HERBAGE PRODUCTION IN THE PEACE RIVER REGION:

SUMMARIES OF RESEARCH RESULTS, 1970-1980

N.A. Fairey and W.L. Pringle*

Agriculture Canada
Research Station
Beaverlodge
Alberta
TOH 0C0

Northern Research Group Publication 82-24

*Superintendent, Research Station, Prince George, B.C.

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INTRODUCTION

The purpose of this bulletin is to summarize research results from herbage production projects conducted during the decade commencing in 1970. No attempt will be made to include information on how the studies were conducted but it is hoped that the form of the information will assist in the transfer of appropriate technology to the primary agricultural producers of the Peace River Region.

BACKGROUND INFORMATION

The basic objective in herbage production is to grow abundant quantities of vegetation per unit land area. The vegetation must be palatable and nutritious to ruminant livestock and must be made available to them throughout the year, either directly by grazing or indirectly after conservation as hay, silage or other products. The length of the grazing season and the distribution of herbage production throughout this period are of particular importance for livestock productivity.

Crop growth is dependent upon sunlight, temperature, water and nutrients, that is the total environment around the crop. In order to maximize herbage productivity, it is necessary to identify the most appropriate species, cultivars and management practices for the environment(s) in question. The results reported herein represent an attempt to determine the adaptation and performance of selected grasses and legumes at Beaverlodge, Alberta, a site typical of the rolling slopes of much of the Peace River Region.

One of the predominant environmental factors that influences crop growth in the Peace River Region is the availability of water. The precipitation records for 1969 to 1979 are documented (Table 1) and can be used to assist in interpretation of experimental results.

TABLE 1. Monthly Precipitation (MM) at Beaverlodge, 1969-79

YEAR	MONTH												ANNUAL TOTAL
	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	
1969	20.3	18.8	31.8	32.3	16.0	50.0	26.2	41.4	125.0	14.0	37.1	9.4	422.3
1970	17.5	7.9	45.0	5.1	24.6	35.8	23.1	40.6	11.4	10.9	49.3	25.7	296.9
1971	74.4	2.3	22.4	14.7	1.8	175.5	66.0	38.9	91.9	10.2	17.0	33.8	548.9
1972	28.4	66.0	41.1	3.0	0.8	54.1	57.9	46.2	72.9	44.4	51.1	42.2	508.1
1973	20.8	24.9	4.1	5.1	9.7	55.9	16.3	100.6	35.6	42.9	38.4	19.3	373.6
1974	72.4	19.6	50.3	12.4	52.1	12.7	69.1	58.9	56.1	11.9	21.3	40.4	477.2
1975	17.3	14.5	25.7	21.6	21.3	71.1	29.5	55.9	11.7	43.7	37.1	61.0	410.4
1976	18.8	21.8	28.7	7.9	50.5	93.5	64.8	157.0	40.1	13.0	4.6	46.0	546.7
1977	25.1	2.5	16.5	3.6	155.4	52.3	120.1	57.7	49.8	40.9	8.1	20.8	552.8
1978	18.5	1.5	13.0	29.7	22.9	51.6	59.4	79.0	71.4	4.6	15.2	25.1	391.1
1979	17.8	69.6	4.3	33.3	30.5	66.8	80.5	27.9	28.7	35.1	0.0	24.6	419.1
63 YR. AVE.	33.5	25.1	26.9	20.3	39.6	58.4	61.2	54.6	42.7	28.4	30.5	30.5	451.7

TIME OF SEEDING STUDY AT BEAVERLODGE

Grass species:	Bromegrass, Creeping red fescue, Crested wheatgrass, Intermediate wheatgrass, Meadow fescue, Reed canarygrass, Russian wildrye grass and Timothy.
Seeding year:	1969
Soil type:	Hythe sandy clay loam, dark gray luvisol.
Harvest years:	1970, 1971 and 1972.
Times of seeding in 1969:	May 23 to June 2 (Late May) June 30 to July 8 (Early July) August 5 to August 15 (Early August)
Results:	In the first full harvest year (1970), annual dry matter yields of creeping red fescue and crested wheatgrass were depressed by the early July seeding compared to the late May seeding. For all the other species, yields were not depressed until seeding was delayed until early August (Table 2).

There was generally no carry-over effect of seeding time on dry matter yields in the second and third full-harvest years, 1971 and 1972 (Table 2). In summary, creeping red fescue and crested wheatgrass should be seeded before mid-June whereas the other six species should not be seeded later than mid-July. It should be noted that precipitation during the growing seasons of 1969 and 1970 was generally lower than average but September of the seeding year was wet (Table 1).

TABLE 2. The effect of time of seeding (Late May, Early July and Early August) on productivity of eight grass species seeded at Beaverlodge in 1969.

Species	Annual dry matter yield (t/ha)								
	1970			1971			1972		
	Late May	Early July	Early August	Late May	Early July	Early August	Late May	Early July	Early August
Bromegrass	4.4a*	4.5a	2.5b	5.8b	6.1ab	7.1a	3.8a	3.9a	3.8a
Creeping red fescue	3.6a	2.8b	1.1c	5.3a	6.1a	5.6a	-	-	-
Crested wheatgrass	3.7a	2.2b	1.2c	4.7a	5.4a	6.7a	3.4a	3.9a	3.7a
Intermediate wheatgrass	3.7a	3.7a	2.1b	-	-	-	3.5a	3.9a	3.7a
Meadow fescue	3.2a	2.9a	1.6b	-	-	-	2.2a	2.7a	2.1a
Reed canarygrass	3.4a	3.8a	2.3a	6.9a	7.2a	6.7a	-	-	-
Russian wildrye grass	1.1a	1.0a	0.3b	5.6a	5.0a	5.9a	2.6a	2.6a	2.5a
Timothy	2.9a	2.2ab	1.8b	7.3a	7.5a	7.5a	3.1a	3.2a	3.5a

*Means, within a species and year, followed by the same letter are not significantly different (P=0.05)

ROW SPACING STUDY FOR PERENNIAL FORAGES

Forage species: Alfalfa (cultivar Roamer), Bromegrass (cvar. Carlton), Reed canarygrass (cvar. Frontier), Slender wheatgrass (cvar. Revenue).

Seeding year: 1970.

Soil types:
1. Landray silt loam black solod (site 1) for all species.
2. Hythe sandy clay loam, dark gray luvisol (site 2) for reed canarygrass and slender wheatgrass only.

Row spacings: 15, 50, 75, 100 and 125 cm apart in North-South orientation.

Harvest years: 1971, 1972 and 1973; two cuts/year in mid-July and mid-September.

Results: Row spacings of 15 to 75 cm resulted in greater dry matter yields than the two wider spacings, with the best spacing being dependent upon the species and site. In general, the row spacing that resulted in the greatest dry matter yield over three harvest years, regardless of species or site, was the 50 cm row width (Table 3).

TABLE 3. Effects of row spacing on the yield of perennial forages grown at two sites at Beaverlodge on a Landray silt loam black solod soil (site 1) and a Hythe sandy clay loam, dark gray luvisol soil (site 2).

Species	Site	Row Spacing (cm)	Annual Dry Matter Yield (t/ha)			
			1971	1972	1973	Mean
Reed canarygrass	1	15	8.3 bc*†	3.8 a	1.4 c	4.6 c
		50	12.1 a	3.9 a	3.1 ab	6.4 a
		75	9.4 b	3.8 a	3.3 a	5.5 b
		100	8.9 bc	4.0 a	2.2 b	5.4 bc
		125	7.1 c	3.3 a	3.5 a	4.6 c
	2	15	9.8 ab†	5.9 a	4.8 a	6.8 ab
		50	11.6 a	5.6 a	4.1 a	7.1 a
		75	10.4 a	4.8 ab	4.9 a	6.7 ab
		100	7.4 bc	4.2 b	4.3 a	5.3 bc
		125	6.6 c	3.8 b	4.6 a	5.0 c
Slender wheatgrass	1	15	8.1 bc	5.4 a	4.3 a#	5.9 b
		50	12.1 a	4.9 b	4.4 a	7.1 a
		75	9.3 b	4.2 c	3.5 b	5.7 b
		100	7.6 bc	3.6 c	3.2 bc	4.8 c
		125	6.4 c	3.0 c	2.6 c	4.0 d
	2	15	4.4 a**	4.6 a	3.5 a#	4.2 a
		50	4.0 a	3.1 b	2.6 b	3.2 b
		75	3.6 a	2.9 b	2.4 b	2.9 b
		100	2.3 b	2.0 c	1.9 c	2.1 c
		125	2.0 b	1.7 c	1.5 c	1.8 c
Bromegrass	1	15	7.0 b	6.5 a	3.4 a	5.7 ab
		50	11.2 a	5.2 ab	3.5 a	6.6 a
		75	7.3 b	4.5 b	3.7 a	5.1 b
		100	5.3 b	4.9 b	4.2 a	5.1 b
		125	5.5 b	4.4 b	4.3 a	4.7 b
Alfalfa	1	15	-	4.7 a	5.9 a	5.3 ab
		50	-	5.1 a	6.9 a	6.0 a
		75	-	4.8 a	5.4 a	5.1 ab
		100	-	4.1 b	5.3 a	4.7 b
		125	-	3.8 b	6.0 a	4.9 b

* Means followed by the same letter, within years, species and sites, are not significantly different (P=0.05).

† High yields due to good rainfall in June (175 mm).

Single cut only.

** Low yields due to poor establishment.

PURE STANDS VERSUS ALTERNATE ROWS OF GRASSES AND LEGUMES

Forage species: Alfalfa (cultivar Roamer), Birdsfoot trefoil (cvar. Leo), Bromegrass (cvar. Carlton), Reed canarygrass (cvar. Castor), Slender wheatgrass (cvar. Revenue).

Seeding year: 1970

Soil type: Landray silt loam black solod with good fertility.

Row spacing: 50 cm

Harvest years: 1971, 1972 and 1973; 1 cut/year in July.

Results: When grown in pure stands the legumes, alfalfa and birdsfoot trefoil, showed much greater persistence of yield in the third harvest year than any of the three grasses. Thus, over a 3-year period, alfalfa and birdsfoot trefoil were the most productive forages (Table 4).

When the grasses and legumes were grown in alternate rows, there was little yield difference between any of the mixtures, or between the mixtures and the pure stands, in the first two harvest years. However, in the third harvest year the yields of the grass-legume mixtures declined to levels below that of the pure legumes but above that of the pure grasses (Table 4). Thus, in the third year, the legume component became increasingly important in maintaining the productive capacity of the forage stand. From this study, the most productive grass-legume stands were alfalfa-slender wheatgrass, alfalfa-bromegrass and birdsfoot trefoil-bromegrass. These combinations were superior to the other mixtures and the pure grasses, and were comparable to the pure legume stands. Birdsfoot trefoil appeared to be less competitive than alfalfa when grown in grass-legume mixtures, being only 34 to 60% of the stand in the third year compared to 61 to 72% for alfalfa. Mixtures containing birdsfoot trefoil have an advantage over those containing alfalfa as trefoil does not induce bloat in grazing cattle. Specific management will have a great impact on the legume content; particularly soil fertility and cutting/grazing regimes.

TABLE 4. Dry matter yields (t/ha) of grasses and legumes grown in pure stands or mixtures comprised of alternate rows of grass and legume.

Basic species	Species in alternate row	Year						Mean DM yield
		1971		1972		1973		
		DM Yield	% Legume	DM Yield	% Legume	DM Yield	% Legume	
---------- Pure stands ----------								
Alfalfa	Alfalfa	8.1 a*	100	9.1 ab	100	7.1 a	100	8.1 a
Birdsfoot trefoil	Birdsfoot trefoil	7.5 a	100	7.6 abc	100	6.8 ab	100	7.3 b
Bromegrass	Bromegrass	5.7 b	0	9.1 ab	0	3.6 efg	0	6.2 cd
Reed canarygrass	Reed canarygrass	7.1 ab	0	7.7 abc	0	2.7 h	0	5.8 d
Slender wheatgrass	Slender wheatgrass	7.1 ab	0	6.6 c	0	3.3 gh	0	5.7 d
---------- Mixtures ----------								
Alfalfa	Bromegrass	8.8 a	69	8.4 abc	58	5.4 bcd	72	7.5 b
Alfalfa	Reed canarygrass	7.4 a	46	7.7 abc	46	4.7 c-f	61	6.6 c
Alfalfa	Slender wheatgrass	8.3 a	54	9.4 a	54	5.9 abc	68	7.8 ab
Birdsfoot trefoil	Bromegrass	7.8 a	55	9.0 ab	49	4.7 cd	50	7.2 bc
Birdsfoot trefoil	Reed canarygrass	8.4 a	50	7.6 abc	22	4.2 def	34	6.7 c
Birdsfoot trefoil	Slender wheatgrass	7.4 a	46	7.0 bc	40	4.9 cde	60	6.4 c

* Means in same column followed by the same letter are not significantly different (P=0.05)

IRRIGATION OF PERENNIAL FORAGES

Forage species: Alfalfa (cultivars Beaver and Anik), Alsike clover (cvar. Dawn), Birdsfoot trefoil (cvar. Leo), Red clover (cvar. Altaswede), Sainfoin (cvar. Melrose), Bromegrass (cvar. Carlton), Crested wheatgrass (cvar. Fairway), Meadow Foxtail (common), Pubescent wheatgrass (cvar. Greenleaf), Reed canarygrass (cvar. Castor), Timothy (cvar. Climax).

Seeding year: 1977 at Beaverlodge.

Soil type: Landray silt loam black solod with good fertility.

Row spacing: 25 cm

Harvest year: 1979; two cuts/year taken in late June and late August.

Irrigation treatments:

(i) Control (no irrigation).
(ii) 8 cm water applied on May 27, 1978.
(iii) 8 cm water applied on May 27 and on June 28, 1978.

Results: The response of each grass and legume variety, in terms of yield in the first harvest year, to the three irrigation treatments is detailed in Table 5. With no supplemental water, and in a year with lower-than-average precipitation, particularly during early summer, the most productive stands included bromegrass, pubescent wheatgrass, reed canarygrass and red clover. It should be remembered, however, that only one variety of each species was studied (excepting alfalfa) so these results may not be indicative of the responses of all varieties of the species studied.

All species, except red clover, responded to supplemental irrigation to varying degrees. The most responsive species to irrigation in late May included timothy, alfalfa and meadow foxtail, all of which had yield increases of 36 to 55%. The species which showed the greatest additional response to a second irrigation, applied in late June after the first cut of grass was taken, included meadow foxtail, crested wheatgrass,

TABLE 5. The effects of irrigation on annual dry matter yields (t/ha) of grasses and legumes in the first full harvest year (1978) at Beaverlodge. Note that yields are based on two cuts/year taken in late June and late August.

Crop species	Variety	Irrigation treatment					
		Control (no irrigation)	8 cm water on May 27	% of control	8 cm water on May 27 and on June 28	% of control	% of May irrigation
Alfalfa	Beaver	5.6	7.6	136	8.5	152	112
	Anik	5.3	7.7	145	8.2	154	106
Alsike clover	Dawn	6.0	7.1	118	8.0	132	113
Birdsfoot trefoil	Leo	5.4	5.9	110	6.1	114	103
Red clover	Altaswede	7.1	7.1	99	7.2	100	101
Sainfoin	Melrose	5.2	6.0	115	7.3	140	122
Bromegrass	Carlton	9.4	11.7	125	14.0	149	120
Crested wheatgrass	Fairway	5.8	7.2	124	9.3	160	129
Meadow foxtail	common	5.9	8.1	138	11.4	194	141
Pubescent wheatgrass	Greenleaf	9.1	11.0	121	13.1	145	119
Reed canarygrass	Castor	8.4	10.3	123	11.8	140	115
Timothy	Climax	5.7	8.9	155	11.0	191	124

Results (Cont'd)

timothy, sainfoin and bromegrass with yield increases (compared to yields after one irrigation) of 20 to 41%. The most responsive species to a total of 16 cm irrigation, applied in two equal applications in late May and late June, were meadow foxtail, timothy, crested wheatgrass and alfalfa, all of which had yield increases over those of the non-irrigated control of 52 to 94%. Red clover and birdsfoot trefoil were the species least responsive to irrigation (Table 5).

ANNUALS FOR FORAGE

Forage species: Oats (cultivars OA-123-81, OT 615, Pendek, Victory), Barley (cvars. Galt, Warrior), Spring Rye, Rape (cvars. Midas, Oro, Petra, Zepher), English Rape, Marrowstem kale, Pea (cvar. Century), Fababean.

Seeding and Harvest years: 1975, 1976 and 1977.

Soil type: Landray silt loam black solod.

Results: The yield and quality (crude protein and phosporus) characteristics of the forage of various annual species, either alone or in a limited range of mixtures, are given in Table 6. The nature of the growing season had a marked effect on yield and protein content, as did forage species and variety. The brassicas (rapes and kales) and legumes (peas and fababeans) had protein contents considerably higher than the cereals. Furthermore, the brassicas had higher phosphorus contents than the other forages. These factors should be considered along with yield in the selection of annual forages for use as livestock feeds.

TABLE 6: Yield and quality characteristics of various annual crops grown for forage at Beaverlodge, 1975-77.

Crop and variety	1975			1976		1977			
	Dry matter yield t/ha	Crude protein content %	Crude protein yield kg/ha	Dry matter yield t/ha	Phosphorus content %	Dry matter yield t/ha	Crude protein content %	Crude protein yield kg/ha	Phosphorus content %
Oats: OA-123-81	3.0 ef*	11.1	319	8.6	0.16 e	8.5 ab	7.2	619 bcd	0.14 d
OT 615	3.7 c-f	11.8	443	3.2	0.17 de	8.7 ab	8.4	742 bcd	0.15 d
Pendek	2.8 f	12.7	359	7.0	0.21 de	7.9 abc	9.1	719 bcd	0.20 c
Victory	3.6 c-f	11.2	402	7.7	0.19 de	8.8 a	7.7	706 bcd	0.15 d
Barley: Galt	4.1 b-e	14.0	572	5.4	0.19 de	5.6 bc	8.5	472 d	0.18 cd
Warrior	2.9 f	9.7	272	6.2	0.21 de	6.3 abc	7.7	488 d	0.17 cd
Spring rye	-	-	-	-	-	7.8 abc	7.2	539 bcd	0.12 e
Rape: Midas	-	-	-	-	-	6.5 abc	12.7	857 bcd	0.25 b
Oro	4.8 b	17.0	803	8.7	0.29 abc	-	-	-	-
Petra	4.7 bc	10.5	491	6.9	0.31 a	4.7 d	16.8	754 bcd	0.26 b
Zepher	4.5 bcd	12.6	577	7.8	0.23 b-e	6.7 abc	16.3	1083 b	0.25 b
English rape:	6.9 a	14.5	1007	12.3	0.30 ab	8.0 abc	19.2	1599 ab	0.34 a
Marrowstem kale:	-	-	-	-	-	5.3 c	18.3	1055 b	0.26 b
Peas: Century	2.8 f	11.2	313	2.1	0.17 de	6.5 abc	15.9	1027 bc	0.16 cd
Fababean:	2.5 f	24.8	619	3.1	0.22 cde	5.0 c	15.0	775 bcd	0.14 d
Mixtures:									
Pendek oats/Century peas	3.6 c-f	16.0	561	7.1	0.18 de	8.0 abc	12.0	959 bcd	0.14 d
Victory oats/Fababean (alternate rows)	3.0 ef	13.5	449	5.8	0.19 de	7.9 abc	8.8	682 bcd	0.15 d
Galt barley/Zepher rape	4.6 bc	12.6	624	7.6	0.24 a-d	6.8 abc	10.0	690 bcd	0.15 d
Galt barley/Victory oats	3.5 def	13.5	462	9.0	0.16 e	7.7 abc	8.3	646 bcd	0.16 d
Mean	3.7	13.5	496	7.1	0.22	7.0	11.6	798	0.19

*Means in same column followed by the same letter are not significantly different (P=0.05).

SAINFOIN: ROW SPACING AND MIXTURES FOR FORAGE

Forage species: Sainfoin (cultivar Melrose), Bromegrass (cvar. Carlton), Crested wheatgrass (cvar. Summit), Meadow foxtail (common), Slender wheatgrass (cvar. Revenue).

Seeding year: 1972 at Beaverlodge, 20 kg seed/ha.

Soil type: Landray silt loam black solod with good fertility.

Harvest years: 1973, 1974 and 1975; two cuts/year taken in early July and mid-September.

Treatments:

1. Sainfoin in 10 cm rows
2. Sainfoin in 50 cm rows
3. Sainfoin in 100 cm rows
4. Sainfoin-Bromegrass mixture in 50 cm rows
5. Sainfoin/Bromegrass in alternate 50 cm rows
6. Sainfoin-Slender wheatgrass mixture in 50 cm rows
7. Sainfoin/Slender wheatgrass in alternate 50 cm rows
8. Sainfoin-Crested wheatgrass mixture in 50 cm rows
9. Sainfoin/Crested wheatgrass in alternate 50 cm rows
10. Sainfoin-Meadow foxtail mixture in 50 cm rows
11. Sainfoin/Meadow foxtail in alternate 50 cm rows

Results: Sainfoin was difficult to establish and yields varied markedly from year to year (Table 7). Even in the most productive year (1974) yields were less than those of alfalfa grown in an adjacent area. Sainfoin grown in 50 cm rows outyield that grown in either 10 or 100 cm rows and produced yields equal to any of the sainfoin-grass mixtures studied. There were no differences between the two methods of seeding the sainfoin-grass stands (mixtures or alternate rows) for the different grasses (Table 7).

It should be noted that sainfoin, unlike alfalfa, is a non-bloating forage legume and therefore is particularly suitable for pasturing livestock.

TABLE 7. Performance of sainfoin grown at various row spacings, and in mixtures or alternate rows, with bromegrass, slender and crested wheatgrass, and crested wheatgrass, and meadow foxtail: 1973 to 1975 at Beaverlodge.

TREATMENT	Annual dry matter yield (t/ha)			
	1973	1974	1975	Mean
Sainfoin, 10 cm rows	1.2 b*	4.5 abc	0.7 f	2.1 e
Sainfoin, 50 cm rows	2.8 a	4.7 ab	1.5 abc	3.0 ab
Sainfoin, 100 cm rows	2.1 ab	3.6 c	1.3 a-d	2.3 de
Sainfoin-Bromegrass mixture, 50 cm rows	2.0 ab	4.7 ab	1.2 b-e	2.6 a-d
Sainfoin/Bromegrass, alternate 50 cm rows	2.2 a	4.9 ab	0.8 def	2.6 a-d
Sainfoin-Slender wheatgrass mixture, 50 cm rows	2.1 a	4.8 ab	1.1 c-f	2.7 a-d
Sainfoin/Slender wheatgrass, alternate 50 cm rows	2.3 a	4.0 bc	0.7 f	2.3 de
Sainfoin-Crested wheatgrass mixture, 50 cm rows	2.4 a	5.2 a	1.7 a	3.1 a
Sainfoin/Crested wheatgrass, alternate 50 cm rows	2.3 a	4.7 ab	0.8 ef	2.6 b-e
Sainfoin-Meadow foxtail mixture, 50 cm rows	2.4 a	4.6 ab	1.6 ab	2.8 abc
Sainfoin-Meadow foxtail, alternate 50 cm rows	2.3 a	4.3 abc	0.8 ef	2.5 cde

*Mean within years followed by the same letter are not significantly different (P=0.05)

SUMMARY OF RESEARCH RESULTS

1. To maximize herbage yields of creeping red fescue and crested wheatgrass in the year immediately after establishment, the stands should be seeded before mid-June. Early seeding is less critical for other grasses, including bromegrass, intermediate wheatgrass, meadow fescue, reed canarygrass, Russian wildrye grass and timothy.

2. For a number of forage species, including alfalfa, bromegrass, reed canarygrass and slender wheatgrass, maximum yields can be obtained using row widths of 50 cm.

3. Over a 3-year period, pure stands of alfalfa and birdsfoot trefoil showed greater persistence of yield into the third harvest year than pure stands of bromegrass, reed canarygrass or slender wheatgrass. When the grasses and legumes were grown in alternate rows, the only stands that yielded as well as the pure legume stands were alfalfa-slender wheatgrass, alfalfa-bromegrass and birdsfoot trefoil-bromegrass. The birdsfoot trefoil-bromegrass mixture has the added advantage of providing bloat-free grazing.

4. Among a range of grasses and legumes evaluated for their responses to irrigation, the most productive species without irrigation (in a relatively dry growing season) were bromegrass, pubescent wheatgrass, reed canarygrass and red clover. With the exception of red clover, each species responded to supplemental irrigation. The most responsive species were meadow foxtail, timothy, crested wheatgrass and alfalfa.

5. Among a number of annual crops evaluated for forage production, the brassicas (rapes and kales) and legumes (peas and fababeans) had protein contents considerably higher than the cereals, but both protein content and yield varied makedly from year to year for all crops. When selecting annuals for forage production, the time and method of utilization must be considered along with the yield and quality of the dry matter produced. The annual crop can then perform an important role in truly supplementing the livestock feed available from perennial forages. For instance, cereals may be particularly useful in mid-summer for green-chop, hay or silage, and kale may prove useful in the fall for green-chop or grazing.

6. Sainfoin is difficult to establish and less productive than alfalfa. When grown in 50 cm rows, a pure stand of sainfoin outyielded a number of sainfoin-grass mixtures. Sainfoin is a non-bloating legume, particularly suited to grazing, but yields may vary markedly from year to year.