Crown Gall Bacteria (*Agrobacterium radiobacter* var. *tumefaciens*) on Cotton Roots in Israel

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ABSTRACT

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During a survey of fields with stunted cotton plants in the Hula Valley of Israel, crown galls were observed on the roots of the plants. The cause of the disease was determined to be *Agrobacterium radiobacter* var. *tumefaciens* biotype 2. In the fields surveyed, about 60% of the cotton plants were infested with this bacterium. Galls appeared smaller where root-knot nematode (*Meloidogyne incognita*) populations were controlled in fumigated soil.

A survey of cotton fields with stunted plants that were suffering from root-knot nematodes (*Meloidogyne incognita*) was carried out during 1979 and 1980 in the Hula Valley in northern Israel (4). Crown gall-type tumors were observed on cotton (*Gossypium hirsutum* 'Acala SJ2') roots. This paper reports the finding, symptoms, etiology, and some experimental data on this disease.

The crown galls looked like dense callus tissue. They were 1–4 cm long, irregular in shape, and dark brown (Fig. 1). The galls were generally located on the taproots, which in many cases had stopped growing. In some cases, spherical galls, 1 cm in diameter, were also found on lateral roots. Except for stunting, no characteristic symptoms were found on shoots of infected cotton plants. During the survey, crown-galled cotton plants were found in six different fields, all in a drained swamp area where the soil contained approximately 25% organic matter. At these locations, 50–70% of the plants examined had crown galls. The bacterium was isolated from galled plants sampled in three fields in the Hula Valley. Isolations were made on a modified New and Kerr selective medium (3), in which erythritol was replaced by mannitol, for 6 days at 27 C. Translucent grayish white colonies, 2–3 mm in diameter, appeared after 4 days. These colonies were used for the pathogenicity inoculation tests. For

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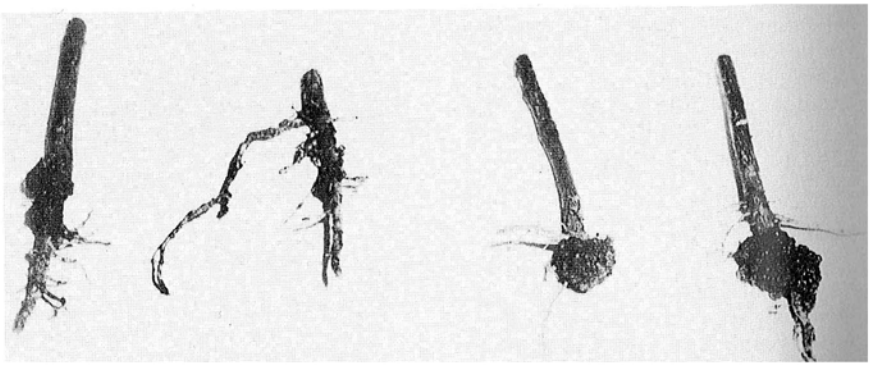

Fig. 1. Cotton roots naturally infected with *Agrobacterium radiobacter* var. *tumefaciens*.

Table 1. The effect of preplant fumigation on the infestation of cotton with root-knot nematode (*Meloidogyne incognita*) and crown gall bacterium (*Agrobacterium radiobacter* var. *tumefaciens*)

Fumigant	Rate applied (L/ha)	Nematode galling index[y,z]	Plants infested with crown gall[z] (%)
Mixture of ethylene dibromide (EDB) + chloropicrin, 1:4	250	0.1 a	56
Edabrom (750 g EDB/L)	120	0.3 a	60
Untreated control	···	2.9 b	58

[y]Index ratings on a 0–5 scale; 0 = no galls, 5 = 75–100% of the root area covered with galls. Numbers in a column followed by the same letter do not differ significantly ($P = 0.05$) according to Duncan's multiple range test.
[z]Means of six replicates, 10 plants in each.

bacteriological tests, the 17 isolates used included two type cultures of *A. radiobacter* var. *tumefaciens* biotype 1: NCPPB 2303 isolated from bitter almond and a local strain isolated from galled roots of *Rosa indica*. Bacteriological characterization of the cotton isolates as biotype 2 was done using the procedure of Moore et al (2).

Twelve cotton seedlings were inoculated, each with 25 ml of suspension containing 1.10^7 colony-forming units per milliliter. The roots were wounded with a flamed scalpel before inoculation. Eight weeks after inoculation, crown galls appeared on all of the plants and the bacterium was reisolated from the artificially inoculated plants.

Inoculation of 24 cotton seedlings in dry heat-sterilized Hula Valley organic soil and in sterilized sandy loam mineral soil with the same strain resulted in an intermediate degree of crown gall infection in the two soil types. Inoculation of 12 cotton seedlings in sterilized sandy loam with isolates from crown galls of bitter almond and rose failed to produce galls; however, galls formed on roots of four almond seedlings and four rose plants inoculated with the cotton strain. In a field experiment to control root-knot nematodes by preplant treatments with various fumigants, the rate of crown gall occurrence in all treatments was the same (Table 1), which indicated that penetration of bacteria into the cotton root was not dependent upon simultaneous infection of the root-knot nematodes. Galls were much larger in the untreated plots, where the root-knot nematode galling index was quite high, than in plots where the nematodes were controlled.

The crown gall bacterium *A. radiobacter* var. *tumefaciens* has been known in Israel as a soilborne pathogen for many years (6) but had never been found on cotton roots. In the United States, cotton was found to be a host for this pathogen (1), but crown gall on cotton in the fields is quite rare. The appearance of this disease coincided with an outbreak of the root-knot nematode, *M. incognita*, in the same area (4). This probably is due to the continuous cultivation of cotton, which leads to a rapid population buildup of these two pathogens under favorable ecological conditions. It could be expected that the root-knot nematode will enhance the invasion of bacteria into cotton roots, as was already reported (5), but the soil fumigation experiment indicated that bacteria could penetrate the root tissues without nematode involvement. It seemed that either the nematode enhanced the intensity of infection or the fumigants reduced the inoculum potential of the crown gall bacterium.

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LITERATURE CITED

1. Anonymous. 1960. Index of Plant Diseases in the United States. Handb. No. 165. U.S. Dep. Agric. 531 pp.
2. Moore, L. W., Anderson, A., and Kado, C. I. 1980. Agrobacterium. Pages 17-24 in: Laboratory Guide for Identification of Plant Pathogenic Bacteria. N. W. Schaad, ed. American Phytopathological Society, St. Paul, MN. 72 pp.
3. New, P. B., and Kerr, A. 1971. A selective medium for *Agrobacterium radiobacter* biotype 2. J. Appl. Bacteriol. 34:233-236.
4. Orion, D., Nessim-Bistritsky, B., and Hochber, R. 1982. Using color infrared aerial photography to study cotton fields infested with *Meloidogyne incognita*. Plant Dis. 66:105-108.
5. Orion, D., and Zutra, D. 1971. The effect of the root-knot nematode on the penetration of crown gall bacteria into almond roots. Isr. J. Agric. Res. 21:27-29.
6. Volcani, Z. 1961. Crown gall disease in Israel. Plant Dis. Rep. 45:823.