Agriculture always should be on the lookout for potentially new crops from the vast resources of the kingdom of wild plants. Of the approximately 250,000 to 300,000 known plant species, less than 100 are grown commercially in the United States for food, feed, or industrial use at economic impact levels above $1 million. Worldwide, less than 300 species are so employed in organized agriculture. Other wild plants probably could become economically viable if given a chance through proper research, development, and perhaps initial financial stimulation.

USDA has maintained an active research program on new crops development for the past 20 years, with main emphasis on industrial oilseed and fiber crops.

The fiber-screening program has uncovered excellent candidates of annual plants that can produce more than 10 times the amount of fiber per year per acre now obtained from hardwood and softwood trees. Several annual species have been studied for their production and utilization aspects. One species, kenaf (Hibiscus cannabinus), has now come to the point where production, pulping, and papermaking technologies are all in place for immediate commercialization.

Paper is traditionally made in this country from pulp prepared from hardwood and softwood trees, but it can also be made from other cellulosic materials such as agricultural by-products, or from annual plants that are specifically grown for that purpose. For example, sugarcane bagasse, wheat or rice straw, flax, and rags all have been used in paper manufacturing. Total paper production in the United States in 1980 was almost 57 million tons: for newsprint (4.2 million tons), other printing and writing paper (13.8), case-making materials (18.6), wrapping paper (4.3), tissue paper (3.9), other papers (1.0), and board (10.9 million tons). Although some of these products were exported, imports exceeded exports by about 3.7 million tons. Newsprint, the type of paper needed to keep you supplied with your daily newspapers and most magazines, is in particularly short supply.
Excess imports amount to approximately 6.5 million tons per year at a cost of $3.5 billion, so the U.S. imports about 1½ times more newsprint than is produced domestically.

As a replenishable resource for paper manufacturing, wood has its problems and limitations, and future availability is expected to decline. Large-scale harvesting of trees on private and public lands, as well as reforestation, is becoming costly and time-consuming; moreover, because wood is used also as a building material and increasingly as an energy source, competition for wood resources is becoming stronger. Wood production is also capital intensive, since it takes from 15 to 50 years after planting before a tree stand can be harvested economically.

An alternative source of cellulosic fiber for paper production would be annual plants, provided that high-yielding species could be identified and further developed to crops with acceptable agronomic qualities and fiber properties. Of the 506 potential species selected from the world's plant kingdom, kenaf (Hibiscus cannabinus) and a few others appeared immediately promising.

Kenaf and some close relatives are native to East Central Africa and can still be found in the wild in Tanzania and neighboring countries. Kenaf is no newcomer to the group of plants that is utilized by mankind. The outer bark contains bast fibers that have been used from time immemorial to make twine and rope, and it is also used for the manufacture of carpet backing. In Florida, kenaf stalks have been grown and utilized commercially as bean poles. They are well suited for this purpose, because they are strong, straight, and up to 20 feet tall.
Kenaf has typical hibiscus flowers, 3 to 4 inches in diameter. They are creamy white with a deep magenta to bordeaux-red center. The leaf shape is varied. Some cultivars have split leaves, very much like marijuana (Cannabis sativa), from which it derived its species name cannabinus. However, other varieties have roundish broad leaves. Kenaf, an annual, can produce either a single stem up to 2 inches in diameter and over 20 feet tall, or several stems of lesser dimensions, from a single seed. It develops a large taproot that provides for deep rooting and is most productive in well-drained soils and a humid, warm climate, but it will also grow in regions with less ideal conditions. Frost and drought will kill the plant rapidly.

In searching for potential annual fiber crops, many things have to be considered. First of all, the fiber quality of the pulped stems has to be satisfactory for papermaking. Second, the plant species must be amenable to cropping practices, with high yields and acceptable resistance to pests and insects under monoculture high-density conditions. Third, harvesting, storage and processing conditions must be developed that can be integrated into existing farming and papermaking facilities.
Kenaf appeared promising on all counts. As a dicotyledonous plant, the plant stem consists of bast and core. The bast fibers are long and similar in dimensions to those from softwoods, whereas the short core fibers are much like those obtained from hardwoods. Many types of paper are made from a blend of hard and softwoods, and kenaf provides a natural blend of such a fiber mixture. Initial chemical pulping trials showed that disintegration of the plant material to primary fibers is easier because of the lower density of the stems than is encountered with wood. The stems also contain lower quantities of lignin, the plant cement that holds fibers together. Pulping requires less chemicals and can be accomplished at lower temperatures and in less time. Preliminary tests showed that kenaf fiber could be refined and bleached easily and manufactured into paper with good opacity and strength.

In the meantime, plant breeders started a research program in which kenaf cultivars were further selected and bred for improved quality and yield. Agronomists developed production methods to establish where kenaf can grow best, what soils and production practices are optimal, and what remedies can be used to stave off attacks of disease and pests. Agricultural engineers were involved in developing harvesting and storage practices. The latter was important, since kenaf is an annual crop and cannot be harvested year around as can be done with trees.

It was found that kenaf could be grown even in short warm seasons as far north as Minnesota, but at the expense of yield; only about 3 tons of dry matter could be produced per acre. In midwestern locations, such as Illinois, yield increased to 5-8 tons per acre. However, in Texas and Florida yields of 25 to 30 tons have been reached, which is approximately 10 to 20 times the yield per acre per year that normally can be obtained from hard and softwoods. Under irrigation, kenaf also has produced high yields in southern Arizona.

In the meantime, chemists and paper technologists were able to demonstrate that kenaf could be made into high-quality book stock and other printing and writing papers with only slight modifications of existing processes using available equipment. It can be used either by itself or in blends with commercial fiber stock. Kenaf can be stored under certain conditions for long periods without significant deterioration of fiber quality. Even compression of harvested kenaf into dense cubes for improved economy in long-distance
transportation, without deleterious effects on ultimate paper quality, was found to be feasible.

Whereas paper for books and other documents should have excellent keeping qualities to last for many years, newsprint can be much lower in whiteness and storage performance. Newspapers and magazines often are discarded soon after they have served their purpose of communication. However, high-speed printing requires light-weight paper with good strength and opaqueness properties. Newsprint normally is prepared in large quantities from mechanical pulp, where wood chips are macerated at steam temperature with a minimum of added chemicals. Refining and bleaching are not carried out to the same extent as with high-quality paper. Whereas chemical pulping processes bring the fiber yield down to as little as 50%, based on woody feedstock, mechanical pulp yields are on the order of 85% of the initial dry matter fed to the digester.

Interest expressed by the American Newspaper Publishers Association (ANPA), an organization of the leading daily newspapers in the U.S., led to research at USDA’s Northern Regional Research Center, in which thermomechanical pulping was tried on kenaf. This work culminated in the production of one roll of newsprint paper, made on the in-house paper machine, that was successfully printed on commercial letterpress equipment of the Peoria Journal Star. Subsequently, cooperation between ANPA, USDA, and pulp and paper companies resulted in a larger trial. Thirty acres of kenaf grown near Yuma was made into newsprint. Whole daily editions of six different newspapers were printed on this paper with excellent results. The kenaf paper held up on all major factors, such as strength, opaqueness, brightness, printability, and linting. ANPA is now planning a scale-up in crop and paper production for full-scale testing. What is more, an economic evaluation of the trial run indicated that kenaf paper costs substantially less than imported newsprint, and that it can provide new opportunities for depressed farm communities in those parts of the country where many pulp and paper mills are already located. The future of kenaf as a newly developed crop for paper production looks bright, and it is well on its way to commercialization.