FLECK AND ACIDOSIS OF POTATOES IN SOUTHWESTERN ONTARIO

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Abstract

Two occurrences of necrotic flecking of Irish Cobbler notato foliage in the Barrow area of southwestern Ontario are reported. Growth symptoms observed in 1970 and attributed to acid soil conditions are also reported. The similarity between necrotic flecking and "speckle leaf" which has been established elsewhere as being air pollution injury is discussed.

Observations

Occurrence of disorders and associated symptoms

In late June of both 1966 and 1968 early potatoes in the Harrow–Leamington area of southwestern Ontario developed a black flecking of foliage (Fig. 1). This condition appeared suddenly in both years and came to our attention on June 27, 1966 and June 22, 9968. The flecking developed on both the upper and lower surfaces of the leaf laminae as conspicuous interveinal speckles which enlarged rapidly to produce irregularly shaped, blackish, necrotic areas, some attaining a diameter of 3.5 mm. A slight upward rolling of the affected leaves accompanied the flecking. In 1966 the symptoms were found on many of the young as well as the old leaves of affected plants, but in 1968 the disorder was more restricted to the older leaves. Affected leaves died in a few days and affected plants died prematurely. No estimates of yield reduction were obtained.

In both years these symptoms occurred about 3 weeks after tuberization commenced and 7 to 10 days before digging the early crop began. In growers' fields the disorder occurred in Irish Cobbler, an early–maturing variety which has been grown locally for more than 50 years. There was no evidence of this condition in fields of Avon, another early variety which became popular in the 1960's. A few numbered potato accessions grown in evaluation trials at the Research Station also showed the disorder. No symptoms were seen in Kennebec or Sebago, which are later-maturing varieties.

The irregular pattern of its occurrence in the area was puzzling. It was generally most prevalent on sandy loam soils of coarse texture, and was conspicuously most severe on the high knolls.

Figure 1. Fleck on Irish Cobbler potato foliage. Affected leaf on left, healthy leaf on right.

In late May 1970, about 2 weeks after the first shoots of the early crop emerged, another off–type foliage symptom was observed in two fields of Irish Cobbler near Harrow. The leaves were interveinally chlorotic and the youngest were purplish–red. The laminae were hard in texture and slightly cupped. Affected plants were pronouncedly stunted and occurred in uniformly affected areas on sandy knolls and higher ground. However, after a few days of wanner weather the new growth of affected plants became normal in growth and appearance, although the off–type color of the affected foliage remained apparent for at least 2 weeks.

Probable causes of aberrant growth and related disorders

Several isolation attempts from the necrotic flecks in conjunction with many microscopic examinations failed to yield evidence of the involvement of a pathogen.

The general restriction of these disorders to the sandy soils and the high ground of affected fields suggested a soil-borne factor as the probable cause. A study of the amounts and types of commercial fertilizers applied to these soils revealed that growers had followed standard recommendations. However, soil analyses of the affected areas gave lower pH readings

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than was suspected, this being particularly so on the knolls and high ground. In 1966 and 1968 pH readings in affected areas ranged from 4.9 to 6.2. Analysis of the two field soils where the aforementioned symptoms were observed in 1970 gave pH readings ranging from 4.0 to 4.2 in severely affected areas and 4.9 where the disorder was less severe.

Hooker et al. (3) have described a speckle leaf disease of potato in southwestern Michigan which caused severe yield losses in 1960 and 1969, but was much less serious in 1970 and 1971. In a series of experiments conducted alongside affected commercial potato fields, in plastic houses with charcoal-filtered and non-filtered air, they established air pollution as the cause of the condition. Striking differences in varietal susceptibility were reported. Photochemical oxidants were postulated as the toxic agents. Johnston (4) reported the probable occurrence in 1954 of speckle leaf on potatoes near Guelph, Ontario. He also reported (4) that in recent years growers in the Bradford Marsh have observed serious foliage injury of this nature on the Norland variety.

In June 1971, Probasco (1), the county agent for Accomak and Northamptom counties of Virginia, U.S.A., reported the occurrence of a mysterious leaf-flecking disorder of white potatoes on the eastern shore. It was speculated that the cause was ozone toxicity. A close similarity of symptoms between the potato disorders of Michigan and Virginia and that observed by us in 1966 and 1968 is recognized. Since early potatoes grown in Virginia are normally planted and harvested a few days before similar crops in southwestern Ontario, it seems that these fleck disorders appeared when crops reached a similar stage of development.

"Weather fleck" of tobacco (5) and "bronzing" of white beans (6) have been recognized for several years as serious disorders in southern Ontario. Both are considered to be caused by air pollution. Like potato fleck these disorders occur between flowering and maturing of the affected crops.

Conclusions

The potato fleck symptoms observed by us in 1966 and 1968 may well be the 'speckle leaf" disorder attributed to air pollution to which reference has already been made. However, abnormal growth observed in two potato fields in 1970, although it has the common factor of occurring only on the higher ground, does not necessarily have any relationship with the fleck disorder. At the same time, nutrition and soil acidity may play a role in both conditions. It is highly probable that the symptoms observed in 1970 were incited by high soil acidity. Potato growing is not recommended for soils with pH below 4.5. It has been established that manganese toxicity (2) may occur when potatoes are grown on highly acid soil. Characteristic symptoms of excess manganese are described as black flecks and streaks on stems, petioles, and laminae of affected plants. Since stem or petiole streaks were not observed in 1966, 9968, or 1970, manganese levels were not considered as being excessive. A marked drop in the pH of many of the heavily fertilized sandy soils in southwestern Ontario in the last 3 to 5 years is of concern. Soil analyses from several potato fields in 1971 and 1972 gave pH readings ranging from 4.2 to 5.3.

While much is known about toxicity symptoms in several crops caused by specific air pollutants applied in controlled environment chambers, much still remains to be learned about conditions that give rise to injury in the field. Although field and laboratory experiments strongly supported the thesis that ozone and its reaction products are the initiating agents of the "weather fleck" response in tobacco (5) and "bronzing" in beans (6), the concentration of ozone required to bring about the toxic response appears to be dependent upon the physiological condition of the host and particularly of the leaf tissue. Atmospheric conditions are recognized as playing an important role in the development of symptoms in the field but yet are hard to assess because of seasonal inconsistencies. The potato fleck disorder of 1966 appeared after a week of unseasonably hot weather with high daily sunshine, whereas that of 1968 occurred after a period of intermittent days of warm sunny and cool cloudy weather. Abnormally high precipitation occurred in late May of 1968; in 1966 rainfall was normal for April, May, and June. It is possible, on readily leached soils, that large differences in rainfall could bring about nutrient imbalances in the plant that might dramatically affect growth.

While the potato fleck disorder is probably a manifestation of damage from air pollution, it has been associated in its occurrence in southwestern Ontario with high soil acidity: therefore further attention to the possibility that fleck is triggered by high soil acidity in relation to nutritional imbalances seems warranted.

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