Scientists Seek High-Yield Soybeans

The soybean industry anticipates world markets for 2 billion bushels of beans by 1985, nearly double the present demand.

This unprecedented demand is challenging growers to plant larger acreages of soybeans and to examine present production techniques. To help growers achieve advances in production, scientists at the U.S. Regional Soybean Laboratory, Urbana, Ill., are cooperating on a broad spectrum of research with the Illinois Agricultural Experiment Station. Research at the Laboratory, administered by ARS, the USDA's Agricultural Research Service, constitutes concentrated team approach to getting answers to the question: How can we step up soybean yields to match increasing world demands?

Nitrogen Utilization:

One puzzle to be solved is how to improve nitrogen utilization. Plant physiologist James E. Harper says about 400 pounds of nitrogen are required to produce a 70 bushel per acre soybean crop. But his research, involving both soil plots and outdoor hydroponic units, shows that neither nitrogen fertilization nor nitrogen-fixing bacteria alone can meet the legume's need for this element at anticipated yield levels. Normally, symbiotic fixation can provide about 100 pounds of nitrogen per acre; however, high levels of nitrate fertilization inhibit fixation.

Accordingly, Dr. Harper is orienting his research toward enhancing the compatibility of the two systems of nitrogen utilization. Soybean plants lose some ability to take up and use nitrate at the end of the growing season – a condition which favors maintaining symbiotic fixation for higher yields. Perhaps some new form of nitrogen fertilizer may be found that is less inhibitory to symbiotic fixation. An alternative may be to seek strains of nitrogen-fixing bacteria that tolerate high rates of nitrogen fertilization.

Nutrients and Lodging:

Improving the crop's ability to use nutrients may intensify another barrier to higher yields -- lodging. Agronomist Richard L. Cooper, research leader of the Laboratory, found that plants affected by early lodging form fewer soybean seeds than do those which escape lodging.

How lodging affects yield is not fully understood, but evidence points to reduced light-use efficiency. When lodging occurs at early pod set, a highly organized crop canopy is disrupted, causing light to be distributed less uniformly over the total leaf area because of increased mutual shading of leaves. Moreover, the older leaves get more light while many younger, more photosynthetically active leaves become shaded. Dr. Cooper suggests that lodging may also lessen yields by stimulating terminal growth and excessive branching at the expense of seed set. Developing semi-dwarf varieties may provide a solution.

Soybean breeders, taking a cue from wheat and rice breeders, are at work developing semi-dwarf soybeans that will be high-yielding as well as resistant to lodging. In other research, Dr. Cooper is investigating the effectiveness of 7-inch rows and low plant populations in preventing lodging. Adequate weed control will be essential for insuring higher yields with narrow rows.

Weeds and Yields:

In research on weed ecology, data on soybean yields are being collected from plots where crops and herbicide treatments have been rotated since 1964. This long-term project, funded by ARS as a cooperative agreement with the University of Illinois, is led by weed scientists, Fred W. Slife of the Illinois Agricultural Experiment Station. Scientists are also compiling information on weed yields, weed seed content of the soil, and herbicide residues -- plus their effects on nematodes and other small animal life in the soil.

Effect of Sunlight:

Plant physiologist William L. Ogren, is probing the secrets of photosynthesis in hopes of increasing soybean yields (AGR. RES., Sept. 1971, p. 8). Dr. Ogren points out that soybeans, compared with plants like corn, sorghum and sugarcane, are inefficient users of sunlight. Photosynthesis in the soybean is retarded by a process called photorespiration wherein the plant, in the presence of light and abundant oxygen, breathes out some carbon dioxide (CO_2) that had previously been incorporated in sugars.

Dr. Ogren is trying to develop nonphotorespiring soybean plants by applying radiation and other nutagenic agents to seeds. If he succeeds in modifying the enzyme that triggers the changing of CO_2 into sugars and vice versa, soybean yields could theoretically increase by about 50 percent.

Content of Beans:

Chemical composition, especially oil and protein content, is an important consideration in developing new soybean varieties. Chemist Orlang A. Krober supervises the annual analysis of 8,000 to 12,000 seed samples, mostly in support of uniform tests in a soybean breeding program which the U.S. Regional Soybean Laboratory coordinates with several State Agricultural Experiment Stations.

He is also developing an experimental infrared reflectance method for determining protein, oil, and moisture content of soybeans. This method may expand the scope of chemical research in breeding programs and may enable growers to be

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