THE INFLUENCE OF ROW SPACING AND DATE OF SOWING ON THE DRY MATTER PRODUCTION OF GREENFEED MAIZE

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ABSTRACT

The effect of varying the row spacing on the dry matter production of PX 610 Maize was examined in monthly harvests from January to April 1975. Increasing the plant population by decreasing the row spacing from 45 and 30 to 15 cm gave increased total yields. Increased production came mainly from increases in the stem component though increases in the amount of leaf were obtained by reducing the row spacing from 30 to 15 cm.

Five sowing dates, beginning in early October and continuing at approximately 3 weekly intervals until late December were compared in 1975/76 and 1976/77. There was no significant difference between the years and the greatest dry matter production of PX 610 was achieved from the late-October and mid-November sowings. Lowest yields were obtained from the early-October and late-December sowings whilst that from early December was intermediate.

Dry matter production in 1974/75 was considerably greater than in the following two years due to accumulation of a higher number of day degrees centigrade.

INTRODUCTION

Considerable attention by research workers has been given to the cultivation of maize as a grain or silage crop in the warmer zones of the North Island. Maize growing is less common in the South Island where Kerr (1975) reported that only 8% of the silage area was located in 1971/72. There are few reports, however, considering the use of maize as a greenfeed which McMillan and Brown (1973) reported was more economic than silage maize for summer feed.

Hutton and Douglas (1975) reported that, of the summer fodder crops available, maize provided large amounts of highly digestible feed at all stages of growth and consistently produced the greatest bulk of digestible dry matter. Greenfeed maize could therefore be an important component in the forage farming *in-situ* grazing systems suggested by Stephen (1975).

There are no reports of research on greenfeed maize south of Canterbury in the South Island, hence the trials reported here were intended to provide information on the effect of row spacing and sowing date on the dry matter production of the crop in this region.

MATERIALS AND METHODS

The three trials reported were carried out on a Wingatui silt loam using the maize variety PX 610.

A row-spacing trial was carried out in 1974/75 and the crop was the fourth in succession after pasture. Row spacings of 15, 30 and 45 cm were allocated to main plots in a 5 replicate split-plot design and 4 assessments of dry matter accumulation were made during growth in sub plots. The seed was sown using a 16 coulter Duncan drill in which the coulters were blocked off to give the appropriate inter-row spacing. Population assessments at the time of the final harvest in April were 333,333 188,188 and 133,333 plants ha^{-2} for the 15, 30 and 45 cm row spacings respectively.

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Superphosphate (24.2 kg P ha^{-1}) was drilled with the seed and 80 kg N ha^{-1} as nitrolime was broadcast on the soil surface approximately 3 weeks after sowing on November 14, 1974. At each harvest all plants within sub-plot areas (3 m x 2 centre rows) were cut at or near ground level and separated into leaf, stem and cob (final sample only). Dry matter was determined in sub samples of each of the components.

Sowing-date trials were carried out in 1975/6 following 3 crops after pasture and in 1976/7 immediately after pasture. Five sowing dates, beginning in early October and continuing at about 3-weekly intervals, were examined in each year. The sowing dates were allocated to main plots in a 4 replicate split-plot design and seed was sown (180 kg ha^{-1}) at 15 cm row spacings together with 24 kg P ha^{-1} as superphosphate using a 16 coulter Duncan drill. In 1975/76, 40 kg N/ha as urea was broadcast by hand on the soil surface immediately after each sowing; no nitrogen was applied in the second year.

Dry matter production was assessed in February, March and April in sub-plot samples of area 1.5m x 10 centre rows. The sampling procedure was similar to that used in the row spacing trial.

RESULTS

The dry matter content and the total yields for each of the row spacings and harvest time are given in Table 1.

Variation in row spacing had little or no effect on the percentage dry matter at each sample time but the dry matter content increased from about 10% at the time of the first harvest in January to about 18% at the time of the final harvest in April.

Within each of the 3 row spacings the total dry matter yields tended to increase as the harvest time was delayed from January up to April although the

TABLE 1: Effect of row spacing on dry matter content and total yields at intervals during growth.

Parameter	Harvest date (1975)	Row spacing (cm) 15	30	45
		a	a	a
Dry matter content (%)	Jan. 20	9.8 d	9.9 c	9.9 d
		a	a	a
	Feb. 13	13.4 c	13.8 b	14.1 c
		ab	b	a
	Mar. 5	15.1 b	14.5 b	15.7 b
		a	a	a
	Apr. 14	18.6 a	18.3 a	18.1 a
	C.V.%		6.0	
		a	ab	b
Total dry matter yields (kg/ha)	Jan. 20	5120 d	3546 c	1940 c
		a	a	a
	Feb. 13	9609 c	9237 b	7997 b
		a	b	b
	Mar. 5	14060 b	10461 b	9056 b
		a	b	c
	Apr. 14	17831 a	15797 a	13451 a
	C.V.%		15.9	

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

differences between the yields obtained in February and March from the 30 and 45 cm row spacings were not significant. At each harvest time an increase in the inter-row spacing from 15 to 30 and from 30 to 45 cm tended to give lower yields although the differences were not always significant. Only at the final harvest in April were the total yields significantly lower with increase in row spacing from 15 to 30 and from 30 to 45 cm.

Linear regressions of the total yields on the number of days from sowing to harvest were calculated separately for each row spacing; the regressions were highly significant in each case $(\gamma > 0.9)$.

The dry matter yields of leaf, stem and cob at the time of the final harvest in April are shown in Table 2. Increase in row spacing from 15 to 30 cm had no effect on cob yield but the yields of both leaf and stem were reduced. A further increase in row spacing from 30 to 45 cm had no effect on the yields of leaf and cob but the stem yield was further reduced.

The total yields obtained at each of the 3 sampling dates for each date of sowing are shown in Table 3; there was no significant difference between the two years and hence the data were averaged over the two years.

For each of the sowing dates yields at the March harvest were significantly higher than those obtained at the February sampling. There was a tendency also for the total yields at the April harvest to be higher than those obtained in March but the differences were not significant for the early October and November sowings.

TABLE 2: Effect of row spacing on the dry matter yields (kg ha^{-1}) of leaf, stem and cob at the final harvest in April

Row Spacing (cm)	Leaf	Stem	Cob	Total
15	5181 a	9499 a	3151 a	17831
30	4188 b	7555 b	4053 a	15797
45	3430 b	6559 c	3462 a	13451
C.V.%		13.4%		

Letters to one side are L.S.D. comparisons vertically within plant components.

At each of the 3 harvest times dry matter production was greatest from the late October and mid November sowings between which there was no difference. The next highest yields were obtained from the early December sowing and the lowest yields came from the early October and late December sowings.

TABLE 3: Influence of sowing and harvest dates on the total dry matter production (kg ha^{-1})

Sowing date	1975	1976	Harvest date Feb. 26	Mar. 28	Apr. 16
			b	a	a
Oct.	3	1	1315 b	4299 c	5632 c
			c	b	a
Oct.	21	21	4526 a	8202 a	10863 a
			b	a	a
Nov.	11	16	4237 a	8477 a	9689 a
			c	b	a
Dec.	4	6	2084 b	5880 b	7914 b
			c	b	a
Dec.	23	24	826 b	3158 c	5631 c
C.V.%				17.4	

DISCUSSION

The linear nature of the growth curves obtained in the 1974/75 trial suggested that maximum yields had not been obtained possibly because the length of the growing season was insufficient. The dry matter content of 18% obtained at the final harvest in April supports this contention as Wilkins (1973) observed that yields of dry matter and of metabolizable energy continue to increase until crop dry matter reached 25%.

Extension of the growing period beyond mid April in this locality is not feasible because of (1) the occurrence of night frost to which maize is very susceptible and, (2) the unliklihood of further growth due to falling temperatures from April onwards (Stephen 1974).

The increase in total yields that resulted from increasing the plant population by reducing the row spacing from 45 to 15 cm confirmed previous reports (Douglas and Dyson 1972, Bunting 1971, Wallace and Davies 1976). The greater yields were mainly achieved through increases in the amount of stem dry matter although there was also an increase in leaf yield when the row spacing was reduced from 30 to 15 cm.

The sowing date trials suggested that for greatest yields sowings should be made between late October and mid-November. The lower yields obtained from later sowing were probably due in part to a shorter time being available for growth. The lower yields obtained from early October sowings may have been occasioned by the adverse effects of low soil temperatures on germination which may have resulted in lower plant populations; clearly this possibility warrants investigation.

One important result of these trials was the very much higher yield obtained in 1974/75 from the 15 cm spacing compared with the best yields obtained in 1975/76 and 1976/77. It seems likely that variation in climatic factors could in part account for these differences.

Hough (1975) observed that growth of maize is negligible below 10°C and approximately linear between 10 and 20°C; he reported also that, for silage maize, 628 accumulated day degrees Centigrade above 10°C are the minimum to take maize from sowing to about 26% whole crop dry matter at which point Wilkins (1973) noted that maximum dry matter yields were obtained. Clearly dry matter yields are related to the level of accumulated day degrees.

In 1974/75 from sowing to final harvest 762 day degrees C were accumulated compared with only 480 and 551 for the November sowings in 1975/76 and 1976/77 respectively. It would seem likely therefore that the poorer yields obtained in the latter 2 years, compared with 1974/75, were to a large extent due to the lower temperatures prevalent in those years.

These fluctuations in yield obtained from maize from one year to the next would not inspire farmer confidence in the crop. Kerr (1975) suggested, however, that maize growing in the south of the South Island may be assisted by the development of cool tolerant hybrids or by the use of hybrids of European or Canadian origin which might be expected to be better adapted to cooler growing conditions compared with American warm-zone varieties such as PX 610. Further work in evaluating the performance of hybrids from other sources is therefore warranted.

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