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Seasonal patterns of pasture production in the Bay of Plenty and Waikato

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Abstract

Patterns of pasture growth were measured on 3 farms in the Bay of Plenty (BOP) and at No2 Dairy (Ruakura Agricultural Centre) in the Waikato from 1989 to 199 1. A standardised trim technique with cages and 4-weekly cutting under grazing was used. Long-term seasonal growth patterns, using a predictive pasture model, were also simulated. Simulated pasture growth from long-term climatic data shows that pasture growth rates are higher in winter, early spring and late autumn in the BOP than the Waikato. However, the actual measurements over the 2 years show that pasture growth over the latter periods is lower at the BOP sites than at the Waikato site. In the BOP the spring peak is much later than in the Waikato while an early summer peak, with higher growth rates than in the Waikato, occurred in the BOP. No such summer peak was evident in the Waikato. The difference between the two regions is caused by the large contribution of subtropical grasses to sward production in summer and autumn, The prolific summer growth of subtropical grasses may explain the low ryegrass content and low pasture production in winter. The lower than expected autumn, winter, spring production may also be caused by low clover content, possibly a result of competition from subtropical grasses and a sulphur deficiency. The apparent low amount of nitrogen fixed by clover may explain the low rates of pasture production over the cooler season. Applications of nitrogen fertiliser may substantially increase dry matter production from April to September.

Keywords pasture, simulation, subtropical grasses, Paspalum, ***Digitaria sanguinalis,*** growth rates

Introduction

Quantifying seasonal distribution of feed supply and identifying possible constraints to pasture production are essential to improve both pasture and animal performance. How much grass is grown, and when, is important for setting stocking rates, calving dates, decisions on timing of nitrogen applications, etc. There is value in knowing how pasture production in the BOP differs from that at the dairying research centres at Ruakura. before extrapolating their results to the BOP. Because milkfat production depends on pasture productionmore than any other single factor, improving pasture growth should be a priority while having regard for the variability in growth resulting from species and the environment.

Pasture growth varies between years and seasons. Although a wealth of data, using a standardised technique, has been reported on rates of pasture growth throughout New Zealand (e.g. Radcliffe 1974b; Radcliffe & Sinclair 1975). few data on pasture productivity are available for the BOP.

This knowledge is also important as a baseline to assess possible effects of climate change. Because the BOP has higher summer temperatures, effects of climate change on farming may be more immediate and pronounced than in the Waikato.

The objective of this paper is to describe the seasonal distribution of pasture production in the BOP compared with that in the Waikato. A similar standardised technique as used in past national trials (Radcliffe 1974a) was employed tomeasure the relative differences in growth between the two regions. To assess yields of ryegrass-dominant swards without limitations other than climate, simulations of pasture growth were also carried out.

Methods

Actual measurements

The measurement sites were located on 3 commercial farms in the Bay Milk Products Ltd. comparative dairy farm monitoring scheme in the BOP close to Edgecumbe, Maketu and Opotiki. Yields at these sites were compared with yields obtained at Ruakura Agricultural Centre (No2 Dairy) in the Waikato (Figure 1).

Cutting technique

The relative pattern of pasture growth was measured by a standardised pasture measurement technique (Radcliffe 1974). Pastures were under grazing, except for small areas protected by cages over the 4-week period used for production measurements. Records of grass production throughout the season collected for 2 years (from July 1989 to April 1991) were available,

No nitrogen was applied at No2 Dairy. Nitrogen was applied to one of the 3 paddocks at Opotiki in early August 1989.

Long-term simulation of pasture growth

Pasture growth was also simulated for ryegrass dominant swards, using the GRASS predictive pasture model (Baars *et al*; 1987a; Baars & Rollo 1987b). This model does not account for subtropical species in the sward. GRASS has accurately predicted pasture growth on high-fertility farms in the greater Waikato area. A common soil type was assumed with an available water content of 100 mm. Yields under a 4-weekly cutting regime, using long-term climate data, were simulated forryegrass-dominant swards at Ruakura. Taurangaand Whakatane.

Results

Actual measurements

Seasonal growth patterns (Figure I)

Spring

In the first year growth rates in September and October were higher in the Waikato than at the BOP sites. The spring peak was later in the BOP than in the Waikato and did not occur until November. In the second year the

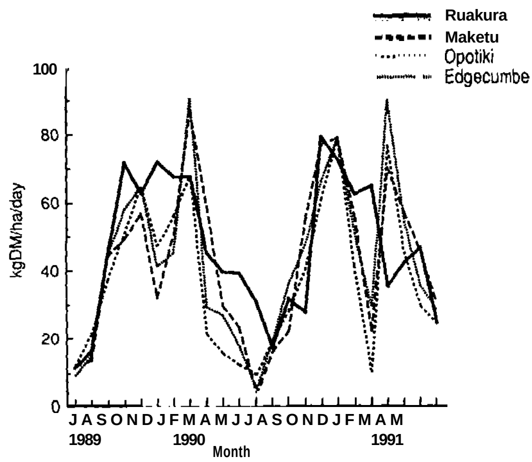

Figure 1 Seasonal distribution ofpasture growth at Ruakura, Maketu, Edgecumbc and Opotiki with monthly cutting (1989-1991).

spring flush started later in the Waikato due to low September growth.

The BOP sites had higher growth rates in September than at Ruakura. However, as in the first year growth rates were higher in the Waikato in October and again the peak in spring production was later in the BOP than in the Waikato.

Summer

In the BOP pasture growth dipped markedly in late December-early January followed by **a** strong summer peak in pasture production in February. In the Waikato there was no noticeable dip in pasture production in late December in 1989/90 and a lesser dip in production than in the BOP in 1990/91. Pasture production declined gradually towards the autumn without a late January-February peak.

Autumn

From April to mid June pasture growth rates in the Bay of Plenty were considerably lower than in the Waikato in both years.

Winter

In both years growth rates were not as high in the BOP as in the Waikato until August.

Species contributions

The ryegrass content of the farms at Edgecumbe and Maketu was lower than in the Waikato (Figure 2). However, at Opotiki the ryegrass content was higher than in the Waikato. This site, at higher altitude than the other farms, is ryegrass dominant.

Overall the clover content in the BOP is lower than the Waikato pastures (Figure 3). The clover content at Edgecumbe was higher than at the other two sites. However, over summer-autumn the % clover was lower at each of the Bay of Plenty farms than at the Waikato site.

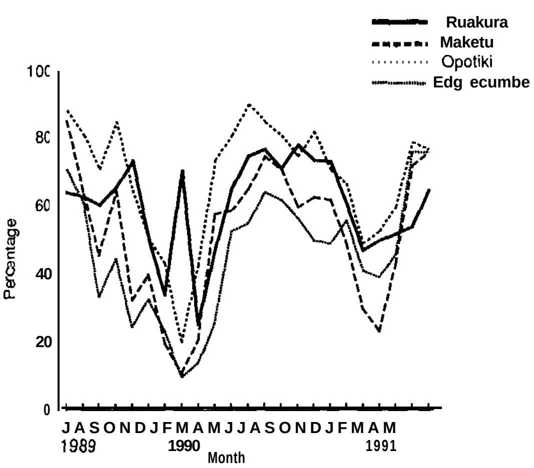

Figure 2 Seasonal distribution of % ryegrass in the sward at Ruakura. Maketu, Edgecumbe and Opotiki with monthly cutting (1989-1991).

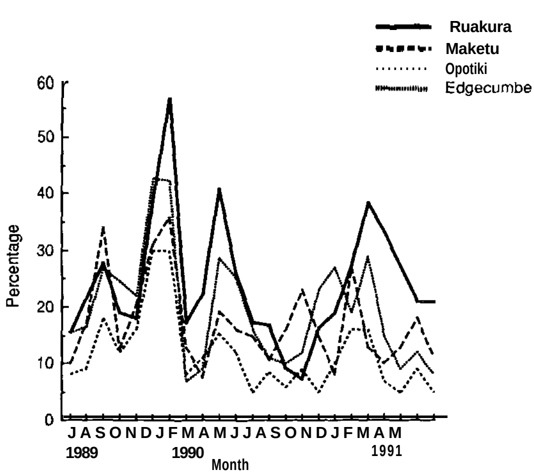

Figure 3 Seasonal distribution of % white clover in the sward at Ruakura. Maketu, Edgecumbe and Opotiki with monthly cutting (1989-1991).

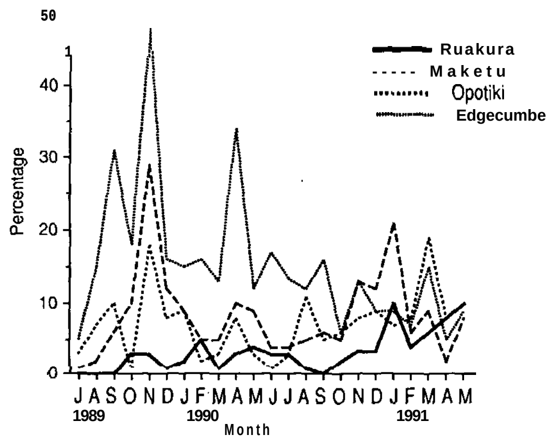

Figure 4 Seasonal distribution of % other grasses in the sward at Ruakura. Maketu, Edgecumbe and Opotiki with monthly cutting (1989-1991).

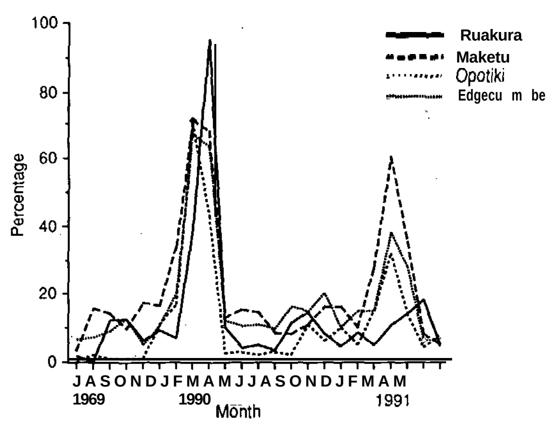

Figure 5 Seasonal distribution of % weeds in the sward at Ruakura, Maketu, Edgecumbe and Opotiki with monthly cutting (1989-1991).

Species other than ryegrass, mainly summer grass (*Digitaria sanguinalis*), made a large contribution at the BOP sites, although less so at Opotiki (Figure 4). Other species contribution peaked in late March in the Waikato. This was caused mainly by a spurt in Paspalum dilatatum *growth.* The Paspalum contribution reached a maximum of only 25% at Maketu. The main contribution comes from other subtropicals in this area. The peak in other species contribution in the Waikato is caused by *Paspalum dilatatwn.* The contribution of *Paspalwn dilatatum was* much lower in the BOP.

Contributions by weed species amounted to 20% and higher in the BOP (Figure 5). This sward component peaked at the time of the December production dip in the BOP.

Simulations

The simulations (Figure 6) show that the "potential" growth rates of ryegrass-based pastures are higher in the BOP than in the Waikato throughout most of the year. Winter-autumn-spring growth rates are considerably higher in the BOP than in the Waikato.

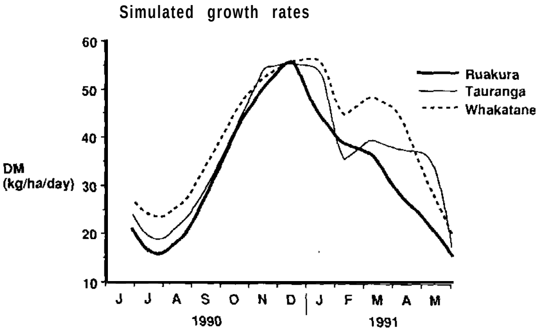

Figure 6 Seasonal distribution of simulated pasture growth rates at **Ruakura, Whakatane** and **Tauranga** with monthly cutting for long term climate **averages** of rainfall and 10 cm soil temperature.

Discussion

Seasonal differences between the Waikato and BOP

Validation results for the model of grassland production to simulate pasture production for the Waikato have been presented by Baars et al. (1987) and Baars & Rollo (1987). In the Waikato, 8597% of the variation in rates of pasture production was explained by this model. A legitimate use of a model is to investigate the potential and then to findreasons whypotentialproduction figures cannot be achieved.

The results of the simulation analyses showed that climate differences should result in higher growth rates in the BOP for ryegrass-dominant pastures from late autumn to mid-spring. Growth rates in spring and winter should be significantly higher. The actual measurements contrast strongly with the results from these simulation analyses. While growth rates in autumn are at least20 % higher in the BOP, winter and spring ***growth*** rates in the BOP are 10-20% lower than in the Waikato.

Three factors may be responsible for these low cool-season growth rates :

1. ***Nitrogen (N) deficiency***

The simulated production patterns suggest large nitrogen deficiencies in late winter-early spring. These deficiencies may be considerably larger than may be inferred from early trial work. Nitrogen responses recorded in the BOP (O'Connor 1982) in the early 1970s were low : 3-9 kg DM /kg N in spring and autumn. The results in this paper suggest large N deficiencies in the area. These low responses may have resulted from widespread droughts over the periods when the N trials were conducted.

2 ***Sulphur (S) deficiency***

The dissection results showed a low contribution of white clover over the period when clover should havehighgrowthrates andNshouldbefixed.Clover may suffer from S deficiencies in this area on dairy farms (Ledgard et al. 1991). No herbage analyses were available for the farms, but herbage chemical analyses may well reveal more widespread deficiencies than presently known.

3. ***Competition from subtropical grasses***

The mid-summer peak in two consecutive years on the BOP sites showed the dominant growth of ***Digitaria sanguinalis*** (L.) Scop., other subtropicals and to amuchlesser extent ***Paspalumdilatatum. The*** low growth rates from March until May resulted from the drying and dying off of the subtropicals over this period causing the low ryegrass content at this time.

The simulations indicate that the climate favours much higher growth rates in spring in the BOP than are being presently achieved. There are marked differences between the two regions in timing of spring peak, spring growth rates, the dip in growth in late December in the BOP and a large summer peak in growth in the BOP. These differences are largely due to the contribution of subtropical species other than Paspalum dilatatum to swardproductioninsummerandearlyautumnasaresult of the warmer climate in the BOP .

Actual growth rates were lower than the Waikato in the first year and spring production was also lower than in the Waikato in the second year. On the other hand the lower than expected growth rates and the low nitrogen responses may also be due to the low growth rates of C4 plants over autumn and early spring.

Influence of subtropicals on pasture performance in the BOP

The results show that thelargepercentage of subtropicals in BOP pastures changes the seasonal growth pattern. Australian data show large effects on nutrititive quality of pasture (Minson & Wilson 1980). Cows are reluctant to eat subtropical grass species because they are always lower in digestibility than temperate species (Minson & Wilson 1980). Thus while growthrates may be high in

February-March, the slump in milkfat continues due to digestibilities for Paspalum 12-13% lower than for ryegrass and possibly even lower for Digitaria and crowfoot grass (*Eleusine indica* (L.) Gaertn.). The effect is even larger due to the lower clover content in February-March.

Ryegrass/white clover-based pastures are desirable and have the best potential in this area. Farmers are repeatedly trying to establish these pastures but on many soil types in the Bay they last only 4-5 years. Field & Forde (1989) reported that a farming organisation stated that summer grass (*Digitaria sanguinalis*) constituted up to 50% of BOP pastures in 1988/89. The data in this paper support this observation and indicate that management practices should restrict the area available for colonisation by restricting the opening up of pastures due to ryegrass loss. As discussed earlier, ryegrass loss is also caused by apparent poor clover performance.

Thus a combination of factors may explain the ingress of subtropicals into a desired ryegrass/white cover sward. As climate change is likely to increase the present contribution of undesirable subtropical species to pasture production in the northern North Island, local research is required in this region to develop control systems preventing the spread of subtropicals in dairy pastures. Continued selection of regional ryegrass ecotypes and incorporation of suitable C4 species in dairying systems are also necessary.

If the higher summer temperatures and present fertiliser deficiencies favour the expression of the potential of subtropicals, it is important to concentrate onstrategies whichfavourhighgrowthratesoftemperate species in the cooler season or to increase the content of temperate grasses in the swards in autumn.

Strategies to overcome the limitations

Management

In Northland Goold (1981) found that mixed kikuyu/ryegrass/white clover pastures became kikuyu dominant when highly stocked with cattle and an 18-day rotation. Highly stocked sheep pastures contained a much higher ryegrass content. Baars et al. (1979), Weeda & During (1987a, b) and Percival & McLintock (1982) have recommended maintaining the balance in mixtures of ryegrass and Paspalum dilatatum. However, to what extent their findings can be extrapolated to swards which suffer from an ingress of subtropical annuals and low clover content may be uncertain. Clearly, swinging the balance to ryegrass dominance in autumn is important for subsequent high winter-spring production.

Nitrogen

Nitrogen is already used in spring. Promoting ryegrass growth in combination with short rotations and hard grazings in autumn may also be of advantage to swing the balance from subtropical to ryegrass dominance as early in autumn as possible.

White clover

Grasslands Kopu white cloverhas a high winter activity and is thought to be more competitive than other lines of white clover on soils high in nitrogen (Van den Bosch et al. 1986). Thisincreased winteractivitymaycomplement the expected extra winter growth produced by winter annuals. However, soil N deficiencies are possibly widespread most of the year.

Annual ryegrasses

General annual ryegrass cultivars (*Lolium multiflorum* Lam.) are now available. Eachcultivarpeaks at different times (Goold, pers.comm.) from autumn sowing through to the following summer. Use of annual ryegrasses is limited although Thorn & Prestidge (1990) indicate that they have considerable potential. From the work by Goold in the Waikato it can be inferred that annual ryegrasses may show excellent performance in the BOP. Different cultivars can be used depending on such management factors as calving date, the need for extra winter feed or the need for extended spring production.

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