Nitrogen and Phosphorus Optimize Barley Silage Production

By R.H. McKenzie, A. Middleton, E. Solberg, J. DeMulder, and H. Najda

Feed demands for Alberta's livestock industry result in some 800,000 acres of barley silage production each year. Farmers want high yielding, good quality silage, but have little information about the nutrient needs of today's varieties. We initiated a three-year study to evaluate the yield potential and fertilizer requirements of several new barley cultivars grown under irrigated and dry land conditions at 10 to 12 sites in Dark Brown, Black, Thin Black, and Gray-Wooded soils across Alberta.

Barley silage is highly responsive to nitrogen (N) and phosphorus (P) fertilization. Varieties differ greatly in their dry matter production and quality, and response to fertilization is variable, depending on the agro-climatic area. Phosphorus fertilizer is essential for optimum production, especially when soil test levels are low.

Nitrogen Fertilization

Barley silage has a high demand for plant nutrients. A typical crop will remove 130 to 180 lb of N, 40 to 60 lb of P_2O_5, 110 to 140 lb K_2O and 15 to 20 lb sulfur (S) per acre. Barley silage is very responsive to N fertilization. Yields can exceed 7.5 tons/A under irrigation and 5 tons/A for dry land, if adequate N is supplied (**Figure 1**). About 110 lb/A N is needed to optimize yields under dry land when soil test levels are low to medium. Nitrogen rates may approach 140 lb/A under irrigation, but lodging can be a problem in high yielding varieties at the higher application rates.

Silage protein is also highly responsive to N fertilization. Protein concentration increased linearly with N applications up to 180 lb/A. However, considerable differences existed among varieties (**Figure 2**). Unfertilized controls had less than 10 percent protein, but depending on the variety, protein concentration could be increased by 50 percent or more at the higher N rates.

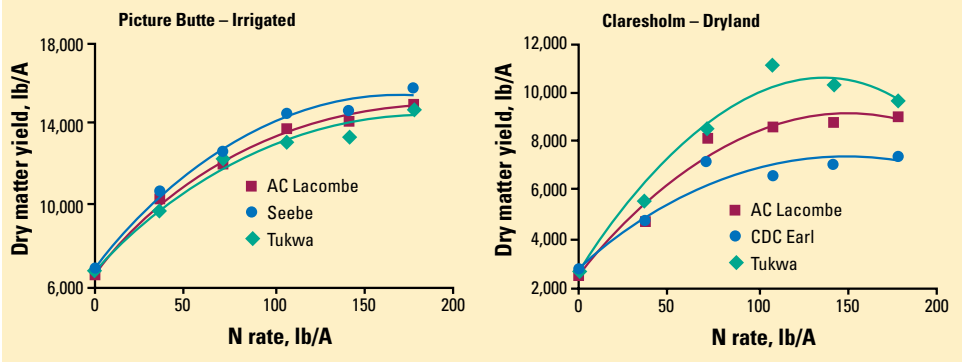

Figure 1. Dry matter silage production of several barley varieties under dryland and irrigation at two locations in Alberta.

Phosphorus Fertilization

Phosphate fertilizer significantly increased silage yield at 25 of 32 site-year locations. Similar to N, varieties responded differently to applied P. Some varieties responded to P fertilization regardless of soil test level. However, when soil test P was 10 parts per million (ppm), or less, P increased yields at all sites except one. More than 70 percent of the sites responded to P fertilization when soil test P was between 10 and 20 ppm. When soil test P was above 20 ppm, the frequency of response was less than 40 percent. **Figure 3** shows the magnitude of response observed to 60 lb/A P_2O_5 at three locations in different agro-climatic areas. Applied P commonly increased yield by about 25 percent, but occasionally response was much higher. For example, P increased the dry matter yield of AC Certa from 6,812 lb/A to 14,483 lb/A at a location in the Black soil zone (data not shown).

Phosphate fertilization had no effect on silage protein at irrigated sites, but it did decrease protein in some of the dry land sites. This was due to a dilution effect caused by the yield increase in response to applied P and suggests that additional N would have been required to maintain the protein levels at the higher yield. BC

The authors are with Alberta Agriculture, Food and Rural Development. Dr. McKenzie is Soil Fertility Specialist, at Lethbridge, AB. Mr. Middleton is Agronomy Technologist at Lethbridge. Mr. Solberg is Research Agronomist at Edmonton. Ms. DeMulder is Agronomy Research Coordinator at Edmonton. Mr. Najda is Forage Crops Agronomist at Brooks.

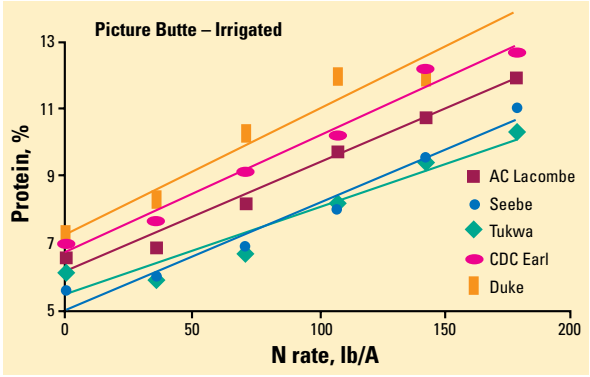

Figure 2. Applied N increases protein concentration of several irrigated barley varieties in Alberta.

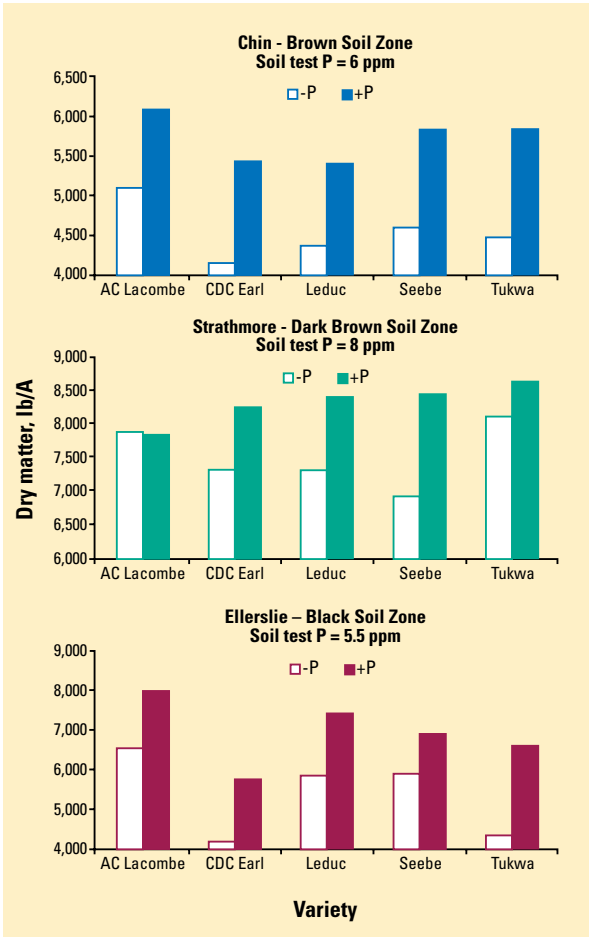

Figure 3. Dry matter silage responds to P fertilization at sites in the Brown, Dark Brown, and Black soil zones in Alberta.