Research Update

FORAGE IMPROVEMENT DIVISION

Growing the Future of Energy

Q&A with Joe Bouton, Ph.D., Senior Vice President and Forage Improvement Division Director

In June, 2006, the Noble Foundation and Ceres, Inc., a California company, announced a long-term relationship for the purpose of developing advanced, dedicated feedstocks for a growing ethanol industry. As a consequence of this announcement and the growing media coverage focused on ethanol production from agricultural feedstocks, we sat down with Joe Bouton, Director of the Forage Improvement Division, to discuss the basics of ethanol and its relationship to agriculture, the impact of bioenergy research on the Forage Improvement Division and the importance of this program to the Noble Foundation.

What is ethanol?
Ethanol is “ethyl alcohol,” commonly referred to as grain alcohol.

Where and how is ethanol sold?
We certainly do not have many outlets in this area – this is one of the national issues concerning use and adoption. There are fewer than 1,000 outlets – gas stations and convenience stores – that sell ethanol in the U.S., which has more than 150,000 of such outlets.

An ethanol plant – a biorefinery – produces fuel-grade ethanol, and that ethanol is then blended in a percentage with gasoline to make a finished motor fuel. Commonly, we hear about E10 (10 percent ethanol/90 percent gasoline) and E85 (85 percent ethanol/15 percent gasoline). It is unlikely U.S. vehicles will run on pure ethanol anytime soon.

What is ethanol currently made from?
The majority of ethanol produced today in the U.S. is made from corn grain with a smaller percentage made from sorghum. In Brazil, the great majority of ethanol is made from sugarcane.

What is cellulosic ethanol?
Cellulosic ethanol is ethanol produced from cellulosic material. Examples of cellulosic material include switchgrass, miscanthus, wood and wood residue and crop residues – or stover – from corn, wheat and barley.

Is the ethanol from corn, sugarcane or cellulosic material the same?
Yes, the ethanol produced from all of these sources is chemically identical.

Are cellulose-based and starch-based feedstocks comparable?
Based on current estimates, cellulosic feedstocks are far better – this is why there is considerable activity in the media recently surrounding these crops. Cellulosic feedstocks are estimated to produce approximately five times more energy than corn.

Is the Forage Improvement Division working to improve both starch-based and cellulose-based feedstocks for ethanol production?
No. We are focused solely on cellulosic feedstocks and, even then, specific feedstocks that are consistent with our forage-based mission and efforts to improve plants that support livestock production systems.

Initially, we will work on switchgrass. The eventual need for a broad range of feedstocks could allow us to look at other crops, like alfalfa, clover, tall fescue and forage sorghum, just to name a few.
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Further, cellulosic feedstocks are intended to have a broader range of adaptability to poorer soils, which would allow them to be grown in regions that cannot support large-scale corn production.

How does the Noble Foundation’s lignin research for forage digestibility impact biofuels?
Rick Dixon and his laboratory have been very successful in manipulating lignin composition and levels in alfalfa and other forages to improve their digestibility.

Cellulosic feedstocks are generally comprised of three components – cellulose (~44 percent), hemicellulose (~30 percent) and lignin (~26 percent). The cellulose and hemicellulose provide a rich supply of carbohydrates that are ultimately used to produce ethanol.

The issue – and the bottleneck in supplying cheap ethanol from cellulosic feedstocks – is gaining ready access to the cellulose and hemicellulose. The obstacle is lignin.

As lignin is responsible for a plant’s structure, strength and rigidity, lignin naturally encompasses the plant’s cellulose and hemicellulose. Because lignin is so effective serving its primary role – as the “scaffolding” within each plant – it has complicated and increased the cost for efficiently converting cellulose and hemicellulose into ethanol. We believe that with the lignin manipulation techniques created in Plant Biology, we can develop plants that are capable of producing ethanol much more efficiently and cost effectively.

How close is cellulosic ethanol to being commercialized?
The technology to create cellulosic ethanol is getting closer to reality. Many companies worldwide are in the later stages of development and entering the early stages of commercial scale-up. Though most of the pieces are in place, the key is to continue to make it more cost-effective and economically competitive.

What is switchgrass? Why is it a good potential source for ethanol?
Switchgrass is a perennial grass native to the prairies of North America. Switchgrass has been identified by the U.S. Department of Energy as a primary target for development as a dedicated energy crop because of its potential for high fuel yields, hardiness and ability to be grown in diverse areas. Switchgrass is relatively drought-tolerant, grows well on marginal cropland and shouldn’t require heavy fertilizing or intensive management practices.

What is the focus of the feedstock development program in the Forage Improvement Division?
Initially, switchgrass. However, with our current expertise in forages, both in breeding and in transformation, we will be well positioned to improve other important bioenergy crops, for example, alfalfa, tall fescue and forage sorghum.

Will dedicated energy crops be more or less attractive for a farmer to produce than grain crops or cattle?
Farmers will choose to grow dedicated energy crops based on simple economics. The economics of these crops will be determined by a combination of variables including market demand, input requirements and costs, government support and the alternative use of the land, for example, cattle production. Despite years of research and the development of improved feedstocks through government research programs, little has been done to definitively establish these economics.

The Agricultural Division will take the lead in looking at many of these issues, at least within Noble’s service area. This is a critical project that will ultimately help define the likelihood of this industry coming to southern Oklahoma and North Texas. More importantly, it will lay the foundation for producer education in the service area and beyond.

Has Forage Improvement’s mission changed? Will Forage Improvement now focus on the development of energy crops rather than forages?
Our mission remains the same: “To develop improved forage cultivars for the southern Great Plains and, in the process, advance the science of plant improvement.” We have assembled an excellent research team that will continue to focus on the development of improved forages – it is this model that has enabled us to advance the science of plant improvement for bioenergy crops.

Our work in bioenergy crops will continue to focus on those crops that have a dual purpose for us – forages and energy. At the end of the day, our work to improve switchgrass – or any other of our target crops – for bio-energy will translate to an improved plant for range management or a better feedstock for cattle.