e-GRO Nutritional Monitoring




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Nutritional Monitoring Series

Pentas

(Pentas lanceolata)

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Pentas plants require medium fertility levels between 150 to 200 ppm N. Optimal substrate pH values for pentas are from 5.8 to 6.2. Substrate pH values below 5.5 can lead to excessive availability of micronutrients, and iron and manganese toxicity can occur on the lower leaves. Substrate pH values above 6.5 inhibit Fe availability

Figure 1. Substrate pH below 5.5 can result in excessive iron (Fe) and manganese (Mn) uptake causing older developed pentas *(Pentas lanceolata)* leaves to develop bronzing.

Pentas

Target Nutrition Parameters

pH Category III:
5.5 to 6.2

Fertility Category:
Medium
150 to 200 ppm N

EC Category B:
1:2 Extraction:
0.6 to 0.9 mS/cm

SME:
1.3 to 2.0 mS/cm

PourThru:
2.0 to 3.0 mS/cm

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Figure 2. Over time, low substrate induced iron/manganese toxicity in pentas *(Pentas lanceolata)* will result in a bronzing, to almost purple coloration of the lower leaves. This purpling can be mistaken for what is considered to be a typical phosphorus deficiency. Photo by: Brian Whipker.

and induce interveinal chlorosis of the recently matured leaves. Low substrate electrical conductivity levels will result in stunted plant growth, lower leaf chlorosis (yellow), and leaf loss.

Fertility Management of Pentas

Pentas *(Pentas lanceolata)* propagated from seed should be grown with a pH range of 5.8 to 6.2. This is the preferred optimal pH range. Pentas are susceptible to low pH induced iron and manganese toxicities. Therefore, the lower pH boundary is 5.8. Generally lower leaf bronzing (Fig. 1) and purpling (Fig. 2) due to acidic conditions will occur at pH values less than 5.5. This will lead to the accumulation of iron in the leaf tissue (Whipker, 2015).

Above pH 6.5, iron (Fe) can become limiting and leads to interveinal chlorosis of the younger growth. High substrate pH above 6.5 can inhibit Fe uptake causing newly developed leaves to develop interveinal chlorosis (Figs. 3 and 4). Corrective procedures for high substrate pH should begin within the range of 6.3 to 6.5.

Use recommended 1:2 Extraction, SME, or PourThru methods to determine and monitor substrate pH and soluble salts [referred to as electrical conductivity (EC)] values. Additionally, conduct routine foliar analysis tests to monitor crop nutrient status. Tissue nutrient levels found in healthy, newly expanded leaves are listed in Table 1.

Figure 3. Substrate pH above 6.5 or over irrigation can inhibit iron (Fe) uptake causing newly developed pentas *(Pentas lanceolata)* leaves to become Fe-deficient and exhibit interveinal chlorosis (yellowing). Photo by: W. Garrett Owen.

Monitoring substrate pH and nutrient status will enable growers to avoid pH induced nutritional disorders.

For seedlings, beginning at Stage 2 (cotyledon emergence), initiate 2 to 3 weekly applications of 50 to 75 ppm N delivered from a 14-0-14 or 14-2-14 fertilizer (Nau, 2011). During Stage 3 (true leaf development) and toning, increase fertility to 100 ppm N under low light conditions or 150 ppm N under high light conditions every two to three irrigations, utilizing a basic (15-0-15) or neutral fertilizer (17-4-17) (Nau, 2011). The target EC is 1.0 mS/cm.

After plugs or liners are transplanted, providing medium fertility of 150 to 200 ppm N is recommend during vegetative growth phase (Nau, 2011). Fertilize with a basic feed such as 15-0-15 or a Cal-Mag formula.

Insufficient fertility levels (low EC) will result will result in stunted growth and lower leaf pale coloration and chlorosis (yellow; Fig. 5).

High EC can cause stunted plant growth, lower leaf necrosis, and flower delay (Fig. 6). Routinely check substrate EC and maintain below 0.9, 2.0, or 3.0 mS/cm, based on the 1:2 Extraction, SME, or PourThru methods, respectively.

Summary

Providing pentas with a moderate level of fertility ranging from 150 to 200 ppm N and maintaining a substrate pH of 5.8 to 6.2 will prevent most nutritional disorders from occurring.

Literature Cited

Nau, J. 2011. Ball Redbook,18th ed. Ball Publishing, W. Chicago, IL.

Whipker, B.E. 2015. Pentas: Lower leaf yellowing and necrosis. E-GRO Alert 4.23

Table 1. Leaf tissue nutrient analysis results for pentas (*Pentas lanceolata*).

Element		Most Recently Matured Leaves from Flowering Plants[1] (Mean and range)
Nitrogen (N)	(%)	3.94 (3.22 to 4.43)
Phosphorus (P)		0.93 (0.61-1.24)
Potassium (K)		3.80 (3.28-4.62)
Calcium (Ca)		0.92 (0.87-0.95)
Magnesium (Mg)		0.52 (0.47-0.58)
Sulfur (S)		0.35 (0.32-0.40)
Iron (Fe)	(ppm)	151.5 (114.0-184.6)
Manganese (Mn)		140.5 (124.9-154.6)
Zinc (Zn)		51.8 (44.9-58.0)
Copper (Cu)		5.7 (3.5-10.1)
Boron (B)		35.9 (33.1-39.5)
Molybdenum (Mo)		-

[1] Source: Whipker (unpublished data) from a nitrogen fertilization rate study funded by the Fred C. Gloeckner Foundation. 'Butterfly Deep Pink' plants were fertilized with 100 and 200 ppm N. Plants sampled at flowering. Mean of 8 plants.

Figure 4. A top view of a pentas *(Pentas lanceolata)* plant exhibiting extensive interveinal chlorosis (yellowing). Photo by: Brian Whipker.

Figure 5. Providing insufficient fertility [low electrical conductivity (EC)] during pentas *(Pentas lanceolata)* production can result in pale leaf coloration and chlorosis (yellowing). Photo by: Brian Whipker.

Figure 6. Excessive fertility [high electrical conductivity (EC)] during pentas *(Pentas lanceolata)* production can cause distorted growth, leaf necrosis, and flower delay. Photo by: Brian Whipker.

Corrective Procedures for Modifying Substrate pH and Electrical Conductivity (EC)

When the pH or substrate electrical conductivity (EC) drifts into unwanted territory, adjustments must be made. Below are the standard corrective procedures used to modify the substrate pH and EC for greenhouse grown crops in soilless substrates.

1. Low Substrate pH Correction

When Fe and Mn toxicity becomes a problem, adjust (raising) substrate pH to the recommended pH range. Corrective procedures to raise low pH levels are listed below. Switching to a basic fertilizer when the substrate pH is nearing the lower limit will help stabilize the pH. If the pH is below the recommended range, then corrective procedures will need to be implemented. Flowable lime is one option. Using a rate of 2 quarts per 100 gallons of water will typically increase the substrate pH by roughly 0.5 pH units. Two quarts can be used through an injector. Additional applications can be made if needed. Potassium bicarbonate ($KHCO_3$) can also be applied. A rate of 2 pounds per 100 gallons of water will increase the substrate pH by roughly 0.8 pH units. This treatment will also provide excessive potassium (K) and cause a spike in the substrate EC. A leaching irrigation with clear water is required the following day to restore the nutrient balance (the ratio of K:Ca:Mg) and lower the EC. As always, remember to recheck your substrate pH to determine if reapplications are needed.

pH Adjustment Recommendations

Flowable Lime

- Use 1 to 2 quarts per 100 gallons of water.
  Rinse foliage.
- Avoid damage to your injector by using rates of 2 quarts per 100 gallons of water, or less.
- Can split applications.

Hydrated Lime

- Mix 1 pound in 3 to 5 gallons of WARM water. Mix twice. Let settle. Decant liquid and apply through injector at 1:15.
- Caustic (rinse foliage ASAP and avoid skin contact)

Potassium Bicarbonate ($KHCO_3$)

- Use 2 pounds per 100 gallons of water
- Rinse foliage immediately.
- *Provides 933 ppm K.*
- Leach heavily the following day with a complete fertilizer to reduce substrate EC and restore nutrient balance.
- Rates greater than 2 pounds per 100 gallons of water can cause phytotoxicity!

2. High Substrate pH Correction

The target pH for many species is between 5.8 and 6.2. Higher pH values will result in Fe deficiency and lead to the development of interveinal chlorosis on the upper leaves. Check the substrate pH to determine if it is too high. Be careful when lowering the substrate pH, because going too low can be much more problematic and difficult to deal with.

Acid-based Fertilizer
If the substrate pH is just beginning to increase, then first consider switching to an acidic-based fertilizer. These ammoniacal-nitrogen (N) based fertilizers are naturally acidic and plant nitrogen uptake will help moderate the substrate pH over a week or two.

Acid Water Drench
Some growers use this intermediate correction if pH levels are not excessively high and a quick lower of the substrate pH is desired. Use sulfuric acid to acidify your irrigation water to a pH 4.0 to 4.5. Apply this acid water as a substrate drench providing 5 to 10% excessive leaching of the substrate. Rinse the foliage to avoid phytotoxicity. Results should be visible within 5 days. Retest the substrate pH and repeat if needed.

Iron Drench
If the levels are excessively high, then an Fe chelate application can be made to the substrate.
Below are the options.

Iron Chelate Drench (options)
- Iron-EDDHA: mix 5 ounces in 100 gallons of water
- Iron-DTPA: mix 5 ounces in 100 gallons of water
- Iron sulfate: mix 4-8 ounces in 100 gallons of water

- Apply as a substrate drench with sufficient volume to leach the pot.
- Rinse foliage immediately.
- Avoid use on iron efficient plants (geraniums).

3. Low EC Correction

If low EC problems occur, increase the fertilization rate to 300 ppm N for a few applications before returning to the recommend fertilization rate for the crop.

4. High EC Correction

Excessively high fertilization rates will result in a marginal leaf burn. Check the substrate EC to confirm your diagnosis. Values greater than 6.0 mS/cm based on the PourThru sampling method can be problematic for many plants.

Switch to Clear Water Irrigations
If the substrate EC is just beginning to increase over time, then leach with a few clear water irrigations to lower EC levels by flushing out the salts.

Clear Water Leaching
If the EC values are excessively high, leach the substrate twice with back-to-back clear water irrigations. Then allow the substrate to dry down normally before retesting the EC. If EC levels are still too high, repeat the double leach. Once the substrate EC is back within the normal range, use a balanced fertilizer at a rate of 150 to 200 ppm N.

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