Water Analysis: Test Kits for Nurseries

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INTRODUCTION

Water is a primary consideration for growing any crop. Plants are 95% water by weight and it is considered to be the universal solvent. Water carries all the essential elements taken up by plants from the soil and is responsible for the transport of nutrients and metabolites throughout the plant. Often times we concern ourselves with water quantity and not as much on the quality of the water supply. The objectives of this paper are to compare some laboratory water analyses with an inexpensive test kit for on-site testing of water.

Water Quality. Many Colorado greenhouse and nursery growers use mountain water, which is nearly pure, and many growers out on the prairie use water from shallow wells, 10.7 to 15 m (35 to 50 ft), and that water is often alkaline. The water quality from these wells also varies considerably during the year depending upon aquifer depletion from irrigation as well as the use of anhydrous ammonia on area farms. Water used in irrigation of nursery plants should be tested at least two times annually.

When selecting a laboratory or a procedure for testing water, there are at least six items that are important for a grower to consider. These include: soluble salts, iron, sodium, calcium, magnesium, and alkalinity. Most laboratories test and analyze other elements, as well. Private laboratories charge from $20 to $90 depending on the total number of individual elements tested (Table 1).

Table 1. Selected private testing laboratories that perform water quality analyses or test kits.

A & L Laboratories	411 North Third Street Memphis, Tennessee 38105-2723	$40.00
Scotts Testing Laboratory	6656 Grant Way Allentown, Pennsylvania 18106	$20.00
Soil and Plant Laboratories	P.O. Box 153 Santa Clara, California 95052-0153	$90.00
SunGro Analytical Laboratory	177 Sanford Road Warwick, New York 10990	$24.00
TGI Technical Services	P.O. Box 173354 Denver, Colorado 80217	$28.00
HACH Company	P.O. Box 389 Loveland, Colorado 80539	$26.50

Testing for Soluble Salts. Soluble salts or the electrical conductivity of the water is probably the most important characteristic of any water source to be determined. The amount of soluble salts is the key to good plant growth. Soluble salts are expressed in units of electrical conductance, that is dS m^{-1} or mS cm^{-1}, which is

equal to the more familiar mmhos cm^{-1}. A satisfactory electrical conductivity for irrigation water is between 0.25 to 0.75 mS cm^{-1}. This is measured with a soluble salts meter. Many models exist, including laboratory grade and portable, and there is a model available for every budget.

Iron Problems. Iron is often a problem in some irrigation water. Water that has passed over iron-bearing rock and soil often has a high level of ferrous bicarbonate dissolved in it. As this water is aerated in an irrigation system, overhead for example, it is changed to ferrous hydroxide and becomes a rusty precipitate collecting on cuttings, bench tops, and floors. The easiest means for eliminating iron from your water is by using an oxidizing system that sprays the water in the air and filtering out the iron precipitate or allowing the iron to settle in a pond.

Sodium Problems. High levels of sodium in irrigation water are detrimental to plant growth, especially lanceolate-leaved foliage species. The addition of soluble fertilizers to irrigation water high in sodium may also complicate plant growth. However, the relationship of the amount of sodium in the irrigation water to calcium and magnesium is more important than the amount of sodium alone. The sodium absorption ratio (SAR) is calculated by the following equation:

$$SAR = \frac{Na^{+}}{\sqrt{\frac{Ca^{+2} + Mg^{+2}}{2}}}$$

Where sodium, calcium, and magnesium are in milliequivalents per liter (meq $liter^{-1}$). This value should be less than 10, but water with a SAR greater than 10 can be made more acceptable for irrigating plants by adding magnesium sulfate (epsom salts) or calcium sulfate (gypsum) to the media.

Understanding Alkalinity. Alkalinity is defined as the amount of carbonates and bicarbonates in the water. A water source that contains many carbonates and bicarbonates is usually considered to be very alkaline and often has a high pH. However, water that has a high pH does not always indicate high alkalinity. Water that has a high pH and low alkalinity often requires little modification. However, highly alkaline water, 100 ppm bicarbonates or greater, can raise the pH of soil media rendering many elements unavailable to plants. This is especially true with plants that require an acidic root environment. Alkalinity is traditionally determined by a laboratory, but there are inexpensive test kits available for on-site testing.

Understanding Water Analysis Results. A typical water analysis is expressed in ppm and/or in meq $liter^{-1}$. The water analyses in Table 2 is from a Colorado greenhouse grower who has two water supplies. One source is from a shallow well and the other from a municipal source. The municipal source originates from mountain reservoirs and is nearly pure compared to the well water, which contains many contaminates including a high level of bicarbonates. The well water requires

some form of treatment to reduce the alkalinity and prevent any soil pH problems.

Water tests performed by commercial laboratories are important, but often the results do not come fast enough. Water quality test kits may be the answer to this dilemma. They are inexpensive and can be done in a timely manner. However, many consider their accuracy questionable and they are not as complete and thorough as standard laboratory testing. The HACH Company has a diverse collection of test kits suitable for on-site testing at reasonable prices (Table 1).

An Example of an Alkalinity Test Kit. The HACH Alkalinity Test Kit (Model AL-AP MG-L) retails for $26.50 for 100 tests. It is based on indicator colorimetry using two indicator dyes, phenolphthalein and bromcresol green-methyl red and they are titrated with 0.035 N sulfuric acid. To perform the test, a volume of irrigation water is measured and phenolphthalein indicator is added. If this turns the water pink, sulfuric acid is added one drop at a time until it becomes clear. This yields the alkalinity in ppm of calcium carbonate. Next the bromocresol green-methyl red indicator is added, which turns the solution green. To this solution sulfuric acid is added one drop at a time until the solution turns pink. The total number of drops to turn the phenolphthalein solution to clear and the number of drops to turn the bromocresol green-methyl red solution to pink multiplied by 20 yields the total alkalinity in ppm.

Table 2. Water analyses from two water sources in Colorado as tested by TGI Technical Services of Denver, Colorado.

	Well water		Municipal water	
Element	ppm	meq liter^{-1}	ppm	meq liter^{-1}
Ammonia	0.00	0.0	0.00	0.0
Bicarbonate	427.00	7.0	37.00	0.6
Calcium	40.00	2.0	15.00	0.7
Carbonate	0.00	0.0	0.0	0.0
Chloride	13.00	0.4	29.00	0.8
Copper	0.02	-	0.05	-
Iron	0.06	-	0.06	-
Magnesium	58.00	4.8	4.00	0.3
Nitrate	8.00	0.1	0.00	-
Phosphate	0.40	-	0.00	-
Potassium	20.00	0.5	0.00	-
Sodium	61.00	3.5	7.00	0.3
Sulfate	198.00	4.1	26.00	0.5
Zinc	0.07	-	0.04	-
Manganese	0.02	-	0.02	-

Table 3. Comparison of alkalinity values resulting from the HACH Alkalinity Test Kit and analysis from a private laboratory.

Laboratory/test kit	Well water (ppm)	Municipal water (ppm)
HACH Alkalinity Kit	400	40
TGI Technical Services	427	37

Comparing the reported alkalinity from a commercial laboratory and the results from the colorimetric test indicates that similar values can be achieved (Table 3). Using a series of sodium bicarbonate solutions in deionized water from 0 to 500 ppm indicates that results from the colorimetric kit may deviate as much as 5% at higher concentrations (Fig. 1). In most cases, this is still acceptable for determining acid ratios for the amelioration of alkaline water.

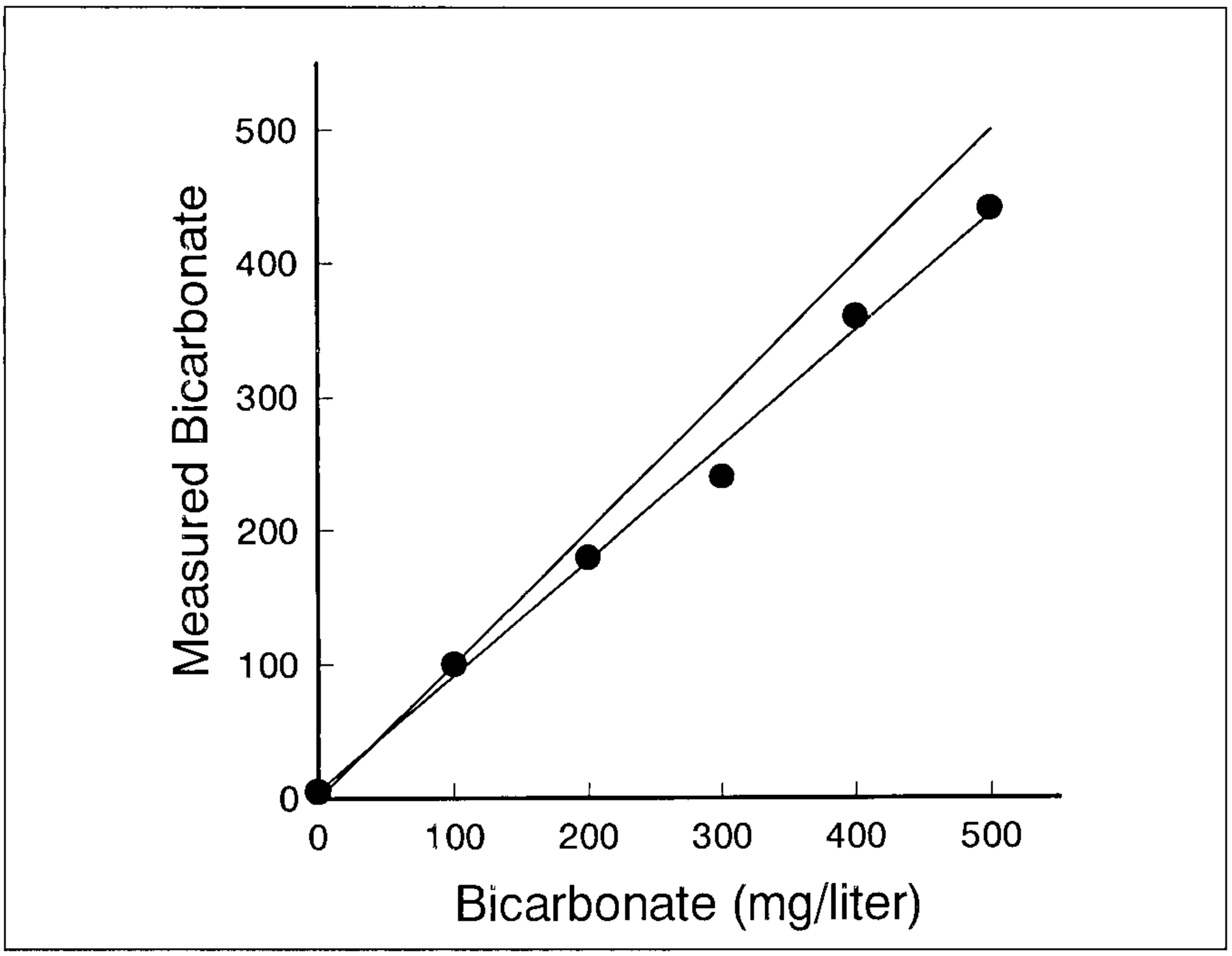

Figure 1. Results from a colorimetric kit for analyzing alkalinity may vary as much as 5% at higher concentrations. A series of sodium bicarbonate solutions in deionized water from 0 to 500 ppm was utilized.

CONCLUSION

Colorimetric test kits do not replace laboratory water analyses, but are inexpensive and appropriate for in-house testing. This can be done to monitor injection equipment and track changes during the interim between laboratory tests.