

HISTORY OF VERTICILLIUM WILT BASED ON AN ALFALFA BREEDERS EXPERIENCE

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The introduction of verticillium wilt on the North American continent took place in the late 1950's. The most talked about variety in 1958 was DuPuits, a variety introduced from France by Northrup King. Once farmers accepted it, all seed companies rushed to obtain a Flemish-type variety for seed increase and sales in the United States. Perhaps you would remember their names - Alfa, Socheville, Orchies, Flandria, FD100, Europa, and Glacier. To others the backcross derivative of Alfa, DuPuits, and Flamande is more familiar - Saranac. Kritlow stated in 1962:

Athe vert fungus can be carried with the seed in diseased fragments of plant tissue. Substantial amounts of alfalfa seed are being imported into the U.S. for breeding, multiplication, and forage purposes. @

Anyone who has planted European breeder seed knows that it has substantial amounts of inert material. Personal communication with Idaho Crop Improvement indicated such occurrences in 1962 - Alfa, 1966 - WB5 and Langmeiler, and again in 1972 with Alfa II.

To protect ourselves from introducing this disease Kreitlow states:

AThe plant quarantine regulations were, therefore, amended effective August 19, 1961, specifying that alfalfa seed may be imported only under permit and that it must be treated upon arrival with a recommended fungicide. @

This was a case of locking the door after the disease had successfully arrived. In the fall of 1962, verticillium wilt was positively identified in an experimental plot in Ontario, Canada. Fortunately it was not recovered the following spring.

In the state of Washington, during the days of numerous Flemish variety increases, OECD variety multiplication and the large expansion of leafcutter bee seed production, a disease was killing alfalfa in hay environments. For over five years, in the early 70's, the Prosser, Washington station with the aid of USDA funding conducted a large stem nematode breeding program, and hay trials using varieties with disease resistance to fusarium wilt, stem nematode, bacterial wilt, root knot nematode, and anthracnose. None of these attempts to solve the problem proved completely successful. The problem got worse.

Fifteen years after changing the quarantine regulations, Richard Peaden started sampling diseased plants in the fall of 1976. Within 15 months the disease had been isolated from Boise, Idaho, - Ontario and Hermiston, Oregon - throughout the Columbia Basin, Washington, - and British Columbia, Alberta, and

Saskatchewan, Canada. From over 38 single spore isolates, no significant differences were found in culture, physical traits or virulence while optimum temperature for growth appeared to be 20°C.

Although studies by Issac in England had not found verticillium contained within the seed, Christen showed that up to 2% of the seed in commercial seed lots carry verticillium. Among seed lots she found five of 20 lots contaminated in 1979, and two of 20 lots in 1980.

Greenhouse and field studies using these contaminated seed lots have amply demonstrated that after 6-8 clippings, vert is widely evident in many plants. Kreitlow states:

A secondary spread by a mower distributes non-sporing fragments of stems. @

In a later study of four North American and three European isolates using two North American and four European cultivars under two temperature regimes on both continents, no differences were discovered as measured by virulence. However, disease severity was greater at the higher temperature. Since 1980, vert has been identified in Wisconsin, Minnesota, Pennsylvania, New York, Wyoming, and Montana. In 1983 it was widespread in Ontario, Canada.

Artificial inoculation involves root clipping of 4-8 week old seedlings, root soaking for 10 to 30 minutes, and reading symptoms on a one to five basis approximately four to five weeks later. A problem often encountered here is category two discoloration which may not be due to the disease organism. Peaden's experience has shown 15% escapes in classes one and two. Summer testing during higher temperatures have a higher escape percentage. Conversely lower temperatures and reduced light have aided symptom development.

Root soak inoculation provides the entrance of conidia spores into the sap stream (xylem vessels). The upward is passive but spores lodge in various locations throughout the plumbing system. Histological studies have shown that in six to eight days, spores are continuous within the xylem. Symptoms develop after some twenty days at locations where conidia spores have lodged and germinated - midrib of leaflet, peduncle, and node. Thus it is possible to have systemic colonization which may or may not be continuous.

Pennypacker and Leath studied inoculated but symptomless plants obtained from six resistant and two susceptible varieties. Verticillium wilt was isolated from 100% of the symptomless plants in five resistant and two susceptible varieties and 95% of the symptomless plants in the other resistant variety Endure. Their conclusion was that, Asymptom free plants are an unreliable indicator of vert free plants. @

Kreitlow states:

In Denmark, verticillium is reported nearly every year - some years the disease

is serious and destroys large areas - while in others it only occurred sporadically and caused minor losses. @

From this summary of 30 research articles, we can see that vert traveled to this continent in inert matter prior to 1961, spread throughout a portion of the U.S. by 1980, and will continue to occur sporadically, depending upon the successful establishment within hay fields governed by the weather. Secondary spread will be by stem fragments from mowers and local conidia infection.

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Post Script:

The reason that Papadopoulos and Pennypacker are important involves the movement of vert in the alfalfa plant, as found in the *Journal of Physiological Pathology* and largely ignored by breeders in this country. Using their ideas, I was able to test for vert using stem cuttings in test tubes of vert for 24 hours, and transferring them to clear water for five days before seeing the obvious vert symptoms in the leaflets, completely bypassing the crown tissue. The inhibition of movement in the plant is the basis of resistance that we searched for and is the same in many other species. Morphology is important.