UNITED STATES DEPARTMENT OF AGRICULTURE
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Information on Crops Research

Crops Research Division

The Plant Industry Station is the headquarters for a national program of field- and horticultural-crops research and related activities, designed and conducted for the betterment of the Nation's agricultural production. The extensive activities of the Crops Research Division at the Station include field-plot, greenhouse, and laboratory work in plant breeding, plant diseases, and plant-growth studies, entailing pioneering research in such scientific fields as plant physiology, and plant pathology.

Developing Better Field Crops

Breeding for yield, adaptation, and disease and insect resistance, and investigations of disease-control methods, are the chief activities in the improvement of cereal, forage, fiber, tobacco, oilseed, and sugar crops at the Plant Industry

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A potato specialist prepares to put potato fruits into a bag to assure the identity of crosses from hand-pollinated flowers.

Station. Collections of varieties of barley, wheat, oats, alfalfa, clovers, soybeans, tobacco, flax, rice, sugar beets, and grasses from all over the world are maintained.

The greenhouse facilities often make it possible to grow an extra crop during the winter months and thus speed the development of new varieties. Seed produced during the winter may be sent to another locality for spring planting, and this in turn may produce seed for a third crop, all in the same year. In this way seed of promising varieties may be built up rapidly and field tested at many locations for further selection.

The history of crop breeding for resistance to disease demonstrates that improvement of crop varieties is a continuous process. On one side is Nature's creation of new diseases. On the other side is man's constant search for genetic resistance and development of varieties that will stand up under attacks of disease organisms. To find needed resistance characteristics, it is sometimes necessary to make inoculation or other screening tests on thousands of varieties from all parts of the world. The search for resistance to race 15B of wheat stem rust—which included the screening of more than 10,000 varieties or strains—is an example. This work is done at the Plant Industry Station and at cooperating State agricultural experiment stations on cereals and other field crops. Once the desired plant characteristics are found, the long process begins of crossing and backcrossing to transmit these characteristics to good commercial varieties.

A story of long, painstaking work is back of almost every plant-breeding achievement in field crops. Hybrid corn, for example, was developed only after years of effort by many scientists. It has been generally adopted by farmers in the United States. In the central Corn Belt States hybrid corn is grown on almost all the acreage seeded to corn. This hybrid principle is now being applied to other crops.

Plant breeders constantly strive for crop varieties that have high and dependable yielding capacity and high quality. Testing wheat varieties for high milling and baking qualities, barley varieties for malting quality, and feed crops for nutritive value are a part of the crop-improvement process. In cotton, for example, spinning quality is one of the important desired characteristics. Scientists at the Station carry on studies to determine fiber strength and spinning quality. On the basis of these tests they can predict the yarn strength of different varieties.

In addition to the greenhouse breeding and development work, testing and selection are performed in nurseries and field plots at the Station, including studies of grazing management of grasses and clovers.

Weed Control and Herbicides

Weeds may be controlled by cultural, mechanical, biological, or chemical methods. Combinations of these methods may often be required to control some weeds. Chemical weed control is now a common farm practice. Investigations at the Plant Industry Station include (1) an evaluation of chemicals for their herbicidal efficiency in preplanting, preemergence, and postemergence sprays for selective weed control in field and horticultural crops; (2) the relationship between chemical structure and herbicidal activity and the modes of action of herbicides; and (3) determination of the physiological effect of herbicides on plant processes and chemical composition.

The absorption and translocation of herbicides are also being studied to improve efficiency in killing deep-rooted perennial weeds and woody plants. Some herbicides are volatile; they may be lost in the vapor state before weeds emerge, or they may evaporate and injure adjacent susceptible plants such as grapes, cotton, and tomatoes. Plant scientists are attempting to change the molecules of herbicides in such a way as to reduce their volatility. The herbicidal properties of hundreds of new chemicals have been evaluated. The most promising ones are being studied more intensively under a wide variety of soil and climatic conditions at field locations.

Chemicals Regulate Plant Growth

Hundreds of chemicals are being investigated to detect new compounds that might regulate the growth, development, fruiting, or keeping quality of useful plants. New materials are first applied to plants in small doses, and those that appear to be effective are given extensive testing. Plant-growth regulators are used commercially to thin fruits; to prevent the dropping of the fruits, flowers, and leaves; to stimulate root growth on cuttings; and to check the sprouting of potatoes.

Radioactive tracers have been used to study the means by which these chemicals enter a plant, the mechanism of transport through the plant, and the final location in the plant tissues. The tracers have shown that growth regulators of the 2,4–D type are absorbed by the plant and transferred to the part that is developing most rapidly at the time of application. At certain concentrations the growth regulators retard the growth of broad-leaved plants (dicotyledons) but do not affect the growth of grasses (monocotyledons) appreciably. These effects are due to differences in the way the plant constituents react to the compound.

Possible future uses for growth-regulating chemicals include (1) holding back parts of a planting to permit a season-long spread of vegetables; (2) checking the growth of shrubs to keep them from dwarfing other plantings; (3) controlling top growth to let more soil nutrients get into the usable parts of a plant and thus increase its nutritional value; and (4) dwarfing a plant, such as alfalfa, so that it can be used as a growing mulch for corn or can furnish nitrogen in pastures without competing with soil-holding grasses.

A seedless greenhouse tomato has been produced experimentally by using a compound made of 2,4–D and certain amino acids. Experimentally the addition of boron to 2,4–D speeded sugar movement within a plant and helped it absorb and move 2,4–D faster to various parts. Bananas ripened with 2,4–D are uniform in color and are

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Plant scientists observe spraying of corn, soybeans, cotton, and wheat with a new chemical being screened for its weed-killing value.

sweet. Moreover, expensive ripening rooms, which are needed when ethylene is used for ripening, are not required. Peach thinning is possible with 3–Cl–IPC (isopropyl N–(3-chlorophenyl) carbamate). One of the deadliest weed-killers, 2,4,5–T, shows promise experimentally when used in a spray to hasten maturity of peaches and apples and to delay maturity and raise yields of bush lima beans.

Alpha-methoxyphenylacetic acid, known as MOPA, is a fast-moving growth modifier that apparently moves both up and down in a plant. It forms a gall at the treated part of a young bean stem and a secondary gall at the plant tip. This stops tip growth, stimulates side shoots, and delays flowering and fruiting of the plant. MOPA may have value in making some plants shorter and bushier. It can move through adjacent roots from one plant to another and from one kind of plant to another. Gibberellic acid is another growth regulator studied experimentally as it affects many field and horticultural crops.

Light and Plants

The effect of length of day and night on the growth and flowering of plants is being investigated in greenhouses and special chambers equipped to provide light or darkness at will. The studies include tests of different wavelengths, or colors, of the visible spectrum.

Length of night affects plant growth more than length of day. Red light stimulates growth of some plants. Far-red, the barely visible radiation on the edge of the spectrum, and infrared undo the effect of red light. Light has been used experimentally to regulate flowering, seed germination, coloring of tomato skins, and growth of bulbs, roots, and seedlings.

Antibiotics

New antibiotics and related compounds are screened for their ability to control crop diseases. Streptomycin, the commonly used medical antibiotic, will control such plant diseases as halo blight of beans, wildfire of tobacco, fire blight of apples, and bacterial spot of tomatoes. Basic studies are made on the absorption and translocation of antibiotics and related substances, and new methods are being developed for testing and using them efficiently.

Better Vegetables, Fruits, and Flowers

About one-third of the vegetable and fruit research at the Plant Industry Station concerns the breeding of better varieties and strains. Most of the remainder concerns crop quality, growth, nutrition, and the causes and control of fungus, bacterial, and virus diseases of vegetables and fruits.

Plant breeders at the Station also do research on ornamental plants. They have made available to the domestic bulb industry new varieties of lilies, and they are developing improved varieties of snapdragons, azaleas, carnations, and daffodils.

Lima bean varieties of good eating and market qualities and dependable

A variety of vegetable and field-crop plants grown entirely under artificial light controlled for quality intensity and duration.

yields have been produced in several sizes that are adapted to different purposes and to wide areas. The development of commercially acceptable types of lima beans that are widely adapted and resistant to nematodes, insects, and diseases is the objective of a program that has become countrywide in scope through cooperation with State vegetable specialists.

Mosaic-resistant snap beans of superior quality, such as Topcrop, have been developed.

As a result of the national potato-breeding program of the Department of Agriculture in cooperation with the States, many new varieties have been produced that are popular with farmers and consumers. Careful breeding work is creating varieties of potatoes that are resistant to the major diseases, mature at the right time, adapt to a specific locality, and have good shape, shallow eyes, and high yield.

The hybrid onion industry has grown out of onion-breeding work. Many onion hybrids are now available to growers.

Sweetpotatoes are being bred for resistance to wilt and black rot and for high carotene content, eating quality, and yield.

The fruit-breeding work of the Crops Research Division and cooperating State stations is particularly valuable to growers of peaches, grapes, pears, strawberries, blueberries, and cranberries.

Strawberry breeders have grown more than 500,000 seedlings, from which a few thousand were selected for further testing. More than 25 have been named and introduced to the trade, and several others are under test. Some of these new varieties are widely grown commercially. One of these, the Blakemore, is the most extensively grown variety in the United States. Almost all the strawberries grown in the eastern part of the United States are infected with hidden virus diseases. Special testing techniques make it possible to isolate clean stocks of 25 varieties that have been propagated for release.

Tomato-breeding work in the Department of Agriculture began about 40 years ago. Prior to that, research aimed at developing resistance to fusarium wilt had been done in a few tomato-growing States. Since 1918 practically all the old varieties have been replaced by new varieties in commercial fields. The tomato acreage has greatly increased. The concentration of the industry has made the disease problem greater and the need for new varieties more acute.

Another phase of research is the introduction and testing of promising seeds and plants from other countries to determine whether they can be used in the genetic improvement of domestic crops. Introduction of the Peruvian wild currant tomato by the Department of Agriculture in 1930 gave great impetus to improving disease resistance in tomatoes. This species proved highly resistant to fusarium wilt and several other diseases. It has been used by many breeders in developing new varieties, including some that are resistant to cladosporium leaf spot, a disease that is troublesome in commercial greenhouses and in some fields where high humidity and cool temperatures prevail during the growing season. Other wild species are being used as parents in attempts to improve disease resistance.

The Crops Research Division conducts research on nematodes in relation to plant growth, and it issues reports on currently prevalent plant diseases. It directs tree- and other plant-research activities at the National Arboretum, which is located at 28th and M Streets NE. in the District of Columbia.

Fungus Collections

The National Fungus Collections, second largest in the United States, contain more than half a million specimens of fungi. They are kept in the herbarium in the North Building, Plant Industry Station. They include the fungus specimens of the Department of Agriculture and the Smithsonian Institution. More than 25,000 species of fungi are included, and about 7,500 species are represented by type material or the equivalent. Particular attention is given to fungi that cause plant diseases. Fungus determinations are made, and mycological information is furnished.