Comparative Forage Yield and Species Composition of "Poor" Versus "Good" Condition Grass Stands under Different Soil Fertility Regimes in Northeastern Saskatchewan

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RATIONALE

- In the Prairie Provinces of Canada, most soils are deficient/low in plant-available N and P.
- In the Parkland region, many soils also contain insufficient amounts of plant-available S, and some soils contain insufficient amounts of available K for high crop yields.
- When soils are lacking in one or more nutrients, plant growth is reduced, resulting in low crop yields. Therefore, application of fertilizers is essential to obtain optimum yield.
- In a field survey, we observed "Poor" and "Good" condition grass areas occurring in the same field on pastureland at Pathlow, Saskatchewan. There were large differences in grass growth between the "Poor" and "Good" condition areas.
- The site has been grazed for more than 30 years. Over the years, this may have created "Poor" condition areas of the field possibly due to overgrazing and "Good" condition areas within the same field. These spatial differences may be due to preferential grazing or differences in soil types across the area.
- However, it was not exactly known whether the poor grass growth in the "Poor" condition areas was due to lack of soil fertility/nutrients, low organic matter, or over grazing resulting in thin stands, change in forage composition and increased soil compaction.
- Also, information was lacking on the suitable techniques that can be used to improve the forage yield in these "Poor" condition areas.

OBJECTIVE

- To find if low forage yields in "Poor" condition areas are due to nutrient deficiencies or some other soil properties and species composition, and to determine comparative forage dry matter yield (DMY), protein concentration (PC), protein yield (PY) and species composition of "Poor"

versus “Good” condition grass stands under different soil fertility regimes on a Gray Luvisol soil at Pathlow in northeastern Saskatchewan.

MATERIALS AND METHODS

- Field experiment was conducted over two years from 2004 to 2005 on a Gray Luvisol soil at Pathlow in northeastern Saskatchewan.
- For this area, the long-term mean annual and growing season (May, June, July, August and September) precipitation is 410 mm and 284 mm, respectively. Precipitation during the growing season was 342 mm in 2004 and 472 mm in 2005, above the long-term average in both years, especially in 2005.
- A 2 x 4 (8-treatment) factorial (two stand conditions x four fertility levels) field experiment with four replications was conducted over two years in 2004 and 2005. Each plot was 2 m x 8 m in size.
- Two stand conditions were “Poor” and “Good”.
- The four annual fertilizer treatments were:
  - ✔ No fertilizer (Nil)
  - ✔ 45 kg N + 10 kg P + 12.5 kg K + 5 kg S ha^{-1}
  - ✔ 90 kg N + 20 kg P + 25.0 kg K + 10 kg S ha^{-1}
  - ✔ 135 kg N + 30 kg P + 37.5 kg K + 15 kg S ha^{-1}
- The fertilizer sources were ammonium nitrate for N, triple superphosphate for P, and potassium sulphate for K and S.
- The fertilizers were broadcast on the surface every year in mid to late April.
- Grass was harvested twice (cut 1 in early July and cut 2 in late September) in each growing season and DMY determined after drying at $55^{o}C$
- Representative forage samples were analyzed for total N to determine PC (total N concentration x 6.25 = PC) and protein yield (PY).

SUMMARY OF RESULTS

- Soil (0-30 cm) in “Good” areas had loam texture, pH 7.1, 9 mg NO_3-N kg^{-1}, 7 mg extractable P kg^{-1}, 694 mg exchangeable K kg^{-1} and 25 mg SO_4-S kg^{-1}. In “Poor” areas, soil had clay loam texture, pH 7.1, 6 mg NO_3-N kg^{-1}, 3 mg extractable P kg^{-1}, 477 mg exchangeable K kg^{-1} and 22 mg SO_4-S kg^{-1}.
- The dominant grasses were smooth bromegrass (*Bromus inermis* Leyss.), and fine grasses mainly creeping red fescue (*Festuca rubra var rubra*) and Kentucky bluegrass (*Poa pratensis* L.).

- In early July 2004, “Good” and “Poor” stands averaged 77% and 24% smooth brome, 9% and 36% fine grass, and 14% and 40% other species by weight, respectively. The corresponding values in early July 2006 after two annual fertilizer applications were 66% and 20% smooth brome, 23% and 70% fine grass, and 11% and 7% other species.
- Total DMY and PY were greater in “Good” than in “Poor” condition grass stands, but the DMY and PY increases from applied N, P, K and S fertilizers blends were greater in “Poor” than in “Good” grass stands.
- The PC was higher in “Poor” than in “Good” condition grass stands in cut 1, but it was higher in “Good” than in “Poor” condition grass stands for cut 2.

CONCLUSIONS

- Lower forage yields in “Poor” compared to “Good” grass stands were most likely due to differences in soil fertility, although other factors such as soil compaction and texture, and plant species composition may have also contributed to lower DMY.
- The results indicate that “Poor” areas can be rejuvenated and forage yields and quality can be improved considerably by applying fertilizer nutrients that are lacking in the soil.
- Also, the significant responses observed in the “good” areas suggest that these regions of the field can benefit from fertilization as well.
- The findings also suggest that fertilizer dollars are best utilized to improve forage yield in both “Poor” and “Good” grass stand areas.

ACKNOWLEDGEMENTS

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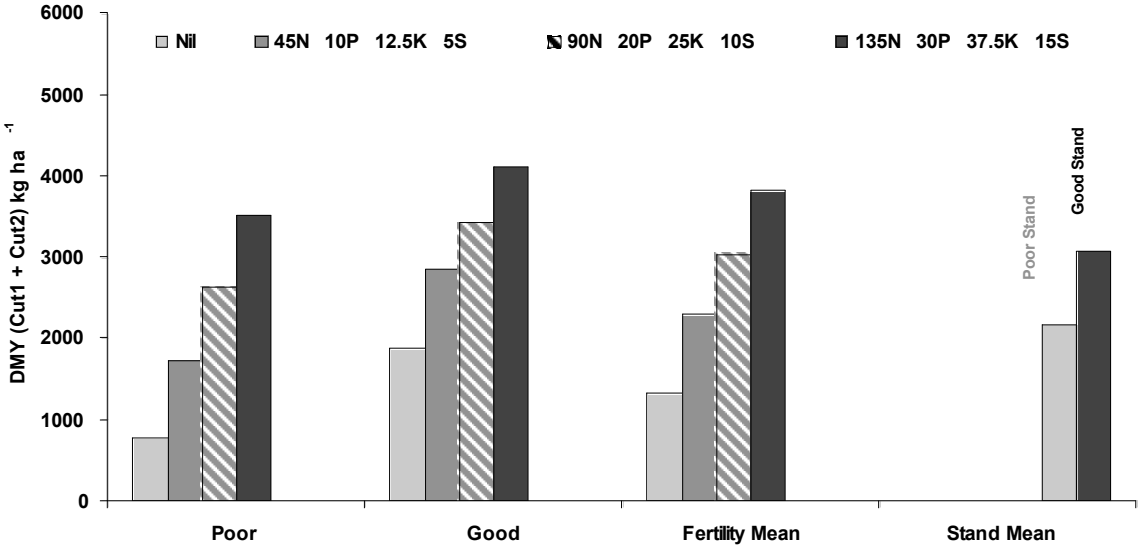

Figure 1. Dry matter yield (DMY) of forage in "Poor" and "Good" condition grass stands with different rates of N, P, K and S fertilizers blends at Pathlow, Saskatchewan in **2004**.

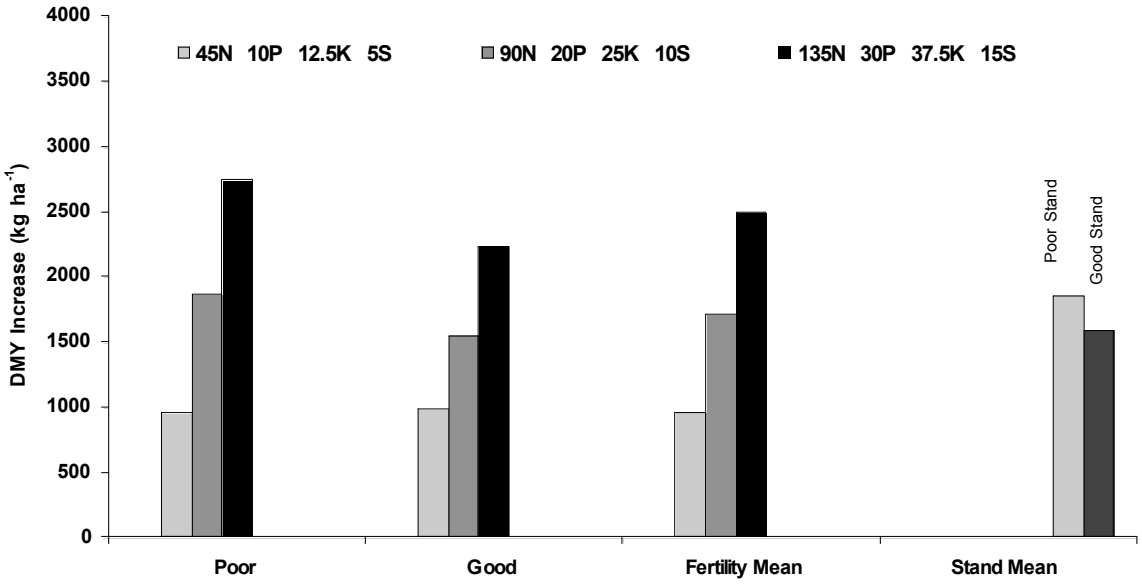

Figure 2. Dry matter yield (DMY) **increase** of forage in "Poor" and "Good" condition grass stands with different rates of N, P, K and S fertilizers blends at Pathlow, Saskatchewan in **2004**.

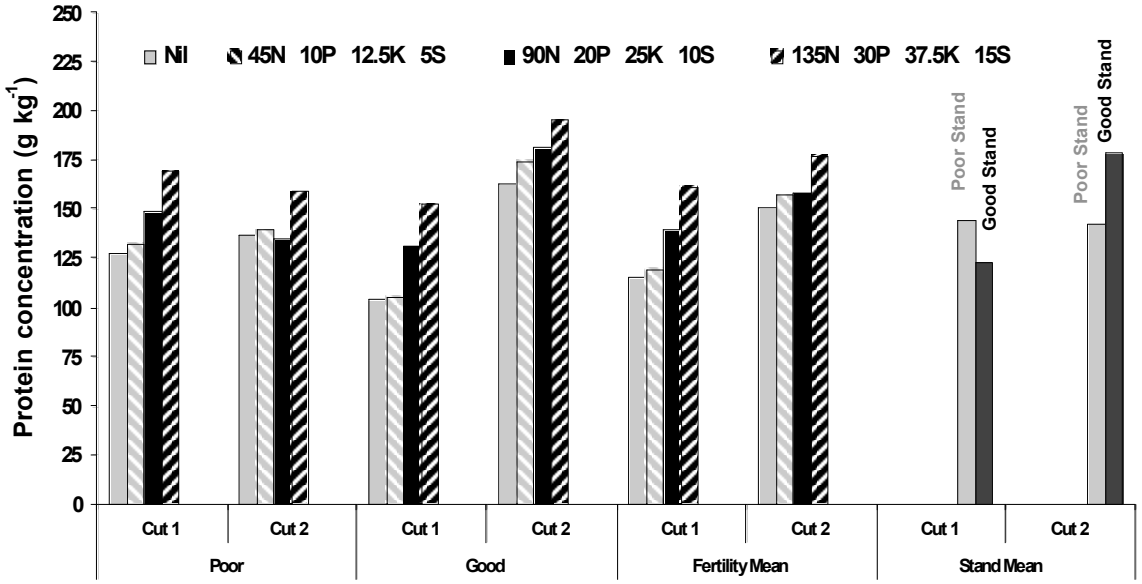

Figure 3. Protein concentration (PC) in first and second cuts of forage in "Poor" and "Good" condition grass stands with different rates of N, P, K and S fertilizers blends at Pathlow, Saskatchewan in **2004**.

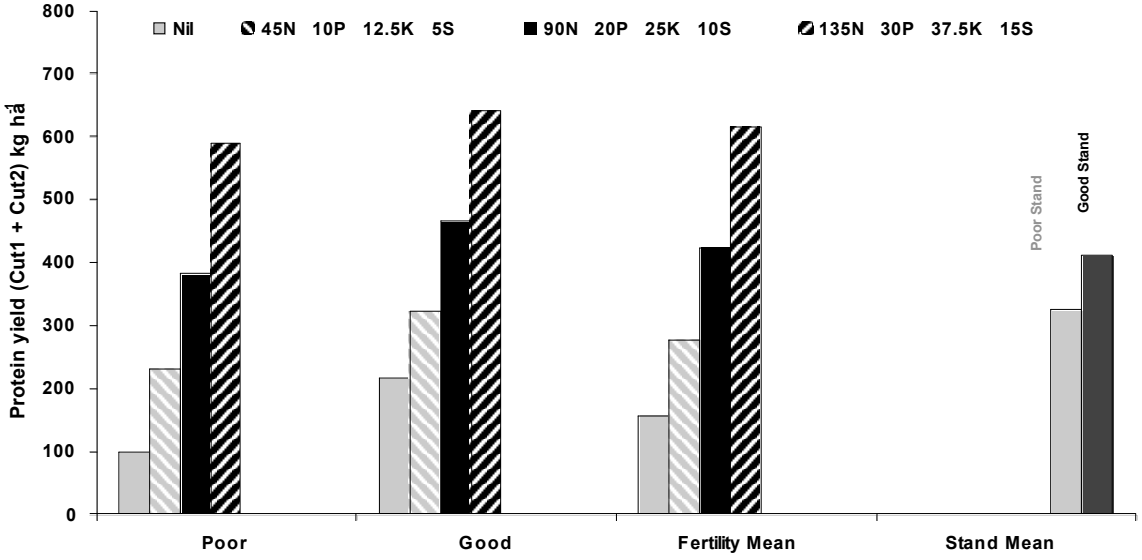

Figure 4. Protein yield (PY) in forage in "Poor" and "Good" condition grass stands with different rates of N, P, K and S fertilizers blends at Pathlow, Saskatchewan in **2004**.

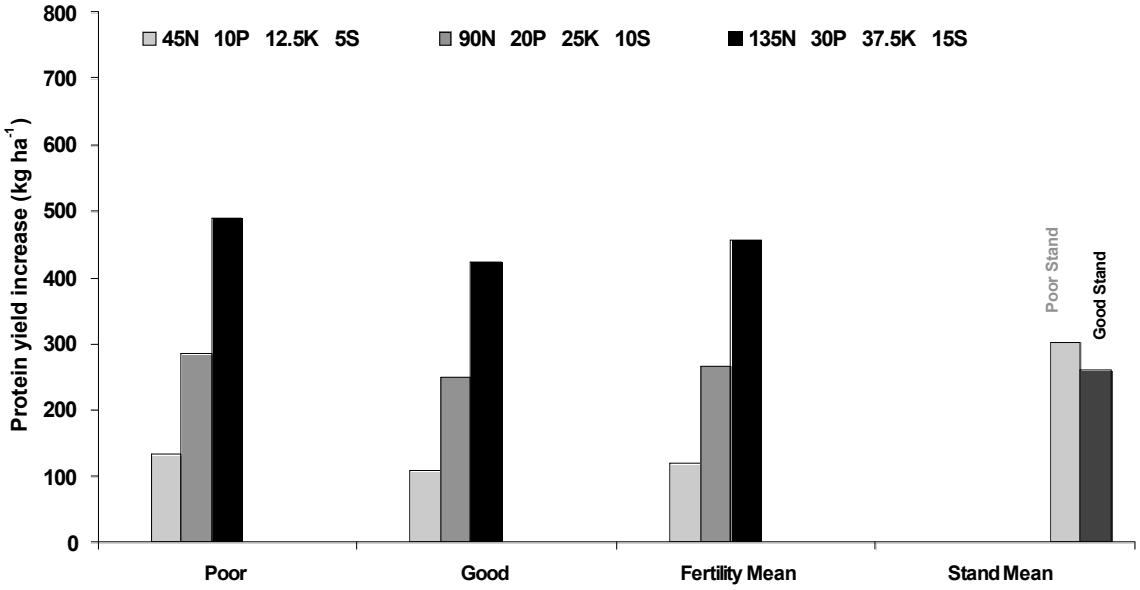

Figure 5. Protein yield (PY) increase in forage in "Poor" and "Good" condition grass stands with different rates of N, P, K and S fertilizers blends at Pathlow, Saskatchewan in **2004**.

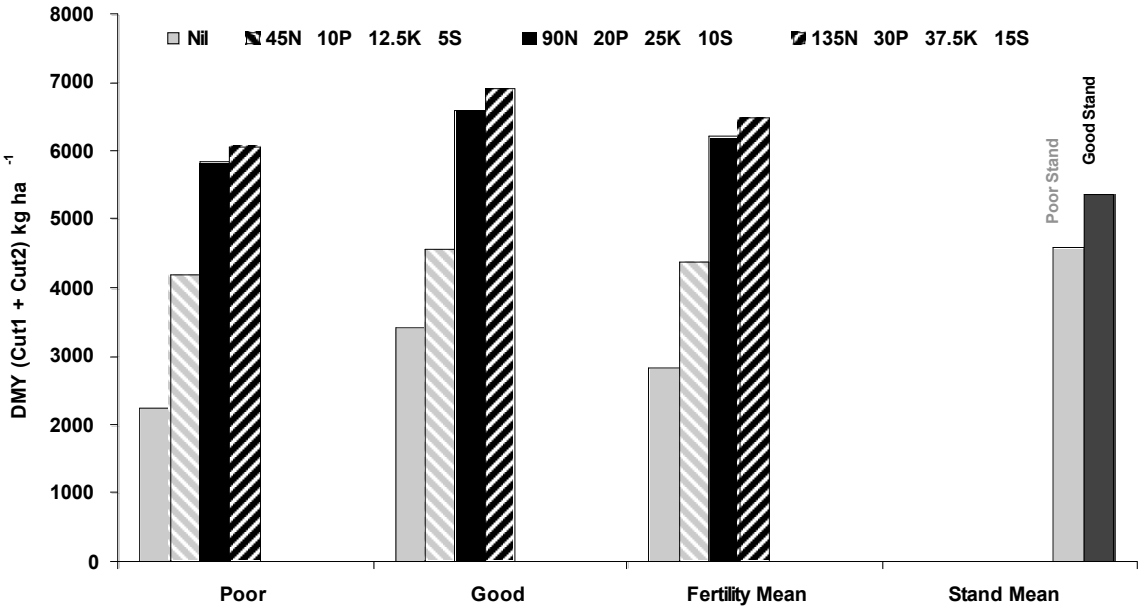

Figure 6. Dry matter yield (DMY) of forage in "Poor" and "Good" condition grass stands with different rates of N, P, K and S fertilizers blends at Pathlow, Saskatchewan in **2005**.

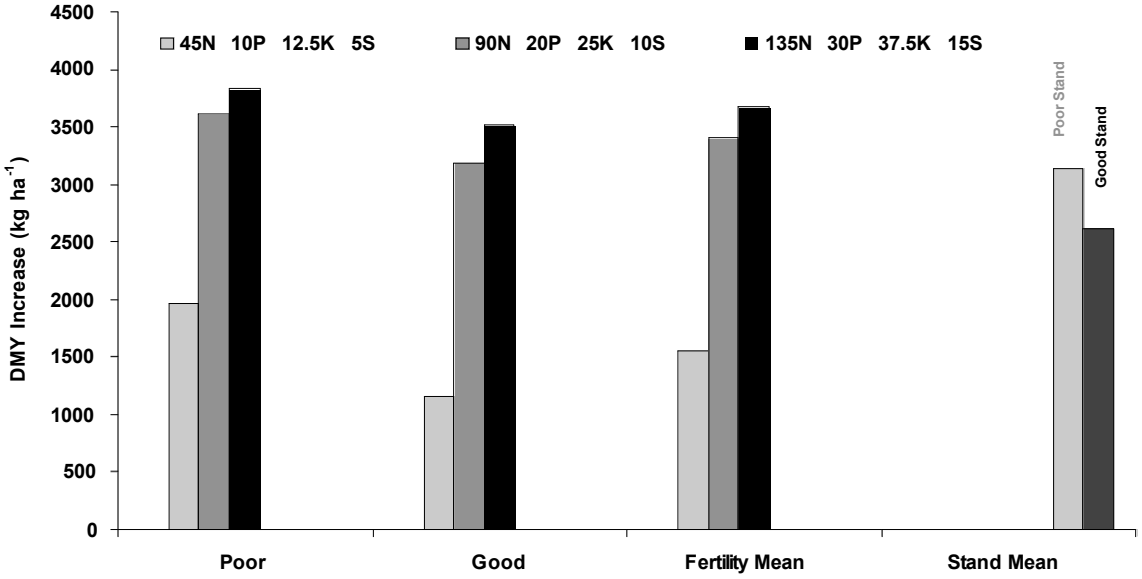

Figure 7. Dry matter yield (DMY) increase of forage in "Poor" and "Good" condition grass stands with different rates of N, P, K and S fertilizers blends at Pathlow, Saskatchewan in **2005**.

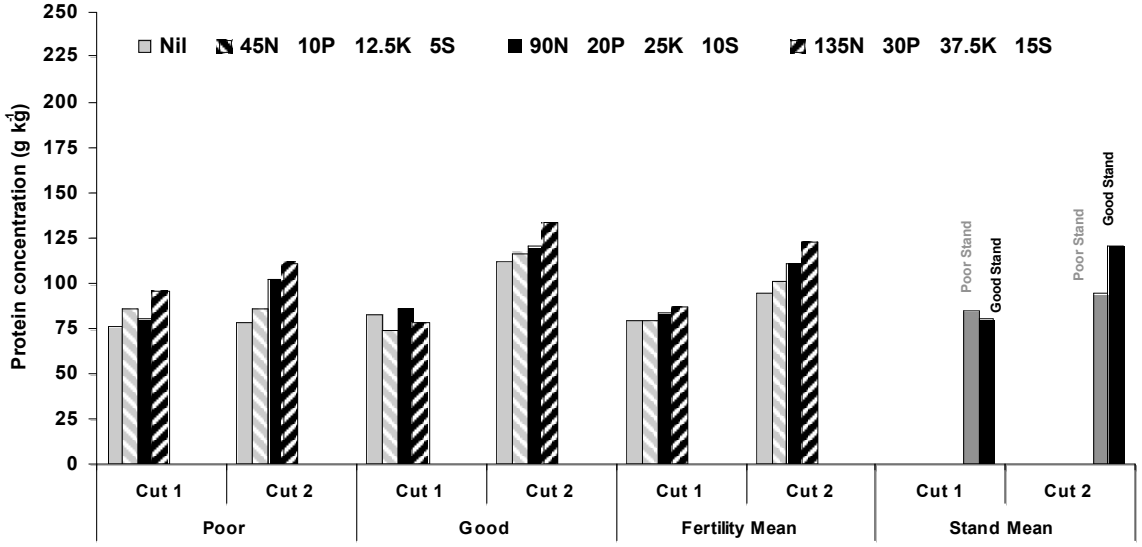

Figure 8. Protein concentration (PC) in first and second cuts of forage in "Poor" and "Good" condition grass stands with different rates of N, P, K and S fertilizers blends at Pathlow, Saskatchewan in **2005**.

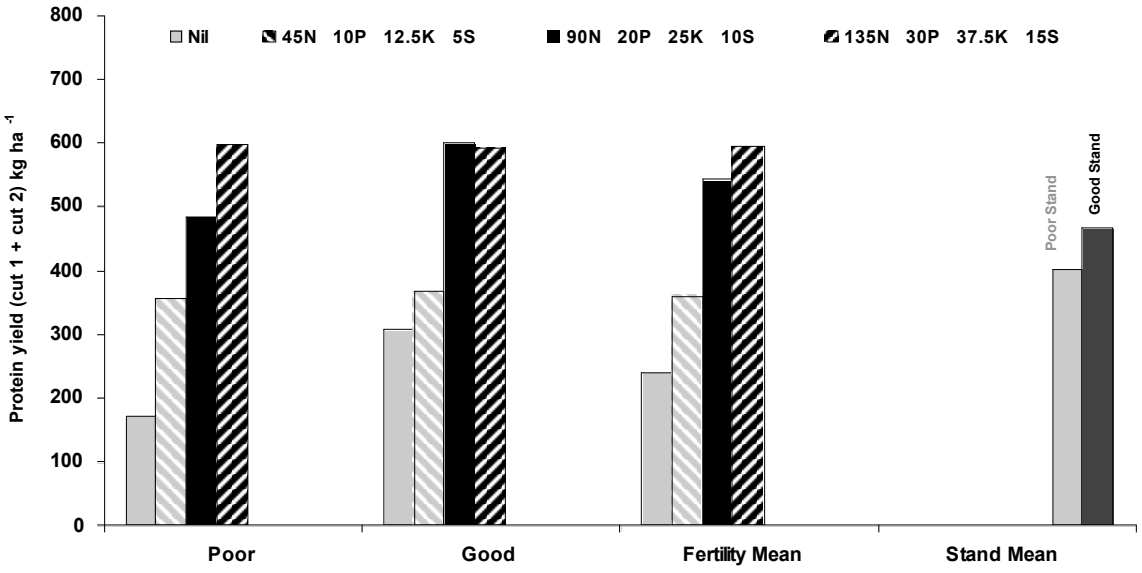

Figure 9. Protein yield (PY) in forage in "Poor" and "Good" condition grass stands with different rates of N, P, K and S fertilizers blends at Pathlow, Saskatchewan in **2005**.

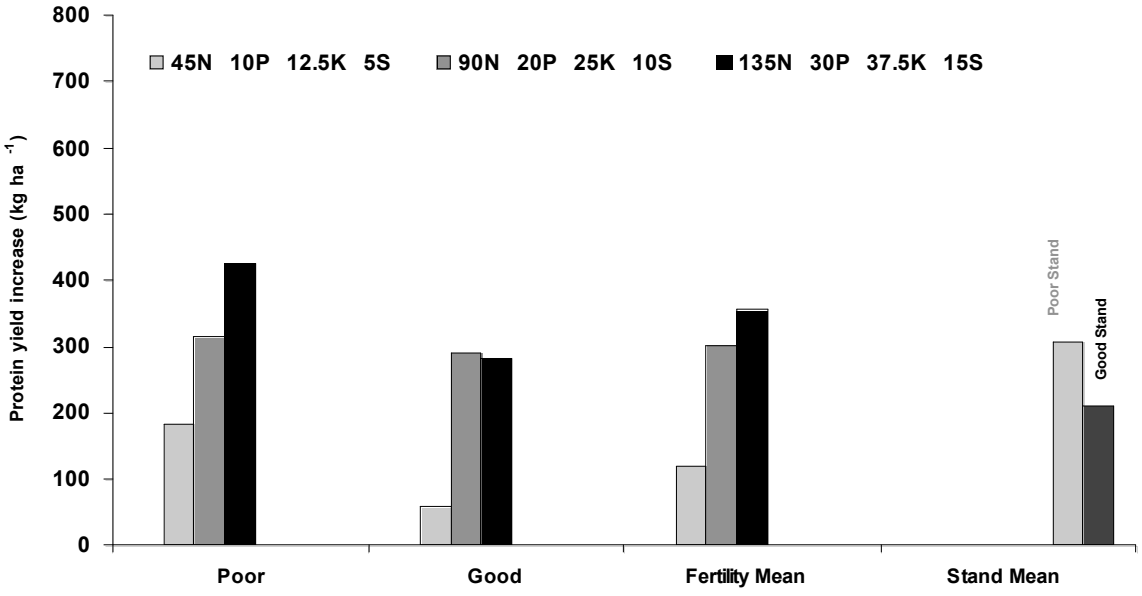

Figure 10. Protein yield (PY) **increase** in forage in "Poor" and "Good" condition grass stands with different rates of N, P, K and S fertilizers blends at Pathlow, Saskatchewan in **2005**.

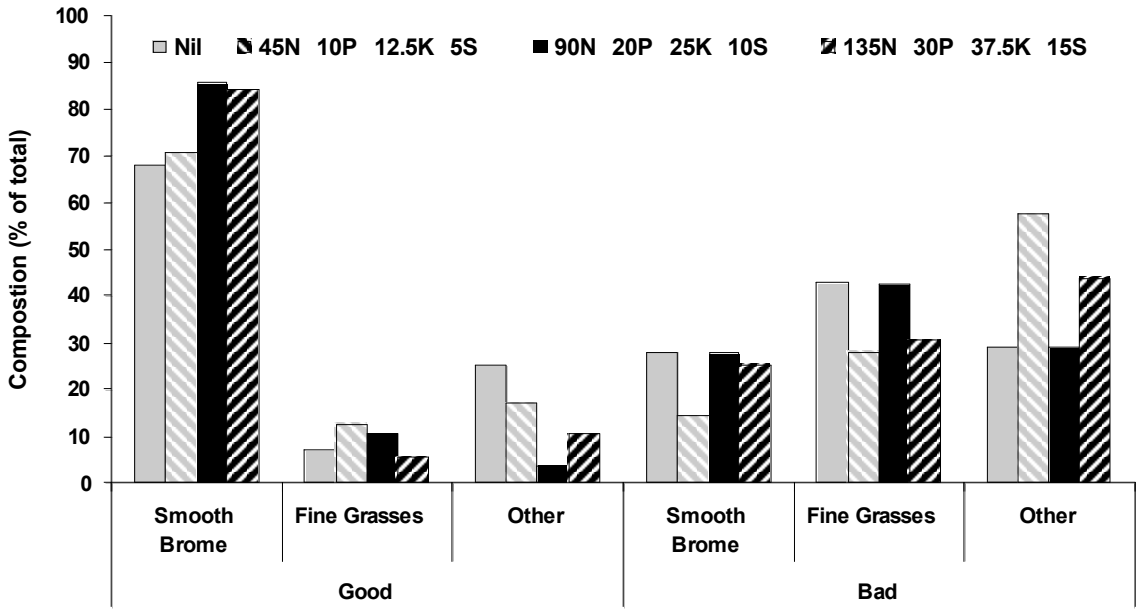

Figure 11. Plant composition in "Poor" and "Good" condition grass stands with different rates of N, P, K and S fertilizers blends at Pathlow, Saskatchewan in early July **2004**.

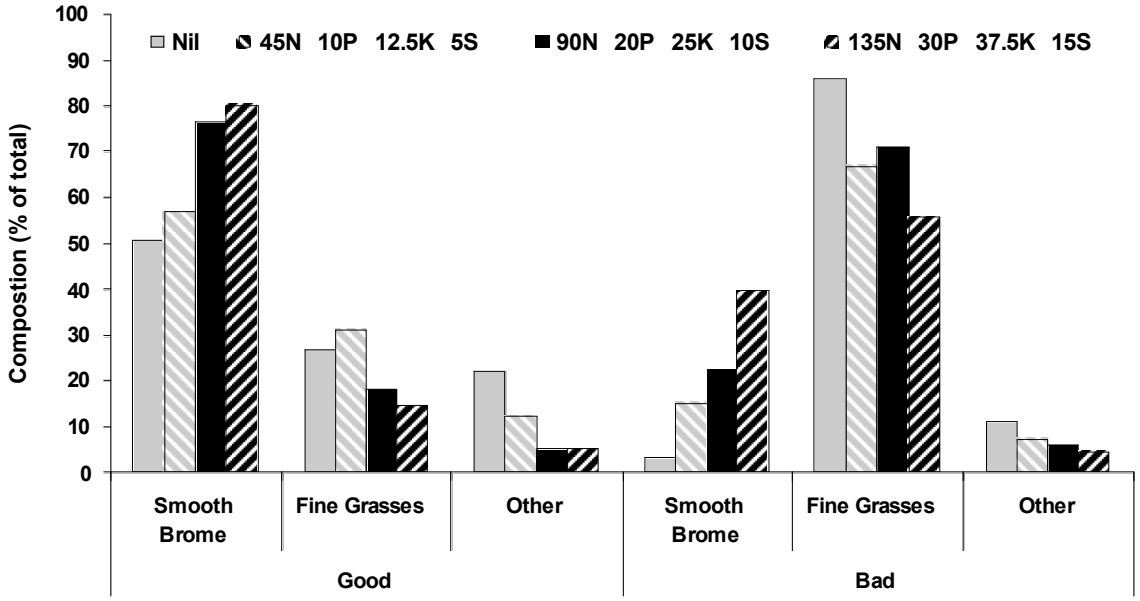

Figure 12. Plant composition in "Poor" and "Good" condition grass stands with different rates of N, P, K and S fertilizers blends at Pathlow, Saskatchewan in early July **2006**.