THE CONTROL OF WEEDS IN HIGH FERTILITY PASTURES

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Summary

Weed control in high fertility pastures is seen as the correction of errors in management or of the effects of breakdown, through vagaries of climate, of management practices known to maintain clover balance and give maximum animal production. The possibility of build up of excessive soil fertility in low rainfall areas and possible remedial action is noted. The present control measures for Californian thistle, docks and barley grass are described. The need for economic assessment of pasture weeds in terms of animal production is noted.

AGRICULTURALLY, weeds are plants that interfere with production, that prevent full realization of the potential of a crop. Control of such plants requires an appreciation of the reasons for their presence and persistence and the application when economically feasible of measures to remove and/or replace them and to remove, modify or alleviate the causative factors. The relevant properties of high-fertility pastures growing in favourable climatic conditions are as follows.

HIGH-FERTILITY PASTURE

The production and maintenance of high-fertility pasture depends on the association of a legume with one or more palatable species capable of utilizing effectively the nitrogen fixed by the legume from the atmosphere and re-cycled by *in situ* grazing by stock (Sears, 1953). Herbage production is ensured by maintaining white clover (the most usual legume) in the sward in sufficient quantity to replace nitrogen lost from the system. Suitable fertilizer and pasture length control are important factors in this respect. Maximum utilization of herbage and yield of animal product is obtained by high stocking rates with periodic intense grazing (Campbell, 1970) adjusted to rate of pasture growth (Brougham, 1970).

Although many species could respond to the consequent build up in soil fertility, frequent non-selective defoliation and heavy trampling restrict the number able to flourish in the sward. Californian thistle *(Cirsium arvense)* , and in dairy pastures docks *(Rumex* spp.), are the most notable species other than perennial grasses, though some such as rushes (*Juncus* spp.) will persist once established. Ryegrass is favoured by this management (Suckling, 1964) and is considered the best associate species for most districts of New Zealand though other grasses can perform equally well — e.g., Kikuyu gress in Northland.

This "blue print" for maximum production in fact provides most of the elements for weed suppression. Selective grazing has been eliminated by converting the animals into mowing machines, fertility transfer has been brought under control, and seeding has been restricted. In addition, good ground cover, large fluctuations of light at ground level, and severe root competition make establishment from seed within the sward difficult.

INGRESS AND INCIDENCE OF WEEDS

Though fertilizer and stock management play the major role in maintaining the standard of herbage production, there are practical difficulties. The necessary subdivision for stock control takes time to develop, is costly, and is complicated by considerations such as aspect, water supply, and stock access. Management requirements are exacting on stock and farmers and are prone to upset by vagaries of climate. Drought and long, cold periods lead to over-grazing, and excess rainfall to pugging, in each instance opening the sward to weed invasion. Insect damage can also lead to similar results. Conversely, excess growth from under-grazing can smother clover and also allow plants to seed. The type and degree of incidence of invaders will depend on the species available and on the interaction of climate, topography, physical characters of the soil, and type of stock carried. Because dairying is associated with medium to high rainfall or with moisture retentive soils, and because cows graze laxly, broad-leaved plants such as buttercups *(Ranunculus* spp.) , chickweed (*Stellaria media),* docks, and ragwort *(Senecio jaccbaea)* tend to be characteristic of weedy dairy pastures. Californian thistle also occurs but like the "unsown" grasses, browntop *(Agrostis* spp.) , poa trivialis *(Poa trivialis),* poa annua (*Poa annua)* and Yorkshire fog (*Holcus lanatus*) it is common to both dairy and sheep pastures in similar areas. In districts subject to summer drought, biennial thistles, storksbill *(Erodium* spp.) and barley grass *(Hordeum* spp.) are the common invaders, while in the cool, moist pastures of South Otago and Southland daisy (*Bellis perennis*) and bromus mollis (*Bromus mollis*) in addition to thistles have been attracting attention.

WEED CONTROL METHODS

Weed control in established high-fertility pasture is thus seen as the correcting of management errors. If planning has included consideration of the requirements for optimum management, then these will be "risk" errors and correction part of the management programme.

A further possibility is that the fertility building process may, in lower rainfall areas, increase the soluble salt content of whole fields to a point favouring less productive species, notably barley grass, winged thistle (*Carduus* spp.) and nettle (*Urtica urens*). This is an inference of the findings of Metson et *al.* (1971) with respect to the accumulation of salts at stock camp sites. Control may then include methods of reducing fertility or maintaining an equilibrium below a danger level.

SELECTIVE CONTROL WITH FERTILIZER AND STOCK MANAGEMENT

"Hoof and tooth" has long been accepted as a means of weed control but whereas in bracken and scrub clearance it was at the expense of the stock, in high-fertility pasture it is a built-in feature of high production methods. Obviously fertilizer level must always be adequate and stock control maintained or improved. Small fluctuations in grass/clover balance are likely to be self-correcting since Scott (1971) has shown that pasture under controlled grazing does not age. Temporary modification of stocking can hasten changes as, for example, the reduction of browntop by treading (Brown, 1971). Control of ragwort and docks by sheep is well known, while Suckling (1964) noted better control of rushes using both sheep and cattle rather than sheep only. Avoiding pugging and over-grazing in winter by use of feeding pads. and temporary fencing to control "camping" are other possibilities.

SELECTIVE CONTROL. WITH HERBICIDES

Once weeds are established or recur regularly, it is now usual to look to herbicides for assistance. The main hindrance to progress has been and still is the need for pi-oducts well tolerated by both clover and ryegrass at efficient herbicidal rates. The butyrics, MCPB and 2,4-DB (Meeklah, 1958), and benazolin meet this specification, MCPB controlling buttercups and biennial thistles and benazolin, chickweed. MCPA and 2,4-D which are cheaper than butyrics and control a wider range of weeds are damaging to white clover. Though selectivity can be improved by using low dose rates at times when the check to the clover is of less importance, at the higher rates necessary for ragwort and giant buttercup *(Ranunculus acris)* control, damage to clover and weakening of pasture may aggravate the weed problem. This is especially the case with picloram which translocates efficiently in Californian thistle and ragwort but is highly toxic to clovers and persistent in the soil for some time. Selective application to the weed only, as with granules, is a means of using such chemicals for light infestations.

None of the grass control chemicals are fully selective to both clover and ryegrass. However, clover-selective chemicals can be used to overcome grass dominance, low rates of paraquat of the order of 0.1 kg/ha applied at the peak of pasture growth hastening the change. Initially herbage production will fall but this can be offset bv shift in season of production and increased nutritive value (Williams and Palmer, 1969) .

PASTURE RENEWAL

If weed infestation is severe and cropping is part of the farm programme, cultivation followed by spraying both in the crop and when sowing back to grass offers the best means of control as well as for reducing soil fertility. Established docks can be eliminated, Californian thistle considerably reduced, and establishment of thistle and dock seedlings prevented by timely spraying of young pasture with butyric herbicides.

Chemical turf destruction with chemicals available at present is not suitable for perennial weed control though it is useful for introducing better varieties of pasture plants, a process which falls within the broad definition of weed control.

SPECIFIC WEED PROBLEMS IN ESTABLISHED PASTURE

CALIFORNIAN THISTLE

Californian thistle thrives in fertile, uncompacted soils not subject to intense drought. Although the aerial shoots are very susceptible to a number of foliage applied, translocated chemicals, movement deep into the taproots and into horizontal roots is very variable and surviving pieces of root establish fresh clones. Competition from crop, especially spring crop, or pasture saved for hay improves the result. However, in permanent pasture, though MCPB will give seasonal control of foliage without harm to the clover, the variability of carry over of control into succeeding years, or of respoase to repeat treatment accounts for the lack of popularity of the procedure and the fear that, where all-grass farming is adopted, Californian thistle may become a limiting pest. This variability is shown in the results of a recently completed series of trials in eastern Southland (Table 1).

TABLE 1: EFFECT OF MCPB ON CALIFORNIAN THISTLES EASTERN SOUTHLAND
Thistle shoots per square metre, January 1912

	Waimumu	*Pukerau*	*Brydone*	*Gore*
Sprayed	Dec. 1968	Dec. 1968	Jan. 1969	Jan. 1969
Re-sprayed	—	Mar. 1970	Feb. 1970	—
Re-sprayed	—	Jan. 1971	—	Jan. 1971
MCPB (kg/ha):				
nil	6.0 A	24 aA	3.4 a	26 aA
1.1	1.1 B	16 bB	3.8 a	20 abAB
1.7	0.8 B	11 cC	3.0 a	11 bB
2.5	1.1 B	11 cC	2.0 a	21 abAB

DOCKS

Docks (broad-leaved *(Rumex obtusifolius),* curled *(R. crispus),* fiddle (*R. pulcher*) are probably the most widely quoted as high-fertility pasture weeds (Elliot, 1955; Cavers and Harper, 1964). The latter authors note that *"R. obtusifolius* has low competitive ability as a seedling and cannot become established in established communities. Once it has produced a deep tap root, however, it is a most troublesome weed and difficult to eradicate."

The rather open base of dairy pastures, particularly when pugged, allows seedlings the opportunity to establish. They are readily killed up to the two- to three-leaf stage with butyrics but resistance rapidly increases with age. The introduction of asulam has provided good control of established docks but some regrowth from woody crowns is inevitable and a second application in the following spring is necessary for a high degree of control.

Asulam causes some check to grasses and clovers with an initial reduction in herbage production but, because of the greater susceptibility of grasses such as Yorkshire fog, may ultimately give improved pasture balance.

BARLEY GRASS

Barley grass (*Hordeum murinum* complex) requires both a high level of fertility for growth and, at establishment, a low level of competition from other plants. Thus, in districts with good summer growth, barley grass is restricted to stock camps, often under trees, where drier conditions and stock trampling ensure the necessary bare ground for establishment. In districts subject to summer drought, it can cover more extensive areas through its ability to establish rapidly with autumn rains, thus taking advantage of the ryegrass/clover recovery lag.

Control, then, must be aimed at removing the weed, preventing or rotating stock congregation, and providing competition, especially over the weed establishment period.

Barley grass is an annual or, as when spring-germinating, a biennial. Since it may reach 100% germination given favourable conditions after ripening (Harris, 1959; Rumball, 1971), eradication by preventing seeding for about two years is a tantalizing possibility. Although this appears feasible with available chemicals on lightly infested. properties, the difficulty of locating and killing all plants, the seed-producing capacity of survivors, and effective transport of seed by stock have weighed against success.

For more extensive areas, lack of chemicals selective to both ryegrass and clover is a handicap both in terms of pasture production and because of the importance of competition in field control. Pronamide and carbetamide are selective to clovers but kill barley grass at the expense of ryegrass production. Subsequent overdrilling of grass would be required, though adjustment of rate and time of application may allow sufficient grass recovery, especially if cocksfoot is present (Hartley et al., 1972) . Hartley (1972) reported a new chemical highly selective to ryegrass, though severe on white clover, with soil residual action against barley grass seedlings. As ryegrass can utilize accumulated salts, is present in barley grass sites (Grant and Ball, 1970), or could be direct-drilled at time of treatment (current trial indication) , this approach via ryegrass tolerance is reasonable should this or other ryegrass selective chemicals become commercially available. Ryegrass could be the equivalent of a fertility draining "white straw" crop. At present, however, TCA or mixtures of TCA and 2,2-DPA are the best compromise in terms of barley grass control and pasture balance (Moffat and MacDiarmid, 1970).

ECONOMIC CONSIDERATIONS

Possible control measures have been outlined but their adoption should depend on their effect on maintenance or increase of profitability. Unfortunately, information on animal yield response to the removal of weeds is meagre or obscured by large parallel changes in other pasture components, especially clover. Grazing trials using stabilized grass/clover and grass/clover/weed associations are necessary to obtain decision-oriented data. However, Spedding (1966) has pointed out that the effect of a palatable weed "on animal output would be related to the difference between the reduction in the total herbage yield (as digestible organic matter) and the percentage of the herbage not utilized". If this is considered in relation to Campbell's (1963) minimum of over 40% herbage not being utilized per grazing by dairy cows, it would appear that, high levels of palatable weeds are necessary to justify expenditure on 'their control. Similar reasoning applies to unpalatable species since one 30 cm diameter nodding thistle per square metre prevents grazing on only 10% of pasture area. If quality or animal health effects occur, much lower numbers may be economically significant. These points require evaluation before weeds and weed control in high-fertility pasture can be defined in economic terms rather than in the eyes of the beholder as influenced by subsidy and taxation considerations or legal and commercial pressures.

REFERENCES

Brougham, R. W., 1970: *Proc. N.Z. Grassld Ass., 32: 137.*

Brown, K. R., 1971: N.Z. *Jl agric. Res., 14: 828.*

Campbell, A. G., 1963: *Proc. N.Z. Grassld Ass., 25: 78.*

——— 1970: *Proc. N.Z. Grassld Ass., 32:* 145.

Cavers, P. B.; Harper, J. L., 1964: *J. Ecol., 52: 737.*

Elliot, I. L., 1955: *Proc. 8th N.Z. Weed Control Conf.: 40-3.*

Grant, D. A.; Ball, P. R., 1970: *Proc. 23rd N.Z. Weed & Pest Control Conf.: 83-9.*

Harris, G. S., 1959: *Proc. 12th N.Z. Weed Control Conf.:* 85-91.

Hartley, M. J., 1972: *Proc. 25th N.Z. Weed & Pest Control Conf.: 62-3.*

Hartley, M. J.; Allen, F. C.; Atkinson, G. C.; Meeklah, F. A., 1972: *Proc. 25th N.Z. Weed & Pest Control Conf.: 46-50.*

Meeklah, F. A., 1958: *Proc. 11th N.Z. Weed Control Conf.:* 61-73.

Metson, A. J.; Saunders, W. M. H.; Nott, J. H.; 1971: N.Z. *Jl agric. Res., 14: 334.*

Moffat, R. W., MacDiarmid, B. M., 1970: *Proc. 23rd N.Z. Weed & Pest Control Conf.:* 107-12.
Rumball, P. J., 1971: *Proc. 24th N.Z. Weed & Pest Control Conf:* 80-4.
Scott, R. S., 1971: *Proc. N.Z. Grassld Ass., 33:* 105.
Sears, P. D., 1953: *N.Z. Jl Sci. Technol., 35A:* 221.
Spedding, C. R. W., 1966: *Proc. 8th Br.* Weed *Control Conf.: 854-60.*
Suckling, F. E. T., 1964: *Proc. N.Z. Grassld Ass., 26:* 137.
Williams, P. P.; Palmer, P. C., 1969: *Proc. N.Z. Grassld Ass., 31:* 96.