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THE COMPOSITION OF GRASS AS INFLUENCED BY FREQUENCY OF CUTTING (GRAZING)

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INTRODUCTION

The method of pasture land management now widely known as close grazing, originated at Hohenheim during the Great War, the experiment proving highly successful. The increased food value per acre obtained is illustrated by the fact that in the course of two years the system raised the carrying power per unit area of the pasture approximately from one cow to three cows.

Following the success of this work the scheme has been carefully investigated at a number of scientific centres in Great Britain with very promising results. Though the matter must still be considered in the experimental stage, more especially in respect to details of application, the publication of the scientific findings has resulted in a wide interest among farmers and dairymen in both Great Britain and Canada.

PRINCIPLES UNDERLYING THE METHOD AND THEIR APPLICATION

This method has for its basis the application of two principles—(*a*) the grazing of the grass while still young and with a high protein content—and (*b*) the liberal dressing of a complete fertilizer with subsequent top-dressings of a nitrogenous fertilizer as growth and weather conditions throughout the season dictate.

For the practical working out of the principles in this rotational system of grazing, the pasture acreage is divided by fences into a series of areas the size of which would be determined by the number of animals to be grazed. The operation of the system involves the moving of the stock from a section just cropped to one carrying two to three weeks' growth of grass. The number and size of the sections should, as far as practicable, be such as to permit of a change, say, every second or third week during the grazing season—the rotation period being roughly determined by the growth made.

In order to maintain, as far as may be practicable a young growth on all the sections it may be necessary to mow an occasional area. This is the more imperative when the number of animals is not sufficient to completely crop the grass before it matures.

The seasonal top dressings of nitrate of soda, sulphate of ammonia or other immediately available nitrogenous fertilizer when deemed necessary, are made to the recently grazed areas on the removal of the stock to a new section. This permits a period of some weeks for the fertilizer to promote new growth before, in the course of rotation, the stock is again pastured on the area.

Seasonal conditions, and markedly the amount and distribution of rainfall, will largely dictate the times and amount of the top dressings as well as the length of the grazing periods.

It is evident from the foregoing that for the successful conduct of this rotational method of pasturing there must be close observation and good judgment on the part of the operator. No hard and fast rules can be laid down for the management of a plan in which there are so many variable factors, e.g., soil, herbage, weather and live stock.

PLAN OF EXPERIMENT

In the early months of 1927 it was decided to institute a field-plot experiment at the Central Farm, Ottawa, which would furnish information as to composition and yield of grass cut at different stages of growth and by this means obtain data indicative of the results from the actual grazing of the land under the rotational system.

The field selected for this investigation had been cut for hay for a number of years; for at least thirty years it had not been ploughed, pastured or manured.

The soil was a deep, moderately heavy, clay loam with an abundance of humus. The nitrogen content of the surface soil (to a depth of six inches) was 0·258 per cent (water free basis) and that of the sub-soil from six to twelve inches was 0·08 per cent. The surface soil had a pH value of 6·39 and a lime requirement of 2,000 pounds carbonate of lime, per acre (Jones method). The strong vigorous growth of grass gave evidence of a high degree of fertility.

Close-Grazing Plots. C.E.F. Ottawa, June 26th, 1928.

A botanical survey of the area revealed a remarkably even "stand" of grass. The dominant grass was meadow foxtail *Alopecurus pratensis*—an early perennial grass of good quality, requiring a rich soil and moist climate. Though not among the heaviest hay grasses, it is valuable for pastures on account of earliness, rapidity of growth after cutting and rich aftermath.

Four adjacent plots (A, B, C, D) were laid out on this area. The frequency of cutting adopted was as follows: "A," weekly: "B," fortnightly: "C," every third week, and "D" at stage for hay (seed formed) with one aftermath. "A," "B," and "C" were cut with a lawn mower, leaving a close-cut sward. Every cutting was weighed and analysed.

As analysis and observation of the soil indicated a degree of fertility decidedly above the average any application of fertilizer was deemed unnecessary, for the first year at least. In this omission the procedure of the first year of this investigation departs from the recognized operation of this system of pasture land management.

The precipitation throughout the period of experiment—May 19 to September 29—was 14·79 inches. It was remarkably well distributed, no week being without a shower. The season evidently was one particularly favourable to the rapid springing up of fresh growth after cutting.

FIRST SEASON'S RESULTS, 1927

Summarizing the essential data for this season, the average composition of the grass of the several plots, in respect to protein and fibre, is presented in the following table:—

PROTEIN AND FIBRE (DRY MATTER BASIS) AS INFLUENCED BY FREQUENCY OF CUTTING, 1927

Plot	Protein	Fibre
	p.c.	p.c.
A. Cut weekly (10 cuttings)	21·20	19·38
B. Cut fortnightly (8 cuttings)	18·60	20·50
C. Cut every third week (5 cuttings)	17·17	22·06
D. Cut for hay, with one aftermath	10·16	28·65

In these data there is clear and strong support that very young grass, in so far, as its dry matter is concerned, is to be regarded as a high protein concentrate. It is on this well established fact that the value and very largely the success of the "close grazing" system rests.

Secondly, these results afford convincing evidence of the steady decline in protein with the development of the grass. The falling off in this nutrient during the first three weeks of growth (approximately 4 per cent on the dry matter basis) though certainly appreciable does not prevent the inclusion of three weeks' old grass in the class of protein concentrates. The high digestibility of the herbage of this age—which was still succulent and leafy and had not sent up its seed stems—together with its high protein content undoubtedly permits its (three weeks' old herbage) classification with grass considered right and necessary for the successful operation of this scheme. Later work may show that the period of growth can be still further lengthened without material impairment of quality.

Considering the fibre content of A, B, and C, it will be observed that the percentage of this constituent increases with the age of the grass, or stated otherwise, the fibre content increases as that of the protein decreases. Although the fibre of C exceeds that of A by approximately 2·5 per cent, the grass of this plot (C) was at the time of cutting always soft and succulent, with no seed stems and no perceptible lignification of the fibre of its foliage.

The grass of plot D (hay and aftermath) calls for separate and specific discussion. It was allowed to grow until its seed was "fully formed." The protein and fibre of this cut on the dry matter basis, were 9·0 per cent and 32·90 per cent respectively. It made a good growth subsequent to cutting and the aftermath, on the same basis, contained protein 11·32 per cent and fibre 24·40 per cent. These figures show the herbage of this plot to be markedly inferior in nutritive value to that of the frequently-cut plots; it had less protein and more fibre.

SEASONAL YIELDS

The yields of dry matter and protein for the several plots furnish very interesting data:—

DRY MATTER AND PROTEIN

Yields per Acre, 1927

—	Dry Matter	Protein
	lb.	lb.
A. Cut weekly (10 cuttings)	2,918	439
B. Cut fortnightly (8 cuttings)	3,344	466
C. Cut every third week (5 cuttings)	4,304	571
D. Cut for hay with one aftermath	5,311	520

Somewhat contrary to expectations, plot D, cut for hay with one aftermath, yielded the highest amount of dry matter, the other plots following in the order of C (cut every third week), B (cut fortnightly) and lastly A (cut weekly); the yields increased as the intervals between cuttings lengthened.

The season's weights of protein are of particular interest. Plot C, cut every third week, furnished the largest amount. The weights of protein from A and B are decidedly lower than that from C, and this may be due to the too frequent cuttings of these plots with a depression in the general vigour and vitality of the plant. The results of this first year's work would seem to indicate that in this scheme of pasturing the grass may be too frequently close-grazed.

It may be safely assumed that grass as cut for hay possesses a lower coefficient of digestibility than very young grass. The evidence for this assumption is ample and satisfactory. Therefore it would seem justifiable as between C and D to conclude that plot C (cut every third week) with its higher total of protein undoubtedly yields the greater amount of this nutrient in a digestible form.

The outstanding feature of the first season's work was that young grass—say, of not more than three weeks' growth—was an exceedingly rich protein food, possessing, on the dry matter basis, 17 to 22 per cent of protein.

SECOND SEASON'S RESULTS, 1928

An application of a complete fertilizer—ammonium sulphate 50 pounds, superphosphate 350 pounds and muriate of potash 100 pounds, per acre—was made in the Autumn of 1927, to all four plots. Early in the spring of 1928 and just before there was active growth the plots were dressed with nitrate of soda at the rate of 160 pounds per acre. The plan of the experiment, as to frequency of cutting, etc.—was that of the previous season.

The precipitation between the first and last cuttings—May 11 and October 26—was 27·7 inches, an unusually heavy rainfall. It included several very heavy rains and was well distributed throughout the whole growing season; no week passed between these dates without rain.

The scheduled dates of cutting were interfered with in a number of cases by rain, it being necessary to a satisfactory carrying on of the work that the plots should be reasonably dry when cut. The season as a whole was undoubtedly favourable, though at certain periods there was too much moisture for optimum growth.

The protein and fibre data for the season are summarized in the following table:—

PROTEIN AND FIBRE (DRY MATTER BASIS) AS INFLUENCED BY FREQUENCY OF CUTTING, 1928

Plot	Protein	Fibre
	p.c.	p.c.
A. Cut weekly (16 cuttings)	28·95	16·53
B. Cut fortnightly (9 cuttings)	22·54	18·88
C. Cut every third week (8 cuttings)	20·74	19·77
D. Cut for hay, with two aftermaths	13·30	26·85

These data confirm those of the preceding season in respect to the influence of frequency of cutting on the protein and fibre content of the herbage, viz., the shorter the period of growth the higher the percentage of protein and the lower that of the fibre.

It will be observed on comparing the data of 1927 with those of 1928 that the protein percentages of the latter year are much higher than those of the former. This holds for all four plots. In accordance with the trend observed in the previous year—the higher the protein the lower the fibre and vice versa—the figures for the fibre of the second season are lower than those of the first. In respect to plot A, the higher protein may be accounted for by the gradual encroachment to the point of possession by white Dutch clover (see photograph). To a certain degree this also explains the results of plot B, for at the close of the season it was estimated that clover formed probably 70 per cent of its herbage.

The higher nutritive value of the grass from D may be accounted for in a large part by the inclusion of two aftermaths, of comparatively young growth. It may also be noted in this connection that the protein content of the herbage of this plot for 1927 was somewhat depressed by the presence of a certain amount of dead grass from the previous season.

In addition to the foregoing, the fertilizer application undoubtedly enriched the herbage of all the plots.

SEASONAL YIELDS

The second season's results in respect to yields of dry matter and protein are presented in the following table:—

DRY MATTER AND PROTEIN

Yields per acre, 1928

Plot	Dry Matter	Protein
	lb.	lb.
A. Cut weekly (16 cuttings)	3,769	1,078
B. Cut fortnightly (9 cuttings)	4,610	1,008
C. Cut every third week (8 cuttings)	4,048	766
D. Cut for hay with two aftermaths	9,306	1,119

Compared with the yields for 1927, all the plots gave much higher results. These heavier yields in 1928 are to be attributed chiefly to the fertilizer applied in the Autumn of 1927 and spring of 1928. This undoubtedly greatly stimulated the growth both of the grasses and clovers and its influence was observable alike on the frequently cut plots as on the hay plot.

Plot D, as in the previous year, gave the heaviest yield of dry matter. There was a very heavy growth as cut for hay on July 3, with two good aftermaths—the last cut October 26, indicating an exceptionally long season of growth. In this season (1928), it also furnished the heaviest weight of protein. If degree of digestibility and protein concentration were not considered, plot D would from the food standpoint be the most profitable of the series. But these —digestibility and protein concentration—are the basic factors which give to the scheme of close-grazing its particular or specific value, and estimated by these factors the product of D falls below that of any of the remaining plots.

The positions of B and C in relation to each other are reversed to those held in the preceding season (1927); in both dry matter and protein plot B now exceeds C. Weather conditions prevented the regular fortnightly harvesting of B to such a degree that only one more cutting was made on it than on C, and this removes from consideration the factor of "interval" or frequency of cutting, as determining the relative growth of these plots. Further, plot C, due to its topography, was found to have suffered from flooding, resulting in a destruction of grass over a part of its area. This naturally reduced its yield.

While the difference between B and C in dry matter yields is appreciable, it is not one of great magnitude. It is otherwise with the protein yields. The decidedly larger weight of this nutrient from B is readily accounted for by the presence of clover, which from the beginning of the season had continued to spread over the plot. By the date of the last cutting this encroachment had proceeded to such an extent that clover formed probably 70 per cent of the plot's herbage.

The dry matter yield of A, as in 1927, is the lowest in the series. From this it is clear that growth (which means total yield per unit area) is depressed rather than promoted by high frequency of cutting.

The protein yield of A, especially high when considered in relation to the low dry matter yield, calls for special comment. The high percentage of protein in the dry matter of this plot has already been pointed out and accounted for. It was due to the herbage being chiefly clover. It is to this same fact that, this phenomally high yield of protein is associated with a low dry matter yield.

SUMMARY

From preliminary work which includes results of two successive seasons the following outstanding features are notable:—

The data of the first season's work show emphatically that young grass, say, of not more than three weeks' growth, is a rich protein food; its dry matter contains from 17 to 22 per cent protein.

Frequent cutting with its incidental conditions (exposure to light, etc.), which are favourable to low growing plants, changes the character of the herbage, encouraging the spread notably of white Dutch clover. By the second year this legume had practicaly taken possession of the weekly cut plot and encroached considerably on the plot cut fortnightly.

In the second season as a result of the incursion of clover, the protein content of herbage from the plots cut weekly and fortnightly ranged from 22 to 30 per cent on the dry matter basis.

In respect to yields of protein, per acre, the plot cut every third week stood first for the first season. In the second season the yields of protein for plots cut weekly, fortnightly and hay with two aftermaths, were of approximately the same weight. The higher digestibility of the protein of the young grass—as from the frequently cut plots—makes it more valuable to the animal than that of grass as cut for hay, i.e., when the seed is fully formed.

In the plan of experiment adopted, the largest yield of dry matter in both seasons was obtained from the plot "cut as hay with aftermath." There is evidence to show that yield of dry matter per unit area decreases with frequency of cutting.

The seasonal conditions generally of both years and especially the well distributed rainfall, favoured the satisfactory operation of this scheme. Neither season had any period of drought which would check the growth of the grass.

Considering the results as a whole the conclusion is reached that the virtue of the method, in so far as it may be deduced from this work, lies in furnishing throughout the season pasturage rich in protein of a highly digestible and highly nutritious character.

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