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Nutrition of Carnations

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Nutrient Imbalances

Nitrogen—The results of our work in Rockland, Nassau and Suffolk counties over the past year indicate that the three most common imbalances are due to nitrogen, potassium and boron. The former is more frequently found in excessive amounts while potassium and boron are more frequently found in deficient than excessive amounts.

Nitrogen imbalance symptoms, whether high or low, tend to be alike in their earlier stages. The first symptom is a reduction in the normal rate of growth accompanied by the occurrence of narrower than normal leaves. The leaves of these plants lose their characteristic curl and take on a brittle, straight, upright form. Beyond this point the symptoms of deficient plants begin to differ from those of toxic plants.

The leaves of deficient plants develop a bluish cast and a waxy cuticle. With time the bluish cast gives way to a sandy color and the surface of the leaf becomes roughened such that the leaf takes on the appearance of sever spider mite damage (figure 1). At about the time when the bluish color appears the terminal leaf pairs tend to remain fused together longer than normal. Although the deficiency is usually checked before this time, if allowed to develop further, terminal leaf pairs will become fused to the point where the growing point developing within them will be checked in upward movement. The continued force of growth causes the stem an inch or two back from the apex to break out through the fused leaf pairs giving rise to the symptom called "curly tip" (figure 2).

Nitrogen toxicity in the earlier stages causes a reduction in growth, straight leaves and a bluish cast to the foliage. Since nitrogen is required in large quantities oversupplies of this nutrient are commonly associated with high soluble salt levels. Thus further development of nitrogen toxicity can be identified through high soluble salt symptoms, ie., grassy plants with thin, straight leaves and light green foliage.

In our studies at Cornell, deficiency and toxicity symptoms of nitrogen, phosphorus, potassium, calcium, magnesium and boron have been induced on White Sim carnation plants. While quality and total production were affected by all nutrients only nitrogen, above and below optimum levels, drastically delayed the production of these plants (figure 3).

Potasssium—Potassium imbalances are more frequently due to low than to high levels of this nutrient. Because of the high potassium content of most complete fertilizers and the frequency of application this at first appears strange. But when one realizes that potassium is readily made unavailable to the plant by being fixed within the soil and is also readily leached from the soil when in an available form this point does not appear strange. Many soils contain 40,000 pounds of potassium per acre furrow slice yet only 1 or 2 per cent of this total amount is available for plant growth.

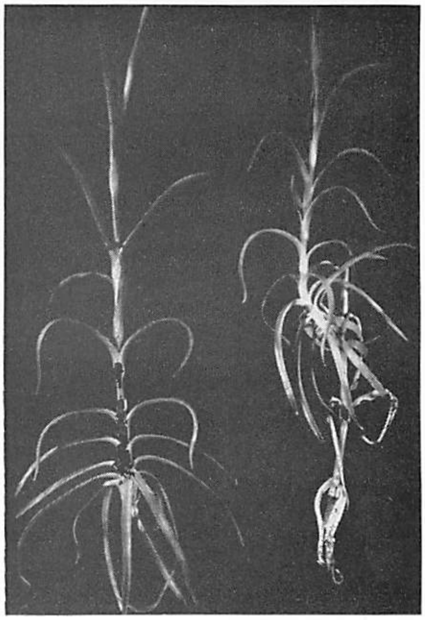

Figure 1. Nitrogen deficiency manifested by waxy, straight leaves, terminal leaf pairs fused, light green foliage and tip burn.

Since potassium is required in large quantities—3 to 5 per cent of the dry weight of the carnation plant is potassium—yet is rapidly lost or converted to an unavailable form in the soil it is found to be one of the most common deficiencies. Early symptoms of potassium deficiency are manifested in death of the lower leaves on the plant followed by a reduction in the number of shoots developing at the top of the plant. With a severe deficiency leaves on shoots bearing flower buds become yellow to salmon in color, flowers die just as the petals begin to open and leaves on young shoots become mottled with necrotic spots (figures 4 and 5).

Potassium toxicity is not so frequently encountered but may be identified by the characteristic reddish-necrotic spots appearing along the margins of the leaf terminals

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of median leaves on vegetative shoots (figure 6).

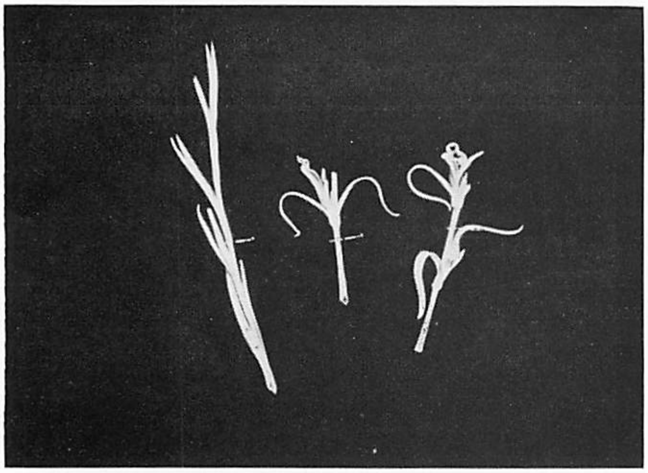

Figure 2. "Curly Tip" of carnation, a nitrogen deficiency.

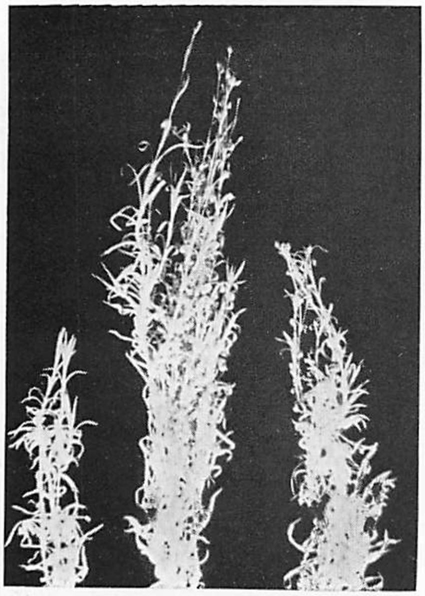

Figure 3. From left to right plants grown at a deficient level of nitrogen, an optimum level and a toxic level.

Boron—Boron is also a nutrient more commonly identified with deficiency than with toxicity. Deficiency symptoms appear first as a very high percentage of splits followed by a group of symptoms which include splitting of the leaf at the point of nodal attachment, flower bud abortion and where buds do not abort petals are few and the style is pronounced (figure 7). These symptoms are followed by "witches broom," (figure 8), and finally death of the lower leaves on current shoots. This begins as a red blotch along the central vein which spreads over the leaf which then becomes necrotic.

Boron deficiencies can be corrected by the application of borax at the rate of ½ oz. per 100 sq. ft. of bench area. A period of about 6 weeks is required for the crop to return to normal. When complete fertilizers containing boron are used regularly there is generally no need to apply borax. However, when injecting fertilizer regularly without boron one should either incorporate borax into the nutrient solution at the rate of 1 oz. during summer and ½ oz. during winter per 1,000 gal. of final solution or apply borax three times during the year at the rate of ⅓ oz. per 100 sq. ft. Boron may also be supplied in a trace element mix applied at the time of soil sterilization. In the case of lighter soils it may be necessary to supplement this with an application of ⅓ oz. borax per 100 sq. ft. about February.

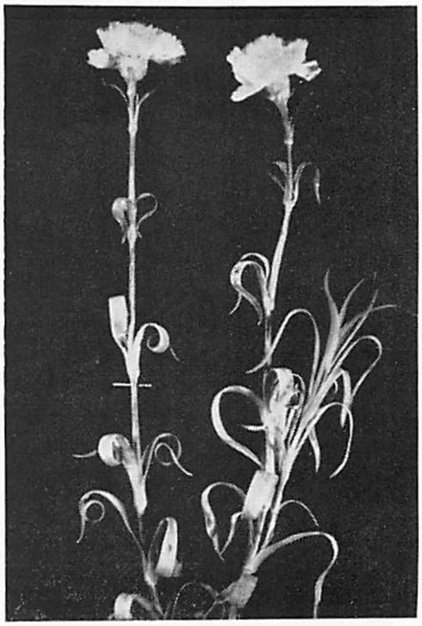

Figure 4. Potassium deficiency on flowering stems as seen in yellow to salmon leaves and dying flowers.

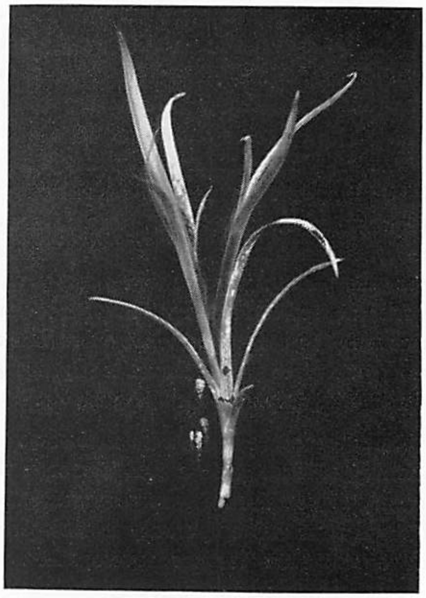

Figure 5. Potassium deficiency on vegetative shoot exhibiting random necrotic spots on median to older leaves.

Boron toxicity is generally the result of an over correction of a deficiency. The symptom is a solid, light-brown burning of the leaf tips of older leaves on current shoots, particularly those which are in bud. The burn gradually spreads toward the base of the leaf until corrections are made. Correction consists of the use of boron free fertilizers, leaching and heavy application of ground limestone.

Magnesium—Calcium, magnesium and phosphorus toxicity and calcium deficiency are very rare when carnations

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are grown in soil mixes. Magnesium deficiency may occur. This deficiency is difficult to diagnose visually since it resembles the effects of poor light conditions or warm night temperatures. The symptom is an overall reduction in vigor and strength of the plant. Flowering stems become too weak to support the flower heads (figure 9). Magnesium levels in the soil can be raised by applying Epsom Salts at the rate of ½ lb. per 100 sq. ft. or by changing the fertilizer nitrogen carrier to magnesium nitrate for a while.

Figure 6. Potassium toxicity as seen by reddish to necrotic spots on terminal end of median leaves of vegetative shoots.

Figure 7. Boron deficiency symptoms showing aborted buds, flower splitting, and leaf splitting at nodes.

Phosphorus—Phosphorus deficiency does not occur too frequently because of the ease with which it can be prevented. When deficient, the lower leaves of the plant die giving a straw color appearance to the lower half of the bench. Many potential shoots fail to develop giving a very thin appearance to the upper portion of the bed. Those shoots, however, which do develop are of normal size. Phosphorus can be supplied in one application of superphosphate at the rate of 5 lbs. per 100 sq. ft. at the time of planting or may be supplied through the regular use of complete fertilizers containing phosphorus.

Development of a Fertilizer Program

Thus far no corrective measures have been listed for nitrogen and potassium, the two nutrients most commonly out of balance. In any fertilization program both of these nutrients must be considered together. While the level of these nutrients supplied to the plant is important the balance between the two can be even more important. Potassium uptake is supressed by high levels of nitrogen in the soil. In one case where 20-20-20 was applied with each watering at the rate of 7 oz. per 100 gal. the soil report indicated a nitrate reading of 65 parts per million and a potassium level of 32. When analyzing the leaves of these plants it was found that the accumulation of nitrogen was above optimum but on the basis of the potassium level of the soil only 50% of the expected quantity of potassium was accumulated. When the rate of application of 20-20-20 was reduced from 7 to 3½ oz. per gal. the level of nitrogen in the tissue dropped to a normal value and the potassium content of the tissue increased from 1.88% to 3.05% of the dry weight of the tissue. This example occurs very frequently with florists and is a strong indication that the influence of the nitrogen:potassium balance often outweighs the effects of the levels of these nutrients in the soil.

It has been our experience that fertilizers heavier in potassium than in nitrogen particularly in the winter and early spring are superior to those having a 1:1 ratio of

Figure 8. "Witches Broom," a late stage of boron deficiency.

Figure 9. Magnesium deficiency showing weak flower stems.

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nitrogen to potassium. If a complete fertilizer is desired one would do well to consider using 20-5-30 or a similar ratio. A 20-20-20 fertilizer could be amended by using one unit weight of muriate of potash with each 6 unit weights of 20-20-20. Or a similar nitrogen: potassium ratio could be prepared by mixing 1 part ammonium nitrate to each $2\frac{1}{2}$ parts potassium nitrate. As a starting point the above formulations once prepared could be applied with every watering at the rate of 13.5 ozs. per 100 gal. of water or every two weeks at the rate of 2 lbs. per 100 gal.

It is very rare that a constant rate of application can be used the year around. The nutritional requirements of the plant differ with season of the year and stages of development of the plant. We have found through our foliar analysis studies that the requirement for nitrogen and potassium during the second summer of growth is low. On this basis one should fertilize either with less frequency or at the same frequency but at a lower rate from May through September of the second year. High nitrogen levels during this period slow down the rate of development of new shoots. This is especially pronounced when the crop is sheared back.

It is also reasonable to expect that the previously mentioned ratio of nitrogen to potassium will not hold up in all cases. Applications of manure in the summer may necessitate lowering the nitrogen component for a couple of months. If a sandy soil is watered heavily in benches there will more than likely be a greater requirement for potassium due to heavy leaching.

Thus the fact that no one ratio and rate of application will hold up for the entire crop indicates that each florist must develop his own fertilizer program. This can be accomplished by (1.) using a regular fertilization program such as every watering, every other watering or every two weeks, (2.) taking periodic soil samples every 4 to 6 weeks and (3.) keeping a log on the response of the plants through visual observations, production records and in the near future foliar analyses. By using a regular fertilization program it is possible to make small adjustments frequently in the fertilizer to suit the response of the plants. With time a desirable fertilizer program will be developed which can be correlated to the periodic soil test readings. This will give a yearly set of soil test levels adjusted to the growers own soil conditions which he can adhere to in the future.

In conclusion one can develop his own fertilizer program by beginning with a 2:3 ratio of nitrogen to potassium at the previously mentioned rates. With the aid of regular soil testing and frequent evaluations of the response of the crop a yearly fertilizer program can be developed which will take into account soil characteristics as well as seasonal fluctuations and stages of development of the crop.

Soil Testing

Many flower growers use the Floriculture Department Soil Testing service as a means to qualify crop production. Many more flower growers could use the service but do not for various reasons. Since the time factor from taking a sample to receiving the results is critical, the following procedure is offered to reduce this time period to the minimum.

TAKING THE SAMPLE

When to Sample

A regular schedule for taking samples should be established. Do not take samples immediately after applying fertilizer. If raw fertilizer particles are accidentlly included in the sample, a wrong analysis will be obtained. Samples should be taken 5 to 7 days after the application of fertilizer. In the case of continuous water-feed programs the time factor is not so important. Do not take samples immediately after watering. Extra water means a longer time to dry the sample. Take samples 2 or 3 days after watering or just before watering, if done more frequently.

A thin-walled coring tube of copper pipe or conduit $\frac{1}{2}$ to $\frac{3}{4}$ inches in diameter, 12 inches long can be used to take samples. On bench crops use the $\frac{3}{4}$-inch diameter tube. Take a minimum of 10 cores from different locations in the bench. On pot crops use a $\frac{1}{2}$-inch tube and sample no less than 10 pots. If less than 10 cores are taken, the error in results obtained may be too high for accurate recommendations. If possible, designate one person to be responsible for taking the samples; less error will result.

Before taking the sample, mark the box and sample card completely with all information needed. Be sure the box and card information is in agreement as to house number, bench, crop, etc.

When taking the sample scrap away the mulch, if present, and the top $\frac{1}{4}$ inch of soil. Plunge the corer the full depth of the soil to get a representative sample. Mix the 10 cores of soil together. Spread the sample on a non-porous, aluminum or similar material pie plate; do not use absorbent newspapers or cardboard, and place in an area to dry thoroughly. Do not dry in direct sunlight. A maximum temperature of 125°F may be used to speed up the drying. Overheating above 125°F will cause loss of certain nutrients. At this temperature the sample should dry in 24 hours.

After the sample is dried, it should be screened to remove all sticks and rocks. There is no sense in paying postal charges on stones or other junk. The screen used can be made of regular metal window screen material.

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YOUR EDITOR,

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