# NUTRIENT CONTENT OF SASKATCHEWAN NATIVE RANGE PLANTS

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**ABSTRACT**
This study reports on the nutrient content and digestibility of five cool-season grasses common in the Mixed-Prairie Ecoregion of Saskatchewan, Canada: (1) green needlegrass (*Stipa viridula* Trin.); (2) needle-and-thread (*Stipa comata* Trin & Rupr.); (3) western porcupinegrass (*Stipa curtiseta* (Hitchc.) Backworth); (4) northern wheatgrass (*Agropyron dasystachyum* (Hook.) Scribn.); and (5) western wheatgrass (*Agropyron smithii* Rydb.). Plant material was collected monthly and analyzed for in-vitro organic matter digestibility ( IVOMD), crude protein (CP), P, Ca, ADF and NDF. All species showed similar intra-seasonal pattern in the various parameters studied and no species x month interactions were found. Differences among species in digestibility and nutrient content were found mainly during the growing season (May-Sept.). In particular, western wheatgrass showed higher IVOMD, CP and P and lower ADF and NDF during that period than the other species. The data suggest the need for supplemental protein and P when grazed during the fall, winter and early spring.

**KEYWORDS**
Mixed Prairie, cool-season grasses, needlegrasses, wheatgrasses, nutrient content, nutritive value, Saskatchewan

**INTRODUCTION**
Livestock and wildlife species grazing native rangelands select their diet from a variety of plant species. These plants may exhibit differences in nutrient content and digestibility. Furthermore, range plants undergo changes in nutrient content and digestibility throughout the year. Because forage quality is a major factor affecting animal performance, knowledge of the nutrient contents and digestibility of range plants is of importance in grazing management decision making. Information on nutrient contents of Saskatchewan rangelands is very sparse and usually covers a short portion of the growing season (Clarke and Tisdale, 1945). This paper is part of a major study documenting the nutrient contents of native range plants of Saskatchewan. In the present paper, we document the nutrient content and digestibility of five common cool-season grasses in the Mixed-Prairie Grassland Ecoregion of Saskatchewan (Harris et al, 1983) and compare the intra-seasonal changes in their nutritive value.

**STUDY AREA AND METHODS**
The study was carried out in the Mixed-Prairie Grassland Ecoregion of Saskatchewan. The climate is semi-arid with an average annual precipitation of 375 mm, of which two-thirds occur during the growing season (May-September) (Harris et al, 1983). Soils are Brown and Dark Brown Chernozemic. Five cool-season grass species were collected monthly in 1995 from normal upland range sites in the region. Precipitation during the year was near or above normal for all sites. Species collected were: (1) green needlegrass (*Stipa viridula* Trin.); (2) needle-and-thread (*Stipa comata* Trin & Rupr.); (3) western porcupinegrass (*Stipa curtiseta* (Hitchc.) Backworth); (4) northern wheatgrass (*Agropyron dasystachyum* (Hook.) Scribn.); and (5) western wheatgrass (*Agropyron smithii* Rydb.). Aboveground parts of each species were collected by clipping random plants near ground level at each of 3 to 5 locations in the region. The material from each location was composited for analysis purposes. An effort was made to remove as much of the old standing material as practical. The material was oven-dried for 48 hours at 70 C and then ground using a Wiley mill before the analysis. All chemical analysis values were calculated on an oven-dry basis. The material was analyzed for in-vitro organic matter digestibility (Troelsen, 1970); crude protein (total Kjeldahl N x 6.25) (AOAC, 1984); phosphorus (Varley, 1966); calcium by the flame atomization method (Hitachie Ltd, 1987); and acid detergent fiber (ADF) and neutral detergent fiber (NDF) as described by Goering and Van Soest, 1970. Data analysis involved analysis of variance and mean comparisons, made using Fisher's Least Significant Difference procedure (Steel and Tories, 1980). Statistical significance was inferred at $P<0.05$. Statistical analysis was carried out using the ANOVA module and the General Linear Model in the Minitab Statistical System (Minitab Inc, 1995).

**RESULTS AND DISCUSSIONS**
**Seasonal Changes**. Pronounced seasonal changes were noted for most parameters studied with the exception of calcium (Ca) and NDF (Tables 1). The pattern was similar among species as judged from the lack of species x month interactions. Organic matter digestibility (IVOMD), protein content (PC) and phosphorus content (P) were highest during May and June. This was expected since those cool-season grasses usually reach maturity some time in July. The above peak was followed by a progressive decline until September when a small increase was noted. This appears to reflect regrowth usually taking place during that relatively moist cool period. The decline continued during the fall and winter months but at slower rate. ADF was lowest during May and June (Table 1). NDF showed similar response, but there were fewer statistically significant differences. No species x month interaction was detected. Ca content showed the least seasonal changes (Table 1). Furthermore, no species x month interactions were found. Ca:P ratio showed a relatively strong seasonal pattern (Table 2). Lowest ratios were observed in May and June, reflecting mainly the high P content during the active growth period. The Ca:P ratio remained high during the fall and winter. The seasonal pattern was similar among species.

**Species Differences**. Species differed in their nutrient content and digestibilty mainly during the growing season (May-Sept.). Western wheatgrass and green needlegrass had higher CP than the other species in May. CP content of western wheatgrass was higher than the other species during the June-Sept. period. P content of western wheatgrass was higher than the other species from May till Sept. but declined in the fall and winter to levels that are similar to or lower than the other species. Western wheatgrass had the highest and northern wheatgrass and western porcupinegrass the lowest IVOMD during May-Sept. The remaining species had intermediate levels. Ca content during the winter, spring and early summer was highest in northern wheatgrass and lowest in western porcupinegrass. Other species had intermediate levels. There were few differences during the remainder of the year. Green needlegrass and northern wheatgrass had the highest and needle-and-thread the lowest Ca:P in late winter and early spring. Fewer differences were noted in the rest of the year. Most of the differences among species in ADF were found in May-Sept. Northern wheatgrass had the highest and western wheatgrass the lowest ADF. Other species had intermediate levels. The main differences among species in NDF were noted in June-Sept., when needle-and-thread had the highest and western wheatgrass the lowest levels. The other species had intermediate levels.

**Nutrient Content in Relation to Livestock Requirements**. The results will be discussed in relation to the animal nutritional requirements guide developed for range livestock by Holechek and Hrbel (1986). The NRC (NRC, 1984) guidelines are adequate for confined animals but may not always be applicable to range animals (Holechek et al, 1989). With the exception of late winter, the digestibility levels found in this study were above or near the 40-45% level suggested as minimal requirements for mature cow maintenance. Lactating cow and growing animal requirements would be met only during the growing season (May-Sept.). CP levels were above or near cow maintenance requirements from April to Oct. for all species (Table 1). The CP levels in most species are adequate for lactating cows during May to July and for growing animals during May-Sept. P content is adequate for cow maintenance from May to Sept., marginal in the fall and deficient in the winter and early spring (Table 1). For most species, the levels of P are inadequate or marginal for lactating cows and growing animals nearly throughout the year. The low P levels in the plants may be a reflection of the low levels of available P in the soils. The soils of the study area developed in glacial material known to be deficient in P (Black, 1968). Ca levels in this study (Table 1) are within tolerable levels (NRC, 1984). The Ca:P ratio ranged mostly from about 1.5:1 to 2.5:1 during May to Sept. Table 2. This is near the range needed for optimum absorption of both minerals (Simesen, 1980). However, the Ca:P ratio during the rest of the year are very high (ranges from about 3:1 to 6:1), suggesting the need for P supplement. The actual quality of the grazing animal diet will likely be higher than reported here. Animal selectivity of plant species and parts would improve digestibility and increase P and CP content. Nonetheless, the data suggest the need for CP and P supplements when rangelands dominated by the above species are grazed in the fall and winter grazing. The data also suggest that lactating cows and growing animals can be supported by these kinds of rangelands without supplement, with the possible exception of P.

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**Table 1**

In-vitro organic matter digestibility (OMD), crude protein (CP) content, phosphorous content (P), Calcium content (Ca), acid detergent fibre (ADF) condentration and neutral detergent fibre concentration for the grass species studied. Values are means and standard deviation in parenthesis.

**1. GREEN NEEDLEGRASS**

| Month | %OMD | %CP | %P | CA(ppm) | ADF | NDF |
|---|---|---|---|---|---|---|
| Jan | 37.14 | 3.83 | 0.057 | 2974 | 45.00 | 75.35 |
| | (1.97) | (1.85) | (0.015) | (894) | (3.60) | (6.30) |
| Feb | 37.51 | 4.79 | 0.070 | 3735 | 40.63 | 68.95 |
| | (2.33) | (1.76) | (0.020) | (199) | (2.14) | (3.03) |
| Mar | 38.62 | 5.30 | 0.070 | 3311 | 40.77 | 69.86 |
| | (1.14) | (1.82) | (0.016) | (574) | (3.14) | (4.12) |
| Apr | 39.99 | 4.81 | 0.064 | 3314 | 41.46 | 69.17 |
| | (2.72) | (0.95) | (0.015) | (412) | (2.44) | (3.41) |
| May | 53.68 | 13.60 | 0.176 | 3224 | 30.72 | 60.53 |
| | (5.44) | (5.35) | (0.067) | (214) | (5.64) | (3.30) |
| Jun | 48.94 | 11.06 | 0.168 | 3111 | 35.16 | 62.81 |
| | (2.78) | (2.85) | (0.050) | (776) | (4.31) | (9.23) |
| Jul | 45.367 | 7.53 | 0.122 | 3305 | 37.07 | 69.09 |
| | (1.15) | (0.99) | (0.031) | (824) | (2.51) | (2.55) |
| Aug | 44.92 | 6.57 | 0.103 | 3414 | 39.90 | 60.78 |
| | (0.92) | (0.46) | (0.022) | (603) | (1.08) | (17.70) |
| Sep | 46.19 | 7.60 | 0.134 | 3459 | 37.67 | 62.25 |
| | (3.88) | (1.86) | (0.038) | (580) | (3.66) | (9.30) |
| Oct | 39.85 | 5.51 | 0.094 | 3373 | 40.51 | 71.01 |
| | (5.49) | (1.57) | (0.039) | (619) | (4.37) | (3.71) |
| Nov | 38.70 | 4.77 | 0.090 | 3233 | 41.39 | 72.97 |
| | (4.78) | (1.10) | (0.028) | (707) | (3.16) | (3.73) |
| Dec | 37.05 | 4.79 | 0.078 | 3350 | 40.39 | 71.17 |
| | (3.97) | (1.44) | (0.010) | (488) | (3.47) | (2.64) |
| F | 9.54** | 6.95** | 4.98** | 0.41ns | 4.59** | 1.98ns |
| $LSD_{0.05}$ | 4.35 | 3.14 | 0.048 | 749 | 4.69 | - |

**2. NEEDLE-AND-THREAD**

| Month | %OMD | %CP | %P | CA(ppm) | ADF | NDF |
|---|---|---|---|---|---|---|
| Jan | 36.82 | 3.94 | 0.090 | 3530 | 41.32 | 70.66 |
| | (3.01) | (1.14) | (0.026) | (836) | (1.73) | (0.98) |
| Feb | 35.68 | 3.75 | 0.090 | 2946 | 40.55 | 71.77 |
| | (1.82) | (1.06) | (0.028) | (542) | (0.39) | (1.76) |
| Mar | 40.90 | 5.56 | 0.105 | 3270 | 39.71 | 68.83 |
| | (1.50) | (0.71) | (0.021) | (708) | (1.49) | (1.52) |
| Apr | 39.89 | 5.62 | 0.093 | 2853 | 40.19 | 68.52 |
| | (1.09) | (0.78) | (0.021) | (522) | (0.60) | (2.25) |
| May | 44.97 | 8.46 | 0.140 | 2873 | 35.53 | 63.26 |
| | (3.64) | (2.15) | (0.017) | (333) | (1.47) | (4.42) |
| Jun | 46.25 | 9.50 | 0.177 | 2832 | 33.69 | 67.33 |
| | (0.92) | (1.08) | (0.042) | (249) | (0.68) | (3.83) |
| Jul | 43.73 | 8.02 | 0.153 | 2898 | 35.74 | 69.61 |
| | (3.68) | (1.98) | (0.046) | (333) | (0.91) | (2.84) |
| Aug | 43.48 | 7.92 | 0.143 | 3261 | 36.20 | 69.84 |
| | (2.85) | (1.35) | (0.017) | (354) | (2.18) | (3.31) |
| Sep | 43.87 | 8.98 | 0.168 | 2856 | 36.17 | 69.90 |
| | (2.52) | (0.49) | (0.033) | (1179) | (1.14) | (2.65) |
| Oct | 39.56 | 6.34 | 0.123 | 3638 | 38.02 | 68.44 |
| | (3.24) | (1.08) | (0.027) | (477) | (3.26) | (1.92) |
| Nov | 39.37 | 5.95 | 0.108 | 4126 | 39.38 | 66.94 |
| | (0.95) | (0.66) | (0.015) | (828) | (1.81) | (4.49) |
| Dec | 39.52 | 5.28 | 0.100 | 3424 | 40.99 | 69.99 |
| | (2.81) | (0.44) | (0.017) | (1029) | (2.46) | (5.42) |
| F | 4.15** | 6.58** | 3.18** | 2.59* | 4.76** | 1.45ns |
| $LSD_{0.05}$ | 3.38 | 1.64 | .039 | 794 | 2.54 | — |

**5. WESTERN WHEATGRASS**

| Month | %OMD | %CP | %P | CA(ppm) | ADF | NDF |
|---|---|---|---|---|---|---|
| Jan | 34.12 | 3.44 | 0.070 | 3072 | 41.63 | 73.65 |
| | (1.01) | (1.50) | (0.033) | (954) | (2.57) | (3.50) |
| Feb | 37.61 | 3.44 | 0.068 | 3025 | 39.05 | 71.79 |
| | (3.47) | (0.73) | (0.017) | (550) | (1.56) | (3.67) |
| Mar | 38.97 | 4.36 | 0.074 | 2782 | 39.11 | 69.97 |
| | (1.24) | (1.04) | (0.029) | (661) | (1.17) | (2.24) |
| Apr | 38.97 | 5.69 | 0.087 | 2903 | 37.47 | 68.61 |
| | (7.11) | (2.52) | (0.038) | (555) | (2.56) | (2.72) |
| May | 57.55 | 15.07 | 0.202 | 2692 | 30.46 | 58.43 |
| | (6.66) | (5.42) | (0.060) | (557) | (4.99) | (5.00) |
| Jun | 53.01 | 13.07 | 0.211 | 3002 | 30.66 | 61.79 |
| | (3.33) | (2.02) | (0.066) | (365) | (2.02) | (2.54) |
| Jul | 49.79 | 11.04 | 0.183 | 3453 | 32.04 | 62.45 |
| | (4.32) | (1.76) | (0.059) | (758) | (1.35) | (1.50) |
| Aug | 48.60 | 9.32 | 0.154 | 3624 | 33.83 | 59.47 |
| | (2.31) | (1.64) | (0.042) | (864) | (1.47) | (5.53) |
| Sep | 52.30 | 11.05 | 0.192 | 3959 | 32.59 | 59.27 |
| | (6.73) | (4.36) | (0.084) | (1164) | (3.08) | (6.09) |
| Oct | 41.96 | 5.82 | 0.104 | 3851 | 36.37 | 67.51 |
| | (7.81) | (2.70) | (0.053) | (1429) | (4.78) | (7.22) |
| Nov | 42.34 | 4.91 | 0.083 | 3656 | 38.14 | 70.36 |
| | (5.69) | (1.56) | (0.037) | (1237) | (2.69) | (4.96) |
| Dec | 38.18 | 5.74 | 0.097 | 3648 | 38.65 | 70.97 |
| | (2.30) | (0.97) | (0.024) | (962) | (1.68) | (3.05) |
| F | 11.1** | 10.9** | 6.26** | 1.82ns | 7.65** | 7.12** |
| $LSD_{0.05}$ | 5.12 | 2.57 | 0.037 | 466 | 3.23 | 5.74 |

**3. WESTERN PORCUPINE GRASS**

| Month | %OMD | %CP | %P | CA(ppm) | ADF | NDF |
|---|---|---|---|---|---|---|
| Jan | 36.90 | 4.21 | 0.080 | 2982 | 42.32 | 71.50 |
| | (3.95) | (1.70) | (0.026) | (658) | (3.75) | (4.08) |
| Feb | 36.43 | 4.13 | 0.068 | 2811 | 41.79 | 70.93 |
| | (2.40) | (0.87) | (0.096) | (215) | (1.52) | (1.75) |
| Mar | 36.27 | 4.84 | 0.076 | 2974 | 41.01 | 69.17 |
| | (1.10) | (0.79) | (0.011) | (433) | (1.76) | (2.41) |
| Apr | 37.80 | 4.46 | 0.070 | 2636 | 40.82 | 69.64 |
| | (1.94) | (1.09) | (0.022) | (448) | (1.71) | (2.84) |
| May | 46.92 | 11.57 | 0.166 | 2594 | 33.25 | 64.62 |
| | (10.44) | (5.61) | (0.075) | (239) | (5.58) | (4.04) |
| Jun | 44.90 | 9.40 | 0.150 | 2372 | 35.93 | 68.18 |
| | (4.35) | (1.80) | (0.034) | (342) | (0.74) | (2.70) |
| Jul | 43.73 | 8.74 | 0.140 | 2327 | 37.46 | 68.75 |
| | (3.73) | (1.06) | (0.010) | (195) | (1.43) | (1.05) |
| Aug | 42.32 | 7.55 | 0.122 | 2885 | 38.40 | 63.08 |
| | (1.21) | (0.57) | (0.011) | (153) | (0.94) | (12.91) |
| Sep | 43.09 | 7.18 | 0.126 | 3340 | 38.04 | 64.32 |
| | (3.03) | (1.28) | (0.031) | (729) | (1.76) | (5.66) |
| Oct | 35.14 | 5.25 | 0.086 | 3224 | 40.51 | 70.10 |
| | (3.45) | (1.28) | (0.016) | (317) | (2.19) | (3.75) |
| Nov | 35.33 | 4.80 | 0.080 | 3053 | 41.70 | 72.21 |
| | (3.53) | (1.03) | (0.009) | (415) | (3.09) | (4.05) |
| Dec | 36.49 | 4.85 | 0.079 | 3066 | 41.03 | 69.81 |
| | (3.55) | (1.04) | (0.020) | (623) | (2.53) | (3.77) |
| F | 3.9** | 6.4** | 6.13** | 3.63** | 5.66** | 1.64ns |
| $LSD_{0.05}$ | 5.12 | 2.57 | 0.037 | 466 | 3.23 | 5.74 |

**4. NORTHERN WHEATGRASS**

| Month | %OMD | %CP | %P | CA(ppm) | ADF | NDF |
|---|---|---|---|---|---|---|
| Jan | 38.04 | 5.19 | 0.088 | 4191 | 41.37 | 67.17 |
| | (3.98) | (1.68) | (0.027) | (499) | (1.91) | (2.86) |
| Feb | 35.23 | 4.79 | 0.077 | 3780 | 41.57 | 70.36 |
| | (0.63) | (1.66) | (0.015) | (614) | (0.39) | (1.93) |
| Mar | 39.49 | 5.88 | 0.083 | 3943 | 40.73 | 68.27 |
| | (2.12) | (1.64) | (0.021) | (657) | (2.14) | (2.83) |
| Apr | 38.87 | 5.90 | 0.087 | 3541 | 41.24 | 69.61 |
| | (0.80) | (2.04) | (0.023) | (580) | (0.84) | (1.07) |
| May | 41.08 | 7.79 | 0.127 | 3296 | 39.12 | 64.42 |
| | (2.87) | (1.36) | (0.006) | (169) | (1.81) | (2.72) |
| Jun | 46.15 | 10.96 | 0.150 | 3317 | 36.91 | 63.61 |
| | (4.26) | (3.66) | (0.026) | (270) | (1.95) | (1.03) |
| Jul | 41.87 | 7.81 | 0.137 | 3336 | 40.12 | 67.79 |
| | (1.09) | (1.70) | (0.006) | (448) | (0.73) | (1.14) |
| Aug | 41.46 | 7.79 | 0.117 | 3420 | 41.37 | 69.31 |
| | (2.50) | (2.60) | (0.015) | (158) | (1.15) | (1.69) |
| Sep | 43.72 | 7.52 | 0.123 | 3853 | 40.49 | 64.35 |
| | (2.11) | (2.18) | (0.025) | (413) | (0.16) | (1.26) |
| Oct | 38.56 | 6.43 | 0.093 | 4200 | 40.59 | 68.25 |
| | (3.64) | (2.44) | (0.023) | (796) | (2.33) | (4.24) |
| Nov | 38.26 | 6.39 | 0.093 | 3803 | 41.28 | 68.20 |
| | (1.91) | (1.95) | (0.025) | (643) | (1.54) | (1.61) |
| Dec | 39.17 | 6.76 | 0.100 | 4063 | 39.94 | 66.84 |
| | (4.86) | (2.28) | (0.034) | (536) | (2.48) | (3.54) |
| F | 4.01** | 1.75ns | 3.28** | 1.4ns | 1.94ns | 3.1** |
| $LSD_{0.05}$ | 3.7 | — | 0.032 | — | — | 3.24 |

**Table 2**. Mean and standard deviation (in parenthesis) of Ca:P ratio for the five grass species studied.

| Month | Green Needlegrass | Needle and Thread | Western Porcupine Grass | Northern Wheatgrass | Western Wheatgrass |
|---|---|---|---|---|---|
| Jan | 5.38 | 3.98 | 4.17 | 5.90 | 4.83 |
| | (1.46) | (0.31) | (0.81) | (2.86) | (1.50) |
| Feb | 5.63 | 3.34 | 4.21 | 5.19 | 4.55 |
| | (1.64) | (0.45) | (0.46) | (1.97) | (0.46) |
| Mar | 4.80 | 3.11 | 3.96 | 5.00 | 3.93 |
| | (0.51) | (0.05) | (0.63) | (1.80) | (0.69) |
| Apr | 5.38 | 3.09 | 4.12 | 4.40 | 3.80 |
| | (1.22) | (0.38) | (1.55) | (1.83) | (1.64) |
| May | 2.13 | 2.05 | 1.86 | 2.60 | 1.52 |
| | (0.93) | (0.09) | (0.80) | (0.09) | (0.76) |
| Jun | 2.03 | 1.69 | 1.67 | 2.25 | 1.61 |
| | (0.87) | (0.57) | (0.51) | (0.38) | (0.77) |
| Jul | 2.95 | 2.14 | 1.68 | 2.45 | 2.08 |
| | (1.32) | (1.07) | (0.24) | (0.40) | (0.91) |
| Aug | 3.43 | 2.31 | 2.37 | 2.99 | 2.56 |
| | (0.85) | (0.38) | (0.15) | (0.55) | (1.16) |
| Sep | 2.76 | 1.82 | 2.71 | 3.25 | 2.40 |
| | (0.91) | (0.86) | (0.56) | (0.99) | (1.22) |
| Oct | 3.51 | 2.87 | 3.74 | 4.12 | 3.68 |
| | (1.23) | (0.75) | (0.97) | (1.91) | (1.48) |
| Nov | 3.31 | 4.43 | 4.04 | 4.20 | 4.44 |
| | (1.17) | (0.56) | (0.65) | (1.87) | (1.27) |
| Dec | 3.44 | 4.33 | 3.73 | 3.47 | 3.57 |
| | (0.14) | (0.63) | (0.92) | (1.26) | (1.30) |
| F | 5.94** | 6.02** | 8.81** | 1.67ns | 6.54** |
| $LSD_{0.05}$ | 1.33 | 0.95 | 0.87 | — | 1.19 |