THE DAY AND NIGHT GRAZING SYSTEM

By V. C. GOODALL, Grasslands Division, Department of Scientific and Industrial Research, Palmerston North.

The influence of the grazing animal on the composition and productivity of the pasture sward has been a major subject for investigation by Grasslands Division over the past 10 to 12 years (1), (2), (3). In particular we have been interested in the effect of dung and urine on pasture growth, and at previous conferences of this association (4) papers have been presented to show that the quantities of plant nutrients returned to high-producing pastures are equivalent in nitrogen to over a ton of sulphate of ammonia per acre per year, in phosphorus to over 6cwt. of superphosphate, and in potash to nearly a ton of 30 per cent. potash salts.

From these figures it is obvious that at high production levels the quantities of nitrogen, phosphorus, and potash excreted by grazing animals are far greater than anything that is applied by the farmer as topdressing. It follows from the results of these and other investigations that the nutrition of pasture plants is dependent more on the grazing animals and on management than on any other factor that may be under the control of the farmer.

If the grazing and management system of a farm is such that dung and urine are not returned to the pasture in the same proportion to the herbage production of that pasture, considerable changes in fertility levels may be rapidly brought about.

Under sheep grazing conditions it is unlikely that any marked transference of fertility from one paddock of the farm to another will take place. On the dairy farm, however, owing to the fact that the animals must be handled twice a day, it is possible that the paddocks which provide the major proportion of herbage are not necessarily those which receive the major return of dung and urine.

There is one aspect of dairy farming which I believe results in a transference of fertility through the dairy cow from one part of the farm to another, viz., the grazing system which involves different sets of paddocks for day and night grazing respectively.

A recent survey of dairy farms conducted in the Taranaki and Manawatu districts shows that the system whereby a paddock or 'series of paddocks is reserved exclusively for night grazing is very common.

On many farms there is a quite obvious advantage to be gained from the operation of such a management system ; at the morning milking no farmer wishes to have his cows any further from the shed than is necessary. Consequently he uses the paddock or paddocks nearest to the shed for night grazing, and moves his cows to the farther paddocks during the day. There could be no criticism of this system if it could be shown that there is no transference of fertility from one part of the farm to another, i.e., that there is no difference in production levels between the paddocks that are used for night and day grazing' respectively. That this is actually the case in practice is suggested by Hancock at Ruakura (5), his conclusions being based on observations of the amount of time spent in grazing and the numbers of defecations and urinations occurring during the day and night periods respectively. Hancock. states that a dairy cow does 60 per cent. of her grazing during the day and. the other 40 per cent. between afternoon and morning milking, that is at night, and that the distribution of dropping from the cow is a little less, than 60 per cent. during the day and a little more than 40 per cent. during the night. Hence he concludes that if the day grazing area is 60 per cent. of the total with 40 per cent. reserved for night grazing, transference of fertility can be completely avoided. The ratio 60 : 40 as regards feeding time of the dairy cow is supported somewhat by the statement of a prominent farmer who found that over the years he required five-eighths of his farm for day grazing and three-eighths for night grazing, which is reasonably close to the 60 : 40 ratio (6).

As regards excretion, the opposite point of view is put by Sir George Stapledon (7) in his book "Ley Farming," where he states that "it is a well-known fact that animals excrete more at night (including dusk and dawn) than they do in the daytime". There

is an obvious discrepancy between the conclusion of Hancock on the: one hand and of Stapledon on the other, and it was considered that a further investigation of the problem should be made.

An obvious explanation of the apparent contradiction lies in the fact that Hancock bases his conclusion on the length of time spent in grazing and the number of excretions occurring during measured periods. He does not take into account the possibility that cows may pass different weights of dung and urine at individual voidings. His conclusions are also at variance with observations by officers of this Division over a considerable number of years, that on a majority of dairy farms there is a marked difference in fertility, as shown by pasture composition, between front and back paddocks of the farm. In the 'paddocks near the dairy shed the pastures are predominantly rye-grass, whereas in. the paddocks which are furthest from the shed and which are used for day grazing, lower fertility grasses are dominant. If these observations are a' reflection of the normal conditions on New. Zealand dairy farms, there can be little doubt that 'fertility levels in day and night paddocks are very different, regardless of the factors that have brought these conditions about.

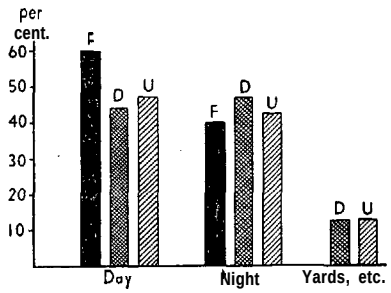
Investigations from this angle were taken a step further in a trial conducted at Palmerston North in which all the dung passed by a number of cows over a period of 36 cow days was collected, weighed, and dried. From these figures the percentages of dung passed at given periods were calculated. The cows used. for this trial were Jerseys in milk, grazing being controlled by electric fence. The distance from shed to paddocks was 150yds.

'The urine passed during this trial was not collected, but all urinations were timed with a stop-watch and individual times of each cow recorded.

It should be mentioned that the cows used had been well handled. The flashing on of a torch at night did not appear to disturb them' at all, and in some cases it was possible to collect faeces direct into weighing container. The average weight of dung passed per day per cow was just over 401b. wet weight, while individual droppings varied from llb. up to 151b. This large difference in individual weights may, I think, be attributed to a period of stormy weather during which there was considerable activity ; during calmer weather

there were longer rest periods and consequently fewer but larger defecations. Weights of individual defecations reached their maximum between 3 'a.m. and 5.30 a.m., when the average for the group reached 5.5lb.; the average for the balance of the 24 hours was approximately 3.5lb. With the urine a similar pattern was followed, although no measurements of quantity were taken. The following figures are based purely on the number of seconds spent in urinating. Here again the average time was greater in the early morning, reaching just over 10 seconds per urination, as against 7.5 seconds during the rest of the period. Over the entire period of the trial the cows as a group averaged 12 defecations per day and urinated 11 times,, these figures coinciding with those of the Ruakura workers.

With the extra weight of dung deposited in the early morning and more lengthy urinations during the same period, our percentage figures are somewhat different. The group as a whole deposited only 43 per cent. of their dung in the day paddock, while 46 per cent. was dropped in the night paddock, the balance being passed on the way to and while waiting at the milking shed. With the urine on a time basis, 46 per cent. was passed in the day paddock and 43. per cent. in the night. The accompanying diagram sets out the balance between the estimated ingestion and the actual percentage of the total dung and urine passed in the day and night paddocks and in the shed and yards.



The point clearly shown is that the actual dung dropped in the day paddock is equal to only 72 per cent. of the dung that would' be deposited here if the feed eaten were in proportion to-the dung dropped, while the dung dropped in the night paddock is 15 per cent. more than should have been returned.

One can readily understand what will happen to a sward that is denied 28 per cent. of its natural manure return, and the improvement that must 'take place on a paddock receiving 15 per cent. more manure than it is actually producing. If we take a herd of, say, 50 Jersey cows grazing the day and night system, they will; over the 6 main producing months of the year, remove over 25 tons of dung from the day paddock, plus a large volume of urine. It can be estimated that this manure removed, from the day paddocks in 6 months represents in fertiliser equivalent about 5801b. of superphosphate, 850lb. of 30 per cent. potash salts, and some 15001b. of sulphate of ammonia,, while on the other hand the night paddock benefits by an equivalent of approximately 2cwt. of superphosphate, 3cwt. of 30 per cent. potash salts, and 5cwt. of sulphate of ammonia.

The amounts seem large, but are for 50 cows, and many herds are larger than this. In addition, there is in fertiliser equivalent about 3601b. of superphosphate, 5301b. of 30 per cent. potash salts, and 900lb. of sulphate of ammonia deposited in races, roadways, and in the dairy shed yards.

It was extremely pleasing; while visiting dairy farms in Taranaki, to see many tanks installed, at the yards for the collection of much of this valuable material deposited there, and while this does not always find its way to the day grazing areas, it is being used to advantage' on weak areas of the farm. However there is still too much being wasted, this being washed off the yards to pollute drains and other areas.

So much for the removal and depositing of dung and urine ; what, if anything, does it amount to when brought down to herbage production in pounds of dry matter per acre?

At Aberystwyth a trial of day and night grazing over some three years showed yields of herbage in the night paddock twice as great as those from the day paddock, while in a favourable year three times the amount of herbage was obtained from the night paddock (7).

At Grasslands Mr Sears and his staff have recently been conducting field trials to measure the difference in yields under the day and night grazing system. In this trial sheep were used, and on the assumption that sheep also get 60 per cent. of their feed in the daytime, one area was cut up into 60 per cent. for day

and 40 per cent. for night grazing. It was known from collections during other feeding trials over some years that sheep pass 60 per cent. of their dung at night, and 40 per cent. during the day.

With this knowledge and using 60 per cent. of the area as day paddock the trial was really designed to find how quickly fertility may be transferred through the grazing animal. A factor in this trial that would further speed the transfer of fertility lay in the fact that the sheep spent 16 hours in the night paddock and 8 hours in the day paddock. This should be compared with the grazing times on a large number of dairy farms examined. On the average 9 hours were spent in the day paddock and 12 hours in the night paddock, the rest of the 24 hours being spent in the yards, etc.

In the first few months of this trial very little difference was evident in the yields of dry matter per acre, but in the following year the production on the night paddock exceeded that from the day paddock by over 20 per cent., while in the following 9 months this difference further increased to 28 per cent. The last 9 months did not include the spring period which would have probably 'widened the margin of yields between the two paddocks.

Marked botanical differences also developed between the two areas. In the day paddock the ryegrass content of the sward fell rapidly as the fertility was lowered, with a considerable proportional increase in the other grasses, chiefly cocksfoot; while percentages of white clover increased, and, in fact, the white clover yielded more dry matter per acre than did that in the night paddock. In the night paddock, while the percentage of ryegrass did not increase a great deal, there was, a large increase in yields per acre of this species.

On the other hand the white clover did not produce as much' as in the day paddock. The drop in production of this clover 'would possibly be due in no small' measure to the overshadowing of the more rapidly growing ryegrass. This shading would' also be very hard on any young plants or seedlings,- as the exclusion of light would spell a fairly rapid end to plants in the seedling stage.

It must be' remembered that these changes in yields and botanical composition took place in only two and a half years of the! day/night grazing system

and on good country; on poorer country one would expect a more rapid deterioration in the production of the day grazing areas, especially with poor clovers in the sward.

A further trial in which we grazed on the day/night system for one year and then reversed the order, gave clear evidence of the ease with which fertility may be, shifted about the farm.

This particular area had been grazed regularly at the 3in. to 4in level for about 3 years and was carrying an even rye/white sward, producing in the vicinity of 13,000lb. dry matter per acre. In this trial it was grazed with sheep that spent about 8 hours in the day paddock and 16 hours in the night grazing area. It should be pointed out that with sheep going straight from paddock to paddock there was no loss of dung or urine in shed or yards, etc., everything that was passed being deposited on one or another of the paddocks.

From an even start as far as production was concerned,. changes were soon apparent. The growth in the night paddock was such that on one or two occasions we resorted to topping with the motor mower, the herbage topped being returned to the paddock. After one year of day/night grazing the relative yields were 100 for the day paddock and 144 for the night area. This was chiefly due to the ryegrass yield that rose from 60 per cent. in the original sward to 80 per cent. in the night paddock, with a corresponding decrease in the clovers. In the day paddock there was an increase in the white clover percentage and also in the cocksfoot, ***Poa*** *trivialis*, and browntop, with a proportional decrease in the ryegress. Thus again there was a detrimental change taking place in a short time and it must surely follow that with the lower fertility grasses creeping in, the milk bucket will be harder to fill.

After 18 months as day and night paddocks the area was closed to stock and the herbage mown off at the 3in. to 4in. level for three months. Grazing was then reversed and what had been the day paddock became the night area, while the night area. became the day paddock.

It must be remembered here that there had been a build up during some 18 months on what was now the day paddock and it would not therefore be expected that rapid changes would again take place. However

at the end of another year the night paddock, which had previously been the day paddock, increased-its yield by almost 50 per cent, and in actual weight of herbage produced. 16 per cent. more than the day paddock (previously the night paddock). Soil fertility can bé defined as the capacity of the soil to satisfy the demands of a crop, be it grass or otherwise, for moisture and nutrients and I think that it has been shown that under the day and night system' as such, there is a definite transfer of fertility from day to night paddock. Hence the day paddock has just not the capacity for continued high production. The fertility equilibrium has been upset by man, and it is for man to restore it to its balance.

What steps **then,** should we take to eliminate, or at least cut down, this transfer of nutrients from place to place? The obvious one of course is to do away with the day/night system of grazing management; there are numerous farmers that could do this without a great. deal of effort.

There are, however, many farms throughout New Zealand, and indeed we visited a number in Taranaki, where to graze the back of the farm at night would be well nigh impossible, the distance from the shed to the back paddocks, with gullies or creeks to cross, would make night grazing of these areas an extremely irksome affair.

One possible adjustment for such conditions would be the feeding on to the day paddock of hay, silage, and crops, which had been grown on the night paddock, but it would take 150 tons of extra silage, that is 3 tons per cow over and above any silage fed that had been made off the day paddocks, to replace the 25 tons of dung carted off by 50 cows. This is a lot of silage, but efforts must be made to return the fertility of these day paddocks and so retain the higher-producing species. A further adjustment could be made by applying a greater proportion of the total fertilisers used, to the day paddock.

Whatever method is used, the aim must be to return to the sward as much animal manure as is possible, to enable the species present to yield to their maximum production.

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DISCUSSION

Q. Would artificial fertilisers be as good as blood and bone for the purpose of replacing the fertility transferred?

A. Yes,, and would probably also give much quicker results, but, as I said, the amounts needed are very large and quite impracticable. A better way is to balance up by stock management on the farm.

Q. Do your figures quoted for fertiliser equivalents assume that all the nutrients in these fertilisers are available to the plant?

A. Yes. I "nave made that assumption, but obviously there will be some error in this owing to the differences in availabity from both types of manure and fertilisers.

Q. Would not there be some' extra losses of nitrogen to the air from the dung and urine droppings ?

Dr. Melville quoted the recent work of Doak showing losses of nitrogen from urine. "Measured losses of nitrogen as ammonia from urine patches under average weather conditions have been of the order of 15 per cent., but other data leads one to expect very much higher losses under hot weather and soil conditions. In addition there are of course the leaching losses and thus we come back all the time to the importance of adequate clovers for nitrogen build-up to keep the cycle going.

Q. Would a cover on a manure sump. avoid losses of nitrogen.

Dr. Melville: We have no measurements on this other than Sears's data showing losses of up to 30 per cent. during a few days' storage of urine during. hot weather. A cover on a sump would probably not help much: It would help if you could make the contents acid in some practical way. Overseas they sometimes add materials to a sump in order to buffer the solution against excess alkalinity development and thus keep the losses of nitrogen down.

Q. Does urine passed on to long grass lose nitrogen to the air to the same extent as urine passed on to short pasture?

Dr. Melville: The nitrogen, loss this way occurs through the decomposition of urea by micro-organisms. These organisms are on the foliage as well as in the soil. I would say that losses are similar for both long and short pasture.