EXPERIMENTS WITH WARM-ZONE CROPS FOR SUMMER GREEN FEED IN WAIKATO

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SUMMARY

Experiments in Waikato with warm-zone crops for summer greenfeed indicated that sudangrass, sorghum-sudangrass hybrids and Japanese millet had the ability to produce recovery growth after having been either grazed off or mown. Because of this they are able to provide feed over extensive periods.

Maize did not recover from cutting and to realise its potential of high D.M. yields was better used at more mature stages.

Other crops investigated were Pearl millet, Hungarian millet, French White millet and sugar sorghum. Of these Pearl millet showed promising production and recovery but needs further testing.

INTRODUCTION

Because periods of low rainfall often occur in summer in the Waikato region, summer greenfeed crops are often regarded as desirable to augment pasture. Commonly maize and Japanese millet are used for this purpose. Maize (*Zea mays*) has long been used for summer greenfeed. Gunning (1959) described its cultivation for this use in Waikato.

Japanese millet (*Echinochloa frumentacea*) has also been known for many years as a warm zone summer greenfeed, and Syme (1946) gave a detailed account of its production.

Clare (1952) mentions sporadic occurrence of photo-sensitisation in stock caused by this crop, and Hart (1966) reported such instances with lambs, with no liver damage, however, and no effect on mature sheep and cattle. It is usually regarded as safe for grazing. It is sometimes called barnyard millet, probably because of its relationship to Barnyard grass, a common Waikato weed.

Sudangrass (*Sorghum sudaniensis*) and sorghum-sudangrass hybrids (*S. sudaniensis x S. vulgare*) were introduced to N.Z. comparatively recently, and early experimental work on them was described by Karlovsky (1966) and Cottier and White (1967).

Instances have occurred in New Zealand of hydrocyanic acid in sorghum forage, causing stock losses. However, the modern cultivars have been evolved with low HCN content and are generally considered safe if recommended methods of usage are followed.

Harrington (1960) in Pennsylvannia, U.S.A. obtained differences in HCN levels due to cultivars, to management and to environment but emphasised that in a very wide range of conditions less than 1% of 1200 samples were dangerous to stock.

Sources of danger are very young plants, fresh regrowth or stunted plants from drought or malnutrition. Such types of growth should not be used. It is recommended that sudangrass and Sorghum-sudangrass hybrids should be used when they are 45 to 60 cm tall.

Pearl millet (*Pennisetum typhoides*) was used by Gerlach in 1971 in a pilot trial in Waikato (unpublished).

French White millet (*Panicum miliaceum*), also called White millet or common millet, is mainly grown in New Zealand for birdseed. It has been regarded as a suspect crop for animal grazing and both Simpson (1946) and Clare (1952) recorded cases of photo-sensitisation and liver damage in sheep.

Hungarian millet (*Setaria italica*) also grown as birdseed has been suspected of photosensitisation effects, when grazed. (Clare 1952).

Sugar sorghums (*Sorghum vulgare var. saccharatum*) are common sorghum cultivars which possess high sugar content in the stems. They have been observed to produce recovery growth after defoliation in a pilot trial (Cottier, unpublished).

METHODS AND MATERIALS

In 1965 sudangrass and sorghum - sudangrass hybrids were compared with maize and Japanese millet in an experiment at Karapiro.

Subsequently similar investigations were conducted. In all there are six experiments at Karapiro, Wardville, Hoe-o-tamui, Pokuru and Rukuhia (2).

Crops

Details of crops included in each experiment are given in the appendix.

Sites

The sites of the six experiments were on soils normally used for cropping, in various stages of the crop rotation, and sown with appropriate fertilisers.

Experimental Techniques

The trials were replicated randomised block designs. Individual plots were five to ten metres long, with four or five rows. Inter-row spacings were mostly 30 or 35 cm, but two trials had 60 cm and 75 cm respectively. Seed was sown with a small mechanical sower or, as with maize, by hand.

Foliage was harvested when ideally the crops were some 75 cm to 1 m tall, although this was sometimes exceeded. Harvesting was done by cutting to about 4.5 cm above soil surface, using a sickle-bar mower or hand-sickles. Outside rows were discarded. Green weights were taken, with representative samples for dry matter determination.

RESULTS

The comparative patterns of growth of maize, Japanese millet, sudangrass and sorghum-sudangrass hybrids were obtained from trials at Karapiro (1965-66) and Pokuru (1967-68).

These were sown late November to early December and were cut once, twice or three times according to regrowth, i.e. first cut after 6 or 7 weeks, in January; second cut in February after 5 weeks regrowth, and a third cut six weeks later in March-April. (For specific details see Appendix).

The effects of each trial were markedly similar and were as follows:

(1) Maize was cut only once, as it produced no recovery growth.
(2) Japanese millet had two good greenfeed cuts but thereafter ran to seedhead.
(3) Sudangrass and sorghum-sudangrass, which behaved very similarly, gave three good cuts of greenfeed. (Table 1)

TABLE 1: Mean dry matter yields (t/ha) of maize, Japanese millet, sorghum-sudangrass hybrids and sudangrass based on data obtained from experiments at Karapiro and Pokuru.

Cut	Maize	Japanese millet	Sorghum-sudangrass hybrids	Sudangrass
1	4.30	3.36	3.23	2.74
2	–	3.25	3.16	3.11
3	–	–	2.13	2.16
Total	4.30	6.61	8.52	8.01

Individual yields are shown in Appendix.

Maize produced the highest dry matter yield in the early stage. Once harvested, however, it had no subsequent recovery growth.

Sudangrass, sorghum-sudangrass hybrids and Japanese millet, while not equalling maize in the first period, were able to produce further dry matter because of their recovery growth. They thus produced feed over a longer period, and, eventually more feed than maize.

Japanese millet produced well from two cuts but thereafter emitted short, heavily-flowering seed stalks unsuitable for greenfeed. In contrast sudangrass and sorghum-sudangrass hybrids still gave useful greenfeed in appreciable amounts, and eventually outyielded Japanese millet in addition to extending the period of availability of greenfeed.

Maize

Higher maize production could have been obtained by delaying utilisation. in another trial of similar type, at Hoe-o-tainui (near Morrinsville), maize was harvested at later stages.

Cut after 80 days from sowing ... 9 970 kg/ha D.M.
Cut after 100 " " " ... 13 080 kg/ha D.M.
In this trial sudangrass sown at the same time was cut twice, at 64 and 100 days, and produced a total of 6 190 kg ha D.M.

At 100 days maize was in the early silk stage and could have been expected to grow further.

Maize is capable of very high yields if allowed to grow to a relatively late stage.

Sudangrass

Sudangrass was included in all six trials, either as Trudan I and Trudan II. The former was used in the earliest trials and the latter in subsequent trials. They were the commercially-available representatives of sudangrass. Trudan I tending to become replaced by Trudan II.

The two lines were directly comparable in one trial only, at Pokuru (1967-68). There they behaved in a markedly similar manner. They were both cut three times and their relative dry-matter production at each sampling was almost the same.

In only two of the trials were three cuts obtained. In all others two cuts were made, with strong recovery growth being apparent. At Wardville and Hoe-o-tainui in 1966-67 both experiments were terminated early to allow preparation for pasture-sowing. For this reason third cuts yield data could not be obtained.

In the Rukuhia trials Trudan II tended to produce less than Japanese millet in the first cut, but there was no doubt of its strong recovery growth. In the Rukuhia trial, 1971-72, Trudan II still recovered (but was not measured) with good green leaf-growth after the late second cut of 30.3.72. All other lines had no regrowth or had seeded.

Over all trials sudangrass confirmed a general growth pattern of strong recovery growth and capacity to produce greenfeed over a long period.

Sorghum-sudangrass Hybrids

These appeared in four trials. They were used as avaiable in small seed-lots for experiments or, in some cases, commercially. Seven different lines were used, namely Hidan 35, Hidan 37, Greenlan, Haygrazer, Sudax, Sudum and Sordan 67. They were not sufficiently compared with each other for reliable judgements to be made on the merits of individual lines. However, as members of a group they behaved similarly. Like sudangrass they throve in conditions of early utilisation and spelling to allow recovery growth. in two trials their representatives gave three good cuts of green feed, i.e., Karapiro and Pokuru, and in the other two trials, at Wardville and Hoe-o-tanui they were cut twice with strong re-growth apparent. Overall these hybrids behaved very similarly to sudangrass.

Japanese Millet

This was included in four trials, i.e. at Karapiro, Pokuru and two successive trials at Rukuhia. These all confirmed that the crop had marked powers in recovery growth after the intial utilisation. After a second cut however, the Japanese millet went to seed, not producing any further greenfeed. This was a marked tendency and resulted in this crop having a less extended greenfeed production season than sudangrass and sorghum-sudangrass hybrids.

Other Crops

Other crops investigated were Hungarian millet, French White millet, Pearl millet and sugar sorghum. Hungarian and French white millet were in two trials at Rukuhia in successive years. Hungarian millet produced little initial bulk and showed little recovery growth. French white millet was somewhat superior in production to Hungarian millet but did not compare with, for instance, Japanese millet in either initial bulk or recovery growth. It is, in addition, a suspect crop, because of photosensitisation and liver-damage effects in sheep, reported by Simpson (1946).

Pearl millet, experimented with in one season only, gave results which indicated that more experiments with it were warranted. In the one experiment at Rukuhia its initial growth and its first recovery growth were at least equal to sudangrass and Japanese millet. It did not recover from a second cut (and was inferior in this regard to sudangrass).

Sugar sorghum was tried in one trial at Rukuhia. It showed fair production and recovery growth, but its total production was significantly lower than some of the other crops. (See Appandix).

DISCUSSION

The six experiments gave information on the growth patterns of the main crops. The trends obtained were fairly consistent, although some of the trials had to be terminated early, e.g. Hoe-o-tanui and Wardville because the land had to be prepared for pasture sowing; and in the Rukuhia trials the wide spacing (60 and 75 cm) gave lower yields per unit area. The 1970-71 Rukuhua trial was not pursued beyond the second cut taken 1.3.71 because the very poor recovery growths of Hungarian millet and French white millet had made by that date. In the 1971-72 Rukuhia experiment the date of sowing was very late and the second cut was not obtained until 30.3.72. Although some regrowth occurred, frost killed all growth in mid-April.

The characteristic capacity for recovery regrowth shown by sudangrass and sorghum-sudangrass hybrids in particular, but also by Japanese millet, could be valuable in some circumstances. They have potential to provide early feed which can be utilised without prejudicing later production, unlike maize where early usage precludes the realisation of its high-yielding potential because of lack of recovery growth. Although the total D.M. produced by sudangrass, sorghum-sudangrass hybrids and Japanese millet can be, accumulatively, quite high, e.g. over 8 000 kg ha in some of the experiments, maize will exceed them in this respect provided that it is allowed to proceed to a sufficiently mature

stage. When it was harvested at Pokuru and Karapiro at 45 and 51 days after sowing, respectively, somewhat more than 4 000 kg ha D.M. was obtained, this being the total production as no regrowth occurred. This was of course much lower than the cumulative D.M. productions of the crops which had recovery growth throughout the season. When maize was harvested at 100 days, at Hoe-o-tanui, the approximately doubled growth period had more than doubled D.M. yield, which was 13 000 kg ha.

If it is known that early greenfeed is required, it might be better to use one of the crops which would recover and produce subsequently, rather than maize. However, usually, in Waikato summer greenfeed would be required in February-March and maize would not be used so early as it was at the Pokuru and Karapiro experiments, and the extra growth period might well have doubled D.M. production.

CONCLUSIONS

It is considered that the growth patterns of sudangrass, sorghum-sudangrass hybrids Japanese millet and maize used for summer greenfeed in Waikato have been established. It would be of interest similarly to investigate Pearl millet further than it has been to date.

Sudangrass, sorghum-sudangrass hybrids and Japanese millet have dissimilar growth patterns to that of maize, being stimulated into further tiller production by defoliation and so producing continuity of greenfeed, whereas maize does not so recover. Judicious use of these different characteristics may be of advantage.

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APPENDIX

Dry Matter Yields in Trials (kg/ha)

Karapiro

	Cut 1	Cut 2	Cut 3	
	10.1.66	11.2.66	25.3.66	Total
Trudan I	2120 dC	2700 bA	1820 a	6640
Hidan 35	1970 dC	2480 bA	1380 a	5830
Hidan 37	2740 bAB	2620 bA	2000 a	7360
Haygrazer	3300 bAB	3530 aA	1970 a	8800
Motiti maize	4100 aA	–	–	4100
Jap.millet	2580 cd BC	2800 abA	–	5380
C. V.	11.4%	13.6%	26.2%	

Wardville (a) Sown 1.12.66.

	Cut 1	Cut 2	
	7.2.67	6.3.67	Total
Trudan I	5940 aAB	2240 a	8180 abA
Greenlan	5750 aAB	2340 a	8100 abA
Sudum	6910 aA	2120 a	9030 aA
Sudax	5100 bA	2370 a	7470 bA
C.V.	14.6%	12.8%	11.1%
M.S.D. (5%)		400	

(b) Late sown 10.1.67

	Cut
	6.3.67
Trudan I	2790 bB
Haygrazer aA	3960 aA

Hoe-o-tanui (a) Sown 30.11.66.

	Cut 1	Cut 2	
	8.2.67	9.3.67	Total
Trudan I	3600 a	2120 a	5720 aA
Greenlan	3450 a	2390 a	5840 aA
Sudum	2940 a	1880 a	4830 bA
Sudax	3250 a	1870 a	5120 abA
C.V.	15.0%	19.2%	11.0%
M.S.D.	660	530	

(b) Late sown 19.12.66

	Cut 1	Cut 2	Cut 3	
	21.2.67	9.3.67	29.3.67	Total
Maize (W.575 uncertified)	–	9970	–	9970
"	–	–	13 080 aA	13 080 aA
Trudan I	4470	–	1720 bB	6190 cB

Pokuru

	Cut 1	Cut 2	Cut 3	
	22.1.68	27.2.68	9.4.68	Total
Trudan I	3490 cBC	3550 a	2460 a	9520 aAB
Trudan II	3230 cC	3600 a	2550 a	9360 aAB
Sordan 67	3800 bc ABC	3460 a	2480 a	9740 aA
Jap. millet	4140 ab AB	3700 a	–	7840 bB
W. 575 Maize	4500 aA	–	–	4500 (NA)
C.V.	15.2%	21%	21%	12%

Note:- Jap. millet 1420 kg/ha on cut 3 almost entirely seed head and stalks and not shown here.

Rukuhia Horotiu sandy loam

	Cut 1	Cut 2	
	27.1.71	1.3.71	Total
Trudan II	780	1500	2280
Jap. millet	4790	2030	6820
Hungarian millet	1470	140	1610
French W. millet	2500	180	2680
C.V.			

Note:- Trudan II unaccountably was relatively poor in this experiment while Japanese millet was exceptionally good. Note that wide row spacing affected yields per given area.

Rukuhia

	Cut 1	Cut 2	
	18.2.72	30.3.72	Total
Trudan II	780 abc AB	2420 aA	3210 a AB
Jap. millet	1080 ab AB	2340 aA	3410 aA
Hungarian millet	400 cB	240 cC	640 cC
French W. millet	1010 ab AB	920 b BC	1920 b BC
Pearl millet			
(a) Katherine	1230 aA	2340 aA	3570 aA
(b) Tamworth	1270 aA	2120 aA	3390 aA
Sugar sorghum			
(a) Tracy	660 bc AB	1070 b BC	1730 bC
(b) Sart.	710 bc AB	1230 bB	1940 b BC
C.V.	34%	26.9%	25.3%

Trudan II had an appreciable third growth, which was not measured. No other crop was similar in this respect. Frost in mid-April killed all further growth. Note wide row-spacing affecting yields per unit area.