LATE-WINTER FORAGE YIELDS OF EARLY-AUTUMN-SOWN CEREALS AND RYEGRASSES IN NORTHERN CANTERBURY

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ABSTRACT

Late-winter forage yields of early-autumn-sown cereals and ryegrasses were measured in northern Canterbury. Absolute forage yields of individual crops varied widely from year to year and in single years from site to site. Rankings of cultivars tended to be less variable. Oats generally gave the highest yields of forage and the ryegrasses least.

Autumn application of nitrogenous fertilizer caused higher forage yields where the crops were established on sites which had been cropped in the preceding summer, but had little affect on sites which had been summer fallowed.

INTRODUCTION

In Canterbury late-winter climatic conditions are such that grass/legume pastures produce little herbage (Rickard, 1968) at a time when breeding ewes have a high requirement for good quality forage (Coop, 1961; Jagusch and Coop, 1971). There is a need, therefore; for farmers to supplement the regular seasonal deficiency in pasture production by feeding either conserved forages and/or fodder crops.

The late-winter shortage of feed tends to be particularly severe on mixed arable/pastoral farms where cash crops and livestock each make up substantial portions of the total enterprise and where the total area of grass/legume pastures is minimal. On this class of farm it is common practice after a cash crop has been harvested in the late summer, to drill into the burned and cultivated stubble a frost-tolerant forage crop for the production of "greenfeed" for *in situ* grazing by breeding stock in the late winter.

In the past a number of crops and their cultivars viz. wheat, oats, barley, ryecorn, rape, turnips, and annual ryegrasses have been used for late winter "greenfeed" production (Davies, 1960; Whatman and Allo, 1962). Although cereal and ryegrass cultivars selected for high forage yield have been sown, farmers generally have preferred to use cultivars that have been readily available at low cost and suited for subsequent harvest as a cash crop. Farmer preference for dual purpose cultivars has created a need to test forage yields of a wide range of crop cultivars. This paper summarises field experiences with cereals, mainly oats and ryecorn; and ryegrasses sown in experiments on farmers' properties in northern Canterbury.

EXPERIMENTAL

In the period 1966-70 ten field experiments with cereals and ryegrasses were carried out in farmers' fields in northern Canterbury. Details of the experimental sites, seeding dates, harvest dates and nitrogenous fertilizer applications are given in Table 1. In the early autumn – late February to late March – cereals and ryegrasses were drilled into cultivated seed beds on areas which in the preceding months had been either cash cropped or summer fallowed. Each experimental crop was sown at the rate commonly recommended for it, together with a basal application of superphosphate; in seven-row plots, each 1.25 m x 40.0 m; in randomized blocks replicated four times.

The cereals and ryegrasses most frequently used were Amuri oats (*Avena sativa* L.) (Milne and Wright, 1969), C R D ryecorn (*Secale cereale* L.) (Greenall, 1956), Arawa wheat (*Triticum aestivum* L.) (Copp, 1965), Grasslands Paroa ryegrass (*Lolium multiflorum Lam.*) (Corkhill, 1966) and Grasslands Tama ryegrass (*Lolium multiflorum Lam.*) (Barclay and Vartha, 1966).

At seven sites nitrogenous fertilizer treatments were applied in factorial combination with the crop cultivars. Sulphate of ammonia at 62.5 kg ha^{-1} was mixed with the basal superphosphate and drilled with the seed and the balance of rates exceeding this quantity was topdressed onto the surface of the seed-bed as soon as the experimental crops had emerged.

Forage yield data were obtained at regular intervals throughout the late autumn and winter months by cutting two quadrats per plot with hand shears. Herbage which had accumulated from seeding to the date of sampling and regrowth herbage produced on areas previously sampled was harvested. The harvested herbage was weighed and a sub sample taken for dry matter percentage determination.

Analyses of variance of plot herbage yields kg DM ha^{-1} were carried out and the multiple range test of Duncan (1955) used to test for statistically significant differences among treatment forage yields.

RESULTS

General

At all sites the experimental crops established well. However on some sites subsequent growth of the experimental crop was hindered either in the late autumn by inadequate soil moisture e.g. Templeton or in the winter by lower-than-average temperatures e.g. Glenroy.

Diseases

On all sites oats, wheat, barley and ryegrass crops generally remained free from disease. At several sites

Proceedings Agronomy Society of New Zealand 8; 1978

TABLE 1: Details of experimental sites, location, soil type, soil analyses, preceding crops, seeding dates, harvest dates and nitrogenous fertilizer (sulphate of ammonia) application rates.

Location	Soil Type	Soil Analyses pH, Ca, K P (Truog)	Preceeding Crop	Seeding Date	Harvest Date	Sulphate of Ammonia kg ha^{-1}			
						N_1	N_2	N_3	N_4
West Eyreton 1	Wakanui shallow silt loam	4.9, 5, 8, 5	Wheat	1. 3.66	26. 7.66	62.5	125	250	-
Sheffield	Lyndhurst silt loam	5.8, 7, 6, 3	Wheat	15. 3.66	8. 6.66	-	-	250	-
Swannanoa	Eyre stony silt loam	6.1, 8, 15, 10	Oats	16. 3.66	2. 8.66	62.5	-	250	-
West Eyreton 2	Eyre shallow silt loam	5.9, 5, 10, 5	Oats	7. 3.67	20. 9.67	-	125	250	500
East Eyreton	Eyre shallow stony silt loam	5.0, 7, 14, 3	Summer fallow	8. 3.67	17. 8.67	77.5	144	288	576
Glenroy	Ashley silt loam	5.7, 5, 3, 3	Wheat	15. 3.67	20. 9.67	-	125	250	500
Rokeby 1	Hatfield silt loam	5.3, 6, 13, 10	Summer fallow	16. 2.67	27. 7.67	77.5	144	288	576
Rokeby 2	Hatfield silt loam	5.6, 6.11, 14	Summer fallow	29. 3.68	23. 8.68	-	-	-	-
Rokeby 3	Hatfield silt loam	5.1, 5, 7.13	Summer fallow	19. 2.70	23. 7.70	-	-	-	-
Templeton	Eyre shallow silt loam		Wheat	19. 3.70	10. 8.70	-	-	-	-

viz Sheffield and West Eyreton 2 C R D ryecorn became infected with leaf rust. *Puccinia recondita* (Robb x Desm.) At West Eyreton 1 Tama ryegrass exhibited symptoms of barley yellow dwarf virus infection.

Pests

Generally the experimental crops remained free from insect pests. However at East Eyreton small areas were damaged by grass grub *Costelytra zealandica* (White) and at West Eyreton 1 Arawa wheat became heavily infested with larvae of Hessian fly *Mayetiola destructor* (Say.)

Forage Yields, General

For the purposes of this paper only forage yields obtained from a single harvest of herbage produced from the uninterrupted growth of the experimental crops from seeding to late winter are considered.

Forage Yields, Crops and Cultivars

Absolute forage yields kg DM ha^{-1} and relative forage yields expressed as a percent of that of the oat crop are given in Table 2. On nine of ten sites the oat crop gave the highest forage yields. These ranged from 1500 kg DM ha^{-1} to 6700 kg DM ha^{-1}. The oat crop was outyielded on one site by C R D ryecorn. At the 1% level of probability oats significantly outyielded ryecorn on five of eight sites and significantly outyielded the ryegrasses on eight of ten sites.

Forage yields of C R D ryecorn varied widely from 950 kg DM ha^{-1} to 5800 kg DM ha^{-1}. Ryecorn was generally lower yielding than the oats. At the 5% level of probability ryecorn was significantly superior to Paroa and Tama ryegrasses on four of eight sites.

Generally the ryegrasses gave the lowest late-winter forage yields. While the forage yields of Paroa and Tama ryegrasses were similar, those of Tama tended to be higher, but at the 5% level of probability were significantly superior to those of Paroa on only four of ten sites.

Arawa wheat was outyielded by the oat crop at each site where both were sown. The ryegrass/oats mixture did not outyield the oat crop.

Forage Yields, Nitrogenous Fertilizer

Overall mean forage yield responses to applied nitrogen are given in Table 3. Applications of sulphate of ammonia caused modest forage yield increases on five of seven sites. The minimum application of the nitrogenous fertilizer to cause statistically significant forage yield increases was 125 kg ha^{-1}. Generally higher rates of application had little additional effect.

On most sites the higher yielding crops tended to be more responsive to applied nitrogen. This trend reached statistical significance on only one site (Sheffield) where Amuri oats gave a substantially

TABLE 2: Main Effects: Crops and cultivars absolute forage yields D.M. kg ha^{-1} and relative forage yields, expressed as a per-cent of oat yields, obtained from uninterrupted growth from late summer seeding to late-winter/early-spring harvest.

	Growth Period days	Tama ryegrass	Paroa ryegrass	Amuri Oats	C.R.D. ryecorn	Arawa wheat	Tama ryegrass + Amuri Oats	C.V. %
West Eyreton 1	147	1990 (69) bB	1610 (56) bB	2900 (100) aA	-	570 (20) cC	-	21.0
Sheffield	85	740 (49) dC	520 (34) eD	1520 (100) aA	1260 (83) bB	920 (61) cC	-	15.2
Swannanoa	139	2160 (55) bBC	1540 (39) cC	3940 (100) aA	-	2780 (71) bB	-	22.2
West Eyreton 2	197	1320 (53) bB	1130 (45) bcBC	2490 (100) aA	950 (38) cC	-	-	14.6
East Eyreton	162	4790 (72) bB	4430 (67) bB	6640 (100) aA	5160 (78) bB	2820 (43) cC	-	15.5
Glenroy	189	2930 (48) bB	2450 (41) cB	6050 (100) aA	5830 (96) aA	-	-	7.4
Rokeby 1	161	4920 (95) bcAB	4460 (86) cB	5180 (100) abA	5460 (105) aA	-	-	7.8
Rokeby 2	147	1880 (88) abcAB	1770 (83) bcAB	2310*(100) aA	1620 (70) cB	-	2080* (98) abAB	13.9
Rokeby 3	154	5280 (79) dBCD	5600 (83) cdB	6740 (100) aA	4460 (66) eD	-	6520 (97) abA	10.8
Templeton	143	2160 (48) cC	1640 (36) dC	4540 (100) aA	3840 (85) bB	-	4520 (97) aA	13.8

* Mapua Oats

TABLE 3: Main effects: Effect of nitrogen fertilizer on forage yields (DM kg ha^{-1}).

	Sulphate of Ammonia (kg ha^{-1})					
	Nil	62.5	125	250	375	C.V. %
West Eyreton 1	1210 bB	1510 bB	2170 aA	2195 aA	-	21.0
Sheffield	813 bB	-	-	1230 aA		15.2
Swannanoa	1970 bB	2770 bAB	3130 aA	3140 aA	-	22.2
West Eyreton 2	810 cC	1200 bB	1400 bB	2475 aA	-	14.6
East Eyreton	4640 a	4180 a	4740 a	5260 a	4520 a	15.5
Glenroy	4030 bA		4400 aA	4350 abA	4520 aA	7.4
Rokeby 1	4960 a	4920 a	5070 a	5180 a	5050 a	7.8

greater response and Paroa ryegrass a smaller response to applied nitrogen.

Forage Palatability

On the few sites where sheep had access to part of the experimental crops no differences in grazing preference were observed, except at West Eyreton 2. There oats topdressed with sulphate of ammonia were hard grazed and oats not treated with the nitrogenous fertilizer were ignored by ewes. Other crops at this site were hard grazed irrespective of nitrogen treatment.

DISCUSSION

In the northern Canterbury experiments late-winter forage yields of "greenfeeds" varied widely. The best crops produced some 300 percent more forage than the poorest crops. Late-winter forage yields of "greenfeed" crops are affected by several factors such as seeding date, the length of time for growth between seeding and harvest, the incidence of disease and pests, climatic conditions especially temperature and rainfall, soil conditions particularly moisture and fertility, and the potential of the individual crop or cultivar for high forage yield. The forage yields of the northern Canterbury "greenfeed" crops were affected to some degree by most of these factors.

The "greenfeeds" were drilled as early as was practical in the circumstances prevailing at each site. Six were drilled in early March, two in early February and two in late March. As a consequence there was a difference of some five weeks between calendar dates of the earliest seedings and the later seedings. Notwithstanding, both high and low forage yields were obtained from the earlier and later seeded cereals and ryegrasses.

The incidence of diseases and pests was low except in the case of C R D ryecorn which became rusted at several sites. It is considered therefore that much of the variation in absolute yields generally did not arise from differences in either seeding date or the presence of diseases and pests but rather was caused largely by differences in the length of time for growth between seeding and harvest, autumn soil and climatic conditions, and the genetic potential of crops for forage yield.

In general crops allowed a growth period greater than 160 days outyielded crops which grew for a period of less than 160 days. Oat forage yields tended to be limited less by a short growth period than were forage yields of the ryegrasses.

Generally "greenfeed" crops established on sites which had been cropped in the preceding summer produced less forage than those grown on summer-fallowed sites. The overall lower forage yields obtained from double-cropped sites were probably due to lower soil moistures at the time of seeding and the consequent slower establishment and growth of the greenfeeds. Low levels of available soil nitrogen may also have been a factor since forage yield responses to applied nitrogen occurred only on double-cropped sites. It appears that the higher forage yields obtained on the summer-fallowed sites were due to the capacity of the fallowed soils to retain more moisture and nitrogen than the cropped soils.

The higher yields of forage obtained on the summer-fallowed sites raises the question of the value and place of the summer fallowing in intensive arable/pastoral farming systems. Notwithstanding the higher yields of forage, it is unlikely at current price for agricultural products that the additional cash return derived from the additional forage produced by a greenfeed crop grown on a summer-fallowed site would exceed the income produced by a cash crop included in a double cropping system. Further if as suggested the benefits of summer fallowing derive from higher levels of soil moisture and available nitrogen the beneficial effects could be reproduced on cropped soils by the use of irrigation and/or nitrogenous fertiliser. It appears that the availability of these render summer fallowing unnecessary.

In general the oat crops outyielded the ryegrasses. Similar results have been reported by Vartha and Rae (1973) who concluded that slow initial growth of Tama ryegrass limits its late-winter forage yield. However where soil and climatic conditions were favourable the annual ryegrasses did as well as the oats which are apparently better adapted to withstand less favourable environmental conditions.

The forage yields obtained in these experiments compare favourably with the yields of herbage obtained in other Canterbury experiments (Stephen, 1973) and from Canterbury pastures over the late-autumn early-spring period (Rickard, 1968). It appears that the combination of a winter grazed forage crop and a summer cash crop in a double cropping system is a useful practice for mixed arable/pastoral farms.

ACKNOWLEDGEMENTS

The authors acknowledge with gratitude the determination of forage dry matters by staff of the Agronomy Laboratory, Winchmore Irrigation Research Station, Ashburton, and statistical analyses of forage yield data by staff of Biometrics Section, Research Division, M.A.F. Wellington and the co-operation of farmers who made available experimental sites.

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