SPECIAL ARTICLES

A LATENT VIRUS OF LILY[1]

THE demonstration by Johnson[2] in 1925 that "healthy" potatoes contain two viruses detrimental to related plant species, seems to be the first record of apparently healthy plants being insidious virus carriers. These potato viruses, originally called "mottle virus" and "ring-spot virus," are now considered to be strains of the same virus and to represent strains of the X-virus as described in England.[3] The term "latent" was introduced by Burnett, *et al.*,[4] in 1931 as the name for one of these strains; the other was designated "virulent latent virus"—an unfortunate specific name since the word "latent" means "not visible or apparent." This specific use of latent has not always been accepted, since Johnson's terms "mottle virus" and "ring-spot virus" were introduced six years earlier. The term *latent* does seem apt as a descriptive adjective and group name for those viruses which normally occur in apparently healthy plants or animals and has been used with this view-point in an important paper by Chester.[5] The term should not be confused with "masking." Masking connotes a departure from normal or complete symptom expression brought about usually by environmental manipulations or changes.

It is customary to report as "new" a newly discovered pathogene—fungus, bacterial organism or virus! This paper announces a "new" *latent* virus widely distributed in bulb-perpetuated lilies. It is not new. Its existence certainly dates back to 1576,[6] the earliest known record of broken tulips, for it is identical with the color-removing virus[7] of tulips which plays the leading rôle in the complex virus disease known as tulip-breaking. This virus is called Tulip Virus 1. In some lily species it is latent. Another tulip virus is sometimes present in both obviously diseased and apparently healthy lilies. Inoculations carried out during the past three years from apparently healthy bulb-perpetuated lilies to Clara Butt and other varieties of tulips have induced extreme forms of tulip-breaking. Tulips have proved remarkably efficient test plants for determining the presence of viruses in species of *Lilium*.

The potato plant and lily species in which latent viruses have been found are vegetatively propagated and have been so propagated for decades. Seedling potatoes do not contain latent viruses. The lily species in which latent viruses have been demonstrated are *tigrinum, candidum* and *longiflorum*. *Tigrinum,* except the variety *diploid,* is always self-sterile, *candidum* is usually so, but *longiflorum* seeds easily. Inoculations with juice from *longiflorum* seedlings have shown that they do not contain this latent virus. In this observation, we find an exact parallel to the circumstances attending potato latent viruses, but it does not follow that this same latent virus will not prove transmissible in the seeds of other lily species.

The economic significance of the latent virus or viruses of *Lilium* is also comparable to the case of the potato. One of the latent viruses of potato is frequently a contributory cause of the streak disease of tomatoes. An apparently healthy lily can cause tulip-breaking or be a menace to other lily species. Lily lovers should avoid planting bulb-perpetuated species among choice seedling lilies.

Recognition of latent viruses among lily species becomes a tool for the interpretation and enlargement of the historical considerations of tulip-breaking, which has been described as the "oldest known plant virus disease." Can we not suppose that wild or semi-wild tulips brought in from Turkestan were healthy until exposed to Madonna lilies in Italian gardens?

The above statements are based on a four-year study of the inter-relation of tulip and lily viruses and will be published in full in a paper on the properties of these viruses.

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[1] Published as Technical Paper No. 250 with the approval of the Director of the Oregon Agricultural Experiment Station. Contribution of the Department of Botany.

[2] James Johnson, *Univ. Wis. Bul.* 63: 1–12, 1925.

[3] T. P. Dykstra, *Phytopath.,* 26: 597–607, 1936.

[4] Grover Burnett and L. K. Jones, Wash. State Coll. Bul. 259: 1–37, 1931.

[5] K. S. Chester, *Phytopath.,* 25: 702–715, 1935.

[6] M. B. McKay and M. F. Warner, *Nat. Hort. Mag.,* 12: 179–213, 1933.

[7] F. P. McWhorter, *Phytopath.,* 22: 998, 1932.

A RESPONSE OF ALFALFA TO BORAX

SEVERAL instances of crop responses to borax have been noted[1] in North Carolina. The symptoms shown by plants which have given this response vary rather widely and include abnormal leaf structure, necrosis of terminal buds and excessive wilting; there has also been noted an apparently unusual infestation with aphis and leaf-hoppers.

Factors contributing to the boron requirement are a high pH of the soil and an abundance of calcium salts.

A relation to other physiological conditions has been evidenced by a case in which borax applied to romaine at a rate of 4 pounds to the acre nearly eliminated the

[1] L. G. Willis and J. R. Piland, *Soil Science.* In press.

symptoms which have been considered characteristic of a deficiency of manganese.

Recently a problem involving the production of alfalfa has become acute in North Carolina. The terminal leaves become yellow without distortion, apical buds do not develop normally, plants wilt badly in dry weather and severe infestation with aphis and leaf-hoppers has been noted. Very heavy applications of lime have been made to the soil on which these characteristics were first noted.

Borax, applied at a rate of five pounds to the acre in March, effectively corrected the abnormal conditions during the same year, but a similar treatment applied late in May did not produce any visible effect until the following year. Tentatively, it is suggested that there is a photoperiodic factor involved.

Manganese appears to supplement the effect of borax, while zinc is antagonistic. The influence of copper is negligible.

A casual survey of alfalfa fields throughout the state has shown that this condition is general on all soils. It seems to have been aggravated by the liberal use of fertilizers high in calcium salts. It conforms in all respects to the description of "alfalfa yellows," which has been considered to be a transmissible disease.

Photographs illustrating this effect of borax were exhibited at the meeting of the American Society of Agronomy in Washington, from November 17 to 20, 1936.

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ENZYMIC SYNTHESIS OF CO-CARBOXYLASE

CO-CARBOXYLASE has been obtained synthetically from vitamin B_1 and orthophosphate (*a*) by an enzymic system of dried yeast from which the natural co-carboxylase had been removed by extensive washing, and (*b*) by an enzyme of the duodenal mucosa of the pig.

(*a*) *Synthesis by Washed Yeast:* To one mg synthetic vitamin B_1[1] 2 cc of Sörensen's phosphate of pH 6.7 was added. The solution was adjusted to pH 6.7 and diluted to 3 cc with distilled water. Five cc of washed dry yeast[2] in 6.7 phosphate was added. The mixture was kept at 30° for 24 hours. Then it was boiled for 4 minutes and centrifuged. The supernatant fluid contained the synthetic co-carboxylase.

(*b*) *Synthesis by Duodenal Mucosa:* Mucosa of pig's duodenum was washed with water, dried in a current of air at 38°, extracted once with ether and four times with acetone. Each extraction was applied for 10 minutes, using the same weight of solvent as the original weight of mucosa. The defatted mucosa was dried at room temperature and powdered. To 500 mg dry powder, 7 cc phosphate of pH 6.8 and one mg of vitamin B_1 were added, and adjusted to pH 6.8. A control was prepared in a similar manner, the vitamin being added just before testing. Both samples were kept for 24 hours at 30°. Then they were boiled for four minutes and centrifuged. The supernatant fluid of the first sample contained the co-carboxylase.

Natural co-carboxylase had been recently isolated in crystalline form from bottom yeast by Lohmann and Schuster.[3] They found that the co-carboxylase is pyrophosphoric ester of vitamin B_1. More recently Stern and Hofer[4] reported the synthesis of co-carboxylase from vitamin B_1 and $POCl_3$. These investigators, however, were unable to obtain co-carboxylase by an enzymic reaction.

The yield of co-carboxylase prepared by enzymic synthesis is nearly 100 per cent., while by $POCl_3$ synthesis it is about 2 per cent.

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[1] I am indebted to Merck and Company, through the kindness of Dr. R. T. Major, for furnishing a sample of their synthetic vitamin B_1.

[2] The dry yeast was prepared by keeping Fleischmann's yeast in an air current at 38° for about three hours. It was washed according to Lohmann and Schuster.[3]

[3] K. Lohmann and Ph. Schuster, *Naturwiss.*, 25: 26, 1937; *Angew. Chem.*, 50: 221, 1937.

[4] K. G. Stern and J. W. Hofer, SCIENCE, 85: 483, 1937.

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