EFFECT OF STOCKING RATE ON BUTTERFAT PRODUCTION OF DAIRY COWS GRAZING KIKUYU GRASS PASTURES FERTILIZED WITH NITROGEN

R. L. COLMAN*† and J. M. HOLDER*

Summary

The effect of stocking rate on the butterfat production of dairy cattle, grazing throughout the year on kikuyu grass pastures fertilized with nitrogen, was measured over two lactations.

Production per cow tended to decline with increasing stocking rate but these changes were not significant. Production per hectare increased significantly as stocking rate increased. The results are discussed in relation to the estimated digestible organic matter intake and the nutritive value of tropical grass pastures.

I. INTRODUCTION

Nitrogen fertilizers increase the yield and extend the growing season of tropical grass pastures (Henzell and Stirk 1963). At Wollongbar Agricultural Research Station near Lismore, N.S.W., Kikuyu grass (Pennisetum clandestinum Hochst.) fertilized with 672 kg nitrogen (N) per ha per annum produced more than 20,170 kg dry matter (DM) per ha and pasture growth exceeded a rate of 34 kg DM/ha/day throughout the ten months period from September 1964 to June 1965 (Colman 1965). It was estimated that an annual rate of 336 kg N would produce 11,200 kg DM/ha.

There appear to be no reports on the use of tropical grass pastures, fertilized with nitrogen, as the sole source of feed for dairy cows nor on the effects of stocking rate in such conditions, although stocking rate has been shown to . have large effects on the utilization and productivity of temperate pastures (McMeekan 1956; McMeekan and Walshe 1963).

The object of this study was to determine the effects of different stocking rates on butterfat production from a predominantly kikuyu grass pasture fertilized with nitrogen, and which was the sole source of feed for the dairy cows over the experimental period.

II. EXPERIMENTAL

The experiment was conducted from September 1965 to June 1967 at Wollongbar, in an environment described by Hudson et al. (1965). The pasture used was predominantly kikuyu grass with small and variable areas of Paspalum dilatatum Poir, Axonopus affinis Chase, and Chloris gayana Kunth. Ammonium

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sulphate was applied annually at a rate of 336 kg N/ha in six dressings from September to May. Molybdenised superphosphate and muriate of potash were applied at rates of 25 and 125 kg/ha respectively in September 1965 and 1966.

Stocking rates of 1.65, 2.47 and 3.29 dairy cows per ha (0.66, 1.0 and 1.33/ac) were maintained over the two year period of the experiment. Three groups each of five animals were used so that the areas available were 3.0, 2.0 and 1.5 ha for the low medium and high stocking rates respectively. In the first year, three mature Guensey cows and 12 heifers (Guernsey, Jersey or Australian Illawarra Shorthorn) were introduced to the experimental area on September 16, 1965 before calving, and grazed as one group until all had calved. On November 15, 1965, one cow was allotted at random to each of the three stocking rate treatments and the groups were completed by random allocation of the heifers. Milk and butterfat production were measured weekly and the cows were weighed each fortnight. Animals were dried off after a 301 day lactation or if yield fell below 1 kg butterfat per week in three successive weeks. Breeding by artificial insemination commenced approximately 60 days from calving.

On July 15, 1966, at the end of the first lactation, all groups were replaced by pregnant Guernsey and Jersey heifers which were randomly allotted to the three stocking rates. Records and management were the same as in the previous lactation.

In the first year each of the treatment areas was sub-divided into four paddocks and animals were grazed week about on a pair of paddocks using a “day” and “night” paddock system. Pastures were therefore rested for one week between grazings. Before the start of the second lactation, the areas were sub-divided into eight paddocks. The “day” and “night” paddock system was continued allowing a three week period between grazings for each pair of paddocks.

III. RESULTS

(a) Seasonal Conditions

In both years, the annual rainfalls were below the average at Wollongbar over 1911 to 1965 of 163 cm. Moisture stress was severe during the spring each year and in the autumn of 1966 rainfall was only 52 percent of the 54 year average (55 cm) for that season. Rainfall was above average from June to August 1966 and March to August 1967.

(b) Calving Dates and Bodyweights

In 1965, the mean calving dates were September 28, September 16 and September 21, for the high, medium and low stocking rate groups respectively, and in 1966 the corresponding dates were August 27, August 18 and August 21. Mean body weights just after calving in 1965-66 were 348, 330 and 365 kg and at the end of lactation 379, 354 and 442 kg for the high, medium and low stocking rates respectively. Comparable figures for the 1966-67 lactation were 272, 238 and 275 kg and 376, 331 and 367 kg.

(c) Butterfat Production and Liveweight Gain

Statistical analysis of butter production (Table 1) was made on individual yields. Production per ha in 1965-66, which did not include production in early lactation before the animals were allocated to treatments, and in 1966-67 increased
TABLE 1

<table>
<thead>
<tr>
<th>Stocking Rate (Cows per ha)</th>
<th>1965-66</th>
<th>1966-67</th>
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<tbody>
<tr>
<td></td>
<td>Per Cow (kg)</td>
<td>Per ha (kg)</td>
</tr>
<tr>
<td>1.65</td>
<td>.73</td>
<td>119</td>
</tr>
<tr>
<td>2.47</td>
<td>81</td>
<td>199</td>
</tr>
<tr>
<td>3.29</td>
<td>68</td>
<td>226</td>
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<td>L.S.D.</td>
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<td>33</td>
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significantly with increasing stocking rate though production per cow did not differ significantly. All cows were heavier at the end of lactation than they were just after calving.

(d) Estimated Pasture Intake

Wallace (1956) using data derived from lactating dairy cattle grazing grass-legume pastures in New Zealand suggested that average daily digestible organic matter intakes (DOMI) could be predicted from the equation:

\[
\text{DOMI (lb)} = 0.35 \text{ FCM} + 0.08 \text{ LW}^{0.72} + 3.0 \text{ LWI}
\]

where FCM = 4% fat corrected milk (lb/day)

\[\text{LW} = \text{Mean liveweight (lb)}\]

\[\text{LWI} = \text{Liveweight increase (lb/day)}\]

Mean liveweight (LW) was calculated from the liveweight of the five animals in each group at the start of lactation. The average daily DOMI of cows during the complete 1966-67 lactation period was estimated to be 7.9, 7.7 and 8.5 kg for the high, medium and low stocking rates respectively. Total DOMI/ha for the same period was 7,565, 5,638 and 4,000 kg respectively.

IV. DISCUSSION

The butterfat yields recorded in both years show that, as with temperate pastures, stocking rate is an important factor affecting production per unit area. Differences in production per cow, although not statistically significant, follow the trend suggested by Mott (1960).

It was calculated from the digestibility data of Holder (1966) that a kikuyu grass pasture fertilized with nitrogen and yielding 11,200 kg DM/ha annually, if kept in a vegetative stage of growth, could provide approximately 6,725 kg digestible organic matter (DOM) per ha. In 1966/7, the estimated intake of the cows at the high stocking rate during the lactation and dry periods was up to 30% greater than the DOM which was estimated to have been produced. In contrast, cows at the low stocking rate appeared to consume only two thirds
of the DOM available. Although intake was estimated using Wallace's (1956) equation, which may be inaccurate (Corbett 1960), it is apparent that stocking rate greatly affected either pasture yield or the utilization of the pasture grown (Campbell 1966).

An increase in pasture yield at higher stocking rates could have resulted from greater and more frequent re-cycling of plant nutrients (Davidson 1964). In addition, there could have been an increase in the nutritive value of the herbage due to an increased proportion of young growth (Milford 1960). Hardison (1966) concluded from a study of the nutritive value of tropical grasses, including kikuyu, that total digestible nutrient (TDN) yield would limit milk production to not more than 5 kg FCM daily. In the second year of this experiment, milk yield from cows at the medium stocking rate averaged 9 kg daily and in early lactation reached 12.5 kg daily, suggesting that kikuyu grass maintains relatively high levels of digestible crude protein (Milford and Haydock 1964) and of digestible organic matter (Holder 1966).

Payne (1963) suggested it should be possible on “good humid tropical pastures” to maintain five dairy cows per ha, each producing at least 2,720 kg milk annually. With a further increase in nitrogen fertilizer usage and an increased stocking rate, it is possible that kikuyu grass pastures in the Wollongbar environment could support this level of production. Such a study is in progress.

V. ACKNOWLEDGMENTS

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VI. REFERENCES