Protection of Sugarbeet Plants Against Development of Rust Disease by Infection with Curly Top Agent

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ABSTRACT

Sugarbeet *(Beta vulgaris)* plants dually infected with rust (caused by *Uromyces betae*) and the curly top agent consistently showed a reduction in rust infection, compared to plants not infected with curly top. Protection of plants from rust infection by curly top was observed in plants under both field and greenhouse conditions.

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Interactions between two different etiologic agents affecting a single plant and leading to antagonistic or synergistic effects on the course of one of the diseases have been described for both field and laboratory situations. Particularly prominent among such interactions is virus-induced protection against the development of several types of air-borne fungus diseases: red clover plants *(Trifolium pratense)* infected with bean yellow mosaic virus are protected against powdery mildew (7); potato plants infected with potato virus X or Y are protected against *Phytophthora infestans* (9); cucumber plants infected with cucumber mosaic virus are protected against scab (*Cladosporium cucumerinum*) (6). Recently it was reported that virus infection also affords protection against soilborne plant pathogens (4); pigeon pea *Cajanus cajan* plants are protected by virus infection against Fusarium wilt (3); and squash plants infected with squash mosaic virus are resistant to stem rot caused by *Fusarium solani* f. *cucurbitae* (4, 8). However, there is only one report of protection by an agent such as a virus against rust (10).

While studying the epidemiology of curly top in the foothill region near Coalinga, California, we noted that sugarbeet *(Beta vulgaris* L.) plants dually infected with rust [*Uromyces betae* (Pers.) Lev.] and curly top consistently showed a reduced development of the rust compared to plants infected with rust alone. We therefore conducted a field study to quantify this observation. Field observations were conducted in October and November, months when rust infection of sugarbeets in that area is prevalent and can reach epidemic proportions, particularly in areas irrigated by sprinklers. We observed in three different sugarbeet fields infected with rust that the number of pustules were reduced up to 90% in leaves infected with curly top (Table 1).

To corroborate the field data, experiments with dually infected plants were conducted with sugarbeets grown in soil in 10.2-cm (4-inch) diameter pots in a greenhouse in Salinas, California. Twenty days after planting, test plants were inoculated with curly top agent (strain Los Banos) by allowing beet leafhoppers [*Circulifer tenellus* (Baker)], reared on curly top-infected sugarbeets, to feed on their cotyledons for 3 days. Plants with moderate curly top symptoms were inoculated with rust by applying (with a hand atomizer) a water suspension of uredospores that were collected from beets grown in the field in the San Joaquin Valley near Coalinga, California. Plants were incubated in a moist chamber for 24 hours, and placed under normal greenhouse conditions. Curly-top-free plants similarly treated with nonviruliferous leafhoppers and inoculated with the rust served as controls.

After 20 days, rust pustules were counted on leaves of the curly-top-infected and control plants. Results of 15 trials, each with three replications, showed, similar to the field experiments, an inhibitory effect by the curly top infectious agent on the development of rust disease (Table 2).

Our data indicate that infection with the curly top agent

TABLE 1. Antagonistic interaction between curly top agent and *Uromyces betae* (cause of sugarbeet rust) in field-grown sugarbeet plants

Field	Number of rust pustules[a]: Plants without curly top symptoms (no.)	Curly top infected plants (no.)	Reduction by curly top (%)
1	232.8	15.7	93
2	180.3	51.0	72
3	115.0	38.8	66

[a]Average number of rust pustules per plant on two intermediate-aged leaves selected at random from 100 curly-top-infected plants and 100 plants without curly top symptoms, selected at random from each field.

TABLE 2. Protection of greenhouse-grown sugar beet plants against rust disease by prior infection with curly top

Sugar beet cultivar	Number of pustules[a]: Control plants	Curly top infected plants	Reduction by curly top (%)
742 (susceptible to curly top)	347.3	37.0	89
S-301H8 (moderately resistant to curly top)	212.1	23.2	89

[a]Average number of rust pustules per plant on two leaves, selected prior to inoculation on the basis of size and age. Counts were made on 135 plants for each treatment, in 15 separate tests.

protects sugarbeet plants against the development of rust disease under both field and greenhouse conditions. Whether the alteration in rust susceptibility by the curly top agent is related to known biochemical (5) and structural changes (1) that accompany the development of curly top disease in sugarbeet plants is unknown.

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