THE EFFECT OF SOWING AND HARVEST DATES ON THE LEAF AND STEM YIELD OF MARROWSTEM KALE IN RELATION TO FEED QUALITY

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ABSTRACT

Leaf and stem dry matter yields were determined at intervals during growth of crops sown on different dates in 1973/74 and 1974/75, and organic matter digestibitilities on samples taken in 1974/75.

Stem yields steadily increased during growth and only levelled off before the final harvest in the September to November sowings. Leaf yields for September and October sowings, and to a lesser extent in the November sowing, increased to a maximum in February/March and declined from then until April remaining relatively constant at about 4000 kg DM/ha thereafter. December-sown leaf yields increased to the 4000 kg/ha level in March and did not change thereafter whereas in the January sowings the leaf yields did not quite attain this level by the time of the final harvest.

Digestibility values for leaf and upper stem were consistently high and did not appear to be much affected by sowing or harvest date. Lowermost stem values were considerably lower and, although harvest date had no effect, the November-sowing values were about 11% lower than those for the January sowing.

Estimates were made of the total yields of digestible dry matter during growth. These suggested that September/October sowings should be grazed in February/March when yields of digestible dry matter were highest; that November sowings should be used from April to June and December sowings not before June. January sowings had no advantage over earlier sowings for grazing up to July.

INTRODUCTION

Little attention has been given to the possible changes during growth in the yields of the leaf and stem components of marrowstem kale (**Brassica oleracea L.**) Workers (During **et al.**, 1963; Scott, 1971; Stephen, 1973 and Drew **et al** ., 1974) have tended to concentrate on total dry matter yields at a single harvest from a single sowing. Where reference was made to leaf and stem yields (Calder, 1944; Robinson and Frame, 1966; Fulkerson and Tossell, 1972 and Stephen, 1974) only one sowing was used; in all cases the proportion of leaf to stem decreased as the plants matured. Stephen (1974) reported that, in sowings made in late November and December in different years, leaf yields remained relatively constant at about 3500-4000 kg DM/ha from late February to the end of July, during which time stem yields steadily increased.

Where different dates of sowing were compared, Fulkerson and Tossell (1972) made reference only to total yields whereas Mortlock (1975) referred only to the percentage contribution of leaf to the total dry matter.

Information is also limited concerning the nutritive value and the degree of utilisation by the grazing animal of medium-stemmed kale. Using 76 cm row spacings Calder (1944) reported that sheep consumed 100% of the leaf and about 61% of the stem in grazing trials from February to June. Scott (1971) used 36 cm row spacings and reported hogget liveweight gains of 60 g/day during winter with 82% utilisation of the crop. With closer row spacings of 15 cm, Stephen and Kelson (1974) and Drew **et al.** (1974) recorded crop utilisations of over 90% in June and July and hogget liveweight gains of 132 g/day were obtained by Drew et al. (1974).

Dent (1963) observed that dry matter digestibility remained fairly constant at about 80% for leaf and ranged between 77-81% for stem top; much lower values of about 61% were recorded for stem bottom. Drew **et al.** (1974) reported a dry matter digestibility value of 80% for the whole plant.

The trials reported here were intended to study the effects of different sowing dates on the yields of leaf and stem and to estimate the feeding value of the crops during growth.

EXPERIMENTAL

The experiments were carried out on a Wingatui silt loam which had previously been cropped with wheat and swedes (1973/74 experiment). The same area was used for the 1974/75 experiment.

In 1973/74 sowing dates of September 11, October 10, November 13, December 4 and January 3 were compared and the experimental details have been reported previously (Stephen 1975).

In 1974/75, sowing dates of November 11 and January 15 were compared in main plots in a randomised block layout with 5 replicates. Medium-stemmed marrowstem kale was used again, drilled in 15 cm rows at 4 kg seed/ha. After an initial period of growth, sub-plot samples were taken at approximately monthly intervals from each date of sowing. At sampling, all the plants in an area of 1.5m x 0.61m were cut at or near ground level and separated into leaf and stem. Dry matter was determined in sub-samples of leaf and upper and lowermost portions of stem, the latter two being averaged for stem-yield calculations. **In vitro** digestibility determinations were also made on these sub-samples.

RESULTS

Dry Matter Yields

The leaf and stem yields from all harvests of each sowing date are given in Tables 1 and 2.

TABLE 1: The effect of sowing and harvesting date in 1973/74 on kale leaf and stem DM yields (kg/ha)

(a) DM YIELDS OF LEAF

SAMPLE DATE	SOWING DATE					
	SEP. 11	OCT. 10	NOV. 13	DEC. 4	JAN. 3	s.e.m. %
DEC. 10	1700 c	–	–	–	–	
JAN. 11	a 5580 a	a 4500 d	b 2360 b	–	–	9.1
FEB. 4	ab 5780 a	a 6500 ab	b 4740 a	c 1420 c	–	11.2
FEB. 27	a 6560 a	a 7740 a	b 4620 a	c 2830 b	d 1250 b	9.7
MAR. 21	a 6230 a	a 5910 bc	ab 5560 a	b 4110 ab	c 2100 b	10.5
APR. 18	a 4410 b	a 4960 cd	a 4860 a	a 4270 a	b 3060 a	6.3
MAY 21	ab 3960 b	a 4230 d	a 4450 a	ab 4130 ab	b 3070 a	9.7
JUN. 27	a 3760 b	a 4240 d	a 4380 a	a 4920 a	a 3860 a	13.2
s.e.m. %	8.5	8.3	9.2	13.0	10.9	

(b) DM YIELDS OF STEM

SAMPLE DATE	SOWING DATE					
	SEP. 11	OCT. 10	NOV. 13	DEC. 4	JAN. 3	s.e.m. %
DEC. 10	470 e	–	–	–	–	
JAN. 11	a 2640 d	b 1600 e	c 610 f	–	–	12.6
FEB. 4	a 3780 c	a 3940 d	b 1750 e	c 320 e	–	22.3
FEB. 27	a 6700 b	a 6410 c	b 3240 d	c 1220 d	d 310 d	8.9
MAR. 21	a 8530 b	a 9530 b	b 6110 c	c 2500 c	d 900 c	11.4
APR. 18	a 11330 a	a 10570 b	b 8390 b	c 5150 b	d 2320 b	8.6
MAY 21	a 12320 a	a 11600 ab	a 10420 a	b 6440 b	c 3560 a	11.0
JUNE 27	a 12300 a	a 13000 a	ab 10540 a	b 8450 a	c 4630 a	11.2
s.e.m. %	11.5	9.5	8.3	12.7	15.5	

Letters above and to one side are L.S.D. comparisons horizontally and vertically respectively

TABLE 2: The effect of sowing and harvesting date in 1974/75 on kale leaf and stem yields (kg DM/ha)

DATE	LEAF SOWING DATE NOV. 11	LEAF SOWING DATE JAN. 13	STEM SOWING DATE NOV. 11	STEM SOWING DATE JAN. 13
JAN. 15	2800 c	–	910 e	–
FEB. 13	4660 b	–	3270 d	–
MAR. 19	a 6070 a	b 2120 c	a 5880 c	b 670 c
APR. 14	a 4200 b	b 2630 bc	a 8370 b	b 2020 b
MAY 14	a 4110 bc	a 3070 ab	a 8820 b	b 2720 b
JUN. 17	a 3710 bc	a 3760 a	a 11740 a	b 4350 a
JUL. 16	a 4390 b	a 3350 ab	a 12840 a	b 5020 a
s.e.m. %	10.6	9.5	9.1	11.9

Letters above and to one side are L.S.D. comparisons horizontally and vertically respectively

(a) Leaf

The dry matter yields of leaf from the September and October sowings were similar to each other at all sample dates from January to late June. For both sowing dates leaf yields increased considerably reaching their maxima of about 6500 - 7700 kg DM/ha about late February; thereafter leaf yields decreased steadily until May when they levelled off at about 4000 kg/ha. The November sowing yields followed the same pattern but lower maximum yields of about 5500-6000 kg DM/ha were attained later in March; they declined thereafter to about 4000 kg/ha in June and July. November sowing yields were significantly lower than the leaf yields from earlier sowing during January and February but were similar thereafter.

December sowing leaf yields increased from early February to late March and remained about the 4,000 kg/ha level from then until the final harvest in late June. Yields from this latter period were similar to those from earlier sowings.

January sowing leaf yields increased steadily until the final samplings in June and July at which times they were slightly less than 4000 kg/ha though not significantly different from the leaf yields from earlier sowings.

(b) Stem

The yields of stem from the September and October sowings were similar to each other at all sampling dates from February to late June. The pattern of stem yield increases tended to be linear from January to about mid April; thereafter there was little significant change in yields until the final harvest in late June when the yields were about 12500 kg DM/ha. The stem yields from the November sowings followed a similar pattern; yields levelled off in late May/mid June at about 10500 and 12300 kg DM/ha until the final harvest in 1974 and 1975 respectively. November sowing stem yields were lower than those from earlier sowings until late May and June when they were similar.

Stem yield increases from both the December and January sowings followed a linear pattern from the first to final sampling dates. The stem yields from the December sowing were significantly lower that those from earlier sowings and similarly the January sowing yields were lower than those from the December sowing from February to June.

In vitro digestibility

Percentage organic matter digestibility data for different harvest dates during growth of the 1974/75 trial are given in Table 3.

TABLE 3: Percentage organic matter digestibility

1. **November 11, 1974 sowing**

SAMPLE DATE	LEAF	UPPER STEM	LOWER-MOST STEM
FEB. 13	86.8 aA*	–	–
MAR. 19	85.2 aA	90.5 aA	53.4 a
APR. 14	79.2 bA	90.6 aA	48.6 a
MAY 14	86.3 aA	87.3 aAB	57.4 a
JUN. 17	87.2 aA	83.1 b B	56.1 a
JUL. 16	89.4 aA	86.9abAB	51.0 a
s.e.m. %	2.6	2.6	4.0

2. January 15, 1975 sowing

SAMPLE DATE	LEAF	UPPER STEM	LOWER-MOST STEM
APR. 14	86.6 a*	74.4 cB	64.3 a
MAY 14	84.9 a	84.7 abA	61.6 a
JUN. 17	85.7 a	85.9 aA	68.8 a
JUL. 16	85.9 a	81.4 bA	64.1 a
s.e.m. %	1.3	1.7	2.8

*Letters based on L.S.D. comparisons

Except for a slightly lower value for the April sample of the November sowing, there were no differences in the leaf organic matter digestibility either among sowing dates or the various harvest dates. The average value of 85.7% was higher than the value for the best Spring leafy pasture (Hutton, 1962).

A similarly high average value of 85% was obtained for the upper stem. The small, apparently significant differences between the digestibility values obtained at the various harvest times and the much lower value obtained for the April sample of the January sowing are not thought to be real effects of sample date; they are more likely to be the result of variability between the materials harvested on the different occasions.

The digestibility values for lowermost stem were consistently lower than the values for upper stem and there were no significant effects due to harvest date. The slightly higher values for the January sowing are considered to be representative of the younger plants in that sowing compared with those of the November sowing.

DISCUSSION

The decline in the proportion of leaf to stem from the first to final harvests confirmed previous work (Calder, 1944; Robinson and Frame, 1966; Fulkerson and Tossell, 1972 and Stephen 1974). The extent of the reduction, however, was influenced by sowing date. In September and October sowings the proportion of leaf as a percentage of the total yield declined from about 75% at the time of the first harvest to about 25% at the final harvest in June. In later sowings this decline was proportionately less as the sowing date was delayed and is probably a reflection of the lesser time available for growth.

Stem yields steadily increased during growth for all sowing dates and levelled off before the final harvest only in the case of the September to November sowings presumably because there was sufficient time for these crops to reach maturity in that period. The pattern of leaf yields differed, however. Whereas in the September to November sowings leaf yields increased to a maximum, considerably in excess of 4000 kg DM/ha and declined to this level from April onwards, the December sowing leaf yields increased up to March and remained relatively constant thereafter at about the 4000 kg/ha mark, this latter result confirming previous results (Stephen 1974); leaf yields in the January sowings only attained the 4000 kg/ha level at the time of final harvests.

It is possible that the higher leaf yields from January to March, achieved by the earlier sowings, may have been in response to more favourable temperature and moisture regimes during earlier growth; the decline in yields thereafter may have been due partly to less favourable climatic conditions and partly to the tendency for shedding of leaves as the plant matures (Calder, 1939). Later sowings may have been unable to achieve as high leaf yields because of lower temperatures and moisture deficiency conditions existing between January and March.

An attempt was made to assess the value of the kale crop for animal feeding during its growth sown on different dates by calculating the digestible dry matter yields in kg/ha at each harvest date. The leaf, with a dry matter digestibility value of 84.7% (= average organic matter digestibility value of 85.7% from Table 3), was assumed to be completely utilised.

It was necessary, however, to make certain assumptions in order to estimate the portion of stem readily eaten by animals at each harvest and likely to promote liveweight gains; such stem would be likely to be represented by a dry matter digestibility value of 84.0% (= average organic matter digestibility value of 85.0% for upper stem in Table 3). For the earlier sown crops at harvest dates up to late February most of the stem was considered to be in this category whereas at the time of the final harvest a very much smaller proportion could be so classified; between these two times it was asumed that the proportion of stem in this category would steadily reduce. With each delay in sowing date thereafter there was assumed to be a proportionate delay before the high proportion of stem in this category began to reduce; the extent of the reduction between then and the final harvest date was proportionately less accordingly.

The results of this exercise (Fig. 1) showed that the yields of digestible dry matter of September - and October-sown crops, which were similar at each harvest, increased to a maximum in late February/March and slowly declined thereafter to level off in May and June. November-sown yields of digestible dry matter also increased from January to March, but at lower yields compared with earlier sowings, and levelled off thereafter at values similar to those from earlier sowings. Yields of digestible dry matter for the December and January-sown crops increased steadily from February to late June; up to April the yields of the December shown crop were lower than those from earlier sowings but subsequently they were similar. January-sown yields of digestible

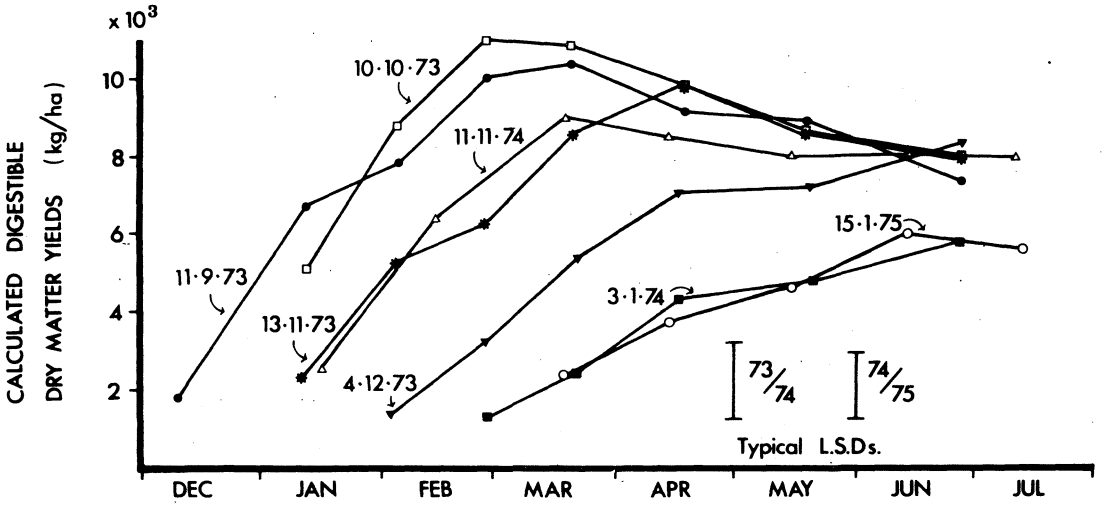

Fig 1 : The effect of sowing and harvest date on the feed value of kale

dry matter however, were lower than those from all earlier sowings.

The comparisons of the yields of digestible dry matter of the crops during growth must be accepted with reservation depending as they do on estimates of the utilised dry matter production. Digestibility values obtained for leaf, upper and lowermost stem, however, agree well with those reported by Dent (1963). Calder (1939) suggested "that the most desirable type of marrow-stem kale would be one composed of plants which possessed a high proportion of leaf to stem . . . . ", and it is evident that the highest feeding values/sowing date occurred when the leaf yields were highest.

The data suggest that September and October sowings should be grazed off in February and March when the yields of digestible dry matter were at their maxima; the decline in these thereafter may be a reflection of the decline in leaf yields and the increased fibre content of the lower stem which reduces the utilisable yield of that component. November sowings should be used from April to June, even though the yields of digestible dry matter from earlier sowings were similar at this time, thereby allowing longer use of the land prior to sowing; December sowings should not be grazed before June when the yield of digestible dry matter of that sowing is highest. January sowings had relatively low yields of digestible dry matter throughout and do not appear to have much merit for feeding up to mid July.

The data on feeding values suggest that agronomic studies on kale which give only dry matter production data may have limited application in practice. Clearly more research is required on the nutritive value of the crop in relation to yield.

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