SUMMER AND EARLY AUTUMN FORAGE YIELDS OF MAIZE, SORGHUMS AND MILLETS IN NELSON AND MARLBOROUGH

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ABSTRACT

Experiments with sudan grass, sorghum – sudan grass hybrids, millets and maize in Nelson and Marlborough indicated that Sudax and PX610 maize were capable of producing 17-18 000 kg DM/ha if harvesting was delayed until late summer or early autumn and where rainfall was adequate following sowing.

Yields were often much lower where nil rainfall was received for several weeks during crop establishment or when crops were harvested prior to late summer.

INTRODUCTION

Gerlach (1974) reported that evapotranspiration exceeds mean monthly rainfall from November to March at Appleby, Nelson, and from October to April at Blenheim, Marlborough. High soil temperatures and soil moisture deficits during these periods, especially in the late summer and early autumn, can result in pasture production falling below the feed requirements of livestock. At a site near Motueka, Radcliffe (1975) found that zero yields were recorded in 5 out of 6 years during January and February due to drought.

Gerlach (1974) included parts of Nelson and Marlborough in the Warm Zone of New Zealand. Low temperature sensitive species, such as maize, sorghum and millet should show normal growth and development in this zone, and could be used for supplementary animal feeding during periods of low pasture productivity.

The results of four experiments to compare the summer and early autumn production of a number of crops are reported in this paper.

EXPERIMENTAL

Details of sites, cultivar seeding rates and sowing dates are given in Table 1.

Japanese millet (**Echinochloa framentacea**), Sugar sorghum cv Sugar drip (**Sorghum saccharatum**), Sudax (**Sorghum sudanense** x **Sorghum bicolor**), Pearl millet cv Tamworth (**Pennisetum typhoides**) and Trudan II (an intercultivar of **Sorghum sudanense**) were sown with a Planet Junior drill at Harakeke and Appleby. Maize (**Zea mays**) was sown by hand. Following sowing, 80 kg N/ha, 70 kg K/ha and 70 kg P/ha was broadcast by hand.

At Waimea West and Wairau Valley, Japanese millet and Sudax were mixed with lime reverted superphosphate which was sown at 250 kg/ha through the fertiliser box of a farm drill. Maize was hand sown after the fertiliser was applied with the drill.

In all trials, plots were cut to 5 cm with a sickle bar mower and the harvested herbage weighed before being sub-sampled for dry matter determination.

1973/74 experiments

The experimental design at Harakeke was split-plot with main plots arranged in randomised blocks with four replications. Crops (Sugar drip, Pearl millet, Japanese millet, Sudax, Trudan II and PX610 maize) were applied to main plots and harvest regimes to sub-plots. Harvest regimes were –

1. First cut January, regrowth cuts February and March.
2. First cut February, regrowth cut March.
3. Single cut in March.

Sub-plots consisted of 8 rows, 19 cm apart and 6 m long, except for maize where there were 6 rows, 25 cm apart and 4 m long. Forage yields were measured by cutting an area of 4 x 1.0 m from maize sub-plots and 4.65 x 0.9 m from other sub-plots.

At Appleby, plots were arranged in a randomised block design with five replications. Harvest regimes and crops sown were the same as at Harakeke, except that XL45 maize was included in the trial. Plots consisted of 8 rows, 19 cm apart and 10.5 m long, except for maize where there were 6 rows, 25 cm apart. Yields were measured by cutting two or three non-randomised areas of 0.9 x 1.5 m from each plot.

1974/75 experiments

The experimental design at Waimea West was split-plot with main plots arranged in a randomised block design with 4 replications. Harvest regimes were applied to main plots and crops to sub-plots.

The experiment at Wairau Valley was intended to have a split-plot design, but was mistakenly cut as a randomised block design with crops and harvest regimes in full factorial arrangement. Statistical analyses were done assuming the latter design.

Sub-plots at Waimea West and plots at Wairau Valley consisted of 5 rows, 18 cm apart and 10 m long, except for maize, where there were 3 rows, 36 cm apart. Forage yields were measured by cutting an area of 7 x 1.1 m from maize sub-plots and 7 x 0.9 m from other sub-plots.

Harvest regimes in both trials were –

1. First cut January, regrowth cut February and March.
2. First cut January, regrowth cut March.
3. First cut February, regrowth March.
4. Cut March only.

TABLE 1: Site details, seeding rates and sowing dates

Site	Harakeke, Nelson.	Appleby, Nelson.	Wairau Valley, Marlborough.	Waimea West, Nelson.
Soil type	Braeburn	Waimea	Hororata	Waimea
Sugar Drip	35 kg/ha	60 kg/ha		
Pearl Millet	25	30		
Japanese Millet	18	25	14 kg/ha	14 kg/ha
Sudax	25	40	29	28
Trudan II	35	40		
PX10 maize	225 000 seeds (s)/ha	225 000 s/ha	140 000 s/ha	140 000 s/ha
XL45 maize		225 000 s/ha		
Planting Date	19.11.73	20.11.73	25.11.74	27.11.74

RESULTS

Accumulated production

Accumulated production at Harakeke, Appleby, Wairau Valley and Waimea West is shown in Figures 1, 2, 3 and 4 respectively.

In all experiments, dry matter accumulated slowly until January after which the rate increased markedly until mid February. The rate declined in March for most crops. This was particularly true of PX610 maize, which produced little or no extra dry matter in March.

At Harakeke, (Fig. 1) only PX610 maize was cut in January, since no other crop had grown sufficiently to warrant harvesting. In February, PX610 maize significantly outyielded all other crops, but by the time of the final cut in March, yields of all crops except Japanese millet were not significantly different from the yield of PX610 maize.

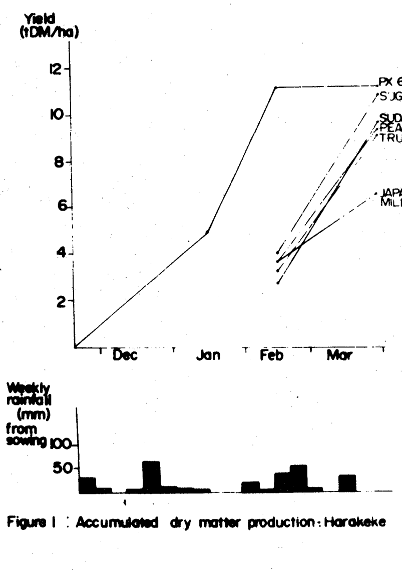

Figure 1 : Accumulated dry matter production: Harakeke

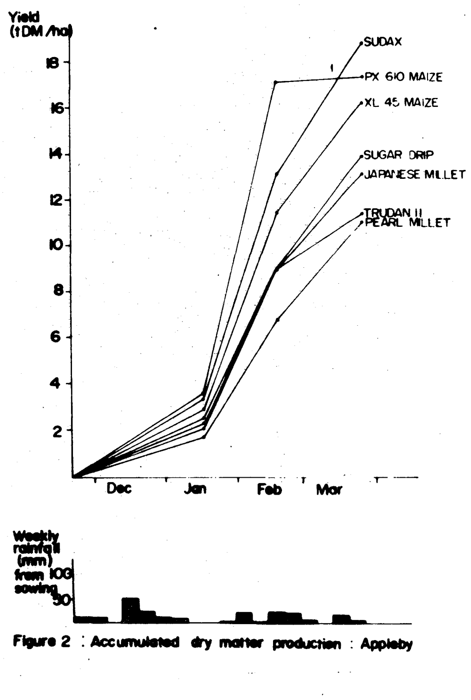

Figure 2 : Accumulated dry matter production : Appleby

At Appleby, (Fig. 2) both maize varieties and Sudax were highest yielding at the January cut, but PX610 maize outyielded all other treatments in February. By March, however, yields of Sudax and XL45 maize did not differ significantly from that of PX610 maize.

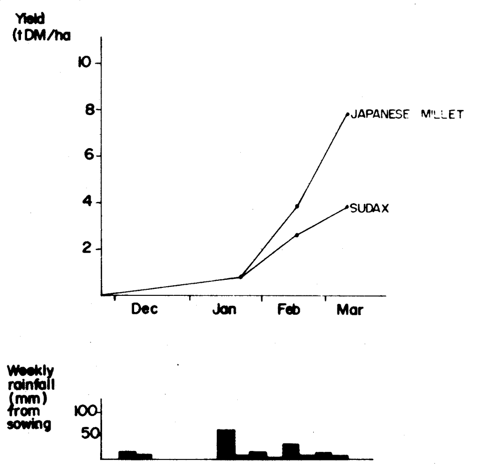

Figure 3 : Accumulated dry matter production : Wairau Valley

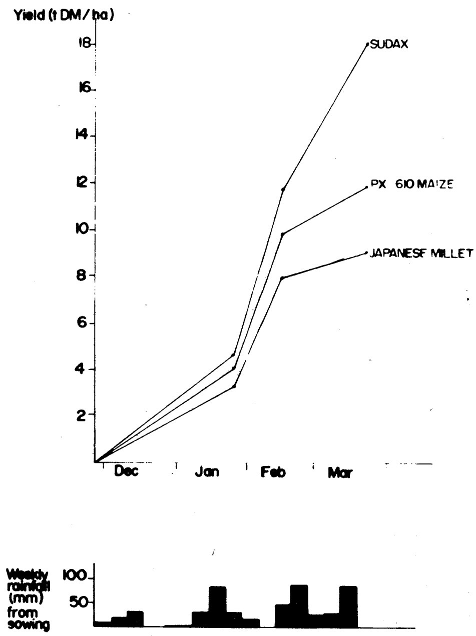

Figure 4 : Accumulated dry matter production : Waimea West

At Wairau Valley, rainfall less than 1 mm was recorded in five out of the eight weeks between sowing and the first harvest in January (Fig. 3). This period of low rainfall, coupled with a shallow depth of sowing was probably responsible for the failure of maize to establish satisfactorily. Sudax establishment was also affected by the dry period and plant numbers were low. Japanese millet was relatively unaffected and satisfactory establishment was achieved. Yields of Japanese millet and Sudax were similar in January, but Japanese millet significantly outyielded Sudax at harvests in February and March.

At Waimea West, rainfall less than 1 mm was recorded in one out of the eight weeks between sowing and the first harvest (Fig. 4) and higher rainfall the month after sowing resulted in a satisfactory establishment of all crops.

Highest yields in January and February were obtained from Sudax, although these did not differ significantly from the yields of PX610 maize. Sudax significantly outyielded both PX610 maize and Japanese millet in March.

Regrowth production

Regrowth was obtained in all experiments from all crops except maize. At Harakeke and Appleby, regrowth yields were similar for all crops except Sugardrip, which tended to yield less regrowth than other crops. At these sites, the rate of regrowth was always less than the rate of dry matter accumulation of the uncut crop, with the result that total forage yields were greater the longer harvesting was delayed.

Total yields

Total yields of crops at Harakeke and Appleby are given in Table 2. The main plot/sub-plot interaction at Harakeke was significant at the 0.01 level.

At Appleby, highest total yields were obtained from Japanese millet, Sudax and Trudan II when crops were cut in January and regrowth in February and March. With the exception of Sudax at the Appleby site PX610 maize yielded significantly more than any other treatment when crops were cut in February and regrowth cut in March. When the first cut was delayed until March, there was no significant difference in yields between crops at Harakeke, except for Japanese millet, which was lowest yielding. At Appleby, PX610 maize, XL45 maize and Sudax were highest yielding.

At Harakeke, there was no significant difference between harvest regimes for maize, but for all other crops yields were significantly higher when harvesting was delayed until March.

Total yields at Wairau Valley and Waimea West are given in Tables 3 and 4 respectively. The main plot/sub-plot interaction was significant at the 0.01 level at Waimea West.

At Wairau Valley, Japanese millet significantly outyielded Sudax under all harvest regimes. Highest yields were obtained when crops were cut in January and a single regrowth cut made in March, or when the first cut was delayed until March.

At Waimea West, Sudax was highest yielding under all harvest regimes. Delayed cutting of crops until February resulted in significantly higher total yields than when crops were first cut in January. There were further yield increases for Sudax and PX610 maize, although not significant, when harvesting was delayed

TABLE 2: Total yields (kg DM/ha) of crops, Harakeke and Appleby

Site	Harakeke		Appleby		
First cut	February	March	January	February	March
Regrowth cut(s)	March		Feb, Mar.	March	
Sugar drip	4830 bB	10480 aA	3780 bcBC	9270 bC	13680 bcBC
Pearl millet	5050 bB	9150 aAB	4380 bAB	7020 cD	10800 eC
Japanese millet	4530 bB	6360 bB	5760 aA	9840 bC	13040 cdBC
Sudax	3830 bB	9140 aAB	5740 aA	13750 aAB	18210 aA
Trudan II	4470 bB	8910 aAB	4650 abAB	10550 bC	11210 deC
PX610 maize	10560 aA	10650 aA	3400 cdBC	16310 aA	16810 aAB
XL45 maize			2770 dC	10860 bBC	15820 abAB
S.E. (log mean)	Vertical .0918 Horizontal .0970		.0785	.0641	.0601

TABLE 3: Total yields (kg DM/ha), Wairau Valley

Month(s) cut \ Crop	Japanese millet	Sudax
Jan + Feb + Mar	3820 bcBC	2350 dC
Jan + Mar	7070 aA	3790 bcBC
Feb + Mar	5040 bAB	2850 cdC
Mar	7590 aA	3550 bcBC
S.E. (log mean)	.1120	

Duncan's lettering applies within and across columns.

until March. There was no significant difference in the total yield of Sudax or Japanese millet when either one or two regrowth cuts were made following the January harvest. The significant difference between maize treatments appears to have been due to chance, since both treatments were identical (maize produced no regrowth).

TABLE 4: Total yields (kg DM/ha), Waimea West

First cut Regrowth cut(s)	January Feb, Mar	January March	February March	March
Japanese millet	6250 bA cB	6780 bA bcAB	9300 bB aA	8420 cB abAB
Sudax	8310 aA bB	8970 aA bB	13540 aA aA	17400 aA aA
PX610 maize	2850 cB cC	4540 cB bB	9550 bB aA	11240 bB aA
S.E. (log mean)	Vertical .0817 Horizontal .0868			

Duncan's lettering to one side and below refers to vertical and horizontal comparisons respectively.

DISCUSSION

From the results of these trials it is apparent that the decision of which crop to sow should be influenced to some extent by when it is expected that the crop will be harvested.

PX610 maize was often one of the highest yielding crops in January and February. However, crops with regrowth potential were able to produce further dry matter after a first harvest with the result that total yields of some crops equalled or surpassed those of maize. Similar results were obtained by Cottier (1973) in trials in the North Island. The regrowth capacity of crops such as Sudax and Japanese millet could be valuable in situations where early utilisation and an extended period of feed availability are considered important.

Sudax would appear to be an alternative to maize when feed is required in late summer or early autumn, since total yields of this crop were equal to or greater than those of maize when harvested at this time.

Cumberland (1974) found in trials with Trudan, Sudax and millet that where cuts were taken before the point of maximum production the total dry matter from the cut and regrowth was less than the accumulated dry matter production of the unharvested crop. Cumberland also found the point of maximum dry matter production to be usually before mid-March from a November sowing. Similar results were obtained in these trials, except that unharvested crops do not appear to have reached maximum dry matter production, since yields were still increasing at the final harvest.

Japanese millet at Waimea West may have been approaching maximum dry matter production in March, since total yields were lower (although not significantly) than those obtained from a February harvest followed by a regrowth cut in March.

The similarity of total yields at Wairau Valley from cutting regimes where crops were cut twice (January and March) or once only (March) is somewhat surprising, since in other trials, harvesting in January resulted in total yields much lower than those obtained when growth was uninterrupted until

March. A possible explanation for this is that crops may have been harvested at a more immature stage of growth in January than at other sites (yields were very low in January), which resulted in the growth potential of the harvested crop being similar to that of the unharvested crop.

The large between site variations in crop yields noted by Cumberland (1974) were also apparent in this series of trials, and appear to be related to rainfall, particularly during the crop establishment period. Rainfall in December at Appleby was above average and crop yields at this site were high, despite a dry January and March. Rainfall at Harakeke was similar to that of Appleby, but yields were generally much lower. This may have been due in part to limiting nutrients, since the trial was situated on a virgin site where soil phosphate and possibly some trace element concentrations were low.

PX610 maize yields were lower at Waimea West than at Appleby, but Sudax yields were similar at the two sites. This may have been due to a very dry period in late December/early January (Fig. 4) at the end of which maize leaves were rolled and the crop was obviously under moisture stress. The effects of this stress period may have been greater on maize than on Sudax, with the result that the Sudax was more capable of responding to the above average rainfall recorded in January, February and March.

At Wairau Valley, December rainfall was well below normal and the long dry period following sowing (Fig. 3) appears to have been responsible for the low yields obtained in comparison with other sites.

Sowing crops earlier than mid or late November may overcome some of the risk of insufficient rainfall for crop establishment, but the risk of frost damage increases with earlier sowing. Also early sowing means a loss of spring pasture production that would otherwise have been available with later sowing.

Despite the risks involved, summer forage crops in the Nelson district and possibly Marlborough, appear to be a suitable means of supplementing poor pasture production due to dry conditions

Over the same period, crop yields in Nelson were considerably higher than pasture yields recorded at a site described by Radcliffe (1975), particularly when harvesting was delayed until late summer or early autumn. However, crop maturity at this time can be well advanced with a high stem to leaf ratio and seed heads fully emerged. This may not be important where the crop is to be ensiled for utilisation in the following winter or summer.

Harvesting before late summer results in lower yields, but feed quality could be expected to be higher than at a later date. Early utilisation also has the advantage of allowing more time for ground preparation and earlier sowing of a subsequent crop.

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