THE COMPARATIVE PRODUCTIVITY AND UTILIZATION OF SOME WINTER FORAGE CROPS

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SUMMARY

Results of three experiments comparing the relative production of turnips, swedes, chou moellier, fodder beet and mangolds are presented together with animal performance data on a fourth trial comparing swedes and fodder beet.

Yields of dry matter and utilizable dry matter were in declining order; chou moellier, fodder beet and mangolds, swedes, turnips.

Similar yields of swedes, fodder beet and chou moellier were obtained from precision seeding and ridging at 61 cm inter-row spacings. The higher yields of these crops obtained from drilling at 36 cm inter-row spacings indicate a need for further studies of crop spacings.

Sowing in mid-October generally gave higher yields of all crops than early December sowing.

Under conditions of high soil fertility chou moellier, fodder beet or mangolds were the best winter forage crops for ewe maintenance and swedes and turnips for hogget growth.

INTRODUCTION

Winter forage crops are as important today as they were ten years ago in spite of the introduction in some regions of less costly methods of wintering stock. For the ten year period 1959-69 (Anon) there has not been any significant decline in the actual area sown in winter forage crops in New Zealand or in the ratio of area grown to area of land under cultivation.

There is one published paper (McGillivray and Davies, 1928) recording the relative yielding characteristics of winter forage crops in New Zealand. Changes in varietal characteristics and in soil fertility over the intervening years make these results of doubtful validity today and it was the main objective of the experiments reported to obtain information under present day conditions.

Development of the precision seeder and associated advances provide the opportunity to place seed at precise intra-row spaces and to subsequently control plant populations. As a result it could be expected that higher yields would be obtained through better light interception by the growing crop, by more efficient use of nutrients and soil moisture and by reduced pest and disease problems. These theoretical advantages were examined by comparing crop yields from precision seeding with those obtained from conventional methods of sowing. The problem in conducting this work was to decide upon the optimum plant population to provide maximum yields. In the absence of published data in New Zealand traditionally recommended seeding rates were sown.

In this paper four of nine experiments conducted at Invermay over the past four years are reported. Differences in yield between crop species have been examined as well as their interactions with methods of sowing and time of sowing, and crop utilization by sheep.

EXPERIMENTAL

All experiments were conducted on an alluvial silt loam belonging to the Wingatui soil set - a highly fertile soil representing 0.5% of the recent soils of the South Island and 0.1% of the soils of Otago.

Experiment 1

Four randomized blocks containing the following treatments were sown:-

Swedes (Sensation)		Ridging (61cm)		Early Sowing (15.10.68)		Chou Moellier
	x	Precision seeding (61cm)	x	Late sowing (3.12.68)	x	(Medium stemmed) drilled 36 cm.
Fodder Beet (Yellow Daeno)		Drilling (36cm)				

Experiment 2

This experiment was a four replicate, split-split plot design which included the following treatments:-

Main plots		Sub-plots		Sub-sub-plots
Early sowing (17.10.69)		Swedes (Rewa)		Ridging (61 cm)
	x	Chou Moellier (Medium stemmed)	x	Precision seeding (61 cm)
Late Sowing (10.12.69)		Fodder beet (Yellow Daeno)		Drilling (36 cm)

Crop utilization data in Experiment 3 (Table 1) agree well with results from two other experiments not detailed in the paper. Low utilization of fodder beet was the outstanding feature, and resulted in yields of utilized dry matter from fodder beet being no greater than those from swedes. Utilization figures in Table 1 were slightly lower for turnips and swedes than in the other experiments measuring utilization, but were higher than for chou moellier, fodder beet and mangolds.

Method of Sowing

The number of seeds sown and established plant populations are shown in Table 2. They varied markedly between crops and methods of sowing. To a large extent this was due to variability in performance of calibrated machinery and to a lesser extent to the ability of individual crops to establish. There was a tendency for crops sown through the precision seeder to establish better than those sown through the ridger or drill.

The effects of method of sowing on yields are shown in Table 3.

In Experiment 1 there was no significant main effect of method of sowing on yield or any interaction with crop species. In Experiment 2 a highly significant ($P > 0.01$) method of sowing x crop interaction on yield took the form of an increase in yields following drilling; the increase being greater for chou moellier than for the other two crops. Ridging and precision seeding provided similar yields with all crops sown.

Because of the variation in plant population and the possibility that this may have unduly affected crop yields, regression analyses were made on data from Experiment 3 where plant population was recorded at harvest for swedes and fodder beet. Analysis failed to reveal any significant population/yield relationship for swedes, in which the mean population was 76,000 plants per hectare. This finding is in accord with that of Lang and Holmes (1965) who found that for row widths of 50.9 - 68.6 cm bulb yields of total digestible nutrients of swedes did not vary much between 37 - 123,000 plants/ha. Thus it can be concluded that yield results for swedes as presented in Table 4 were unaffected by population.

Fodder beet showed a significant ($P > 0.01$) quadratic regression in which yields reached a maximum of 14,300 kg/ha dry matter at 93,600 plants/ha. As the mean population in Experiment 3 was 67,000 plants/ha, it seems likely that yields of fodder beet may have been under-estimated. Populations of fodder beet achieved at establishment in Experiment 1 (Table 2) were also lower than the optimum in Experiment 3 and once again yields of fodder beet may have been under-estimated. The comparison between ridging and precision seeding would not have been affected by plant population.

Experiment 3

Crops were compared in a four replicate randomized block design with plots sufficiently large (0.10 ha) to enable the grazing of hoggets and measurement of liveweight changes. This was the experiment with which Dr T.N. Barry conducted the nutrition studies referred to later in this paper.

The method of sowing used was that generally recommended for each crop.

1. Turnips (Red Globe) ridged at 61 cm inter-row spacings.

2. Swedes (Calder) " " " " " "

3. Chou Moellier (Medium stemmed) drilled at 36 cm inter-row spacings.

4. Fodder beet (Yellow Daeno) precision seeded at 61 cm inter-row spacings.

5. Mangolds (Yellow Globe) precision seeded at 61 cm on inter-row spacings.

Experiment 4

This experiment, sown in 1969, was similar in design to Experiment 3. For brevity only hogget liveweight gains are presented for this trial.

RESULTS AND DISCUSSION

Crop Yields

Mean yields from three samplings during winter for Experiments 1, 2 and 3 are presented in Table 1 together with utilized dry matter yields and percent utilization for Experiment 3.

In two of the three experiments chou moellier gave higher yields ($P > 0.01$) than the other crops, while in Experiment 2 chou moellier gave highest yields together with fodder beet. Yield of fodder beet was greater ($P > 0.01$) than swedes in two of the three comparisons shown in Table 1 and significantly inferior ($P > 0.01$) in the third. In Experiment 3 mangolds gave similar yields to fodder beet, while turnips proved significantly lower yielding than all other crops.

Thus on high fertility soils highest crop yields are likely from chou moellier followed in descending order by fodder beet and mangolds, swedes and turnips.

TABLE 1: Yields of Dry Matter kg/ha, Utilised Dry Matter kg/ha and Percentage Utilisation.

	Dry Matter kg/ha			Utilised Dry Matter kg/ha	Utilisation %
Experiment	1.	2.	3.	3.	3.
Turnips			4,420 cC	3,690 dD	83
Swedes	9,750 bB	11,980 bB	5,570 cC	4,910 cdC	88
Chou Moellier	12,830 aA	17,490 aA	12,250 aA	10,000 aA	82
Fodder Beet	8,180 cC	17,310 aA	8,740 bB	6,060 bcBC	69
Mangolds			8,990 bB	7,600 AB	84
C.V. %	21.9	22.4		15.3	

TABLE 2: Numbers of Viable Seeds Sown (S) and Plant Populations (P) ooo's/ha.

	Ridged		Precision Seeded		Drilled	
<u>Experiment 1</u>	S	P	S	P	S	P
Swedes	162.8	113.9	162.8	141.8	274.4	114.6
Fodder Beet	192.6	82.3	111.1	82.2	160.4	111.5
Sig. interactions		1%				
L.S.D.	5%	26.4	1%	35.0		
<u>Experiment 3</u>						
Swedes	170.3	116.1	170.3	129.3	167.9	87.0
Fodder Beet	175.4	107.1	133.3	110.6	365.6	126.9
Chou Moellier	242.0	142.6	103.6	99.4	375.6	103.1
Sig. interactions	1%					
L.S.D.	5%	5.6	1%	7.6		

TABLE 3: Method of Sowing x Crop Interaction on Field (kg/ha dry matter).

	Ridged	Precision Seeded	Drilled
Experiment 1			
Swedes	9,750	9,860	9,750
Fodder Beet	8,860	7,620	8,180
Interaction not significant; main effect of methods of sowing not significant:			
L.S.D. 5% 2,100			
Experiment 2			
Swedes	9,940	10,660	15,270
Fodder beet	14,950	15,920	21,050
Chou Moellier	15,130	13,860	23,470
Sig. interaction 1%			
L.S.D. 5% 2,570			
1% 3,470			

TABLE 4: Time of Sowing x Crop Interactions on Yield (kg/ha dry matter)

Experiment	1	1	2	2
Time Sown	15.10.68	3.12.68	17.10.69	10.12.6[illegible]
Swedes	10,650	8,970	14,710	9,250
Chou Moellier	13,900	11,770	19,850	15,120
Fodder Beet	7,060	9,420	22,440	12,170
Sig. interactions	1%		5%	
L.S.D. 5%	1,900		45,750	
1%	2,500		6,400	

No measurements were made of the population of chou moellier at harvest. Results of Robinson and Frame (1966) showed no difference in yield from seeding rates of 1.1 - 10.1 kg/ha. It is estimated that these seeding rates would have provided populations from about 124,000 plants/ha upwards. In view of the high populations shown in Table 2 it seems unlikely that population affected yields of chou moellier.

Precision seeding did not result in any yield increase of swedes, chou moellier or fodder beet compared with convention ridging. The high yields obtained from drilling swedes, chou moellier and fodder beet indicate a need for further studies on inter and intra-row spacings.

Time of Sowing

Experiments 1 and 2 which compared mid-October and early December sowing gave insignificant ($P > 0.01$) times of sowing x crop interaction. These are shown in Table 4.

In Experiment 2 time of sowing did not affect swede yields, but early sowing resulted in increased yields of chou moellier. Fodder beet, because of considerable weed competition in Experiment 1 gave lower yields from the early sown treatments. In Experiment 2, where weeds were controlled, yields of fodder beet were markedly better ($P > 0.01$) from the earlier sowing. Higher yields ($P > 0.05$) were also obtained from early sowing of all other crops in Experiment 2.

Animal Performance

Results of hogget liveweight changes together with estimates of ewe grazing days (Barry pers. comm.) on the different crops are presented in Table 5. The ewe grazing day estimates were calculated from intake digestibility and utilisation data.

Results in Experiment 3, (where hoggets were fed ad lib) show a clear superiority of turnips and swedes over chou moellier, fodder beet and mangolds. Barry found this to be due to a lower voluntary intake on the latter three crops - difference in digestibility between crops being small. In Experiment 4 hoggets were held on each crop for a set period of time in an attempt to force the hoggets to consume greater amounts of fodder beet. A loss in liveweight was recorded on fodder beet and small gains on swedes and chou moellier - reflecting the high grazing pressure. Swedes were consumed rapidly and this resulted in a depression of potential gains as hoggets were held on the crop for too long a period of time.

There was no limitation on the amount of fodder beet available.

For the ewe flock a maintenance level of feeding is suitable for much of the winter. Crops which provide a high yield of utilizable dry matter are the most suitable crop, as shown in Table 5. Thus for ewe feeding chou moellier is considered the best crop followed by fodder beet and mangolds, swedes and finally turnips.

TABLE 5: Hogget Liveweight Changes (g/day) and Estimated Ewe Grazing Days.

	Hogget Liveweight Changes (g/day)		Estimated Ewe Grazing Days
Experiment	3*	4	3*
Turnips	128aA		3,060
Swedes	156aA	15aA	4,280
Chou Moellier	60bB	15aA	13,240
Fodder Beet	28bB	-66bB	7,760
Mangolds	39bB		10,380
C.V. %	52.0%	25.6%	

* Barry pers. comm.

CONCLUSIONS

1. Chou moellier provided the highest yields of dry matter, utilizable dry matter and ewe grazing days of the winter forage crops compared on a recent alluvial silt loam.

2. Fodder beet and mangolds were inferior to chou moellier in all of the above respects and failed to provide acceptable weight gains for hogget growth.

3. Turnips and swedes, while providing the lowest yields of dry matter and utilizable dry matter, sustained the highest hogget growth rates.

4. Early sowing (mid-October) is recommended for swedes, chou moellier and fodder beet in preference to later sowing in early December.

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