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Calcium Deficiency Disorders in Poinsettias

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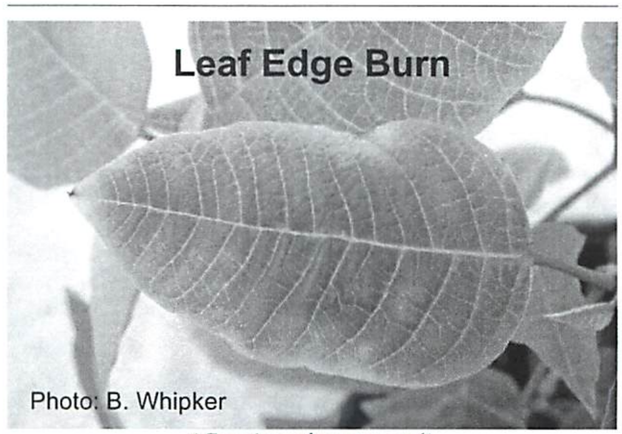
Poinsettias are the top selling potted flowering plant in the United States and Europe. Their history in the United States begins with Joel Poinsett, the U.S. Envoy to Mexico from 1825 to 1830. Poinsett introduced poinsettias to America in 1825, which, of course, led to the common name, poinsettia. The poinsettia was formally named *Euphorbia pulcherrima* by Karl Ludwig Willdenow, head of the botanical gardens in Berlin, and was scientifically described by his custodian Johann Friedrich Klotzsch in 1834. In the United States poinsettias were initially marketed as cut flowers and it was not until the early 1900's that the first pot varieties were selected. In 2005, wholesale poinsettia sales in the United States totaled more than $242 million and numbered more than 59 million pots, according to the U.S. Department of Agriculture. North Carolina is the second greatest producer of poinsettias, with California first.

Popularity and history do not change the basic nutritional challenges faced in producing poinsettias as a greenhouse pot crop. Though research has been ongoing since the 1940's, much work remains to be done to resolve the unique nutritional problems associated with this high value crop. Calcium (Ca^{2+}) deficiency in particular is associated with several metabolic disorders in poinsettias such as bract necrosis, leaf edge burn and lateral stem weakness. Bract necrosis (BN) and leaf edge burn (LEB) are both characterized by black or brown necrotic spots or patches along the edges of bracts or leaves. These spots can coalesce until the entire margin is necrotic, which is then easily attacked by *Botrytis* causing further damage. Lack of stem strength is problem during shipping for many varieties and can be aggravated by poor nutrition and growing conditions. When trying to prevent and correct calcium problems it's good to understand how calcium moves in poinsettias.

Calcium has important roles in cellular signalling and strengthening cell walls, so deficiencies will result in weaker tissues. It is transported by water movement in the xylem and thus requires transpiration to reach young leaves and bracts. High relative



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humidity, low temperatures, poor air circulation or any other condition that reduces transpiration reduces uptake of water, and therefore calcium content. Additionally, several soil chemistry factors limit Ca^{2+} availability such as high EC, imbalanced nutrition, low pH and low Ca^{2+} concentration. Ongoing research has found that though calcium deficiency plays central role in BN, LEB and stem weakness, simply increasing amounts of available calcium may not help very much.

Bract Necrosis and Leaf Edge Burn. Most crops in production greenhouses are supplied more nutrients than required for satisfactory growth (known as luxury consumption). For many crops this strategy works quite well, but with poinsettias excess nutrition, particularly late in the season, creates problems. The relationship between BN, LEB, nitrogen (N), potassium (K) and Ca^{2+} must be kept in mind. Bract necrosis is associated with Ca^{2+} deficit as bracts have reduced stomatal density and very low rates of transpiration. Therefore, bracts take up Ca^{2+} slowly so even a slightly low Ca^{2+} contents may cause problems. In fact, bracts account for only 0.1 to 0.5% of the total Ca^{2+} transported to the whole shoot and most of that is transported during the very early stages of growth. Since Ca^{2+} in the bracts is mostly transported in early development, a luxuriant supply of Ca^{2+} in combination with lower K and/or N during early growth may increase the final Ca^{2+} content of the bracts.

Another approach to preventing BN is to maintain a slight K+ deficiency, which results in a greater Ca^{2+} content in the bracts and the whole plant without degrading quality. This relationshiop is to be expected given the known Ca^{2+} – K^{+} antagonism. More surprising, however, is that the Ca^{2+} concentration will also be higher in bracts of plants grown under slight N deficiency than plants with ample N. Nitrogen deficiency prompts the proliferation of young root tips, which are known to be the site of Ca^{2+} uptake. As a result, plants under slight N deficit have a greater ability to absorb calcium.

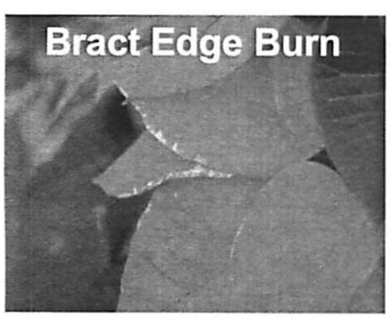

Photo: W. Roland Leatherwood

Plants grown under slightly reduced N, K, or altered N:K regimes will be similar in size, and have comparable number and size of bracts compared to plants with raised with 'luxury consumption' nutritional availability, but have less incidence of bract necrosis during the postharvest period.

Poinsettias grown under high N availability have a high growth rate and a decreased root:shoot ratio. The resulting plants have a shorter postharvest life, increased leaf and cyathia abscission, and greater incidence of bract necrosis. Accordingly, under high growth rates, Ca^{2+} is most deficient at the bract and leaf edges, the location where bract necrosis and leaf edge burn start. High growth rates exceed the plant's ability to supply enough Ca^{2+} to distal parts. Similar problems from N induced high growth rates are seen in other crops. Incidence of blossom end rot of tomato, lettuce tip burn, and apple bitter pit are all directly related to tissue growth rate and calcium deficiency in distal tissues.

To avoid many of the problems associated with Ca^{2+} deficiency growers should use several approaches. Reduce fertility rates and watering during the final weeks of production and if possible, use water only the last two weeks. Keep in mind when using slow release fertilizers that they should be mostly dispersed by the time the last few weeks of the crop cycle comes around. In any case, do not apply new fertilizers of any kind towards the end of the production cycle. Maintain low humidity and high air circulation in the greenhouse to increase transpiration. Growers should monitor calcium amounts in soil and tissues throughout the crop cycle. If either test indicates low Ca^{2+}, then weekly 200 - 400 ppm $CaCl_2$ sprays (Table 1) from first color to the delivery week will help counteract the problem. Be sure to use reagent grade $CaCl_2$ as horticultural grade contains impurities that may damage the bracts. Anhydrous and dihydrate forms are available. The dihydrate form is usually less expensive (Fischer Scientific Cat.# S75070). Also, use a spreader sticker during application and apply as a fine mist just until the bracts or leaves glisten.

At the end of the crop cycle, growers often lower temperatures to hold plants for sale, aggravating BN and LEB. Low temperatures and high soil moisture result in low water movement through the plant. Calcium concentrations continue to drop in bracts as the plant ages. Timing of the crop and production cycle can help minimize the amount of time that plants are held in unfavorable conditions.

Stem Breakage. During shipping, poinsettias must be able to withstand a greater degree of mechanical stress than found in the greenhouse. Stem breakage results in loss of salable plants and has a direct correlation with calcium deficiency. Nitrogen too plays a role. Experimentally, poinsettias grown with 75 mg L^{-1} N have greater lateral strength than those grown at 125 mg L^{-1} N. Also, plants grown with either 15:2:20 or 15:5:15 NPK had significantly stronger stems than those grown with 20:10:20 NPK at both rates. In each case, lower N resulted in stronger laterals and plants with equal appearance compared those provided complete nutrition. Stem strength can be improved with direct application of Ca^{2+} as a spray or as supplemental liquid feed. Plants fertilized with NH_4NO_3 and $Ca(NO_3)_2$ have stronger stems compared to those receiving no additional calcium. To help strengthen stems, growers can apply a 300 ppm $CaCl_2$ spray as described above, if indicated by soil and foliage test. However, the treatment is less effective on self-branching cultivars.

There are other methods to reduce stem breakage. Increasing light levels to above 3,000 foot candles in the period before short days, adding ring supports to pots and stronger cultivars are common approaches. Use of thicker cuttings, up to 7 mm in diameter, reducing the number of laterals by pinching to 4 to 5 nodes, and increasing spacing also help. Spacing is perhaps the trickiest method to understand here. Because plants grown at bench edges will have more horizontal branches they are more likely to break during sleaving. However, spaced too closely branches become thinner and weaker. The goal is spacing that will produce a large branch angle and diameter, but not such that there will be a problem during sleaving. To get there, allow a few days after the canopy closes before spacing.

Stock Plant Management. Proper Ca^{2+} nutrition for poinsettias is not limited to the production environment, but is a concern before cuttings are ever taken. Poinsettia stock plants are susceptible to LEB during periods of high productivity and rapid growth. When large numbers of cuttings are produced rapidly, the plants' ability to take up Ca^{2+} is pushed to the limit. Since poinsettias are already poor at Ca^{2+} distribution, situations involving rapid growth, such as cutting production, are likely to result in Ca^{2+} deficiencies. Equally important, *Botrytis* spores can infect these necrotic areas and subsequently travel on cuttings harvested from infected stock plants. These cuttings are much more likely to develop disease problems during shipping or propagation.

In the case of stock plants, ammonical N in any amount greatly increases leaf edge burn so favor nitrate fertilizers such as $Ca(NO_3)_2$. However, some ammonium is needed too, so don't apply nitrate fertilizers exclusively. Leaf edge burn is dramatically reduced when 500 ppm Ca^{2+} is applied as a foliar spray rather than soil applied. Appropriate management of N availability and source, reduction of K availability, and increasing supplemental Ca^{2+} will go a long way to resolving most Ca^{2+} disorders growers encounter with poinsettias, resulting in robust and long lasting crops.

So what can you do this fall to prevent Ca^{2+} related disorders? Several simple steps can be taken. From the first week of color to delivery apply 200 to 400 ppm $CaCl_2$ spray as directed above. Stop or sharply reduce fertilization during the final weeks of production. Make efforts to reduce humidity and increase air circulation during the crop cycle. Overfeeding can lead to nutrient antagonisms and rapid weak growth, so keep the plants on a strict 'diet'. Also, favor nitrate fertilizers a little more than with other crops. Finally, contact your cutting supplier to find out which varieties are susceptible to LEB or stem breakage. There may be more resilient alternatives available.

Table 1. Dilution Table for Calcium Solutions

Amount of Final Spray Solution	Calcium Chloride Dihydrate $CaCl_2 \cdot 2H_2O$ (~27% Calcium)	Calcium Chloride Anhydrous $CaCl_2$ (~39% Calcium)
100 gallon	1 lb.	12 oz.
25 gallon	4 oz.	3 oz.
3 gallon	1/2 oz.	3/8 oz.
Approximate ppm Calcium	324 ppm	357 ppm

Source: Paul Ecke Ranch. ©1999 Paul Ecke Ranch All Rights Reserved

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