COOL SEASON FORAGE CEREAL TRIALS IN MANAWATU AND WAIRARAPA

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ABSTRACT

Summer maize crops can provide a high per hectare yield of dry matter for silage conservation. A complementary cool season crop is needed in order to achieve high annual forage yields. Because there are few data available indicating potential crops for this role, yields of selected cereals were measured in several trials, conducted in the Manawatu and Wairarapa over the 1972/74 seasons.

Dry matter yields from 5,300 - 21,300 kg/ha were recorded. Research is now required on the value and use of these crops as animal feeds. A discussion of the cereals as a cool season forage crop is presented.

INTRODUCTION

Maize is finding increasing use as a summer silage crop and consequently farmers are looking for a suitable complementary forage crop for cool season growth. Although the use of forage crops capable of high per hectare production has been promoted for many years (Mitchell, 1966) there are few data available indicating the yield potential of the various cool season crops which could be used in double cropping systems. Cool season forage crops could be grazed **in situ** or cut and conserved as silage or haylage in the spring. These forages may also be used for the manufacture of pelletted feeds during the late winter-spring months when summer crops are not available. Farms with a significant area of cash crop are seeking winter forage crops suitable for growing between the successive summer crops. The cool season temperatures are probably sufficiently high in the Manawatu-Wairarapa region to allow satisfactory forage production from many species without encroaching into the growing season of the summer cash crops.

The growing period of the cool season crop must be sufficiently flexible to fit into the maize season. Typically, maize is sown in late October and early November in the lower North Island and harvested for silage from March to May, depending on the season and hybrid maturity. This leaves a 5-7 month gap for sowing, growth, harvesting a winter forage crop, and preparation of land for sowing the following maize or summer cash crop.

A series of trials were undertaken in the Manawatu-Wairarapa over the 1972-1975 period to obtain yield data on a range of commercially available cereal cultivars. These survey data were collected over a 4-9 month growing period.

EXPERIMENTAL

The following cereal cultivars were selected for the trials:

Oats - Amuri, Mapua, Achilles, Algerian
Wheat - Karamu
Barley - Kakapo

Tama ryegrass was also included in several of the trials.

The four main trials are described in Table 1. Additional data were collected from mid April sown crops on farms in Masterton (1973) and Feilding (1974) as well as two oat crops used for water balance studies at Palmerston North.

A randomised block design with four replicates was used in each trial. Individual plots were 12.2 x 2.4 m in the 1972 trials and 9.2 x 4.8 m in the 1974 trials. The plots were sown with a standard coulter drill at 15 cm row spacing and a cereal seeding rate of 110-115 kg/ha. Tama ryegrass was sown at 35 kg/ha. A compound fertiliser was applied either prior to the final cultivation or at sowing at the rate of 20:18:32 (N:P:K) kg/ha. Final yield measurements were made by cutting two randomly selected 0.45 x 1.00 m samples from each plot leaving a 2 cm stubble. Intermediate measurements made at 2- or 3-week intervals on some trial crops were used to construct growth curves. Crop height and growth stages at final harvest are given in Table 2. Height of the seedheads or the average leaf canopy of upright parts of the crop was measured.

Disease and pest sprays were not used on these trials. Supplementary nitrogen was applied in August as urea at approximately 50 kg N/ha. Adequate cool season rainfall ensured that crops were not water stressed and water-logging was not a problem because soils were all free-draining.

RESULTS AND DISCUSSION

Forage yields: Dry matter production ranged from 6,300 to 21,300 kg/ha (Table 3) thereby establishing that the small grain cereals examined can produce significant forage during the cool season. Some of the yield differences were due to stage of harvest (Table 2), therefore earlier sowing and/or later harvesting might have increased yields especially in trials lb and 3.

Oat cultivars have been grown as winter cool season forages in California and Georgia (U.S.A.) where yields exceeding 10,000 kg DM/ha have been recorded (Meyer et al., 1957; Morey, 1961) and a top yield of 21,000 kg DM/ha measured (Schoner et al, 1976). In Canada and northern U.S.A. small grain cereals grown as summer cool season forages have yielded in excess of 10,000 kg DM/ha (Gardner and Wiggans, 1961; Anderson and Kaufmann, 1963; Folkins and Kaufmann, 1974; Nass et al., 1975). Vartha and Allison (1973) recorded 8720 kg/ha

TABLE 1: Summary data for the main trials

Trial	Year	Sowing Date	Final Harvest	Location	Number of Cultivars	Soil
la	1972	13.4	12.10	Palm Nth	2	Manawatu fine sandy loam
lb	1972	12.5	28.9	Palm Nth	3	"
2	1974	30.4	18.11	Palm Nth	5	"
3	1974	16.5	4.11	Feilding	5	Te Arakura sandy loam
4	1974	22.5	6.12	Masterton	6	Manawatu sandy loam

herbage dry matter from Tama reygrass during winter cool season in Canterbury. Clearly, the environment of the Manawatu-Wairarapa produces crops of small grain cereals as winter cool season forages comparable to those in other parts of the world.

TABLE 2: Crop height (m) and cereal growth stages (in parenthesis) at final harvest

Cultivar	Trials				
	la	lb	2	3	4
Oats-Amuri	1.15(2)	(1)	1.55(3)	1.00(2)	1.50 (3)
Achilles			1.60(3)	1.20(2)	1.90(3)
Algerian					1.50(3)
Wheat-Karamu			0.90(4)	0.95(3)	1.00(4)
Barley-Kakapo			1.20(4)	1.25(2)	1.30(4)
Ryegrass-Tama	0.55(1)	(1)	1.15(2)	0.80(1)	1.30(2)

1. Vegetative 3. Milk
2. Heads emerging 4. Dough

These data are supported by yields measured in non-replicated trial plots on farms. Dry matter production for cereals on the Masterton property were 14,200, 18,300, 13,400 and 14,200 kg DM/ha for Mapua-oats, Achilles-oats, Tama ryegrass and ryecorn, respectively at the 31 October 1973 harvest; and on the Feilding property were 9,000, 7,440, and 11,120 kg DM/ha for Amuri oats, Tama ryegrass and Kakapo-barley, respectively at the 14 October 1974 harvest. Mapua oat yields of 13,400 and 12,200 kg DM/ha were measured at Palmerston North in 1974 and 1975, respectively.

Seasonal growth: Management decisions designed to maximise dry matter production must be based on an understanding of the growth and development of the crop. Growth curve data were collected on several oat cultivars over three years (Figure 1). Between year comparisons are difficult because of the confounding effects of sowing date and cultivar but the large increase in dry matter after August should be noted. The growth rates between successive sampling dates were estimated and are presented in Figure 2. The initial low growth rates reflect both the crop establishment phase and the cool winter temperatures. However, after August the growth rates typically exceeded 100 kg DM/ha/day and in some cases exceeded 200 kg DM/ha/day.

TABLE 3: Forage yields (kg DM/ha) of the cereals at final harvest

Cultivar	Trials				
	la	lb	2	3	4
Oats-Amuri	16,100	7,000	12,300	6,900	18,600
Achilles			12,200	8,300	21,300
Algerian					18,000
Wheat-Karamu			11,800	8,000	15,200
Barley-Kakapo			11,200	6,300	14,700
Ryegrass-Tama	7,100*	5,300	13,000	6,200	10,600
LSD (0.05)	2,400	1,052	1,920	1,450	3,390

* Cut to 5 cm stubble on 23 August and allowed to regrow

The potential of these cereals as cool season forages in the Manawatu can only be reached if the management system used allows the crop to achieve these high spring growth rates.

The comparatively low mid-winter trial yields (Table 4) illustrate the reduced forage production which can be incurred by harvesting crops early. This problem is accentuated when autumn sowings are delayed through delays in maize harvesting.

Components of yield: As the crop develops, the proportion and quality of the stem, leaf and seed components change thereby altering the nutritive value of the crop. Typical changes in the components of an oats crop up to head emergence are shown in Figure 3. An obvious factor is the very large stem component which increases during vegetative growth until it may account for approximately 60% of total dry matter at ear emergence.

The dry matter content of the plant is relatively constant until head emergence occurs and subsequently increases as maturity approaches (Figure 3). Similar changes in DM % have been reported by Smith (1960) and Gardner and Wiggans (1961).

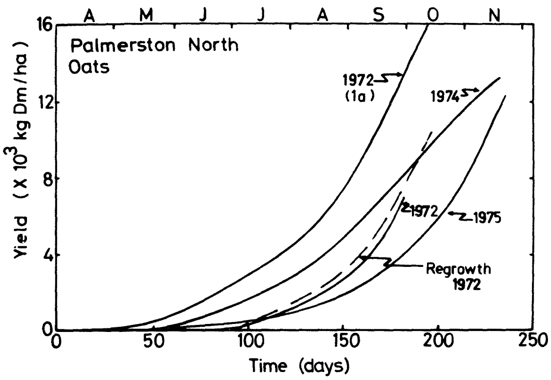

Figure 1 Growth curves for oats. Cultivars Amuri (1972) and Mapua (1974, 1975) were grown.

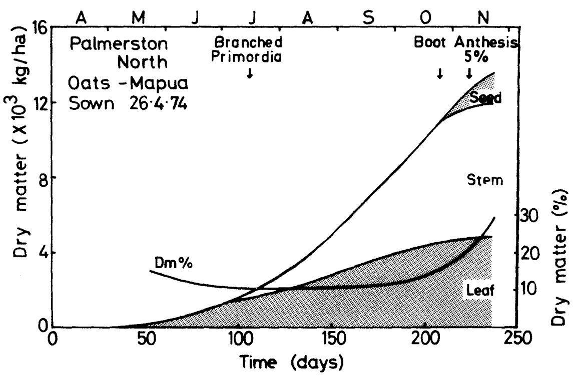

Figure 3 Seasonal changes in yield components and dry matter % of total forage.

Nutritive value: Clearly the cereals produce high yields of dry matter and their adequacy as animal feeds can now be examined. Further research is required into their use as animal feeds, but some observations can be made at this point.

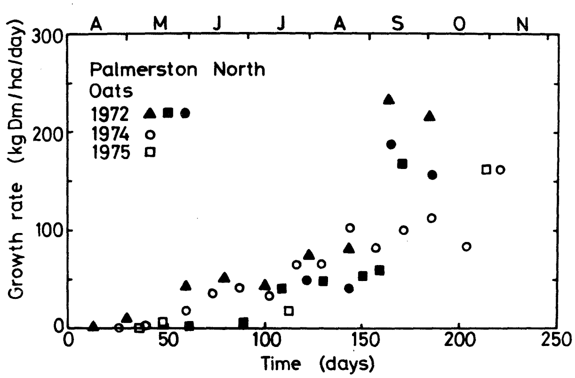

Figure 2 Daily growth rates computed from data presented in Figure 1.

There are characteristic changes in the crude protein and fibre contents of cereal forages as they develop. Crude protein content typically declines from 24-30% during early vegetative growth to 10-12% or less at heading and thereafter remains realtively constant (Meyer **et al.**, 1957; Smith, 1960). On the other hand the crude fibre content shows an opposite trend. The greatest changes in crude protein content are associated with the growth stage at which a particular cultivar is sampled. The effects of fertiliser and cultivar are small (Nass **et al.**, 1975).

Protein contents measured on samples from the final harvests in trials 2-4 ranged from 4.0 to 9.8% compared with 19.1% measured on Mapua oats sampled on 5 August 1974.

These changes in quality need to be more fully identified and must be considered when the crop is used as an animal feed. There may have to be a compromise between harvest date and yield in order to maximise animal performance.

Diseases and pests: Crown rust, powdery mildew and barley yellow dwarf virus were observed on several cultivars but did not appear to reduce yields significantly. Nevertheless, cereal cultivars which are to be used extensively for cool season forage production in the North Island will require resistance to these diseases (Eagles and Taylor, 1976). There were no problems with insect pests but birds caused serious damage on cultivars with grain present.

TABLE 4: Mid-winter forage yields (kg DM/ha) of the cereals harvested in late July/early August.

	Trials				
	la	lb	2	3	4
Harvest date	11.8	28.7	2.8	30.7	8.8
Cultivar					
Oats-Amuri	5,005	896	2,340	250	154
Achilles			2,510	130	250
Algerian					246
Wheat-Karamu			2,000	250	228
Barley-Kakapo			1,560	310	324
Ryegrass-Tama	3,050	558	1,780	0	0
LSD (0.05)	660	332	206	146	58

CONCLUSIONS

1. High dry matter yields can be obtained from several cereal cultivars under the environmental conditions prevailing in the Manawatu-Wairarapa cool season. Spring growth contributes a major proportion to production when the crops are sown after mid-April.
2. Further study on fitting these crops into current or future farming systems is required. One problem is that extended rain periods in April-May or during September-November can seriously distrupt farm schedules to the point where the farmer may prefer to winter fallow. Normally summer crops are given first preference in any management decisions.
3. Further study is required on the nutritive value of these crops and the optimisation of harvest date to

cut maximum material of a nutritive quality suited to animal requirements.

4. The cultivars grown in the trials appeared to withstand the wet soils experienced in these seasons. The suitablity of these and other cultivars for one or more mid-season defoliations either by grazing or mechanical harvesting needs to be examined.

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