# Seasonal pattern of growth of subterranean clover-grass pasture 

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Summary. The seasonal pattern of pasture growth rate and total production during the growing season from June to November were estimated in both a small plot area and in a grazed field. Growth rate ranged from 26 to $104 \mathrm{~kg} / \mathrm{ha} . \mathrm{d}$ and total production from 9330 to $10480 \mathrm{~kg} / \mathrm{ha}$. Estimates of dry matter availability were made based on the measurement of pasture height using either an Ellinbank or Falling Plate pasture meter. There was little difference between the estimates based on either meter. The Ellinbank meter is preferred to the Falling Plate meter as it is quicker to use.

## Introduction

The pattern of pasture growth in various seasons of the year, and in similar seasons in different years, is of major importance in determining the quantity of feed available to support a grazing production system. The major determinants of this pattern are solar radiation and daylength, temperature, available soil moisture, the quantity of herbage already present and soil fertility. Not only is the feed supply subject to these and other factors but the feed demand of the grazing animal is also subject to a range of physiological and physical factors. A complex system of this nature is well suited to examination and prediction using simulation modelling.

One model of interest during the 1980's was SHEEPO, and its parent model BREW, developed by the Victorian Department of Agriculture and Rural Affairs, Werribee. A critical input requirement for these and related models is a seasonal pattern of potential pasture growth rate. Nett pasture growth (i.e. not accounting for pasture decay), determined for conditions where soil moisture and pasture dry matter availability (DMA) arc at levels not limiting growth. is a minimum requirement.

A major limitation to the use of the models for the cereal-livestock areas of South Australia was the paucity of data on the seasonal production of pasture in these areas. Accordingly this paper reports two sets of measurements of seasonal changes in nett pasture growth rate, and production, of a mixed subterranean clover-grass pasture in the Lower-north of South Australia.

## Methods

The observations were made during winter and spring 1986, in a naturally regenerating subterranean clover/annual grass pasture which at 5 weeks post germination comprised $66 \%$ legume (mainly Trifolium spp.), $9 \%$ annual rye grass, Lolium spp. 14\% other grasses (largely barley grass, Hordeum leporinum). and $10 \%$ soursob, Oxalis pes-caprae growing on a red brown earth soil (surface 10 cm with 63 ppm available P, $0.12 \%$ total N, 28 ppm nitrate N, $1.0 \%$ organic C, over 500 ppm available K, in August 1986) at Turretfield Research Centre. 60 km NE of Adelaide, South Australia. April to October rainfall in 1986 was 414 mm ; long term average 374 mm . Two sets of data were recorded: in a 'plot' area, and in a surrounding 1 I ha paddock.

The plot area comprised three adjacent sub-areas, each of $13 \times 15 \mathrm{~m}$ : two (West, East) to determine pasture growth rate under optimum conditions for pasture growth. with DMA controlled by mechanical defoliation, and the third (Uncut) to measure pasture growth under undefoliated conditions. The three sub-areas were irrigated once during early June to ensure that moisture availability did not limit pasture growth. Estimates of DMA were made by the non-destructive technique of measuring pasture height and constructing a height/availability relationship using the dry matter yield of a small number of quadrats cut to ground level. Height measurements were made using both an Ellinbank (EB) (I) and a Falling Plate (FP) (2) pasture meter weighing 2.1 kg . Both meters were $0.1 \mathrm{~m}^{2}$ in area.

The West and East sub-areas were each laid out with a $6 \times 6 \mathrm{~m}$ grid of 49 identified positions each marked with a wire pin spaced I m apart for the measurement of pasture height and hence the calculation of DMA and nett growth rate. Each sub-area was subjected to repeated cycles of the following procedures from the time DMA first reached about $1000 \mathrm{~kg} / \mathrm{ha}$ to the end of the pasture growing season:

Day 0 cut with lawn mower to height of $4-5 \mathrm{~cm}$ (optimum height for pasture growth (3)) and the clippings removed;

Day 14 take 49 measurements of height (EB, FP) at the identified positions, and cut 7 square (EB) and 7 round (FP) quadrats of $0.1 \mathrm{~m}^{2}$ from around the edge of the $6 \times 6 \mathrm{~m}$ grid area for calibration of pasture height/pasture availability relationship;

Day 28 as for day 14, and in addition mow the sub-area to a height of $4-5 \mathrm{~cm}$. as at Day 0 . to begin the next cycle of observations.

The treatments of the two sub-areas were out of phase such that one sub-area was mown each 14 days.
Mean DMA for day 14 and day 28 was estimated using the mean height and height/availability relationships determined on days 14 and 28, respectively. By August it was considered that a 28 day cycle was too short to maintain DMA within the optimum range for growth and the cycle was increased to 42 days (21 day recovery and growth periods).

Nett pasture growth rate was calculated as the mean of estimated changes in DMA for individual locations between the 14- and 28-day measurements, while total production was calculated by adding successive growth amounts for each location, with the assumptions that the amounts were absolute and that locations in the East sub-area mapped onto equivalent locations in the West sub-area.

In the Uncut sub-area 49 measurements of height, and calibration cuts, were made each fortnight (three weeks after August) as for day 14 above.

DMA. and hence growth and nett growth rate, was estimated in the surrounding grazed field at monthly intervals using the 'open' and 'closed' quadrat cage technique with 13 cages. Pasture DMA was estimated from pasture height (mean of four measures on each occasion) and height/availability measurements similar to that described for the sub-areas above.

In each of the three sub-areas pasture height was measured on 10 occasions to provide 9 estimates of growth rate over the growing season. Six measurements of height were made in the field. Calibration regressions based on both round or square quadrats were similar and therefore all calibrations of height were based on the pooled sets of measurements. In four cases (undefoliated 3, field I) one outlier point was removed from the pooled regression.

## Results and discussion

There was an apparent mid-August to early-September trough in pasture growth rate as estimated by measurement of the West and East sub-areas (Table I, Fig 1(a)). There was also a depression in growth rate of the Uncut sub-area during the same period, but not in the field. This trough may have resulted from the observed difficulty in recovery of the pasture when defoliated on a 28 day cycle or, alternatively, from a short period of waterlogging and/or low temperature with such a short term effect not being detected in the field due to the longer periods between measurements.

Total production of the undefoliated sub-areas was considerably less than that of the defoliated sub-area (Fig 1(b)) with most of the difference arising in the last six weeks when the defoliated areas continued to grow for a longer period before maturing. Total production in the field (Fig 1(c)) was slightly greater than in the defoliated sub-areas but the seasonal pattern was similar. Production ranged between $60 \%$ and
$68 \%$ of potential production as indicated by the formula ((April-October water use (mm) - 70) * 45) provided for legume pasture by French (4).

Estimates of DMA made with both pasture meters were generally similar (Tables I. 2): given the large standard errors no differences were significant. However, with growth rate and total production (Fig $1(a)(b)(c))$ there were several significant differences for the defoliated plots but none for the field.

The advantages of the technique used in this study of being non-destructive and allowing successive measurements at the same location are offset by the large standard errors of the estimates. mainly due to the error of the prediction associated with the regression. Accordingly it is important to have minimal error in the regression. This is likely to be the case when mean DMA is between 1.5-2 and 4-5 t/ha and there is a wide range of dry matter present.


Figure 1. (a) Mean pasture growth rate for defoliated sub-areas ( $\mathrm{n}=49$; Ellinbank $q-q$, Falling Plate $\mathrm{n}-\mathrm{n}$ ) and field ( $\mathrm{n}=13$; Ellinbank 0 --O, Falling Plate --•) conditions (significance for t -test of difference between meters indicated); (b) total pasture production ( $\mathrm{n}=49$ ) for defoliated (Ellinbank $0-0$, Falling Plate -0 ) and undefoliated (Ellinbank 171-0, Falling Plate --•) sub-areas (significance for $t$-test of difference between meters for the defoliated and undefoliated sub-areas (top and middle lines) and for one way AOV for the difference between the data points (bottom line)); (c) total pasture production ( $\mathrm{n}=13$ ) for the field for both Ellinbank ( $0-0$ ) and Falling Plate ( - -) meters (no significant difference between meters), during 1986.

Table 1. Mean DMA ? s.e.m. (kg/ha) for each pasture meter (Ellinbank, Falling Plate) for the two defoliated (West, East) and the undefoliated sub-areas on each occasion during the 1986 growing season.

| Date | Defoliated |  |  |  | Undefoliated |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Ellinbank |  | Falling Plate |  | Ellinbank | Falling |
|  | West | East | West | East |  |  |
| 11.06 | $800 \pm 374$ | ${ }^{1} 645 \pm 377$ | $843 \pm 395$ | ${ }^{4} 708 \pm 398$ | $647 \pm 378$ | $745 \pm 399$ |
| 26.06 | ${ }^{\text {d }} 1254 \pm 372$ | $947 \pm 374$ | ${ }^{1} 1237 \pm 399$ | $949 \pm 395$ | $1034 \pm 374$ | $987 \pm 395$ |
| 10.07 | $1524 \pm 225$ | ${ }^{4} 1616 \pm 228$ | $1646 \pm 188$ | ${ }^{1} 1609 \pm 194$ | $1732 \pm 231$ | $1652 \pm 195$ |
| 30.07 | $\mathrm{d}_{2} 555 \pm 168$ | $1654 \pm 93$ | ${ }^{4} 491 \pm 252$ | $1588 \pm 101$ | $3060 \pm 555$ | $3066 \pm 507$ |
| 15.08 | $1796 \pm 222$ | $\mathrm{d}_{2961} \pm 362$ | $1773 \pm 258$ | ${ }^{\text {d }} 2966 \pm 398$ | $4082 \pm 738$ | $4422 \pm 845$ |
| 28.08 | $\mathrm{d}_{2613} \pm 332$ | $1798 \pm 268$ | $\mathrm{d}_{2} 262 \pm 279$ | $1787 \pm 284$ | $4804 \pm 846$ | $4883 \pm 1098$ |
| 11.09 | $1882 \pm 219$ | $\mathrm{d}_{2} 517 \pm 388$ | $1936 \pm 240$ | $\mathrm{d}_{2501} \pm 439$ | $5089 \pm 713$ | $5925 \pm 1011$ |
| 02.10 | ${ }^{4} 3598 \pm 271$ | $2397 \pm 299$ | ${ }^{\text {d }} 3591 \pm 252$ | $2498 \pm 299$ | $6986 \pm 1880$ | $7412 \pm 1266$ |
| 23.10 | $2567 \pm 373$ | ${ }^{4} 4234 \pm 273$ | $2542 \pm 367$ | ${ }^{4} 4285 \pm 316$ | $7265 \pm 1456$ | $7337 \pm 1504$ |
| 13.11 | $2966 \pm 502$ |  | $3110 \pm 393$ |  | $6760 \pm 1567$ | $6712 \pm 1449$ |

${ }^{4}$ sub-area defoliated after DMA measured
Table 2. Mean DMA ? s.e.m. (kg/ha) for each pasture meter (Ellinbank, Falling Plate) for 'open' (0) and 'closed' (C) cages in the field.

| Date | Cage Type | Ellinbank | Falling Plate |
| :--- | :---: | :---: | :---: |
| 19.06 .86 | O | $1388 \pm 390$ | $1427 \pm 409$ |
| 15.07 .86 | C | $2407 \pm 299$ | $2490 \pm 268$ |
|  | O | $1426 \pm 440$ | $1342 \pm 380$ |
| 11.08 .86 | C | $3133 \pm 431$ | $2965 \pm 369$ |
|  | O | $1834 \pm 388$ | $1719 \pm 449$ |
| 09.09 .86 | C | $4055 \pm 509$ | $3833 \pm 620$ |
|  | O | $2529 \pm 461$ | $2637 \pm 746$ |
| 09.10 .86 | C | $5637 \pm 1184$ | $5617 \pm 1209$ |
|  | O | $4546 \pm 825$ | $4799 \pm 835$ |
| 13.11 .86 | C | $5586 \pm 1039$ | $5754 \pm 958$ |

It follows that there is a substantial assumption in accepting the estimates of DMA to be absolute when calculating individual estimates of growth rate and total production: a situation akin to that made in using the destructive 'open' and 'closed' quadrat cutting technique, that adjacent quadrat areas have the same DMA.

As the Ellinbank meter is quicker to use, and there is no other counteracting feature in favour of the Falling Plate meter. the Ellinbank is the meter of choice for measuring height in estimating DMA either in detailed investigations as here, or in pasture budgeting in commercial situations.

## References

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