THE SOLUBLE OXALATE CONTENT OF SOME TROPICAL PASTURE GRASSES GROWN IN SOUTH-EAST QUEENSLAND

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ABSTRACT

Summer and autumn regrowth of twenty-five tropical pasture grasses from nine genera were analysed for water-soluble oxalate. Setaria anceps *cultivars (3.5% oxalate) have more than twice the concentration found in the buffel grass cultivars. All the other species had less than 1% oxalate in the dry matter. It is concluded that, of the species tested, only* Setaria anceps *is likely to be involved in acute oxalate toxicity of grazing animals.*

INTRODUCTION

Setaria anceps (*sphacelata*) can contain high levels of oxalate, which, under certain circumstances, may be toxic to grazing cattle (Jones, Seawright and Little 1970). Death follows acute signs of hypocalcaemia and is accompanied by deposition of calcium oxalate crystals in the kidneys (Seawright, Groenendyk and Silva, 1970). The presence of high levels of oxalate in *Setaria* was only discovered after the release of these grasses for commercial use (Jones, Seawright and Little 1970). The possibility of high oxalate levels in other tropical pasture grasses already in use or under experimental evaluation was examined in the study reported here.

Previous work has shown that in *Setaria* the nitrogen nutrition of the plant, the age of the plant and the particular plant part can influence the oxalate concentration (Jones and Ford 1972). Consequently, the grass species studied here were well fertilized and only young leaf blades were sampled. Since the soluble oxalate is implicated in the binding of calcium, this and not total oxalate was measured.

MATERIALS AND METHODS

Twenty five grasses from nine different genera were used (Table 1). All were grown on adjacent plots measuring 2.0 m x 2.5 m on uniform prairie-like soil overlying granodiorite at 60-80 cm (Thompson and Murtha 1960) on the CSIRO Pasture Research Station, Samford. The grasses were planted vegetatively on September 30, 1970, and were maintained as pure stands by regular weeding. Before planting, and again on September 19, 1971, the plots received 48 kg P, 62 kg K and 75 kg N/ha. The plots were cut back to 7.5 cm in October 1971 and allowed to regrow until January 26, 1972. On this date most of the species had commenced flowering. From each plot 150-200 leaf blades were plucked and dried at 80°C before grinding to pass a 1 mm sieve. The plots were cut with a forage harvester to a 7.5 cm stubble on February 28, 1972, fertilized with 48 kg P, 62 kg K and 75 kg N on March 14, and with 200 kg N and 100 kg K/ha on May 5, 1972. The plots were again sampled on May 31, 1972, as described above.

Leaf material was also obtained from *Cenchrus setigerus* (Birdwood grass), *Pennisetum clandestinum* (Kikuyu) and *Ditigaria decumbens* (Pangola). The Birdwood grass was grown on an adjacent site to the main experimental area described above. The Kikuyu grass was grown on another site on the C.S.I.R.O. Samford Research Station, and the Pangola grass at the C.S.I.R.O. Beerwah Experiment Station. All species were well fertilized.

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TABLE 1

The soluble oxalate content of various tropical pasture grasses, (a) twenty-five grasses sampled in summer and autumn, (b) miscellaneous samples. (Percent anhydrous oxalic acid in the leafblades)

	Grasses	Percent oxalate Summer	Autumn
(a)			
1.	*Bracharia decumbens* CPI 1694†	0.27	*
2.	,, ruziziensis CPI 30623	0.13	0.18
3.	,, humidicolor CPI 16707	0.92	0.89
4.	,, brizantha CPI 15890	0.40	0.54
5.	*Cenchrus ciliaris* cv. Biloela	1.80	1.80
6.	,, ,, cv. Molopo	1.50	1.40
7.	*Chloris gayana* cv. Pioneer	0.10	0 09
8.	,, ,, cv. Samford	0 07	0 08
9.	*Dichanthium aristatum* (Commercial)	0 07	0.08
10.	*Digitaria didactyla*	0.53	*
11.	,, *smutsii* CPI 38869	0.36	0.57
12.	*Paspalum commersonii* cv. Paltridge	0 05	0 09
13.	,, *dilatatum* (Commercial)	0.12	0.10
14.	,, *plicatulum* cv. Rodd's Bay	0 08	0.13
15.	*Panicum coloratum* cv. Bambatsi	0.20	0.17
16.	,, ,, Kabulabula CPI 14375	0.50	0.39
17.	,, ,, ,, CPI 16796	0.38	0.31
18.	*Panicum maximum* cv. Gatton	0.46	0.36
19.	,, ,, cv. Petrie	0.52	0.80
20.	,, ,, cv. Sabi	0.39	0.52
21.	*Setaria anceps* cv. Nandi	3.1	2.8
22.	,, ,, cv. Narok	3.5	3.8
23.	,, ,, cv. Kazungula	4.2	3.7
24.	,, ,, CPI 33453	3.1	3.3
25.	*Urochloa mosambicensis*	0.44	0.67
(b)			
26.	*Cenchrus setigerus* CPI 17655	1.4	
27.	*Digitaria decumbens* Pangola	0.35–0.65	
28.	*Pennisetum clandestinum* Kikuyu	0.72	

†Commonwealth Plant Introduction Number.
*Not sampled.

Soluble oxalate was determined by gas-liquid chromatography as described previously by Jones and Ford (1972). The oxalate was expressed as percent anhydrous oxalic acid in the dry matter. No correction was made for possible interference of plant calcium during the extraction.

RESULTS AND DISCUSSION

The similarity in ranking of the grasses at the two sampling dates is evident from Table Ia. The actual values were also very similar for the summer and autumn samplings.

Setaria anceps had far higher oxalate concentrations than all the other species tested (Table 1). The next highest group—*Cenchrus*—had only half the values recorded for *Setaria,* and the remaining species all had oxalate concentrations below 1.0%.

The very low values found in *Chloris gayana* and *Paspalum dilatatum* are in accord with earlier results (Jones, Seawright and Little 1970) and the low values with *P. plicatulum* agree with those of Garcia-Rivera and Morris (1955). All the Digitaria species had rather similar values but the *Brachiaria* species differed rather

widely (Table 1a). *Brachiaria humidicolor* (*dictyoneura*) had much higher levels (0.9%) than the other three species examined.

Wide variations among different varieties of *Panicum maximum* in their oxalate concentration were reported by Garcia-Rivera and Morris (1955), and the range (1.0-2.3%) was far higher than with the *Panicum* species and cultivars reported here. Our low values are, however, in agreement with the value reported by Mathams and Sutherland (1952). It is possible that the larger leaved guinea grasses may have higher oxalate concentrations than the finer leaved cultivars examined here.

The low value for *Pennisetum clandestinum* (Table 1b) contrasts with the high values (2.4-2.6%) reported for *Pennisetum purpureum* (Elephant grass) in the literature (Garcia-Rivera and Morris 1955; Lal, Johari and Mehta 1966).

It is clear from these results that the *Setaria anceps* introductions are exceptional in their very high concentration of oxalate. As shown previously, cv Nandi has lower oxalate than the other two cultivars (Jones, Seawright and Little 1970, Smith 1972). As there have been no toxicity problems in long term grazing trials with nitrogen fertilized Nandi setaria at Samford (R. J. Jones—unpublished data), it seems very unlikely that problems of acute oxalate toxicity will be encountered with the other tropical grass species examined in this study. However, possible chronic effects of oxalate on calcium metabolism (Gontzea and Sutzescu 1968) may be more important. This aspect requires further work to determine the influence of oxalate intake on the performance of animals on improved pasture.

Finally, it is of interest that the three grass genera shown by Dougall and Birch (1966) to have pH values in the cell sap of less than 6 have all been shown to be high in oxalate. These are *Cenchrus, Pennisetum* and *Setaria,* all closely related genera in the tribe Paniceae.

ACKNOWLEDGEMENTS

We wish to thank Mr. J. von Fürstenrecht for the field work and Miss L. Vorobieva for assistance in the laboratory.

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(Accepted for publication August 8, 1972)