DIGESTIBILITY AND CRUDE PROTEIN CHANGES IN TEN MATURING PASTURE SPECIES

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Summary

Pure stands of ***Festuca arundinacea, Phalaris tuberosa, Bromus*** *mollis*, ***Lolium rigidum,*** *Medicago* ***sativa,*** *Medicago truncatula, Vulpia* ***myuros, Trifolium*** *subter-,* ***raneum,*** *Dactylis* ***glomerata*** and *Hordeum* ***lepoinum*** were harvested weekly between September 17 and December 17, 1968. Dry matter digestibility ***in vitro*** and crude protein concentrations were determined.

A temporary reversal of the decline in digestibility with advancing maturity occurred when rainfall followed a period of drought. *Lolium* ***rigidum*** declined in digestibility at the rate of 0.9 percentage units per day in the four weeks after flowering, while seven other species declined at the rate of 0.3 to 0.5 units per day.

Mature ***Festuca arundinacea*** and *Medicago* ***sativa*** were higher in digestibility than the other species. The digestibility and protein content of pasture species to be grazed as summer residues continued to decline after the seeds had matured.

I. INTRODUCTION

Many temperate Australian pastures are dominated by annuals whose maturation coincides with the end of the growing season. These pastures may be grazed as dry residues during the summer months or conserved in spring as hay crops. If cutting for hay is delayed, significant losses in digestibility and crude protein content may occur (Radcliffe and Newbery 1968).

Pastures frequently include invading species which can in some years dominate the originally sown species. Since it is difficult to maintain a theoretically desirable botanical composition in a pasture, many farmers are prepared to accept the ecological changes in composition brought about by the invasion of less productive early maturing species. Little is known of the digestibility and crude protein changes which occur in the individual species found in temperate Australian pastures.

This paper records changes in the *in* ***vitro*** dry matter digestibility and crude protein content of ten commonly occurring pasture species grown at Northfield, South. Australia, during the spring of 1968.

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II. MATERIALS AND METHODS

Ten species were sown in pure stands using a split plot randomised block design with eight replications at the Northfield Research Centre on May 6, 1968. The species used were ***Festuca arundinacea*** Schreb. cv. Demeter. *Phalaris tuberosa* L. (C.P.I. 193Q5), brome grass (***Bromus mollis*** L.), Wimmera ryegrass (*Lolium rigidum* Gaud. cv. Wimmera), lucerne ***(Medicago sativa*** L. cv. Du Puits), barrel medic ***(Medicago truncatula*** Gaertn. var. ***truncatula),*** silvergrass *(Vulpia myuros* (L.) Gmel.) , subterranean clover (***Trifolium subterraneum*** L. ssp. yanninicum Katzn et Morley cv. Yarloop), cocksfoot *(Dactylis glomerata* L. cv. Currie), and barley grass ***(Hordeum leporinum*** Link). All were commercial seeds except bromegrass, silvergrass and barley grass which were obtained as screenings from a seedcleaning contractor.

The experimental area, a red-brown earth, was fallowed for two months, and then dressed with superphosphate (110 kg/ha) one week before sowing.

The species were sown by hand in plots 8.5 x 1.2 m. High seeding rates were used but, due to the wide variation of seed weights, no attempt was made to use the same seeding rate for different species.

Each species plot was split into 14 maturity sub-plots, each 122 x 6 1 cm. Starting on September 17, 1968, one sub-plot within each species was harvested from each replication every week by cutting an area of 91 x 30.5 cm with hand sheep shears. The physiological stage of growth of the harvested material was also recorded.

After discarding any invading species, the sub-plot samples were oven-dried overnight at 90°C, and were ground in a Wiley mill to pass a 1 mm screen.

Duplicate ***two*** stage ***in vitro*** digestibility analyses (Tilley and Terry 1963) and Kjeldahl crude protein determinations were made on the ground samples using the techniques previously described (Radcliffe and Newbery 1968).

The data were examined by split plot analyses of variance.

III. RESULTS

Table 1 shows that, although all species declined in digestibility with advancing maturity between September 17 and December 17, 1968, there were significant differences between the species in the rates at which these changes took place. The flowering dates of the individual species and the weekly rainfall for the experimental period are also given in Table 1.

The weekly mean crude protein figures for the ten species during the same time interval (Table 2) show significantly different rates of decline between the species.

IV. DISCUSSION

The species varied widely in digestibility. The lower initial digestibility values observed for cocksfoot are in agreement with the observations of Minson, Raymond and Harris (1960) who found this grass four to six digestibility units lower than ryegrass at the same stage of growth.

In the month. following flowering, Wimmera ryegrass lost digestibility at the rate of 0.9 units per day. A similar rate of decline has already been observed in mixed pastures dominated by perennial ryegrass (Radcliffe and Newbery 1968).

TABLE 3

Weekly rainfall and weekly dry matter digestibility measured between September 17 and December 17, 1968

Date 1968	Weekly Rainfall (points)	Dry matter digestibility (%) Barley grass	Wimmera ryegrass	Yarloop subclover	Barrel medic	Brome grass	Silvergrass	Phalaris	Lucerne	Currie cocksfoot	Demeter fescue
17.ix	1	64*	72	71	72	70	69	67	72	60	67
25.ix	11	60	68	69	63	67	61	61	66	56	61
1.x	61	60	76*	68*	65	72	66	64	65	56	53
9.x	226	56	63	60	61	62	64	62	67	58	60
15.x		53	59	62	57*	62*	61	59	62	57	59
22.x	15	48	54	56†	54	60	60	57	60	56	57
29.x	101	46	52	54	54	56	59*	57*	62	56	60
5.xi	92	43	46	49	47†	52	54	54	57*	54	56
12.xi	41	42	48	49	47	47	54	52	58	53	57
19.xi	15	41	42	44	45	47	51	47	60	54	56
26.xi	14	34	42	36	36	42	46	45	54	50*	55*
3.xii	26	34	37	26	27	36	45	41	50	45	57
10.xii	32	33	34	35	32	30	45	40	53	47	55
17.xii		38	37	36	30	33	44	39	52	45	52

Level of probability	5%	1%
L.S.D. between species	1.8	2.6
between dates	1.5	2.1

* Commencement of flowering
† Seedpods descending

TABLE 2

Weekly crude protein content measured between September 17 and December 17, 1968

Date 1968	Crude Protein % Barleygrass	Wimmera ryegrass	Yarloop subclover	Barrel medic	Bromegrass	Silvergrass	Phalaris	Lucerne	Currie cocksfoot	Demeter fescue
17.ix	13.3	9.7	18.7	23.3	16.4	14.9	13.0	24.1	13.6	14.7
25.ix	12.6	9.2	16.6	20.5	13.6	13.6	13.3	23.2	12.8	13.4
1.x	11.1	7.8	16.1	20.1	14.1	12.6	13.1	21.4	11.7	11.1
9.x	9.2	7.7	14.3	22.8	15.6	13.1	15.3	24.3	11.2	13.6
15.x	10.0	7.3	14.8	21.8	12.6	12.4	13.6	22.5	11.6	11.5
22.x	8.1	6.6	11.6	18.7	11.0	11.2	12.4	21.5	11.4	12.4
29.x	8.4	6.8	12.3	20.1	9.6	10.2	11.9	21.2	11.2	11.8
5.xi	7.8	6.0	9.7	16.4	7.9	8.7	9.9	17.8	9.7	10.6
12.xi	6.4	4.9	9.2	14.5	6.7	8.2	8.1	16.6	9.2	10.0
19.xi	6.5	5.6	9.0	12.8	6.1	7.8	7.7	17.8	9.0	9.5
26.xi	6 9	4.3	8.5	13.2	4.7	6.4	7.1	15.7	8.5	8.4
3.xii	5.9	4.7	7.4	11.7	3.9	5.9	6.3	14.4	7.4	7.6
10.xii	4.7	3.6	6.9	9.4	3.3	5.3	5.1	14.1	6.9	6.4
17.xii	6.1	4.0	7.7	10.5	2.8	5.1	5.3	14.3	7.7	7.2

	5%	1%
level of probability	5%	1%
L.S.D. between species	0.8	1.2
between dates	0.5	0.7

The rate of digestibility decline for phalaris, bromegrass, silvergrass, barley-grass, Yarloop subterranean clover and barrel medic averaged 0.3 to 0.5 digestibility units per day in the month following flowering. These values are similar to those recorded for mixed pastures by Wilson and McCarrick (1966). They observed that perennial ryegrass swards containing other species showed a reduced rate of digestibility loss compared with pure stands of perennial ryegrass.

Results from the present experiment show that the cutting management of pasture hay crops should be related to the growth physiology of the dominant species present. Where several pastures reach the hay cutting stage at the same time, those crops dominated by ryegrass should be mown first because of their higher rate of digestibility decline.

Demeter fescue and lucerne showed a much smaller seasonal decline in digestibility than the other species. The digestibility of the Demeter fescue is maintained by the continued production of new tillers which offset the lower digestibility of the maturing older tillers.

Although the protein levels in barrel medic and subterranean clover were higher than in all the grasses examined, the digestibility data suggest that the tops of these legumes could be of very limited value once the seedpods have descended.

Some wilting was observed by September 25, 1968. A number of species showed a significant increase in digestibility when rain fell in the week ending October 1, 1968, but only the perennials Demeter fescue, lucerne and cocksfoot showed a response to the continued rainfall of the following week. It appears that rainfall after a period of drought can temporarily reverse the decline in digestibility with advancing maturity. This effect has been observed previously in subterranean clover-perennial ryegrass pastures (Radcliffe and Newbery 1968).

The nutritive value of pasture hay crops and mature pasture residues depends on the voluntary intake by the animal (Blaxter 1962). Blaxter, Wainman and Wilson (1961) have shown a linear relationship between intake and digestibility. Hogan, Weston and Lindsay (1969) recorded a reduction of over 20 per cent in the organic matter intake by sheep fed phalaris cut at a late stage of maturity compared with early cut material. Their mature material appears to be similar in composition to phalaris in this trial in early November. In the following five weeks, the protein content fell by half and the dry matter digestibility declined by over ten percentage units. It must be expected that if phalaris is allowed to grow to maturity before grazing, voluntary intake will be depressed to a much greater degree than that recorded by Hogan, Weston and Lindsay (1969). The level below which protein content restricts intake appears to be between 8.5 per cent (Blaxter and Wilson 1963) and 6.0 per cent (Minson and Milford 1967). Most of the grasses were below 7.0 per cent crude protein within four weeks of heading, and had even lower values at maturity.

Annual ryegrass commonly invades and dominates perennial pastures. The data show that highly digestible hay of adequate protein composition can be made if such a crop is conserved at the onset of ryegrass ear emergence. If, however, the crop is allowed to mature, the summer paddock feed produced will be lower in quality than most of the other species investigated.

In areas with an annual summer drought, the selection of pasture paddocks for hay making should, therefore, take into account the botanical composition and consequent quality losses from the remaining paddocks which are to be used for summer grazing.

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