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Effect of timing and intensity of first defoliation on subsequent production of 4 pasture species

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Abstract

Two simulated pasture studies were carried out at Swift Current, Sask., to determine the effects of date and height of first harvest in the year following establishment on the yield of 4 species in subsequent years. Altai wild ryegrass [*Leymus angustus* (Trin.) Pilger], Russian wild ryegrass [*Psathyrostachys junceus* (Fisch.) Nevski] and crested wheatgrass [*Agropyron desertorum* (Fisch.) Schult.] were used in both studies; alfalfa [*Medicago sativa* L. ssp. × *varia* (Martyn) Arcangeli] was included in the second study only. In both studies plots were first cut at 1 of 6 dates, approximately 2 weeks apart, during the period from mid-May to late July in the year following establishment. Cuts were made either at a 5 cm or at a 10 cm height to simulate medium grazing and light grazing, respectively. After the first cut, forage was harvested in that year whenever 10 cm of regrowth was present. In the next 5 years in the first study and 3 years in the second, all forage was harvested at 5 cm height on 15 May and thereafter whenever 10 cm of regrowth was present. Treatment effects were greatest in the year treatments were imposed and in the first post-treatment year. In the treatment year, highest forage yields were obtained from plots cut at 5 cm, but in subsequent years, forage yields were higher from plots cut at 10 cm in the treatment year. Moisture conditions in the seeding and establishment years affected the response to treatments. Date of first cut in the treatment year affected yields in subsequent years in both experiments although differences declined with time. Crested wheatgrass was more affected by date of first cut than were the other species. The cutting dates for highest yields in each case correlated with flowering date and indicate that seedings of these grasses should not be harvested until they have flowered. The results of this study also indicate that to ensure continued high forage yields, the first harvest of these grasses should be less intense than subsequent harvests.

Key Words: Altai wild ryegrass, Russian wild ryegrass, crested wheatgrass, *Leymus angustus, Psathyrostachys junceus, Agropyron desertorum,* simulated grazing

Under the semiarid conditions of southwestern Saskatchewan, pasture production is low. It is primarily limited by amount and variability of precipitation (Kilcher 1965) and by the production potential of the native grasses. An extensive program of testing and selection has identified and produced cultivars of several drought-tolerant, winter-hardy forages that are more productive than native species and have acceptable nutritional quality (Henrichs and Carson 1956, Lawrence and Troelsen 1964, Lawrence 1977).

A standard agronomic practice in this semiarid region is to delay the first use of seeded forages until the year following seeding, to enable the seedlings to develop sufficient crown and root reserves to allow them to tolerate subsequent grazing. The grasses, particularly Russian wild ryegrasses [*Psathyrostachys juncea* (Fisch.) Nevski] and Altai wild ryegrass [*Leymus angustus* (Trin.) Pilger]-(Lawrence 1979a, 1979b), have low seedling vigour, produce little forage during their seedling year (Lawrence and Kilcher 1972), and are susceptible to grazing pressures during that year. Crested wheatgrass [*Agropyron desertorum* (Fisch.) Schult.] is a more vigorous grass but it too can be susceptible to grazing pressure during the seedling year. Alfalfa [*Medicago sativa* L. ssp. ×*varia* (Martyn) Arcangeli] is frequently included in seeded pastures because of its yield potential, its nutritional quality, and the fixed nitrogen it provides to grasses (Heinrichs 1969).

The time of first use in the next year is often dictated by economic considerations and overall pasture availability. However, because seeded dryland pastures in this part of Canada are usually considered to be permanent and thus unbroken for periods in excess of 20 years, it is important that these pastures, when newly seeded, are not grazed for the first time in a way that would result in long-lasting deleterious effects on production. For southwestern Saskatchewan, there is a lack of published information on how soon, and the extent to which newly seeded pastures can be grazed. Holt et al. (1986) have suggested that grazing Russian wild ryegrass in the first crop year should be delayed until the plants are fully headed.

The objective of this study was to determine the effects of date of first cut and cutting height in the year after seeding upon the subsequent productivity of 4 pasture species grown under dryland conditions in southwestern Saskatchewan.

Materials and Methods

The study consisted of 2 simulated grazing experiments, one initiated in 1976, the other in 1978, and located approximately 200 m apart on the dryland area of the Agriculture Canada Research Station, Swift Current, Sask. At this location the 104-year mean annual precipitation is 361 mm and the 30-year mean annual Class "A" pan evaporation for 1 April to 30 September is 1,150 mm. The treatments in both experiments consisted of 4 forage species, 6 dates of first use in the year following the seedling year, and 2 cutting heights in the first year of use. Three pasture grasses, 'Summit' crested wheatgrass, 'Mayak' Russian wild ryegrass, and 'Prairieland' Altai wild ryegrass, and a pasture alfalfa cultivar ('Drylander') were seeded on a Swinton loam soil (Ayres et al. 1985), an Orthic Brown Chernozem (Canada Soil Survey Committee, Subcommittee on Soil Classification 1978). This soil type is equivalent to an Aridic Haploboroll (USDA-SCS Soil Survey Staff 1975).

Each plot consisted of 4 rows 7 m long and spaced 0.6 m apart. The plots were seeded using a Swift Current cone delivery forage-plot-seeder with double disc row openers equipped with depth control bands. Seeding rate was 67 seeds per meter of row, which is the recommended seeding rate for pastures in southwestern Saskatchewan (Leyson et al. 1981). Plots were arranged in a split plot

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Table 1. Growing season and annual precipitation at Swift Current.

Year		Month					Total[2]	Annual
Expt 1	Expt 2	April	May	June	July	August	(Apr–Aug)	Total
		(mm)						
SY[1]	—	9	23	122	45	38	237	339
TY	—	8	102	24	72	26	232	346
1st PTY	SY	44	45	63	11	16	179	297
2nd PTY	TY	28	52	51	34	29	194	294
3rd PTY	1st PTY	4	13	70	76	32	195	329
4th PTY	2nd PTY	15	39	98	59	16	227	315
5th PTY	3rd PTY	11	82	43	119	41	296	418
104-year mean		22	43	73	52	43	232	361

[1]SY = Seedling Year; TY = Treatment Year; PTY = Post Treatment Year
[2]Total growing season precipitation

design with 4 forage species as main plots, 6 dates of first cut sub-plots, and 2 cutting heights arranged as sub-sub-plots. The treatments were replicated 4 times. In the first experiment, the alfalfa did not establish and the effects of the cutting treatments were measured on the 3 grasses only.

In the year following the seedling year, and in that year only, plots were cut in accordance with the prescribed cutting treatments of date and height. Plots were first cut at 1 of 6 dates spaced about 2 weeks apart: 16 May; 2, 14, and 29 June; 13 and 29 July in the first experiment and 16 May; 1, 15, and 29 June; 16 July; and 2 August in the second experiment. These dates of first cut span the usual period of maximum dry matter production for established grasses in this area (Kilcher and Lawrence 1979). The dates also covered the period of flowering and seed set for all 3 grasses.

In the first or treatment year only, grasses were initially cut at 5 cm to simulate moderate grazing, or 10 cm to simulate light grazing pressure. Second and subsequent cuttings of regrowth in the first harvest year were taken at the treatment cutting heights whenever there was 10 cm of regrowth beyond the height of the previous cut.

In subsequent years, all plots were cut at 5 cm at about 15 May and thereafter whenever there was 10 cm of regrowth beyond the height of the previous cut.

At each harvest, the 2 centre rows of plants were harvested with the Swift Current forage plot harvester IV (Thompson 1972) for yield measurement before trimming off the 2 outside or 'guard' rows. End effects were minimized by trimming 60 cm from each end of the plot and by using grassed pathways. Each plot was harvested 5 to 7 times per year depending on regrowth which varied with precipitation (Table 1). However, because of the variable number of harvests among years and despite the importance of growth distribution, only total annual dry matter yields are presented.

Statistical analysis was conducted in 3 ways. First, all treatments and years were analyzed for total annual dry matter production using analysis of variance (ANOVA) according to the model for a split plot in space and time described by Steel and Torrie (1980). Replicates and years were considered random effects and species, date of first use, and height were fixed effects. Secondly, because treatment year results were clearly different from those of the subsequent years, an analysis was carried out on the post-treatment years only. The statistical model for both analyses is complex. Both species and years are whole plots. Dates of first use in the first harvest year are subplots and cutting heights are sub-subplots. Combined analysis indicated significant interactions of species × years, date × years, and height × years. Consequently, a third analysis was carried out in which the results were analyzed separately for each year and each species using a split plot arrangement with dates of first cut in the first harvest year as main plots and cutting heights as subplots (Steel and Torrie 1980). Standard errors of the means were calculated for significant factors and interactions and differences were tested using LSD (Carmer and Walker 1982).

Table 2. Effect of forage species (S) and harvest year (Y) on the annual yield of forage species in simulated pastures averaged over date of first cut and height of first cut in the treatment year.

Forage species (S)	Year (Y) TY	PTY-1	PTY-2	PTY-3	PTY-4	PTY-5	PTY[1] mean	All years[2] mean
	($kg\ DM\ ha^{-1}$)							
Experiment 1.								
CWG	1189	1305	702	706	645	841	840	899
RWR	582	1155	807	909	857	1087	963	900
AWR	891	1115	831	955	597	979	895	892
Mean	887	1192	780	857	700	969	900	897
SE	87*	47*	45	50*	36*	60*	28*	20
Experiment 2.								
CWG	872	853	1039	1370	—	—	1088	1034
RWR	326	767	1056	1758	—	—	1194	977
AWR	304	726	721	1356	—	—	934	777
Alfalfa	538	609	885	1198	—	—	898	808
Mean	510	739	925	1420	—	—	1028	899
SE	86*	63*	66*	102*			36*	12*

[1]PTY mean includes post-treatment year yields only
[2]All-years mean includes treatment year yields and post-treatment year yields
*Difference between means within a year is significant (P=0.05)

Table 3. Effect of height of cut (H) in the first harvest year (Y) on the annual yields of grass in simulated pastures averaged over forage species and date of first cut in the treatment year.

Height of cut (H)	Year (Y) TY	PTY-1	PTY-2	PTY-3	PTY-4	PTY-5	PTY[1] mean	All years[2] mean
(cm)	(kg DM ha^{-1})							
Experiment 1.								
5	1079	978	747	825	681	936	834	875
10	696	1410	813	892	752	1002	967	922
Mean (Y)	887	1192	780	857	700	969	900	897
SE	61*	55*	30*	28*	18*	30*	25*	28*
Experiment 2.								
5	626	679	905	1410	—	—	998	905
10	394	798	945	1431	—	—	1058	892
Mean (Y)	510	739	925	1420	—	—	1028	899
SE	29*	25*	NS	NS			27*	NS

[1]PTY years mean includes post-treatment year yields only
[2]All years mean includes treatment year yields and post-treatment year yields
*Difference between means within year is significant (P=0.05)

Results and Discussion

Precipitation during the growing season is the principal environmental factor affecting dryland forage production in southwestern Saskatchewan. Growing season precipitation (Apr–Aug) in the seeding and treatment years of the first experiment was near the long-term mean (Table 1). Growing season precipitation was below average during the first 3 post-treatment years, becoming near or above average in the 4th and 5th post-treatment years, respectively. Kilcher (1980) found that despite the erratic variation in precipitation at Swift Current, 5 years of forage yield data were sufficient to rank species and treatments.

The second experiment was seeded in a year when growing season precipitation was lower than the long-term mean. Establishment was good but growth during the seeding year was poor. Growing season precipitation was below normal in the following 2 years, the treatment year and the first post-treatment year, but near or above normal thereafter.

Effect of Species on Annual Forage Yields

Species alone had no effect upon forage yield in the first experiment across all years (Table 2) but yields of the 3 species differed significantly in the post-treatment years. A cross-over in the rankings of the 3 species by year resulted in a significant species × year interaction. Crested wheatgrass established quickly and produced the highest yield during the treatment year. Crested wheatgrass is a vigorous and quickly establishing grass (Lodge et al. 1972). In contrast, Russian wild ryegrass takes more than 1 year to develop its yield potential (Lawrence and Heinrichs 1977) and yielded about 50% of crested wheatgrass in the treatment year. Altai wild ryegrass was intermediate to these 2. White and Wight (1981) reported similar low first year forage yields of Russian wild ryegrass. The slower establishing ryegrasses produced higher yields in subsequent years. Thus the inverse relationship between treatment and post-treatment yields resulted in no significant yield difference when all the years were considered together. The conclusion of Kilcher (1980) that the first 2 years of perennial crop yield data were too erratic to be included in long-term means might result from similar significant cross-over interactions during the establishment phase.

In the second experiment, there was also a significant species × year interaction. Crested wheatgrass again out-performed the ryegrasses and alfalfa in the treatment year but in subsequent years the ryegrasses and the alfalfa had either reversed or were reversing this trend. Thus when all years were considered, the yield advantage of crested wheatgrass was much less than observed in the treatment year. Altai wildrye was more affected by the dry initial years than either Russian wild ryegrass or crested wheatgrass and did not respond to the increase in precipitation in the final year of the experiment as much as Russian wild ryegrass. It should be noted, however, that Altai wild ryegrass has a somewhat different growing pattern than Russian wild ryegrass, being about 2 weeks later in maturity. Growth under Swift Current conditions is affected both by total growing season precipitation and its distribution over the growing season. As a result of the maturity difference, the distribution of precipitation may have favoured crested wheatgrass and Russian wild ryegrass more than Altai wild ryegrass. Alfalfa did not yield as well as crested wheatgrass but showed a similar pattern of response over years.

Effect of Initial Height of Cut

In the first experiment, dry matter yields in the treatment year were significantly greater when the forage was cut at the shorter height (Table 3). However, the greater yield from the 5 cm cutting height in the treatment year, or first harvest year, was followed by reduced forage production over the next 5 years. The greatest yield reduction occurred in the first post-treatment year despite good growing season precipitation. The mean post-treatment yield was 16% greater for the plants cut at 10 cm in the treatment year compared to those cut at 5 cm in the treatment year and the 6-year mean yield which, including treatment year yields, was 5% greater. The results show that any initial advantage obtained by a shorter cut in the first year did not compensate for depressed yields in subsequent years.

Results of the second experiment were generally similar to those of the first experiment except that the deleterious effect of the lower cutting height did not persist beyond the first post-treatment year, although there was a tendency towards lower yields in subsequent years. Because this was a shorter study, one cannot be certain whether the plants cut at 10 cm would eventually have outyielded those cut at 5 cm.

The less persistent effect of cutting height upon the subsequent yields in the second experiment, compared to the first experiment, may be due to the conditions under which the stands were established and treated. The lower precipitation during the first 2 years of the second experiment resulted in smaller plants that were probably still struggling to become completely established. Russian wild ryegrass, in particular, takes more than 1 year to develop its yield potential (Lawrence and Heinrichs 1977). Drought is also known to promote hardening of crops against further stress. Thus, in comparison to the stresses placed upon the plants at that time by water shortages, the effects of cutting height upon plant development and establishment were probably minor.

The significant interaction between forage species and height of cut (S×H) in the second experiment was a consequence of differences in the rates of development and growth habits of the 4 forage species. In the treatment year, Russian wild ryegrass, a decumbent grass, had very little growth, particularly above 10 cm. Consequently, cutting at 5 cm resulted in yields nearly 3 times greater than the plots cut at 10 cm. In contrast, crested wheatgrass, a grass with a more erect habit of growth and a more rapid growth rate in its first year, yielded only 19% more from a 5-cm cut than from a 10-cm cut. Based on the 4-year means, crested wheatgrass cut at 10 cm produced the higher yield (1,008 and 1,059 kg • ha^{-1} for 5 and 10 cm, respectively) whereas for Russian wild ryegrass the 5 cm cut was higher yielding (1,020 and 935 kg • ha^{-1}). Altai wildrye, being intermediate in response to crested wheatgrass and Russian wild ryegrass, showed no yield advantage to either cutting height for the 4-year mean yield (773 and 777 kg • ha^{-1}). Alfalfa yields behaved like those of Altai wild ryegrass (816 and 799 kg • ha^{-1}). When only the data from the post-treatment years were considered, only the effect of height of cut in the treatment year was significant.

Effect of Date of First Cut

In both experiments, when the treatment year yields were included in the analysis, there was a significant interaction between forage species, date of first cut in the treatment year, and year of harvest (S×D×Y). This interaction reflected the contrast between treatment year and the first year after treatment. The differences between forage species in their response to date of first cut persisted in the first experiment but not in the second, shorter experiment.

In the first experiment, highest mean yield of crested wheatgrass over all years and over only the post-treatment years occurred when first cutting dates in the treatment year were between mid-June and mid-July (Table 4), the period after crested wheatgrass flowers and during which it sets seed. Early harvesting and subsequent defoliations in the treatment year may have reduced establishment and affected reserves needed for regeneration before the onset of winter. Similarly, late cutting, by allowing flowering and seed set followed by several defoliations, may also have reduced reserves.

Trends similar to those for crested wheatgrass were observed for Russian wild ryegrass but differences between dates of first cut were small and not significant. Holt et al. (1986), in a grazing study at Swift Current, found that date of first use of Russian wild ryegrass pastures affected production the following year but not that of subsequent years. Since Russian wild ryegrass takes more than 1 year to develop its full yield potential (Lawrence and Heinrichs 1977), 1 year of deleterious treatment prior to complete establishment may be compensated for by continued establishment in subsequent years. These characteristics probably contribute to the superior grazing qualities of Russian wild ryegrass.

Altai wildrye exhibited a different pattern of yield response compared to the other 2 grasses. Averaged over the 6 years of the study, and over the 5 years post-treatment, yields of Altai wild ryegrass were not reduced in the plots cut late in the treatment year. Altai wild ryegrass, like Russian wild ryegrass, may compensate for deleterious treatment with continued establishment. Its later flowering may also explain a shift to achieving maximum yields from later dates of cut in the treatment year than was found for the other 2 grasses.

In the second experiment, highest yields for the 3 grasses and for

Table 4. Effect of grass species (S), date of first cut in treatment year (D), and harvest year (Y) on annual yield of 3 grasses in simulated pastures in Experiment 1. (Yields averaged over height of cut).

Year (Y)	Date of first cut in treatment year (D) 16 May	2 Jun	14 Jun	29 Jun	13 Jul	29 Jul	Mean	SE
	(kg DM ha^{-1})							
Crested wheatgrass								
TY	652	953	1180	1246	1609	1495	1189	146*
PTY-1	1120	1227	1417	1385	1435	1245	1305	72*
PTY-2	654	679	761	740	775	605	702	47*
PTY-3	697	661	808	887	683	504	706	51*
PTY-4	682	684	633	678	625	571	645	32
PTY-5	856	887	797	918	830	762	841	31*
5-yr Mean[1]	802	828	883	922	870	737	840	51*
6-yr Mean[2]	777	849	933	976	993	864	899	67*
Russian wildrye								
TY	550	582	543	530	608	678	582	47
PTY-1	1111	1062	1177	1196	1249	1140	1155	57
PTY-2	755	777	849	919	773	770	807	49
PTY-3	842	876	1007	1029	876	824	909	54
PTY-4	839	816	896	892	839	861	857	31
PTY-5	999	1030	1195	1174	1027	1099	1087	57
5-yr Mean	909	912	1025	1042	953	939	963	63
6-yr Mean	850	857	944	957	895	895	900	56
Altai wildrye								
TY	706	695	685	916	1107	1240	891	55*
PTY-1	969	1015	1164	1114	1196	1235	1115	75
PTY-2	846	758	812	872	824	871	831	37
PTY-3	868	929	955	911	1040	1026	955	38
PTY-4	537	599	632	539	657	622	597	34
PTY-5	895	918	1017	1014	1052	979	979	48
5-yr Mean	823	850	916	890	954	947	895	40*
6-yr Mean	804	824	878	894	979	996	895	37*

[1]5-yr mean includes only post-treatment year yields
[2]6-yr mean includes treatment year yields and post-treatment year yields
*Difference between dates of cut within year is significant (P=0.05).

Table 5. Effect of date of first cut in treatment year upon the subsequent annual yield over height of cut of 4 forage species in simulated pastures in Experiment 2.

Year	Date of first cut						Mean	SE
	16 May	1 Jun	15 Jun	29 Jun	16 Jul	1 Aug		
	(kg DM ha^{-1})							
Crested wheatgrass								
TY	477	504	804	899	973	1576	872	141*
PTY-1	811	915	802	744	845	1002	853	96
PTY-2	930	1080	1014	966	1056	1182	1039	80
PTY-3	1270	1425	1468	1302	1357	1400	1370	80
3-yr mean[1]	1004	1140	1095	1004	1086	1195	1088	61
4-yr mean[2]	872	981	1022	978	1058	1290	1034	65*
Russian wild ryegrass								
TY	276	298	349	334	490	508	326	25*
PTY-1	622	700	716	860	858	845	767	31*
PTY-2	1032	1092	1050	1080	1050	1032	1056	43
PTY-3	1686	1859	1856	1756	1710	1678	1758	74
3-yr mean	1113	1217	1207	1232	1206	1185	1194	37
4-yr mean	904	987	993	1008	1002	1016	977	27*
Altai wild ryegrass								
TY	179	299	290	291	294	469	304	40*
PTY-1	484	567	622	704	1018	958	726	57*
PTY-2	630	666	726	702	810	786	721	34*
PTY-3	1221	1318	1354	1333	1453	1454	1356	45*
3-yr mean	778	850	901	913	1094	1067	934	10*
4-yr mean	629	713	748	758	894	917	777	27*
Alfalfa								
TY	219	411	409	633	668	885	538	99*
PTY-1	506	586	549	567	712	735	609	36*
PTY-2	912	792	918	936	858	876	885	60
PTY-3	1096	1306	1197	1187	1126	1276	1198	48
3-yr mean	838	895	886	894	899	962	898	34
4-yr mean	683	780	768	830	841	943	808	40*

[1]3-yr mean includes post-treatment year yields only.
[2]4-yr mean includes treatment year yields and post-treatment year yields.
*Difference between dates of cut within year is significant (P=0.05).

alfalfa occurred when the first cut in the treatment year was delayed until mid- to late-July (Table 5). This was especially true for the yields in the treatment year and the first year after treatment. Thereafter, date of first cut in the treatment year had little effect upon yield. The initial 3 dry years during this experiment may have been more deleterious to subsequent production than the effect of the cutting date. Drought stress may have affected the rate of development of the plant by shortening the flowering period so much that the date when cutting would have had the greatest effect fell between 2 cutting dates and so was missed. In addition, under drought conditions seed germination may be extended over a period of years, reducing the effect of a single year's treatment. Based on both experiments, delaying first use until late June-early July generally produces the highest long-term dry matter yields.

The long-term effect of date of first cut on the yield of a forage species is thus greatly affected by establishment conditions. Because crested wheatgrass is a vigorous grass that establishes quickly, the date of first use will have greater effects than is the case for the other species. Conditions that slow its establishment may therefore reduce the effect of such first year treatments.

Date of first cut has less effect upon Russian wild ryegrass due to its slower establishment. Under good establishment conditions, Russian wild ryegrass can be utilized early with little long-term deleterious effect. Under poorer establishment conditions, short-term damage may occur but the grass rapidly recovers. Nonetheless, caution in the time of first use is still advised because the trends were similar to those of crested wheatgrass with highest long-term yields occurring when first cutting was delayed until after flowering.

Establishment during a year of normal precipitation, as in the first experiment, allows early utilization of Altai wild ryegrass in the subsequent year without causing long-term effects. Under drought conditions, however, as in the second experiment, the plants remain susceptible to damage into the second year and are more susceptible than Russian wild ryegrass. Where that happens, the effect of the date of first cut in the treatment year on the yields in subsequent years indicates that the plots first cut in July continued to produce the highest seasonal yields.

Thus it must be concluded that when forage crops are established under good weather conditions, the deleterious effects of cutting too early in the treatment year will be short-term. However, the effect may be of greater significance in conditions where grass establishment is limited or retarded, especially in crops that do not establish easily.

Conclusions and Management Implications

The way in which a seeded pasture is managed in its first year of use may have effects on its subsequent productivity. Cutting height appeared to have the greatest effect, suggesting that cutting or grazing should be minimized in the year of first use to enhance subsequent productivity. The effect on subsequent production of date of first cut varied with the species and may be more significant in the long term for rapidly establishing, more erect species like crested wheatgrass than for more closely establishing decumbent species like the ryegrasses. Date of first use had a smaller and shorter-term effect on the subsequent productivity of Russian wild ryegrass and Altai wild ryegrasses. Nevertheless, the results of this study suggest that in Saskatchewan, both crested wheatgrass and Russian wild ryegrass should not be cut or grazed in the first year of use until late June or early July and that Altai wild ryegrass should not be used prior to July. Results also suggest that the initial cut of alfalfa should be delayed until after it flowers. A convenient method for judging when a new grass stand is ready to be grazed would be to tie this to phenotypic development. Newly seeded pastures should not be grazed the first time until the dominant grasses have flowered.

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