Domestic Rubber

The United States is the world's largest consumer of rubber, and the search for domestic sources to replace imports of this strategic material continued after the end of World War II. Following the wartime development of synthetic Buna S (see p. 7), chemists created several other synthetic rubbers with special properties. One of these resulted from USDA research.

Soon after the war ended, ERRC chemists were looking for ways to use whey, a surplus byproduct of cheesemaking that was both abundant and inexpensive. They found that lactic acid, obtained by fermenting whey, was a useful starting point for making a class of chemicals called alkyl acrylates. These, in turn, were used to make acrylate polymers. Because the products were rubbery and derived from lactic acid, they were named Lactoprene. Deficiencies in the original product led to further research and an improved product called Lactoprene EV. Commercialized in 1948 by the B.F. Goodrich Company, it was adopted by the automotive industry, where acrylic elastomers are still used for seals that resist oil and high heat. While interest in finding new uses for whey stimulated the original research, the commercial products used today are all derived from petroleum.

Another contribution to synthetic rubber production was made after the war by scientists at the Southern laboratory, who improved the process by substituting a chemical prepared from citrus peel and pine trees for an initiator made from petroleum. The SRRC improvement was quickly adopted by the industry.

In recent years, the search for alternative sources of rubber has begun anew. Congress has made it a matter of national policy that the United States should seek independence from foreign supplies of rubber. First in the Native Latex Act, passed in 1978, and again in the 1984 Critical Agricultural Materials Act, Congress called for development of "economically feasible means" for growing guayule and other "hydrocarbon-containing plants for the production of critical agricultural materials."

The United States cannot rely on synthetic rubber alone. Natural rubber is more elastic, more resilient, and more resistant to heat buildup than synthetics. Also, natural rubber is a renewable resource, unlike synthetics made from petroleum. At present, the United States each year imports some 800,000 tons of natural rubber worth about $500 million. It is indispensable for airplane tires, surgical gloves and dozens of other products. Automobile tires are typically made of synthetic rubber blended with natural rubber.

The new Government policy statements reactivated research by ARS on alternative sources of natural rubber—and on guayule in particular. An ARS chemist in 1978 found that spraying guayule with bioregulators about 3 weeks before harvest causes young plants to produce 2 to 6 times the normal yields of rubber. The ARS scientist said his process would not only increase yields 30 to 35 percent but would also reduce the growing time by a year or two. The bioregulators used are trialkylammonium compounds, a group of organic substances.

In another contribution, scientists at the Northern lab in Peoria developed a 1-minute test of guayule for rubber, resin, and moisture content. It replaced slow and tedious methods of analyzing the plant for rubber content. Presently, researchers are evaluating about 3,000 guayule samples a year from 10 research locations.

And at the Western lab, goldenrod is back in the picture. WRRC scientists believe that techniques of modern genetic engineering might be used to overcome its deficiencies. Chief among these are the fact that it doesn't yield enough latex and that the chemical chains in its rubber molecules are short, making for an inferior rubber. Regional researchers think it may be possible to borrow genes for high rubber production from the *Hevea* plant or guayule and to transfer them, via altered DNA in yeast or bacteria, into goldenrod or other fast-growing plants so they can produce premium rubber. Results, say the scientists, are years away, but they may be well worth waiting for.

In 1947, Eleanor Shutt of the Eastern lab worked on an experimental batch of Lactoprene EV, a rubbery product first derived from lactic acid in surplus whey.

Kenaf: New Papermaking Crop

Kenaf, a tall, fast-growing relative of cotton and okra, may be a commercial crop whose time has finally come. That, at least, is the opinion of many scientists, business people, and growers, who are convinced that kenaf will soon provide an abundant domestic source of pulp for paper—and a profitable new crop for farmers.

Kenaf is not a recent discovery. Research on the plant began in 1956, when a team of researchers at the Peoria lab examined some 500 fiber crops, looking for a supplement to wood pulp in the manufacture of paper. Nearly 100 were selected for closer study, and in time, kenaf was singled out as the most promising candidate. Engineers explored the pulping characteristics of the crop and the subsequent strength of the paper, and researchers looked at ways to grow, harvest, and store it. In the mid-1970's, a Peoria chemist developed ways to process kenaf pulp for newsprint.

Product tests followed. *The Peoria Journal-Star* made a successful press run on kenaf newsprint in 1977, and several other daily papers printed editions on kenaf paper later that year. Then, in 1978, NRRC research on kenaf was stopped to allow private industry time to develop the crop further. There was disappointingly little action, however, and since 1986, a federally funded Kenaf Demonstration Project has worked to spur adoption of the crop by the paper industry. A successful kenaf production program would improve this country's trade balance, since at present, we have to import about $4 billion worth of newsprint annually.

Today, through cooperative agreements with several private firms, it looks as if kenaf will finally make the leap from laboratory to industry. In 1988, a Chicago research and development magazine selected the NRRC-developed process for making newsprint from kenaf as one of the 100 most significant technologies of the year. Now, in rural Texas, a cornerstone has been laid for the first commercial newsprint plant to use kenaf, and research is under way at other ARS locations to evaluate the tender tops of kenaf, which are not useful for making paper, as a forage crop for cattle and sheep.

According to ARS research agronomists, kenaf can be grown as an annual crop under a wide range of conditions all over the South and Southwest, and its tops have potential as a supplement in alfalfa-based pellet feed. Further, Peoria scientists have demonstrated that the papermaking qualities of kenaf are not limited to newsprint; they insist that it can make quality papers as well. Finally, from all indications, growing kenaf should provide farmers with a healthy net return.

A stand of kenaf, a fast-growing fibrous plant with the potential to supplement paper pulp from wood, is grown on a farm in the Rio Grande Valley of Texas.