THE CURLY-TOP DISEASE OF VEGETABLES IN THE PACIFIC NORTHWEST

by

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The curly-top disease which is widely distributed and well known on sugar beets, has been found to attack a large number of vegetable crops as well as many wild plants, weeds, and ornamentals. This virus disease occurs only where the beet-leaf hopper occurs. This insect acts as a carrier of the disease from plant to plant and when it migrates from one place to another it distributes the disease to the susceptible plants upon which it feeds.

REGIONAL OCCURRENCE

In the semi-arid regions of Central Washington, Eastern Oregon, Southern Idaho and similar areas southward are the natural breeding grounds for the beet-leaf hopper. The disease is especially prevalent on susceptible crops in the irrigated sections of this region and is frequently spread by the migration of these leaf hoppers to outlying areas and occasionally even to the area west of the Cascade mountains in Washington and Oregon.

CROPS AFFECTED AND INJURY CAUSED BY CURLY-TOP

The curly-top disease is very destructive as it occurs on the tomato, bean, spinach, garden beet, mangel, Swiss chard, pepper and some varieties of squash and pumpkin. It affects less severely cucumbers, melons and other vegetables. On tomato it has long been known as western yellow blight. The name, yellows, which is more descriptive of the symptoms on the tomato than curly-top, has also been proposed. A young tomato plant is often killed outright. When an older plant is attacked it stops growing, the leaflets roll upward, become leathery and turn yellow; fruits ripen prematurely and the whole plant gradually dies. Curly-top on other vegetables often kills the plant in the seedling stage and injures older plants causing a slow death in many cases. The disease, when it is severe, stops the growth of the plant and the development of fruit in all of the susceptible vegetables.

THE INSECT CARRIER

The beet-leaf hopper, as mentioned above, breeds in the desert areas and migrates to cultivated fields. The widespread occurrence of the insect and its

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habit of migrating from breeding grounds to areas at some distance make the prob-
lem of suppressing the insect a most difficult one and one for which no general
recommendations are available at the present time. The United States Bureau of
Entomology, however, is devoting much study to the life habits and control of the
beet-leaf hopper in the interest of the sugar-beet growers as well as growers of
susceptible vegetables.

TESTS FOR RESISTANT VARIETIES

Extensive experiments have been carried out during the last few years by
State and Federal research workers to find and develop resistant vegetable var-
ieties which could yield well in sections where the curly-top disease was preva-
lent. Tomatoes, beans, squashes, and pumpkins have received special attention
from the Federal investigators working in cooperation with the Oregon Experiment
Station.*

Tomato. No varieties of tomato have been found which show satisfactory
resistance although much of the work to date has centered on this vegetable.
The work of breeding and improvement is being continued, however, in the hope that
it will eventually yield a tomato variety suitable for the sections where the
disease is destructive.

Beans. More encouraging results have been secured in the case of the bean,
squash, and pumpkin. Resistance has been found among the field-bean varieties.
The Burtner Blightless, California Pink, California Red, Jenkins and Red Mexican
are the most resistant of the dry or shell beans tested. The Burtner Blightless,
a white pea bean, originated by a grower in Wasco county, Oregon, after whom it
is named, may also be used as a snap bean for home consumption. Although used
to some extent, it is less suitable than the common snap bean varieties for Commer-
cial canning. The popular varieties of snap beans are very susceptible to curly-
top while lima beans as a group show strong resistance.

Squashes. Among the true squashes the popular varieties of the Banana and
Hubbard groups are very susceptible. With the exception of the Marblehead group,
the varieties of Cucurbita maxima or true squashes have been found to be uni-
formly very susceptible. Varieties of the Marblehead group are sufficiently re-
sistant to be grown where curly top occurs in severe form. The Marblehead is
the most uniform of this group. The strain known locally as the Yakima Marble-
head is grown extensively in the Yakima Valley. Another strain or variety was
developed on the Hermiston Project and is known as the Umatilla variety. In
its present stage of development it is somewhat variable. The Marblehead is a
large squash but is of excellent quality for table use and is a good keeper.

Pumpkin. The pumpkin group includes many varieties commonly called pump-
kins and some that are generally listed as squashes although they all belong to
the Cucurbita pepo species. Some varieties in this species are rather resistant
and some very susceptible. Big Tom, Golden Oblong, and Southern Field, of the
Connecticut Field Group and some varieties in the Vegetable Marrow Group have
shown partial resistance. The Sweet Potato and Table Queen of the Fordhook

* Mr. W. W. Tracy of the United States Department of Agriculture, stationed at
Twin Falls, Idaho, has cooperated and has carried on similar investigations
in Southern Idaho with results similar to the findings reported here.
group, Bush Scallop of the Patty Pan Group, and Giant Crockneck and Giant Straight-neck of the Crockneck-Straightneck group are extremely susceptible. The affected vines die early and produce few fruits under conditions of severe infection.

The most resistant varieties of pumpkins belong to the Cucurbita moschata species. Sweet Cheese or Kentucky Field, Calhoun and Large Cheese of the Cheese group, Tennessee Sweet Potato and the various varieties of Cushaw have all shown marked resistance. The varieties of the Cheese group are the most promising for domestic purposes and commercial canning. Three Japanese varieties, Chirimen, Kikuza, and Saikya have been tested. They appear to be very resistant to curly top but mature too late to be of value to growers in this region.

**PRACTICES THAT MAY REDUCE CURLY-TOP IN TOMATOES**

These practices will perhaps appeal to the home owner or small operator who finds it difficult to mature a crop because of the disease and who wishes to make special effort to evade the disease. They do not meet the requirements of the commercial grower.

Experiments conducted at the Umatilla Experiment Station and by Federal and Staic workers in California and elsewhere have shown that shading reduces the amount of curly-top damage in tomatoes. The plants were grown under frames, covered with muslin cloth. The frames were not tight enough to exclude the leaf hoppers. However, the leaf hoppers prefer to feed on plants in the open and for this reason probably communicate less of the virus to the plants growing in the shade. In addition it appears that plants growing in the shade, even though they are inoculated by the insect, are not as seriously injured as plants growing in the sun. It may be advisable to use cloth-covered frames to a limited extent where experience shows that tomatoes cannot be grown without such protection.

Growers have in some cases reduced the amount of curly-top damage by growing tomatoes in the shade of trees or buildings or by furnishing shade crops in the field. Tall growing crops, such as sunflowers, have been used between rows to furnish shade and in California experiments* have materially reduced the percentage of disease. To secure the desired development by the time it was needed, the shade crop was planted about a month before the tomatoes were set. Plants that will grow rapidly and tall enough to produce shade, of course, compete with the tomatoes for plant food and moisture. Since there was a lessened natural spread of the disease after July 1, it was found that the shade crop could then be removed to permit better development of the tomato crop without greatly increasing curly-top loss. The value of a shade crop for any section can be determined best by the grower who tests such shade for a portion of his field.

Delayed setting in the field has been tried at Hermiston, Oregon, for two seasons. Damage from curly-top was reduced by this practice as compared with a total loss in the early crop. Losses in the later crop were bad enough but after all a quantity of tomatoes was harvested. The amount of curly-top in the early, mid-season, or late crop will depend, in part, on the abundance of the leaf hoppers at the time these crops are growing. Also, older plants are definitely less susceptible than seedlings. Home owners can often afford to set out plants at different seasons and although many or all of the plants may be lost some will usually escape the disease and give some yield even under the most severe conditions.

* United States Department of Agriculture Technical Bulletin 189.
There may be some benefit derived from sowing seed directly in the field. The plants are not subjected to the shock of transplanting and can perhaps resist the disease to some extent. If allowed to stand thickly in the row, many plants may be killed by curly-top and still leave a number to develop and produce fruit.

In regions where curly-top on tomato is severe it is best to grow beets and tomatoes or other susceptible vegetables at a distance from each other. The leaf hoppers like to feed on the beet and will tend to concentrate on the beet foliage where they naturally increase in numbers, and become a real menace to adjacent susceptible crops.