THE TOLERANCE OF SUBTERRANEAN CLOVER (*Trifolium subterraneum* L.) to CHEMICAL WEED CONTROL IN IMPROVED PASTURES.

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I. INTRODUCTION.

The growth of improved pastures and its associated uplift of soil fertility, coupled with the necessity to maintain a reasonable ecological balance between grasses and legumes, has drawn attention to the need for weed control as a cardinal principle of pasture improvement.

Apart from their noxious characters and other undesirable features affecting livestock, weeds can be recognised from the point of view of pasture establishment into three main groups :-

GROUP A. Weeds which must be destroyed before successful pasture establishment can be attempted - hoary cress (*Cardaria draba* L.), Cape tulip (*Homeria collina* Vent), ragwort (*Senecio jacobaea* L.), stinkwort (*Inula graveolens* Desf.), St.Johns wort (*Hypericum perforatum* L.).

GROUP B. Weeds which severely compete with the early establishment of pasture and can be classed as the "growing pains" of pasture. Such species which delight in the original uplift of soil fertility, and lack of vigorous competition are saffron thistle (*Carthamus lanatus* L.) slender thistle (*Carduus pycnocephalus*), variegated thistle (*Silybum marianum* G.), cape weed (*Cryptostemma calendula* L.), etc.

GROUP C. Weeds of established pasture - capable of invasion and establishment into well managed pastures. Black or spear thistle (*Cirsium vulgare* Ten.), scotch thistle (*Onopordum acanthium* L.), variegated thistle (*Silybum marianum* Gaertn.), docks (*Rumex* spp.), and in certain areas of N.S.W., Patersons curse (*Echium plantagineum* L.).

With the object of integrating the use of chemical weedkillers as an economical method of pasture improvement, our experimental work is aiming to evaluate the effect of hormone weedkillers on each of the above groups with special reference to:-

a. The economic application rate of hormone weedicides for weed control.

b. The tolerance of associated clovers to various chemicals and in relation to time of application.

c. The influence of spraying on the botanical composition of the pasture sward.

Experimental work conducted in 1953 on weed control in improved pasture was mainly directed at Group B and C., and was carried out at Goulburn, Yass, Cootamundra, and Singleton.

The experiment was an extensive one, involving some 30 treatments at 4,8,12, and 16 oz. acid equivalent of the particular herbicide. Plots were laid down on a replicated and randomised system, the plot size being standarised at 1½ chains by 15 ft., and all treatments were applied with a low volume boom fitted with fan No.32 Monarch nozzles applying 10 gallons of spray per acre.

2,4-Dichlorophenoxyacetic acid (2,4-D) was applied as the sodium salt, amine salt (with and without wetting agents), the emulsifiable acid, and the ethyl butoxyethanol, methyl cyclohexyl glycerol and polyethylene glycol esters.

2 Methyl 4-chlorophenoxyacetic acid (M.C.P.A.) was applied as the sodium salt and amine salt.

Parachlorphenoxyacetic acid (P.C.P.A.) was applied as the amine.

For the purpose of this paper, reference will be made only to the Yass and Cootamundra sites which gave the best opportunity to study the reaction of subterranean clover.

At Yass, the experimental site was on an improved pasture of perennial ryegrass (Lolium perenne L.), and subterranean clover heavily infested mainly with saffron thistle, and in certain plots with slender thistle. Plots were grazed with cattle during the currency of the trial, and heavily grazed with sheep from December onwards. At Cootamundra, pasture contained Wimmera rye (Lolium rigidum), subterranean clover - Mt.Barker and Bacchus Marsh strains, infested with saffron thistle, star thistle (Centaurea calcitrapa) and variegated thistle. Plots were not grazed during the currency of this trial. Spraying was conducted in July, August, September and October.

Stages of development are summarised :-

MONTH OF SPRAYING	SAFFRON THISTLE	SUBTERRANEAN CLOVER- (MT.BARKER)
July	6 leaves in 2 whorls-1½-2½"long	2-5 leaves 2"long.
August	6-9 glabrous leaves-3-4" long	4-5 leaves 3"long 2-4 runners.

MONTH OF SPRAYING	SAFFRON THISTLE	SUBTERRANEAN CLOVER- (MT.BARKER)
September	27 hairy leaves in 4 whorls	3-5 runners each with 4-5 leaves (Bacchus Marsh flowering).
October	Centre stalks 4" high - 8 expanded leaves.	Well defined runners - flowering.

Evaulation was restricted to visual observations conducted at monthly intervals until January, and the following statement summarises the trends which became apparent. Detailed observations are not presented in this paper but are available for inspection.

II. WEED CONTROL.

General results indicated that the growing conditions afforded weeds in improved pasture, render such plants more susceptible to hormone weedkillers than under low fertility or natural pasture conditions.

Low rates of 2,4-D gave 100% control following July and August spraying. Eight and twelve ounces gave adequate control in September and October sprayings; the 4 ounce rate giving poor control after the later sprayings.

No difference between formulations of 2,4-D was apparent following the July and August sprayings. The ester formulations, particularly the ethyl ester and the butoxy-ethanol ester, showed to advantage only in the September and October sprayings. No difference between various amine formulations was reported, and the 2,4-D acid formulation gave comparable results with the amine salt of 2,4-D.

M.C.P.A. sodium salts at 4 ounces in July and August, gave unsatisfactory results while8 and 12 ounces showed variable results at the later sprayings.

M.C.P.A. amine gave slightly better results than the sodium salt.

P.C.P.A. gave the poorest results at equivalent rates, but at 1 and 1½ lb. rates, the herbicidal action was quite good.

III. TOLERANCE OF SUBTERRANEAN CLOVER.

The reaction of subterranean clover was studied with particular reference to possible reduction in stand; to overall reduction in vigour and yield; morphological changes; and effect on flowering.

M.C.P.A. sodium salt, and M.C.P. amine did not noticeably affect clover density, leaf size, or flowering at any rate or at any time of spraying.

All formulations of 2,4-D at all rates affected subterranean clover. It was considered that only at the 1 lb. rates reduction in the number of clover plants was noticed.

The reaction of subterranean clover varied according to the time of spraying, the formulation used, and the strain of subterranean clover.

Briefly, our observations show the influence of time of spraying.

1. July Spraying. Suppression of clovers became noticeable six weeks after spraying. This was associated with a marked overall check to the plots treated with 2,4-D, showing a characteristic symptom of small triangular leaflets, frequently cupped and puckered.

   Inspection one month later showed that the leaflet which followed this triangular leaflet was a large multiple leaflet, bearing from six to nine leaflets. The leaflets following this modification were normal in shape and size. In most cases, by late October, the stand was equal to the control plot in density and height. Flowering was delayed only at the high rates (12 and 16 ounces).

2. August Spraying. Somewhat the same sequence followed - viz. suppression 5-6 weeks after spaying with triangular leaflets → multiple leaflets → normal leaflets → delay of flowering at high rates. Observations on these treatments indicated that no considerable reduction in the number of flowers set, except at the 1 lb. rates.

3. September Spraying. The original reaction occurred here within a month of spraying.

   The triangular leaflet modification was apparent, and cupping of leaflets gave a greyish green appearance to the treated plots. The plant did not produce a multiple leaflet, but switched quickly to normal size and shape. Suppression in height and density was not so apparent as in earlier spraying, and recovery was practically completed in mid November.

4. October Spraying. Visual modifications were not noticeable except at 1 lb. rates where a few cases of stem twisting were apparent. Flowering proceeded normally, and seed setting was not affected by the spraying, and it is considered that this spraying caused the least interference with the growth of clover.

There is sufficient evidence from this work to indicate that there is a differential reaction of subterranean clover when sprayed at different times during its development.

In regard to the effect of different formulations of 2,4-D on subterranean clover tolerance at the 4 and 8 ounce rate, no apparent difference between formulations was noticed in regard to the time of appearance of original modifications, severity of the primary suppression, and in the rate of ultimate recovery.

However, at higher rates, the recovery from the original symptoms occurred quicker in the amine plots than in the ester plots. In regard to September treatments, the amines and esters recovered at the same rate and esters were more severe and plots recovered slower at the 16 ounce rates.

The most severe formulation which produced all variations to the above modifications with abnormal severity, was parachlorphenoxy-acetic acid. Its action was spectacular in its injury on subterranean clover producing tubular leaflets, multiple stems, fluted leaves, etc.

The influence of strain in relation to tolerance of subterranean clover to hormone weedkillers was not thoroughly investigated. It was noticed, however, that Bacchus Marsh which was flowering during the September spraying did not subsequently show reactions to 2,4-D.

IV. BOTANICAL COMPOSITION OF SPRAYED IMPROVED PASTURES.

It has been recently emphasised by Willoughby (1954) that the ecological balance between species in pasture at a particular time can be largely influenced by competition for plant nutrients, particularly under certain fertility conditions, and at stages of pasture development, where supplies of nitrogen and phosphate are limiting.

His work has shown the competition which sub-clovers can contribute to the establishment of the grass component of the pasture.

Our observations particularly at Cootamundra indicated a considerable increase in the grass component in treated plots, especially on the July and August plots. This may be associated with either reduction in weed competition, or seasonal suppression of clovers, or an interaction of both influences. Detailed experimental work on this aspect is projected for this season.

Our work has indicated that certain trends viz. the economical control of weeds in improved pastures can be achieved; reaction to hormone weedkillers vary according to weather, time of spraying, formulations, and rate of application.

For full acceptance of chemical weed control as a regular practice of pasture improvement, it requires now detailed work on other weed problems, other associated legumes, and in particular the influence of spraying on the botanical composition as it effects the nutritional value of the pasture sward.

V. REFERENCE

Willoughby, W.M. (1954). Aust. J.Agric.Res.5: 157-180.

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