Fitting Annual Winter Cereals and Red Clover into the Corn Production System to Stimulate Biofuel Biomass Production

Cellulosic ethanol production is now being conducted on a commercial scale, with two production facilities using corn stover as feedstock operating in Iowa. Incorporating cover crops into the corn production system could enhance corn growers’ profitability by producing a second cellulosic feedstock or by serving as a carbon source to replace soil carbon removed with corn stover.

Winter annual cereal cover crops such as cereal rye, wheat or triticale could provide a corn grower significant spring biomass for cellulosic ethanol. Cover crop research at MSU/KBS has indicated that 0.5 to 1 ton of cereal rye biomass could be chopped as early as mid-April for ethanol production, thus fitting the corn planting requirements. If a perennial legume could be incorporated into a corn system without detrimental yield consequences, continuous biomass could be achieved without the need to plant a cover crop every year.

This project looked at corn systems that included cover crops to increase the total cellulosic biomass without detrimental environmental or corn yield effects.

Results included:
- Establishing the experimental sites provides the proof of concept that a corn silage + winter annual cover crop cropping system is plausible under Michigan growing conditions.
- The inclusion of the winter annual cover crop significantly de-risked the cropping system with regard to total biomass yield. In the 2012-13 crop cycle, the cereal rye and triticale cover crops increased cropping system biomass yield by 44% relative to the no-cover control.
- Corn silage biomass has higher conversion efficiency to ethanol relative to cover crops due to the grain component present in the corn silage biomass. Similar to objective #1, the inclusion of the winter annual cover crop significantly de-risks the cropping system with regard to ethanol yield on a land area basis. In the 2012-13 crop cycle, the cereal rye and triticale cover crops increased cropping system ethanol yield by 28% relative to the no-cover control.
- A corn silage plus cover crop bioenergy cropping system generates a very favorable net ecosystem carbon balance.
- A corn silage plus cover crop bioenergy cropping system generates a very favorable net energy balance.
- In a typical Michigan winter-spring cycle such as that experienced in 2012-13, cover crops will provide sufficient biomass to result in a profitable harvest as a biofuel feedstock. However, following a harsh winter such as that experienced in the 2013-14 cycle, cover crop yields may be compromised to the point where harvest may not be justified.

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