PRESENT STATUS OF THE MOSAIC DISEASE OF VEGETABLE CROPS IN SOUTH FLORIDA

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The farm lands along the Atlantic coast from West Palm Beach to Homestead constitute one of the largest winter vegetable sections in the United States. Practically all of the common vegetables are found in this area at some time during the season from October to May, varying from snap beans in early fall to peppers, squash, lima beans, and tomatoes in late spring. The approximate acreages of the most important crops are as follows: peppers 4,200; squash 3,500; eggplant 1,000; cucumbers 2,000; lima beans 3,000; snap beans 30,000; and tomatoes 11,000. Since harvests of these crops are made at a time when green vegetables are scarce in most parts of the country, the acre value in South Florida is usually high. Accordingly, any factor that influences yields is quickly reflected in the income of the individual farmer.

Florida vegetables have suffered heavy losses at various times from both fungus and bacterial diseases but only recently have some of the crops listed above shown serious infections by virus diseases. While diseases due to virus infections have been present to some extent each year on practically all crops, their importance when compared to other diseases has been considered only nominal. Since 1944, however, the increase in severity of all virus troubles in South Florida has been at an alarming rate, reaching a point at the present time when the future of some crops is in doubt, unless resistant varieties can be developed. In order that this problem may be more clearly seen, a brief description of the most important diseases is given below:

Snap Beans. The common bean mosaic virus has been noted in all fields each season for the past three years, usually being somewhat more prevalent in early fall and late spring than during the mid-winter months. Until the season of 1946-47, most of the trouble was confined to the foliage, with only an occasional pod showing distortion or roughness. During this past season, however, many fields throughout the South Florida area became heavily infected, with both pods and foliage showing typical virus distortions. The condition became so serious during January and early February that prices of beans from some infected fields dropped almost 50% on local markets.

Inoculation studies showed that the cause of this outbreak was due to the common bean mosaic virus or some variant of this virus. Since these studies were only exploratory in nature and did not cover the entire field, it is possible that other viruses may have been involved. Due to the fact that the common bean mosaic and its related strains are seed-borne, it may be assumed that the initial infection concerned in the present case was introduced in the seed. Much of the secondary spread may have resulted from aphid infestation, as this insect was present in most fields during the season. Previous studies have shown that most species of aphids are capable of transmitting the virus. Another possible contributing factor, especially in the detection of symptoms, may have been the unusually high daily mean temperatures during the months of October through January. Mo-

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saic is difficult to diagnose under certain weather conditions but weather has little effect on its presence. Low temperatures mask symptoms of mosaic whereas reasonably high temperatures favor their appearance. Comparative data show that temperatures during this period were approximately 10° F. higher than the long time average for these months.

Peppers. When considered from a monetary viewpoint, peppers have suffered much greater losses during the past three years than beans. Most peppers in South Florida are started in seed beds, then transplanted by hand to the fields. This method of handling subjects the plants to considerable bruising and may contribute appreciably to the spread of the virus diseases. In addition to this, aphid infestation is very heavy at times and spread by aphids is probably the most important factor in the spread of the disease.

Virus leaf mottling appears in most cases on peppers soon after the plants are transplanted. As the plants increase in size new leaves become infected and, finally, the fruits themselves. In the latter case the fruits become knotty, irregular in size, and poor in color. Seldom do fruits reach normal size, thus yields are reduced both in quantity and in grade.

During the past year pepper fields began showing severe mosaic symptoms by early November and continued to do so throughout the entire season. Many fields failed to yield sufficient fruit to pay cost of production while others showed heavy losses in grade. At no time during the season were there full shipments of top grade peppers from South Florida and most of this can be attributed to mosaic infection.

The principal cause of pepper mosaic in this section of the state is very probably cucumber virus 1, although other viruses may be involved also. This particular virus is known to attack a wide range of wild host plants, many of which are found along local canal and ditch banks, thus opportunity is afforded at all times for spread of the virus to pepper fields by aphids. Little attempt has been made in recent years to kill out wild hosts around cultivated fields so the present serious condition may be the result of this neglect.

Squash. The growing of squash in the Pompano area of Broward County has been curtailed to a considerable extent during the past three years as a result of heavy mosaic losses. Many growers have either quit growing this crop or else have moved to other sections where "new" land may be had. experience having shown that repeated plantings on the same land results eventually in total loss of the crop. While the Pompano section has suffered the greatest losses from mosaic, there is no section along the lower Florida east coast that is free of this trouble.

As in the case of peppers, squash plants usually show infection in the early stages of growth, although the heaviest damage occurs immediately before and during the harvest period. The leaves show mottled or savoyed areas, also dark green and yellow blotches. In some cases, blossoms fall before fruits are set and infected fruits that remain on the plants show mottled areas which make them unfit for market. It is not uncommon to see more than 50% of the fruits from an infected field discarded on account of mosaic infection. In many cases entire fields are abandoned by the time of the first harvest.

The principal virus connected with squash mosaic appears to be cucumber virus 1. Since this virus is not believed to be seed-borne, we may assume that it persists on wild host plants in or near cultivated fields. Several different insects are capable of transmitting the disease from one plant to another, but it is probable that aphids are largely responsible for the present widespread infection in South Florida. In this connection it is of interest to note that losses have been particularly severe during warm periods when insect infestation was high.

Cucumbers. Although cucumbers are not

grown in South Florida on a large scale, the per acre returns are usually fairly high, consequently any appreciable reduction in yield becomes of considerable importance to the individual farmer. While diseases such as downy mildew and bacterial wilt are serious at times, mosaic is becoming more of a limiting factor in production each year. All fields show some loss from this disease and many yield less than half a crop. Much as in the case of squash, it is no longer safe to grow cucumbers on old lands in this section.

Mosaic may attack cucumbers at any time. The young leaves become dwarfed, cupped, densely clustered, and dark green. Old leaves turn yellow and the fruits become dwarfed and malformed. This results in reduced yields in the fields and very heavy losses in the packing sheds due to grading out fruits that fail to meet grading standards.

Cucumber mosaic is caused by one or more strains of cucumber virus 1. As in the case of peppers and squash, this disease lives over from one year to another on wild host plants and can be spread from these to the cucumbers by insects. Aphids are particularly bad on this crop and aphid transmission is probably the most important factor in disease spread. The elimination of weeds around the fields appears to be the first step in control. After this, a rigid attack on insect infestation, particularly the aphids.

Tomatoes. Virus diseases have been present on tomatoes in South Florida for many years but have not been of serious concern to the average grower due to the fact that good yields have been had in most cases in spite of widespread infections. In recent years, however, losses due to mosaic have become fairly common and in some instances quite serious. As in the case of other vegetable crops, mosaic may attack tomatoes in this area at any stage of growth. Some fields have been observed where most of the plants showed infection shortly after transplanting while others showed symptoms at any time from date of first bloom to last harvest.

There are a number of different viruses that attack tomatoes but the two most common in South Florida are cucumber virus 1. and tobacco virus 1. Very likely, there are others present also, since host plants of some of these forms are common over much of the territory. The symptoms usually noticed first in commercial fields are spindled, spirally twisted, curved or filiform young leaves with older leaves becoming chlorotic and often rolled or folded. These are the typical symptoms of cucumber virus 1. In other cases the plants may be normal or stunted but with the leaves showing bright mottled patterns with raised green areas. Some foliage may show a fern-leaf distortion or may be otherwise reduced in size. These are symptoms of tobacco virus 1. Regardless of the virus concerned, infected plants suffer from reduced leaf area and impaired chlorophyl activity, both of which influences yields and quality of fruits.

As in the case of peppers, much of the tomato acreage in South Florida is set with plants from seed beds. The amount of bruising that results from this method of planting could account for a considerable amount of disease spread. Insects, particularly aphids, may also play an important role in disease dissemination during certain periods of the winter season.

In most cases tomato mosaic gains entrance to both seed beds and cultivated fields through the medium of wild host plants. There are few if any fields in South Florida which are free of all weeds capable of harboring one or more of the tomato viruses, consequently the possibility of infection from these sources is present at all times. While better insect control and a general clean-up of ditch and canal banks would probably not completely control the mosaic troubles on tomatoes, this practice would very likely reduce to a considerable degree the severe losses that are being experienced in some sections of the lower Florida east coast.

Wild hosts. There are many weeds in South Florida which harbor viruses of various kinds. These grow in profusion along canal and ditch banks and provide a constant source of inoculum for several of the cultivated crops. That these weeds play an important part in the present serious condition can not be doubted, however, the identity of the respective viruses on these wild host plants is not well known and until a thorough study of them is made a sound program of control can not be recommended. During the past year, the Everglades Experiment Station at Belle Glade has instituted studies on the problem and out of this should come a better understanding of the disease complex and a logical approach to the commercial control of all mosaic troubles in South Florida.

CONTROL OF CELERY DISEASES

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One of the tests given to inmates of insane asylums to determine their eligibility for release is to give them a mop and let them into a room containing a wash basin running over the brim. If the patient begins to mop the floor before he turns off the faucet he stays. For at least sixty years farmers and experiment station workers have been mopping celery diseases frantically while the basic sources continue to flow unheeded.

We spend approximately a quarter of a million dollars in Florida annually for chemicals, and a lot more for labor and equipment in attempts to control our number one celery disease, Cercospora blight. A substantial portion of state appropriations are spent finding out which chemical to use, how many pounds to add to 100 gallons, how many gallons to spray on an acre, what supplements to mix with it, how often to apply it, proper pressure, orifice size, nozzles per row and a dozen other technical angles.

At first we were exploring the use of copper compounds. Bulletin 366 published in 1942 summarizes results of eleven years work by Townsend of the Belle Glade station on the use of copper-containing materials. Now the trend is toward organic materials, particularly the carbamates. At Sanford we like a mixture of iron and zinc dimethyl carbamates, now being marketed in 70 percent active powders as Fermate, Zerlate and Karbam. We find that one pound each of the iron and zinc salts in 100 gallons of water, applied weekly at the rate of 125 gallons per acre, controls blight. The sprayer should operate at 300 pounds pressure and have at least three nozzles per row.

Although we like this mixture best there are other materials that will control blight. The sodium ethylene carbamate marketed as Dithane D14, the zinc ethylene carbamate sold as Dithane Z 78 or Parzate, and the quinone marketed as Phygon have all been reported as effective. Many of the old copper compounds still do a good job when properly applied.

The working out of a satisfactory spray program is important but even the best spray program is only an emergency measure to save the celery crop until a more basic solution can be found. Growers want an immediate solution of their problem and fungicide sprays are rapid. Also it is easy to set up a spray experiment, for a dozen chemical manufacturers are willing and eager to furnish samples for test. But pathologists would be doing a serious disservice if they allowed pressure from either short sighted growers or aggressive mer-