Zinc Content of Potato Leaves*

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The need of zinc for the normal development of plants has been well established. The amounts required are small and zinc falls into the category of an essential trace element. The first recognition of a zinc requirement for plant growth was made by Mazé[1] who showed that corn would not develop normally in the absence of zinc.

The findings of Mazé have been confirmed repeatedly by numerous investigators and the list of plants which require zinc for normal development has become so extensive as to suggest that zinc is required by all higher plants.

More recently it has been shown that zinc is a required component of many enzyme systems in humans and animals.[2] It is likely that zinc is a normal constituent of animals as well as higher plants.

The soils in certain areas of the United States have been shown to be very deficient in zinc content. These deficiencies are most pronounced in highly leached acid soils but may be encountered also in highly alkaline soils. High alkalinity tends to reduce the availability of zinc. High organic matter in the soil also accentuates zinc deficiencies.

Zinc deficiencies may be corrected by application of soluble zinc compounds to the soil or through foliar (leaf) sprays containing zinc compounds. The latter method has proved very effective and the zinc deficient plant responds quickly to the treatment.

The early symptoms of zinc deficiency in the plant are an intervenal chlorosis which closely resemble the symptoms of manganese or iron deficiency. These symptoms may be so similar that the exact nature of the deficiency may be determined only after careful experimentation. As the zinc deficiency becomes more severe, abnormal leaf growth may result. Such leaves exhibit dwarfing, paleness (chlorosis), curving and, in severe cases, degeneration and necrosis.

It is safe to say that the growth of a plant may be greatly reduced before evidence of trace element deficiency can be observed visually. When the deficiency is so severe that visible evidence exists, the plant is in a serious condition physiologically.

A severe deficiency of trace elements in a plant may be determined frequently by the analysis of the plant for the elements in question. Finch and Kinnison[3] found that the leaves of healthy

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*The leaf samples were collected by Dr. W. G. Hoyman in connection with project RMA 9.

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pecan trees contained from 13 to 16 parts per million (p.p.m.) of zinc. The symptoms of zinc deficiency in the pecan are described as "pecan rosette." Rosetted leaves contained only 3 to 4 p.p.m. zinc. Applications of zinc raised the zinc content to that of healthy leaves and the rosetted leaves became normal. Generally speaking, the zinc content of healthy plants is between 25 and 100 p.p.m.[4] When the zinc content falls below 25 p.p.m., deficiencies may be encountered.

Excessive amounts of zinc may also be harmful to the plant. Bergh[5] found that the growth of potatoes was reduced when the leaves contained 135 p.p.m. zinc. The optimum zinc levels for potato leaves is very likely somewhere between 25 and 100 p.p.m.

The zinc content of various crops grown on zinc deficient soils of Washington has been determined.[6] It was found that mature potato leaves grown on these soils contain about 16 p.p.m. zinc. Although no symptoms of the deficiency were evident, the growth of the plants was stimulated by zinc application. These same workers considered the potato to be intermediate in its zinc requirement with plants such as bean, flax, soybean and corn having higher requirements.

There has been some indication that potatoes grown in North Dakota respond favorably to the application of zinc sprays to the foliage. Hoyman[7] reported that the yield of potatoes may be increased significantly by the application of zinc. The response was variable and may have been influenced by the previous history of the soils, such as tillage practice or perhaps the use of zinc-containing sprays or dust in previous years.

In order to gain some information concerning the status of zinc in potato leaves in North Dakota, a determination was made of the zinc content of samples of mature leaves taken from the mid-section of the potato stem. These samples were selected from fields which had not received applications of zinc-containing fungicides or insecticides during the growing season in which they were taken. The samples were air-dried, ground and analyzed for their zinc content by the dithizone method. The results of the analyses are shown in table I.

The zinc contents found in the potato leaves suggest that the level of zinc in the soil is sufficient for normal growth in most cases. There is considerable variation in the zinc content which ranged from 13 to 87 p.p.m. Those samples which contained from 13 to 30 p.p.m. zinc, but showed no visible evidence of zinc deficiency, may well be somewhat deficient and show a response to foliar applications of zinc. In all probability those samples which contained above 30 p.p.m. zinc have a plentiful supply of available zinc. The wide variations may be due to variations in soil moisture, organic matter and alkalinity, all of which are known to influence the availability of zinc. The application of zinc-containing fungicides in previous years could also increase the amount of available zinc in the soil.

TABLE I.—**Zinc in Potato Leaves—Arranged According to Variety.**

Lab. No.	Variety	Source	Date Sampled	PPM Zinc
		A. Eastern Section		
1	Triumph	Fargo	6/21/51	87
2	Triumph	Northwood	6/29/51	81
3	Triumph	Grand Forks	6/27/51	63
4	Triumph	Hatton	6/25/51	80
5	Triumph	Grafton	6/27/51	57
6	Triumph	Cummings	6/25/51	53
7	Triumph	Grafton	6/27/51	53
8	Triumph	Hatton	6/27/51	61
9	Red Pontiac	Northwood	6/29/51	29
10	Red Pontiac	Larimore	6/26/51	60
11	Red Pontiac	Grafton	6/27/51	37
12	Red Pontiac	Hoople	6/26/51	29
13	Red Pontiac	Grand Forks	6/27/51	24
14	Red Pontiac	Cummings	6/25/51	57
15	Red Pontiac	Park River	6/26/51	81
16	Red Pontiac	Hoople	6/26/51	54
17	Red Pontiac	Northwood	6/25/51	78
18	Red Pontiac	Hatton	6/27/51	54
19	Pontiac	Thompson	6/27/51	81
20	Cobbler	Grand Forks	6/27/51	60
21	Cobbler	Hatton	6/27/51	40
22	Red Warba	Hatton	6/27/51	13
23	Kennebec	Northwood	6/25/51	57
		B. Western Section		
24	Cobbler	Sentinel Butte	7/27/49	37
25	Triumph	Beach	7/27/49	53
26	Triumph	Sentinel Butte	7/27/49	50
27	Triumph	Beach	7/28/49	33
28	Cobbler	Alamo	8/4/49	50
29	Triumph	Ray	8/6/49	55
30	Triumph	Ray	8/6/49	66
31	Triumph	Williston	8/3/49	48
32	Triumph	Crosby	8/4/49	48

There is no appreciable difference in the zinc content of the samples obtained from different areas, wide ranges being observed in every area sampled. If these analyses are typical, it would appear that potatoes in North Dakota generally have an adequate supply of zinc and would not respond greatly to supplemental applications. It is possible, however, that crops in fields which are maintained at a high level of productivity year after year could deplete the supply of available zinc and respond favorably to application of soluble zinc compounds.

Since other crops such as flax, corn and beans have higher zinc requirements than potatoes[6] one may expect to encounter zinc deficiencies more readily in them than in potatoes.

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THE REDWOODS AND THE "BIG TREES"

When nature dealt out her gifts, she endowed California with a number of extraordinary things. But none is more startling than the two species of sequoias—the redwood, world's tallest tree, and the big tree, largest and oldest living thing known.

Sequoias are the venerable ancients of the vegetable kingdom. They thrived in vast forests 100 million years ago when the earth was dominated by 30 ton dinosaurs and fearsome flying reptiles. Some 45 species of fossil sequoias have been found in the rocks throughout the northern hemisphere. But little by little the sequoias lost their hold, until today only the redwood and the big tree remain, the last living representatives of their giant, lusty race. They are found only in California.

The redwood and big tree are brothers under the bark and have a general family resemblance, but each has a distinctive and individual personality of its own. They even prefer completely different surroundings. The redwood grows in a narrow, 500 mile belt bordering the mild, foggy coast of central and northern California into southern Oregon. It never climbs above an elevation of 3,000 feet. The big tree, on the other hand, likes the spartan environment of winter cold and deep snows in the mountains and is found only in seventy-odd scattered groves stretching for 240 miles along the west slope of California's lofty Sierra Nevada, from elevations of 3,500 to 8,500 feet.

Someday, to take your mind off taxes, wars and presidential elections, pace off a distance of 36 feet on lawn or sidewalk. Or, if you have the space, measure a circle with a circumference of 101 feet. The first is the diameter, the latter the girth of the General Sherman tree, patriarch of all sequoias. Then imagine it extending into the air 272 feet, equal to a 25 story hotel, and weighing 6,172 tons, about the same as a good sized ocean freighter. When you have digested these incredible figures and accepted its age at around 4,000 years, you will be ready to believe that there is enough timber in the General Sherman tree to build 45 five room bungalows or to construct a box completely enclosing the liner Queen Elizabeth—if there were any reason for such a ridiculous undertaking.

The redwoods of the coast are supertrees, too, but they cannot compete in size and age with these mountain monsters. The biggest redwoods measure up to 23 feet in diameter, although the average is from 10 to 15 feet. Also their life span of 1,500 to 2,000 years makes them youngsters compared with the big trees. But in height the redwood is supreme. The founders tree at Dyerville Flat, commemorating the three men who started the save the redwoods movement, towers 364 feet—the tallest accurately measured tree in the world. The big trees stand as ponderous individuals or in impressive groups among pines and fir. The redwoods grow close ranked in massed twilit forests of almost tropical luxuriance.

It is a tossup which sequoia is the more remarkable tree. But not to the lumberman. While the wood of the big tree is coarse and brittle, fit only for low grade uses, such as grape stakes, the redwoods produce grade A lumber which is growing in popularity throughout the country. This difference in the commercial usefulness between the two sequoias has resulted in 90 per cent of the big trees living peaceful, undisturbed lives in protected federal and state reservations, while most of the virgin redwoods are destined to succumb to ax and saw in another generation.