DENSITY AND COVER ESTIMATES OF SOME NON-PALATABLE HERBACEOUS PASTURE WEEDS

GRAEME W. BOURDÔT and DAVE KELLY

*Agricultural Research Division, Ministry of Agriculture and Fisheries,
Canterbury Agriculture and Science Centre, Lincoln*

*and
Department of Plant and Microbial Sciences, University of Canterbury*

SUMMARY

Density and ground-cover estimates of six non-palatable herbaceous weeds of high-producing pastures in New Zealand were made in two consecutive summers, near Hamilton, Palmerston North and Christchurch. The survey provided objective estimates of the relative and absolute importance of Scotch thistle (*Cirsium vulgare*), winged thistle (*Carduus pycnocephalus* and *C. tenuis*), nodding thistle (*Carduus nutans*), Californian thistle (*Cirsium arvense*), ragwort (*Senecio jacobaea*) and rushes (*Juncus* spp.). Scotch thistle, Californian thistle and rushes were most important overall but there were significant regional differences in species importance. Total weed ground cover was higher in 1985/86 than 1984/85, reaching 9.1% near Palmerston North for these six species alone.

INTRODUCTION

Weeds interfere with man's production of plants and animals thereby incurring costs; the costs of weed control and of lost production. The former cost is easily assessed since the costs of herbicides, cultivation and other weed control procedures are usually known. The cost of lost production cannot be assessed without objective information on the interference of the weeds in the plant production system. Subjective estimates are unsuitable for this purpose. The lack of such information in New Zealand agriculture, except for scrub weeds (Bascand and Jowett 1982), has been highlighted recently in a discussion paper by Monsanto N.Z. (Monsanto N.Z. 1984).

Without objective production-loss information, it is impossible for weed science research priorities to be assigned in a way which maximises the national benefit. It is also impossible to undertake cost-benefit analyses for pasture weed control on individual farms. Furthermore, the increasing need for accountability in research makes it imperative that weed scientists assess objectively the economic importance of perceived weed problems. In this paper we discuss surveys which measured densities and covers of non-palatable herbaceous weeds in some high-producing pastures in New Zealand.

METHOD

We restricted attention to non-palatable herbaceous weeds, as their effect on pasture production should be proportional to area covered. In the field, recording was limited to a list of target species which we felt was likely to include the most important species; the six discussed here are Scotch thistle, winged thistle, nodding thistle, Californian thistle, ragwort and clump-forming rushes. We surveyed only high-producing pasture, where production losses and benefits of weed control are greater than on low-producing pastures. Our aim was to estimate the density and cover of each target weed in the high-producing pasture, using an NZMS 1 topographical map (scale = 1:63 360), in summer when weed cover peaks (Kelly and Popay 1985).

The sampling unit was a paddock. Paddocks were selected within each map, using computer-generated random coordinates falling within the high-producing pasture map units (P1; see Hunter and Blaschke 1984) of the New Zealand Land Resource Inventory (MOW 1979). Most randomly selected paddocks were within 400 m of a road. The same

Proc. 39th N.Z. Weed and Pest Control Conf.

paddocks were surveyed in both years.

To reduce the time spent in each paddock we used a truncated point-distance nearest-neighbour technique (Batcheler 1975) instead of a more traditional bounded plot method such as quadrats. Thirty points at 7 m spacings along a randomly orientated sampling line, were examined in each paddock. The distance from the point to any list-weed occurring within a 3 m search radius was measured. The distance from this plant, if present, to any list-weed was then measured, again within a 3 m radius. The procedure was repeated once more to get the distance from the nearest neighbour to the next-nearest neighbour, if present. The density of each species was estimated from the distances from the points to individuals of that species, after correcting for clumping using the nearest and next-nearest neighbour distances.

The methodology was modified in the second year. The sampling intensity within a map was reduced from one paddock per 1000 ha P1 to one per 1666 ha as the former gave needlessly small 95% confidence limits (6%-11% of total density). The search radius was reduced from 3 m to 1.25 m. The measure of plant size was changed from plant diameter to length of the longest leaf (except for rushes where clump radius was used in the second year). As a result of these changes, the average time spent in each paddock fell from 48 minutes in 1984/85 to 32 minutes in 1985/86 and the 95% confidence limits rose to 13% — 16% of total density. The 1985/86 survey was conducted largely in December, but in 1984/85 data was not collected until January-February.

TABLE 1: Frequency, density and cover values for weeds of high-producing pasture estimated from point-distance data for each of three NZMS 1 maps in two consecutive summers.

	N65		N149		S83		
Year of survey*	84/85	85/86	84/85	85/86	84/85	85/86	mean
a) Frequency (% of survey lines (paddocks) on which species encountered)							
Scotch thistle	56	43	86	83	71	54	66
winged thistle	7	11	10	14	0	0	7
nodding thistle	1	2	0	0	14	8	4
Californian thistle	59	67	60	33	27	36	47
ragwort	37	20	36	26	0	0	20
rushes	20	20	37	24	1	0	20
b) Density (plants/ha)							
Scotch thistle	883	401	1226	6444	352	1009	1719
winged thistle	108	458	82	1254	0	0	317
nodding thistle	0	93	0	0	46	96	39
Californian thistle	5537	6007	2662	4189	354	595	3224
ragwort	235	487	814	2347	0	0	647
rushes	1234	946	1158	1236	8	0	764
c) Cover (% ground area covered)							
Scotch thistle	0.26	0.40	0.65	4.03	0.21	0.62	1.03
winged thistle	0.06	0.22	0.02	0.56	0	0	0.14
nodding thistle	0	0.11	0	0	0.04	0.22	0.06
Californian thistle	1.21	3.39	0.46	1.49	0.06	0.26	1.15
ragwort	0.08	0.56	0.10	1.43	0	0	0.36
rushes	1.44	2.13	0.84	1.57	0.04	0	1.00
total cover	3.05	6.81	2.07	9.08	0.35	1.10	3.74

*The durations of the measurement periods for each map were:—

N65 17/1/85 — 5/3/85 and 2/12/85 — 3/1/86

N149 22/1/85 — 5/2/85 and 14/12/85 — 20/12/85

S83 28/1/85 — 25/2/85 and 28/11/85 — 13/12/85

The three maps surveyed (N65, N149 and S83) were chosen because they were close to the bases of the survey teams in Hamilton, Palmerston North and Christchurch.

To see if there were significant differences in the relative importance of the six weeds over the two seasons or between maps, correlation coefficients were calculated for cover values. The correlation coefficient will be close to 1.0 where the relative importance of the species between seasons or sites is similar.

RESULTS

Some species were considerably more widespread within the maps, than were others (Table 1a). Californian thistle was the most widespread species on N65 but Scotch thistle was by far the most widespread species on N149 and S83. Nodding thistle was rare on N65 and not encountered on N149 whilst neither winged thistle nor ragwort were encountered on S83.

Density estimates varied widely between years, particularly for the annuals and biennials. In most cases (except rushes which were roughly constant and Scotch thistle in N65 which declined to 45%) the densities of the species were higher in 1985/86 (Table 1b).

For all species, ground cover was greater in 1985/86 (Table 1c). Usually due to increases in density of plants and cover per plant. For Scotch thistle in N65, a 54% increase in ground cover resulted from a 340% increase in cover per plant, while density declined.

The weed occupying the greatest area varied between years on N65 and N149, but not on S83. The ground covers of the six species for 1984/85 and 85/86 were significantly positively correlated for N65 and for S83, but not for N149 (Table 2a). This shows that the relative importance of the species was similar in both years near Hamilton and Christchurch. Correlation coefficients were also computed to see if differences in the relative importance of the species between maps were significant. Only N149 and S83 showed significant similarities in the relative cover of these six weeds over both years (Table 2b).

TABLE 2: Correlations between years and sites in percentage cover for six herbaceous weeds.

Comparison and site	n*	r	p
(a) between years (1984/85 versus 1985/86)			
N65	6	0.906	<0.05
N149	6	0.668	NS
S83	6	0.948	<0.01
(b) between sites (over both years)			
N65 versus N149	12	0.283	NS
N65 versus S83	12	0.070	NS
N149 versus S83	12	0.749	<0.01

n, number of coordinates; r, correlation coefficient; p, probability

DISCUSSION

Three estimates of weed importance are presented here (frequency, density and cover), of which cover is most important. Frequencies were relatively stable over the 2 years at all sites, but densities increased in 1985/86 for most species. It is unfortunately not possible to separate the differences due to different seasons from the effect of time of survey, but both were probably important. Weed densities may have been higher in 1985/86 because it was a more favourable growing season. On the other hand, the late time of survey in 1984/85 meant that some weeds had disappeared before the survey, particularly, winged thistles which begin to flower in October and usually die before January. Recorded densities of winged thistle were much greater in 1985/86.

The cover data are important in four ways; for assessing variation between years, variation between maps, the relative and absolute importance of the different species and the overall levels of total weed cover. The two to four-fold increase in total weed cover in 1985/86 shows how temporal variation can affect weed control programmes. Ideally, either long-term averages or accurate predictions of weed cover in the coming season are required. The need to consider different regions individually is shown by differences in cover of different weeds in our three areas. Such regional differences confuse the question of which weeds are the most important nationally. For example, while rushes were of major importance in N65, they barely featured in S83; winged thistles were most abundant in N149. Some species would reach much higher cover values in areas outside those we surveyed (e.g. nodding thistle near Ashburton).

Our six species included the most common non-palatable weeds in the surveyed pasture. Three weed species, rushes, Scotch and Californian thistles, had similar, high average, cover values taken over all sites. The determination of which was the most serious would depend on the sites and years considered. However rushes may be economically more important overall as their pasture cover is fairly constant through the year; in contrast, the thistles cover less area in winter (Kelly and Popay 1985). The other three weeds were all much less common in our survey areas than the first three, though each can be locally important as noted above.

The final point is the absolute level of total weed cover. This varied markedly with region. The short-lived pastures of Canterbury mixed farms had lower weed levels than the, generally permanent, pastures near Hamilton and Palmerston North. Even so, weed infestations ranging from 0.35% to nearly 10% of pasture area imply significant opportunity costs due to production forgone. What is needed is to measure (or model e.g. Barlow 1985) lost production in monetary terms. This would necessitate the translation of pasture losses into livestock production losses. Seasonal changes in pasture loss (weed cover) will need to be understood to allow such an analysis. Our results certainly seem to justify research on pasture weeds.

ACKNOWLEDGEMENTS

We thank Ian Popay, Anne Saunders and Alec Thompson (MAF); Oliver Sutherland, Libby Burgess, and Maree Williams (DSIR); Jack Alex (Guelph University, Ontario) for conducting the North Island surveys; Geoff Hurrell and Don Ross (MAF), for data analysis; Caroline Strachan (MOW) for supplying Land Resource Inventory data; Les Batcheler (FRI) for providing the computer programme for data analysis; and Monsanto New Zealand Limited for financial assistance.

REFERENCES

- Bascand, L.D., and Jowett, G.H., 1982. Scrubweed cover of South Island agricultural and pastoral land. *N.Z. J. of Expt. Agric.* 9: 307-327.
- Barlow, N.D., 1985. A Model for Pest Assessment in New Zealand Sheep Pastures. *Agricultural Systems* 18: 1-37.
- Batcheler, C.L., 1975. Probable limits of error of the point distance-neighbour distance estimate of density *Proc. N.Z. Ecol. Soc.* 22: 28-33.
- Hunter, G.G. and Blaschke, P.M., 1984. The New Zealand Land Resource Inventory Vegetation Cover Classification. Report No. WS 585, Ministry of Works and Development, Christchurch, N.Z.
- Kelly, D. and Popay, A.I., 1985. Pasture production lost to unsprayed thistles at two sites. *Proc. 38th N.Z. Weed and Pest Control Conf.*: 115-118.
- Monsanto, N.Z., 1984. The estimated costs of weeds to the Agricultural sector of the New Zealand economy. A discussion paper prepared by Monsanto New Zealand Limited, 15 p.
- MOW, 1979. Our Land Resources. A bulletin to accompany New Zealand Land Resource Inventory Worksheets, produced for the National Water and Soil Conservation Organisation by the Water and Soil Division, Ministry of Works and Development, 78 p.