TOLERANCE OF CLOVERS TO HERBICIDES

L. J. MATTHEWS

Research Division, Department of Agriculture, Hamilton

Summary

This paper reviews the tolerance of white clover (*Trifolium repens*), red clover (*T. pratense*), and subterranean clover (*T. subterraneum*) to specific herbicides. Varietal differences are not taken into consideration. The paper is based on a review of trials conducted by the Department of Agriculture since 1950.

INTRODUCTION

CLOVER, especially white clover (*Trifolium repens*) is the nitrogen factory of New Zealand grasslands. Clover suppression is most serious when the initial fertility of the sward is being increased. Damage at this stage usually reduces fertility which results in clover increase, and this has often been interpreted as indicating no damage to the clover has occurred. With increasing fertility the percentage of clover declines and high producing grasses assume dominance, so that the productivity of a pasture may be measured in terms of grass growth rather than clover growth.

STAGE OF GROWTH

Seedlings are more sensitive than mature plants. Once established both white clover and red clover (*T. pratense*) are not killed usually with one application except for benzoic preparations and picloram. Subterranean clover (*T. subterraneum*) may be killed with a single application by a much wider range of materials. The perennial clovers show most damage during the spring and late autumn months. Damage in autumn followed by poor growth conditions may cause very severe depression. In summer when clover is normally dominant, and in winter when it is making little or no growth, damage is less severe. On the whole, short-grazed clover is less severely depressed than when 3 to 4 in. high.

SOIL ACTION

Some materials show a more persistent effect on clover through soil absorption than leaf absorption—for example, butyric, 2,2-dichloropropionic acid and amitrole.

RATES OF APPLICATION

Materials that are toxic to clovers are relative in their action. Minimal rates of application, or rates ineffective for weed control will damage clover. For some compounds increasing the rate of application may not markedly increase toxicity.

TOLERANCE TABLES

Tables 1 to 3 are based on a standard rate of application. All rates are given in pounds active ingredient per acre, and materials are listed in order of increasing toxicity.

TABLE 1: SYSTEMIC TYPE PREPARATIONS

Compound	Application Rate (lb)	White Clover			Red Clover			Subterranean Clover			Remarks
		2-3 True Leaf Stage	Mature	2-3 True Leaf Stage	2-3 True Leaf Stage	Mature	2-3 True Leaf Stage	2-3 True Leaf Stage	Mature		
MCPB	1-1½	5 D	Nil D	15 D	5 D	5 D	Nil D	5 D	Nil D		Damage is more severe if absorbed through soil.
2,4-DB	1-1½	5 D	Nil D	25 D	5 D	5 D	Nil D				Action is more severe if absorbed through the soil.
4-chloro-2-oxobenzothiazolin-3-ylacetic acid	¼	15 D	Nil D	5 D							
4-CPA	4	5 D	Nil D	5 D	Nil D	Nil D	Nil D	Not known	Not known		
Bromoxynil	¾	20 R	5 D	25 R	5 D	5 D	5 D	40 D	20 D		Not verified by sufficient trials.
Ioxynil	¾	30 R	5 D	30 R	5 D	5 D	5 D	20 R	5 D		Not verified by sufficient trials.
MCPA	1	40 R	40 D	20 R	10 D	10 D	10 R	10 R	5 R		Esters of MCPA are almost equally as toxic as 2,4-D on subterranean clover.
2,4-D	1	40 R	30 D	90 R	10 R	10 R	10 R	10 R	40 D		Require further evidence.
Mecoprop	1½-2	100 R	40 R	100 R	20 R	20 R	100 R	100 R	50 R		Not employed to any extent.
Dichlorprop	1	100 R	30 R	100 R	60 R	60 R	100 R	100 R	60 R		
2,4,5-T	4	100 R	80 R	100 R	80 R	80 R	100 R	100 R	100 R		
Phenoprop	4	100 R	90 R	100 R	90 R	90 R	100 R	100 R	100 R		Not employed to any extent.
2,3,6-TBA	8-30	100 R	100 R	100 R	100 R	100 R	100 R	100 R	100 R		Not used extensively.
Dicamba	4	100 R	100 R	100 R	100 R	100 R	100 R	100 R	100 R		Not used extensively.
Picloram	¼-1	100 R	100 R	100 R	100 R	100 R	100 R	100 R	100 R		Complete kills of seedlings even at ¼th lb.

TABLE 2: OTHER HERBICIDES

Compound	Application Rate (lb)	White Clover			Red Clover			Subterranean Clover			Remarks
		2-3 True Leaf Stage	Mature	2-3 True Leaf Stage	2-3 True Leaf Stage	Mature	2-3 True Leaf Stage	2-3 True Leaf Stage	Mature	2-3 True Leaf Stage	
MH	4	Nil D	Nil D	Nil D	Nil D	Nil D	Nil D	Nil D	Nil D	Nil D	
Diquat	1	30 D	5 D	15 D	15 D	5 D	10 D	10 D	5 D	5 D	Not normally employed except as a desiccant.
Paraquat	1	30 D	5 D	15 D	15 D	5 D	10 R	10 R	5 D	5 D	Paraquat is more severe than diquat.
Dinoseb	1	15 R	5 D	30 R	30 R	5 D	25 R	25 R	5 D	5 D	Amine salts are more selective than ammonium salt.
Dinosam	1	20 R	10 D	40 R	40 R	10 D	30 R	30 R	10 D	10 D	
DNOC	1	30 R	10 D	50 R	50 R	10 D	40 R	40 R	10 D	10 D	Not employed in pastures.
Nitrofen	1	40 R	15 D	40 R	40 R	10 D	40 R	40 R	10 D	10 D	Precise data not available.
TCA	30	40 R	15 D	60 R	60 R	15 D	60 R	60 R	15 D	15 D	
2,2 dichloropropionic acid	10	60 R	15 D	60 R	60 R	15 D	80 R	80 R	15 D	15 D	For both seedling and mature clovers depression through soil is more marked.
Amitrole	1	90 R	60 R	90 R	90 R	60 R	90 R	90 R	80 R	80 R	
Amitrole-T	1	100 R	80 R	100 R	100 R	80 R	100 R	100 R	90 R	90 R	Action through soil is severe.

TABLE 3: PRE-EMERGENCE HERBICIDES
Considered only for broad groupings

<i>Name of Compound</i>	<i>Remarks</i>
Quaternary ammonium compounds	Completely selective
Phenols	Very safe. DNOC is less selective than dinoseb or dinosam or pentachlorophenol
Acetamides, carbamates, thiolcarbamates and dithiocarbamates	Acetamides are non-selective (thiolcarbamates retard germination more than carbamates or dithiocarbamates)
Chloro-substituted aliphatic acids	Some clover survival
Phenoxy compounds	Some clover survival with 2,4-DES and 2,4-DEB
Aromatic amine derivatives	Hard seed may survive
Nitriles	Hard seed may survive, particularly with ioxynil and bromoxynil
Substituted aromatic carboxylic acids	Endothal, DCPA and chloramben are much less persistent than 2,3,6-TBA and dicamba
S-triazines	Clovers are among first species to recover at rates up to 10 lb
Substituted ureas	No recovery for 6 to 12 months at rates up to 10 lb
Uracils	No recovery for 12 months plus at rates up to 10 lb
Others	Amitrole is short-termed. Picloram long-termed even at low rates

The term "depression" denoted by "D" signifies percentage retardation in growth—100% depression implies a complete kill. The term "reduction" noted by "R" signifies percentage kill—100% reduction implies a complete kill of all plants. Some compounds cause a depression in growth which is so insignificant that it is difficult to measure. This is denoted by "nil D" and is equivalent to a light grazing.

PRACTICAL APPLICATION

SEEDLING CLOVERS

(First true or trifoliate leaf)

- (1) MCPB may be used on all three species once complete ground cover is obtained. Red clover is more sensitive to damage than white or subterranean clover.
- (2) The salts of 2,4-DB should not be employed on red clover. For herbicidal efficiency, 2,4-DB should be employed on the other clovers only when there is a dominance of seedling polygonums.
- (3) The compound 4-chloro-2-oxobenzothiazolin-3-ylacetic acid at the low rates $\frac{1}{8}$ to $\frac{1}{4}$ lb is not quite as selective as MCPB on white clover. Its effect on the other species is not known fully.
- (4) The addition of small amounts of MCPA and 2,4-D markedly reduce the selectivity of the phenoxybutyrics.

MATURE CLOVERS

- (1) MCPB may be used on all three species. Broad red clover for seed crops is sensitive to late spraying and should be sprayed before the beginning of October.
- (2) Preparations of 2,4-DB should not be employed where red clover is dominant.
- (3) The compound 4-chloro-2-oxobenzothiazolin-3-ylacetic acid may be used even for late autumn application on white clover.
- (4) Paraquat and diquat at rates adequate for grass weed control and pasture renovation normally check clover equivalent to a severe grazing or mowing.
- (5) Both MCPA and 2,4-D are most severe in their action on white clover in spring and late autumn periods, and cause least depression in summer when clover is normally dominant or in winter when clover is making little or no growth. Damage to red clover follows a similar pattern, especially with 2,4-D which should not be used on this species.
- (6) For subterranean clover, the esters of MCPA and 2,4-D are decidedly more damaging than the equivalent salt preparations.
- (7) Both TCA and 2,2-dichloropropionic acid even at light rates of application cause clover suppression, particularly in the case of the latter material reaching the soil. Normally the depression is equivalent to two or more severe grazings, effect being most severe in late autumn.
- (8) All other preparations previously referred to are too damaging for overall application. Some of the more persistent materials, such as picloram, are so severe that their use appears unwarranted even for spot application in agricultural areas.

DISCUSSION

All preparations of herbicides available cause some damage to clovers. With the most selective material damage may be non-measurable but with more persistent materials, such as picloram, total depression may last for a year or so. The percentages given for the damage in Table 1 (systemic preparations) are not absolute and could vary widely under varying climatic conditions. The classification of compounds in Tables 1 and 2 is rather arbitrary, as a number of preparations in the latter table are more systemic in action than ioxynil and bromoxynil. Mixtures have not been dealt with in detail, but damage to clover is relative to the most toxic additive.

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