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Nutritional Monitoring: *Marigolds*

(Tagetes erecta & T. patula)

Marigolds require a low to medium level of fertility at 100 to 200 ppm N. The optimal pH range is between 5.8 to 6.2. This will avoid low substrate pH induced iron and manganese toxicities which occurs if the pH drifts lower than 5.5. Substrate pH values above 6.5 can also inhibit iron availability.

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Target Nutrition Parameters

pH Category III:
5.8 to 6.2

Fertility Category: Low to Medium
100 to 200 ppm N

EC Category A,B:
1:2 Extraction - 0.4 to 0.9 mS/cm

SME - 0.9 to 2.0 mS/cm

PourThru - 1.3 to 3.0 mS/cm

Figure 1. Lower leaves of a marigold exhibiting yellow and bronzing leaf coloration due to a low substrate pH.

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Fertility Management of Marigolds

Marigolds are considered to require a low to medium levels of fertility. Most growers supply between 100 to 200 ppm N. The lower end of the N rate is commonly used to help control excessive growth.

Marigolds should be grown with a pH range of 5.8 to 6.2. This range will help avoid two of the most common nutritional issues with the crop. The most disasterous is a low substrate pH induced iron and manganese toxicity that occurs if the pH drifts lower than 5.5 (Figs. 1 to 3). Lower leaves will develop a bronze speckled appearance. This is due to toxic levels of iron, and sometimes manganese, accumulating in the tissue. Albano et al. (1996) found that lower leaf symptoms developed when leaf tissue iron levels exceed 1000 ppm (Table 1). One should denote that both iron and manganese predominately accumulate in the lower foliage and then progress up the plant. It will take a few weeks for plants to grow out of this condition once the pH is corrected to the 5.8 to 6.2 range.

Substrate pH values above 6.5 can also inhibit iron availability. This is why the optimal substrate pH range is between 5.8 and 6.2 (Fig. 4). The range of 6.2 to 6.4 is the point in which corrective procedures should begin.

Figure 2. Low substrate pH results in the lower leaves developing a bronzing coloration due to the accumulation of iron and manganese (toxicity).

Both nitrogen deficiency (Fig. 5) and phosphorus deficiency can occur with marigolds. Nitrogen deficiency develops as an overall yellowing of the lower foliage or overall plant. This disorder occurs when the fertilization rate is too low. Also note, water stress and tight spacing can also result in lower leaf yellowing. Phosphorus deficiency usually appears as a lower leaf purple coloration. It is most commonly observed when the growing temperatures are cool and low fertiilization rates are used.

Summary

Therefore, providing low to moderate levels of fertility of 100 to 200 ppm N and providing a substrate pH range of 5.8 to 6.2 will prevent most nutritional disorders of marigolds.

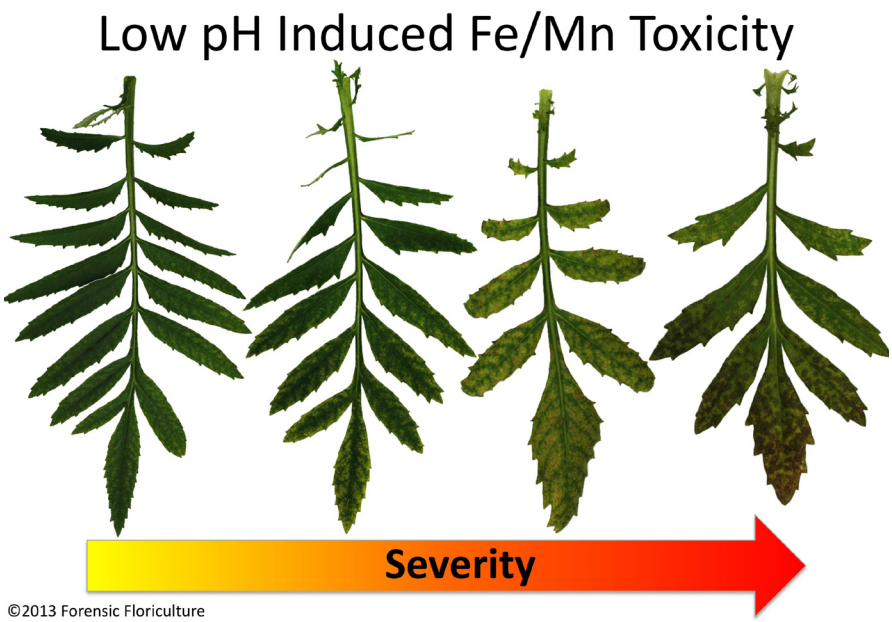

Figure 3. Progression of leaf symptoms due to a toxic accumulation of iron and manganese induced by a low substrate pH.

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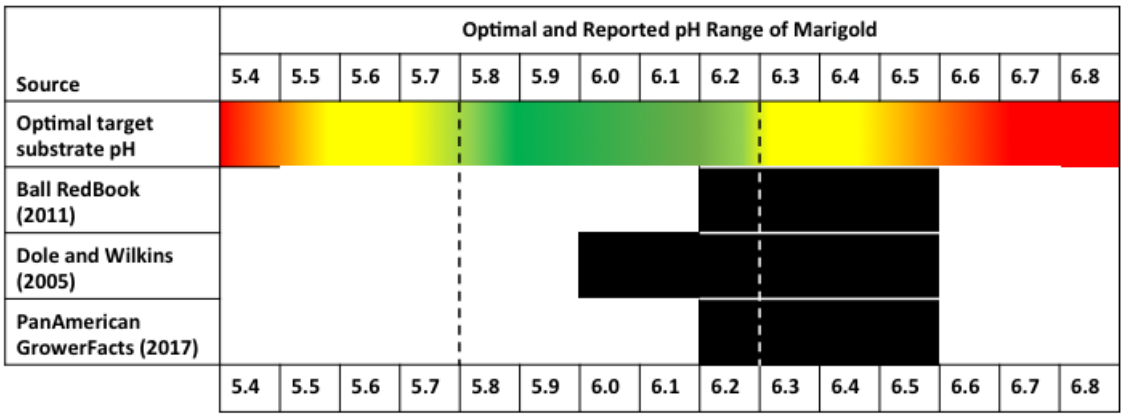

Figure 4. Reported and optimal pH range for marigolds based on literature indicating upper and lower pH limits inducing deficiencies and toxicities.

Table 1. Recommended range of leaf tissue nutrient analysis for marigold (*Tagetes spp.*).

Element	African Marigold [1] *(Tagetes erecta)*	French Marigold [1] *(Tagetes patula)*
Nitrogen (%)	2.20 – 5.50	3.32 – 3.62
Phosphorus (%)	0.23 – 0.67	0.49 – 0.54
Potassium (%)	1.50 – 2.19	2.79 – 2.88
Calcium (%)	0.88 – 2.74	2.36 – 2.72
Magnesium (%)	0.35 – 1.56	1.33 – 1.44
Sulfur (%)	0.18 – 0.88	1.34 – 1.44
Iron (ppm) [2]	45 – 454	92 – 115
Manganese (ppm)	4 – 385	275 – 558
Zinc (ppm)	22 – 235	76 – 97
Copper (ppm)	5 – 143	19 – 25
Boron (ppm)	15 – 49	34 – 40
Molybdenum (ppm)	0.1 – 0.60	0.22 – 0.62

[1] Source: Bryson and Mills (2014)

[2] Iron levels exceeding 1000 ppm are considered toxic (Albano et al., 1996).

Management

Monitor marigolds to make sure that the substrate pH is within the recommended range of 5.8 to 6.2. Limiting or reducing other sources of plant stress will also help to prevent these symptoms.

Corrective Procedures

Corrective procedures for low pH 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. Typically, a rate of 2 quarts per 100 gallons of water will increase the substrate pH by roughly 0.5 pH units. The flowable lime may be applied using a fertilizer injector. Additional applications can be made if needed.

Potassium bicarbonate can also be applied. The 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 amounts of potassium and cause a spike in the substrate EC. The day following a potassium bicarbonate application, a leaching irrigation with clear water is required to restore the nutrient balance (the ratio of K:Ca:Mg) and lower the EC level. As always, remember to recheck your substrate pH to determine if reapplications are needed.

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 ASAP.

Provides 933 ppm K

Leach heavily the following day with a complete fertilizer to reduce EC levels and restore nutrient balance.

Rates greater than 2 pounds per 100 gallons of water can cause phytotoxicity!

Figure 5. Low fertilization rates will result in an overall pale yellow coloration due to insufficient nitrogen.

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