THE EFFECTS OF THE WEATHER ON LATE BLIGHT AND TUBER QUALITY

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Abstract

Abnormally low rainfall, together with generally low atmospheric humidity and strong, dry winds, prevented a late blight epidemic on Prince Edward Island in 1960. Tubers harvested early in September, near the end of a hot, dry period, were high in specific gravity. The dry period was followed by rain which increased the volume of the crop but decreased the specific gravity of the tubers. Stem-end discoloration was severe in tubers from plants destroyed by top killer when soil moisture was low; no discoloration occurred in tubers from plants killed when soil moisture was at a normal level.

Introduction

The July-September season of 1960 was the second driest on record as shown by meteorological and late blight incidence tables extending back to 1922 at Charlottetown. During the thirteen weeks from July 1 to September 29, the precipitation was only 5.73 inches (Table 1) or approximately one-half the 39-year mean for the period. An additional 0.70 inches of rain on September 30 raised the total precipitation to 6.43 inches for the entire three-month period. The 39-year record of dryness for the three-month period was established in 1945 when only 6.38 inches was recorded. The wettest July-September period was that of 1942 when the precipitation totalled 20. 10 inches.

The extremely dry season of 1960 provided the opportunity to study late blight of potato (Phytophthora infestans) under a rare set of weather conditions for Prince Edward Island; to investigate the effect of low rainfall on the specific gravity of tubers; and to check the possible role of drought as a factor contributing to the incidence of stem-end discoloration following the killing of the tops by chemical sprays.

I. LATE BLIGHT

Late blight made its initial appearance in a field of Irish Cobblers at York on July 14, a new "zero date" and seven days earlier than average, The threat, however, failed to develop beyond a few scattered trace infections, and a very few moderate infections in some shore areas where occasional fogs provided additional moisture for the fungus.

The reason for the comparatively disease-free season is quite readily explained from the meteorological data, a summary of which is given in Table 1. It was an unusually dry season. Rain volume, however, does not in itself provide

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Table 1. Weather Summarv - 1960

Week	Mean Temp.	Mean Hum.	Rain Inches	Total Rain Inches	Dates of Rain							No. Rains
					1	2	3	4	5	6	7	
July 1-7	65.5	72.4	0.26	0.26			R	R	R			3
July 8-14	66.4	81.0	0.59	0.85		R		R		R		3
July 15-21	68.1	73.3	1.11	1.96			R		R	R	R	4
July 22-28	66.4	72.7	0.14	2.10			R			R		2
July 29-Aug. 4	69.7	77.4	0.07	2. 17			R		R	R		3
Aug. 5-11	65.6	75.6	0.26	2.43	R	R		R				3
Aug. 12-18	69.2	72.4	0.00	2.43				T*				
Aug. 19-25	69.4	84.4	0.61	3.04		R		R	R	R		4
Aug. 26-Sept. 1	69.2	59.2	0.12	3.16				T			R	1
Sept. 2-8	61.0	65.1	0.00	3.16		T						
Sept. 9-15	63.9	71.9	1.30	4.46	R	R	R	R	R			5
Sept. 16-22	52. 7	74.1	1.26	5.72			R		R	T		2
Sept. 23-29	57.3	78.3	0.01	5.73							R	1
Sept. 30			0.70	6.43	R							1
Total				6.43								32
Mean	64.9	73.7										

*Unmeasured trace.

the answer. There have been years when blight was severe although the rainfall was well below average; and there have been years when blight was rare although the rainfall was considerably above average for the July-September season. Examples are 1957 and 1959 in which severe late blight epidemics occurred when precipitations were 7.82 inches and 7.03 inches respectively, and 1935 and 1940 in which no blight and only a trace occurred under rainfalls of 15.69 inches and 13. 11 inches respectively.

A study of late blight-weather relationships for the 1922-60 period has shown that rain volume as a factor in the development and spread of the disease is governed by the frequency of the rains and by the character of the fine intervals. Humidity and wind are the governing factors. Thus a year with a high volume of rain may produce little disease if a large portion of the precipitation falls in a few widely-spaced heavy rains, the intervals between being characterized by low relative humidities and drying winds. The year 1957 was in marked contrast to the above conditions. The small volume of 7.82 inches recorded for the thirteen weeks from July 1 to September 29 was made up of recorded rains on 37 separate days. In addition to these recorded rains there were seven days in which unmeasured trace amounts fell and there were seven weeks in which the mean relative humidities were between 80.6 and 89.4, the mean for the thirteen weeks being 80.8.

The season of 1960 was quite generally characterized by low relative humidities and strong, dry winds which not only made it impossible for late blight to develop but also produced the worst forest fires in the history of the province.

In an attempt to build up an infection in the plots in which fungicides are screened, water suspensions of late blight spores were disseminated frequently over the plants in the unsprayed buffer and border rows. The first dissemination was made on July 20, and by July 28 from one to three lesions were found in a few of the rows. Repeated attempts, many of them in evenings, were made through August and into September, and in the latter part of this period the spores were sprinkled over the sprayed plots as well. By September 20, when the test was terminated by the application of top killer, only 15 per cent defoliation had occurred in the unsprayed check plots.

II. SPECIFIC GRAVITY OF TUBERS

The rainfall for the ten weeks beginning July 1 was only 3.16 inches and the amounts for the last four weeks of this period were 0.00, 0.61, 0.12, 0.00 inches respectively. During the last week of this extremely dry period Green Mountain tubers were dug and individually tested for specific gravity. The specific gravities ranged from 1.082 to 1.104 with the mean at 1.094. These values would give starch percentages in the range of 15.88 to 20.30 with the mean at 18.27 and dry matter percentages in the range of 21.00 to 25.62 with the mean at 23.50.

The weeks of September 9 and September 16 produced 1.30 inches and 1.26 inches of rain respectively (Table 1) and plant growth was stimulated, The plants in the same plots used for the first specific gravity analysis were destroyed by spraying them with a top killer on September 20 and a few days later the tubers were dug. The crop had benefited a great deal, in respect to volume, from the rains; the tubers being considerably larger than they were on September 2, However, it was found that the increased volume had been achieved at some expense to specific gravity; the individual tuber range dropping back to 1.073-1.091 with the mean at 1.084. These specific gravity values would give starch percentages in the range of 13.97 to 17.68 and a mean of 16.24; dry matter percentages would be in the 19.00 to 22.87 range and the mean at 21.37.

III. STEM-END DISCOLORATION

A brown discoloration in the xylem, and frequently in the adjacent parenchyma as well, sometimes occurs in the stem end of tubers from plants that have been killed down by spraying with top-killing chemicals. The cause of this phenomenon is not clearly understood although it has been investigated by many research workers. In general, the workers agree that a positive correlation exists between the rapidity of the killing and the amount of discoloration, but in some experiments no correlation was indicated. Reports concerning effect of the age of the plants when killed are confusing, some workers (1, 7, 9, 10) presenting data to show that more discoloration occurs when the tops are killed early and others (2, 3, 6, 12) that discoloration is greater when the plants are killed at or near maturity. It was apparent in one experiment in Maine (5) that discoloration induced by top killing increased with the age of the plants until they were maturing from natural causes, then decreased. In another Maine test (4) the date of killing was of no significance.

The above antithetic results seemed to indicate that the experiments were being influenced by some other condition, probably climatic. It is known that the discoloration occurs more frequently on the west coast of North America than in states and provinces on the eastern side. The phenomenon has never been reported from Great Britain. Hoyman (8, 9, 10) as well as Kunkel and his associates (11) have published data from well-organized field experiments to show that drought increased the discoloration. These results were confirmed by Callbeck(3) in greenhouse tests but Meadows (12) failed to establish them in her studies at Cornetl.

Advantage was taken of the drought conditions on Prince Edward Island in 1960 to study the influence of soil moisture on the phenomenon. Green Mountain potatoes, planted on May 26, were killed on September 9, or 106 days after planting, and the same variety, planted May 31, was killed on September 20, or 112 days after planting. Thus there was only a 6-day difference in the ages of the two groups. A sodium arsenite top killer at the concentration of five quarts per 100 gallons of water was used in both cases and applied at the rate of 100 gallons per acre. In each case, the tubers were examined 14 days after spraying the plants.

It will be observed in Table 1 that September 9 was at the end of an extremely dry period while the plants killed on September 20 had received 2.56 inches of rain in the interim. Thus one group was killed when the soil was very dry; the other group when the soil was reasonably moist. On cutting and examining the tubers it was found that those from the plants killed during the drought period had stem-end discoloration. In most tubers the symptoms were classified as severe, in some tubers the discoloration having affected the vascular ring for a considerable distance beyond the point of stolon attachment. No discoloration was apparent in the tubers from plants killed when the soil moisture was normal.

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