a biennial, mostly germinating in the autumn and always flowering and dying in its second summer (Hartley 1983).

MCPB at 1.6 kg ai/ha applied in September-October kills all thistles (Hartley 1983; Popay, unpublished). MCPB causes no damage to clover and therefore has no effect on pasture composition or yield (Meeklah 1958).

Third, seasonal patterns of cover, and recovery after spraying of ragwort shown in Fig. 1 b are based on population studies by Thompson (1985). Ragwort, growing in pasture, is a biennial or short-lived perennial which germinates at most times of the year, with a main peak in autumn and a substantial second peak in spring (Thompson 1985).

A spring application of 2,4-D at 1 .0 kg ai/ha was used. In Thompson's populations, 20% of the rosettes present in spring were large, multicrowned and hard to kill. 2,4-D damages clovers and affects pasture composition and quality for several weeks. *The* amount of clover damage was estimated. Ragwort is assumed not to be grazed by dairy cattle, so that its only effect is to reduce the grazed pasture area.

Economic Assessment

A simulation model of a factory supply dairy herd (Barlow, unpublished) was used to translate seasonal weed cover into revenue losses. Losses were assessed both for stocking rate reductions required to maintain per animal performance, and for reductions in per hectare milkfat if stocking rate is maintained.

The model was first tested using 1985/86 pasture growth rates from the Taranaki Agricultural Research Station and a stocking rate corresponding to one of the farmlet treatments, Realistic patterns were generated for live weights, milk output and standing herbage throughout the year (r^2 = 0.9, 0.9, 0.5 respectively).

The model was then used to simulate 12 years' production, given a repeated seasonal pasture growth pattern characteristic of the station, and with the seasonal losses in pasture cover shown in Fig. la for unsprayed Scotch thistles, adjusted to an annual average of 5%. Using the corresponding cover losses following a spray (Fig. la), the stocking rate was identified which gave the same per cow live weight and milkfat production over four years as in the unsprayed situation. An estimate was also obtained for revenue increase if stocking rate remained constant, The procedure was repeated for a 10% initial Scotch thistle cover, and representative covers of 5%, 10% and 20% for ragwort, distributed between seasons as in Fig. 1 b. In the case of ragwort the effect of the spray was shorter lived and was assessed over two years (Fig 1 b). The effect of clover losses from 2,4-D was mimicked by reducing metabolisable energy (ME) content of spring and summer herbage by 2%. This corresponds to a 40% reduction in a 40% sward clover content, given the different ME values for grass and clover, and the effect of this on energy content and quantity of ingested material translates into liveweight losses in the order of those observed in trials (Hartley and Thomson 1982). In spite of loss of clover and subsequent nitrogen fixation, reduction in total pasture yield is slight and short-lived (Meeklah 1958).

RESULTS

The economic benefits of controlling Scotch thistle or ragwort on any particular property can be estimated from column 5 of Table 1 (total % increase in gross margin), by multiplying by the per hectare gross margin (GM) for that property. Thus, for Scotch thistle, the benefit ($/ha) of controlling a given infestation is approximately 0.016 x % weed cover x GM/ha if stocking rate is raised, and only 75% of this if it is not (Barlow 1985a). For ragwort the benefit is 0.0043 x (% weed cover — 6) x GM/ha again reduced to 75% of this if stocking rate is constant. These results are based on low rather than high covers since this gives better estimates if cover losses are restricted to part of the farm (Barlow 1985b).

The benefits of controlling ragwort were considerably lower than for Scotch thistle, partly because of the incomplete control of multi-crown and large ragwort rosettes, and the consequent rapid recovery of the population (Fig. lb), and partly because of the clover damage by 2,4-D. The latter was estimated to reduce benefits by 2% of the per hectare gross

Table 1' The economic benefits of a single spray on different infestations of Scotch thistle with MCPB and ragwort with 2.4-D. GM gross margin, SR = stocking rate. $ benefits assume GM ha^{-1} = 756 (MAF 1986). Total %GM increase is the annual increase assuming stocking rate is raised, accumulated and discounted at 15% over the period of effectiveness of the spray Figures in brackets are for a ragwort spray causing no clover damage. The constant stocking rate in column 7 is the economic optimum, given the unsprayed weed cover.

Species	% cover unsprayed	% cover sprayed	Annual % increase i" GM/ha	Total discounted % increase in GM/ha	$/ha discounted benefit (SR raised)	$/ha discounted benefit (SR constant)
Scotch thistle	5	1.6	2 6	8.0	60	44
	10	3.2	6 2	19.0	144	61
Ragwort	5	3.2	-0.3 (1.0)	-0.6 (1 7)	— 4 (13)	-7 (10)
	10	6.4	1.0 (2.2)	1.7 (3.8)	13 (29)	10 (24)
	20	12.8	3 7 (5.9)	6.5 (10 2)	49 (77)	36 (48)

margin (comparing figures for ragwort in Table 1 with and without clover damage), or $14-16/ha assuming 1986/87 gross margin of $756/ha. Ragwort, however, is poisonous to stock and a noxious plant. Assuming its only effect is to occupy pasture space, and given control costs of $29/ha for 2,4-D, it is uneconomic to control ragwort until cover reaches about 18%, equivalent to a summer cover of 27% or a population of 2.7 flowering plants/m^2. This is a very high population which few farmers would dare to permit.

The cost of MCPB, including application, is about $47/ha, so the economic threshold for control of Scotch thistle is around 4-6% cover, or 10% summer cover, assuming 1986/87 gross margin/ha. This corresponds to 1 flowering plant and some rosettes in 6m^2, or 1667 flowering thistles/ha. The spring population, at the time the spraying decision is made, would be 1 thistle (>11cm diameter) in 3m^2.

Many farmers use 2,4-D to treat Scotch thistles. Taking lost production from damaged clover as worth $14-16/ha, the threshold for control rises to 5-7% or 14% summer cover, equivalent to 1 flowering plant plus some rosettes in 4m^2, or 2500 flowering thistles/ha.

DISCUSSION

The ragwort population described here had a high proportion of multi-crown plants which are difficult to kill. Other populations with fewer such plants may be more economical to control. The biggest problem with ragwort is knowing whether its poisonous nature actually reduces stock performance under normal grazing. If it does not then our results hold true, but more research is needed to establish this.

Maximum benefits are achieved by raising stocking rate, and are directly related to per hectare gross margin. Benefits if stocking rate is not increased can be close to the maximum but can be very much less, depending on the intensity of management (Barlow 1985a). Barlow (1985b) suggested that the effect on revenue of a seasonal pasture loss or improvement, in percentage terms, could be better approximated by the average of the seasonal percentage pasture changes than by the percentage annual change. Table 1 shows that the percent increase in gross margin is only about 80% of the average percent change in pasture cover due to weed control in a dairy system. For example, the % increase in pasture cover from controlling Scotch thistles occupying 10% of the pasture is ((100 − 3.2)/(100 − 10) − 1) x 100 = 7.6, compared with a 6.2% increase in gross margin.

While the above results rely on a number of assumptions, modelling is one of the few ways in which the many different effects of a pasture change on a production system, some of which carry over into subsequent seasons and years, can be integrated into a single figure for change in revenue from that system.

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