MARYLAND COOPERATIVE EXTENSION
UNIVERSITY OF MARYLAND
COLLEGE PARK•EASTERN SHORE

Fact Sheet

Fact Sheet 866

MANAGING pH IN THE GREENHOUSE ENVIRONMENT

The pH of any solution is defined as its concentration of hydrogen ions. A high concentration of hydrogen ions yields an acidic solution and a low pH. The pH is measured on a scale ranging from 0 to 14, with 0 being the most acidic and 14 the most basic. A pH of 7 is defined as neutral, neither acidic nor basic. The pH of growing media is important because it affects the availability of nutrients to plants, which in turn affects plant growth.

The pH of growing media is affected by many factors, including the pH and alkalinity of irrigation water and the effect of fertilizers. Irrigation water and media should be tested for pH before growing plants.

Water pH

- Irrigation water pH should be 5.8-6.0
- Water pH varies based on the amount of dissolved gases it contains, mainly carbon dioxide
- In order to get a correct measurement of water pH, allow the sample to sit overnight and cover it to prevent the surrounding environment from contaminating it

Recommended Media pH

- Most crops grown in soilless media prefer slightly acid conditions (pH 5.6–6.2)
- Other crops such as azaleas, hydrangeas, snapdragons, vinca, pansies, and dusty miller prefer more acid conditions (pH 4.8–5.8)
- Seed geraniums and marigolds prefer less acidic media (pH 6.5–6.7)
- pH determines which nutrients are available to plants and in what quantities
- Deficiencies can occur even if the nutrients are present in the media if the pH does not allow the nutrient to become soluble enough for absorption by the plant

Effect of pH on Nutrient Availability

Nutrient availability	Very low pH (less than 5.0)	Low pH (5.0-5.5)	Optimum pH (5.6-6.2)	High pH (6.5-7.0)
Soluble—available to plant roots		Manganese, iron, copper, zinc, and boron	Maximum availability	Molybdenum, magnesium, calcium
Insoluble—not available to plant roots	Magnesium, calcium	Molybdenum, calcium, magnesium, sulfur		Phosphorous, iron, manganese, copper, zinc, boron
Highly soluble—toxic levels	Ammonium, manganese, iron, copper, zinc, boron			

- If crops are sensitive to particular toxicities, then the pH can be adjusted to where these nutrients are less soluble

Factors Contributing to Media pH

- Quality, pH, and alkalinity of irrigation water
- Fertilizers used
- Physical properties of components of media mix
- Chemical properties of alkaline (basic) water
  - The most important factor in the effects of irrigation water on media pH is the alkalinity content of the water, not its pH
  - Major chemicals that contribute to alkaline irrigation water include bicarbonates and carbonates
  - Minor chemicals include dissolved hydroxides, ammonia, borates, organic bases, phosphates, and silicates
  - The reactions between the carbonates and their concentrations are the main buffering system that controls the pH of the irrigation water
  - Water with high concentrations of carbonates tends to raise the pH of the media over time
  - Total carbonates also may have toxic effects on roots
  - Therefore it is important to remove or neutralize total carbonates from irrigation water
- Fertilizer effects on media pH
  - Over time, fertilizers can change the pH of a media by leaving a residue that can be acidic or basic
  - By alternating between acid forming fertilizers and base forming fertilizers the pH can be maintained within a desired range
  - Fertilizers with high ammonium, ammonia, and urea content tend to acidify the soil
  - Other nutrients that tend to lower the pH are sulfur, chlorine, and phosphoric oxide
  - Fertilizers that tend to raise the pH contain nitrate, calcium, magnesium, potassium oxide, or sodium
  - Neutral fertilizers, such as any potassium salt other than potassium nitrate, leave no residue in media, either acidic or basic
  - Fertilizer labels indicate whether a particular fertilizer source tends to acidify the media or raise the pH in terms of calcium carbonate per ton of fertilizer
- Media components
  - Cannot be changed after planting
  - Physical properties:
    - Total porosity
    - Water holding capacity
    - Air capacity
    - Available water
    - Wet weight

Controlling Media pH

- Pre-plant: easy to change media or components, apply dolomitic limestone or sulfur
- Post-plant: more difficult to change media pH
- Neutralizing alkalinity
  - Acidifying water by injecting sulfuric, phosphoric, or nitric acid into water to reduce a high pH
  - Acid injection is an economic method of eliminating alkalinity in the irrigation water and thus maintaining media pH
  - Use of these acids potentially escalates levels of nitrogen, phosphorous, or sulfur in the media
  - Make adjustments in the fertilization program (consult an engineer/water specialist)
- For moderate changes in pH of media;

discontinue use of base forming fertilizers and switch to acid forming fertilizers

- If pH deviates greatly from desired pH levels, apply elemental sulfur or sulfur compounds (not sulfates)
  - Apply as a top dressing at a rate of about 2 ml or 1/3 tsp of ground sulfur for each 6-inch pot
  - Takes 2-3 weeks for pH to change
  - Apply a suspension of sulfur as a soil drench
  - Depending on original pH and media components the pH will decrease by 0.5-1.5 pH units
- For faster results apply aluminum or iron sulfate as a surface application or by dissolving them in water and applying them as a soil drench
- After applying the soil drench, gently wash foliage to avoid burning plants
- If iron deficiency is also a problem, apply iron sulfate
- If pH is slightly lower than desired pH levels:
  - Discontinue injecting acid into irrigation water
  - Discontinue using acid forming fertilizers and switch to basic forming fertilizers
- For a greater increase in pH apply limestone (potassium bicarbonate)
  - Use dolomitic limestone, not calcitic
  - Dolomite supplies both calcium and magnesium to plants
  - Calcitic limestone applies high quantities of calcium that can lead to a calcium-induced magnesium deficiency
  - Powdered limestone applied per pot takes 6 weeks for pH to change
  - To raise pH by 0.5 to 1.5 units, apply 3-5 lbs of dolomite to each cubic yard of media
  - If plants show signs of low pH stress, apply flowable suspensions of dolomite as a media drench
  - Drench with flowable limestone at a rate of 2-4 quarts per 100 gallons
  - In 2-3 weeks pH can change 0.5 to 1.5 pH units depending on original pH and media components

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