THE INFLUENCE OF HARVEST DATE ON PRODUCTION OF MARROWSTEM KALE

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ABSTRACT

Dry matter production of marrowstem kale was studied in 2 field trials on different soil types. The first, sown in November 1971, was sampled monthly from February to July 1972 and the second, sown in December 1972, was sampled at 3-weekly intervals from March to July 1973. Percentage dry matter contents of the various yield components were determined at each sampling date.

The mean leaf yields were similar in each year throughout the periods studied and there was little or no difference in the dry matter content of the leaf.

Stem and total yields increased linearly from the initial to final sampling dates, though the magnitude of these yields was considerably greater in 1971/72. Stem yields in both years increased threefold over the sampling period and stem dry matter content progressively increased at the same time.

INTRODUCTION

Marrowstem kale is an important winter-feed crop which occupied over 14,000 hectares of land in 1970-71 (Lewin, 1973) in Otago and Southland. Sowing is recommended in November/December for winter feed or in October for summer feed (Keenan, 1971). Total dry matter winter-feed yields of 10,000 kg/ha and more have been reported by Keenan (1971) and Scott (1971).

The rate of dry matter accumulation during crop growth does not appear to have received much attention. Calder (1944) reported a gradual increase in productivity from February to April but in the May/June period a decrease was recorded. Robinson and Frame (1966) reported an increase in total yield in March compared with a January harvest.

The trials reported here were intended to study in more detail the pattern of dry matter accumulation over an extended period and the extent to which the leaf and stem components contributed to total yield.

MATERIALS AND METHODS

Similar trials were carried out in 2 consecutive years, the first on a Wingatui silt loam ploughed out of pasture in July 1971 and the second on a Warepa silt loam ploughed out of swedes, following pasture, in October 1972.

Monthly harvests were carried out from February to July in the 1971/72 trial whereas approximately 3-weekly harvests, from March to July, were made in the 1972/73 experiment. Sampling dates were allocated to individual plots, 10m x 1.22m in size, arranged in randomised block designs. There were 4 replicates in 1971/72 and 5 in 1972/73.

Medium-stemmed marrowstem kale [**Brassica oleracea,** L.] was drilled in at the rate of 3 kg seed/ha using a Duncan drill (15 cm spacings) on November 23, 1971 and December 21, 1972. Treflan was rotary-hoed in for weed control prior to sowing and 22 kg P/ha as reverted superphosphate was drilled in with the seed.

At each sampling time, all the plants in an area of 3m x 0.61m within the plot were cut at ground level. The plants were separated into leaf, upper soft stem and lower fibrous stem and samples of each were taken for dry matter determination.

RESULTS

Yield for the two trials shown in Table 1. The trends of the results were constant in both seasons though the stem and total yields were considerably greater in the 1971/72 trial.

Leaf

There were no significant differences in the dry matter yields of leaf between the various sampling dates in 1971/72 (Table 1). In the 1972/73 trial, the yield of leaf at the last sampling date was higher compared with all previous samples between which there was little or no difference. The mean leaf yields in each year were very similar.

Leaf yields appeared to follow a slight downwards trend from the first to final sample in 1971/72 compared with an upward trend in 1972/73. Neither of the linear regression lines calculated for each year were significantly different from the horizontal thereby indicating little or no consistent change in yield of leaf from February to July.

There were significant differences in percentage dry matter of leaf between the sampling dates (Table 2), but there was no consistent pattern. The differences were of a small order, however.

Stem and total yield

Yields of soft and fibrous stem are not presented because each followed the pattern for the total stem.

Stem yields progressively increased at each successive sampling date in both years (Table 1). There was

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TABLE 1: Mean dry matter yields (kg/ha) at each harvest date

(a) **1971/72**

Dry matter yields

Harvest date	Leaf	Stem	Total
Feb. 25	4102 a	3808 d E	7910 e D
Mar. 28	4509 a	5394 d DE	9902 deCD
Apr. 27	3803 a	7329 c CD	1 1132 cdBC
May 26	4162 a	8220 c BC	1 2382 bcABC
Jun. 28	3825 a	8951 bcABC	1 2777 abcABC
Jul. 19	3489 a	1 0260 abAB	1 3749 abAB
Jul. 31	3759 a	1 1132 a A	1 4891 a A
C.V. %	16.6	13.7	11.9

(b) **1972/73**

Dry matter yields

Harvest date	Leaf	Stem	Total
Mar. 29	3421 c B	1379 e D	4800 cE
Apr. 18	3691 bc B	2305 d C	5995 d DE
May 10	3772 bc B	2446 d C	6217 cdCD
May 30	3679 bc B	3251 c B	693o cdBCD
Jun. 21	4062 b AB	3909 b AB	7971 bAB
Jul. 12	3811 bc B	3648 bc B	7459 bcBC
Jul. 26	4616 a A	4554 a A	9170 a A
C.V. %	10.6	13.7	10.2

TABLE 2: Mean leaf dry matter percentage/sampling date

1971/72		1972/73	
Sampling date	% DM	Sampling date	% DM
Feb. 25	14.0 abA	Mar. 29	12.3 bcA
Mar. 28	12.2 cA	Apr. 18	12.4 b AB
Apr. 27	12.5 bcA	May 10	11.2 c B
May 26	13.8 abcA	May 30	12.4 b AB
Jun. 28	14.2 abA	Jun. 21	13.2 abA
Jul. 19	14.6 a A	Jul. 12	13.2 abA
Jul. 31	12.9 abcA	Jul. 26	13.6 a A
C.V. %	8.8	C.V. %	6.9

approximately a three-fold increase in stem yields from the first to final sampling dates. The total dry matter yields showed a similar progressive increase.

Linear regression analyses of both the stem and total yields on the number of days from sowing to sampling were found to be significant in both years (Table 3), and the non-linear component proved to be non significant in all cases indicating that both stem and total yields increased linearly from the initial to final sampling date.

The regression coefficients in respect of the total yields for both years were compared and no significant difference was found between them. Despite the difference in magnitude of the total yields for the two years, the rate of total dry matter accumulation was similar over the sampling period.

Percentage dry matter data for the stem components are shown in Table 4.

Dry matter contents of the two stem components were lower in 1972/73, particularly in the case of the lowermost fibrous part of the stem. Compared with the soft stem portion the lower fibrous part of the stem had a higher dry matter content.

Significant differences in dry matter content of both stem portions at the various sampling dates were obtained. Results were not clear-cut however, and in general it appeared that the percentage dry matter tended to be lower in the first 3 samples compared with later sampling. When the percentage dry matter contents of the soft and fibrous stem portions were averaged, there was a progressive increase in dry matter percentage as the plants matured, except in 1971/72 when there was a reduction at the final harvest.

TABLE 3: Relationship between both stem and total yields and the number of days from sowing to harvest

Year	Yield parameter	Correlation coefficient (r)	Linear regression equations
1971/72	Stem	0.993 ***	$Y = -11.7 + 43.67x$
	Total	0.986 ***	$y = 4617.8 + 39.36x$
1972/73	Stem	0.900 ***	$y = -752.7 + 23.94x$
	Total	0.849 ***	$y = 1987.8 + 30.97x$

TABLE 4: Mean stem dry matter percentages/sampling date

	1971/72				1972/73		
Sample date	Soft stem	Fibrous stem	Mean	Sample date	Soft stem	Fibrous stem	Mean
Feb. 25	9.5 e E	11.8 d C	10.6 e D	Mar. 29	9.6 d E	11.3 d C	10.5 d D
Mar. 28	10.6 deDE	16.0 c B	13.3 d CD	Apr. 18	11.4 c D	13.1 bcBC	12.3 c C
Apr. 27	12.4 cdCD	16.3 bcB	14.4 cdBC	May 10	9.9 dE	12.1 cdC	11.0 d CD
May 26	14.3 bcBC	19.2 abAB	16.8 abAB	May 30	12.7 b C	14.7 a AB	13.7 b B
Jun. 28	16.1 abAB	19.0 abAB	17.5 abA	Jun. 21	14.0 a AB	14.6 abAB	14.3 abAB
Jul. 19	17.3 aA	20.4 a A	18.8 a A	Jul. 12	13.2 b BC	15.1 a AB	14.1 abAB
Jul. 31	15.4 abAB	17.4 bcAB	16.4 bcAB	Jul. 26	14.3 a A	15.8 a A	15.1 a A
C.V. %	9.6	11.6	9.7	C.V. %	4.9	8.7	6.1

DISCUSSION

Much of the data reported here agreed with other published work. Total dry matter yields, for example, were in the same general range as those reported by Keenan (1971) and Scott (1971). The percentage dry matter contents of leaf were similar to those recorded by Frame and Robinson (1966) although the data for stem dry matter were somewhat higher. The increase in percentage dry matter of the stem component with little change in that of the leaf also confirmed the observations by Frame and Robinson (1966).

The trends of the results obtained in the present study were similar in both seasons but the magnitude of the stem and total yields was considerably greater in the 1971/72 trial. Three factors could possibly account for this difference. Firstly, low rainfall in the early stages of growth in 1972/73 may have retarded growth and hence reduced yields; rainfall amounted to about 330 mm from December to July with only 23 and 14 mm being recorded for January and February respectively, compared with over 800 mm during the 1971/72 trial. Secondly, the 1972/73 trial was sown 4 weeks later than the first trial, and delay in sowing date can reduce yields (Fulkerson and Tossell, 1972). These two factors probably account for the lower yields initially but the fertility status of the Warepa yellow-grey earth was known to be lower than that of the Wingatui recent alluvial soil and this may also have been a factor contributing to the lower yields recorded in the 1972/73 trial.

In the present study, total dry matter production progressively increased from the initial to final sampling times, thereby confirming the increased yields recorded up to April by Calder (1944) and the higher production obtained by Robinson and Frame (1966) in March compared with January. Calder (1944), however, reported a reduction during the May/June period but a "levelling-off" of yields or a continued increase as found in the present work would seem to be more logical expectations.

Of some significance, in the present work, was the linear nature of the increase in total production from February to July, particularly as this occured during a period of falling temperature (Fig. 1) which might have been expected to reduce the rate of. dry matter accumulation. Since there was no evidence of a "levelling-off", maximum production was not attained by the time of the last sampling. Other factors being favourable, higher temperatures, within certain limits, increase growth rates. Hence the rising temperature regime that occurs in Spring and Summer (Fig. 1) might be more conducive to the attainment of maximum potential yields compared with the lower temperatures that occured for most of the growing periods in the trials reported here. Sowing earlier in Spring, for example, instead of November or December, is likely to promote faster growth rates and lead to higher yields partly due to a more favourable temperature regime and also because of an increase in the period available for growth.

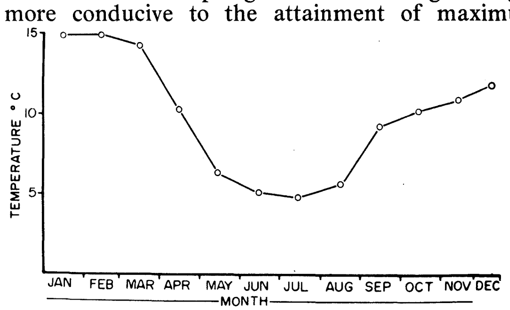

Figure 1: Mean air temperatures 1963-1973.

Within the periods studied, both Calder (1944) and Robinson and Frame (1966) noted that increase in total yield was due to stem growth since leaf yields showed very little variation, and the data reported here confirmed this observation. Both the continuance of climatic conditions suitable for growth and the length of the growing period will influence the amount of stem growth made. Hence the length of time between sowing and harvest will influence the percentage contribution of leaf to total yield. This might explain the very wide differences in percentage leaf reported, e.g., 21-62% (Robinson and Frame, 1966), 18-55% (Keenan, 1971) and 25-55% (Fulkerson and Tossell 1972). High percentages of leaf indicate a shorter period of growth or that climatic conditions may have been unfavourable for continuance of stem growth, though the former is the more likely explanation.

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