Researcher converts alfalfa into fuel

FORT COLLINS, Colo. — Farmers in the United States, Canada, Russia, Australia, France, Italy and South Africa agree: Alfalfa is an outstanding crop just the way it is.

But a Colorado State University chemical engineer is developing processes to make alfalfa a cornucopia. Among the potential alfalfa products suggested by Professor Bruce Dale are fuels and chemicals, human foods and improved animal feeds.

In addition, his processes greatly increase the digestibility of the cellulose, or fiber portion, in such materials as corn stover, wheat straw or rice straw so that roughage becomes a feed that compares favorably with grain. That translates into a new source of ruminant livestock feed.

Unlike many researchers who aren't sure how or when their research results may be applied, Dale is confident that his discoveries not only will be applied but that they will affect agriculture worldwide.

"I expect the cellulose conversion process to be a practical agricultural tool that should vastly increase the potential amount of animal feed supplies throughout the world in a few years," Dale predicted.

He's just as enthusiastic about using the process to make a good product, alfalfa, into a much better one.

The approach involves a new technique called ammonia freeze-explosion, which converts alfalfa cellulose to fermentable sugars that can effectively be removed from protein, the other valuable component of alfalfa. Sugars then can be fermented to produce ethanol or other fuels and chemicals, while the protein products can be converted to improved animal feeds or perhaps even human food.

"Producing a number of things from alfalfa allows us to share production costs for each product," he said. "Thus, producing fuel and food from a renewable resource can be supportive rather than competitive, as has been the case with attempts to convert other food products such as corn and wheat to alcohol."

Other attractions of alfalfa are that it is growth worldwide and is a perennial. Perhaps most important is the fact that alfalfa fixes its own nitrogen, which means less use of fossil fuel to grow the crop. In scientific papers, Dale has reported that his alfalfa conversion process should produce 10 gallons of alcohol for every gallon of fossil fuel used.

Dale's enthusiasm for alfalfa also is based on favorable laboratory results that reinforce a principle of chemical engineering: Components of a mixture grow in value as they are separated and concentrated.

He explained that a number of techniques, or combinations of techniques, can provide fuel, chemicals, food or feed from alfalfa. They all are based on separating the plant's protein portion from the cellulose portion at some point in a process.

Removing cellulose from alfalfa makes the legume a much better feed, especially for such animals as chickens and pigs, which have trouble digesting fiber.

One possible technique involves a relatively simple process to separate alfalfa's leaves, which contain most of the plant protein, from the stalks, which are mostly cellulose. The leaves make a high-quality animal feed while the cellulose-rich stems are fermented to make alcohol or chemicals. Fermentation residue also is a potential protein-rich animal or human food.

Dale said a half ton of high-protein animal feed or 200 pounds of protein suitable for human consumption remain after each ton of alfalfa is processed into alcohol. Dale noted, however, that extensive testing and development probably are required before alfalfa protein can be incorporated into human food products.

Another technique involves fermenting the whole alfalfa plant, then separating the protein-rich residue for food.

In many ways, Dale's discoveries sound almost too good to be true. A number of scientists throughout the world have spent years just trying to find a way to convert cellulosic materials to animal feed.

Yet, Dale is not the only one who's confident he's on to something. Companies already have stepped forward to help Dale put his cellulose conversion method to a large-scale test. Construction should begin this spring on a pilot plant to test converting alfalfa and other materials to improved animal feeds. The plant should be in operation at CSU this summer.

Most of the testing with a large operation is aimed at determining costs per ton of material treated and how much the product is worth per ton after it is treated. The latter aspect will be measured by large-scale feeding trials.

He said that an operation aimed solely at feed production may have to serve 1,000 animals or more to be profitable. "I expect my process to be refined so that it should cost less than $5 per ton to treat hays or straws and increase the material's value by about $25 to $30 per ton. We don't know if the process will help someone who has just 30 or 40 head, but we should be able to answer that question after we test various sizes of operations," Dale said.

Dale's laboratory testing shows that his ammonia freeze-explosion method can turn about 90 percent of the cellulose of plant materials into sugars that animals can digest. This compares with approximately 50 percent for such conventional methods as gaseous ammonia.

A primary function of the pilot plant at CSU will be to produce enough material to carry out large-scale feeding trials. "Again, we're not expecting any surprises, but we have to ensure that treated material is safe and effective on a large scale," Dale emphasized.

The greatest impact of increasing the digestibility of cellulosic materials probably will be overseas, Dale said. "We have a relatively cheap feed supply in this country and the ability to grow great quantities of wheat and corn. This often isn't the case overseas, but most countries have a supply of roughage materials."

The CSU engineer said that "even the most conservative estimates" indicate that a facility that produced both fuel and feed from alfalfa would be profitable now.

The fuel, ethanol, is an "excellent" octane enhancer for gasoline and is effective in a 90 percent gasoline-10 percent ethanol mixture, Dale said. He added that ethanol can be converted into ethylene with a fairly simple chemical process, so ethanol not only is an octane enhancer but also is the base from which a variety of chemicals are made.

"In essence, alfalfa is a chemical feedstock as well as a feed," Dale said.

Dale has been working on techniques to convert cellulose to alcohol for about five years.

Directory lists conservation groups

WASHINGTON, D.C. — From clean air to clean water; from wild turkeys to wild horses, from saving the dunes to saving the tallgrass prairie — the people who know natural resources are listed in the National Wildlife Federation's 1983 Conservation Directory.

The directory includes 12,000 individuals and 1,800 organizations, from the African Wildlife Leadership Foundation to Zero Population Growth. The 300 pages of the directory's 28th edition, published this month, list key contacts and addresses for organizations involved with natural resource management in the United States and 113 countries.

Included are federal, state and Congression officials, committees and agencies concerned with the environment, as well as thousands of citizens groups — with interests as varied as the North American wild sheep, the desert tortoise, the whooping crane, and even the holly bush.

The listings of organizations — U.S. Government, citizens, state and international — include the address, telephone number, names of directors, statement of purpose, and the size of each group.

The directory also contains:

- A list of U.S. and Canadian state and provincial fish and game administrators.
- A guide to major colleges and universities offering professional training for careers in conservation and environmental protection.
- Lists of National Forests, Parks, Seashores and Wildlife Refuges.
- A list of conservation offices for foreign governments.
- A list of periodicals and directories of interest to conservationists.

The 1983 Conservation Directory can be obtained for $9 plus $1.55 for shipping charges per order (regardless of number of books ordered) by writing to the National Wildlife Federation, 1412 16th Street, NW, Washington, D.C. 20036.