Biofuel study looks at cost to wildlife and environmental diversity

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Whether we can grow bio-energy crops such as switchgrass and forage sorghum isn't the question, said a Texas AgriLife Research scientist.

The question is, where's the nitrogen going to come from to grow these crops and how much is it going to add to the cost of the end product, said Dr. Gerald Smith, AgriLife Research legume breeder based in Overton.

And there also are hidden costs, such as the effect of fencerow-to-fencerow crops on wildlife and biodiversity, he said.

"It's time to take the monoculture blinders off," Smith said.

Smith and a team of scientists based at Texas AgriLife Research and Extension centers at Overton, Beeville, Beaumont, Stephenville, Vernon and Lubbock are looking at various cropping systems to solve both problems -- the cost of nitrogen and ways to preserve habitat for valued species such as the whitetailed deer.

"We don't know the long-term future of cellulose bio-fuel crops, but we want to be ready in Texas to grow them if they prove lucrative," he said. "And we want to preserve our wildlife while we do so."

Smith and other Overton forage and livestock researchers have worked with legumes for livestock systems specifically for East Texas and the southern U.S. for years. Smith, a legume breeder, has developed

numerous varieties bred for improving winter grazing, including Apache Arrowleaf Clover and Rio Verde lablab, a new forage and seed crop for Texas.

But this study is one of the more complicated that he's been involved with, he said, as it tries to look at the interactions in the big picture, not just what is happening in the hay pasture or wildlife food plot.

"We know we can use legumes as a source of nitrogen," Smith said. "We have a couple of different kinds that we have worked with here that we know will work in these soils. But now we want to look at sustainable production of cellulosic biomass with attention to natural resource conservation and wildlife stewardship. It's a different ball game. There's a lot we need to learn."

Smith and the team know that both cool-season legumes like clovers and warm-season legumes such as cowpeas can bring a lot of nitrogen in a cropping system. They even have a pretty good idea of how much nitrogen, in terms of pounds per acre, different varieties under various cropping systems can add to the soil.

Any type of plant other than a legume quickly exhausts nitrogen reserves in the soil and has to have some source of nitrogen, either from commercial fertilizer made from fossil fuels or animal waste such as composted chicken litter. The cost of producing and hauling the litter to the field can be a limiting factor on economical crop production, particularly in the southern region, where nitrogen is more quickly leached from sandy, acidic and weathered soils, Smith said.

"We have known this for a long time," Smith said. "But there's a lot of things we don't know. We also want to be able to match that or complement the use of the fertilization nitrogen with the nitrogen that we are gaining from the legumes. If we have to apply nitrogen (as well)

through commercial fertilizer or manure, we want to make sure the plant that we are applying it for uses it very efficiently."

For example, though it's known how much nitrogen a legume fixes in the soil, it's not known how much will be made available to a crop such as a high-biomass sorghum. And if commercial fertilizer or manure has to be added to the system, it is not known when can it be added so that the legume won't over-compete with the biomass crop for space and nutrients.

And there are questions about the effect on wildlife. In previous studies, Smith and Dr. Billy Higginbotham, Texas AgriLife Extension Service wildlife specialist, have established the most attractive legume mix for whitetailed deer food plots. But they don't know how deer will adapt to various cropping systems where legumes are intercropped with high-biomass sorghum.

"There are a lot of questions," Smith said. "Can we make the system more efficient by using multiple sources of legumes and a really low rate of fertilizer, or is it more efficient to maybe even skip a year of application of fertilizer? Is it more efficient to grow cowpeas one year and the high bio-mass sorghum the next year?"

There are also questions about what happens in a drought, in terms of crop survival and nitrogen usage, he said.

All these questions make for a very complicated research design. And in Texas, one size or design doesn't fit all, Smith said.

For example, from eastern to the western limits of northern Texas, average annual rainfall varies greatly. In Longview, it is about 46 inches. In Lubbock, 450 miles to the west, it is less than 19 inches, he said.

"Obviously such a gradient will dictate differing specifics such as farming systems, appropriate legumes, adapted cellulosic biomass species and targeted wildlife such as whitetailed deer, quail and turkey," Smith said.

Soils and other environmental aspects also differ widely from border to border. In northeast Texas and southeast Oklahoma, soils are sandy and low in plant nutrients and nitrogen costs for pastures or any crop will be high.

At the Overton site, tests will examine how legumes fit into any forage production system for grazing or biofuel feedstock. Smith and Higginbotham will give special attention to the effect on whitetailed deer grazing using automatic cameras, Smith said

In Central Texas, near the Stephenville, dryland trials will examine biomass production from native, warm-season perennial grasses grown with native warm-season annual legumes and naturalized annual cool-season legumes. The tests will look at carbon sequestration, soil organic matter and nitrogen levels on different soils over several years.

At Vernon, team members will work with annual medics and alfalfa, both legumes, to reduce nitrogen fertilization on perennial cool-season and warm-season grasses.

At Beeville, about 70 miles north of Corpus Christi, annual precipitation is about 32 inches and temperature varies from 42 degrees in January to 95 in August. Team members will look at multi-year and multi-location cellulose yields of native, warm season perennial grasses fertilized with native warm-season annual legumes.

Despite the different cropping systems, it's important to remember that sites will evaluate adapted legumes as nitrogen-source crops for

cellulosic biomass production systems, Smith said.

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