ANATOMY OF A MEADOW

An OU botanist asked why an apparently unfit grass survives for lengthy periods. The answer is important to agriculture

By BOB LIPTON

Triple awn grass is a scraggly, puny-looking annual that grows in an abandoned field for 8 to 15 years before it bows, as it must, to competition from hardier, more competitive plants. Generations of scientists and laymen have observed this fact, and most never gave it a second thought. One man not only thought twice about it—he decided to discover why. Dr. Elroy Rice, OU professor of botany, a few years ago began a series of experiments to spot the significance of the long survival record of triple awn grass. In doing so, he joined a class of men typified by the first journalist who realized he had a great story when he saw a man biting a dog.

It is news to scientists when they see a clear example of "survival of the unfittest." And what is more unfit than frail triple awn grass (farmers call it wire grass) compared with its successors, the bunch grasses and prairie plants?

Research funds from the National Science Foundation totaling $79,200 have provided Rice with back-to-back three-year research projects dealing with the competitive ability of early invaders of abandoned fields. The key to survival is the production of chemicals which inhibit the growth of nitrogen-fixing and nitrifying bacteria, which are all-important in providing the minerals required by higher plants.

Any research project is a mighty oak tree compared to the tiny acorns of observations and hypotheses from which it originates. Here is what Rice used as starting points:

"The revegetation of abandoned fields occurs in four stages. At first, nothing but weeds can grow for two or three years. Then small annual grass (like triple awn) comes in, staying for periods of 8 to 15 years. The third phase of the cycle is of unknown duration. Typified by bunch grasses, such as little bluestem, this stage has been known to last for 40 years, but may go on for 100 years or more. Finally the field resembles a true prairie.

"When people stop cultivating a field, it's usually because the minerals in the soil, in particular nitrogen compounds, have been depleted. By experimentation, I found that the pioneer weeds need very little nitrogen. Prairie plants require considerably more. Nitrogen is added to the soil chiefly by the activity of nitrogen-fixing bacteria. Also important are nitrifying bacteria, which change ammonium compounds to nitrates that are absorbed easily by plants.

"Like other investigators, I was puzzled by the slow invasion of climax grasses. I hypothesized that perhaps the low-nitrogen-requiring early invaders of abandoned fields may produce inhibitors of the nitrogen-fixing and nitrifying bacteria. This would give such plants a selective ad-

The man who asked why, Dr. Elroy Rice, professor of botany, stands in the 10-acre tract leased by OU to study the cycle of a prairie.

vantage over plants with higher nitrogen requirements and could conceivably slow down the rate of succession."

Rice's first NSF grant, amounting to $29,800, terminated January 31. In the three years covered by the grant, 21 species of pioneer plants were studied in sand cultures under laboratory conditions in the OU greenhouse. Fourteen of these species were found to be active producers of phenolic compounds which inhibited growth of the test bacteria. "My first step was the screening of extracts of these plants to see if the extracts were inhibitory to nitrogen-fixing and nitrifying bacteria. The extracts were tested in soil. Experiments were designed to determine whether the inhibitory chemicals are adsorbed by colloidal material, such as clay in the soil. After ascertaining that the chemicals do in fact get out into the substrate, or soil, I ran tests to determine the effects of heat and various microorganisms in the soil on the inhibitors. Although the effectiveness of the chemicals was not impaired in any significant way, it must be remembered that no experiment can duplicate exactly the conditions that exist in nature. In other words, we haven't proved anything yet, but we are building up evidence, lots of it."

After the extracts were tested in soil, Rice tried growing bean plants in sand. Each pot contained two plants. In one pot, each plant was inoculated with strains of the appropriate nitrogen-fixing bacteria. In another, an inoculated plant grew side by side with a selected inhibitor species. After

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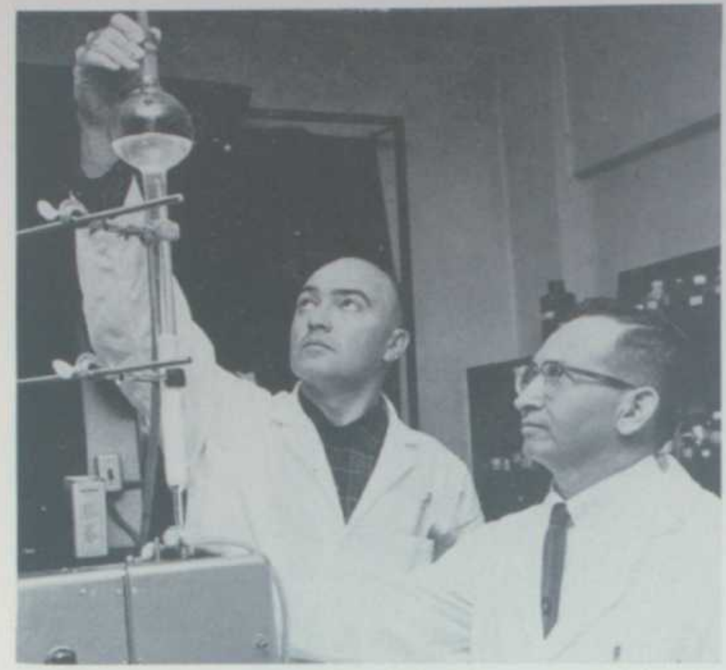

Dr. Rice (right) and his research assistant, Bob Parenti, spend several hours each day in the laboratory working on the project.

being allowed to grow for several weeks, the number of nodules on the roots of the bean plants were counted and compared with each other. In every pot that contained an inhibitor plant, there were less nodules on the roots of the legume than in the pots which contained no inhibitor species.

The conclusion, according to Rice: "Under greenhouse conditions, in sand cultures, the selected inhibitor species were shown to inhibit nodulation of certain legume plants." (Nitrogen-fixing bacteria are known to thrive in the nodules.)

Soil will replace the sand in Rice's next experiment, one more step along the tedious road that leads to verification of a scientific theory. The new NSF grant, like the first, is administered by the OU Research Institute. The additional money will enable Rice to hire a second research assistant, joining the present aide, Robert L. Parenti of Wayne, Neb. These days Rice is searching for a qualified assistant.

"Good ones are not easy to find," Rice comments. "There's a large number of assistantships available in comparison to the number of people trained for them. Although it's hard to lure someone out of industry or teaching on the small salary we can afford, an assistantship is a wonderful opportunity for someone who is seeking an advanced degree."

Excellent training in research techniques is one important benefit that accrues from activity in research. "An assistant receives much more valuable training by working on a research project than he would ever get just as a student," Rice says. "At least every week or so we try out some new technique that even I have never used before. We find that new methods are sometimes necessary if we are to get answers to the questions we're asking."

Research projects mean long hours to the people involved. "Bob (Parenti) and I both put in a half a day at least on this research," Rice says. "This is in addition to teaching, advising, committee work and so on. It's pretty unusual when I don't work from 7 a.m. until 10:30 p.m."

While some of the questions concerning inhibitory weeds and the chemicals they produce are being answered by Rice and Parenti in the laboratory, another question waits for the distant future to decide. How many years does it take before an abandoned field turns into prairie? "Wait and see," say scientists, who are speaking of what may be a 100-year wait. In addition to the length of time involved, trouble often arises from the fact that people don't like the idea of letting land go unused for long periods.

The OU department of botany and microbiology leases a 10-acre tract west of Norman that has been abandoned since 1941. Department officials are finding themselves forced to explain to impatient laymen, who want to use the land for some "worthwhile" purpose, why it is necessary to keep the land idle if anything is to be learned about the length of the revegetative cycle.

A common question put to scientists refers to possible practical applications in their work. The common answer is, "None." Rice, however, has an answer in the affirmative, which is surprising in view of the fact that he is doing basic research, the kind that does not lend itself ordinarily to immediate significance of a practical nature. Rice points out that today the agricultural world is undergoing a philosophical change of major proportions. "It has been thought for many years that most plants require the nitrate ion for proper growth. Evidence now indicates that the ammonium ion may be just as usable by plants as the nitrate ion. This is particularly important because the positively charged ammonium radical is held by the soil particles (clay molecules) so that the compound cannot wash down past the depth of rooting," Rice explains. "The nitrate radical is negatively charged and cannot be held by the clay molecules, which also are negatively charged. A clay molecule starts out a neutral, but for some reason a silicon atom in the molecule is replaced by an aluminum atom, and a negative charge results.

"One chemical company has on the market a product which prevents the nitrification of ammonium compounds to nitrates. It so happens that little bluestem, the dominant plant in the bunch grass stage, also is very effective in preventing the nitrification process. This may result in a buildup in the amount of available nitrogen in the surface layers of the soil."

It is apparent that Rice is well on his way to modifying an answer once given by Ralph Waldo Emerson to the question, "What is a weed?" Emerson's answer: "A plant whose virtues have not been discovered."

It is to the great essayist's credit that he allowed for the possibility of virtue existing in a weed, for Rice may find that kind of plant to be quite useful in a research project that promises to be of wide interest to the agricultural experts in the future.

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