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The Nature of the Wilt of Carnations caused by Pseudomonas caryophylli (Bacterial Wilt)

by

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One of the more important pathogenic limitations to the production of carnations is bacterial wilt caused by Pseudomonas caryophylii (Burkh.). The most striking symptom of this disease is a sudden wilting of one or more branches. These wilted branches have a gray-green color and become dry. A vascular discoloration may be found extending from the roots to the upper portion of the plant.

Roots of an infected plant gradually disintegrate and become soft, often sloughing off when the plants are lifted from the soil. The outer basal portion of the plant may be soft with decay evident. When the bark of this area is torn away, the exposed tissue is sticky to the touch and is yellow to brown in color.

To date there is no satisfactory means of eliminating the organism, once it has entered the plant. Present controls recommended are the use of clean cuttings and soil pasteurization. In the light of recent advances in chemotherapy for the control of plant diseases, it may be possible to control bacterial wilt by such means. In order to approach the control of this disease by chemotherapy, it is necessary to understand the nature of the wilt.

Microscopic investigations of cross-sections of diseased stems showed that one or several of the water conducting vessels were plugged by bacterial masses. Further explorations revealed proliferation of parenchyma cells in the immediate area of infection, and the walling-off of a bacterial mass by initiation of new tissue. In more advanced stages of infection there appeared to be disintegration of woody tissue.

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*This is a summary of some of the work done by Oliver Holtzmann during the time he served as a Research Fellow for the Colorado Flower Growers Association. Condensed by your editor.

Longitudinal sections of diseased plants showed that infected areas of xylem tissue were continuous from the basal portion of the plant up into the leaves. Where infection was restricted to a small group of the vessels, the infectious mass of bacteria was confined to that area throughout the length of the stem.

All rooted carnation cuttings placed in bacterial suspensions and filtrates of bacterial suspensions wilted in two to three days. All rooted cuttings placed in sterile distilled water were still turgid at the end of a week.

Carnation cuttings did not wilt when suspended in bacterial filtrates from which the proteins and other large molecular compounds were removed by precipitation with ethyl alcohol. This suggests that the wilt-inducing factor is either destroyed by the alcohol or may be present in the insoluble fraction.

Water Intake

Rooted and unrooted cuttings placed in sterile water showed the same tendency to take up a large amount of water during the first two days and then decrease on succeeding days. Rooted and unrooted cuttings placed in bacterial suspensions of P. caryophylli showed an inability to take as much water during the first two days.

Apparent Effect on Rate of Respiration of Roots

Observations made of rooted carnations in various treatments were based on the comparative amount of gas given off by the roots. These observations showed that carnations in treatments of bacterial suspension, filtered bacterial suspension, diseased plant extract, and filtered diseased plant extract gave off large amounts of gas. Those cuttings in healthy plant extract and soluble fraction of healthy plant extract gave off a moderate amount of gas. A small amount of gas was given off by roots of cuttings in filtered agar water, filtered healthy plant extract, and the soluble fraction of diseased plant extract. There was no gas evolution of the roots of cuttings in sterile water, soluble fraction of bacterial suspension, soluble fraction of filtered healthy plant extract, and soluble fraction of filtered diseased plant extract.

Inner Nutrition of Carnations

Using a technique called paper-partition chromatography, the amino acid and sugar contents of healthy and diseased carnations were determined.

Two dimensional chromatograms of the concentrated juice samples of healthy carnations showed 13 amino acids which were identified by position and substitution: aspartic acid, cysteic acid, glutamic acid, serine, asparagine, threonine, glutamine, tyrosine, lysine, gamma-amino butyric acid (GABA), valine, leucine or isoleucine, and proline.

In the two-dimensional chromatograms of the concentrated diseased plant juice, it was found that cysteic acid and lysine were absent. The amino acids, aspartic acid, serine, asparagine, glutamine, and GABA were present but in a smaller concentration. However, proline was increased in the diseased plant extract and glutamic acid, threonine, tyrosine, valine, and leucine or isoleucine were apparently no different in concentration from that found in the concentrated healthy carnation plant extract.

Quantitative sugar analysis resulted in an increase in fructose and a decrease in an unidentified sugar in the diseased plants, whereas glucose remained the same.

It is postulated that the wilt-induction may be due to the combination of several factors such as (a) increased temperature, (b) accompanied by disintegration of the water-conducting tissue, (c) increased respiration with the presence of a toxin, and (d) the mechanical blocking of water conduction vessels.