The Life Span and Number of Leaves Produced by Sugarbeet Plants Infected with Cercospora beticola[1]

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Introduction

Although *Cercospora beticola* Sacc. is an important pathogen of sugarbeet leaves, we could find no published information on how the resulting disease affects the production and life span of the leaves. Such information would contribute to a fuller understanding of the injury caused by this leaf spot disease. This paper describes how Cercospora leaf spot affects the life span of individual leaves and the total number of leaves produced by infected sugarbeet plants.

Materials and Methods

The varieties used were American Crystal 3N (susceptible) and 6322-0 (moderately resistant) which were planted April 30th in the experimental plots of the American Crystal Sugar Company, Mason City, Iowa. The resistant and susceptibie plants were in long single rows surrounded by other varieties. We also used susceptible plants which were sprayed with fungicides and these were planted in small plots containing four 25-foot rows spaced 22 inches apart. Ten unsprayed plants of each variety and ten sprayed plants of the susceptible variety per plot were randomly selected for observation. The plants were uniformly inoculated with *Cercospora beticola* on June 30th, and fungicide applications were made four times, July 7 and 21, August 4 and 18. One plot was sprayed with a maneb derivative (Dithane M-45) at the rate of 2 lb/40 gal water/acre, and another plot was sprayed with 60% wettable powder of triphenyl tin hydroxide (Du-Ter 60 W) at the rate of 0.5 lb/40 gal water/acre.

We measured life span by tagging selected leaves on each plant once a week beginning with June 27, 5 weeks after emergence. The youngest unfurled leaf (5-8 days after its first appearance in the furled condition) was tagged on each plant by placing loosely around the petiole a strip of plastic tape embossed with the date. Once a week thereafter, we tagged the youngest unfurled leaf or leaves, if two or more appeared equally young. In this way usually one or two leaves per plant were tagged

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each week, even though the plant was producing 4-6 leaves a week. In addition to tagging new leaves each week, we recorded the death of previously tagged leaves, thus we were able to estimate the life span of the leaves. Total leaf production for the season was estimated by counting all living and dead leaves, dried petiole remnants, and leaf scars at harvest, October 6.

Results

The pattern of disease development. Figure 1 shows that tagged leaves killed by disease first began appearing among the treatments at different dates: susceptible unsprayed, end of July; susceptible sprayed with maneb, end of July; resistant, middle of August; susceptible sprayed with organic tin, end of August. After August 2, the number of dead tagged leaves on the susceptible unsprayed plants became significantly greater than on the other plants. By September there was severe disease incidence on the susceptible unsprayed plants and moderate disease incidence on the other plants. No leaves in any of the treatments died due to natural senescence; the tagged leaves which died were killed by leaf spot disease.

Leaf production. The total number of leaves, living and dead, tagged and untagged, was counted on the unsprayed resistant and susceptible plants on August 8 when the epiphytotic was in its early stages. No significant differences occurred between

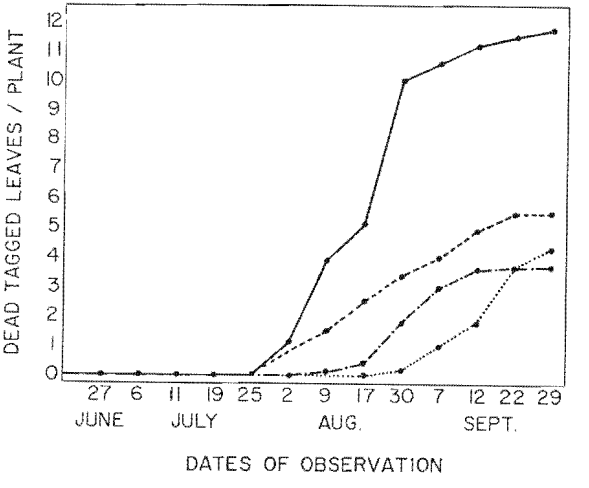

Figure 1.—Average number of tagged sugarbeet leaves per plant that were killed by Cercospora leaf spot in the plots at Mason City, Iowa. Solid line = susceptible variety. Dash line = susceptible variety sprayed with maneb. Dash-dot line = unsprayed resistant variety. Dotted line = susceptible variety sprayed with organic tin fungicide.

these two groups of plants. Total number of leaves was also counted on the two varieties and the spray treatments at harvest when the epiphytotic was at its maximum. The average number of leaves per plant was: 61 for susceptible unsprayed, 58 for susceptible sprayed with organic tin, 54 for resistant unsprayed, and 51 for susceptible sprayed with maneb. Total leaf production among the different treatments was not significantly different (at the 5% level); however, the average number of living leaves was significantly less on the susceptible unsprayed plants (15 leaves) than on the resistant or sprayed susceptible plants (28-32 leaves). Seventy-seven percent of the leaves produced were killed by disease on the susceptible unsprayed plants as compared to 44-49% in the other treatments.

Life span of leaves. Some of the earliest tagged leaves survived to harvest; these leaves (13 weeks old) were only on the tin-sprayed and resistant plants, and furthermore, these leaves had little or no disease during the season. The earliest tagged leaves on the maneb-sprayed susceptible plants were all subsequently killed by moderate leaf spot developing by harvest. Thus, it appears that leaves with little or no disease will remain alive for at least 13 weeks, and had we tagged leaves earlier than June 27, we may have found that the life span of disease-free leaves would be even longer than 13 weeks. At harvest the age of the leaves still alive was 1-5 weeks on the susceptible unsprayed plants and 7-13 weeks in the other treatments.

We also estimated the life span of leaves in a commercial field of sugarbeet plants located at Hollandale, Minnesota. Although the plants were of a variety (American Crystal 38) moderately susceptible to Cercospora leaf spot, the entire field was free from disease. At harvest, September 29, among 12 randomly selected plants there were 2-6 yellow senescing leaves per plant but no evidence of dead leaves, dried petiolés, or leaf scars. This suggests that under disease-free conditions most (perhaps all) of the leaves of thrifty sugarbeet plants survive until harvest.

Discussion and Conclusions

We assume that the number of leaves, petiole remnants, and leaf scars present at harvest indicates the total leaf production for the season (with the exception of the cotyledons and the first one or two pairs of true seedling leaves). Therefore, we interpret our data obtained at harvest in Mason City to indicate that among moderately and severely diseased plants total leaf production is essentially the same, even though two varieties and two fungicide treatments were involved.

On the resistant plants the onset of the epiphytotic was forestalled by 3 weeks, and the number of leaf spots increased at a slower rate as compared to the susceptible unsprayed plants. A slower rate of disease development also occurred on the fungicide-sprayed susceptible plants. Although genetical resistance and fungicidal treatments had no effect on total leaf production, they prolonged the life span of the leaves.

Experiments by Soine (2)[1] in fields free from leaf spot disease showed that mechanical removal of 75% of the leaves of sugar-beet plants at some time between July 31 and September 15 reduced root yields by 0.6-2.2 tons per acre as compared to check plots. However, other investigators in Mason City, Iowa, working with severe epiphytotics of leaf spot in check plots where presumably about 75% of the leaves were destroyed, found root yields reduced by 5.3-7.7 tons per acre when compared to fungicide-treated plots (1). These results suggest that leaf spot disease may be doing more damage to the plants than could be accounted for by merely reducing the photosynthetic area.

Literature Cited

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[1] Numbers in parentheses refer to literature cited.