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Summary with Implications
A pooled-analysis of previous Nebraska Beef Report Articles examined the impact of rumen undegradable protein (RUP) supplementation for cattle grazing different types of forage. Each lb of RUP supplement increased ADG by 0.63 lb/d when cattle were grazing smooth brome and 0.43 lb/d when grazing warm season grasses. Cattle did not respond to RUP when grazing summer annuals which were high (18.2%) in CP.

Introduction
Forages have been widely used to background cattle before entering the feedlot. The energy content of the grass determines the potential cattle gains but protein content of the grass may also limit performance. Although grass can be relatively high in protein, the protein is almost all rumen undegradable protein (RUP) which means that it provides very little rumen degradable protein (RDP). The low level of RUP supplied from grass leads to less metabolizable protein (MP) for the animal to use and MP requirements are high for growing cattle.

There is a cost to supplementation of RUP and understanding how to maximize gains with minimal RUP supplementation on different types of forage is important. There can be confusion on how much supplement is needed across the growing season because CP content of the forage changes as the forage matures and cattle are selective grazers which can influence the total amount of CP consumed. This pooled analysis was done to determine the gain response to RUP supplementation while cattle are grazing a variety of different grasses.

Procedure
Data were collected from 10 previous studies that were published in the Nebraska Beef Cattle Reports ranging from 1987–1991. These 10 studies included 458 steers and 210 heifers grazing a variety of grasses. Crude protein of the forages varied from 10.4–21.7% and was measured in diet samples collected over the grazing period from cannulated steers. This method of forage analysis helps mitigate the risk of using an incorrect figure due to selective grazing. Two studies with bromegrass pastures did not measure CP content using diet samples. The RUP supplement came from a variety of sources (blood meal, corn gluten meal, Soy-Pass, feather meal) and ranged from 0–0.562 lb RUP per head daily. All studies included a control that provided an energy supplement with no RUP. Also each supplemental RUP treatment was formulated to have equivalent energy as the control to ensure that any response in ADG was due to RUP and not energy. In order to compare the response across trials, ADG was regressed above the ADG of the control treatment. This allowed the trials to be compared based on the additional ADG the cattle gained from the RUP supplementation.

Studies were divided into three types of forage being grazed. Within this analysis five studies evaluated cattle grazing brome grass, three studies evaluated cattle grazing warm season grass, and two studies evaluated cattle grazing summer annuals. The goal was to determine if type of forage affected ADG response to increasing RUP supplementation. Another goal was to determine if CP content of the grass affected the response to RUP supplementation. The hypothesis was that grass with lower CP would have a greater response to RUP supplementation. Considerable research has been conducted to determine the RUP content of common forages grazed in Nebraska. However, those procedures assume that soluble protein in the forage is rapidly and completely degraded in the rumen.

Results
Looking into the correlation between ADG and amount of RUP supplement relative to type of forage, warm season grasses had the strongest correlation (r²=0.79) and showed an increase of 0.43 lb in ADG for each 1 lb increase in RUP supplementation. Cattle grazing bromegrass showed a similar trend (P = 0.93) with 0.63 lb ADG increase with each additional lb of RUP supplementation, however, the correlation was slightly lower (r²=0.65). Summer annuals had no correlation (r²=0.00) and did not show a response to the RUP supplement (slope of the line was not different from 0; P = 0.84). The differences observed due to type of forage may be due to forage quality, specifically CP content.

The idea to evaluate the relationship between CP of the forage and ADG related to increasing RUP supplement stemmed from the trends observed in the types of grass. The average CP for brome grass was 16.0%, the average CP for warm season grass was 10.4%, and the average CP for summer annuals was 18.2%. Based on CP content and the results observed from the forage type groupings the advantage of RUP supplementation has a break point in forages that contain between 16.0% and 18.2% CP.

Responses shown here could be due to high intakes and rapid passage of forage through the rumen. This allows undegraded RDP to pass from the rumen in the liquid contents and enter the omasum and eventually the small intestine. The undegraded Н.Б.О.О.
smooth bromegrass and supplemented with DDGS had an ADG response of 0.67 lb per lb of RUP from DDGS (2016 Nebraska Beef Cattle Report, MP 103:61). It is important to take into consideration the cost of the RUP supplement and the type of forage being grazed to determine if RUP supplementation is profitable.

**Conclusion**

In conclusion, supplementing calves grazing brome or warm season pastures with RUP will increase ADG, roughly an increase of 0.5 lb/d for each lb of RUP supplement. However, identifying an inexpensive source of RUP is key for supplementation to be profitable.

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