

HARROWING OF PASTURES.

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The practice of harrowing pastures appeared to gain popularity about the year 1929 and almost coincided with the introduction of the so-called "new system" of grassland management. This doctrine stressed the importance of harrowing to spread the accumulation of animal droppings after each grazing and maintained that the periodical cultivation of grass was just as essential as the cultivation of a root crop. Prior to that time many farmers in New Zealand had been alive to the necessity for spreading the animal manure and periodically carried out this operation with the use of chain or light tripod harrows. Subsequently however, grass harrows became more severe and manufacturers vied with each other as to the amount of "penetration" obtained by their particular make of harrow. The original main idea of a surface working implement was almost lost from sight; for a time the terms harrow and cultivator were almost synonymous, and the only limiting factor to deep cultivation was the horse power available on the average dairy farm. It is probably this last consideration which swung back the pendulum. Today there are few farmers who go in for deep pasture cultivation and probably the number who adopt the practice of mere fertility spreading is not much greater than it was ten years ago.

This paper, while agreeing at the outset with the principle of fertility spreading, seeks to examine the other reasons often advocated for pasture cultivation.

Reasons for Harrowing.

Grassland harrows may perform one or more of the following functions:-

- (a) Spreading of animal droppings.
- (b) Tearing out of portion of the herbage covering..
- (c) Penetrating the soil and opening up the sward along the path of the tines.

Ordinary chain harrows or light tripods will accomplish only the first of the above functions and may be said to be essentially concerned with the spreading of manure. Flexibility is an advantage in that on uneven ground all the surface is covered.

The second function as well as the first is carried out by a heavier tripod harrow. It is claimed that such an implement tears out weeds and patches of coarse grass which hinder the growth of better finer grasses. It tends also to produce an even surface in the sward, reducing high places and filling up low places.

A number of different makes of harrow claim to perform the third function and sometimes by having a short length of chain harrow attached, they endeavour to scatter animal droppings which have not been broken by the tines. The main portion of the so called penetrating harrows consists of sharp tines, sometimes bent forward and to one side to aid clearance of herbage and other material which may collect. The benefits claimed for these implements are that besides the spreading of animal droppings, and the tearing out of weeds and patches of coarse grass, the soil becomes aerated; drainage is assisted and the sharp cutting tines have the effect of root pruning which encourages the development of younger and more vigorous roots. The exponents of this type of harrowing only recommend such treatment on a pasture two or three times a year, preferably in late autumn, winter or very early in the spring. It is essentially treatment for moister conditions so that the implements can penetrate to the full and also, so that the soil will offer the minimum resistance. But what of the pasture? A maxim has arisen "Leave the land black", so presumably the pasture is considered to be quite capable of taking care of itself even under drastic treatment.

The spreading of animal manure.

Various estimates have been made regarding the fertilizing value of animal excrements. Hudson⁽¹⁾ has estimated that the fertility removed from a good pasture may be equivalent to 98 lbs. carbonate of lime, **185** lbs. superphosphate, 500 lbs. 3% potash salts and **750** lbs. sulphate of ammonia per acre annually and that through the grazing of mature stock most of the lime, phosphate and potash and a large proportion of the nitrogen is returned. It appears essential therefore, under cow grazing at least, to spread this fertility over the pasture. After cows have grazed a field the heaps of solid manure, representing heavy dressings of fertility on comparatively small areas, cause the grass in the immediate vicinity to become unpalatable and coarse dark green patches are formed unless the heaps are spread. Smallfield⁽²⁾ asserts that on really good pasture the spreading of droppings during the growing season does not appear necessary as the droppings seem to melt and decay very rapidly as compared with those on poor grass-land which are fibrous and do not decay readily unless broken up and spread. Elliott⁽³⁾ makes similar observations regarding Taranaki pastures, but gives the reason that during spring and early summer a vigorous pasture lifts and breaks up the soft droppings with no assistance from harrows. Sheep residues do not appear to need spreading as they are small and scattered, but those of the horse are more compact and are particularly prone to cause patchiness if left undisturbed.

The tearing of the sward.

When the coarse green patches resulting from undisturbed heaps of stock manure form in a pasture they persist for a considerable time due to the rank unpalatable nature of the herbage. It seems reasonable to suppose that they should be torn apart to allow air and sunlight to have a sweetening effect on them and so render them more quickly palatable to live-stock.

It can be taken as an axiom that any unproductive surface covering should be removed or disturbed to allow useful species to thrive. Under adverse conditions creeping grasses such as brown-top and paspalum form a carpet of herbage, often referred to as "mat", which is low producing and is not relished by stock. Valuable species such as white clover cannot thrive and the tearing out of much of the matted herbage will enable the air and light to get down to the soil surface. Moss is another undesirable species which suppresses useful species and which requires tearing out. Another example of the useless species which can be attacked by the harrow is bracken fern. On dairy farms bracken fern cannot be crushed out by dairy cows as with bullocks on sheep country and a good harrowing in the spring on dairy pastures tending to become fern infested is warranted.

The claim that severe harrowing removes broad leaved weeds cannot be substantiated unless at the same time the harrowing is drastic enough to tear out valuable grass species in addition. It is a question as to how far one can go in regard to the opening up of the sward without reseeding. A bare space in a pasture may ultimately be taken up by weeds if left for Nature to cover as best she may. There is a feeling that severe harrowing may cause the spread of ragwort and when one considers the nature of this weed - its rhizomes spreading beneath the sward capable of producing shoots when the turf is broken - there is reason to doubt the wisdom of disturbing the sward on ragwort country.

There are other objections to the opening up of a sward without subsequent reseeding particularly when its main components

- (1) Hudson, A.W., Bulletin 31, Dept. Sci. & Indust. Research.
- (2) Smallfield, P.W., "Farming in the Auckland Province", N.Z. Journ. of Agric., July 1935.
- (3) Elliott, A.G., "Harrowing of Pastures", N.Z. Journ. of Agric. August, 1938.

are useful species such as ryegrass, white clover and cocksfoot and it is considered that once such a pasture has been established harrowing should be confined to the spreading of animal manure.

Soil penetration.

The above statement has been made with due regard to the arguments put forward in support of turf and soil penetration. On a good firm pasture, without any vestige of mat, it is difficult, to determine to what extent soil aeration would benefit and whether root pruning is desirable. Just as on the soil surface any depletion of cover must be made good, so, under the surface roots cut off from the parent plant must be renewed: Do new roots tend to rejuvenate the parent plant or is unnecessary energy expended in their formation? In horticultural practice root pruning generally restricts growth and the same may apply with pasture plants. Whatever work is performed in pasture cultivation however should be reflected in the vigour or production of the sward and the following experiments are being carried out to determine what the effects are in regard to pasture production.

Experiment on a Rye-White Clover Pasture.

At Marton experimental area an experiment was laid down in 1934 using Hudson's alternate mowing and grazing technique. The pasture was of medium quality, dominantly ryegrass and dogstail, with white clover sub-dominant and containing some cocksfoot, poa trivialis and sweet vernal. As it was grazed by sheep any improvement from harrowing would not be due to the spreading of animal droppings and as there was no suggestion of "mat" or coarse patches such as are to be found on some cow pastures the benefits of harrowing would be confined to aeration, root pruning, etc. Six replications of plots were marked out for each treatment and the latter consisted of:

- (1) No harrowing.
- (2) Harrowing in autumn.
- (3) Harrowing in winter.
- (4) Harrowing in both autumn and winter.

A penetrating harrow of well known make was obtained and the cultivation was carried out in two directions, i.e. one stroke north to south and one stroke east to west. All plots received the same fertilizers (Super 4 cwt. per annum) and lime at the rate of 1 ton initial application and 3 cwt. annually was applied over the whole area. The first harrowing was actually carried out on treatments 2, 3 and 4 in July 1934, therefore the initial treatment of treatment 2 was, strictly speaking, winter harrowing. The following results were obtained up to 8th May, 1935.

Yield in lbs. of Dry Matter Per Acre.

	<u>Average Yield.</u>	<u>Relative Yield</u> (Treatment 1 = 100)
Non-harrowed plots	7,321 lbs.	100
Harrowed plots	6,747 lbs.	94.7

It will be seen from the above that the initial winter harrowing caused a reduction in pasture yield during the following season which was particularly dry.

From 8th May, 1935, the yields from treatments 1, 2 and 3 may be considered separately because the cultivations given were made in the autumn, winter or autumn and winter as originally set out. It is convenient to review these yields for each complete growth season, ending in the growth period preceding the autumn harrowing of each year.

Production from pasture harrowed at different periods
and non-harrowed.

		Yield in lbs. of dry matter per acre.			
Product- ion Period		NO Harrow- ing	Harrow- ed Autumn I	Harrow- ed Autumn & Winter	Harrow- ed Winter
8-5-35 to 15-4-36	Production	11,062	11,049	11,045	10,829
	Relative yield	100	99.9	99.8	97.9
15-4-36 to 7-5-37	Production	12,564	12,612	12,433	12,234
	Relative yield	100	100.4	99.0	97.4
7-5-37 to 12-4-38	Production	6,617	6,621	6,457	6,316
	Relative yield	100	100.1	97.6	95.5
Total 3 seasons	Production	30,243	30,282	29,935	29,379
	Relative yield	100	100.1	99.0	97.1

It is evident from the above data that no increase in production of herbage has been obtained from pasture cultivation, and in fact, the winter harrowing appears to have slightly decreased the yield. There did not appear to be any seasonal trend in the production of the various treatments, i.e., no particular treatment appeared to give a higher production than another at a period of shortage. No marked differences in the sward are yet apparent although botanical analysis of the sward suggests that winter harrowing has slightly increased the ryegrass at the expense of the cocksfoot and that autumn harrowing has slightly decreased the white clover.

The above experiment is being continued but it can now be stated that in this pasture cultivation with deep penetrating tines did not bring about immediate improvement in production.

Experiment on a Paspalum Pasture:

It is often stated that cultivating a paspalum sward even when the latter is not in a "sod-bound" condition results in considerable improvement. To determine the effect of deep harrowing on paspalum an experiment was commenced at Ruakura in the autumn of 1937. The pasture is dominantly paspalum with white clover sub-dominant and it is one typical of large areas in the north. A similar make of harrow to that in the Marton experiment is being used but the treatments are confined to two, viz.,

- (1) No Harrowing
- (2) Harrowing in winter.

A modification of Hudson's alternate mowing and grazing technique is used owing to the fact that paspalum under repeated mowing, even when one grazing is interpolated, would tend to assume the unnatural spreading habit common on lawns where it is present. Experience has shown that the system adopted needs further modification because part of the production is not measured and a new method is now being used. Nevertheless, the former method enables relative differences between the two treatments to be measured.

From the first harrowing, which was given on 27th July, 1937, until the second harrowing on 8th August, 1938, the production from the harrowed plots was greater by about 8 per cent. than on the

non-harrowed but the difference was not statistically significant. It is unwise to draw any conclusions at this stage, however: and one can merely report progress. No differences have yet been observed as regards the pasture sward of the two treatments, but in view of the nature of the sward, this phase of the experiment may later be of importance.

Summary:

In this paper I have endeavoured to bring forward some exact evidence on the question of the value of deep penetrating harrows. The effect of spreading animal manure has been merely discussed and it is agreed that under certain conditions this practice must have considerable value although some writers contend that *oil* vigorously growing pasture, it is unnecessary. Also, the removal by tearing out from the surface undesirable herbage is considered beneficial, but it should preferably be accompanied by reseeding because of the dangers of weed invasion on the bare spaces so created. The likelihood of the spread of ragwort on country infested with this weed when severe harrowing has been practised has been mentioned.

On a sheep pasture composed chiefly of ryegrass, dogs-tail and white clover severe harrowing either in autumn or winter or both autumn and winter, did not cause increase in herbage production over a period of three years. An experiment at Ruakura on a *paspalum* dominant sward is in progress and although some benefit appeared to be obtained in the first year the increase was not significant.

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DISCUSSION.H.E. Annett:

I am very pleased to see they have started experiments on harrowing, I am very much in favour of harrowing. In regard to more severe harrowing, I am against very severe tearing of the pastures. A short penetrating harrow has given the best results on my farm. In regard to the trials carried out at Marton, you will recognise they are only carried out with sheep. The harrowing of sheep pastures is not so important as with cattle pastures, I think it is very different proposition, and **even** you will find that **harrowing** will not spread dry droppings on the pastures so I would like to see trials carried out on dairy farms. I do not think results obtained on sheep farms would be accepted by anyone, and I would not like to apply them to dairy farms. I would like to tell you about other points but I know time is going on, but I think we have to be very careful in giving advice to farmers. Today farmers, if they can get out of work they will. If they say they do not want to harrow they will not do it.

A.W. Green:

Was it new -pasture laid down in 1934. If so I would expect very little benefit from the harrowing for the first two or three years.

J.W. Woodcock:

It was old pasture. With regard to bacteria - several years ago I did believe myself that there must be something in aeration of the sward - the bacterial activity and opening up of the soil and aeration - but actually we have to accept what results as I have put forward in this paper. They are actually results that have been obtained. As regards carrying out of experiments on dairying pastures - these pastures although grazed by sheep are a fairly high producing pasture: and the reason why we could not carry them out on dairy farms is on account of the technique involved. I quite believe that there may be different results but one thing we can say at present is that sheep farmers do not necessarily need to use this severe harrowing or any type of harrowing at all.