Managing Crested Wheatgrass Pastures

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Management of Crested Wheatgrass Pastures

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HIGHLIGHTS

- Crested wheatgrass is adapted to dry conditions, resists trampling and close grazing, has excellent seedling vigor, and competes successfully with other species.
- Crested wheatgrass produces about twice as much forage as native range and can be stocked three times as heavily.
- Crested wheatgrass is best used as spring pasture because it produces abundant early growth.
- Complementary grazing systems that use crested wheatgrass and native range produce 70% more beef per unit area than adjacent native range.
- High daily weight gains are possible with summer-fall use of crested wheatgrass pasture.
- Crested wheatgrass outyielded adjacent native range after 50 years of continuous production.

The widespread adaptability of crested wheatgrass, *Agropyron cristatum* (L.) Gaertn. and *A. desertorum* (Fisch.) Schult., has led to its extensive use in the range livestock industry. It has been seeded on 1 million ha in Western Canada. Extensive regrassing with crested wheatgrass began in the mid-1930's on abandoned farmlands and overgrazed rangelands in the dry areas of the Prairie Provinces. Since then, crested wheatgrass has also been used for pasture and hay in the moister areas of Western Canada.

Crested wheatgrass is popular because it produces an abundance of high-quality seed that will germinate, emerge, and grow under adverse conditions. Seeds sown in spring or early fall can germinate and develop into seedlings in 8-12 days under favorable conditions. Or the seeds can remain in the soil for up to 5 years until conditions are favorable, and then germinate and grow. These characteristics, and its high forage yield, have made crested wheatgrass an important forage grass for seeding rangeland and land taken out of crop production.

Crested wheatgrass is particularly adapted to dry conditions, is winter-hardy, withstands close grazing and severe trampling, and competes successfully with plants of other species. These characteristics make it particularly suitable for pasture.

Several characteristics limit its productivity and use. It is rather unpalatable after it matures. It remains dormant in summer. Its yield is high in the first few years after establishment, drops rather sharply in the fourth or fifth year, and then maintains a steady long-term productivity level. Proper management of crested wheatgrass for pasture can reduce the effect of these unfavorable characteristics.

High-yielding varieties of crested wheatgrass have been developed: Nordan and Summit (standard types) are adapted to the southern prairie regions, Fairway and Parkway (fairway types) to the northern areas.

EASE OF ESTABLISHMENT

Crested wheatgrass can be seeded on fallow, stubble, or land infested with annual weeds. It can be sown in the spring, early fall, or late fall. A firm seedbed is essential to the establishment of a satisfactory stand. Seedlings thrive best under cool growing conditions, such as those prevalent during fall and early spring. In the semiarid areas, sow the seed in rows spaced 45-60 cm apart, and in the moister areas at 30 or 35 cm row spacings. Sow about 80-100 seeds to each metre of row. This will require 3-4 kg of seed per hectare for the wide spacings and 5-6 kg for the narrower-spaced rows. Annual and biennial weeds that may grow up with the establishing stand of crested wheatgrass will be crowded out in a few years.

Do not graze crested wheatgrass the first year. Allow the plants time to become established.

Crested wheatgrass produces more plant material than native grasses or Russian wild rye, *Elymus junceus* Fisch., another introduced dryland grass, during the establishment period. This gives it an early start in mixed stands. In the first 7 weeks of growth after they emerge, crested wheatgrass seedlings

produce more leaf and root material than Russian wild rye, or about twice as much total dry matter (Table 1). The early advantage gained by crested wheatgrass persists beyond the initial establishment period. In another study, crested wheatgrass seedlings produced more leaf and root material than Russian wild rye seedlings when both were grown for 90 days. This advantage was maintained when the seedlings were grown in a range of root zone temperatures from cool to warm (7-27°C).

TABLE 1 WEIGHTS (mg) OF CRESTED WHEATGRASS AND RUSSIAN WILD RYE SEEDLINGS IN THE FIRST 7 WEEKS

	Crested wheatgrass			Russian wild rye		
Week	Leaf	Root	Total	Leaf	Root	Total
1	3	1	4	2	1	3
3	30	11	41	17	6	23
5	293	81	374	142	45	187
7	1244	292	1536	614	213	827

EARLINESS OF GROWTH

Crested wheatgrass grows quickly early in the spring. This rapid growth and its palatability make it ideal for early spring pastures. The peak forage production period for crested wheatgrass is in May, whereas native prairie does not reach its peak production until June. Crested wheatgrass produces over 90% of its total annual yield before 1 July; 65% of the total production of native prairie is made after 15 June (Fig. 1).

At Manyberries, Alta., the height of leaves of crested wheatgrass plants was measured on various dates each spring for 10 years. Leaves were 10 cm high and therefore ready for grazing by 30 April in most years. The earliest date on which the leaves of crested wheatgrass were 10 cm high was 18 April, and the latest, 12 May. In comparison, the native grasses were 10 cm high 2-3 weeks later.

The early growth of crested wheatgrass was also illustrated in a study at Swift Current, Sask. The forage of crested wheatgrass and native prairie areas was harvested and weighed at 2-week intervals from mid-April to mid-September. Average forage production for crested wheatgrass by 1 May was 159 kg, and 2 weeks later 383 kg. By 15 May native prairie had produced only 19 kg of forage (Fig. 2).

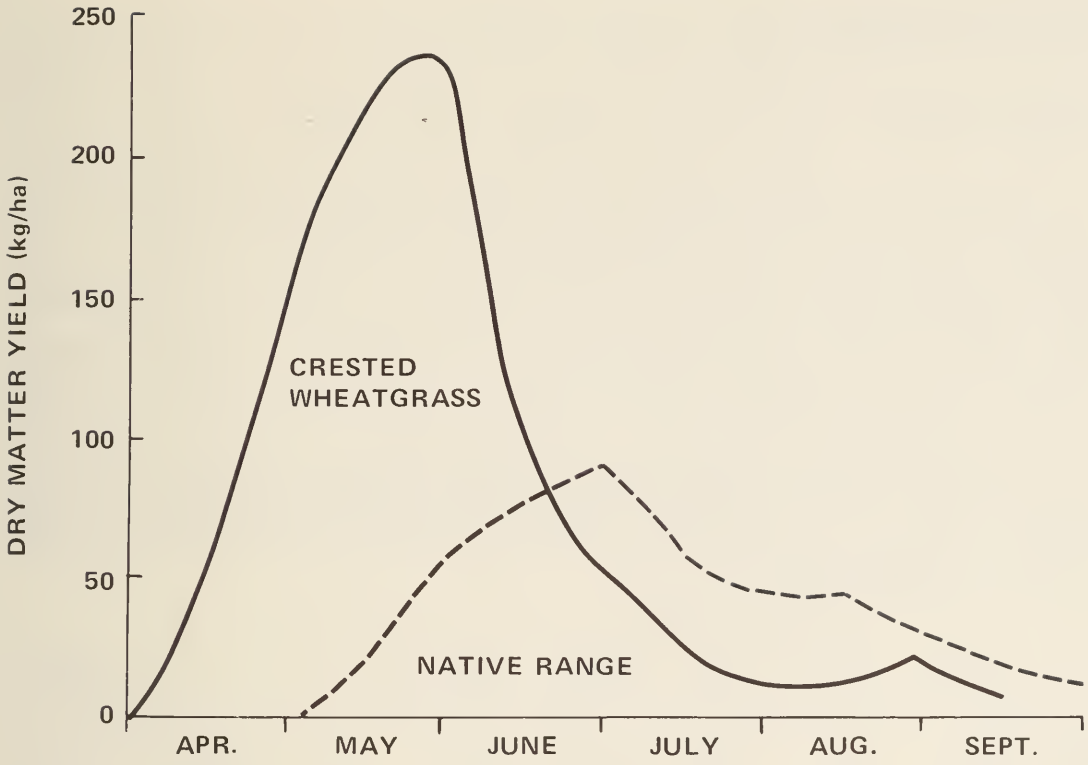

Fig. 1. Yields of crested wheatgrass and native range at Swift Current, Sask.

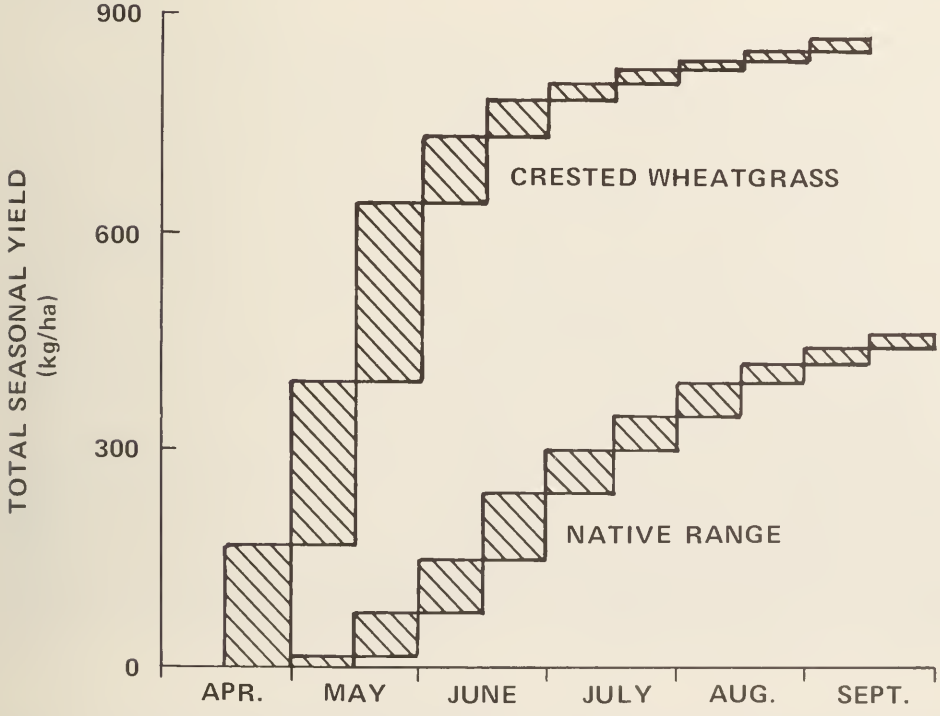

Fig. 2. Comparative cumulative yield for successive biweekly periods, April to September, for crested wheatgrass and native range at Swift Current, Sask.

PRODUCTION

Forage yields

Crested wheatgrass produces, on the average, about twice as much forage per hectare as does native range without fertilization. At Manyberries, forage production over 24 months averaged 880 kg/ha on crested wheatgrass pastures and 410 kg/ha on native range pastures (Fig. 3). Every year during the test, except the first year, the total yield of forage was greater on the crested wheatgrass pastures than on the native range pastures. In 1957, a fairly dry year, the 3-year-old stand of crested wheatgrass outyielded native range by 20%. In 1970, it produced 270% more forage than did the native range. In general, the yields of crested wheatgrass and native prairie reflect variations in precipitation. Crested wheatgrass recovers from drought faster than native range.

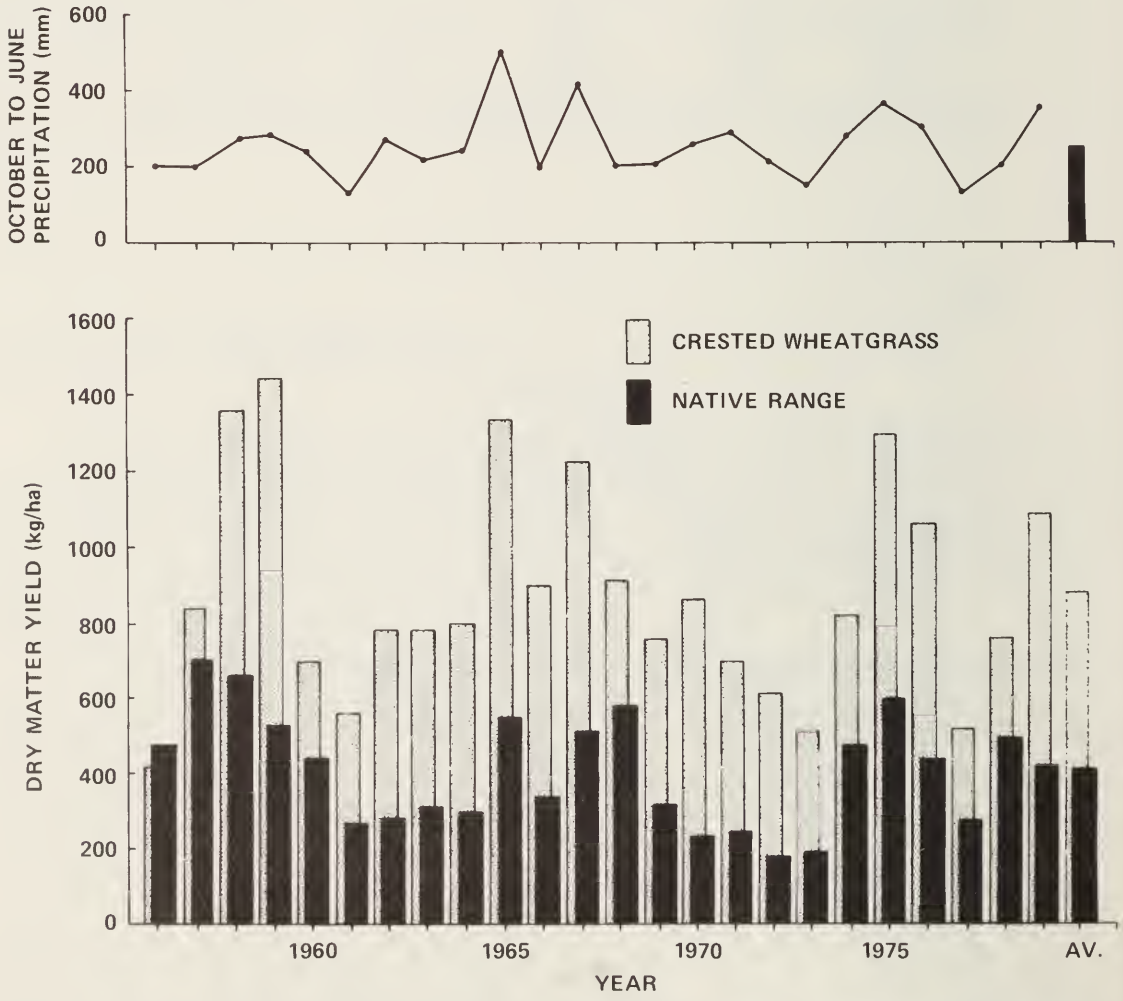

Fig. 3. Yield of crested wheatgrass and native range for 1956-79 compared with October to June precipitation at Manyberries, Alta.

In the drier parts of the prairies, crested wheatgrass is productive for many years. At Manyberries, crested wheatgrass stands seeded in 1928-37 produced more forage in 1965, a year with favorable moisture conditions, than in any previous years. In other areas of the Northern Great Plains, it has remained productive for very long periods. At one location, its second highest annual yield was produced in the 44th year after seeding.

The inclusion of alfalfa, particularly creeping-rooted varieties (Rambler, Roamer, Drylander, Kane, and Rangelander), in mixtures with crested wheatgrass increases the forage yield and extends the period of high nutritive value pasture. In one study, the inclusion of alfalfa at 1 kg/ha in the seed mixture doubled the 5-year average yield of crested wheatgrass (Table 2).

TABLE 2 PASTURE PRODUCTION OF CRESTED WHEATGRASS AND A CRESTED WHEATGRASS-ALFALFA MIXTURE

	Annual production, kg/ha					
Pasture	1st yr	2nd yr	3rd yr	4th yr	5th yr	Av
Crested wheatgrass	1050	540	970	960	580	820
Crested wheatgrass-alfalfa	1280	800	1330	2190	2570	1635

Animal production

Livestock gain most weight when they graze crested wheatgrass during the spring (May-June) grazing season. At Manyberries, yearling ewes gained 0.7 kg/head more when they grazed it during the spring than when they grazed native range. During the summer (July-August) and fall (September-mid-November) yearling ewes gained less on crested wheatgrass pasture than on native range. Total gain for the grazing season was 18.9 kg/head on native range and 16.4 kg on the crested wheatgrass pastures (Table 3).

Although gain per head was greater on native range than on crested wheatgrass pastures, gain per hectare was greater on crested wheatgrass than on native range. During the 10-year grazing trial, yearling ewe gains per hectare on crested wheatgrass ranged from 1.75 to 4.67 times as great as on native range over a 7-month grazing season. Average gains per hectare were 24.3 kg on crested wheatgrass and 9.3 kg on native range (Table 4).

At Swift Current, gains of yearling steers grazing crested wheatgrass and native range were recorded for 2 months in the spring. Average gains per hectare were 77.0 kg on crested wheatgrass and 28.8 kg on native range. In both grazing studies, the crested wheatgrass pastures were stocked about three times as heavily as the native range.

Crested wheatgrass pastures can be grazed all year, if necessary. Studies conducted near Stanmore, in southern Alberta, show that cattle make

TABLE 3 GAINS OF YEARLING EWES ON CRESTED WHEATGRASS AND NATIVE RANGE PASTURES AT MANYBERRIES, ALTA.

	Gain, kg/head	
Season	Crested wheatgrass	Native range
Spring	10.0	9.3
Summer	4.6	6.3
Fall	1.8	3.3
Total	16.4	18.9

Note: Yearling ewes grazed the pastures for 7 months each year for 10 years.

TABLE 4 ANIMAL GAINS ON CRESTED WHEATGRASS AND NATIVE RANGE PASTURES

	Yearling ewes[1]		Yearling steers[2]	
	Crested wheatgrass	Native range	Crested wheatgrass	Native range
Stocking rate, ha/AUM[3]	0.65	1.90	0.65	1.75
Gains, kg/ha	24.3	9.3	77.0	28.8
Av daily gain, kg/head	0.08	0.10	0.95	1.00

[1]Seven months of grazing per year, Manyberries, Alta.

[2]Two months of grazing per year, Swift Current, Sask.

[3]Animal unit month.

good gains on crested wheatgrass used as the only pasture. In this study, cows grazed crested wheatgrass continuously for 5 years. During particularly severe winters, they were given crested wheatgrass hay as needed and, during one winter, some oats were used to supplement the ration. Crested wheatgrass was most palatable during the spring and in the fall after some snowfall, even though it was dry and brown.

The use of crested wheatgrass as summer pasture (mid-June-September) has been studied at Swift Current. Yearling cattle were grazed on pastures that had previously been used for several years for spring pasture. The grazing period was 108 days in each of 3 years and 1.2 ha was allowed per yearling. The average daily gain per head was 0.83 kg. Cattle gained 0.95 kg/head per day in June, 0.73 kg in July, and 0.86 kg in August and September. The average total gain per animal was 90 kg.

At Webb, Sask., yearling steers grazed crested wheatgrass-alfalfa pastures for 6 years. Three pastures were grazed from mid-May through June. Each pasture was used an average of 42 days per year. Stocking rate

was 0.57 ha/animal unit month (AUM). The pastures were part of an area that had been initially seeded to crested wheatgrass, then plowed and disked, and seeded to crested wheatgrass and creeping-rooted alfalfa 5 years later. Fields were grazed in the following and subsequent years. The three pastures contained different amounts of alfalfa (Table 5). Animal gains were related to the amount of alfalfa the pastures contained. The adequate alfalfa pasture had a 16% alfalfa component derived from seeding alfalfa at 1 kg/ha. Gain per steer averaged 1.00 kg/day. Pasture with a lower component of alfalfa produced less animal gain per day and less animal gain per hectare.

TABLE 5 COMPOSITION OF CRESTED WHEATGRASS–ALFALFA PASTURES AND THE EFFECT OF ALFALFA COMPONENT ON ANIMAL WEIGHT GAIN

	Percent composition[1]			Animal gain, kg	
Pasture description	Crested wheatgrass	Alfalfa	Other species	Mean daily gain	Gain per ha
Adequate alfalfa	73	16	11	1.00	90
Moderate alfalfa	77	7	16	0.95	81
Low alfalfa	85	3	12	0.86	80

[1]From ground cover data.

Nutrition

Crested wheatgrass, like other grasses, declines in feeding value as it approaches maturity, and livestock eat less of it because of lowered palatability. On the basis of recommended nutrient levels, it provides adequate protein and phosphorus for beef cattle during the spring months, provided forage intake is adequate.

In the spring, the leafy growth contains about 20-29% protein and 0.19-0.36% phosphorus. During the shot-blade or heading stage crested wheatgrass contains 14-17% protein and 0.17-0.24% phosphorus. As the plant matures the amounts of protein and phosphorus decline rapidly and, at maturity, the plants contain only 2-8% protein and 0.02-0.14% phosphorus.

Crude protein contents at the leaf and heading stages of growth are above the minimum requirements of 7.5-10% for maintenance or growth of beef cattle. After it has flowered, crested wheatgrass does not meet the nutritional requirements for protein. The decline in phosphorus content is similar. The grass provides sufficient phosphorus for maintenance or rapid growth of beef cattle only at the leaf and heading stages. After it has flowered, the amount of phosphorus in the grass is below the nutritional requirements. Mature cattle require 0.15% phosphorus for maintenance and 0.20% for growth.

USE

Crested wheatgrass can be grazed more heavily than native prairie without reducing its productivity. Grazing to a stubble height of 5 cm allows the use of 70% of the herbage.

To ensure the long-term productivity of forage grasses, a part of the herbage produced must be left over at the end of the grazing season as carry-over. With native prairie, this residue should be 40-50% of the total average annual production and should include about 20% of the seed stalks. Tests at Swift Current showed that crested wheatgrass can, and should, be used more heavily. Grazing to 70% use of the average annual growth, as measured in the first week of July, did not decrease the productivity any more than grazing to 50% use (Table 6). The pasture grazed at 70% use produced an average annual forage yield of 757 kg/ha, whereas that used to 50% was less productive, particularly in dry years, with average annual production of 677 kg/ha.

TABLE 6 TOTAL PRODUCTION AND UTILIZATION OF CRESTED WHEATGRASS AT TWO INTENSITIES OF USE

	Heavy use			Light use		
		Utilization			Utilization	
Year	Production, kg/ha	kg/ha	%	Production, kg/ha	kg/ha	%
1st	640	370	58	650	265	41
2nd	1000	740	74	915	370	40
3rd	875	620	71	840	370	44
4th	825	495	60	600	370	62
5th	600	495	82	570	370	43
6th	600	495	82	485	245	51
Av	757	536	70	677	332	50

Crested wheatgrass ground cover was low before the tests, but increased in the pasture grazed at the 70% use rate (Table 7). This ground cover was a result of fewer but larger individual plants, and the increased productivity is undoubtedly attributable to this.

Height-weight studies have been conducted to determine the relationship between height and weight of herbage. Measurements and weights of many crested wheatgrass plants from numerous sites show that a general relationship exists between height and weight. The bulk of the herbage of

TABLE 7 GROUND COVER OF CRESTED WHEATGRASS AS INFLUENCED BY TWO INTENSITIES OF GRAZING

Species	Ground cover, %				
	Before grazing	70% utilization		50% utilization	
		5th yr	7th yr	5th yr	7th yr
Crested wheatgrass	3.7	8.0	6.7	3.6	3.2
Other grasses	1.0	1.2	0.7	1.0	0.7
Forbs	T	T	T	0.1	0.2
Annual weeds	T	0.2	0.3	0.2	0.6
Total	4.7	9.4	7.7	4.9	4.7

T = trace.

crested wheatgrass is in the lower parts and only a small amount is in the upper half (Fig. 4). The crested wheatgrass plants averaged 45 cm in height. Grazing to a stubble height of 15 cm removed only 40% of their total herbage. Grazing to 5 cm left 30% of the plant herbage uneaten. Removal of 90% of the height resulted in removal of 70% of the herbage.

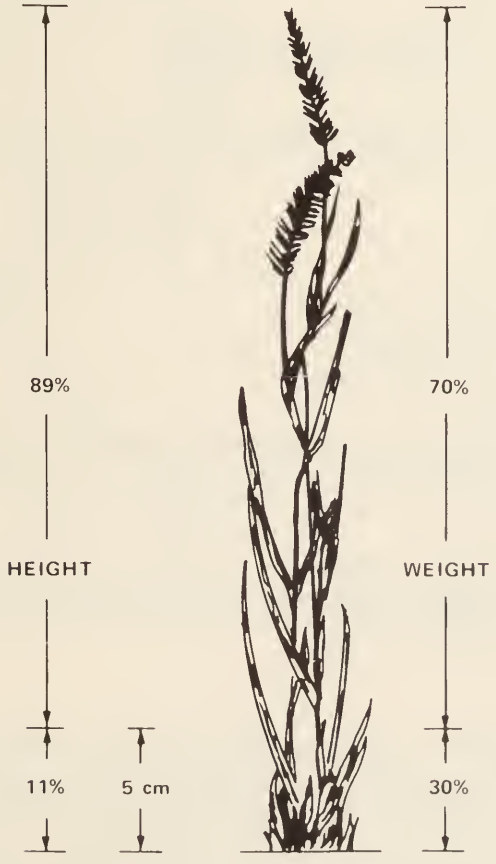

Fig. 4. Height-weight relationship of crested wheatgrass plants.

MANAGEMENT

Crested wheatgrass can be grazed in spring, summer, and fall, but it is most palatable and nutritious in the spring. In late April, May, and June, it is unexcelled as a palatable, nutritious, productive pasture grass. In earliness of spring growth, it is equaled only by Russian wild rye.

Studies at Manyberries show the seasonal preference of sheep for crested wheatgrass and native range. With free-choice feeding, ewes prefer crested wheatgrass before 5 July and after 25 October (Fig. 5).

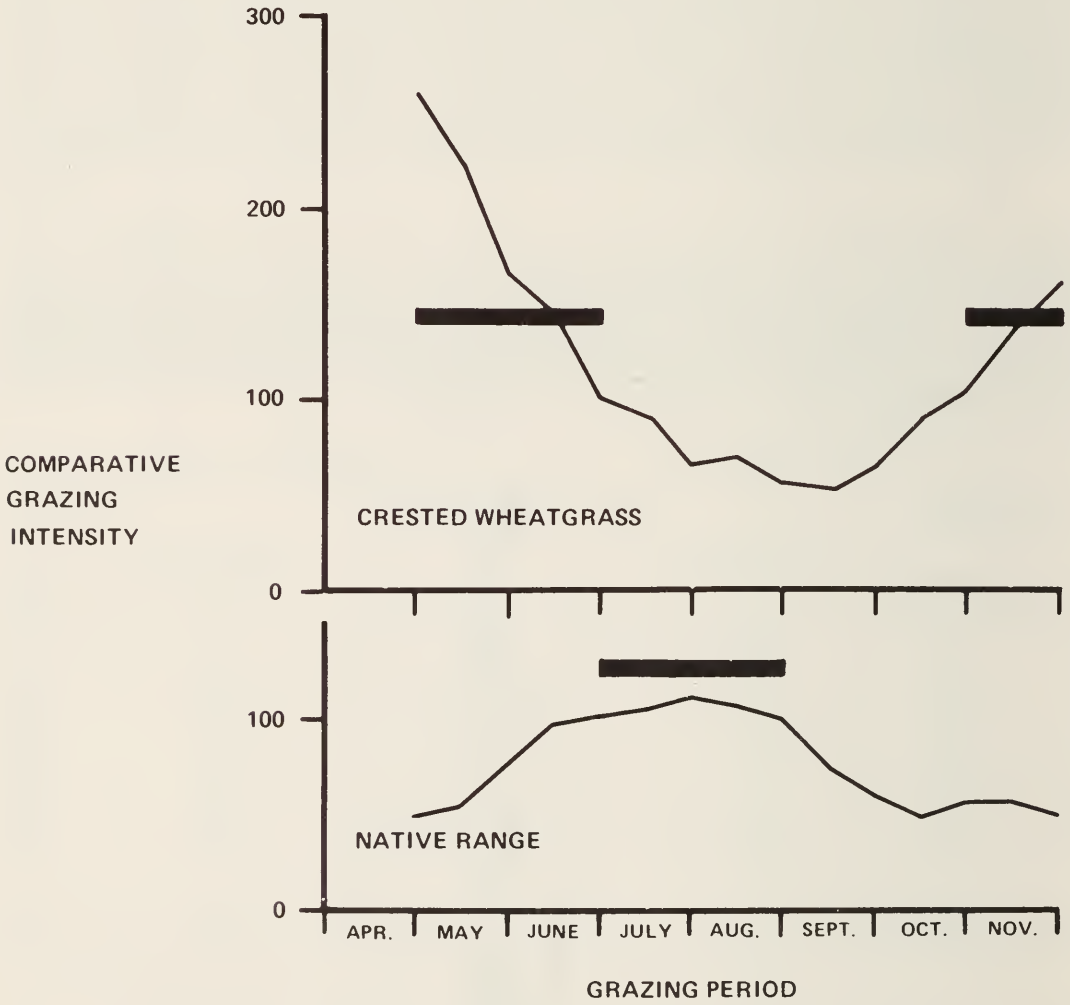

Fig. 5. Comparative grazing intensity, or seasonal preference of ewes for crested wheatgrass and native range. Heavy horizontal bars indicate periods with preference ratings over 100 at Manyberries, Alta.

When given access to crested wheatgrass and native range, cattle prefer crested wheatgrass in early spring. Cattle held on crested wheatgrass in the spring make more use of it during the summer on adjacent crested wheatgrass and native grass pastures than do cattle allowed free-choice all season.

Complementary systems that use a combination of crested wheatgrass and native range pastures are based on a ratio of 1 ha of crested wheatgrass to 4 ha of native range. Thus, three systems are recommended.

System 1: Crested wheatgrass alone grazed May to mid-June; both crested wheatgrass and native range grazed free-choice from mid-June through September.

System 2: Both crested wheatgrass and native range grazed free-choice all season, May through September.

System 3: Crested wheatgrass grazed alone May to mid-June; native range grazed alone from mid-June through September.

These systems were used at Swift Current, and returns in animal weight gain, gain per hectare, and increased stocking rates show that they are more productive than native prairie used alone (Table 8).

TABLE 8 BEEF GAINS PER ANIMAL AND PER HECTARE UNDER COMPLEMENTARY GRAZING SYSTEMS AND ON NATIVE RANGE

	Av stocking rate, ha/AUM	Av annual gain, kg	
		Per animal	Per ha
System 1	0.89	110	39
System 2	0.76	106	43
System 3	0.85	96	39
Native range	1.17	84	22

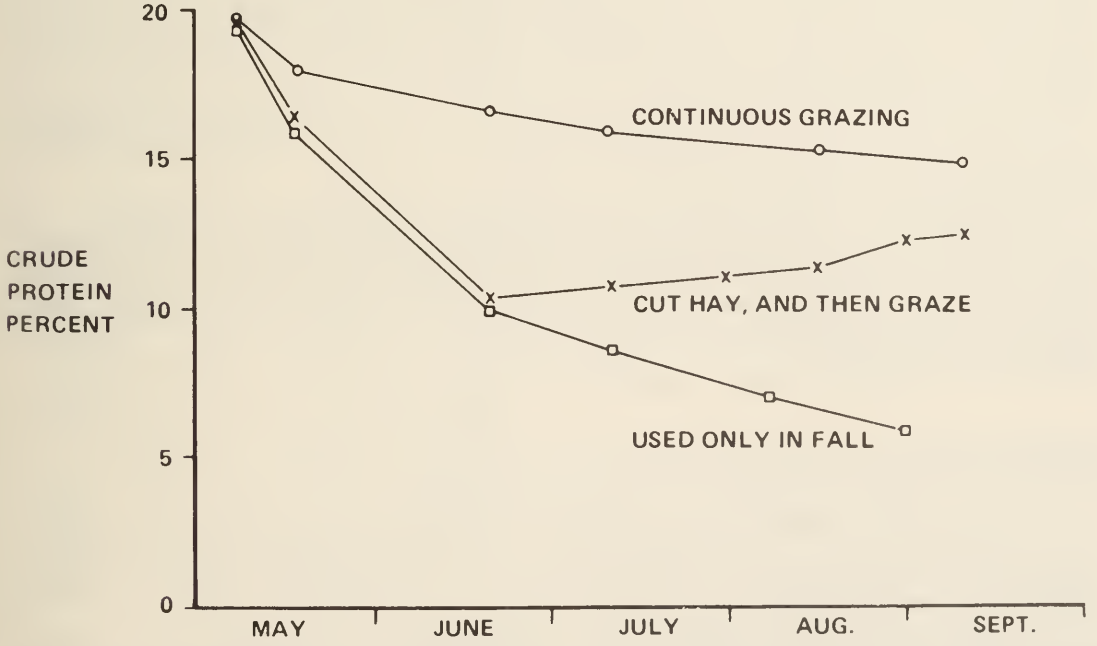

Fig. 6. Percentage of crude protein in crested wheatgrass under three systems of use at Swift Current, Sask.

The first system is more efficient than the other two. Animal gains were not appreciably higher, but after 7 years the vegetation of the native range portion contained more of the valuable forage grasses and was more productive.

Crested wheatgrass can be used as continuous spring-to-fall pasture, especially in areas with favorable moisture conditions. Season-long use of crested wheatgrass pasture results in a continuing higher level of crude protein in the plants than use of crested wheatgrass as pasture only after haying or as fall pasture. As a consequence, its nutritional value is higher (Fig. 6). In the fall, however, use of crested wheatgrass is not usually recommended because animals gain more weight on Russian wild rye.

MAINTAINING PRODUCTIVITY

Renovation of crested wheatgrass

A crested wheatgrass stand that has been grazed for several years may become unproductive (sod-bound). Unproductive stands of crested wheatgrass should be broken up, worked down, and reseeded to a grass-legume mixture. Although breaking and reseeding are more expensive than renovating, they give worthwhile returns in higher yields of high-quality forage. The addition of alfalfa or another legume increases the productive life of the stand.

Various methods of renovating sod-bound stands have been tried. Cultural methods range from a single disk operation through double disk, Noble blade, plowing, and heavy-duty cultivator operations. Any cultural operation usually reduces the numbers of plants, decreases the production of forage, and allows weedy growth to develop the first year after treatment. In following years, increase in forage production is directly related to intensity of cultivation. Eventually production of forage on renovated areas equals that on untreated sites.

Mowing and fall burning are satisfactory treatments for removing old growth accumulated from previous years. Production of forage is not affected, but consumption is increased. Spring burning reduces early use, forage yield, and total consumption.

Fertilization

Unproductive stands of crested wheatgrass can be made more productive through the use of fertilizers. In tests at various research stations, applications of nitrogen at 30-50 kg/ha doubled the yield of crested wheatgrass (Table 9). Applications of nitrogen at 120-250 kg/ha, under some conditions, can triple or even quadruple the yield of forage. Crested wheatgrass showed little response to applications of phosphorus alone.

TABLE 9 CRESTED WHEATGRASS PRODUCTION (kg/ha) 1–5 YEARS AFTER FERTILIZATION, MANYBERRIES, ALTA.

Fertilizer	Years after treatment					Total, kg/ha
	1	2	3	4	5	
Check	270	270	295	410	330	1575
30 P	265	275	310	425	390	1665
30 N	575	345	320	455	415	2110
30 N + 30 P	575	360	325	455	415	2130
60 N	725	420	370	480	440	2435
60 N + 30 P	715	435	350	475	375	2350

However, the addition of phosphorus at 15-50 kg/ha along with the nitrogen increased production of forage a further 10-25%.

Initial and residual responses of crested wheatgrass to fertilizers are related to both seasonal precipitation and temperature. In hot, dry years, plants respond poorly to initial or residual fertilization; the responses are better during cool, wet years. However, if the fertilizer is not used in the year of application, it remains in the soil to increase yields in succeeding years. At Manyberries, an application of fertilizer produced increases in forage yields 5 years after treatment, and at Swift Current, response to nitrogen was evident 10 years after one heavy application. The best way to assess the residual effect of fertilizer is to leave an unfertilized check strip in the pasture. When differences between the fertilized area and the check strip can no longer be detected, it is time to apply fertilizer again.

Control of weeds

Under some conditions, weeds may invade established stands of crested wheatgrass. This often occurs after nitrogen fertilization, and especially after a dry year, when weeds show a great response to the added nitrogen. This weed growth can account for up to 75% of the total yield of the vegetation. Annual weeds are not a serious problem in crested wheatgrass stands; however, perennial weeds, particularly pasture sage, *Artemisia frigida* Willd., are and they should be controlled.

Control is possible through spraying or mowing. Pasture sage; prairie rose, *Rosa* spp.; and western snowberry, *Symphoricarpos occidentalis* Hook., can be controlled with the use of herbicides. Mowing reduces pasture sage, but only temporarily.

In a mixture of alfalfa and grass, weeds can sometimes be controlled by mowing. A light spraying of herbicide in early spring before the alfalfa begins to grow, or in the fall when the alfalfa is dormant, controls biennial and winter annual weeds.

SOIL CHANGES UNDER OLD STANDS OF CRESTED WHEATGRASS

Soils formed under native range vegetation are at equilibrium in composition. This equilibrium soon changes when the soils are cropped. For example, the organic matter content of a wheat-fallow rotation seems to be leveling off, after 60 years, at about 46%, whereas under continuous wheat, the organic matter content was 63% of that of nearby native range. Under crested wheatgrass seeded more than 50 years ago, the organic matter content was 76% of that of adjacent native range.

The estimated energy released from the decomposition of crested wheatgrass root material in the soil was about 66% of that released from roots under native range. The amount of energy generated by burning the root material was similar for crested wheatgrass and native range but the amount of root material available in the top 13 cm of soil was greater under native range than under crested wheatgrass. Therefore, less energy was available to produce stable organic matter and for the biochemical processes related to the quality of soil under crested wheatgrass than under native range.

Bulk density, a measure of soil compaction, was higher under crested wheatgrass, whereas water-stable aggregates, a measure of susceptibility to erosion, were higher under native range. Amounts of nitrogen and total organic carbon were higher on native range than on adjacent crested wheatgrass sites. Both nitrogen and organic carbon are needed for good plant growth.

Although a good root system is essential for the utilization of soil moisture and the uptake of soil nutrients, aboveground vegetative production is equally important, because it provides forage for grazing animals and plant litter for ground cover. On the basis of forage yield and longevity, crested wheatgrass is a useful pasture grass for revegetation in the dry areas of Western Canada.

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CONVERSION FACTORS

Metric units	Approximate conversion factors	Results in:
LINEAR		
millimetre (mm)	x 0.04	inch
centimetre (cm)	x 0.39	inch
metre (m)	x 3.28	feet
kilometre (km)	x 0.62	mile
AREA		
square centimetre (cm^2)	x 0.15	square inch
square metre (m^2)	x 1.2	square yard
square kilometre (km^2)	x 0.39	square mile
hectare (ha)	x 2.5	acres
VOLUME		
cubic centimetre (cm^3)	x 0.06	cubic inch
cubic metre (m^3)	x 35.31	cubic feet
	x 1.31	cubic yard
CAPACITY		
litre (L)	x 0.035	cubic feet
hectolitre (hL)	x 22	gallons
	x 2,5	bushels
WEIGHT		
gram (g)	x 0.04	oz avdp
kilogram (kg)	x 2.2	lb avdp
tonne (t)	x 1.1	short ton
AGRICULTURAL		
litres per hectare (L/ha)	x 0.089	gallons per acre
	x 0.357	quarts per acre
	x 0.71	pints per acre
millilitres per hectare (mL/ha)	x 0.014	fl. oz per acre
tonnes per hectare (t/ha)	x 0.45	tons per acre
kilograms per hectare (kg/ha)	x 0.89	lb per acre
grams per hectare (g/ha)	x 0.014	oz avdp per acre
plants per hectare (plants/ha)	x 0.405	plants per acre