NC STATE UNIVERSITY

Providing Fall Pansies with Proper Nutrition

By testing your pansies' root substrate, you can steer clear of unnecessary nutrient deficiency or toxicity symptoms and keep your crops on schedule.

Todd J. Ca

Top: Pansies with low phosphorous levels. Bottom: High phosphorus levels, resulting in phophorous deficiencies. (Photos courtesy of Brian Whipker.)

Fertility monitoring and management for pansies requires a balancing of the plants' needs. Growers must be aware and manage root substrate pH and electrical conductivity (EC), as well as provide adequate, but not excessive, levels of all the essential elements for pansies.

Conducting root substrate testing either in-house or through a commercial lab will help ensure that your fertility program is on target. Ideally, testing should be conducted every two weeks and plotted to detect trends before any deficiency or toxicity symptoms appear. Tips on conducting PourThru Monitoring are available from the NC State University Web site at www.pourthruinfo.com.

PH

The pH of your root substrate (medium) dramatically influences nutrient availability to plants for a soil-based substrate or an organic soilless substrate. Therefore, it is important to maintain the root substrate pH within a range that provides adequate availability of all essential elements. A substrate pH above 5.8 for pansies grown in a soilless root substrate can result in boron (see "Boron" section) or iron deficiencies. In addition, the incidence of black root rot caused by the fungus *Thielaviopsis basicola* also increases at substrate pHs greater than 5.8. A very low pH, below 4.8, can result in micronutrient toxicities.

High substrate and irrigation water pH can adversely affect nutrient availability and subsequent plant growth. However, the major factor regulating pH rise in substrate solutions is the degree of alkalinity of the irrigation water. If the irrigation water contains a high concentration of carbonates and bicarbonates, the substrate solution pH will rise to undesirable levels during plant production. The optimal pH varies by the root substrate used. The range for a soilless root substrate is 5.4-5.8 and for a soil-based substrate is 5.6-6.0 (See Table 1). Test your water to determine your alkalinity level, and take corrective actions like injecting acid to neutralize alkalinity if required.

Following are rapid corrective measures to take to adjust the root substrate pH in pots or benches already containing plants. Iron sulfate and hydrated lime may burn the foliage and should be applied only to the root substrate. Rinse the plant's leaves if any solution comes in contact with them. Some plants may be sensitive, so test a small area or a few plants before treating a large area. Adjustment of pH is rapid, but effects are not long lasting; recheck the pH in a week and reapply solution if necessary.

To Lower pH (select one):

Option 1. Dissolve 1-2.5 pounds of iron sulfate [$FeSO_4 \cdot 7H_2O$] in 100 gallons of water. Apply to the root sul application. Iron sulfate may increase th tivity (EC) level and may release toxic root substrate's exchange sites.

Option 2. Add sulfuric acid to clea approximately 4.5, and apply the solutio Rinse off foliage. Retest substrate pH, an the pH is within the desired range.

To Raise pH (select one):

Option 1. Apply flowable limestone p with a rate of 1-2 quarts per 100 gallons tion from the foliage after applying.

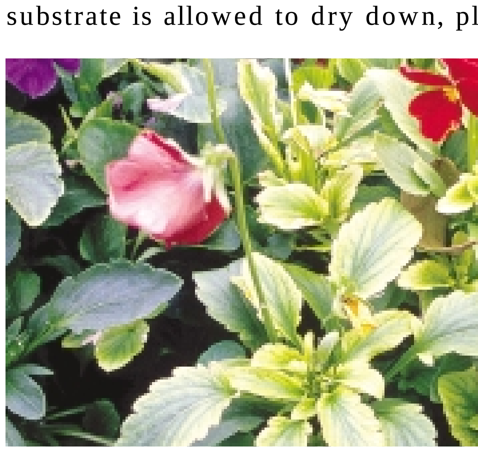
Option 2. Mix two pounds of potass water, and apply as a substrate drench Lightly mist off any solution from the fol supplies 933 ppm potassium but does n which could be low when the substrate p ance, apply a complete, basic-type ferti day after the potassium bicarbonate appl

Option 3. In a plastic bucket, mix one gallons of warm water. Allow the mixtu solution into another plastic bucket. App injector set at 1:100 or 1:128. Hydrated with skin and metal. It may displace an sites of the root substrate into the soil so using hydrated lime if high levels of amn root substrate. Lightly mist off any solutio

ELECTRICAL CONDUCTIVIT

Soluble salts refer to the total dissolve given time and are measured in term Nitrogen and potassium are the main fer EC concentration of the root substrate; irrigation water can also impact the EC.

Excess salts accumulate when leachin when too much fertilizer is applied or w high amount of dissolved elements. Exce ciated with poor plant growth. Plant sy leaves as leaf chlorosis and progress to n substrate is allowed to dry down, pl



symptoms because of root tip dieback, which further inhibits water and fertilizer uptake. High EC has also been linked to an increased incidence of Pythium root rot.

At the opposite end of the spectrum, when the EC content of the root substrate is too low, plant growth is stunted from lack of fertilizer. Symptoms of low EC typically are lower leaf yellowing (nitrogen deficiency) or lower leaf purpling (phosphorus deficiency).

To promote good growth, maintain EC levels between 0.75-1.5 mS/cm (see Table 1). See fertilization tips under the next section, "Nitrogen," for periods of excessive leaching due to high rains.

NITROGEN (N)

Plants with nitrogen deficiency exhibit slow growth, stunting, lack of lateral shoot growth and, with advanced conditions, lower leaves initially turn greenish purple to yellow (chlorosis). Leaf abscission occurs after prolonged deficiency conditions. Excess levels of nitrogen will result in a darker green color, reduced plant growth and delayed flowering.

A fertilization rate of 125 ppm nitrogen on a constant liquid fertilization or 175-200 ppm nitrogen constant liquid fertilization with excessive leaching (outdoor production) is recommended. See Table 1 for specific fertilization recommendations based on growth stage and fertilization practices.

Some growers find the addition of slow-release fertilizer in larger pots or tubs to be beneficial, especially in the South where heavy rainfall removes large amounts of nutrients. Another common practice used after a heavy rainfall is to immediately fertilize pansies with around 200-300 ppm nitrogen, which helps restore the nutrient charge. Even though the substrate is already thoroughly saturated from the rain, this keeps the plants from stalling due to lack of fertilizer.

PHOSPHORUS (P)

Phosphorus deficiencies can occur and are first expressed as stunting with the leaves

Top: High phosphorus levels, resulting in iron deficiency. Bottom: High fertilization rates can cause margial leaf necrosis if plants dry down.

turning darker green, followed by the lower leaves becoming reddish purple. Lack of phosphorus, root rot, wet substrate and cool temperatures can cause this reddish purple coloration. So if you see the lower leaves turning

purple, the fi

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nitrogen will
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Potassium
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A fertiliza
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CALCIUM

Calcium d
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Table 1. Optimal fertilization and substrate nutrient levels for pansies.

Item	Units	Optimal Range[a] Seedlings	Optimal Range[a] Finishing	Coments
pH		5.4 to 5.8	5.4 to 5.8	Rotate between acid residue and basic residue fertilizers to help maintain pH levels between 5.4 and 5.8 Too low of a pH can induce Mg deficiency. Too hight of a pH can induce B and Fe deficiencies and lead to an increased incidence of *Thielaviopsis basicola.*
EC	mS/cm	0.25 to 0.5 or 0.375 to 0.75	0.75 to 1.5 or 1.12 to 2.25	(Based on the SME method) (Based on the PourThru method)
N	ppm	Until first true leaves, 50 ppm N every 3 to 5 days First true leaves to plug transplant, 100 ppm N every 3 to 5 days	125 ppm constant liquid fertilization without leaching or 175 to 200 ppm constant liquid fertilization if leaching is excessive (outdoor production) or 225 to 275 ppm with weekly fertilization under minimum leaching	Nitrate-nitrogen should comprise >75% of total N, with remainder being ammoniacal-N or urea-N.
P	ppm	Limit P applications to avoid stretching	Provide limited amounts of P to avoid stretch (5 to 10 ppm)	Do not preplant incorporate P into the root substrate to avoid stretch.
K	ppm	Until first true leaves, 41 ppm K every 3 to 5 days First true leaves to plug transplant, 83 ppm K every 3 to 5 days	104 ppm constant liquid fertilization without leaching or 145 to 166 ppm constant liquid fertilization if leaching is excessive (outdoor production) or 187 to 228 ppm with weekly fertilization under minimum leaching	
Ca	ppm	25 to 50	50 to 100	
Mg	ppm	12.5 to 25	25 to 50	Mg deficiencies can be encountered if: 1) pH is too low or 2) if k or Ca levels are too high with respect to Mg levels.

[a] Ranges based on the saturated paste extract method. Fertilization levels would be 25-50 percent lower with a subirrigation or reduced leaching irrigation program in order to achieve similar substrate nutrient levels as with a 20 percent leaching program

constant liquid fertilization will provide
Table 1). In many locations, there is suffici
but in areas of the Southeast and Northe
especially important if you are using a fe
um, like 20-10-20.

While providing some calcium to pa
much. Boron deficiency induced by exces
with the use of calcium nitrate ($Ca(NO_3)_2$),

MAGNESIUM (MG)

Initially, magnesium deficiency sympto
sis (yellowing) of older, lower leaves. Up
and with advanced conditions, the leave
(dead, brown tissue).

A fertilization rate of 25-50 ppm m
ization will provide ample levels of t
areas have sufficient magnesium in t
not always the case in the Southeast
are required. This is especially impor
that does not contain magnesium, like

If your fertilizer does not contain enou
monthly applications of magnesium sul
Apply at the rate of 1-2 pounds per 100 ga
other fertilizers to avoid possible precipitat

BORON (B)

Boron deficiency can be a serious p
are initially expressed on the new lea
growth being thick-textured and strap
death of the growing point can occ

growth. It is important to correct boron deficiency when symptoms first appear because growing point death or distorted leaves cannot be reversed. If deficiency symptoms are severe, it is rarely economical to try to reverse the damage. Dispose of the crop.

Excessive levels of calcium can have an antagonistic effect on boron availability, and growing the crop at substrate pHs above 6.2 can tie up boron. Make sure your fertilizer or irrigation water contains ample levels of boron. Limit excessive calcium applications by avoiding calcium nitrate-based fertilizers, and maintain the pH within the acceptable range of 5.4-5.8 to ensure that boron is readily available to the plant.

IRON (FE)

Problems with iron deficiency are usually associated with the pH being too high. Symptoms appear as a distinct interveinal chlorosis of the younger leaves, progressing to complete lighter yellow leaves, and then tip dieback under severe conditions. Deficiencies can also occur with root death, overirrigation, poor drainage of the root substrate, insect damage (fungus gnat larvae) to the roots or when excessive levels of lime are applied.

Apply iron as part of your normal fertilization program. Maintain the root substrate pH between 5.4 and 5.8 for a soilless root substrate, and 5.6 and 6.0 for a soil-based substrate to maximize iron availability. Take the corrective actions listed under the "pH" section if modifications are required.

WHICH FERTILIZER TO USE?

Based on the nutritional needs of pansies, there are a number of fertilization strategies that will work. If your system is working, don't change it. But if you want to change, there are four factors to consider when selecting a pansy fertilizer.

1. Pansies prefer a lower pH. Is the fertilizer acidic?

2. Most acidic fertilizers are high in ammoniacal nitrogen and phosphorus. Height control of pansi
cult enough without supplying too h
Does the fertilizer have less than 30
and a low amount of phosphorus?

3. Does the mix supply all of the essen
water supply enough calcium and mag
from the fertilizer?

4. Where are the microelements?

No single fertilizer fulfills all of the
the special pansy blends are excellent f
cause a pH increase — even though pa

What to do? Rotate fertilizers! Use p
3-30 or 13-2-13 ratios, which provide a
nesium and micros, but have low amo
niacal nitrogen. Then use a fertilizer l
has a low amount of phosphorus. Mon
within the acceptable range of 5.4-5.8
gram will keep your pansies on track.

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