# Nitrogen Fertility Effects on Italian Ryegrass Yield & Quality

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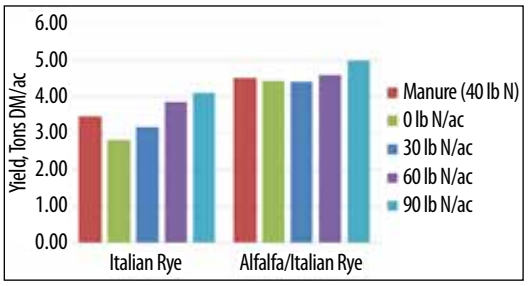
Italian ryegrass has gained popularity among dairy farmers due to its excellent quality, fast growth in cool conditions, and in places where alfalfa management is a struggle due to harsh winters and poorly drained soils. Its low lignin and high fiber digestibility are hard to beat compared to other grasses and alfalfa, which makes it ideal for feeding to high-producing cows. Similar to other grasses, it is responsive to nitrogen (N) fertilizer, but we have had many questions about how much N should be applied to increase yield and protein content. Increasing N can improve yield and protein content, but may lead to excess N in the soil if not taken up by the crop and can lead to volatilization into the air, leaching into groundwater, or running-off into nearby watersheds. Current Wisconsin recommendations (UW-Ext. Pub. A2809) for N fertilizer application to cool-season grasses for hay or pasture is 130-160 lbs N/ac total per year.

**Figure 1.** Yield of pure Italian ryegrass and an alfalfa/Italian ryegrass stand fertilized with different levels of nitrogen per acre after each cutting.




In early May 2020, two sets of plots were established by no-tilling Italian ryegrass (Allegro, Byron Seeds) into a moderate/poor stand of alfalfa at 10 lbs seed/ac or as a pure stand at 20 lbs seed/ac. No fertilizer was applied prior to planting. Plots were fertilized after each cutting with no fertilizer, 8,000 gal of liquid dairy manure/ac (40 lbs N/ac), or urea at 30, 60, or 90 lbs N/ac. The alfalfa/Italian ryegrass crop was harvested five times and the pure Italian ryegrass was harvested four times throughout the growing season. The initial alfalfa/Italian ryegrass stand was harvested based on the alfalfa maturity and was earlier than the initial harvest of the pure Italian ryegrass. Harvest timings were 25-32 days for four of the harvests. One harvest had a 20-day interval for the interseeded alfalfa due to good summer growing conditions.

Overall interseeded alfalfa/ryegrass yields were good, ranging 4.5-5 tons DM/ac with only a slight effect of additional N on yield. Unfertilized plots yielded 4.45 tons DM/ac while yield of fertilized plots was 4.4, 4.6, and 5.0 tons DM/ac for the 30, 60, and 90 lbs N/ac treatments, respectively. Manure plots yielded 4.52 tons DM/ac while receiving 40 lbs N/ac through liquid dairy manure, which falls within the fertilizer rates of 30-60 lbs N/ac. Protein content increased from 17.6% crude protein (CP) for unfertilized plots to 18.4% CP for the 30 and 60 lbs N/ac treatments and 19.5% CP for the 90 lbs N/ac treatment. Fiber digestibility was not affected by N fertility with an average of 67% neutral detergent fiber digestibility (NDFD) at 30 hours. Estimates of N removal based on CP data show a minimal effect of N fertilizer for the alfalfa/Italian ryegrass stand with unfertilized plots having 46.2 lbs N removed on average from each cutting, while 90 lbs N/ac plots had 53.9 lbs N removed each cutting. This reflects poor efficiency of applied-N compared to unfertilized plots, especially considering the total N applied was 160 lbs N/ac for manure, and 120, 240, and 360 lbs N/ac for the three treatments. Incremental cost for fertilizer per ton additional forage (0.5 tons) for 90 lbs N/ac rate was ~$340/ton and thus would not be considered economical. The same would be found for lower rates of N fertilization. Thus, if interseeding Italian ryegrass into an alfalfa stand, N fertilizer is likely not economical. Manure application to replace other nutrients removed, especially potassium, may be warranted.

Pure stands of Italian ryegrass are different, with N fertilizer helping increase yield and protein across treatments. Total yields were highest for the 90 lbs N/ac rate (4.12 tons DM/ac) with slightly lower yields for 60 lbs N/ac (3.87 tons DM/ac), manure treatment (3.46 tons DM/ac), 30 lbs N/ac (3.16 tons DM/ac), and unfertilized plots had the lowest yield (2.86 tons DM/ac). Protein increased from 11.3% for the unfertilized plot up to 12.3, 13.6, and 14.3% for the 30, 60, and 90 lbs N/ac rates, respectively. Protein values were low for first and second cuttings, possibly due to absence of applied-N prior to first cutting and greater forage maturity. Third and fourth cuttings had significantly greater protein

content (14-20% CP) with greater values for the 60 and 90 lbs N/ac rates. A fertilizer application (commercial or manure) before or at establishment would have likely improved protein content at first and second harvests. NDF digestibility was not different between treatments with an average of 68% NDFD-30 hr. The N removal rates were lower for the unfertilized (23 lbs N/cutting), manure (29 lbs N/cutting), and 30 lbs N/ac (29 lbs N/cutting) treatments and increased for the 60 lbs N/ac rate (39 lbs N/cutting). The 90 lbs N/ac rate only had a slightly higher N removal (44 lbs N/cutting). Considering minimal difference in yields between the 60 and 90 lbs N/ac rates and only slightly lower protein values, the 60 lbs N/ac rate (180 lbs N total) likely optimized yield potential and fertilizer cost inputs which is somewhat higher than current recommendations for total N applied. The 60 lbs N/ac treatment more closely matched the total N applied (180 lbs N) with the total N removal (156 lbs N) compared to the 90 lbs N/ac treatment (270 lbs N applied vs. 176 lbs N removed). The manure treatment of 8,000 gal/ac was intermediate to the 30 and 60 lbs N/ac treatments across most measures except protein content, with some potential to use additional fertilizer to increase yield and protein content.

In addition to yield and quality, farmers should consider impacts of N fertilizer on soil nitrate levels. The pure ryegrass stand had only slightly increased soil nitrate levels after the last cuttings (2-5 ppm nitrates). However, soil nitrates were significantly increased for the alfalfa/interseeded ryegrass mix with 90 lbs N/ac applied (24 ppm) compared to 60 lbs N/ac (7.8 ppm) or 30 lbs N/ac (2.6 ppm). This reflects less efficient uptake of N and potential increased loss of N through leaching or run-off. Nitrogen fertilizer use should be at a level that optimizes yield while minimizing risk of water/environmental contamination. As part of the goal to better allocate nutrients, nutrient management planning is critical to ensure nutrients are applied based on soil characteristics and crop demands.