การขาดธาตุสังกะสีในต้นส้มของประเทศไทย

Zinc Deficiency of Citrus in Thailand

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Citrus fruits have been grown in the kingdom of Thailand for many centuries. These are very popular fruits as food, and they provide a good source of income to the grower. The full potential for production is not realized, howewer, due to many factors, one of which is zinc deficiency.

Zinc is an essential element for the growth of plants. It is required in very small quantities by the citrus plant. Zinc is effective in very small quantities because it functions in the enzyme systems which regulate plant life. One such enzyme system is the auxins, which control shoot growth and produces very characteristic symptoms when it is absent. It functions in others which control leaf size, the conversion of starches and sugar in the leaf and the utilization of other plant nutrients.

CAUSE OF ZINC DEFICIENCY

Zinc deficiency arises from many different causes, but the three main ones are: (1) low zinc content in the soil, (2) unavailability of the zinc present in the soil and (3) management or other practices which depress the availability or uptake of zinc from the soil by the plant

Total zinc is low in soils developed from parent materials low in zinc, such as the sandy soils of the Korat Plateau and the latosols developed from basic igneous rock. Soils developed from granite or gneisses may also be low in zinc. Soils that have developed laterite horizons, such as those that occur in many parts of Thailand have low zinc content.

The citrus plant requires a moderately acid soil of pH 5.5 to 6.0 for best growth. This is the level at which the availability of zinc is at an optimum for the plant. If the pH is above 6.0 the zinc becomes immobile in the soil and zinc deficiency is the result. The deficiency becomes more severe as the pH increases. Citrus grown on high pH soils such as those of the alluvial plains of the Mekong River and its tributaries and those formed from limestone in Pak Chong and Phra Buddhabat, and other high pH soils of Thailand often show zinc deficiency symptoms. Zinc deficiency will also occur on acid sandy soils where the mobile zinc has been removed from the soil by leaching.

Zinc deficiency may occur where high levels of phosphate fertilizer have been applied. In one experiment where 30 kgms/rai of phosphate had been added

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to the soil, more than 80% of the trees showed zinc deficiency symptoms. Zinc deficiency may also be caused by the application of liming materials to the soil, especially where there are marginal supplies present.

The citrus plant has a shallow root system with few root hairs. This provides a relatively low nutrient absorption capacity, so that any factor which may affect the root system, such as mechanical injury etc. will cause or intensify zinc deficiency. Zinc deficiency was observed in one orchard where the grower had grown sweet potatoes in the rows between citrus. When the potatoes were harvested the tree roots were damaged and zinc deficiency was the result. In many Thai Citrus Orchards ants are a cause of root damage which contributes toward or intensifies zinc deficiency. Virus and fungus diseases also intensify zinc deficiency in two ways: (1) by damaging the root system and (2) blocking the conducting tissue in the plant so that the zinc cannot be transported to the growing part of the plant.

Zinc is taken up by the plant during the entire year. However, citrus produces several flushes of new growth each year. Zinc uptake is greatest during these periods and deficiency symptoms are most likely to be found on the foliage at this time.

Zinc deficiency has been observed on various species of citrus in Thailand. However, the tangerine seem to be the most sensitive plant to this deficiency. Figure 1 shows the areas in Thailand where zinc deficiency has been observed on citrus by the author (accompanied by Dr. Sorasith Vacharotayan on all parts of the survey) during a benchmark survey of plant nutrient deficiencies in Thailand. Zinc deficiency would be expected to be found in all other areas of the kingdom where citrus is grown.

DIAGNOSIS OF ZINC DEFICIENCY

Zinc deficiency may be diagnosised by several different methods. Leaf analysis, deficiency symptoms, experimental plots, soil tests, spray tests and pot tests may be used. For best results two or more of these should be used together for diagnosis of nutrient deficiency. Leaf analysis and observance of deficiency symptoms are most often used.

Observance of leaf symptoms is the fastest method, but correct diagnosis requires experience. The characteristic symptoms that develop in zinc deficiency and the rapid response of the plant to applications of zinc make this one of the easier deficiencies to diagnose by this method. If the deficiency is recognized in its early stages and proper corrective measure applied little loss of yield or quality will result. However, if the deficiency progress to the stage where symptoms are prominent, both yields and quality will be reduced.

Leaf analysis requires more time, but has the advantage that a deficiency may be recognized before the symptoms appear on the plant. This assures that the deficiency may be corrected before reduction of yield occurs. Many workers (1, 4, 5, 7) agree that if leaf levels of zinc are below 18 parts per million (ppm)



Fig. 1. Areas of Thailand where zinc deficiency was found on citrus. Tangerine was the major species showing the deficiency, but it was found on all species grown in each area.



Fig. 2. Zinc deficiency symptoms of citrus. The leaves are smaller than normal, are brilliant greenish yellow in color between darker colored strong yellowish green veins and midrib. The leaves are bunched at the end of the twig due to the shortening of internodes as a result of the deficiency. The group of leaves at the bottom of the photograph show the early stages of the deficiency. These symptoms are characteristic for all species of citrus.



Fig. 3. Dieback of citrus due to zinc deficiency. In the more severe stages of deficiency, first the small twigs die back and then the larger twigs as can be seen in this photograph. Note the leaves showing the characteristic symptoms in the lower portion of the photograph.

deficiency will result. The levels are adequate between 20 ppm and 80 ppm, and in excess above 80 ppm but not toxic until they reach above 400 ppm.

ZINC DEFICIENCY SYMPTOMS

Zinc deficiency produces very characteristic symptoms on citrus. The symptoms first appear on the new growth of the tree as zinc is immobile in the plant and is not translocated from the area of storage to the area of use. The terminal leaves on the new flush of growth will be the first to show the symptoms. The leaf develops a brilliant greenish yellow color in the areas between the veins while the viens and midrib remain a darker strong yellowish green color (3). The discoloration between the veins first begins as small yellow mottles, which gradually extends to the margin of the leaves later the margin becomes the same color with only a narrow band of strong yellowish green remaining along the veins and the midrib (Fig. 2). The leaves are smaller than normal, narrow and erect in growth. The distance between internodes on the twig are shortened resulting in the reduction of twig length and the bunching of small leaves at the terminal. The leaves will shed prematurely, the twigs die back, and eventually the larger branches will also die back giving the tree a brush-like appearance.

Zinc deficiency may be mild, moderate or severe depending upon soil conditions and treatment given the plant. In a mild or slight deficiency, only a few terminals on a small number of trees will exhibit the symptoms and these may disappear after the flush of growth ceases. Each succeeding flush of growth will produce increasing numbers of terminals showing symptoms and the symptoms will become persistent. The leaf will be slightly reduced in size, the reduction becoming more pronounced as the deficiency becomes more severe. There will be little or no effect on twig length or upon fruit yield or quality at this stage.

In the severe stage of deficiency most or all of the terminals will be effected. Leaves will be small and twig length greatly shortened. In the more severe stages the leaves may emerge as very small, almost white with only the veinal areas being green. The leaves do not enlarge, tend to shed early and twigs die back early. In time the larger twigs and branches die back giving the tree a brushy appearance (Fig. 3). Fruits are small, misshapen, and lose their green color prematurely. The numbers of fruit are small, the pulp is dry, woody and insipid, and the fruit drops prematurely from the tree.

Moderate deficiency is between these two extremes in its effect upon the plant. Zinc deficiency develops progressively from slight to severe very rapidly unless the deficiency is corrected by the grower.

Zinc deficiency often occurs as multiple deficiency with either iron or manganese. When the multiple deficiency occurs, recognition of either deficiency is very difficult as they tend to mask each other. When one deficiency is corrected, the others then come into sharp focus. Combinations of zinc deficiency with iron deficiency has been observed on the acid sandy soils of Northeast Thailand and combinations with manganese on the high

pH soils developed from limestone and on the latosols developed from the basic igneous rocks.

CORRECTION OF ZINC DEFICIENCY

The use of materials such as zinc sulfate, zinc oxide, zinc carbonate, zinc nitrate and zinc chelate (Zn NaEDTA) may be used to correct the deficiency. Generally zinc sulfate has proven to be satisfactory as a source of zinc for the correction of the deficiency. The materials may be applied to the soil or as a foliar spray. The chelate may be more desirable where soil conditions are unfavorable for use of the sulfate.

The soil application should be at the rate of approximately five (5) pounds per tree for zinc sulfate. The chelate should be applied according to the manufacturers directions. Where soil conditions are unfavorable for zinc availability, it may be more desirable to use spray applications. Zinc sulfate should be used at the rate of five to ten pounds per 100 gallons of water (2.5 to 4.75 kgms in 400 liters of water), the use of hydrated lime in the solution at one-half the rate of zinc sulfate is recommended to prevent burning of the foliage. Zinc sulfate with hydrated lime often leaves a residue upon the foliage which increases the infestation of insects, especially the scale insects. To reduce this danger, zinc oxide or other neutral sources of zinc may be used without the hydrated lime.

The spray should be applied to the early flush of growth for best results. A second spray should be applied about 30 days later where the deficiency is moderrate to severe. The spray should be applied when the first symptoms are noted on the foliage of a few trees. This eliminate the application of periodical sprays and reduces the cost of zinc application to the citrus. It is not necessary to insure full coverage of the tree as in the case of insecticide sprays so that about 10 gallons of spray per tree is sufficient.

Recovery from the deficiency is usually rapid after the application of zinc to the tree. The new growth will be normal in size and color but the old growth that exhibited the symptoms may still exhibit these symptoms until the leaves are shed from the tree.

สรุป

ธาตุสังกะสีเป็นธาตุหนึ่งที่พืชต้องการเป็นจำนวนน้อยมาก แต่ก็เป็นธาตุที่จำเป็นสำหรับการเจริญเติบโตของพืช มีความสำคัญต่อระบบเอนไซม์ต่าง ๆ ของพืช ควบคุมระบบการเปลี่ยนแป้งให้เป็นน้ำตาล และระบบอื่น ๆ อีกหลายอย่างในพืช

พืชที่ขาดธาตุสังกะสีนั้น กล่าวได้ว่าเนื่องมาจากเหตุสามประการคือ 1) ดินมีธาตุนี้น้อยอยู่แล้ว 2) ดินมีธาตุนี้มากแต่อาจจะไม่อยู่ในรูปที่นำไปใช้เป็นประโยชน์ได้ง่าย และ 3) การปฏิบัติที่เกี่ยวกับดินและการปลูกบางอย่างก่อให้เกิดการขาดธาตุอาหารนี้ขึ้นได้

ดินแถบที่ราบสูงโคราช ซึ่งเป็นดินร่วนทราย และดินพวก latosol ซึ่งเกิดจาก

หินอัคนี และหินแปลบางชนิดของประเทศไทยมักจะมีแนวโน้มที่จะมีระดับธาตุสังกะสีที่ต่ำ

ดินที่มี pH สูง โดยเฉพาะดินที่เกิดจากหินปูนหรืออยู่ในบริเวณที่มีภูเขาหินปูน มักจะมีระดับธาตุสังกะสีที่ต่ำในขั้นที่ไม่เพียงพอสำหรับส้ม อาทิเช่น ดินในบริเวณปากช่อง พระพุทธบาท และตามบริเวณลุ่มแม่น้ำโขง ส่วนดินที่เป็นกรดมาก ๆ ก็มีแนวโน้มที่จะขาดสังกะสีเหมือนกัน ทั้งนี้เนื่องจากธาตุนี้จะถูกชะล้างโดยน้ำฝนออกไปเสียจนหมด

การพรวนดินรอบโคนต้น น้ำขัง มดปลวก และอื่น ๆ ที่ตัดหรือทำลายรากของส้มจะทำให้ส้มดูดธาตุสังกะสีได้ไม่เพียงพอกับความต้องการ ทั้งนี้เนื่องจากระบบรากของส้มนั้นอยู่ตื้น ๆ และไม่ค่อยมีรากฝอย ซึ่งเป็นปัญหาที่สำคัญที่สุดอย่างหนึ่ง

ส้ม โดยเฉพาะส้มเขียวหวานที่ปลูกอยู่ทั่วไปในประเทศไทยจะแสดงอาการขาดธาตุสังกะสีอย่างแพร่หลายที่สุด อาการที่แสดงออกสามารถเห็นได้อย่างชัดเจน โดยที่ใบจะมีลักษณะต่าง บริเวณระหว่างเส้นใบจะมีสีเขียวอ่อน หรือเหลือง ส่วนบริเวณที่ติดกับเส้นใบจะยังเขียวสดอยู่ ใบจะเล็กและลีบผิดขนาด เป็นลักษณะของใบที่ชาวบ้านเรียกกันทั่ว ๆ ไปว่า "ใบแก้ว" เมื่ออาการหนักขึ้น ยอดของต้นส้มจะแห้งตาย และในที่สุดก็แห้งตายไปทั้งกิ่ง ต้นส้มจะแคระแกรน และการให้ผลจะน้อย และลูกเล็กและมีคุณภาพต่ำ

การแก้ไขอาการขาดธาตุสังกะสีของส้มสามารถกระทำได้โดยใช้สังกะสีซัลเฟท สังกะสีอ๊อกไซด์ สังกะสีคาร์โบเนต สังกะสีไนเตรท หรือสังกะสีคีเลท (Zn Na E DTA) ฉีดให้ทางใบหรือใส่ลงไปในดินรอบ ๆ ต้นก็ได้ สังกะสีซัลเฟทมักจะใช้กันอย่างแพร่หลายและใช้กันในอัตราประมาณ 5 ปอนด์ต่อหนึ่งต้น โดยใส่ให้ทางดิน ถ้าจะใช้การฉีดให้ทางใบ ใช้สังกะสี 2.5–4.75 ก.ก. ละลายในน้ำประมาณ 400 ลิตร และควรผสมปูนขาวหนักประมาณครึ่งหนึ่งของจำนวนสังกะสีซัลเฟทที่ใช้ละลายผสมลงไปด้วย ฉีดให้ต้นละประมาณ 40 ลิตร ก็พอ ควรฉีดในระยะส้มเริ่มแตกใบอ่อน และควรจะฉีดทันทีเมื่อเริ่มสังเกตเห็นอาการขาดสังกะสีเกิดขึ้น ไม่ควรปล่อยทิ้งไว้ให้อาการหนักเสียก่อนแล้วจึงฉีด ฉีดครั้งที่สองควรกระทำภายหลังจากครั้งแรกประมาณ 30 วัน

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