result in other forms of host toxicity if improperly used.

Well, gentlemen—that is a base canard they have spread about me. Here it is—still November the first—and I am through talking.

As a matter of fact, I am intentionally cutting this talk short. Just before I came up here on the platform, the chairman asked me if I knew the definition of an audience and before I could reply he said, "An audience is something that you should leave before it leaves you."

THE ROLE OF THE REGIONAL VEGETABLE BREEDING LABORATORY IN BREEDING AND TESTING NEW VEGETABLE VARIETIES

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For those who may not be familiar with the purpose and organization of the Regional Vegetable Breeding Laboratory, let me say that it was established in 1936 to aid in the development of improved varieties of vegetables for the South in collaboration with the 13 Southeastern States. Emphasis should be placed on cooperation with the state agricultural experiment stations, each of which, from Virginia to Oklahoma and Texas and all States south and east, has an official collaborator, appointed at the recommendation of each Station Director.

As a matter of fact, cooperation among the vegetable breeders of these States and of the U. S. Department of Agriculture has developed far beyond the point of formal collaboration, to the mutual advantage of all groups. The breeding of vegetables and other plants is a rather complex process, being made up of several distinct operations. These steps include the selection of breeding materials as parents, the adoption of a system of breeding, making the crosses (which involves a wide variety of techniques according to the crop), the selection of individuals and later of breeding lines, the regional comparison of the new lines with established varieties, and finally the increase of seed and introduction of the new variety. Some of these operations can be accomplished only by the active cooperation of a number of individuals. Other steps are often more effective if several workers can get together to pool their resources.

A good example of the necessity for cooperation is the regional testing of promising breeding lines. Here in the South the Southern Section of the American Society for Horticultural Science has set up an organization to handle such trials. While the horticulturists initiated the organization, it is open to all station workers in the region who are actively interested in vegetable breeding and in new varieties. It includes quite a number of plant pathologists, a few agronomists, and many horticulturists not actively engaged in the earlier phases of breeding. The work is done by a crop chairman and a variable number of cooperators, depending on the interest in and importance of the crop. The cooperators are usually widely scattered over the entire region. The chairman collects the several lots of seed, distributing identical sets to all cooperators. With the help of the group at annual meetings and by correspondence, he develops a set of forms for taking notes. At the end of the season all records are sent to the chairman, who assembles the information for reporting to all the cooperators. Where several newly introduced varieties have been included in the trials, a report may appear in one of the trade journals.

There are several advantages of such a comprehensive test to the vegetable breeder and ultimately to the vegetable grower. Information in regard to seasonal effects on a breeding line in comparison wth a standard variety accumulates very rapidly in the regional test. Questions of fruit size, quality, and production under adverse conditions receive a ready answer. This often prevents the introduction of a breeding line of limited adaptability that looks good locally for a few seasons, and thus may save growers and seedsmen money and the investigators embarrassment by avoiding subsequent commercial failure. Since seedsmen quite understandably hesitate to add to their list varieties adapted to only a small area, the demonstration of wide regional adaptability for a new introduction permits its enthusiastic acceptance by the seed companies and thus assures a seed supply more comparable to that of established varieties.

Florida Station workers are making important contributions to these cooperative tests. G. K. Parris, in charge of the Watermelon and Grape Investigations Laboratory at Leesburg, has recently assumed the chairmanship for the watermelon trials. Cooperators in the tomato work include F. S. Jamison at Gainesville, B. F. Whitner at Sanford, G. D. Ruehle at Homestead, D. G. A. Kelbert and J. M. Walter at Bradenton, and Emil Wolf and Norman Hayslip of the Everglades Station, who have trials at Boynton Beach and Ft. Pierce. R. A. Conover, plant pathologist at Homestead, is making one of the sweet corn plantings this year. Other locations for sweet corn include Bradenton and Gainesville. Additional Southern Cooperative Vegetable Trials in Florida are at Sanford on English peas, by R. W. Ruprecht, at Hastings on broccoli and cabbage by E. N. McCubbin, and at the Everglades Station on snapbeans by W. A. Hills. It should be made clear that such trials are inactive on some crops, such as table beets, for which we find little or no justification at present. Other crops, such as celery, are not grown in enough widely separated districts in the South to make cooperative tests feasible.

To illustrate the increased effectiveness of cooperation in vegetable breeding let me cite the work on nematode resistance in the tomato. In the early thirties the Division of Plant Introduction of the U. S. Department of Agriculture sponsored a trip to South America by the late H. Loran Blood, U.S.D.A. plant pathologist then located at the Utah Station. Among the vast array of tomatoes secured were several lots of a related wild species, *Lycopersicon peruvianum.* Seeds of this material were distributed widely to tomato research men. In 1941 D. M. Bailey of the Tennessee Station reported resistance to nematode in *peruvianum.* Unfortunately the strains resistant to nematode were very difficult to cross with the tomato species used commercially. Just before World War II Paul G. Smith of the California station succeeded in growing three F_1 plants of the cross Michigan State Forcing X *L. peruvianum* by means of embryo culture. These plants were self-sterile and appeared to be sterile in crosses with the commercial type of tomato. Since this work had to be discontinued because of the war, cuttings were sent to V. M. Watts, tomato breeder at the Arkansas Station. Watts was successful in getting self-fertile plants from crosses between the nematode-resistant hybrid and other commercial varieties but under his conditions was unable to select pure resistant stocks. Because of this difficulty seeds of these lines were sent to W. A. Frazier out in Hawaii. Frazier and his associate R. K. Dennett were able under conditions in Hawaii to isolate resistant lines that were "essentially homozygous" for this character and part of the seeds were returned to Watts, who is now bringing the fruit up to commercial size. The net result is a valuable new source of nematode resistance in the tomato. Now it could be argued that all of this might have been done at a single location by a single man, and we shall have to admit that theoretically it could, but experience tells us that theory and practice are here at odds. We can say that such informal cooperation is proving to be a very effective way of getting satisfactory results.

The remainder of the time will be devoted to the activities of the Vegetable Breeding Laboratory working with others, particularly as they are related to the improvement of varieties of vegetables in Florida.

The late B. L. Wade, who was in charge of the Laboratory from its inception until he went to the University of Illinois in September 1948, was enormously interested in the breeding of snapbeans. A great deal of emphasis was placed on resistance to disease in beans as well as in other crops being bred at the Laboratory. In January 1940 he distributed small samples of 47 breeding lines to bean breeders at experiment stations in the Southeast. A planting was grown at the Everglades Station at Belle Glade. Most of these beans were in the third or fourth generation of crosses between U. S. No. 5 Refugee or other varieties originated by Wade and W. J. Zaumeyer at Greeley, Colorado, and varieties common in the South. Such lines were not fully fixed in many of their characters and this gave State cooperators a chance to select for types especially adapted to each area. At Belle Glade this selection was done by G. R. Townsend, at the time plant pathologist with the Everglades Station. In the early plantings injury from the bean leafhopper was severe, and susceptible lines were attacked by rust and by powdery mildew. Of the first 47 lines grown, seven were selected, seed being saved on a single-plant basis. In 1941 five of these lines were eliminated because of the presence of several races of rust. The two remaining lines were named in 1943 and released to the seed trade for increase and sale to the local growers. These two breeding lines were named Florida Belle and Florida White Wax. They are resistant to the common races of rust that exist in Florida, to powdery mildew, and to common bean mosaic, and they are heat and drought tolerant. In addition to serving as important commercial varieties these two snap beans have been used in the breeding program as parents. Their disease resistance has been transferred to several hundred additional breeding lines many of which have been or are now under test in Florida.

Contender, a new fresh-market snap bean, was recently introduced in cooperation with the Mississippi, Florida, and Alabama agricultural experiment stations. It is expected that this bean will be of some value to the commercial growers of Florida as a shipping type. Usually about 50 percent of Contender's pods reach the No. 4 sieve size 50 days from planting. The pods are similar to those of Stringless Black Valentine; but under most conditions they average ¾ of an inch longer, and are slightly heavier and thicker. The pod shape of No. 3 and 4 sieve sizes is a plump oval, but pods of larger sieve sizes approach the round index and are generally classified as off-round. No significant difference has been found between the curvature of the Contender and Stringless Black Valentine pods from the first harvest when grown at Belle Glade. The pods do, however, tend to curve more after the first harvest or during hot weather. The color index is considered medium for both varieties. Contender develops some purple splashing of the pods when grown on very infertile soils, the amount being negligible under desirable growing conditions. The pods of this variety are stringless and the total fiber content is significantly lower than that of Stringless Black Valentine. The seeds are buff with a slight mottling of brown and they average approximately 70 per ounce. Contender is resistant to common bean mosaic and has considerable resistance to powdery mildew. Yields have been consistently higher than those for Black Valentine.

Our breeding work with snap beans is now being done by J. C. Hoffman of our staff, who was formerly horticulturist at the Everglades Station. Trials of breeding lines are being continued at several locations in Florida as well as in other Southern States. W. A. Hills of the Everglades Station has recently selected two new lines from such material. They combine resistance to disease with high quality. Both will probably be entered in the 1951 Southern Snap Bean Cooperative Trials, of which Hoffman is the chairman.

Interest in frozen beans is on the increase in Florida. Mr. Gray Singleton, Southland Frozen Foods, Inc., Plant City, Florida, has tested a large number of our breeding lines. This work is also in cooperation with the Agricultural Experiment Station. Cooperation with commercial concerns has been found to be very effective, since they supply freezing facilities and help evaluate our more advanced breeding lines for processing. A new selection of B1515 may have some very valuable commercial possibilities as a freezing and shipping type. Seed of this is being increased with a view to introduction.

In addition to the processing tests, many commercial growers have been very cooperative in comparing these new breeding lines with standard varieties. These commercial tests are considered of the greatest importance in evaluating advanced breeding lines, and without this help from growers we could accomplish little.

Our breeding work with English peas is, in a sense, pioneering, since there is now no large, well established pea industry in the South. This is a cool weather crop, yet it lacks adaptability to long periods of cold weather and has a narrower range of optimum growing conditions than cabbage, for example. In its early life it can be quite hardy, yet when it comes into flower it loses its hardiness to cold while exhibiting a distressing dislike for hot weather. Southern winters being what they are, our English pea breeder, J. A. Eades, who is also chairman of the Southern Cooperative Pea Trials, faces a problem of considerable dimensions. He has had a good deal of success in developing dwarf to semi-dwarf lines with a high degree of cold hardiness through the first eight nodes and that yield much better under adverse conditions than established varieties like Alaska, Progress, Thomas Laxton, and Little Marvel. Hardiness has been obtained from the cold resistant Willetts Wonder and Austrian Winter and high quality from the standard market garden varieties, such as Progress. Cold tests carried on in the field during the winter are supplemented by the artificial freezing of young plants in a liquid that freezes at a temperature much lower than that at which water freezes.

It has been observed that practically all varieties of peas are hardy for the first three nodes and that this early hardiness is lost when the plants come into bloom. The earliest varieties, which bloom early, thus soon lose their resistance to cold. One trick in breeding for hardiness, then, is to select plants that bloom a little later, yet maintain this resistance to cold until they come into bloom. Some tolerance to heat has also been observed and incorporated in the hardy lines. Wando, a variety introduced by the Vegetable Breeding Laboratory, combines a considerable degree of resistance to both heat and cold. So do two advanced breeding lines, P17 and P84. Both of these are in the Southern Cooperative Pea Trials. These have been grown by R. W. Ruprecht at the Central Florida Experiment Station at Sanford and by F. S. Jamison at Gainesville. These trials have turned up two varieties for freezing that look promising—Dark Skinned Perfection and Victory Freezer. The development of fully satisfactory market garden and processing types of English peas would be a boon to Florida growers by providing a cash crop at a relatively slack season.

The tomato breeding program at the Regional Vegetable Breeding Laboratory has been conducted since 1945 by C. F. Andrus, who has developed the pattern of the Southern Cooperative Vegetable Trials in his capacity as chairman of the tomato variety tests. Disease resistance has been, and still is, the keynote of the tomato breeding efforts. Most breeders agree that resistance to fusarium wilt should be a requirement for every variety for which a wide distribution is anticipated. Other diseases for which resistance is now available in breeding lines include alternaria, anthracnose, bacterial wilt, collar rot, early blight, late blight, leafmold, mosaic, rootknot, septoria, southern blight, spotted wilt, and stemphylium. It should be pointed out that a number of these breeding stocks are lacking in size of fruit or other horticultural characteristics. Considerable progress has been made toward combining resistance to several diseases in a single stock, usually a combination of resistance to fusarium wilt and to two or three other diseases.

More work is being done on the breeding of tomatoes than of any other single vegetable crop in the South. This is reflected in the larger number of breeding lines—no less than 160 observed thus far in the cooperative trials. As with other crops, the Laboratory sends to State men breeding lines of tomatoes as sources of disease resistance or other desirable characters. During the past three years 107 packets of seed of tomato breeding stocks have been sent to Station workers in Florida alone.

The Laboratory has two new breeding lines, grown in the cooperative trials under the numbers STEP 68 and STEP 89 in which Florida growers have shown considerable interest. Both of these lines rank high in the STEP trials, which indicates, among other things, a wide adaptability to diverse growing conditions, and can mean consistency in production over a period of years. STEP 68 has large red oblate fruits that mature as early as Grothen's Globe. In addition it is resistant both to fusarium wilt and to alternaria leaf spot. STEP 89 is the most productive tomato in the cooperative trials, and equals Rutgers in size, earliness and appearance. It is also resistant to fusarium wilt. It is anticipated that tests of these two varieties in Florida will total over a hundred acres this season.

The development of the Congo watermelon is another example of the value of cumulative contributions by many interested workers. Congo's value to the industry lies in its combination of four highly desirable characters, viz, fruit size, dessert quality, shipping quality, and resistance to anthracnose. The anthracnose resistance was found in a watermelon brought to this country from Africa by a missionary. Crosses were made with that melon as one parent at the Iowa Experiment Station. This material was selected at Leesburg, and also at the Regional Vegetable Breeding Laboratory by C. F. Poole, who is now breeding vegetables in Hawaii, and by C. F. Andrus, who has continued the breeding of watermelons at the Laboratory. A selection was crossed with Garrison and seedlings were saved on the basis of four characters mentioned. The "cooperation" thus far was more or less haphazard, but from this point on the tests in growers' fields and the estimates of shipping quality were the result of the interest of many people working together towards a definite goal. Among these were State and Federal research men, State extension workers, railroad agricultural agents, seedsmen, and growers in Florida and northward along the coast to the Carolinas.

The Leesburg and Charleston laboratories have worked together very closely for the past 12 years. This has included a generous exchange of breeding materials which have been used at both locations. One result of this cooperation is the wilt resistant Ironsides watermelon, which is about ready for release by the Florida station and the Department.

My own breeding work is with cabbage and sweet corn. Breeding techniques for cabbage have received a good deal of attention. These include methods of storage, the flowering of plants from the spring crop under controlled conditions, with and without flower-stimulating chemicals, and artificial tests for resistance to cold in the seedlings. Numerous crosses have been made between well adapted breeding lines and yellows-resistant varieties of high quality. These are being selected for desirable combinations in the fall crop.

Considerable resistance to the corn ear worm is being obtained in adapted sweet corn inbreds. This appears to be of two types—physical structure and some chemical constituent that is unattractive to the insect. After careful consideration of the evidence I have come to the conclusion, in spite of lively discussions between proponents of the two theories, that the two are not mutually exclusive, but that a long, tight husk may supplement the more subtle chemical resistance in reducing damage from this insect.

Another important problem of sweet corn growers in the South is the maintenance of sugar content of market corn shipped to the North. Both the original sugar content and the rate of loss at various temperatures are concerned. This is perhaps a good place to introduce the work of our chemist, Margaret Kanapaux. Numerous samples of both varieties and breeding lines of sweet corn have been analyzed for sugar content just after harvest and after storage at room temperature and at 45° F. Varietal differences have been found for both reducing and total sugars as well as differences in sugar retention at both temperatures. The work thus far indicates the possibility of increasing both sugar content and sugar retention in sweet corn through selection.

A great variety of chemical tests are made each year in support of the breeding program. These include many assays of the ascorbic acid content of snapbeans and cabbage, and especially of tomatoes. The thiamin content of English peas is under investigation. Fibre content and the color values of pods of snap beans are other characteristics that are accurately determined in the laboratory. Nutritive values are among those things that are affected by both hereditary factors and growing conditions. While the slogan "Eat this because it is good for you" is not one that is calculated to guarantee the acceptance of a new variety, it is something that is important to the general health and as such is the proper concern of the plant breeder.

In this discussion of the breeding and testing of new vegetable varieties I have emphasized cooperation among those engaged in this work as one of the essential "facts of life." I favor cooperation not just because it might be a popular movement, but because it helps get results. Biological research is at least as complex as research in engineering and in the sciences of physics and chemistry. It is a considerable source of satisfaction that vegetable men in the South interested in the development of new varieties are finding a mutual advantage in the exchange of information and materials of aid in their research and that these are being handed on to the growers of Florida and other southern States as increased help in solving their common problems.

NEW VEGETABLE VARIETIES FOR FLORIDA

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Since 1944 the last information on vegetable varieties for the State of Florida was compiled, hundreds of new varieties and lines of vegetables have been tested and evaluated by experiment station workers in all vegetable growing areas in the State. Much of the information in this paper has been contributed by these investigators.

Plant breeders have placed much emphasis on resistance to plant diseases in the breeding of vegetables. The number of new varieties which have resistance to one or more serious diseases testifies to the great strides that have been made along this line. Resistance to disease (and in some instances to insects) is highly important. In fact in some areas it is absolutely necessary where soils have become so contaminated with destructive diseases that the growing of susceptible crops is no longer profitable. Rotation of crops on these lands tends to reduce the severity of infection on the next susceptible crop, but proves of little value if conditions are optimum for the development of disease. At present the only practical answer to the problem of infested soils is through resistant types.

Many modern vegetable varieties are not only resistant to soil-borne disease such as fusarium wilt, bacterial wilt, potato scab, etc., but also extremely resistant to diseases which cause leaf and fruit spots such as early blight, late blight, grey leaf spot, and so forth. One of the new cantaloupe varieties is even considered resistant to attack by aphids as well as the powdery mildew. The breeding of these characters into vegetables has required years of diligent work by the men responsible for the great advances that have been made. There are still many problems to be solved. Unfortunately many of the new varieties, especially those resistant to certain diseases, seem to be adaptable to a very limited area and environment. This seems to be especially true of tomatoes. Many new tomato varieties that seem to have nearly every desirable character such as multiple resistance to diseases, excellent quality and high yield capacity in the area of their conception, fail miserably in another area, often only a few miles away with