

Paper 5

CONTROL OF WEEDS IN LUCERNE

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INTRODUCTION

Since the review by Allen (1967) there have been several important developments concerning the incidence and control of volunteer plants in lucerne. These include: the acceptance of the grazing system advocated by Iverson in the 1967 review; the introduction of a number of new herbicides tolerated by lucerne or permitting changes in methods of crop establishment; the appearance and/or spread of a number of diseases and pests with the potential to reduce the competitive ability of the stand at critical periods and to kill lucerne plants; a surge of new cultivars introduced or bred to reduce or avoid the consequences of the presence of disease and pests. Finally more accurate predictions of the costs and benefits of weed control are now possible from the accumulated weed control data.

A survey by Mumford (1980) showed that many stands are sprayed for annual weeds (48% in Canterbury, 64% in Southland). Farmers believed that the average loss (median response) caused by weeds in lucerne was 4-6% and the worst possible loss (median response) was 10% (Canterbury) or 22% (Southland). These farmer estimated losses were as high for lucerne as for any other crop and "reflect farmers' concern for pests and such estimates are fundamental to the decision to use pesticides." Currently available control measures are described, and presented below.

ESTABLISHMENT OF STANDS

Preparation of the seed bed.

The objectives for weed control prior to sowing remain the same as those outlined by Allen (*loc. cit.*) — i.e., "to kill all perennial weeds and to endeavour to reduce the possibility of competition of annual weeds during crop establishment. Elimination of couch (*Agropyron repens*), onion twitch (*Arrenatherum elatius*) and other grasses together with yarrow (*Achillea millefolium*) and docks (*Rumex* spp.) is especially important since no satisfactory control is available once the crop is established." This

advice is still true but there are now a number of herbicides available to assist cultivation in controlling perennial weeds: glyphosate 1.5 — 2.0 kg/ha and amitrol 4.0 — 6.0 kg/ha plus 2,2-DPA 5.0 — 10.0 kg/ha. The replacement of cultivation entirely with oversowing (Musgrave and Lowther, 1976) or with no tillage (Matthews, 1972; Atkinson, 1976; Butler and Meeklah, 1979; Hart and Jacobson, 1979) suggests control of vegetation is as important as the preparation of a 'good seedbed'. Establishment of lucerne with reduced tillage is reviewed by Musgrave (Paper 3).

The possibility of replacing runout lucerne stands with herbicide and direct drilling has been suggested and as weed control can be adequately achieved, some factor other than vegetation control or a seedbed must be preventing re-establishment.

Cultural weed control.

Allen (*loc.cit.*) outlined in cultural weed control practices, but a number of trials have altered these recommendations. Increase in seeding rates though effective as a weed control method does not alter stand production or life (Palmer and Wynn-Williams, 1976). The recommendation to sow lucerne with a suitable perennial companion grass has also been tested (Cullen, 1965; Douglas and Kinder, 1973; Vartha, 1973; Janson, 1975). Yields from mixtures with grasses such as cocksfoot, tall fescue or prairie grass and particularly from a lucerne and cocksfoot mix sown in alternate rows (Cullen, *loc. cit.*) have been as high as pure lucerne. Regrettably this research on grass mixtures has been done on fertile soils or semi-arid soils and not on light drought-prone soils where most lucerne is grown and therefore has not been accepted as a system by farmers. The conclusion from all published papers is that a perennial grass provides control of annual weeds in mature lucerne and does away with the need to use herbicides for this purpose, but at the cost of lucerne production.

Sowing of lucerne with annual species as cover crops has been widely tested and adopted (Palmer, 1968; Palmer and Wynn-Williams, 1972; Janson and Knight, 1973; Janson, 1975; Wynn-Williams, 1975; 1976a; 1976b). Pea and brassica crops are the most frequently used cover crops (Allen, pers. comm.). However, cover crops do not suppress weeds without severe competition with lucerne.

Allen (*loc.cit.*) stated that no further cultural control is possible until lucerne is approaching flowering or producing crown buds. He recommended grazing rather than mowing as the more efficient system. Research by Musgrave (1972) showed that a cut at the 4 to 5 leaf stage of lucerne did not impede the development of the lucerne crown allowing earlier cultural weed control.

Chemical weed control.

Allen (*loc.cit.*) pointed out that chemical weed control seldom results in less lucerne and usually results in more, but that the decision to treat is an economic decision.

He reported on the use of prophan, EPTC and trifluralin, pre-plant or pre-emergence, and stated that their strengths as treatments, namely to kill weeds as they germinated, prevented them from becoming popular owing to the unpredictable nature of weed infestations and optimism of New Zealand farmers, and that current use favoured 2,4-DB, dinoseb or MCPB. That situation changed with the introduction of benfluralin (benfifen) (Taylor, 1969a; Meeklah *et al.*, 1972). It was more effective than 2,4-DB at controlling weeds such as fathen (Taylor, 1969a) and there were a considerable number of Department of Agriculture trials that tested it (Clare and Matthews, 1969). It was replaced by trifluralin as more active and no less selective in the mid 1970s. Trifluralin 1.0 kg/ha is often used where a cover crop such as peas, brassicas or barley is sown. Grass herbicides such as carbetamide 2.5 kg/ha and propyzamide 1.5 kg/ha have replaced, 2,2-DPA and are tolerated better by lucerne and though 2,4-DB and MCPB continue to be used post-emergence for general weed control, dinoseb has lost popularity due to the possibility of damage to young plants. As 2,4-DB and MCPB have to be applied after the 3 trifoliolate leaf stage, weed control is often poor and competition of weeds with the lucerne has already occurred.

Chemical control is the only method of controlling seedling perennial weeds and aggressive annual species, and the herbicides that can be used are set out in Table 1.

In areas where warm zone grasses (summer grass, *Digitaria sanguinalis*; barnyard grass, *Echinochloa crus-galli*; Indian doab, *Cynodon dactylon*) are present, control can be achieved with EPTC 4.2 kg/ha. Seedling docks can be controlled with trifluralin or 2,4-DB while yarrow, dandelion (*Taraxacum officinale*) and nodding thistle (*Carduus nutans*) can be effectively controlled with 2,4-DB 0.75 kg/ha plus bentazone 0.75 kg/ha. Delay in controlling these seedling weeds may cause uncontrollable weed problems later in the lucerne crop. The use of brassica cover crops may remove the opportunity to selectively control hormone sensitive weeds such as docks, yarrow, dandelion and nodding thistle.

Table 1: Recommended herbicides for use in lucerne establishment (from Atkinson and Meeklah, 1980).

Herbicide	Rate kg a.i./ha	Trade name	Weeds controlled
<i>Preplant soil incorporated</i>			
carbetamide	2.5	Carbetamex	grasses
EPTC	4.0-6.0	Eptam	grasses & broad-leaved
propyzamide	1.0	Kerb	grasses
trifluralin	0.8-1.0	Treflan	grasses & broad-leaved
<i>Post-emergence</i>			
bentazone	0.75	Basagran	nodding thistle
2,4-DB	1.0	2,4-DB	broad-leaved
dinoseb amine	1.2	dinoseb	broad-leaved
MCPB*	1.0	MCPB	nodding thistle
propyzamide	1.0	Kerb	grasses

*Not registered.

MATURE STANDS

Cultural weed control

Important factors of management include fertiliser usage, defoliation frequency, irrigation, insect control and disease. Insect damage and disease affect the competitiveness of the stand and may also affect the volunteers, but little published data is available.

Fertilisers are important for lucerne vigour and Stephen (1964) suggests that where adequate fertiliser is applied, volunteer species do not increase. When fertiliser is inadequate, volunteer species tend to increase though not always (Lammerink, 1959). Grazing frequency is also particularly important if weeds are to be kept to a small proportion of the stand (O'Connor and Vartha, 1968; Janson, 1975; McLeod, 1978). Lobb (1969) reported on a 4 year trial with different cutting techniques (Table 2).

Table 2: Changes in weeds (as % of total DW) over 4 years in a mowing trial at Winchmore (from Lobb, 1967).

Cutting Stage	Dryland		Irrigated	
	Start	End	Start	End
Early bud	3	49	12	34
50% flower	3	12	25	63

The increased invasion by weeds in Lobb's trial even with a long cutting interval suggests fertiliser was inadequate for a cutting regime. Invasion by weeds into lucerne stands can be rapid; for example in a grazing trial at Lincoln, lucerne that was grazed every 4 weeks to control aphids collapsed within two years (Table 3).

Table 3: Weeds (as % of total DW) in lucerne spelled for 3 or 6 weeks, over 2 years (from Smallfield *et al.*, 1980).

	Spelling period (weeks)	
	6	3
Spring	42	68
Mid summer	0	47
Autumn	7	76

Janson (1972) showed that weedy but otherwise healthy stands, could be changed to clean stands, even on a soil that restricted lucerne root development, by spelling for reasonable intervals between cuttings.

A 7-year trial at Wairakei Research Station examined the effect of weed free conditions from establishment. Hayed areas produced 9000 kg/DM/ha and grazed areas 13000 kg/DM/ha. Effective chemical weed control at establishment led to higher initial total DM yields but long term yields were not altered. Lucerne yields were increased 1000 to 2000 kg DM/ha with applied herbicide each year and there was a corresponding decrease in volunteer DM (Meeklah *et al.*, 1976).

Cultural control methods which reduce the dependence on herbicides for controlling annual species with awned seeds are being sought. In pastures volunteers with awned seeds such as barley grass or storksbill, may affect stock production (Atkinson and Hartley, 1972; Hartley and Atkinson, 1972; Hartley, 1975; Hartley and Bimler, 1975) and profitability (Loughnan, 1964; Rumball, 1970; Shugg and Vivan, 1973; Hartley and Atkinson, 1978). The effect of barley grass in lucerne on stock production has not been tested but it is unlikely to be different from that in pasture. Partial control of barley grass and other annual weeds can be achieved by making silage rather than hay. Lucerne can be ensiled and the product is useful for stock. (Jagusch *et al.*, 1978). If the lucerne and weeds are harvested before weed seeds are shed, viable seeds are made inviable by ensiling and the annual weed cycle is broken.

The introduction of cool season annual species such as 'Grasslands Tama' ryegrass or cereals (O'Connor and Vartha, 1968; Janson, 1972; Palmer, 1976; Vartha, 1976) is useful for weed control. However the increase in cool season production is offset by a reduction in summer production.

Chemical weed control.

The necessity for annual weed control is not clear (Palmer, Paper 4) but the herbicides that do give control have been well documented. The herbicide 2,2-DPA (Cassells and Upritchard, 1968; Meeklah, 1969) formed the basis of chemical weed control but 2,2-DPA was not active on broadleaved weeds. Atrazine was added and gave good results (Cassells and Upritchard, 1968; Meeklah, 1969) but mixtures of atrazine with paraquat (Taylor, 1969b) soon found widespread use (Forgie, 1973). A number of other products were tested and still remain available: simazine, terbacil, propyzamide (pronamide), carbetamide,

metribuzin, cyanazine and hexazinone, while others such as ethidimuron and isobumeton have not remained available (Miles, 1969; Atkinson and Douch, 1973; Honore *et al.*, 1973; Logan and Arnst, 1973; Meeklah and McRobb, 1973; Rae and Patterson, 1973; James and Atkinson, 1979). It is estimated from industry sources that about 80% of the market is paraquat plus either atrazine or simazine, and atrazine rather than simazine is used in 70% of the situations. The herbicides available for use are given in Table 4. Cost of paraquat plus atrazine applied was approximately \$47/ha in 1980.

Table 4: Recommended herbicides for use in mature lucerne (from Atkinson and Meeklah, 1980).

Herbicide	Rate kg a.i./ha	Trade name	Weeds controlled
asulam	1.2	Asulox	docks
bentazona + 2,4-DB	0.75 0.75	Basagran + 2,4-DB	broad-leaved & nodding thistle
carbetamide**	2.5	Carbetamex	grass
metribuzin*	0.7	Sencor	broad-leaved
paraquat	0.6	Gramoxone	broad-leaved
propyzamide**	1.0	Kerb	grass
terbacil	0.8-1.0	Sinbar	broad-leaved
hexazinone	1.0-1.5	Velpar	broad-leaved nodding thistle
atrazine*	1.0	Atrazine or Gesaprim	broad-leaved
simazine*	1.0	Simazine or Gesatop	broad-leaved

* A mixture with paraquat is required.

** A mixture with paraquat is not always required but generally recommended.

Perennial weed control.

The necessity for controlling all perennial 'volunteers' is not certain. Where a 'perennial pasture species' has been intentionally sown with the lucerne, yields have been as high as pure lucerne (see seedling weed control review section).

Some perennial volunteers can be partly controlled: docks with asulam 1.3 kg/ha, browntop with hexazinone 1.0 kg/ha (James and Atkinson, 1979), horehound (*Marrubium vulgare*) with terbacil (Allen, unpubl. data) or hexazinone (Butler, unpubl. data), and *Poa pratensis* with propyzamide (Meeklah *et al.*, 1973). Yield increases following removal of browntop and *Poa pratensis* are large (James and Atkinson, *loc.cit.*; Lane and Cornwell, 1981). No satisfactory chemical control of yarrow, couch or dandelions are presently available though a number of new products appear promising. The use of glyphosate for selective weed control in lucerne is not possible (Meeklah and Butler, unpubl. data).

CONCLUSION

Palmer (*loc.cit.*) has outlined the changes in the lucerne/volunteer association. At establishment annual weed competition may be reduced by cultural practices but in situations where aggressive annual weed species occur or where seedling perennial weeds are present, effective herbicide control is available, and may be economic. During the initial productive phase of the crop, annual volunteers can be reduced by correct management with either mowing or grazing and fertilizer. Herbicides will improve the proportion of lucerne though this increase may not increase total DM. Herbicides will remove most of the weeds though this has not increased stand life in long term trials. The removal of perennial volunteers such as browntop is essential but the control of tall growing perennial forage grasses is of little benefit.

Given that a large proportion of the lucerne crop is sprayed each year, that farmers believe that there is a response from spraying, and that farmers need more information to be completely happy with their pesticide decisions (Mumford, 1980), the recommendation of Palmer's (Paper 4) not to control annual weeds must be critically examined.

Either the farmers have not been presented with data and conclusions from weed control trials or reasons other than economic factors are influencing the decisions of farmers to spray for weeds.

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DISCUSSION

Douglas: I'm interested in the possibility of rejuvenating lucerne stands when they thin to less than 20 plants/m², why not overdrill, with herbicides, to save the cost of stand renewal?

Butler: There are herbicides available to either selectively or non-selectively control weeds but perennial weed seedlings are not controlled.

Palmer: People who have tried this have invariably had a failure and there's a research need here.