Aster Yellows Virus in Celery

spray treatment of natural breeding area of aster leafhopper controls spread of important virus disease to celery fields

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Annual losses as high as 30%—caused by aster yellows virus—have been cut to 5% by growers of the Arroyo Grande Valley of San Luis Obispo County who annually produce about 1,200 acres of celery valued at approximately $2,500,000.

During 1951, 1952, and 1953 the spread of the aster yellows virus by the aster leafhopper—*Macrosteles fascifrons* (Stal)—became a serious economic threat to the celery industry in the valley. Many individual growers lost 50% or more of their plantings.

Celery plants infected with the aster yellows virus are not marketable and are a total loss to the growers.

Infected plants are characteristically light green or yellow and show elongated, twisted, and intertwined leaves. Diseased plants often are referred to as Twisters.

The first symptom of the disease is a yellowing of the veins of the youngest leaves. Usually the yellowing is followed by an elongation and upright growth of the leaves. Diseased plants are often taller than adjacent healthy plants. As the disease progresses the plants become yellow and dwarfed. The petioles lose the upright position, become brittle and frequently crack. This often results in secondary disease organisms invading the plant and causing a heart rot. In some plants aster yellows virus causes a severe stunting of the leaves which results in an open flattened dwarfed plant.

Celery infected with aster yellows virus showing yellowing, twisting, and intertwining of leaves.

Repeated field applications of DDT insecticide to the celery at regular intervals—sometimes as often as every 10 days and from 6–8 applications—generally obtained a good kill of leafhoppers in the fields but did not control the spread of the virus.

Aster yellows virus, besides causing a serious disease of celery, also infects many other vegetables, ornamental plants and weeds. The only groups of plants considered to be immune to infection are the cereals and grasses.

More than 20 different species of leafhoppers are capable of transmitting aster yellows virus but only one—the aster leafhopper—is important in the spread of the disease in the Arroyo Grande Valley.

To determine the factors responsible for the high aster leafhopper populations in the valley, a study was made of the life history, habits, movements, host plants and favorite breeding areas of the leafhoppers. Periodical observations and collections were made with an insect sweep net—in celery fields, on ditch banks, natural breeding areas and on cultivated crops—to learn where the leafhopper occurs, under what conditions it develops high populations and what is the main source of the leafhopper populations that move into the celery fields.

Creek bottom areas were found to be the most important habitat of the aster leafhopper. This insect thrives best on low, sparse, open vegetation in moist situations. However, high populations were also found on dense vegetation growing on stream margins. Large numbers of leafhoppers were regularly encountered on such plants as rabbitfoot grass—*Polypogon monspeliensis* (L.) Desf.; water parsley—*Oenanthe sarmentosa* Presl.; water cress—*Radicula nasturtium-aquaticum* (L.) Britt & Rendle; willow herb—*Epilobium franciscanum* Barbey; common monkey-flower—*Mimulus guttatus* Fischer; speedwell—*Veronica anagallis-aquatica* L.; and toad rush—*Juncus bufonius* L.

The aster leafhopper was also found in alfalfa fields, pastures, grain fields, home gardens, lawns and on ornamental flowers. Leafhoppers from these habitats were usually considered to be of only minor importance in the spread of the aster yellows virus to celery. However, it was found that they were sometimes important locally when celery fields adjoined alfalfa fields or pastures.

Helicopter applying DDT insecticide to favorable breeding sites of leafhoppers in creek bottom.

The results of the observations indicated that the creek bottom areas were the most favorable natural breeding sites and that when the leafhoppers moved into the celery fields those areas constituted the most important source of leafhoppers for the spread of the virus to celery.

Leafhoppers occurring on the range grasses and weeds during the spring move—as the vegetation dries in April and May—into the creek bottom where they find a moist habitat suitable for the production of high populations. As the creek area gradually dries during May and June the leafhoppers move into the green celery fields. Because the creek vegetation dries only in certain areas and not in others there is a more or less irregular movement of the leafhopper from the creek into the celery fields over an extended period of time. This gradual influx would explain the failure of DDT to prevent spread of the virus.

The first infections of celery with aster yellows virus were usually noted in early June. Celery transplanted in early March

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and harvested in June escaped damage and showed only a trace of virus infection. In contrast, celery set out during April and May and harvested in July showed a definite increase in the percentage of plants infected. Severe damage was first noted in late June and became progressively more severe in July, August and September. Celery planted following the last week of July and harvested during the latter part of October, in November and December usually showed only a low percentage of infected plants.

The leafhopper populations in celery usually decreased during July and August. Because no reproduction of the aster leafhopper has been noted on celery, the spread of aster yellows virus appears to be entirely dependent on the insects that move into celery from other locations.

The percentage of leafhoppers naturally infective with the aster yellows virus was determined by monthly collections in the natural breeding areas. Leafhoppers were collected and fed in groups of 10 on healthy test plants to determine the percentage actually carrying virus. Seasonal infectivity of the leafhoppers would indicate when and from what habitats the insects were potentially the most likely to spread the virus.

The percentage of aster leafhoppers found to be naturally infective varied with habitat, season, and the predominant host plant in the area. Usually about 2% were naturally infective during April. As the season progressed, the percentage of infective individuals increased to 12% in June, 22% in August and reached a peak of 36% in September of one year.

It is evident that the period of highest disease incidence in celery does not coincide with the presence of the highest number of leafhoppers in the celery fields. This is true because it takes 2–3 weeks for the disease symptoms to develop on the celery plants and also because the percentage of leafhoppers carrying virus increases as the season progresses.

Control Program

A spray program—designed to control the leafhoppers in their natural breeding sites—was initiated in the spring of 1955, soon after leafhopper populations were noted in the creek area. DDT oil sprays were applied by a fixed wing airplane at approximately two week intervals beginning April 16 and continuing until the final application on July 21.

The spray program was repeated in 1956 and 1957 with applications made by helicopter. In 1956 applications were made on May 10–11, May 21–23, June 6–7, June 20–21, and on July 3–8. In 1957 only three applications were made —on April 19, May 6, and June 25.

In 1958, because of the late and heavy spring rains, the creek carried a heavy flow of water over an extended period of time. This resulted in conditions unfavorable for the development of a leafhopper population until July when only a single application of insecticide was necessary.

Losses due to aster yellows infection of celery in the Arroyo Grande Valley have been light—less than 5%—during the past four years. The logical conclusion to be drawn is that the DDT reduced the leafhopper population at the source and was responsible for the reduction in the amount of aster yellows infection of celery. However, what the disease situation would have been if no insecticides had been applied to the creek can not be determined because it was not possible to leave untreated checks without jeopardizing the whole program.

The cost of the control program has been nominal to the cooperating growers who contributed each year an amount equal to the cost of making one application of DDT to each acre of celery they grew.

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acre for each application has tended to give better control than obtained with DDT. Further, Guthion has a suppressing action on spider mites and the walnut aphid. Sevin at eight pounds of 50% wettable powder per acre for each application has resulted in control equal to that obtained with DDT. Although Sevin tends to suppress the walnut aphid population it may—as DDT does—induce an increase in the spider mite population.

Trithion at one pound per acre has not given adequate control of the codling moth when used alone. However, in combination with DDT, to control the walnut aphid and spider mites, Trithion has a tendency to improve the control of the codling moth.

Ethion at high dosages has shown promise in controlling the codling moth, but has not equaled DDT. Delnav also has resulted in insufficient control.

A careful examination of the young developing walnuts usually indicates whether the codling moth control program is adequate. When boring into the green husks the caterpillars leave piles of brown frass at the entrance of the burrow. At first, the piles of frass are tiny and can be overlooked easily. Late first brood and second brood caterpillars usually penetrate the nuts at the side or the base. The brown frass produced shows up rather distinctly on the green husks. If 1.5% or more of the nuts are being attacked a treatment is probably justified.

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CUT FLOWERS

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Los Angeles and San Francisco market areas and, particularly, for cut flowers and foliages sold in the state. For out-of-state shipments, consignment selling is greater, especially when the deals are with central-market wholesale dealers who are primary distributors for smaller wholesalers and jobbers.

Specialization appears to be growing in the cut flower trade, as is evidenced by the growth in the number of special buyers in the Los Angeles metropolitan and other markets. The buying specialists have the job of selecting products in the wholesale markets and delivering or holding them for their retailers, for a commission. Such an arrangement provides the retailer with a skilled buyer who recognizes and can select flowers of the desired quality characteristics. In an industry that largely depends on sale by inspection, buying specialists could provide a very beneficial service to the retail trade.

Wholesalers attempt to establish and maintain long-time business relations with both growers and retailers. Central market wholesalers are often very solicitous of near-by grower interest. They assure such growers a regular outlet and advise with them on market conditions and prices as a means of assuring themselves a source of supply and minimizing the likelihood of direct sales to retailers.

Wholesalers are equally solicitous of their retailers. Generally, they follow rigidly a policy of adhering to the established grower-wholesaler-retailer market channel, introducing whatever commission men and jobbers may be needed to facilitate sales.

To be continued

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