THE USE OF SORGHUMS AS FORAGE CROPS

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ABSTRACT

An account is given of sorghums for forage crops in New Zealand based on local experiments and on over seas information. Their cultural requirements and their various types are discussed. Sudan-grass and sorghum-Sudangrass hybrids have already shown to be useful for summer greenfeed because of their recovery tillering after cutting or grazing. Sorghum forage more suitable for silage, such as suger sorghum, has not been fully investigated in New Zealand but experimental evidence suggests potentialities in this field including the possibility of sugar syrup production. Reference is made to cyanide toxicity in grazing sorghum crops and the avoidance of hazards by recommended methods of management.

INTRODUCTION

For some years interest has been focused on supplementing pasture production with high yielding and high energy forage crops. The dry summers in the last few years have underlined the need for green feed when pastures turn brown and the production drops. Several members of the genus, sorghum and their hybrids have been introduced and tested in New Zealand for this purpose.

As the nomenclature of the sorghums has sometimes caused confusion, the following information may assist in clarifying the position. The recent literature indicates that the common grain sorghum formerly called **Sorghum vulagre** (Pers.) is now correctly called **Sorghum bicolor** (Lynn.) Moench. Other varieties belonging to this genus are:

Sudan Grass (**Sorghum sudanense** (Piper) Hitch.) a tufty tall tropical crass often used in the production of hybrids.

Johnson grass (**Sorghum halepense** (L) Pers.) a rhizomatous tropical grass spreading quickly and seeding prolifically.

Columbus grass [**Sorghum almum**] another rhizomatous member from South America, a cross between cultivated sorghum and **S. halepense.**

Sorgo, also called Sweet sorghum or Sugar sorghum [**Sorghum vulgare cv. Saccharatum,** or **S. saccharatum**], a juicy, sweet stemmed plant widely used for fodder and also for sugar syrup production.

The sorghum-Sudan grass hybrids (e.g. Sudax, Sordan), being interspecific have intermediate characteristics of their parents. Trudan I and II are inter-cultivar hybrids in which both parents are Sudan grasses. Of the hybrids, fresh F_1 seed is required each year. On the other hand, Sugardrip and Tracy are cultivars of Sorgo of which seed can be obtained from the standing crop as long as no crosspollination with other cultivars occurs.

For the purpose of stockfodder, for New Zealand conditions, Sudan grass, sorghum/Sudan grass hybrids, Sugar sorghum and perhaps Sorgo/sorghum hybrids are of interest.

REQUIREMENTS

Originating from Africa (probably Ethiopia), the majority of the sorghums require warm summers for good development and production. From experience gained in trials, it is suggested that soil temperatures of 16-18 deg. C at 10 cm depth are needed for germination. Similar or higher air temperatures could ensure further development without stagnation. There is little growth below 15 deg. C, and it has been found that sorghum seedlings were injured when exposed to temperatures below 10 deg. C (A.O. Taylor pers. comm.). The standing crop is susceptible to frosts. This restricts the crop to areas with a warm summer and places the time of sowing about November-December. In practice, it was observed that sowing about two weeks after the usual time for planting maize was suitable for the sorghums. Most members of this group show considerable tolerance to moisture stress.

They grow on a wide range of soils from light loams to heavy clays with a pH ranging from 5.0 - 8.5. In general it can be said that the soils suitable for maize can also be used for sorghums but the latter tolerate salinity better than maize.

Being thinner stemmed and of narrower foliage than maize, the sorghums allow closer spacing. As a fodder crop, a spacing of about 45 cm, with 15-20 kg of seed/ha has been used, while for silage a narrower spacing of 30 cm with 25 kg/ha seed could be applied.

In view of the fact that population densities in excess of 600,000 have been successfully applied with sorghums at the Grassland Research Station at Hurley (Sheldrick, 1971) and in our own experiments, there is scope for further studies in this field.

YIELDS

It is evident in the literature that sorghums are capable of very high D.M. yields if conditions are favourable. In Hawaii, for example, forage sorghum harvested for silage throughout the year with up to seven cuts produced 30,000 kg/ha dry matter (Plucknett **et al.** 1971). In the U.S.A., Sudan grass and the sorghum/Sudan grass hybrids may be cut as pasture up to five times in about 100 days, giving 20,000 kg D.M./ha, a production which so far has been reached only once in New Zealand experiments. These high productions are obtained in

temperatures above those usually experienced in the so-called Warm Zone of New Zealand. In the more temperate conditions of the Grassland Research Institute, Hurley, Britain, Sheldrick (1971) obtained production approaching 15,000 kg D.M./ha from sorghum hybrids used for ensiling.

In New Zealand, the sorghums were mostly incorporated in departmental greenfeed trials spread over the country (Auckland, Waikato, Bay of Plenty, Manawatu, Hawkes Bay, Blenheim, Nelson, Westland and Otago) and often compared with maize, millets and other summer crops e.g. turnips, chou moellier, etc.

The yields of Sudan grass and sorghum/Sudan grass hybrids being cut frequently were published by Cottier (1972). Highest yields in the Waikato were obtained at Pokuru near Te Awamutu where the crops were cut three times in a period of 77 days (22 January - 9 April):

	kg D.M./ha
Trudan I	9520
Trudan II	9360
Sordan 67	9740

Doggett (1970) quotes dry matter yields in Arizona, the crop being cut five times in a longer period of growth of 107 days from June 9 to October 6:

	kg D.M./ha
Trudan I	16,530
Trudan II	18,450

Trudan II and Sudax showed a good potential also in other areas of New Zealand. In the Auckland area, production of over 6000 kg/ha D.M. were obtained with Trudan II and over 8000 kg/ha D.M. with Sudax.

In the Nelson district, a maximum of more than 11,000 kg/ha D.M. was obtained with Trudan II, 15,300 kg/ha with Sudax and 13,000 kg/ha with Sugar sorghum cv. Sugardrip. In Blenheim, Trudan did not produce more than about 5800 kg/ha D.M., but in Otago yields of over 7000 kg/ha D.M. were obtained with the same hybrid.

In the Wairoa district (Hawkes Bay), Sugar sorghum yields ranging from 6600 kg - 28,000 kg/ha D.M. were obtained in 1970. It was further shown in a number of trials that all sorghums tested were capable of considerable regrowth after cutting. This is an advantage over maize which can be cut only once.

Whereas in general the Sudan grasses and sorghum/Sudan grass hybrids do not outyield maize if treated as a full season crop, the Sorgo's and also the Grain sorghum/Sorgo hybrids seem worth further investigation. The sugar content of the former is an added advantage.

Trials with six varieties of sugar sorghum introduced in 1968 from the Beltsville Research Station, U.S.A. were set out in 1969/70 in Auckland, Te Kauwhata, Wairoa and Blenheim to determine the sugar content of the stem and, in Auckland and Wairoa the production of greenfeed. Expressed as a percentage of the D.M. of the stalk, the sugar content ranged as follows:

Auckland	3.4 - 8.2%
Te Kauwhata	4.1 - 6.4% (crop affected by frost)
Wairoa	5.1 - 14.3%
Blenheim	7.7 - 9.2%

In the Auckland and Wairoa trials, the green weights were as follows:

	AUCKLAND		WAIROA	
Variety	Weight of Stalk kg/ha	Weight of Leaf kg/ha	Total weight of plant kg/ha	Weight of Stalk kg/ha
Brawley	45 653	17 129	36 132	25 885
Rio	54 569	19 239	31 985	19 900
Sart	33 371	8 621	22 169	17 141
Sugardrip	33 445	9 324	54 205	40 604
Tracy	69 181	14 909	44 294	36 132
Wiley	75 250	19 424	39 798	33 789

The total fresh weight ranged from about 22,000 kg — 95,000 kg/ha with a dry matter content ranging from 19.1% to 32.9%. The sugar production calculated from the stalk yields ranged from 603 kg/ha for the variety Sart in Auckland to 3530 kg/ha for Wiley in Wairoa. Doggett (1970, p. 254-55) quotes comparable yields of sugar syrup for Sart, Tracy and Wiley averaging 1266 litres/ha in West Virginia in 1956-58 and 3737 litres/ha for Mississippi in 1953-55. These New Zealand results look promising, particularly if it is realised that at 50% concentration the sugar syrup is suitable for canning fruit and at 80% concentration it can be used for table syrup and in the dairy industry for sweetening evaporated milk.

Sugar sorghum or Sorgo will produce recovery growth if cut as greenfeed but is then inclined to be lower yielding than Sudan grass and S/S hybrids similarly managed. More important, the young regrowth may have high cyanide levels. Therefore it cannot be recommended for this purpose. The more appropriate use for Sugar sorghum in New Zealand appears at present to be similar to its preferred use in the U.S.A., i.e. as silage. Under local conditions, it should be compared with maize and there is an obvious field of investigation here. The high sugar content may also be a point of interest.

The sorghums can produce a good quality stock feed. In the Ord river valley in Australia McCray found that Sudan grass and S/S hybrids are capable of sustained production of 2lb live weight per day in beef cattle or two gallons milk in dairy cattle taken from a crop 10 weeks old. The digestibility was slightly lower than that of maize (60% against 65%) and it is not a complete food, but is valuable as supplementary feed. Sudax fed in two cuts in Australia (McCray, 1966) gave 2998 kg A.D.M. and 469 kg protein/ha.

HCN TOXICITY

Instances have occured in New Zealand in which cattle deaths have been attributed to hydrocyanic acid poisoning through grazing sorghum. Most sorghums contain dhurrin, a cyanogenic glucoside which on hydrolysis in the rumen produces the toxic hydrogen cyanide. The quantity of dhurrin depends on the type of sorghum, the stage of growth and growth conditions. In general it is young growth which may be dangerous. Harrington (1966) in Pennsylvania recommended that Sudan grass and Sudan grass/sorghym hybrids should not be used before they attained a height of at least 45cm as measured to the central leaf tip and that after grazing or cutting they should be rested until the height of 45cm is re-attained. A period of stress, e.g. droughts or frosts, may also increase the concentration (McCray, 1966) and the regrowth after such a period should therefore be allowed to mature before use. Boyd **et al.** (1938) stated the following levels which have been generally accepted:

0 - 50 mg HCN/100 gram dry matter of herbage = safe to stock

50 - 75 mg HCN/100 gram dry matter of herbage = doubtful toxicity

75 - above mg HCN/100 gram dry matter of herbage = dangerous to stock

At low levels the toxin is apparently rapidly broken down and detoxified (Macadam, 1970; W.H. Bishop, Ruakura, Pers. Comm.), so the same amount of cyanide that would be lethal if eaten quickly would be quite harmless if ingested over a longer period.

Once these principles are understood, danger to stock can be avoided by proper methods of management.

In addition, selection and breeding for low dhurrin content, in particular with species of Sudan grass, has resulted in cultivars being available with low toxicity levels. This is reflected in the sorghum/Sudan grass hybrids which together with Sudan grass can be regarded as relatively safe provided they are properly managed. The Sugar sorghums and their hybrids are more inclined to higher dhurrin levels in the young foliage and so are more suitable for use at a later stage for ensilage.

CONCLUSIONS

1. Sudan grasses and sorghum/Sudan grass hybrids are a useful greenfeed for areas with a warm summer, particularly in the districts where dry conditions reduce pasture production.

2. They have an advantage in that they can be cut several times and produce a good regrowth after each cut. In total production of a full season's growth, they are generally out-yielded by maize while they have a slightly lower digestibility than maize.

3. Sugar sorghum can out-yield maize and has the additional advantage of being suitable for the production of sugar syrup. The latter could be valuable for the canning of fruit and sweetening of evaporated milk. This group should by preference be used for the production of silage. Further research on the Grain sorghum/Sorgo hybrids should be undertaken.

4. Stock losses through the production of cyanogenic glucoside dhurrin which occurs in young sorghum seedlings and regrowth or flushes after a period of stress can be avoided if proper methods of management are applied.

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REFERENCES

Cottier, K. 1973. Experiments with warm zone crops for summer greenfeed in Waikato. Proceedings of the Agronomy Society of N.Z. **3:** 25-31.

Dogget, H. 1970. Sorghum: Longmans, Green & Co. Ltd.

Harrington, J.D. 1966. Hydrocyanic acid content of Piper Trudan I and six sorghum-Sudan grass hybrids. Pennsylvania State University, College of Agricultural Bulletin **735.**

McCray, C.W.R. 1966. Sorghum Handbook, Queensland Department of Primary Industries Publication No. **2.**

Macadam, J.F. 1970. Danger in Sorghum feeding. Agricultural Gazette of N.S.W. **61:** 664.

Plucknett, D.L., Younge, C.R., Tzuno, T., Tamimi, Y.H. and Ishizaki, S.H. 1971. Sorghum production in Hawaii. University of Hawii Agricultural Experimental Station Research Bull. **143.**

Sheldrick, R.D. 1971. Trials of sorghum for forage. Technical Report No. 9 Grassland Research Institute, Hurley, Maidenhead, Berks., U.K.