Energy Use and Efficiency in Grass Seed Crop Production

Energy prices are an important consideration in managing grass seed production costs. Energy costs and costs of inputs tied to energy have risen faster than seed prices. Changes in public policy and international instability could drive energy prices up even more sharply. Energy costs in the form of fuel, electricity, fertilizers, pesticides, etc. can make crop production a challenge. However, there is no information on energy use and efficiency in grass seed crops.

Field trials were conducted in Evening Shade perennial ryegrass and Falcon IV tall fescue to measure energy consumption. Seed yield, straw, and other production characteristics were determined and a life-cycle energy budget was constructed. Energy capture and partitioning was manipulated by these treatments:

1. Spring applied N (160 lbs/acre – perennial ryegrass, 120 lbs/acre – tall fescue)
2. Trinexapac-ethyl (Palisade®) plant growth regulator (PGR)
3. Control (no spring N, no PGR)

Spring N was applied in March by an orbit air spreader system and the PGR was applied in May to control lodging. Yield components were collected near peak anthesis in June. Seed crops were harvested with a small-plot swather and small-plot combine in July.

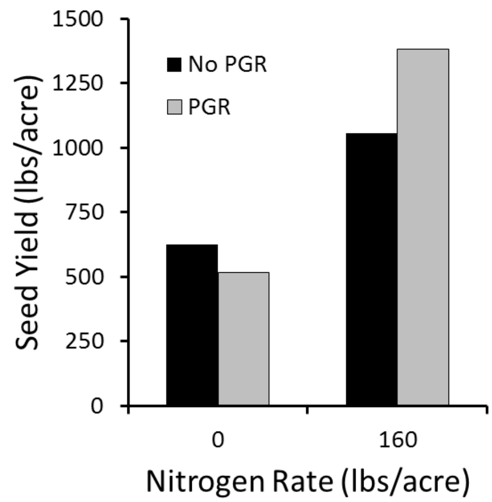

Figure 1. Effect of N and PGR on seed yield in perennial ryegrass.

Average seed yield for 2010 and 2011 was increased by spring N in perennial ryegrass and was further increased by PGRs (Fig. 1). However, only a combination of spring N and PGR consistently increased seed yield in tall fescue (Fig. 2).

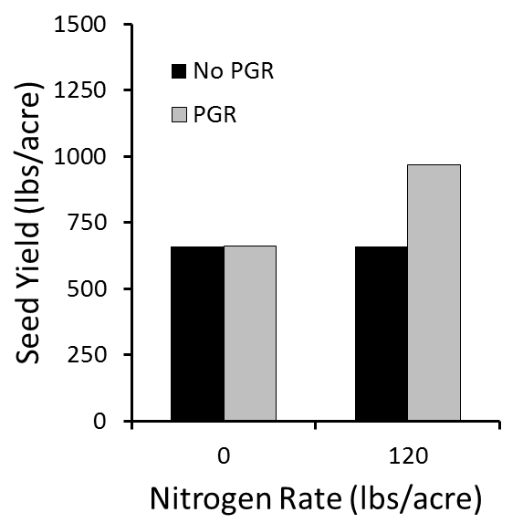

Figure 2. Effect of N and PGR on seed yield in tall fescue.

The difference between straw yield with and without spring N was much greater in perennial ryegrass than in tall fescue (Fig. 3 and Fig. 4). While the lower spring N rate in tall fescue (120 lbs N/acre) could be partly responsible for the difference between the species, the amount of straw produced by tall fescue without spring N was much larger than observed in perennial ryegrass. PGRs produced small but consistent reductions in straw yield.

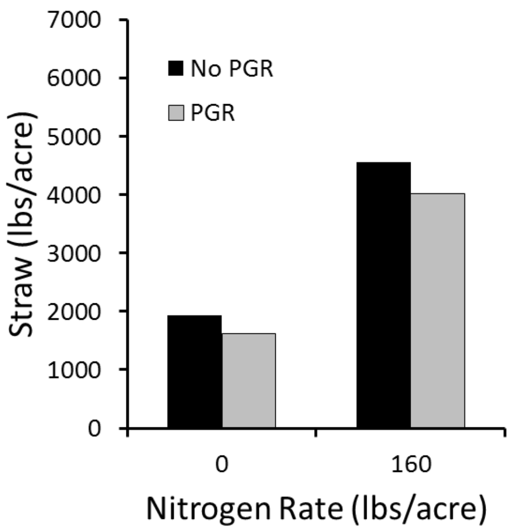

Figure 3. Effect of N and PGR on straw yield in perennial ryegrass.

Perennial ryegrass energy consumption ranged from 4,080 to 8,760 MJ/acre, depending on management inputs. Energy consumption for tall fescue (4,001- 7,589 MJ/acre) was slightly lower than perennial ryegrass. Energy consumption for grass seed crops falls within the published range for other crops such as wheat, soybeans, and barley.

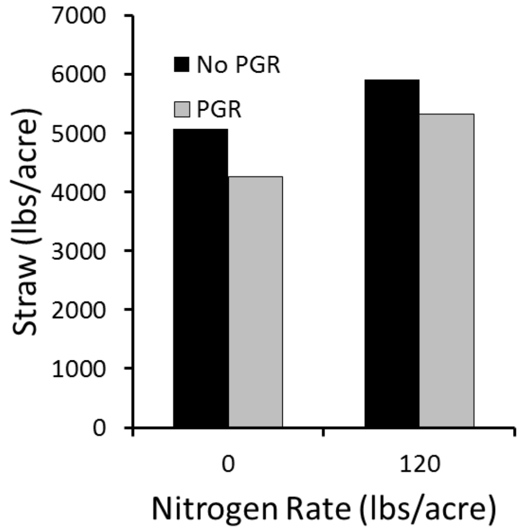

Figure 4. Effect of N and PGR on straw yield in tall fescue.

Seed energy outputs vary with seed yield: low energy output with low yield (4,338 and 5,546 MJ/acre in perennial ryegrass and tall fescue, respectively) and high energy output with high yield (11,659 and 8,151 MJ/acre in perennial ryegrass and tall fescue, respectively). Energy efficiency is determined by the ratio of energy produced (output) to energy consumed (input). When energy efficiency ratios are greater than 1, energy production exceeds consumption with the net gain coming from capture of solar energy. Energy efficiency ratios for seeds were greater than 1 in all but one treatment.

Energy embodied in straw further increased output (maximum at 45,777 and 53,370 MJ/acre for perennial ryegrass and tall fescue, respectively). Straw is either harvested for livestock feed or is chopped to decompose in place, and energy is recovered as livestock products or plant nutrients released in the soil. Efficiency ratios for combined seed and straw harvests ranged from 4 to nearly 12.

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