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THE EFFECT OF GRAZING TIME AND SUPPLEMENTARY FEEDING OF HAY ON PRODUCTION PER COW IN EARLY LACTATION

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SUMMARY

An experimental approach has been made to assessing the effect on per cow production of farm management practices designed to minimize the wastage of pasture herbage and the damage to sward and soil structure which occurs during late winter and early spring in areas such as the Hauraki Plains and parts of Northland.

The effect of restricting the time available to cows for grazing each day to either four hours or eight hours has been compared with unrestricted grazing, and the contribution of supplementary feeding with hay of good to average quality has been assessed under these conditions.

Experimental treatments were applied for three weeks, of which the first week comprised a changeover period, and experimental results were assessed from productions for the last two weeks.

A split-plot latin square design was used, individual members of each of twelve sets of identical twins being allocated either to one group which was fed hay as supplement or to a second group fed on grass alone. These groups were designated "hay" and "no hay". Grazing times were allocated to cows of the same set according to the arrangement of a 3×3 latin square, of which there were four replicates.

It was shown that both grazing time and the feeding of hay as a supplement had large and statistically significant effects on milk yield, milk composition and liveweight. Under the conditions of the trial, the feeding of hay after four hours' grazing produced a greater increase in milk yield and milk solids than doubling the time available for grazing.

Cows restricted to eight hours' grazing, on average, consumed 9 lb hay daily and produced similar amounts of milk and milk solids as when given unrestricted grazing. It has been estimated that under these conditions the efficiency of conversion of the total feed consumed to milk was appreciably higher when the diet was grass alone, since approximately 2 lb of hay was required for each additional pound of fat-corrected milk.

The short-term economics of the conversion of hay to milk have been examined, and it has been concluded that under conditions similar to those applying in the present trial, a comprehensive appraisal of likely responses to a complete range of different supplements, including concentrates, is required.

Attention has been drawn to the appreciable amount of hay consumed where grazing was unrestricted, although this did not increase production significantly.

The merits and disadvantages of the current experiment have been discussed, and requirements for further study of this problem of adequately feeding cattle in early lactation have been outlined. Within this context, the importance of initiating and developing complementary investigations into the effect of differing management systems on pasture growth, utilization and yield, and on soil structure and fertility is stressed. These must proceed within the local problem environment.

INFORMATION derived from many papers presented at previous conferences of this Society has assisted in establishing sound principles for increasing plant and animal production in New Zealand. Successful application of these to a wide range of environments has generally required few modifications.

In some important dairying areas, however, local application of what is currently recognized as good husbandry and management is seriously complicated at times by problems of topography, climate and soil, both separately and in combination. In parts of Northland and the Hauraki Plains, for example, difficulties arising from combinations of at least two of these factors can seriously complicate adequate winter and early-spring feeding of livestock, and prejudice both pasture and animal production for the full dairying season.

Difficulties of wintering dry stock during June and July have been reduced on many farms through the use of wintering barns or uncovered platforms made of concrete, sawdust or wood shavings. Here the cattle are fed until calving, and it is not uncommon for them to be wintered on supplementary feed (mainly hay) during the last eight weeks of pregnancy. In these circumstances, hay is generally fed to appetite. Unless cows have been very poorly fed in their previous lactation, and thus are very thin at the time of drying-off, they will regain previous weight losses on a ration of average quality hay and calve in good condition.

The spelling of pasture during this period generally results in substantial grass growth, and makes available feed sufficient to meet the markedly increased nutrient requirements of cattle in the critical, immediate post-calving period.

In many seasons, however, farmers are faced with several difficult but important decisions concerning the best way to utilize pasture herbage at this time. Systems of break-grazing and the high-stocking intensities used successfully on the free-draining soils of other highly-productive dairying districts cannot be applied readily, since, where soil

conditions are wet, a large fraction of the feed available would be trampled underfoot, and regrowth prejudiced by damage to both the pasture plants and the topsoil.

While recognizing the merit of full feeding on high quality herbage in early lactation, some farmers in these areas have resorted at times to systems of on-and-off grazing, and to extended use of wintering barns and platforms in an attempt to improve pasture utilization and to minimize hoof damage. Periods of restricted grazing employed vary according to soil and weather conditions. There is, however, very much less flexibility associated with a system of platform feeding of milking cows than for dry stock, and considerably greater scope for prejudicing individual animal performance by underfeeding in early lactation. Hence, for these conditions, a satisfactory compromise is required between management practices aimed at encouraging abundant and continuous pasture growth, and systems of feeding which will ensure an adequate plane of nutrition for milking cattle in early lactation. Examining ways of achieving maximum pasture growth in these areas is accomplished best within the specific problem locality, where the short- and long-term effects of varying degrees of defoliation and trampling can be clearly demonstrated and measured. Examination of the strictly nutritional aspects of the problem is less complicated, requiring essentially the measurement of the influence of varying degrees of feed restriction and supplementation on milk yield and composition. In addition to their immediate relevance to stock feeding in difficult environments, results from these studies can have much wider significance. Hence, provided similar feedstuffs and livestock are available, the trials from which they are derived should preferably be made where adequate experimental control is possible, and not necessarily in any particular locality.

Since the 1962-3 dairying season, therefore, it has been one of the tasks of the nutrition section at Ruakura Agricultural Research Centre to investigate the consequences of various feeding practices which either are being used, or might be employed in late winter and early spring by dairy farmers located on wet soils. It is with some of these results that the present paper will be concerned.

SPECIFIC PROBLEMS REQUIRING INVESTIGATION

Discussion both with individuals farming problem soils in parts of Northland and South Auckland, and with farm advisory personnel working in these localities revealed that

initially, at least, answers to two particular queries were required. The first was to assess the effect on per cow production of reducing the time the herd had access to pasture each day, since, by shortening the grazing time, pasture wastage and soil damage are effectively reduced under wet conditions. The second was to determine the contribution to per cow production which the feeding of hay in early lactation would make under conditions both of restricted and unrestricted grazing.

Hay was the supplementary feed of choice, since soil conditions generally do not favour the use of heavy machinery at the time silage can be made to best advantage and large quantities of hay are conserved from surplus grass somewhat later each year. Concentrate feeding in early lactation is considered to be more costly than hay feeding, and consequently is not widely practised.

In all these discussions it was stressed that, where wintering platforms were used, generally there was abundant grass available in the late winter-early spring period. The problem was to utilize this without undue waste and to minimize damage to soil structure and hence recovery of grass growth.

NATURE OF THE TRIAL

Because of the extent of the information sought, it was decided the trial should involve a changeover design and be essentially short term. This would enable the inclusion of an analysis of both grazing time and hay supplementation separately and together in one experiment. It had the disadvantage that it was not possible to measure carry-over effects from each treatment over the complete lactation, but it permitted a relatively precise evaluation of treatment effects to be made for each experimental period. This appeared to be the best approach to employ in the initial investigation of the problem since, apart from the immediate relevance of the results to this, the method provided a means for isolating the most important of several treatments for further consideration in later seasons.

(1) EXPERIMENTAL TREATMENTS

In practice, variation in daily grazing time may be required from week to week, but for experimental purposes some standardization is required. The periods chosen for the present trial were four hours, eight hours and twenty

hours. The first was selected to approximate, on average, to practices which would be required under the wettest conditions, the second to grazing during the day between milkings when conditions were less severe and evaporation rates relatively high, and the third, to continuous grazing conditions where soil type and moisture presented no problem to efficient pasture utilization. These times were considered to span the range of conditions likely to be encountered. In addition, the effect of feeding hay as compared with no hay supplementation was determined for each grazing time.

(2) STATISTICAL DESIGN

A split-plot latin square design was used, individual members of each of twelve sets of identical twins being allocated either to one group which was fed hay as supplement or to a second group fed on grass alone. These groups were designated "hay" and "no hay". Grazing times were allocated to cows of the same set according to the arrangement of a 3×3 latin square. The use of twelve sets of identical twin cows allowed four replicates of this basic design.

(3) LIVESTOCK

Twin cows comprised four sets of 2-year-olds, five sets of 3-year-olds and three sets of mature cows. Members of each twin set were provisionally allocated before calving either to the "hay" or "no hay" group according to their anticipated calving dates. Some amendments to the groups were made immediately following calving to provide a similar mean calving date for each. Individual calving dates ranged from July 21 to August 29, 1965, for the "hay" group, and from July 19 to August 14, 1965, for the "no hay" group. Mean calving dates for the respective groups were August 5 and August 1, 1965, and the mean starting date for the first experimental treatment was six days later for the "hay" and eight days later for the "no hay" group. These short preliminary periods were necessitated by the system employed of recording intake and milk by weeks, and by the requirement to reject, for other than calf-feeding, milk produced during the four days immediately post-calving. During this time, all cows were fully-fed on grass.

Excluding this preliminary period, all cows remained on trial for the first nine weeks of their lactations.

(4) FEEDING AND MANAGEMENT

Individual members of each twin set were grazed separately in two herds, each herd being fed sufficient grass to prevent limitations in the quantity available restricting intake at all grazing periods. The splitting of twin members in this fashion is general practice in this type of trial, since it overcomes sucking, a common problem amongst twin cows.

Twenty-two acres, comprising 16 acres of winter and early-spring growth, and 6 acres of spring regrowth were used in the trial. The electric fence was used extensively, and cows were fed a fresh break of grass each day. The two herds were always grazed in adjacent paddocks, and to ensure for each treatment period that cows in the "hay" and "no hay" groups had both a similar type and amount of pasture herbage available, paddocks were alternated daily between each group.

Milking was twice daily at 5.00 a.m. and 3.00 p.m., and cows were returned to their paddocks following the morning milking by 7.00 a.m. Stock on the four-hour grazing were removed at 11.00 a.m. to a shavings pad adjacent to the milking shed, and those fed hay were offered this to appetite until the following morning's milking. Those on the eight-hour restriction were also held on the shavings pad following the afternoon milking, and overnight, during which time they were fed hay. Both of the unsupplemented groups were held in one yard, and each of the groups fed hay in separate yards.

The cattle on unrestricted grazing which were fed no supplement returned to their paddock immediately after milking. Those receiving hay were offered this for approximately 2½ hours daily in two periods, one following the morning, and the other the afternoon milking. The hay offered to all groups was weighed and sampled daily, and was fed in wooden troughs designed to minimize hay wastage and protected from the weather by galvanized iron roofing. Hay residues were collected each day from the three groups, weighed and sampled, and these data were used to calculate the group mean daily intakes of hay, and hay dry matter. Water was available in all yards and paddocks.

The hay was of average to good quality. It had been field cured and baled on January 3, 1965, from pastures predominantly ryegrass, white clover, Yorkshire fog and paspalum, and a representative sample fed to four adult

wethers for fourteen days during October, 1965, gave a mean apparent digestibility coefficient of 60%.

(5) MEASUREMENTS

- (a) Hay intakes were computed for the last two weeks of each treatment period from the amounts of hay offered to and refused by each treatment group. These were converted to dry matter intake using estimates of the percentage D.M. of the hay offered and refused obtained after drying representative samples for 24 hours in a forced draught oven at 100°C.
- (b) Milk yields of individual cows were recorded and representative samples of milk were drawn at each milking. These were composited for each week, and the bulked samples were analysed for fat percentage by the Gerber method, and for total solids gravimetrically. The amounts of milk, fat and non-fatty solids produced have been presented as total amounts for the last two weeks of each treatment period.
- (c) Liveweights of individual cows were recorded daily following the morning milking.

RESULTS

(1) THE EFFECT OF THE TIME AVAILABLE FOR GRAZING ON HAY CONSUMPTION

Total quantities of hay dry matter eaten per cow in each treatment and period are shown in Table 1. Respective mean daily dry matter intakes of hay for cows on four, eight and twenty hours' grazing were 11.2, 7.8 and 3.1 lb, equivalent to 13.2, 9.2 and 3.7 lb of air-dry hay. Expressed as T.D.N., these were approximately 6.6 lb, 4.6 lb and 1.8 lb respectively.

TABLE 1: HAY DRY MATTER INTAKE
(lb/cow/2 weeks)

<i>Time Grazing (hr)</i>	4	8	20
Period 1	126	93	49
Period 2	166	108	37
Period 3	176	127	42
Mean	156	109	43

Except under conditions of unrestricted grazing, intakes of hay dry matter increased appreciably from period 1 to period 3. This is probably a reflection of increased appetite post-calving, a phenomenon previously noted for lactating cattle fully-fed on fresh pasture herbage (Hutton, 1963).

Table 1 shows that by limiting grazing to 20% of the time available where there was no restriction, a 3½-fold increase in hay consumption was induced. When the restriction was reduced to 40%, this changed to approximately 2½ times the amount eaten under conditions of unrestricted grazing.

(2) THE EFFECT OF THE TIME AVAILABLE FOR GRAZING AND SUPPLEMENTARY FEEDING HAY ON:

(a) *Milk Production*

The mean milk production per cow for the two-week experimental period is shown for each treatment in Table 2, together with the production differences attributable to supplementary feeding of hay. The standard error of the differences between milk yields obtained at each grazing time has been calculated from the average error mean square after analysing separately the data from the "hay" and "no hay" groups. Use of the latin square design permitted removal of between-cow variations from this term. In testing the significance of the production differences distinguishing "hay" from "no hay" feeding, *i.e.*, the within-set differences, however, account was taken of the variation in response between-sets.

TABLE 2: THE EFFECT OF GRAZING TIME AND HAY ON MILK PRODUCTION PER COW (LB)
(2 weeks total)

<i>Time (hr/day)</i>	4	8	20	<i>SE Diff.</i>
Hay	312	358	360	16
No hay	228	284	333	
Difference	84	74	27	
SE			20	

Table 2 shows that in the absence of a hay supplement, an increase in the time cows were at pasture from four to eight hours raised production significantly by 56 lb, or 4 lb of milk per cow per day. Increasing this again by twelve hours produced an additional increment of 49 lb, equivalent to 3.5 lb of milk per cow per day.

In contrast, where hay was fed as a supplement, much smaller changes in per cow production were obtained with increase in grazing time. Thus, although there was a 46 lb increase in milk yield when the restriction was eased from four to eight hours, there was no significant difference between the productions at eight hours and under unrestricted grazing.

The consumption of hay produced significant increases in milk yield at both intensities of grazing restriction, but not where grazing was unrestricted. For the four- and eight-hour restriction periods, these were 6.0 and 5.3 lb milk per cow per day, respectively.

(b) *Butterfat*

The effects of both supplementary feeding and grazing time on the percentage butterfat in milk, and butterfat production per cow (lb) are shown in Table 3.

TABLE 3: THE EFFECT OF GRAZING TIME AND HAY ON BUTTERFAT PRODUCTION

<i>Time (hr/day)</i>	4	8	20	<i>SE Diff.</i>
(1) BUTTERFAT PERCENTAGE				
Hay	4.8	4.6	4.5	0.14
No hay	5.3	4.9	4.5	
Difference	-0.5	-0.3	—	
SE		0.14		
(2) PRODUCTION PER COW (LB) (2 WEEKS TOTAL)				
Hay	14.8	16.3	16.1	0.7
No hay	12.3	13.9	15.1	
Difference	2.5	2.4	1.0	
SE			0.8	

Fat percentage follows the customary pattern of increasing as rate of milk secretion falls. This trend is more marked for the "no hay" than the "hay" group and, as shown in Table 2, milk productions of the former had fallen most as grazing time was reduced. Significant within-set differences in fat percentage occurred at both levels of grazing restriction. In this comparison, however, the milk from cows fed hay was substantially lower in fat than for those fed grass alone.

The relative changes in secretion of fat and non-fat components of milk with decreased intake can be deduced from

the data in Tables 2 and 3. For the "no hay" group, these show that milk production declines by 32%, and fat production by only 18% as grazing time is reduced from twenty hours to four hours. Comparable changes for the "hay" group are 13% and 8%. Nevertheless, the overall drop in butterfat yield associated with restriction in grazing time is substantial. The feeding of hay both after four and eight hours' grazing results in highly significant increases in production per cow ($P < 0.01$) amounting in both cases to approximately 1.25 lb butterfat per cow per week (Table 3).

(c) Non-fatty Solids

Restricting the time available for grazing produced a small but progressive fall in the percentage of non-fatty solids in milk, irrespective of whether cows were fed grass alone or a hay supplement. In contrast to the analysis of percentage butterfat, hay feeding caused slight increases in the percentage of non-fatty solids at all grazing times, but none were significant ($P > 0.05$). Increasing the grazing time from four to twenty hours resulted in highly significant ($P < 0.01$) increases in the percentage of non-fatty solids and the extent of this increase was unaffected by supplementary feeding. It is concluded, therefore, that while hay feeding produced significant increases in milk yield under conditions of restricted grazing, the relative rate of secretion of non-fatty solids remained unchanged. In contrast, increased grass intakes produced a significant rise in milk yield and the percentage of non-fatty solids. Thus the relative fall in the production of non-fatty solids which occurred as grazing time was reduced from twenty hours to

TABLE 4: THE EFFECT OF GRAZING TIME AND HAY ON MILK NON-FATTY SOLIDS

<i>Time (hr/day)</i>	4	8	20	<i>SE Diff.</i>
(1) S.N.F. PERCENTAGE				
Hay	8.8	9.0	9.1	0.06
No hay	8.7	8.8	9.0	
Difference	0.1	0.2	0.1	
SE			0.12	
(2) PRODUCTION PER COW (LB) (2 WEEKS TOTAL)				
Hay	27.4	31.9	32.7	1.4
No hay	19.9	25.1	30.2	
Difference	7.5	6.8	2.5	
SE			1.9	

four hours (16% for the "hay" group and 34% for the "no hay" group) was greater than for milk or butterfat.

The net effect of feeding hay on the yield of total milk solids is calculated by summing the within-treatment differences shown in Tables 3 and 4. These results are surprisingly similar for the four- and eight-hour grazing periods, amounting to approximately 5 lb of milk solids per cow per week.

(d) Liveweight

Information on liveweight has been included since it provides an additional measure of animal response to the different planes of nutrition imposed. For the "hay" group, there was a highly significant difference between the liveweights for the four-hour and the unrestricted grazing treatments. There were also substantial differences in liveweight attributable to hay feeding at all grazing times, but, curiously, the mean difference between the "hay" and "no hay" groups was smallest for the four-hour period when hay intake was highest.

These differences were in part due both to variations in gut fill, and to progressive change in body condition. Respective mean liveweights of cows in the "hay" and "no hay" groups were 721 and 732 lb immediately before the start of the first experimental period, and 714 and 684 lb for this two-week period. In this short interval, most of the additional 19 lb apparently lost by the cows fed on grass alone must have been caused by a disproportionate change in degree of fill. On the other hand, comparison of the mean liveweights of cows in each group obtained for the three weeks immediately following completion of the trial, and when uniform conditions of grazing were imposed, produced a difference of 27 lb in favour of the supplemented group. Hence, the 38 lb mean within-set difference in liveweight covering the full nine-week experimental period probably represents the extent to which the feeding of hay reduced loss of body condition after calving.

TABLE 5: THE EFFECT OF GRAZING TIME AND HAY ON LIVWEIGHT (lb/cow)

<i>Time (hr/day)</i>	4	8	20	<i>SE Diff.</i>
Hay	691	706	718	10
No hay	660	620	651	
Difference	31	86	67	
SE ·			12	

DISCUSSION

(1) THE SIGNIFICANCE OF GRAZING TIME

The effect of varying the time cows are at pasture on individual productions has been clearly demonstrated. Increasing grazing time from four hours to eight hours raised the mean daily production by 4.0 lb of milk per cow. A further increase to unrestricted grazing produced 3.5 lb additional milk per cow, raising production to approximately 24 lb of milk daily.

Management systems which attempt to minimize pasture and soil damage by applying severe restrictions on the time cattle have access to pasture can therefore be expected to depress production markedly, even over relatively short periods. In the absence of supplementary feeding, substantially lower productions can be anticipated, even when an apparently moderate restriction, namely, withholding cows from pasture overnight, is applied.

(2) THE ROLE OF SUPPLEMENTARY FEEDING UNDER CONDITIONS OF RESTRICTED GRAZING

This trial has demonstrated the importance of hay feeding for maintaining high levels of production where the time cows spend on pasture is limited. For cows which had only four hours' grazing time, the consumption of 13 lb of hay produced one-and-a-half times as much additional milk as was obtained from four hours' extra grazing without hay.

One most interesting result is an apparent interaction of grazing time with hay feeding, for despite the fall in hay intake which occurred when the grazing restriction was relaxed from four to eight hours (4 lb per cow per day), approximately 9 lb of hay appeared to cause an increase in production per cow of slightly more than 5 lb of milk per cow per day. This represents a requirement of approximately 2.0 lb of hay for each additional pound of fat-corrected milk produced, equivalent to a 16% conversion efficiency of digestible energy from hay to milk energy.

This is much lower than comparable indexes calculated for cows at the same stage of lactation and fed to appetite solely on fresh pasture herbage (Hutton, 1966). Hence, despite the similarity in total milk production achieved both after eight hours' grazing plus hay supplement and unrestricted grazing, energetically the feeding of grass alone is probably the more efficient. It also raises the possibility that both in terms of the energetics and economics of feed

provision and conversion, the feeding of high quality concentrates at relatively low levels, either alone, or with hay, might, under conditions of restricted grazing, prove more efficient than hay feeding alone.

Much depends upon the amount of hay which farmers have available regularly, and their attitude towards its use. If, because of a particularly high stocking rate they are able to make sufficient only for wintering purposes and do not have to harvest large amounts of surplus growth as a means of pasture control, the making or purchase and feeding of additional hay after calving under enforced conditions of restricted grazing could prove costly. The current trial has shown that with grazing restricted to four hours daily over two consecutive weeks, total hay dry matter intake was 156 lb. This additional feed increased total butterfat production by 2.5 lb. If the hay dry matter is valued at one penny per pound, and each pound of butterfat inclusive of end-of-season bonuses at 4s., the value of the feed used will have exceeded returns for the fortnight by 3s. per cow. A similar calculation applied to the data recorded with eight hours' grazing gave a credit balance of 6d. per cow. These computations take no account, however, of the lift in total lactational yield which will probably be achieved in a normal lactation as a result of supplementary feeding of this type. Their purpose is to focus attention on the need to consider input-output relationships with a full range of supplementary feedstuffs, since, under efficient farming conditions, the margin between the cost or market value of average quality hay and additional butterfat resulting from the use of this can be small.

It is of considerable practical and nutritional significance, however, that in the present trial cows which were given access to grass during the day only, and fed hay as a supplement overnight, were able to produce as much milk and milk solids as when fed unrestricted grass. In general, previous trials have shown that under conditions of restricted grazing and supplementary feeding, cows in early lactation produce significantly less than if fed on abundant grass alone. Invariably, however, these trials have been concerned with feeding a limited ration of grass where no time restriction has been imposed on grazing, and supplementary feed in addition. This may account, in part, for the apparent inconsistency.

Information presented in Table 2 shows that, even under conditions of abundant pasture, it is not possible for grazing animals in early lactation to obtain in eight hours all the

feed they need to reach peak production. This is despite the observations of Hancock (1952) that, given unrestricted grazing, dairy cattle spend fewer than eight hours of each day grazing. The importance of resting and cudding intervals between periods of intense grazing activity was apparent even for some cows on the four-hour restriction.

The mean difference between the productions of the "no hay" group after eight and twenty hours' access to pasture was surprisingly large, and implies that there was a considerable difference between treatments as a result of grazings following the afternoon and before the morning milking.

(3) SUPPLEMENTARY FEEDING UNDER CONDITIONS OF UNRESTRICTED GRAZING

Despite the abundance of pasture herbage available where no restriction was imposed on grazing time, the cattle offered hay under these conditions consumed on average 3 lb of dry matter in this form each day. If it is assumed that cows on both the "hay" and "no hay" groups ate similar amounts of pasture dry matter, and that hay consumption was additional to this, by using the conversion ratio of hay to milk calculated previously for the eight-hour grazing restriction, it can be estimated that this extra feed should have produced an additional 27 lb of F.C.M. In fact, the mean difference between the supplemented and unsupplemented groups on unrestricted grazing was 26 lb of F.C.M., but on analysis this was found not statistically significant.

When considered with the marked mean liveweight difference between members of the same twin sets on 20 hours' grazing, however, this result indicates that further investigations into the possible significance of supplementary hay feeding in early lactation under conditions of abundant grass availability are warranted.

(4) MERITS AND LIMITATIONS OF THE CURRENT TRIAL AND FUTURE REQUIREMENTS

As assessed from the results of the present experiment, the use of several treatments over relatively short periods, their application to all cows, and the superimposing of a split-plot trial by inclusion of identical twins has been relatively successful in allowing the appraisal of a much wider range of inputs than otherwise would have been possible. The relative precision of the latin square and the split-plot analyses can be seen from the appropriate standard errors in Tables 2 to 5.

Most, if not all, of the period of production adjustment associated with treatment change was removed by inclusion of the changeover interval of one week between treatments. This is consistent with previous observations that when marked changes in either level or type of feed are applied to milking cows, practically all the adjustment to both intake and production occurs in the first week. In the present trial, only in the analysis of percentage non-fatty solids was the variance associated with periods significant. Hence, for certain nutritional studies at least, there could be considerably more scope for using changeover trials in early lactation than previously appeared possible.

Within the present context, however, short-term experiments and changeover designs have certain limitations, for they may not permit full expression of a treatment or assessment of any long-term, carry-over effects. From the results presented, it would appear important to determine for more extended periods the effect on per animal performance of certain combinations of restricted and unrestricted grazing times, and reference has been made already to the importance of assessing all types and various combinations of supplementary feedstuffs for use under these conditions in early lactation.

Equally important is the requirement for local research investigations to provide quantitative information on the extent to which the practices under examination are likely to influence pasture growth, utilization and management in general, both in the short and long term. Officers of the Field Research Section of the Research Division, Department of Agriculture, in collaboration with the Farm Advisory Division, Department of Agriculture, have commenced work on this problem. It is hoped that collation of data which will be forthcoming from these trials with results obtained from experiments such as the present one will provide information of considerable value for farmers in the "wet" dairying areas of this country.

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