THE STOCK PARASITE POSITION IN RELATION TO GRASSLAND.

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1. INTRODUCTION: -

No clearer demonstration could be desired of the vital relationship obtaining between the condition of grasslands and the prevalence of internal parasites in, sheep, than this last year's widespread losses of hoggets from worms. Consideration of the high standard of efficiency attained at the present time in pasture improvement and in methods of supplying supplementary feed, only makes clearer the necessity for learning more of the relation of the parasite to permanent pasture, if this deterioration due to parasites is to be prevented. And whilst an effective method of medicinal treatment is still in most cases admittedly., lacking, it is obvious that proper management of the pasture is also required before the problem can be solved,

It is only too clear that the economic loss to the country due to hogget mortality would reach a very high figure could it be accurately expressed in £.s.d. In England, from the same cause, losses in one district amongst 43 farmers amounted, during the winter of 1933-34, to £10,341, *an* average *of* £240 each. Nor is mortality the only form of economic loss,; one must further take into consideration loss of. condition and failure to grow and fatten, Of sheep with a low grade infestation of parasites.

In the present paper it is my desire to discuss primarily the enormous part which is played by nutrition in control of parasitic disease:, and to emphasize the fact that a nigh standard of pasture management is no less essential than is intensive pasture improvement.

Throughout , references will, of necessity, be made to individual parasites; and of these in particular to the small intestinal and small stomach worms which are chiefly responsible for losses amongst hoggets. Mention will also be made of the large stomach or barber's pole worm - a notorious blood sucker affecting all classes of sheep.

It should be noted at, this point that knowledge of the existing parasitic diseases in New Zealand itself, is very slight in proportion to the whole volume of knowledge available on the subject. For this reason many of the views here expressed are derived from observation of English and Australian conditions; nevertheless, with some slight degree of modification they will no doubt be found to fit in with conditions in New Zealand also. It is hoped that investigational work now in progress will presently provide ample information specific to the country.

2. IMPORTANCE OF NUTRITION AND PASTURE MANAGEMENT IN THE CONTROL OF PARASITIC DISEASES:-

(a) Nutrition: -

The influence of proper feeding is a primary factor in controlling parasitic diseases. There should be nothing new in this statement, because early this century Gilruth, the then Chief Veterinary officer of the Department of Agriculture, and his

colleagues, streesed the importance of an adequate supply of, feed in controlling losses due to "parasi tic gastri tis" as he termed the disease responsible for losses amongst hoggets. To-day this same advice holds true because the severity of the disease amongst hoggets is definitely influenced by. the nutritional state of the young growing anima and an available supply of feed all the year round would prevent lambs suffering any check until they were twelve months old, after which time they become relatively immune to the effects of the parasites. The importance of nutri tion is again seen in the case of older sheep which have developed a resistance to the effects of the large stomach worm, because this immunity may he broken down if the sheep are exposed to under-nutrition, which results during a period of drought., Besides building up a powerful resistance, a plentiful supply of feed lessens the daily grazing period of the sheep and so decreases the risk of infection.

Until other effective means of controlling internal parasi tes are available, therefore, improved nutri tion offers the only solution, and it is to pasture improvement and improved methods of supplementary feeding that-we must look in future in order to stop the present deterioration due to increased parasitism, caused by under-nutrition, and to allow for greater production than ever before- However, where the rate of infection is high, as in the case of sheep grazing on heavily contaminated pastures-,---adequate feeding alone may not be a sufficient safeguard against the development Of disease because a thorough knowledge of proper pasture management is essential.

(b) Pasture Management:-

Although farmers scattered throughout the Dominion have pinned their faith on pasture improvement, as the solution to their problem, it has resulted in heavy losses and has so tended to become discredited in the minds of certain grasiers. The trouble is invariably due to lack of proper knowledge in regard to the manage-ment Of sown pastures and it is frequently believed that overstock----.-ing cannot occur on the latter, but unfortunately it can occur just a8 readily on improved as on unimproved natural areas.

Where one sheep is carried per acre; the chances of a single parasite being ingested by a sheep is unity, but where two sheep per acre are carried the chances are doubled and also the number of parasites contaminating the pasture is doubled, So that the chances of a sheep picking up parasites varies as the square Of the concentration of the sheep.

The aim should alwa-s be to expose the sheep to the least possible risk of infection ani this can be done by avoiding long periods of stocking, that is rotating the sheep, and avoiding the necessity for close grazing which leads to a maximum intake of parasites' due to the fact that, in any one paddock, the *mass* of the infection lies under the protection 'of the lowest leaves of the plant near the ground.

Other factors influence pasture management and these will be discussed fully below.

3. FACTORS TENDING TO INCREASE THE RISK OF PARASITIC INFESTATION:-

[a) Overs tocking:-

Sown pastures are capable of being stocked at the rate of ten or more sheep to the acre, wit iout being overstocked. However, if the sheep are not rotated or th : numbers reduced and this heavy stocking is persisted with, it will not be long before the more palatable species of plants are eaten out with the results that the

sheep are soon exposed to under-nutrition, Given unfavourable seasonal conditions, grave overstocking may result and as a consequence of this lack of sufficient feed the resistance of the sheep becomes lowered. In addition, heavy contamination of the ground results and the sheep becomes exposed. to a heavy rate of infestation, Both factors combined, result in definite clinical signs of parasitism being shown and unless something is done in the way of removing the sheep or reducing the numbers, mortality will result. Where overstocking occurs on improved pastures the risk of sheep becoming parasi tised is greater than on natural pastures, due to the increased rate of stocking, which is at times out of all proportion to the available f e e d , ,

(b) Close Grazing:-

This is closely related to overstocking, and as mentioned earlier, it leads to a maximum intake of infective parasites. Sheep being selective feeders tend, to nibble certain plants very close to the ground and for this reason long periods of stocking should be avoided and cattle used to cleanup the roughage.

c) Effect of Certain Climatic Conditions:-

Dull warm weather with intermittent showers, in contradistinction to bright sunny weather, is ideal from the point of view of the parasite i tself, and i t is during such weather that sheep are exposed to the greatest risk of infection. However, other seasonal influences play their part in influencing the survival and longevity of the parasite on pasture. These will be discussed under separate headings as follows:-,

(i) Drought: This has always been' considered *one of* the most lethal natural fac tors in controlling parasi tic diseases . The life cycle of the large stomach worm, for example, is such that the female parasite in the stomach of the sheep lays eggs. (at an extremely rapid rate, a single female being capable of laying 5-10,000 eggs per day and a sheep showing clinical evidence of the disease may harbour 2-10,000 parasites of which half would be females) which are voided with the droppings and provided satisfactory moisture conditions are available they become embryonated, hatch in 24 hours and liberate a small immature parasite or larva, which after undergoing two moults reaches the infective stage, at which stage as the name indicates, it is ready to infect a sheep. The time taken to reach the infective stage is five days under artificial conditions but under field conditions where temperatures vary , six or more days would probably be required. The life cycle may be illustrated diagrammatically as follows:-

'Sheep .	(Pas ture.			) Sheep.
Adult female parasi te .	Egg (hatches in 24 hours)	Imma ture parasi te (pree. infective stage).	Infective Stage (reached o n 5-6 day) .	Adult.

Drought a.:fec ts the large stomach -worm adversely in that it destroys all stages of the parasite in a few weeks and so it is no source of danger during prolonged dry weather. However, in the' case Of the small intestinal worm, with its high pathogenicity for young sheep, the eggs will develop to the stage where a young viable parasite moves within the shell but will.-not develop further and hatch until adequate moisture is provided.. In this stage it can remain alive for 15 months and therefore, although development is inhibited during drought , the storing up of "potential" infection occurs and this will lead, with the advent of prolonged rain, to a mass hatching resulting in rapid infestation of the sheep and with an already lowered resistance it may succumb to the effects of the

parasites. This was found to be a primary fac tor in the winter outbreaks of "parasi tic gas tri tis" in England in 1933-34, which resulted in euoh heavy losses economically.

Light rain during periods of drought will often help to wipe out an infection already present due to the fact that the mass of already embryonated eggs hatch and the pre-infection stages are over taken wi th dryness, before they can reach the infec tive stage which is further resistant to dessication.

(ii) Cold: If the distribution of the large stomach worm and the small intestinal paraei te in Australia, were marked on a rainfail map, it would be seen that the former is distributed in the summer rainfall areas (chiefly central and northern New South Wales and southern Queensland) and the latter is distributed in the winter rainfall areas although i t does extend up in to the summer areas. I t indicates that the large stomach worm is a summer parasite, depending on a summer rainfall for its existence and showing its effects in late summer and autumn, whereas the small intestinal parasite tends to 'be a winter parasite being distributed over the southern and colder states such as Tasmania and Vic toria, where the, s tomach worm is practically nan-existent. This latter parasite furthermore does not extend into areas having a rainfall less than 20 inches unless in exceptionally wet seasons and it develops best at temperatures' from 75-85° F. Losses in the case of the small intestinal worm have been recorded in areas having rainfall as low as 16-18 inches annually and for this reason is probably the most widely spread parasite in Australia,

In all probability a similar distribution in respect Of rainfall and temperature exists here in Mew Zealand of which we are not yet aware. The spread of the large stomach worm is limi ted by temperature particularly and requires a summer rainfall - it is definitely not a winter parasite. On the other hand the small intestinal parasite and its close relation the small stomach worm, are both capable of developing during the winter and will extend into areas with very low temperatures; Jus t exactly what part heavy frosts play on the development of this parasite is not exactly known.

(iii) Wst Seasons: The superabundance of herbage which follows a wet season favours the development of the paraai tes on pasture in that it protects them from the drying rays of the sun, whereas short pasture leads to their destruction because air currents and the heat of the sun soon dries up the droppings in which they would develop were an adequate supply of moisture available.

(d) The Nature of the Herbage:-

In England, Taylor has expressed the view that clover pastures are a greater source of infection than grass pastures because the structure of a clover plant is such that parasites can climb up the simple leaf stalk and reach the trifoliate leaf without being short-circui ted in any way, whereas the blade and sheath of a shoot of grass tends to divert the ascending parasites to the underside of the lower leaves , which are usually avoided by the grazing sheep.

(e) Ploughing, Topdressing, and Burning of Paddocks:-

The view held that ploughing a paddock will destroy the infective parasites it harbours is entirely incorrect in the light of recent knowledge. It has been shown that after being turned in by six inches of soil they can regain the surface and remain alive for ten months or more, the loose soil of a ploughed paddock being more favourable than the hard surface of a permanent pasture where

they are exposed to rapid' alternation of moist 'and dry conditions.

No actual experimental work has been carried out which shows the effect of liming and topdressing on the survival of parasites but the application of *one* ton of salt per acre to a pasture had no effect in reducing the soil infestation;

Although burning is not a practice to be recommended, if carried out with due respect to the seeding of grasses so as to prevent deterioration, it. will destroy an infestation present. Paddocks left unstocked following a burn will prove invaluable for use by lambing ewes and young sheep.

4. THE PART PLAYED BY MEDICINAL TREATMENT:-

From time immemorial' veterinarians have administered medicines in the treatment of disease and more recently they have advocated the 'use of drenches in the control of parasitic diseases. However, without detracting too much from the efficacy of this measure, it is only of secondary importance in any scheme of control to protect hoggets from the ill-effects of the small. intestinal worm. Although.. the blues tone and nicotine mixture is widespread in its use, its efficiency is low against the latter parasite and should be considered only a supplementary measure, to adequate nutrition. Also, the nicotine fraction makes the mixture a dangerous one where weak sheep are concerned. In addition, for satisfactory results, treatment should be commenced at weaning time and repeated every three weeks until the following spring.

The large stomach worm differs from the small intestinal parasite in that it is less refractory to the action of anthelmintics and can be effectively removed by drugs such as carbon tetrachloride, bluestone, bluestone and nicotine, and least of all tetrachlorethylene. Consequently medicinal treatment against this latter parasite, should be considered, of primary importance.

Heavy expenditure' by graziers on the purchase of drenches, often gives them a false sense, of security, in that they rely-almost solely on the efficiency of the drench to control the parasites, -with the result that hoggets die because the treatment does not remove the heavy rate of infestation to which, they are often exposed or compensate for the under-nourishment which lowers their resistance to the invading parasi tes.

5. PREVENTION OF PARASITIC DISEASE:-

Already the importance of adequate nutrition and proper pasture management havs been stressed as two important fundamentals in lowering mortality from internal parasites. Therefore, in this last section it is proposed tc discuss some of the nutritional measures which can be adopted and to point out by what means the risk of parasitic infestation may be minimised.

(a) Pasture Improvement:-

The advantages of pasture improvement far outweigh the disadvantages, and it is a very vita2 factor 'in controlling the effects of parasitism and in increasing production. It has offered the only solution in certain areas -ok New South Wales where sheep-breeding has been oonsidered impossible due to the effects of worms in young sheep. At times instead. of increasing the carrying capacity gradually, pastures, merely because they are improved, are subjec ted to such stocking that they are completely eaten out and yet graziers appear resentful if it is. suggested that sheep carried on such pastures are definitely under-nourished. Consequently for optimum benefits to be derived, both in respect of nutrition and Control of

internal parasites, a system of rotation, which makes it possible to practise intensive stocking for a short period and then spelling to allow regeneration of the pasture,' is ideal.

Resorting to sown pastures as a means of overcoming the effects of parasitism. often results in one or two improved grass paddocks becomi"hospital" paddocks, Which are danger areas for young sheep. For example, it is often the practice to have one or two paddocks which are a good source of available feed and are capable of heavy stocking. These are kept usually fairly continuously stocked y sheep which are in an unsatisfactory condi tion - most frequently as a result of parasitic infestation. As a result, they become fairly heavily contaminated, and when" ewes and'lambs or weaners, already showing the effects of parasitic infestation, are "put' into the paddock 'at a high' rate of stocking, in' the hope that the extra, feed will overcome the effects of the' worms, instead of 'picking up they die because the extra, feed does not compensate for the'mass infestation. they receive. However, should the change over be made during a dry spell the results would be beneficial due to the' fact, as previously pointed out, that' dryness inhibits the development of the parasite to a stage when it is a dangerous menace to the sheep.

Need for greater Knowledge':- "It is necessary for sheep-owners to realise that the greater the 'restriction of a grazing area and the- less selective feeding compulsory for the sheep, together with an increased rate 'of stocking, the greater is the care and intelligence required in the management of both pasture and sheep" - such is the opinion of Dr.' Clunies Ross, the leading authority on parasitic diseases in Australia and now--appointed to the International, Wool Secretariat in London.

(b) Turnips and Fodder Crops:- '

Graziers differ in their opinions of the value of turnips as a source of feed for hoggets. Some will state that losses did not commence until the hoggets were "put on to turnips", others cannot speak too highly of the excellent results they have obtained. For my part I have had little experience of this method of farming and cannot discuss the question very thoroughly, but results obtained in England with sheep pastured on arable land may give some indication of the possible cause of losses. It has been shown that two types of losses occur on arable land. The first, or least important, is due to sheep becoming infested from a heavy residual infection which has survived in the soil from the previous season, and the second is due to "auto-infection" where sheep infect the soil from their own droppings and become re-infested. Although the first type of loss can only be overcome by selecting new areas for ploughing, the second can be overcome by allowing the sheep to graze only small areas at a time, occupying one area no longer than a week and definitely not allowing them to wander back over the already grazed portion.

(c) Handfeeding:-

Where the plane of nutrition plays such an important part as it does in helping hoggets to resist the effects of the small intestinal and small stomach worms, feeding should be commenced early. If hoggets are allowed to get to the stage where they are definitely weakened by the effects of the parasites which they harbour, hand feeding will not prevent losses. Gradual loss of condition is the first clinical sign of parasitic infestation and if pastures are becoming bare, supplementary feeding should be commenced. Weak lambs are preferably drafted off and kept separate from the more thrifty ones and if the necessity arises they can be put into bare yards with a few old ewes and fed on dry feed, which, unfortunately, they often refuse to eat. Where lambs have actually begun to die great difficulty will be experienced in checking further losses especially

where lambs take time to become accustomed to artificial methods of feeding.

(d) Rotation of Stock:-'

The rotation of cattle, over twelve months of age, with sheep is very valuable, in that more suitable feed is provided for the latter as the coarse roughage, which tends to become dominant, is removed, allowing the more palatable grassea to survive. Horses actually do 'damage to a pasture, being selective feeders and for preference should not be rotated with sheep. Cattle further reduce the degree of infestation on the ground and are not a source of r-e-infestation, except in fluke areas,

(e) Danger Areas:-

During dry spells, creek banks and river beds are often a source of heavy infestation because sheep tend to. concentrate on these areas, which usually-. have a green shoot, and so heavily contaminate the 'ground. Low-lying areas receiving drainage from hilly country provide green- feed on which the whole of' a flock may concentrate and provide very heavy contamination.

CONCLUSION::

Throughout this paper grasslands -and grassland management has been kept well in the foreground and no attempt has been made to discuss other aspects of the stack parasite: problem, such as symptoms;- diagnosis and treatment. It is hoped that too much importance has not been placed on the question of nutrition, to the detriment of other aspects of control, such as medicinal treatment and methods of psophylaxis. Whereas the smail intestinal and, small and large stomach worms are responsible for ,the major proportion of losses from' parasitic diseases , other parasites are at times responsible for mortalities and in these cases the skill of the veterinarian should be sought.

One cannot stress too strongly the close co-operation which should exist between the Fields and Veterinary Divisions of any institution in order that sufficient light could be thrown on a problem which is of such economic importance to, the country and to the individual.

DISCUSSION.

Dr. Hopkirk, Wellington, stressed the importance of nutrition in control of parasites and pointed out that the previous season had been an abnormal one in that although in many parts feed- was available, it was of a soft, mushy type and unsuitable for sheep, in that there was not sufficient roughage for them to be able to chew their cud.

He further pointed out 'that sheep coming from hilly country where they are exposed to little or no infestation of parasites, on to plain country, have no immunity to parasites 2nd -frequently succumb to the heavy infestations to which they are exposed on improved country.

Mr. Dossor, Timaru, was pleased to hear how much the nutrition- @. aide had been stressed and said that he himself had a good deal of experience of parasite trouble in Canterbury. From his experience, sheep weaned on to stubble paddocks frequently did better than those put on. to rape. He wanted to know whether there was any explanation for this observation. He stressed, the fact that prevention was better than cure.-

Mr. Smeaton, pointed out that prior to weaning a farmer was advised by a local veterinarian to put his lambs suffering from parasites, on to bare paddocks and dry feed. He did this, but the death rate practically doubled ahd he was at a loss to know what to do. In describing this incidence he was wondering whether the speaker could give him any explanation of the fact.

Mr. Stringer, Oamaru, stated that a North Otago farmer had some 300 hoggets of which 16 died, all being ewe lambs. He tried out various drenches but they had no effect. He said that on post-mor tom of these lambs the wind-pipe was blocked by masses of long, white worms, and wished to know if these were Lungworms.

Dr. Hopkirk, in briefly replying to questions which had been asked him pointed out that 'lambs should be weaned on to green grass paddocks which have been rested and could later be put on to rape. He further pointed out that in his opinion the excess of white clover in Canterbury was one of the attributing causes of the heavy infestation of parasites in lambs. In answer to one question, he pointed out that putting bluestone in drinking water was quite ineffective in controlling parasites.

He further stated that there was no difference in the resistance of ewe or wether lambs to the effects of parasitic infestation. However, whereas wether lambs can be fattened and sold in January or February, ewe lambs are carried over through the Winter and succumb to parasitic infestation in late Autumn and early Win ter.

Mr. Cole explained that there should be no difference in weaning lambs on to rape or stubble paddocks, provided both hnd been stocked previously with sheep. The effect of ploughing does not completely destroy all parasites present in the soil, but from experience, sheep weaned on to ploughed paddocks are exposed to less infestation than those weaned on to permanent pasture kept continually stocked with sheep.

It is very difficult to discuss the relative value of this pr ocedure, without actually knowing the history of the paddocks concerned.

In reply t o Mr. Smeaton the speaker pointed out that when lambs were allowed to get i n t o a very weak condition, frequently lsss of appetite resulted and although hand fed, they.

showed n 3 inclination to eat. Where losses are experienced every year, lambs should be hand fed to a small extent before weaning s3 that should the necessity arise later, they do not take two or three days to become accustomed to dry feed.

Furthermore bluestone and nicotine is the only drench with any efficiency against the parasites responsible for hogget mortality.

In regard to Mr. Stringer's remarks, although Lungworms are present in large numbers, frequently in lambs, it is usually found that these lambs have in addition a heavy infestation of the Black Scsur parasite. While there is no medicinal treatment for Lungworms, treatment of sheep with bluestone and nicotine will remove a large percentage of the Black Scsur parasites, increasing the resistance of the individual sheep and allowing it to throw off the infestation with Lungworms.