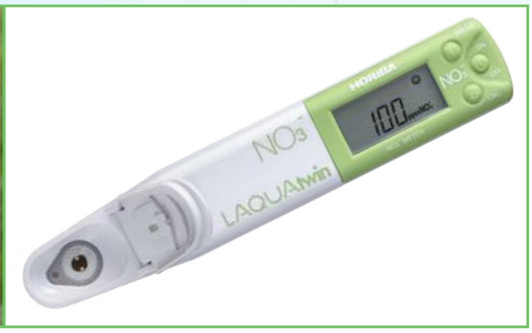
AGRICULTURA

Nitrate Measurement in Turf Grass

Nitrate concentration in grasses can be used as an indicator of soil nitrogen (N) availability for their growth. Research at the University of Connecticut suggests verdure sap nitrate-N concentrations at 200-300 ppm as the optimum level.

Application Note

01-2015



Introduction

Grasses store nitrogen (N) as nitrate in the bases of stems and shoots. Research conducted by Guillard and Morris (2013) at the University of Connecticut suggests that nitrate accumulate in the shoot bases of perennial turf grasses during the fall (when new leaf blade formation declines), which could be a significant source of N for the turf plant at the onset of new growth in the following spring after winter dormancy. At the optimum critical level of nitrate-N concentration and beyond, the turf response will plateau or flatten out – increasing the fall verdure nitrate-N concentrations with more fertilizer beyond the optimum critical level will not increase the grass quality in the fall or the following spring; the maximum quality response has been reached.

Pocket-sized LAQUA twin Nitrate Ion meter was used to measure nitrate-N concentrations in verdure sap. It eliminates the need to transport samples to a laboratory for expensive analysis performed using either colorimetry or chromatography by trained analyst.

Method

Calibrate the LAQUAtwin Nitrate Ion meter according to manufacturer's instructions.

Sample Collection And Preparation

1. Mow the turf to desired height and remove mowed clippings.
2. Collect verdure samples—aboveground parts of the turf plant remaining after clippings removed. A golf-ball sized, compressed verdure sample is usually sufficient to produce adequate sap for the test.
3. Squeeze the sap from the verdure sample using a hydraulic or garlic-type press.

Sample Measurement

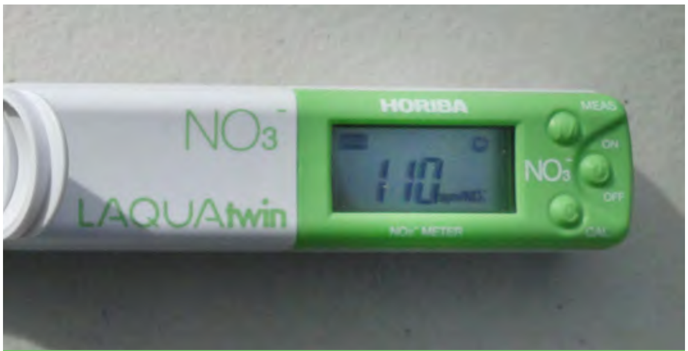
1. Place some drops of the extracted sap directly into the sensor.
2. Record the reading once stabilized—☺ appears.
3. After each sample, rinse the sensor with water and blot it dry with tissue.

Collect verdure samples—aboveground parts of the turf plant remaining after clippings removed. A golf-ball sized, compressed verdure sample is usually sufficient to produce adequate sap for the test.

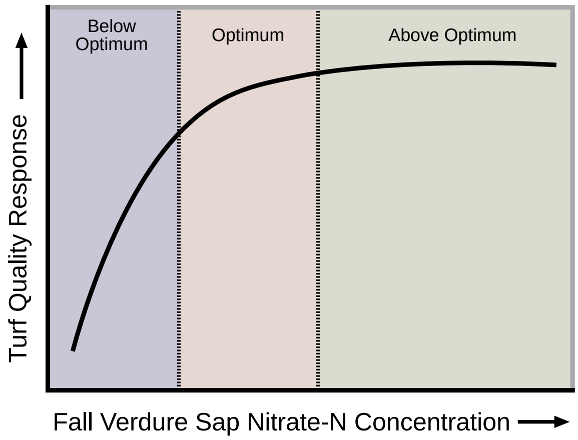
Continued at the back

Continued from the front


Place some drops of the extracted sap directly into the sensor.



Record the reading once stabilized—☺ appears.



Results and Benefits

Research at the University of Connecticut suggests that no fertilizer is required in the fall if the verdure sap nitrate-N concentrations are 200-300 ppm or above during October through November in their climate (critical values were based on turf mowed to a height of 2¼ inches and test was conducted using Horiba's LAQUA twin Nitrate ion meter). If less than 200, it suggests that some nitrogen be applied to obtain optimum turf responses. When readings are between 100 to 200 ppm, 0.25 to 0.33 lbs N/1000ft2 can be considered. If readings are less than 100 ppm, then 0.33 to 0.50 lbs N/1000ft2 can be considered, provided that N is applied before the onset of winter.

REFERENCE

Guillard, Karl and Morris, Thomas. The Verdure Sap Nitrate Test To Guide Fall N Fertilization of Turf Sod. Sod Nutrient Management Technical Guide TG-0265-R1, June 2013

REV 0, 6 JULY 2015

Nitrate Ion Meter for crop B-741

Measurement range: 100~9,900 ppm (NO_3^-), 23~2,200 ppm (NO_3^--N)

[Accessories included]

- Standard solution for crops (300 ppm & 5000 ppm) (14 mL)
- 2 CR2032 batteries
- Instruction manual
- 5 Pipettes
- Cleaning solution bottle (250 mL)
- Crop sample press
- 3 Medical cups
- Quick manual
- Carrying case

LAQUAtwin Pocket Ion Meters Lineup

pH COND Na+ K+ NO3– Ca2+ Salt EC

http://www.horiba-laqua.com

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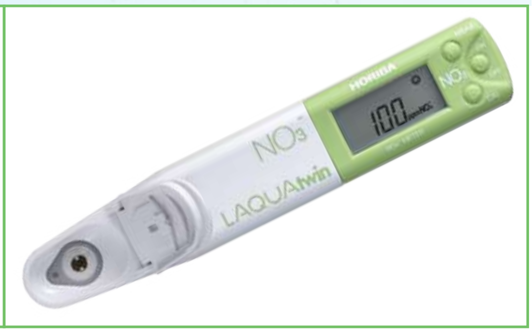
Application Note

02-2016

Rapid In-Field Determination of Nitrogen in Onions

Fresh root sap analysis with LAQUAtwin nitrate ion meter offers cost-effective, rapid and easy solution to determine nitrogen status in onion plants. The nitrate-nitrogen (NO_3-N) concentrations in onion vary at different growth stages. The acceptable root sap NO_3-N concentration range for 0.5 to 1.5-inch onion bulbs is 350 to 500 ppm.



Introduction

Nitrogen is a nutrient taken up by plants in the form of ammonium and nitrate ions for their green leafy growth. When ammonium fertilizers are applied to plants, the ammonium is converted to nitrate by nitrification process. Also, organic matter broken down in soil is transformed into ammonium first and then eventually into nitrate. These circumstances result in more nitrate in soils. Thus nitrogen tests measure nitrate rather than ammonium.

Plant tissue such as leaf and petiole contain high levels of nitrate, which has been shown over many years to be a good indication of the nitrogen status of the plant. Testing laboratories analysing for nitrogen content of dry plant tissue usually require ample time for collecting, transporting, drying, grinding and analysis. They deliver results after several days. With modern technology, quick tests for determining the nitrogen content in plant tissue like handheld nitrate meters with ion selective electrode, chlorophyll meter, and nitrate test strips have been developed.

As a general rule for nitrate testing, twenty petioles of most recently fully expanded mature leaves from different plants in a field are required for a representative sample. However, with onions, roots are used to determine nitrate levels.[1]

The LAQUAtwin nitrate ion meter provides the easiest way to measure nitrate concentration in fresh plant sap. The sensor requires only few drops of sap, which can be quickly extracted using a garlic press. The meter analyses the sap in just few seconds and displays reading expressed as either nitrate (NO_3) or nitrate-nitrogen (NO_3-N) ppm units. Results can be obtained immediately in the field with much less effort and relatively low cost. These advantages over conventional laboratory testing are useful for onion growers in determining fertilization applications.

Method

Select mg/L or ppm NO_3-N in the LAQUAtwin nitrate ion meter set-up. Calibrate the meter according to manufacturer's instructions using the 150ppm and 2000ppm nitrate standards included in the kit. The readings of 150ppm and 2000ppm nitrate standards will be calibrated as 34 ppm and 450 ppm NO_3-N, respectively.

Sample Collection And Preparation

1. Collect root samples from 20-30 representative onion plants in the field. Use a small spade or other lifting tool to remove the plants.
2. Cut the roots from the bulbs and wash with distilled or deionized water to remove soil.
3. Blot the roots dry with a paper towel and mix them thoroughly.
4. Load a random sample of roots in a garlic press and squeeze the sap.
5. Place drops of sap onto the flat sensor until it is fully covered. Record the reading once it is stable.
6. After each use, rinse the sensor with distilled or deionized water and blot dry with soft tissue.

Continued at the back

Continued from the front

7. Repeat the procedure two or three times with the remaining sample if possible. Calculate the average of the readings of the samples.

It is best not to take readings in areas of direct sunlight or high temperatures. Collect samples and bring them indoor for analysis. Allow the samples and standards to reach same temperature before proceeding with the analysis.

Refer to [Technical Tip 2: LAQUAtwin Ion Sensor Maintenance Procedures] for detailed information on conditioning, cleaning, and storing the nitrate ion sensor. The technical tip can be downloaded from the support section of our website www.horiba-laqua.com.

Results and Benefits

Onion roots display the greatest response to available nitrogen supply of any plant part.[2] They are used in analysis because of the stable nitrate concentrations in the root xylem. The LAQUAtwin nitrate ion meter has been successfully used in determining nitrate-nitrogen (NO_3-N) in onions and readings have been found correlated with lab results.[3]

When sampling, it is important to note the onion growth stage so you can determine the correct sufficiency guideline to apply with your analysis results. Sufficiency guidelines are generally expressed as nitrate-nitrogen (NO_3-N) values. The NO_3-N refers to the nitrogen portion of the nitrate molecule. The table below

Table 1: General Sufficiency Guidelines for Onion Root Sap

Onion Stage of Growth	Acceptable Onion Root Sap Concentration	
	NO_3^- (ppm)	NO_3-N (ppm)
Up to 5 leaves	3400-4300	768-972
5 to 7 leaves	2600-3400	588-768
Bulb Initiation	1300-2150	294-486
Bulb Bulking	850-1700	192-384

ppm is parts per million, equivalent to mg/L

provides the general guidelines for acceptable root sap nitrate concentrations at various stages of onion plant growth.[4] Notice that the nitrate concentrations decline as the plant matures. For 0.5 to 1.5-inch onion bulbs, the acceptable root sap NO_3-N concentration range is 350 to 500 ppm.[1] You may use the table in interpreting the LAQUAtwin nitrate ion meter results. Record the initial analysis results and use them to compare future results.

References and Suggested Readings

1. Hartz, T., Jackson L., Schulbach, K., and Smith, R. Guide to Nitrogen Quick-Tests for Vegetables with the Cardy Nitrate Meter. Retrieved from https://www.cdfa.ca.gov/is/docs/Schulbach95.pdf
2. Sullivan, D.M., Shock, C.C., Horneck, D.A., Stevens, R.G., Pelter, G.Q. and Feibert, E.B.G. (2001). Nutrient Management for Onions in the Pacific Northwest. PNW 546. Retrieved from https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw546.pdf
3. McDonald, M.R., McKeown, A.W., Scott-Dupree, C.D., and Westerveld, S.M. Assessment of Chlorophyll and Nitrate Meters as Nitrogen Tests for Cabbage, Onions, and Carrots. HorTechnology, April-June 2004, pp 179-188. Retrieved from http://horttech.ashspublications.org/content/14/2/179.full.pdf+html
4. Petiole Sap Nitrate Guidelines. Michigan State University Extension. Retrieved from http://msue.anr.msu.edu/news/petiole_sap_nitrate_guidelines
5. Bevacqua, R. and Cardenas, T. (2002). Nitrogen Monitoring Techniques for Vegetable Crops. Circular 579. College of Agriculture and Home Economics New Mexico State University. Retrieved from http://aces.nmsu.edu/pubs/_circulars/CR579.pdf

Nitrate Ion Meter for crop B-741

Measurement range: 100~9,900 ppm (NO_3^-), 23~2,200 ppm (NO_3^--N)

[Accessories included]

- Standard solution for crops (300 ppm & 5000 ppm) (14 mL)
- 2 CR2032 batteries
- Instruction manual
- 5 Pipettes
- Cleaning solution bottle (250 mL)
- Crop sample press
- 3 Medical cups
- Quick manual
- Carrying case

LAQUAtwin Pocket Ion Meters Lineup

pH | COND | Na^+ | K^+ | NO_3^- | Ca^{2+} | Salt EC

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Measurement of Potassium in Rice

LAQUAtwin is a series of pocket ION meters. Using Ion Selective Electrode (ISE) technology, they are available for measuring Conductivity, Calcium, Nitrate, Potassium, Sodium, Salt concentration and pH measurement. Using just a tiny amount of sample, the LAQUAtwin proprietary flat sensors can quickly and accurately measure the values of the chemical parameters in the field.

Introduction

Potassium is a necessary nutrient for soil in which rice grain is grown, as it is critical in maximising yield.

In order to profitably produce rice, reliable information regarding the potassium content of the soil must be available to farmers. Thus, we can analyse the potassium content of the plant tissue in the roots of the rice grain.

To determine the potassium content, the Horiba LAQUAtwin K+ ion meter can be used. This is an easy and quick method used to determine the potassium content of soil for the growth of rice crops.

Method

1. The above ground portion of the crop is separated from the root using shears.
2. The lower stem is washed of soil.
3. The stem is cut into 1 cm pieces.
4. The pieces of stem are frozen overnight
5. A frozen piece of stem is placed in a sap press to obtain the sap
6. A small sample of the sap is placed on the sensor of the LAQUAtwin K+ ion meter and the potassium content is measured after one minute.
7. To repeat sampling, wash the sensor with tap water and pat dry with a paper tissue.

Results and Benefits

The use of the Horiba LAQUAtwin K+ ion meter to measure the potassium content of soil around rice crops will improve farmers' knowledge of the potassium accumulation. Accordingly, farmers can fertilise their crops with optimal amounts of potassium.

The LAQUAtwin K+ ion meter is small and compact, and convenient to carry for easy on-site testing. Its easy-to-use interface is simple for anyone to use the LAQUAtwin K+ ion meter.

Average tissue K levels for rice plant parts at growth stages for K treatments, 2004.

Growth Stage	Plant Part	Tissue K %		
		0 lbs K/a	50 lbs K/a	200 lbs K/a
First tiller	Whole	2.53	2.99	2.62
Internode elongation	Whole	2.19	2.27	2.82
Internode elongation	Flag leaf	1.85	2.34	2.37
Internode elongation	Lowest leaf	1.62	1.99	2.24
Internode elongation	Stem	2.77	2.88	3.20
10% Heading	Whole	1.50	1.71	1.74
10% Heading	Flag leaf	1.60	1.56	1.73
10% Heading	Lowest leaf	1.45	1.39	1.37
10% Heading	Stem	1.47	1.28	1.49
10% Heading	Head	0.92	0.91	0.86

Dry matter and K uptake for K treatments at three rice growth stages, 2004

Growth stage	Pre-plant K treatment (lbs K/a)			Pre-plant K treatment (lbs K/a)		
	0	50	200	0	50	200
	...Dry matter (lbs/a)...			...K uptake (lbs K/a)...		
First tiller	131	154	220	3.5	4.5	5.7
Inter-node elongation	1770	2070	1853	33.1	44.7	52.8
100% heading	6734	7055	7660	101	120	131

David Dunn, Gene Stevens "Plant Mapping Potassium in Rice Tissue: What Part to Sample When?: Second Year (2004) Progress report" University of Missouri-Delta Center

Pocket ION Meter

LAQUAtwin

Unique Features

Calibrate and measure at the touch of a button—the smiley face will tell you when the result can be read.

Hassle-free automatic calibration with a few drops of standard solution reassures you of your measurement accuracy. Two-point calibration is also possible.*1

*1 Except for B-711

LAQUAtwin is fully waterproof and dustproof.

The meter and sensor are fully waterproof*3 and dustproof, so you can take it anywhere.

*3 IP67 rated. Will withstand immersion for 30 minutes at 1 m. Not suitable for underwater use.

LAQUAtwin: the only meters with flat sensor technology.

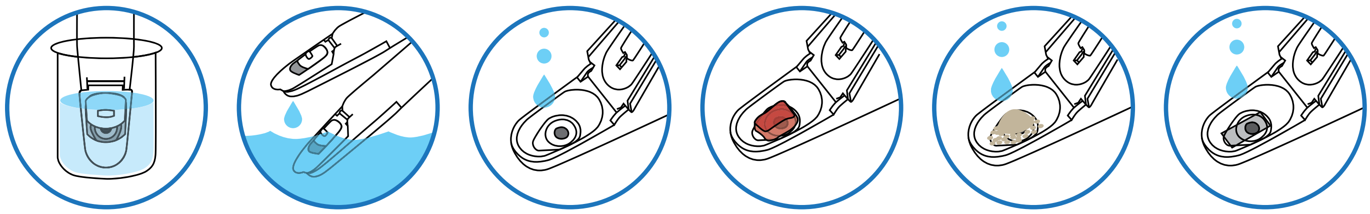
HORIBA's highly-sensitive, flat sensor technology opens up new possibilities for sampling and sample types. Only a small amount of sample is required, so you can easily sample in situ without the need for beakers or other labware. Sensors are easily replaced as required.

Carry case comes as standard for handy portability.

The compact carry case contains everything you need for your measurements, including the standard solution and sampling sheets.

1 X 6 One meter, six methods.

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



01 Immersion
When you're in the lab, you can test the sample in a breaker. Ensure the sensor guard sliding cap is open.

02 Scoop
Use as a scoop to test water eg from a river. A vertical scoop for an aquarium is also available with a unique sensor guard.

03 Drops
Place a drop of the sample onto the sensor with a pipette. Laquatwin meters can measure sample volume as low as 0.1mL

04 Solid Samples
Foods containing some moisture can be tested by placing a small piece directly onto the sensor.

05 Powders
Laquatwin meters can also test dry powders. Simply place the powder sample onto the sensor and drop on your defined volume of pure water.

06 Paper and textiles
To test sheets of paper and textiles, cut up the sample into small pieces and place directly onto the sensor. Drop on your defined volume of pure water.

Lineup

pH

Accurate pH measurements in a few seconds, from a single drop.

Water pH varies in different environments, and a slight change can often have a major effect.

Whether you need to keep the pH of an aquarium within tight limits, are checking for the acidity of rain water or for the quality of meat and fish products, LAQUAtwin compact pH meters are ideal for you. No matter where and when you need to test.

COND

Determine water conductivity with as little as 0.12 mL of sample.

The conductivity of rain water is a trusted guide to determining atmospheric purity. In agriculture, measuring the conductivity of soil allows farmers and agronomists to determine optimum fertilizer usage and check the 'health' of soil after salt water damage. The LAQUAtwin meter makes conductivity testing simple, anywhere.

Na+

Only compact meter for a quick and reliable measurement of sodium ion at the scene using ion selective membrane.

K+

Only compact meter for a quick and reliable measurement of potassium ion at the scene using ion selective membrane.

NO3–

Only compact meter for a quick and reliable measurement of nitrate ion at the scene. Special application packages for crop (B-741) and soil (B-742) are also available.

Ca2+

Only compact meter for a quick and reliable measurement of ionized calcium at the scene using ion selective membrane.

http://www.horiba.com/laquatwin

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Application Note

04-2015

Potassium Determination In Plant Tissue

Comparison of LAQUAtwin Potassium Ion Meter and ICP Spectrometry

Trials revealed close significant correlation (r values were 0.80 and 0.93 for first trial and second trial respectively) between the LAQUAtwin Potassium Ion meter readings and ICP results obtained from plant's fresh petiole sap and dried tissue respectively. This suggested that LAQUAtwin Potassium Ion meter could be an appealing field method substitute for rapid determination of potassium concentration in plant.

Introduction

Plant tissue analysis has been used for evaluating the nutritional status of vegetable crops. The conventional laboratory method for plant tissue analysis is Inductively Coupled Plasma (ICP) spectrometry, which requires a dried plant tissue to be subjected to either wet digestion or dry ashing prior to analysis. Among the recent techniques for nitrate-nitrogen (NO_3-N) and potassium (K) management in vegetable crops has been the use of petiole sap analysis to determine supplemental fertilizer needs.

The LAQUAtwin Potassium Ion meter was used to measure K concentration in fresh petiole sap of pak choi (Brassica rapa, Chinensis group) plants, which were grown, applied with K and other nutrients, and harvested at University of Hawaii's Magoon Research facility. The results were compared to K concentration in dried tissue of the same plant analysed by wet digestion and ICP.

The pocket-sized LAQUAtwin Potassium Ion meter is ideal for on-site testing as it provides quick result with just a few drops of sample that doesn't require tedious preparation. It eliminates the need to transport samples to a laboratory for costly and time-consuming ICP spectrometry analysis.

Method

Sample Collection And Preparation

For LAQUAtwin Potassium Ion meter analysis, plant's petioles were collected immediately after harvest at 5 weeks after emergence and fresh weights were recorded. Petioles were pressed in a garlic press to extract sap. One (1) ml of sap was diluted with deionized water to a volume of 5ml. After calibrating the LAQUAtwin Potassium Ion meter according to manufacturer's instructions, few drops of the diluted sap were placed into the sensor of LAQUAtwin Potassium Ion meter to determine the potassium concentration.

For ICP spectrometry analysis, plants were placed in a conventional oven at 70°C and were dried for 72hrs. The dried weights were recorded. The dried samples were submitted to a laboratory for ICP spectrometry analysis to determine the potassium concentration.

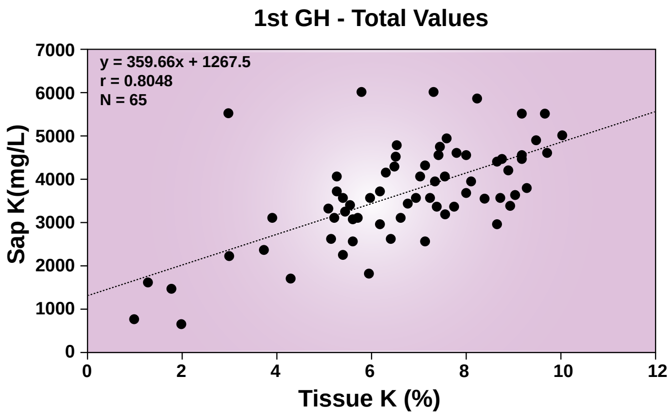

Figure 1: Relationship between K concentrations in fresh petiole sap and dried tissue of pak choi plant measured by LAQUAtwin Potassium Ion meter and ICP Spectrometry respectively for 1st greenhouse trial (n= 65)

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Continued from the front

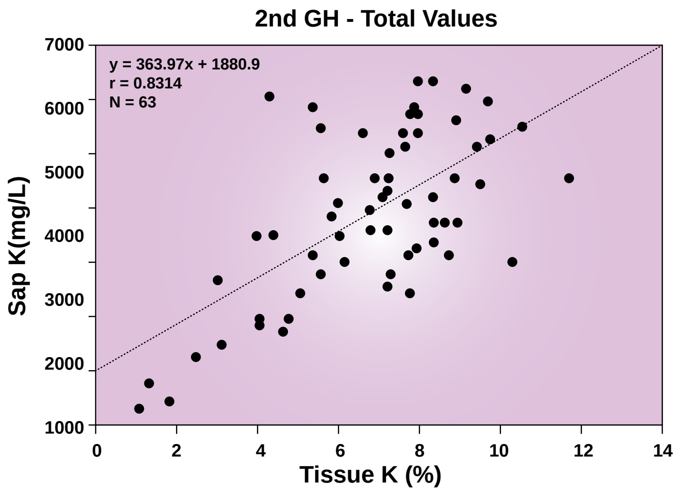

Figure 2: Relationship between K concentrations in fresh petiole sap and dried tissue of pak choi plant measured by LAQUAtwin Potassium Ion meter and ICP Spectrometry respectively for 2nd greenhouse trial (n= 63)

Results and Benefits

The K concentrations increased linearly in both the sap and dried tissue with increased amount of K applied (see figures 1 & 2) and the relationships were highly significant ($P<0.0001$). The correlation coefficient (r) was stronger between the LAQUAtwin Potassium Ion meter and ICP spectrometry results when totals of the replicates were used for correlation analysis – r values were 0.80 and 0.93 for first trial and second trial respectively. With these results, it was concluded that the LAQUAtwin Potassium Ion meter, which is easy to use and less expensive than standard laboratory analysis, is a valuable tool for onsite monitoring of plant's K status. It was also concluded that 4500-5000 mg K/L for fresh petiole sap and 7.5% tissue are critical levels for K concentration in pak choi plant.

Petiole Potassium Sufficiency Levels

(Source: University of Florida)

Crop	Growth Stage	K (ppm)
Tomato (field)	First Buds	3500-4000
	First Open Flowers	3500-4000
	First 1-inch Diameter	3000-3500
	First 2-inch Diameter	3000-3500
	First Harvest	2500-3000
	Second Harvest	2000-2500
Tomato (Greenhouse)	Transplant to second fruit cluster	4500-5000
	Second cluster to fifth fruit cluster	4000-5000
	Harvest Season (Dec.-June)	3500-4000
Bell Pepper	First Flower Buds	3200-3500
	First Open Flowers	3000-3200
	Fruits Half-Growth	3000-3200
	First Harvest	2400-3000
	Second Harvest	2000-2400
Eggplant	First Fruit (2-inches long)	4500-5000
	First Harvest	4000-4500
	Mid Harvest	3500-4000
Potatoes	Plants 8-inches Tall	4500-5000
	First Open Flowers	4000-5000
	50% of Flowers Open	4000-4500
	100% of Flowers Open	3500-4000
	Tops Falling Over	2500-3000

SUPPLEMENTARY INFORMATION

- Dilution – Undiluted sap can be analysed directly. However, sap for some crops has to be diluted to keep the determinations within the range of the calibrated standard curve. In another study conducted with LAQUAtwin Potassium Ion meter, it was found that sap diluted with water or 0.075M aluminum sulfate solution resulted in higher K recovery than undiluted one (Rosen et al). For testing sap diluted with 0.075M aluminum sulfate, 150ppm and 2000ppm K standard solutions with aluminum sulfate were prepared for calibration.
- Sap K Concentration - To determine K concentration of the undiluted sap, the meter reading obtained for the diluted sap should be multiplied by the dilution factor (final volume divided by original volume), which is '5' in the method described above. Alternatively, set the meter coefficient to 5.00 (default value=1.00). This meter feature eliminates manual computation for diluted or even concentrated sample by using a coefficient that can be set from 0.01-9.90. Refer to the Multiplying Compensation Setting of the meter's instruction manual.

References and suggested readings

1. Chandrappa Gangaiah, Amjad A. Ahmad, Nguyen V. Hue, and Theodore J.K. Radovich. Comparison of potassium (K+) status in pak choi (Brassica rapa Chinensis group) using rapid cardy meter sap test and ICP spectrometry. The Food Provider. May 2015
2. Carl J. Rosen, Mohamed Errebhi, and Wenshan Wang. Testing Petiole Sap for Nitrate and Potassium: A Comparison of Several Analytical Procedures. HORTSCIENCE 31(7):1173–1176.1996

REV 0, 18 AUGUST 2015

B-731 Potassium Pocket Ion Meter

B-731 Potassium Ion K+

WATER PROOF | MICRO VOLUME | 2 PT CAL

Features

Flat potassium sensor capable of 2-point calibration and result compensation (multiplication/known factor) setting for quick and direct measurement of microsamples

Applications include

Plant tissue testing, soil analysis, cultivation management, fertilizer strategies, crop quality

LAQUAtwin Pocket Ion Meters Lineup

pH — Acidity and alkalinity
COND — Conductivity and TDS
Na+ — Sodium Ion
K+ — Potassium Ion
NO3– — Nitrate Ion
Ca2+ — Calcium Ion
Salt EC — Salt (NaCl)

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HORIBA

LAQUAtwin K+

Application Note

Measurement of potassium in soil

LAQUAtwin is a series of compact water quality testers. Using Ion Specific Electrode (ISE) technology, they are available for Conductivity, Calcium ion, Nitrate ion, Potassium ion, Sodium ion and pH measurement. Using just a single drop of sample, the LAQUAtwin proprietary flat sensors can quickly and accurately measure the values of the chemical parameters for quality check of food in production lines.

Introduction

Typically, Atomic Absorption (AA) or Inductivity Coupled Plasma-Optical Emission Spectrometry (ICP-OES) is used to measure potassium ion, by first extracting the potassium ion from sample soils by 1 mol/L ammonium acetate (CH3COONH4). These are the methods performed in laboratories.

A simpler method for a rapid measurement of potassium ion in soil uses the LAQUAtwin potassium ion meter B-731. The extraction method is the same as the lab method. The following procedure explains how you can measure K^+ with good correlation to analytical lab tests.

Method

1. Put 1g each of air-dried soils (four samples) in 100mL glass beakers, two beakers per soil sample.
2. Prepare two kinds of extraction per soil sample, one by adding 20 ml of 1mol/L CH_3COONH_4 to one beaker, and 20ml of 0.01mol/L CH_3COONH_4 to another beaker.
3. Shake the beakers around 1 hour to extract K^+ from the soil using a bench top shaker.
4. Calibrate LAQUAtwin B-731 with 150mg/L and 2000mg/L K^+ standard solutions included in the product.
5. Measure potassium ion concentration of the filtrated solution with calibrated B-731 and with ICP-OES (e.g. HORIBA Jobin Yvon. Model ULTIMA2).
6. Perform this measurement with 4 different samples.

Results and Benefits

The Laqua Twin B-731 allows for a simple on site determination of potassium which provides accuracy close to laboratory techniques.

[1]Table 1 shows the results from ICP-OES and LAQUAtwin K^+ extracted with 1 mol/L and 0.01 mol/L CH_3COONH_4.

[1] Internal study by HORIBA labs, 2013

*Extraction efficiencies will vary amongst soil samples.

Table [1] : K^+ concentrations measured by ICP-OES and LAQUAtwin exctracted with 1 mol/L CH_3COONH_4 and 0.01 mol/L CH_3COONH_4.

(Unit : mg/L)

Kind of soil	Extracted by the use of 1 mol/L CH_3COONH_4		Extracted by the use of 0.01 mol/L CH_3COONH_4	
	ICP-OES	LAQUAtwin K^+	ICP-OES	LAQUAtwin K^+
For vegetables (in house)	35	120	27	25
For Chinese cabbage (field)	16	76	14	14
For turnip leaf (Komatsuna)(field)	25	130	18	19
For potherb mustard (field)	21	93	17	16

Based on table 1, higher value against ICP-OES is detected by LAQUAtwin K^+ with 1 mol/L CH_3COONH_4 extraction, due to strong interference by NH+ of CH_3COONH_4. However, with 0.01 mol/L CH_3COONH_4 extraction, although the extraction efficiency is reduced by approximately 80%* (Figure 1), very good correlation (R=0.981, R2=0.962) is obtained between ICP-OES and LAQUAtwin (Figure 2).

Figure 1 shows the potassium extraction efficiency measured with ICP-OES. Setting 1 mol/L CH_3COONH_4 as 100%, efficiency trend is plotted depending on different CH_3COONH_4 concentration.

Figure 2 shows the correlation between ICP-OES and LAQUAtwin K^+ measurements with 0.01 mol/L CH_3COONH_4 extraction.

Fig. 1 : Variation of extraction efficiency with CH_3COONH_4 concentration.

*Extraction efficiencies will vary amongst soil samples.

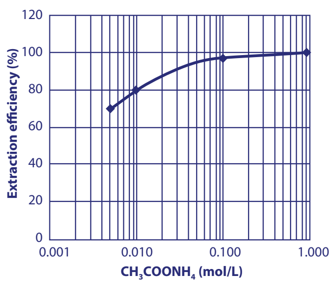
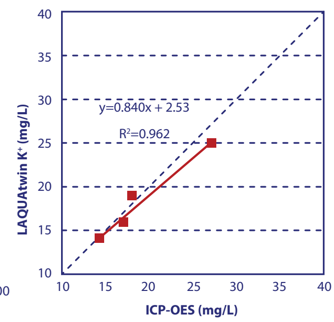


Fig. 2 : Relation between measured values of K^+ (mol/L) by ICP-OES and by LAQUAtwin.



Pocket ION Meter

LAQUAtwin

Unique Features

Calibrate and measure at the touch of a button—the smiley face will tell you when the result can be read.

Hassle-free automatic calibration with a few drops of standard solution reassures you of your measurement accuracy. Two-point calibration is also possible.*1

*1 Except for B-711

LAQUAtwin is fully waterproof and dustproof.

The meter and sensor are fully waterproof*3 and dustproof, so you can take it anywhere.

*3 IP67 rated. Will withstand immersion for 30 minutes at 1 m. Not suitable for underwater use.

LAQUAtwin: the only meters with flat sensor technology.

HORIBA's highly-sensitive, flat sensor technology opens up new possibilities for sampling and sample types. Only a small amount of sample is required, so you can easily sample in situ without the need for beakers or other labware. Sensors are easily replaced as required.

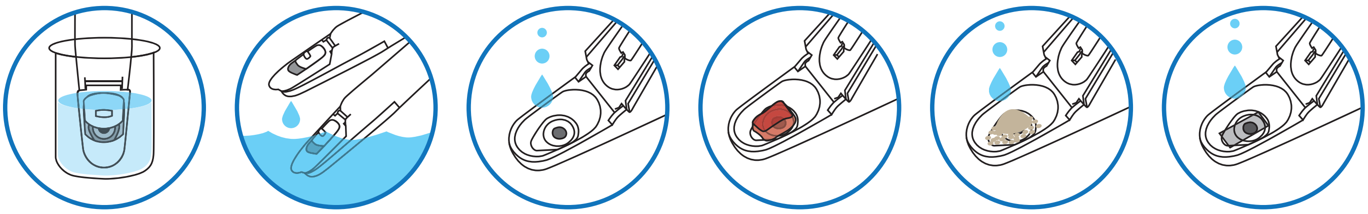
Carry case comes as standard for handy portability.

The compact carry case contains everything you need for your measurements, including the standard solution and sampling sheets.

1 X 6

One meter, six methods.

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



01 Immersion
When you're in the lab, you can test the sample in a breaker. Ensure the sensor guard sliding cap is open.

02 Scoop
Use as a scoop to test water eg from a river. A vertical scoop for an aquarium is also available with a unique sensor guard.

03 Drops
Place a drop of the sample onto the sensor with a pipette. Laquatwin meters can measure sample volume as low as 0.1mL

04 Solid Samples
Foods containing some moisture can be tested by placing a small piece directly onto the sensor.

05 Powders
Laquatwin meters can also test dry powders. Simply place the powder sample onto the sensor and drop on your defined volume of pure water.

06 Paper and textiles
To test sheets of paper and textiles, cut up the sample into small pieces and place directly onto the sensor. Drop on your defined volume of pure water.

Lineup

pH

Accurate pH measurements in a few seconds, from a single drop.

Water pH varies in different environments, and a slight change can often have a major effect.

Whether you need to keep the pH of an aquarium within tight limits, are checking for the acidity of rain water or for the quality of meat and fish products, LAQUAtwin compact pH meters are ideal for you. No matter where and when you need to test.

COND

Determine water conductivity with as little as 0.12 mL of sample.

The conductivity of rain water is a trusted guide to determining atmospheric purity. In agriculture, measuring the conductivity of soil allows farmers and agronomists to determine optimum fertilizer usage and check the 'health' of soil after salt water damage. The LAQUAtwin meter makes conductivity testing simple, anywhere.

Na+

Only compact meter for a quick and reliable measurement of sodium ion at the scene using ion selective membrane.

K+

Only compact meter for a quick and reliable measurement of potassium ion at the scene using ion selective membrane.

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JOA-MD0010 / OHSAS18001 JOA-OH0068

CE RoHS COMPLIANT

Application Note

Measurement Of Calcium In Soil

LAQUAtwin is a series of pocket ION meters. Using Ion Selective Electrode (ISE) technology, they are available for measuring Conductivity, Calcium, Nitrate, Potassium, Sodium, Salt concentration and pH measurement. Using just a tiny amount of sample, the LAQUAtwin proprietary flat sensors can quickly and accurately measure the values of the chemical parameters in the field.

Introduction

All plants need calcium rich soil to grow. The calcium is used by the plant in developing the plant cell walls and membranes. Furthermore, it is a non-leaching mineral (it will stay in the soil) and will improve water penetrability and reduce soil salinity. It is thus helpful to determine the amount of calcium contained in soil. Generally, Atomic Absorption Instruments (AA) or Inductivity Coupled Plasma-Optical Emission Spectrometry Instruments (ICP-OES) are used to measure the amount of calcium ions present in soil. An easier method involves extracting the calcium ion from sample soils with 1 mol/L ammonium acetate (CH3COONH4), and then by using the handy and affordable LAQUAtwin calcium ion meter B-751.
The LAQUAtwin Ca2+ meter is used as a quick check to determine the Calcium content of soil.

Method

1. Dry the soil for about a week, and sift it using a 2mm diameter net sieve.
2. Place 1g of test soil in 100mL glass beaker and add the 20 mL of 1mol/L CH3COONH4 to the beakers.
3. Shake the beakers (amplitude 40m/min, speed 250 rpm) for 1 hour to extract Ca2+ from the soil using a laboratory shaker (Recipro Shaker SR-IIW made by Taiyo Kagaku Kogyo Company of Japan).
4. Filter the liquid through JIS No.6 filter paper.
5. Calibrate LAQUAtwin B-751 with 150mg/L and 2000mg/L Ca2+ standard solutions which contain the same concentration of CH3COONH4 as in the filtered samples. (Do not use the standard solutions packed with the instrument)
6. A small sample of the filtered solution is placed on the sensor of the LAQUAtwin Ca2+ and measured. To repeat sampling, wash with tap water and pat dry with a paper tissue.

Results and Benefits

The use of accurate Calcium ion testing in controlling the calcium content of soil ensures that the plants which are grown in the soil are given the necessary minerals and can easily absorb water. The table below shows that the results given by the LAQUAtwin Ca2+ pocket meter are comparable to those from Inductivity Coupled Plasma-Optical Emission Spectrometry Instruments (ICP-OES).

Soil types	Measured Ca2+ concentration (mg/L)		CaO converted values (mg/100g of air-dried soil)	
	ICP-OES	LAQUAtwin B-751	ICP-OES	LAQUAtwin B-751
For bell pepper	130	140	360	390
For tomato	110	120	310	340
For spinach	82	88	230	240
For lettuce	88	97	240	270
For kale	59	68	160	190

The LAQUAtwin Ca2+ pocket meter is small and compact; convenient to carry around in your pocket for quick on-site testing. Its easy-to-use interface is simple for anyone to use the LAQUATwin Ca2+ pocket meter.

Pocket ION Meter

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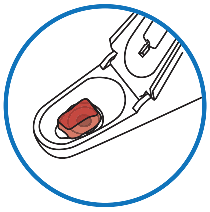

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COND

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Nota de aplicación

Salinidad del suelo y impacto sobre la producción de caña de azúcar

LAQUAtwin es un rango de medidores de bolsillo de electroquímica. Los medidores de iones usan un electrodo selectivo, para medir el potasio, el calcio, los nitratos y el sodio este rango también incluye medidores de pH y de conductividad. Con tan solo una gota de muestra, el sensor plano LAQUAtwin mide rápidamente y con precisión las concentraciones de parámetros químicos en el campo o en laboratorio.

Introducción

La caña de azúcar es una fuente importante de azúcar utilizada en la industria alimentaria. El crecimiento de los cultivos de caña de azúcar está afectado negativamente por la salinidad del suelo. Por lo tanto, es necesario determinar la concentración de sodio de los suelos en zonas donde se están cultivando las plantas de caña de azúcar.

El sodio es un mineral generalmente presente en el suelo, pero un exceso su concentración puede actúa como un factor limitante por el rendimiento del crecimiento de la caña de azúcar. Por esta razón, es útil de medir la salinidad del suelo sobre el que se cultivan cultivos de caña de azúcar.

Se puede utilizar el medidor HORIBA LAQUAtwin Na+ para determinar el contenido de sodio en el suelo. Este medidor representa un método fácil y rápido para controlar la concentración de sodio en suelo.

Método

El sodio es soluble en agua, toma una muestra 1g de suelo y mezclarla con 4g de agua tibia y mesclar la solución de suelo.

Después de 5 minutos, las partículas en suspensión se sedimentan para producir la muestra de agua salada del suelo.

Una pequeña muestra se puede extraer con una pipeta.

Pone la muestra de solución de suelo el sensor del medidor LAQUAtwin Na+ y asegurarse de cubrir todo el sensor para medir la concentración de sodio después de un minuto el

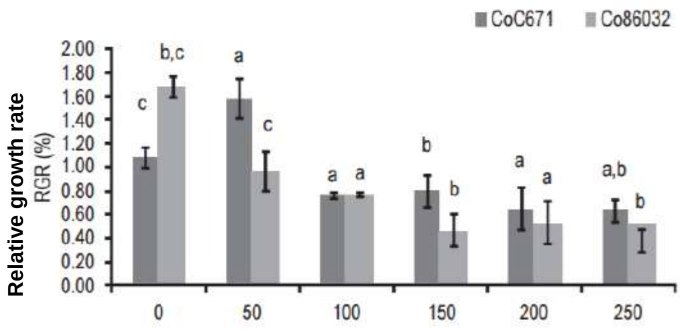
Para repetir la medición, lava el sensor con agua del grifo y secar con un pañuelo de papel.

Resultado y Beneficios

El uso del medidor de HORIBA LAQUAtwin Na+ para medir la concentración de sodio del suelo mejorará el conocimiento de los productores para escoger la mejor tierra para el cultivo de caña de azúcar y por lo tanto permitir un rendimiento optimizado de los agricultores.

El medidor LAQUAtwin Na+ es pequeño y compacto; cómodo para llevar en el bolsillo para facilitar las pruebas en cualquier lugar. Su interfaz sencilla a usar hace de este equipo una herramienta accesible a cualquier persona.

Impacto del NaCl sobre la repuesta fisiológica y bioquímica de la caña de azúcar



Características únicas

Medidor de bolsillo

LAQUAtwin

Realice calibraciones y mediciones con tan solo pulsar un botón; le indicará que ya puede leer el resultado.

La sencilla calibración automática con tan solo unas gotas de solución de calibración, le garantiza la exactitud de la medición. También se puede realizar la calibración en dos puntos y hasta 3 y 5 puntos con los modelos pH33 y EC33.

LAQUAtwin es totalmente a prueba de agua y polvo.

El medidor y el sensor son totalmente resistentes al agua y al polvo, por lo que puede llevarlo donde quiera.

1 IP67: no da errores al sumergirse en agua a una profundidad de un metro durante treinta minutos. Sin embargo, el producto no puede usarse bajo el agua

LAQUAtwin: Tecnología única de sensor plano ISE y pH

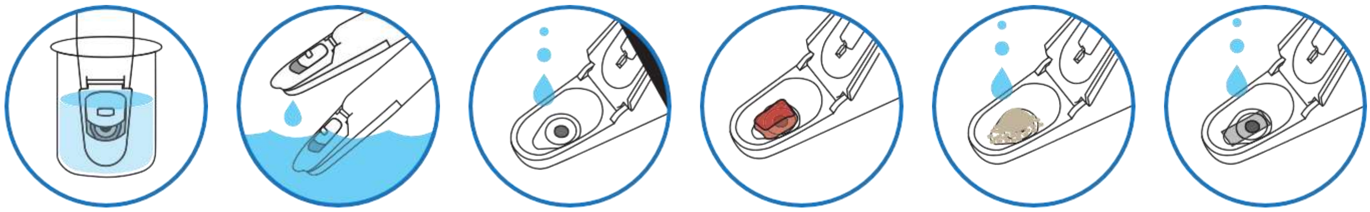
La tecnología HORIBA de sensor plano de alta sensibilidad abre nuevas posibilidades para medir diferente tipos de muestras. Puede hacer una medición a partir de un volumen de 0.1 ml y no necesita vaso para calibrar o medir, solo punga unas gotas directamente en el sensor.

Incluye un estuche para transportarlo de forma práctica.

El estuche compacto contiene todo lo que necesita para las mediciones, incluyendo las soluciones de calibración y una pipeta de plástico.

1 X 6 Un medidor, seis métodos de medición

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



1 Inmersión

Cuando se encuentre en un laboratorio, puede analizar la muestra en un vaso de precipitados. Asegúrese que la tapa deslizante que protege el sensor esté abierta.

2 Muestreo

Utilícelo como una pala para analizar el agua, por ejemplo, de un río.

3 Gotas

Los medidores LAQUAtwin pueden medir volúmenes de muestra de tan solo 0.1ml. Coloque una gota de la muestra en el sensor con una pipeta.

4 Muestras sólidas

Los alimentos que contengan cierta humedad pueden analizarse si coloca un trozo pequeño directamente en el sensor.

5 Polvos

Los medidores LAQUAtwin también pueden analizar polvos secos. Simplemente, coloque la muestra de polvo en el sensor y versa encima el volumen definido de agua desionizada.

6 Papel y tejidos

Si desea analizar hojas de papel y tejidos, corte la muestra en trozos pequeños y colóquelo directamente en el sensor. Versa encima un volumen definido de agua desionizada.

Rango

pH

Medición precisa de pH directamente a partir de una sola gota. El pH del agua varía en función al ambiente y un ligero cambio a menudo puede tener un gran impacto. Tanto si debe mantener el pH de un acuario dentro de niveles estrictos, comprobar la acidez del agua de lluvia o la calidad de producto alimenticio (carnes, pescados…), los medidores de pH de bolsillo LAQUAtwin son la solución perfecta. No importa dónde o cuándo debe realizar un análisis.

COND

Determine la conductividad con tan solo una muestra de 0.12 ml. La conductividad del agua de lluvia es una referencia fiable para determinar la pureza atmosférica. En agricultura, la medición de la conductividad del suelo permite a los agricultores establecer el uso óptimo de fertilizantes y comprobar la «salud» del suelo tras el daño provocado por el agua salada. Los medidores de conductividad LAQUAtwin hace que el análisis de la conductividad sea una tarea sencilla que se puede realizar en

Na+

Único medidor de bolsillo para medir rápidamente y con precisión el sodio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 23 a 2300 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

K+

Único medidor de bolsillo para medir rápidamente y con precisión el potasio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 39 a 3900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

NO3–

Único medidor de bolsillo para medir rápidamente y con precisión el nitrato con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 30 a 9900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

Ca2+

Único medidor de bolsillo para medir rápidamente y con precisión el calcio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 40 a 4000 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

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Soil Salinity Measurement in Almond Orchard

Application Note

02-2017

Crops have different levels of tolerance to salinity. Testing soil salinity is the best way to check soil condition in the orchard before salt damage occurs. The $EC_{1:5}$ test is used to estimate soil salinity (EC_e). The soil salinity threshold value for almond is 1.5 mS/cm.

Introduction

Soils with high concentration of salts can induce salinity stress and restrict the growth of salt-sensitive plants. Among the factors that can cause salinity stress (See Figure 1), toxicity of ions, usually sodium (Na), chloride (Cl), and boron (B), is the most common that result in leaf tissue damage. In the orchard, the most typical salt damage observed is "leaf-tip burn" (See Figure 2) and the best way to prevent it is by monitoring the soil salinity. The advantage of soil salinity monitoring is remedial action can be performed on soil before symptoms on leaf tissue appear. Annual testing of soil samples from selected locations in the orchard should be part of every growers' management program.

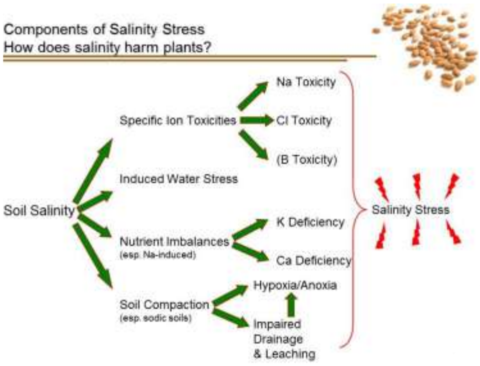

Figure 1: Components of Salinity Stress
Source: Rosenzweig, B. (2016). Soil Salinity Management.

Figure 2: Leaf-tip Burn in Almond Orchard
Source: Rosenzweig, B. (2016). Soil Salinity Management.

Electrical conductivity (EC) is the method used to measure soil salinity, which is influenced by the concentration and composition of dissolved salts. Salts increase the ability of a solution to conduct an electrical current, so a high EC value indicates high salinity. The LAQUAtwin EC 11, 22 and 33 conductivity pocket meters measure electrical conductivity in drops or micro-volume samples and display reading in just few seconds. The replaceable sensor is made of two flat titanium metals coated with platinum black that resist corrosion. The meters are programmed with standard recognition function for automatic calibration and automatic temperature compensation (ATC) function for accurate measurement.

Based on the Australian Soil Fertility Manual published by Commonwealth Scientific and Industrial Research Organization (CSIRO), sodium chloride (NaCl) is the major offender in the development of saline soils in Australia. The LAQUAtwin Salt 11 pocket meter can be used to measure NaCl concentration in soils. The meter measures the conductivity of the sample and converts it to salinity reading in either parts per thousand (g/L) or percentage (%) unit.

Method

A. Soil Sample Collection

Select representative sites in the orchard for routine sampling.

Drip Irrigated Orchards

Collect double handful of soil from two locations—20cm from the dripper and on the edge of the wetted area ~ approx. 60cm from the dripper. Soil should be drawn from two or three depths in the root zone—every 30cm down to 1m. Place soil sample from each depth/location in a bag for analysis.

Continued at the back

Continued from the front

Sprinkler Irrigated Orchards

The sampling is similar to that of drip irrigated orchards, except three locations are sampled—2meters of a sprinkler, 1/3 distance between sprinklers on a diagonal, and middle of the sprinkler pattern. If the irrigation system has a designed and measured distribution uniformity of ≥ 80% or salinity results from 2 or more years indicate there is no variation by location, then the number of locations could be decreased.

B. Soil Salinity Measurement

1. Allow the soil sample to dry by leaving the sample bag or container open for at least a day. It can be oven-dried on a tray in a cool oven.
2. Crush dried sample with a mortar and pestle, rolling pin or hammer so there are no large aggregates (clods of soil 2mm or larger). Remove any foreign matter, plant matter, and stones from the sample.
3. Add 1 part soil for every 5 parts distilled or deionized (DI) water. For example, mix 50g soil and 250ml DI water in a container.
4. Shake the container for 3 minutes to dissolve the salts. For clay loams and clay soils, more shaking (for 1 minute every 3 minutes, repeat 3 times) will dissolve more salts and increase the accuracy of the test.
5. While allowing the solution to settle for a minute before testing, calibrate the LAQUAtwin EC 11, 22 or 33 pocket meter with 1413µS/cm and 12.88mS/cm conductivity standards included in the kit. Rinse the conductivity sensor with DI water and blot dry with soft tissue between standards and after calibration.
6. Immerse the conductivity sensor in the solution (without touching the soil in the bottom of the container) and record the **$EC_{1:5}$** reading once it has stabilized. Alternatively, place drops of solution onto the sensor using the pipette included in the kit.
7. Rinse the conductivity sensor with DI water and blot dry with soft tissue.
8. Convert the **$EC_{1:5}$** reading to actual soil salinity (**EC_e**) by multiplying the value by the conversion factor based on the texture of the soil sample (Refer to Table 1 below).

Table 1: $EC_{1:5}$ to EC_e Conversion Factors

Soil Texture	Multiplication Factor
Sands	17
Sandy Loams	13.8
Loams	9.5
Clay Loams & Light Clays	8.6
Medium & Heavy Clays	7

Note: These factors are calibrated for southern NSW (AU) soils
Source: Gibbs, S. (2000).Salinity Notes: How to Texture Soils & Test for Salinity.

Results and Benefits

Monitoring soil salinity can help identify the current soil conditions, predict problems, and establish baseline for management decisions. Crops have different levels of tolerance to salinity. The soil salinity threshold value for almond is 1.5 mS/cm. Table 2 below shows the salt tolerance data for selected crops.

Soil salinity derived from electrical conductivity (EC) measurements in the field or laboratory are often reported with subscript abbreviations to indicate the origin of the sample tested and the method used to determine the salinity. Common abbreviations and their descriptions are explained below.

- **$EC_{1:5}$** – test used to estimate soil salinity (**EC_e**). It is determined by mixing 1 part soil with 5 parts DI water. After mixing the sample and allowing the sediments to settle, the electrical conductivity of the solution is tested.
- **EC_e** – the estimated amount of salt in the soil. **EC_e** = **$EC_{1:5}$** x conversion factor (based on soil texture)
- **EC_{se}** – the electrical conductivity of a saturated soil extract, which should be conducted by a National Association of Testing Authorities, Australia (NATA) accredited laboratory. **EC_{se} = EC_e**

A soil salinity test gives an indication on the soil conditions around the plant roots, taking into account the influence of soil texture. Texture is an estimate of the relative amounts of sand, silt, and clay particles in a soil. It affects fertility, water holding capacity, internal drainage, irrigation scheduling, and soil workability for tillage. Soil texture usually changes with depth. To guide you identify soil texture, refer to *Salinity Notes: How to Texture Soils & Test for Salinity by Simon Gibbs*.

Table 2: Salt Tolerance Data for Selected Crops

Crop	Soil Salinity EC_{se} (mS/cm)*			
	0% Yield Loss	10% Yield Loss	25% Yield Loss	50% Yield Loss
Almond	1.5	2.0	2.8	4.1
Avocado	1.3	1.8	2.5	3.7
Citrus	1.7	2.3	3.3	4.8
Date Palm	4.0	6.8	11.0	18.0
Lucerne	2.0	3.4	5.4	8.8
Olive	2.7	3.8	5.5	8.4
Onion	1.2	1.8	2.8	4.3
Pistachio	4.0	4.5	5.0	6.0
Pomefruit	1.7	2.3	3.3	4.8
Potato	1.7	2.5	3.8	5.9
Stonefruit	1.7	2.2	2.9	4.1
Tomato	2.5	3.5	5.0	7.6
Vine	1.5	2.5	4.1	6.7
Beans	1.0	1.5	2.3	3.6
Eggplant	1.1	2.5	4.7	8.3
Cucumber	2.5	3.3	4.4	6.3
Capsicum	1.5	2.2	3.3	5.0

*Equivalent to dS/m
Source: Irrigation Management Training. Measuring Soil Salinity.

References and Suggested Readings

1. Rosenzweig, B. (2016). Soil Salinity Management. Available at https://growing.australianalmonds.com.au/2016/02/28soil-salinity-management/ (Accessed 30 December 2016).
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Revision 1.0, 23 January 2017

LAQUAtwin Pocket Ion Meters Lineup

pH COND / TDS Na^+ K^+ NO_3^- Ca^{2+} Salt EC

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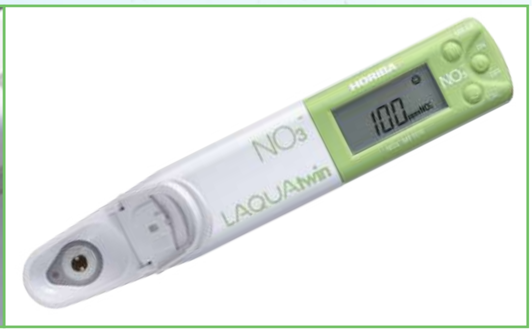
LAQUAtwin NO3

Nota de aplicación

02-2015

Medición de nitrato en suelo para determinar el Nitrógeno disponible para la planta.

La concentración de nitrato en suelo es un buen indicador de la cantidad de nitrógeno disponible para el cultivo. Los requerimientos en Nitrógeno (NO3-N) cambia por cada tipo de cultivo, pero en general una concentración entre 10 y50 mg/kg considerada como óptima.



Introducción

Los análisis de suelo han hecho usado por mucho tiempo para determinar las concentraciones de nutrientes disponibles para las plantas. Nitrógeno es uno de los nutrientes esencial, que se convierte aminoácidos y luego permite la producción de enzimas y parte estructural de la planta.

El medidor de Nitrato LAQUAtwin NO3-11 puede ser usado para determinar la concentración de Nitrógeno (NO3-N) en muestra de suelo. Es un equipo de bolsillo fácil a usar que entrega resultados inmediatos en campo, lo que permiten eliminar el envió de la muestra a laboratorios y también el tiempo de entrega de los resultados que es de dos semanas en promedio.

Método

Colección y preparación de las muestras

1. Tome una muestra de suelo seco y pásala en un tamiz de 2 mm
2. Prepare la solución de suelo mezclando el suelo con agua en ratio 1:5 (ejemplo: 5 g de suelo y 25 ml de agua). Mezclar por un minuto y deje la muestra reposarse por 5 minutos o realizar una filtración directamente después de la mezcla.

Calibración

Calibrar el medidor de nitrato LAQUAtwin usando las dos soluciones de calibración. Asegúrese de configurar el equipo por que entrega los resultados en mg/l o ppm Nitrógeno (NO3-N).

Medición de las muestras

1. Mide el agua usada por la dilución
2. Nota el valor y tómelo como el valor blanco.
3. Enjuagar el sensor con agua destilada y secarlo con un papel absorbente
4. Usa unas gotas de la parte superior de la solución de suelo y del líquido filtrado
5. Nota el valor cuando está estable
6. Enjuagar y luego secar el sensor con agua entre cada medición

Tome una muestra de suelo seco y pásala en un tamiz de 2 mm

Resultados y beneficios

Para obtener resultados en NO3-N en mg/kg en suelo, usa la formula siguiente: NO3-N mg/kg = resultado de la medición de la solución de suelo de NO3-N en ppm (o mg/L) x 5. Si se usa una diferente ratio de dilución tendría que cambiar el “5”.

El Nitrato exprimido en Nitrógeno (NO3-N) representa la cuantidad de Nitrógeno disponible en el suelo que puede ser absorbido inmediatamente por el cultivo. El valor optimo depende de cada tipo de cultivo, pero en general en valor no tiene que ser más bajo que 10 mg/kg y no debe pasar más de 50 mg/kg. Sin embargo, el nitrato puede cambiar con el agua del suelo de esta manara las concentraciones pueden fluctuar en función del movimiento del agua en el suelo.

Nitrógeno NO3-N (mg/kg)

Bajo	Cuidado	Bueno	Bueno	Cuidado	Alto
0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60

Figure 1: Guide to the interpretation of nitrate-nitrogen values for soils (Source: Soil health for vegetable production in Australia—Part 4)

Para determinar la cuantidad de nitrógeno en fertilizante para llegar a los requisitos nutricional del cultivo, la concentración de NO3-N medida en cultivo se sustrae de la concentración óptima para el cultivo.

Información adiciónale

- **Suelo** – Muestra humedad necesita que ser secada con secador de cabello o por el sol si el suelo se deja en el sol. Eso permite de eliminar el efecto de la humedad del suelo que puede diluir la concentración de nitrógeno. Muestra con mucho barro tiene que ser machucada.
- **Agua** - Agua o soluciones de sales diluidos puede ser usadas para extraer el nitrato la la mayoría de los suelos porque básicamente todos los nitratos del suelo con baja capacidad de intercambio de anión son solubles en agua. El principal límite del agua es su bajo fuerza iónica que puede causar resultado irregular en filtrado con suspensión. También usar extractante que contiene cloruro puede generar interferencia por las muestras medidas por cromatografía iónica y electrodo selectivo de ion (ISE). Sulfato de amonio (NH4)2SO4 es el extractante recomendado por las mediciones de nitrato con electrodo ISE (Griffin et al., 1995).
- **Soluciones de calibración** – Para verificar las concentraciones de NO_3-N. Las dos soluciones incluidas con el medidor permiten calibrar el medidor por concentraciones de NO3-N a 34 y 450 ppm.
- **Unidad de medición** – El medidor de nitrato puede ser configurado para medir en mg/L o ppm de Nitrato (NO3-) o Nitrato exprimido en Nitrógeno (NO3-N). Refiere se al manual para realizar la configuración. Si el medidor medir en NO3 los puntos de calibración serán de 150 y 2000 ppm o 34 y 450 ppm si el medidor mide NO3-N.

Referencias

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3. Griffin, G., Jokela, W., Ross, D., Pettinelli, D., Morris, T., and Wolf, A. (2009). Chapter 4 Recommended Soil Nitrate Tests. Recommended Soil Testing Procedures for the Northeastern United States. Cooperative Bulletin No. 493.
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REV 0, 4 AUGUST 2015

Medidor NO3-11S: kit para análisis de suelo

Rango de medición: 30~600 ppm (NO3-), 6.8~140 ppm (NO3--N), 3.4~68 kg/10a (NO3--N)

Accesorios incluidos:

- Medidor de Nitrato NO3-11
- Soluciones de calibración (30 ppm, 300 ppm) (14 mL)
- 2 pilas CR2032
- Manual de instrucción
- 5 pipetas
- Botella de solución de limpieza (250 ml)
- 3 botellas de extracción (100 ml)
- 2 spatulas para muestreo de suelo
- Pincitas,
- Papel de muestreo B
- 2 soportes para papel de muestreo
- Guía rápida
- Maletín de transporte.

Línea de medidores de bolsillo LAQUAtwin

pH COND Na+ K+ NO3– Ca2+ Salt EC

pH del suelo y disponibilidad de nutrientes

El rango de pH deseable por un crecimiento óptimo para varios tipos de planta es entre pH 6 y 7.5 además a estos valores de pH, los nutrientes se conviertan lo más disponibles para las plantas. Se puede determinar el pH del suelo mesclando una muestra de suelo con agua y mediando esta solución de suelo acuosas con los medidores LAQUAtwin.

Introducción

El pH del suelo es la medición de la acidez o alcalinidad en el suelo. En la escala de pH, pH 7 es neutral. Debajo de 7.0 es ácido y abajo es alcalino. El pH del suelo afecta los nutrientes disponibles para el crecimiento de las plantas. En suelo muy acido, el aluminio y manganeso se conviertan más disponibles and también más toxico mientras tanto el calcio, fosforo and magnesio están menos disponible para la planta.

pH del suelo	Crecimiento de la planta
> 8.3	Demasiado alcalino para la mayoría de las plantas
7.5 pH del suelo	Disponibilidad del hierro es un problema en suelo alcalino
7.2	de 6.8 a 7.2 casi neutral de 6.0 a 7.5 aceptable para la mayoría de las plantas
7.0	
6.8	
6.0	
5.5	Reduce la actividad microbiológica del suelo
< 4.6	Demasiado acido para la mayoría de las plantas

En suelo muy alcalino, el fosforo y la mayoría de los micronutrientes están menos disponibles.

Antes de diseñar o plantar un nuevo jardín o cultivo, es importante de entender los requisitos de pH de cada variedad de planta. La determinación del pH puede dar informaciones útiles tal como si el suelo es apropiado para la planta que queremos cultivar o si necesitamos ajustar el pH para un crecimiento óptimo. El pH del suelo puede ser medido fácilmente y directamente en el campo con los medidores de pH HORIBA LAQUAtwin pH11, pH22 y pH33. Estos medidores de bolsillo pueden ser calibrados hasta 5 puntos usando solución de calibración tipo USA. El modelo pH 33 tiene un sensor de temperatura incorporado y una función de compensación de temperatura para calibrar y medir el pH exacto a la temperatura medida. Referirse a las especificaciones técnicas de cada modelo.

Método

Calibra el medidor de pH LAQUAtwin siguiendo las instrucciones del fabricante usando por lo menos dos soluciones de calibración para encerrar el pH esperado.

Preparación de la muestra y medición

El método descrito abajo es basado sobre el método US EPA 9045D. Es también aplicable para la medición de pH en agua sucia, barros activados y líquidos no acuosos. Si la muestra contiene agua, el volumen de agua debe ser menos que 20% del volumen total.

1. Añadir 20ml de agua a 20g de muestra de suelo en un vaso. Mesclar 5 minutos y cubrir.

2. dejar la solución de suelo por descansar 1 hora.

3. Medir la solución y notar el valor de pH y temperatura.

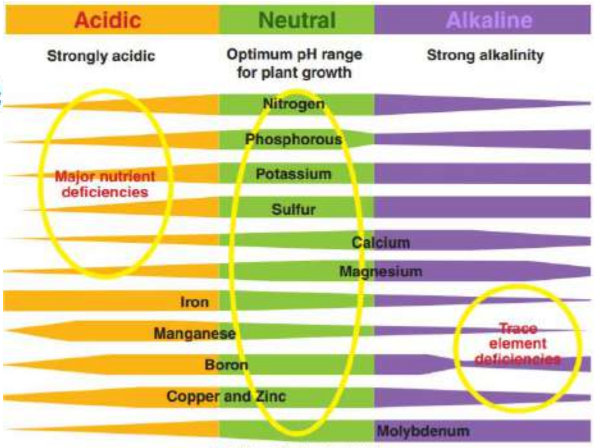
Para obtener resultado preciso, la solución de calibración y la muestra deben tener la misma temperatura. Si el electrodo está cubierto de una película de aceite o grasa, limpiarlo y enjuagarlo con detergente y agua.

pH4.0-6.0	pH5.0-6.5	pH6.0-7.5	pH5.0-7.5	pH6.0-8.0
Potato	Apple	Apricot	Banana	Avocado
	Blackberry	Cherry	Rhubarb	Asparagus
	Cranberry	Grapevine	Strawberry	Ginger
	Gooseberyy	Grapefruit	Rasberry	Leek
	Mango	Hazelnut	Carrot	Mint
	Melon	Hop	Cauliflower	Paprika
	Pineapple	Lemon	Sweet corn	Watercress
	Pomegranate	Lychee	Cucumber	
	Watermelon	Mulberry	Garlic	
	Basil	Nectarine	Lentil	
	Chicory	Peach	Parsley	
	Fennel	Plum	Pepper	
	Olive	Quince	Pumpkin	
	Peanut	Artichoke	Shallot	
	Sweet potato	Bean	Spearmint	
	Rice	Beetroot	Thyme	
	Rosemary	Broccoli	Tomato	
	Sage	Brussels sprouts	Turnip	
	Soybean	Cabbage		
		Calabrese		
		Celery		
		Chinese cabbage		
		Chives		
		Lettuce		
		Millet		
		Mushroom		
		Mustard		
		Onion		
		Pea		
		Peppermint		
		Radish		
		Spinach		

(Source: Gurumaganize.org)

Resultado y Beneficios

El rango de pH deseable en el suelo para un crecimiento optima de la plantas es de 6.0 a 7.5. Generalmente, estos valores de pH son aceptable por la mayoría de la plantas y los nutrientes se convierten más disponibles. El pH del suelo es importante porque afecta directamente la disponibilidad de los nutrientes, nitrógeno, fosforo y potasio



Soil pH and Nutrient Availability
(Source: Bluedale - http://www.bluedale.com.au)

son los nutriente básico necesaria en grande cantidad. Calcio, magnesio y sulfuro son nutrientes secundarios necesarios en cuantidad más pequeña. Zinc y magnesio son los micronutrientes necesarios en muy baja cuantidad. Las deficiencias de nutrientes secundarios y de micronutrientes pueden ser fácilmente arregladas guardando el pH del suelo a un valor óptimo.

El pH del suelo afecta también la actividad de los microorganismos, la población de bacterias que descomponen la materia orgánica declina y su actividad reduce cuando el suelo tiene un pH muy acido, en esta caso se observa una acumulación de materias orgánicas amarradas con nutriente en particular el nitrógeno.

Aumentar el pH del suelo

Aplicar una sustancia que contiene un tipo de cal (carbonato de calcio) como caliza o fresno de madera puede aumentar el pH del suelo. Lo más fina es la caliza lo más rápido y efectivo será. La cantidad de caliza depende del tipo de suelo. El fresno de madera contiene alta concentración de potasio y calcio una pequeña cantidad de fosfato, boro y otros nutrientes aunque no esta tan eficiente como la caliza puede aumentar el pH del suelo si la operación es repetida varias veces.

Bajar el pH del suelo

Aparte de los fertilizantes basados con amonio y material orgánica, el sulfato de aluminio y sulfato y azufre son sustancia común para bajar el pH del suelo. El sulfato de aluminio es preferido pero el cambia el pH del suelo desde el momento que se disuelve en el suelo. Azufre toma más tiempo para tener efecto porque tiene que ser convertido en ácido sulfúrico

Referencia y lecturas sugeridas

1. US Environmental Protection Agency Method 9045D Soil and Waste pH, Revision 4, November 2004
2. Changing the pH of your Soil. Clemson University Cooperative Extension. www.clemenson.edu

Medidores de bolsillo de pH HORIBA LAQUAtwin

Características

Sensor de pH plano con compensación de temperatura ofrece mediciones rápidas y confiables directamente a partir micromuestras de 100 µl.

Aplicaciones

Análisis de aguas dulces (lluvia, ríos, lagos, manantiales), acuarios, aguas residuales, análisis del suelo para una agricultura mejorada, análisis de la frescura de los alimentos. Fermentación y elaboración de la cerveza, laboratorios de investigación, controles de calidad de productos médicos y cosméticos, odontología preventiva, educación escolar, etc.

Rango de medidores de bolsillo HORIBA LAQUAtwin

IMS

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JOA-MD0010 / OHSAS18001 JOA-OH0068

Application Note

Conductivity and Elephant's Foot Testing

LAQUAtwin is a series of pocket ION meters. Using Ion Selective Electrode (ISE) technology, they are available for measuring Conductivity, Calcium, Nitrate, Potassium, Sodium, Salt concentration and pH measurement. Using just a tiny amount of sample, the LAQUAtwin proprietary flat sensors can quickly and accurately measure the values of the chemical parameters in the field.

Photo Credit: Elio Jovicich, University of Florida.

Introduction

A physiological disorder in greenhouse hydroponic sweet pepper (Capsicum annuum L.), where the base of the plant's stem becomes swollen below the cotyledon level and wounds develop at the base of the stem's epidermis has been named "Elephant's Foot".

Sodium is a mineral constantly present in soil, but an excess of it concentrated at the base of the plant stem has been shown to have a correlation with Elephant's Foot in plants. It is necessary to analyse the conductivity of soil in which hydroponic sweet pepper is grown to consider the extent to which the stem of the plant has accumulated salt.

To determine the conductivity of the soil, the Horiba LAQUAtwin Conductivity meter can be used. This is an easy and quick method used to measure the conductivity of soil.

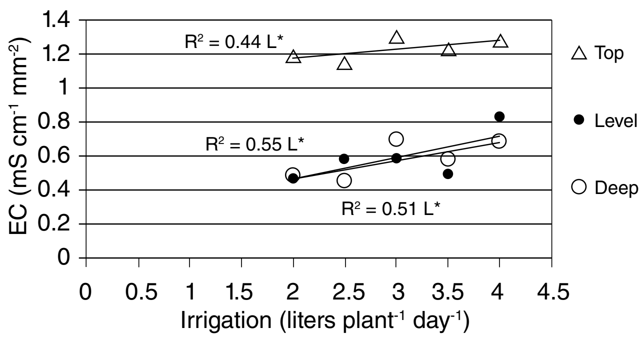
Method

1. A small 5g soil sample is watered down with 20 ml of water.
2. The water and soil mixture is shaken, thus 'washing' the soil.
3. A small sample can be extracted via pipette
4. This is placed on the sensor of the LAQUAtwin Conductivity meter and the conductivity is measured after one minute.
5. To repeat sampling, wash the sensor with tap water and pat dry with a paper tissue.

Results and Benefits

The use of the Horiba LAQUAtwin Conductivity meter to measure the conductivity of soil will improve farmers' knowledge of the sodium accumulation and hence choose the best land to grow sweet pepper crops and avoid Elephant's Foot disorder.

The LAQUAtwin Conductivity meter is small and compact, and convenient to carry for easy on-site testing. Its easy-to-use interface is simple for anyone to use the LAQUAtwin hand held Conductivity meter.



Salt accumulation on the stem base (measured by EC) and volumes of nutrient solution per plant per day at the three transplant depths: "Top": plants transplanted to half of the container height, "Level": plants transplanted to the cotyledons level, and "Deep": plants transplanted to the 2nd node. Electrical conductivity values for each transplant depth and irrigation volume average four soilless media type (coconut coir, peat mix, perlite, and pine bark). L*, linear polynomial effect at 5% level of significance.

Jovicich, E. and Cantliffe, D.J. 2001. "Transplant Depth, Irrigation, And Soilless Media Effect On 'Elephant's Foot' Plant Disorder In A Hydroponic Greenhouse Sweet Pepper Crop". Acta Hort. (ISHS) 559:515-520

Pocket ION Meter

LAQUAtwin

Unique Features

Calibrate and measure at the touch of a button—the smiley face will tell you when the result can be read.

Hassle-free automatic calibration with a few drops of standard solution reassures you of your measurement accuracy. Two-point calibration is also possible.*1

*1 Except for B-711

LAQUAtwin is fully waterproof and dustproof.

The meter and sensor are fully waterproof*3 and dustproof, so you can take it anywhere.

*3 IP67 rated. Will withstand immersion for 30 minutes at 1 m. Not suitable for underwater use.

LAQUAtwin: the only meters with flat sensor technology.

HORIBA's highly-sensitive, flat sensor technology opens up new possibilities for sampling and sample types. Only a small amount of sample is required, so you can easily sample in situ without the need for beakers or other labware. Sensors are easily replaced as required.

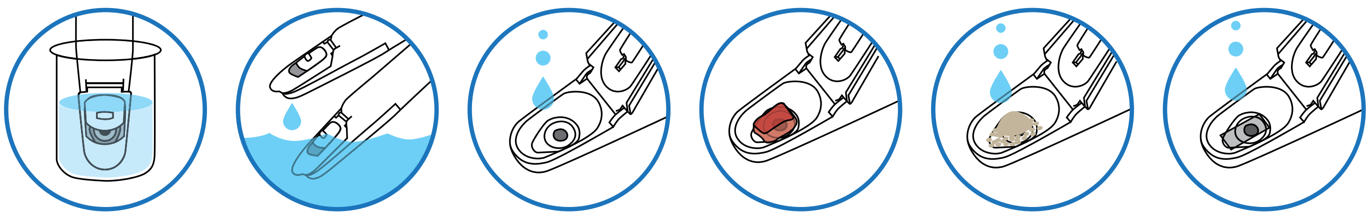
Carry case comes as standard for handy portability.

The compact carry case contains everything you need for your measurements, including the standard solution and sampling sheets.

1 X 6

One meter, six methods.

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



01 Immersion

When you're in the lab, you can test the sample in a breaker. Ensure the sensor guard sliding cap is open.

02 Scoop

Use as a scoop to test water eg from a river. A vertical scoop for an aquarium is also available with a unique sensor guard.

03 Drops

Place a drop of the sample onto the sensor with a pipette. Laquatwin meters can measure sample volume as low as 0.1mL

04 Solid Samples

Foods containing some moisture can be tested by placing a small piece directly onto the sensor.

05 Powders

Laquatwin meters can also test dry powders. Simply place the powder sample onto the sensor and drop on your defined volume of pure water.

06 Paper and textiles

To test sheets of paper and textiles, cut up the sample into small pieces and place directly onto the sensor. Drop on your defined volume of pure water.

Lineup

pH

Accurate pH measurements in a few seconds, from a single drop.

Water pH varies in different environments, and a slight change can often have a major effect.

Whether you need to keep the pH of an aquarium within tight limits, are checking for the acidity of rain water or for the quality of meat and fish products, LAQUAtwin compact pH meters are ideal for you. No matter where and when you need to test.

COND

Determine water conductivity with as little as 0.12 mL of sample.

The conductivity of rain water is a trusted guide to determining atmospheric purity. In agriculture, measuring the conductivity of soil allows farmers and agronomists to determine optimum fertilizer usage and check the 'health' of soil after salt water damage. The LAQUAtwin meter makes conductivity testing simple, anywhere.

Na+

Only compact meter for a quick and reliable measurement of sodium ion at the scene using ion selective membrane.

K+

Only compact meter for a quick and reliable measurement of potassium ion at the scene using ion selective membrane.

NO3–

Only compact meter for a quick and reliable measurement of nitrate ion at the scene. Special application packages for crop (B-741) and soil (B-742) are also available.

Ca2+

Only compact meter for a quick and reliable measurement of ionized calcium at the scene using ion selective membrane.

http://www.horiba.com/laquatwin

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Nota de aplicación

Medición de pH en savia de planta

LAQUAtwin es un rango de medidores de bolsillo de electroquímica. Los medidores de iones usan un electrodo selectivo, para medir el potasio, el calcio, los nitratos y el sodio este rango también incluye medidores de pH y de conductividad. Con tan solo una gota de muestra, el sensor plano LAQUAtwin mide rápidamente y con precisión las concentraciones de parámetros químicos en el campo o en laboratorio.

Introducción

En varios casos es necesario medir el valor de pH en la savia de planta para determinar el estado de salud de la planta. Si el valor de pH está arriba de 6.4, la planta es más propensa a ser atacada por los insectos del otro lado un pH debajo de 6.4 puede conducir a algunas enfermedad. Por eso el pH optimo deseo un la savia es de pH 6.4. Los análisis de suelo y de savia en laboratorio son informaciones importantes pero los resultados solo son disponibles días a veces semanas después de la colecta de muestra. Eso puede ser problemática porque en muchos casos el productor tiene que reaccionar rápidamente si hay un problema. En este caso los medidores de pH HORIBA son equipos muy útiles para diagnosticar la salud de la planta en tiempo real. Es equipo es fácil de usar y entrega un resultado preciso en tan solo segundos.

Método

Para hacer la medición, colecta unas hojas y póngalas en el picador a ajos y exprima para obtener unas gotas de muestra de savia. Generalmente, las hojas maduras aportan una indicación más precisa del estado de salud de la planta. La muestra de savia puede ser medida directamente con los medidores de pH LAQUAtwin pH11, pH22 o pH 33. Después de calibrar el equipo, coloca la muestra sobre el sensor y asegurase de cubrir completamente el electrodo. Espera 30 segundos antes de tomar el valor en la pantalla.

Si el valor de pH medido es diferente de más de 0.5 pH del valor óptimo 6.4, puede ajustar de la manera siguiente:

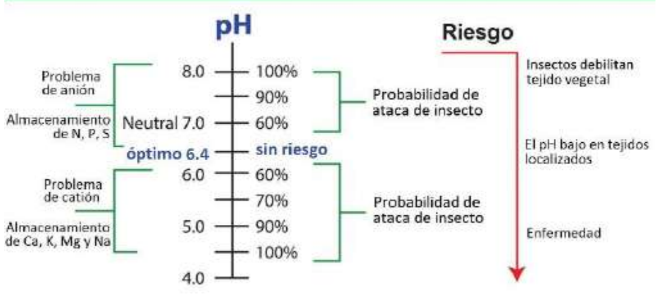
- Si el pH está más que 0.5 pH arriba del valor pH 6.4: añadir una pequeña cantidad de fertilizante de fosfato
- Si el pH está más que 0.5 pH debajo del valor pH 6.4: añadir una pequeña cantidad de fertilizante de calcio/potasio

Después de una semana, repite el análisis para asegurarse que el pH está más cercano del valor óptimo pH 6.4

Resultado y Beneficios

El uso del medidor de PH HORIBA LAQUAtwin permite de diagnosticar el pH interno de la planta y de asegurarse que está cerca del valor óptimo para mantener una buena salud de la planta y evitar problema sobre su cosecha.

Este medidor es práctico para llevar en todos lados y fácilmente realizar medición en el campo o en laboratorio. Gracias a su simplicidad de uso el LAQUAtwin es accesible para todos usuarios.



Medidor de bolsillo

LAQUAtwin

Características únicas

LAQUAtwin: Tecnología única de sensor plano ISE y pH

La tecnología HORIBA de sensor plano de alta sensibilidad abre nuevas posibilidades para medir diferente tipos de muestras. Puede hacer una medición a partir de un volumen de 0.1 ml y no necesita vaso para calibrar o medir, solo punga unas gotas directamente en el sensor.

Realice calibraciones y mediciones con tan solo pulsar un botón; le indicará que ya puede leer el resultado.

La sencilla calibración automática con tan solo unas gotas de solución de calibración, le garantiza la exactitud de la medición. También se puede realizar la calibración en dos puntos y hasta 3 y 5 puntos con los modelos pH33 y EC33.

LAQUAtwin es totalmente a prueba de agua y polvo.

El medidor y el sensor son totalmente resistentes al agua y al polvo, por lo que puede llevarlo donde quiera.

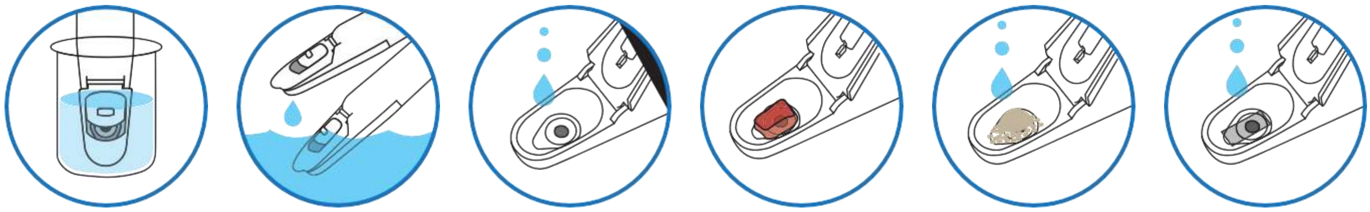
1 IP67: no da errores al sumergirse en agua a una profundidad de un metro durante treinta minutos. Sin embargo, el producto no puede usarse bajo el agua

Incluye un estuche para transportarlo de forma práctica.

El estuche compacto contiene todo lo que necesita para las mediciones, incluyendo las soluciones de calibración y una pipeta de plástico.

1 X 6 Un medidor, seis métodos de medición

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



1 Inmersión

Cuando se encuentre en un laboratorio, puede analizar la muestra en un vaso de precipitados. Asegúrese que la tapa deslizante que protege el sensor esté abierta.

2 Muestreo

Utilícelo como una pala para analizar el agua, por ejemplo, de un río.

3 Gotas

Los medidores LAQUAtwin pueden medir volúmenes de muestra de tan solo 0.1ml. Coloque una gota de la muestra en el sensor con una pipeta.

4 Muestras sólidas

Los alimentos que contengan cierta humedad pueden analizarse si coloca un trozo pequeño directamente en el sensor.

5 Polvos

Los medidores LAQUAtwin también pueden analizar polvos secos. Simplemente, coloque la muestra de polvo en el sensor y versa encima el volumen definido de agua desionizada.

6 Papel y tejidos

Si desea analizar hojas de papel y tejidos, corte la muestra en trozos pequeños y colóquelo directamente en el sensor. Versa encima un volumen definido de agua desionizada.

Rango

pH

Medición precisa de pH directamente a partir de una sola gota. El pH del agua varía en función al ambiente y un ligero cambio a menudo puede tener un gran impacto. Tanto si debe mantener el pH de un acuario dentro de niveles estrictos, comprobar la acidez del agua de lluvia o la calidad de producto alimenticio (carnes, pescados…), los medidores de pH de bolsillo LAQUAtwin son la solución perfecta. No importa dónde o cuándo debe realizar un análisis.

COND

Determine la conductividad con tan solo una muestra de 0.12 ml. La conductividad del agua de lluvia es una referencia fiable para determinar la pureza atmosférica. En agricultura, la medición de la conductividad del suelo permite a los agricultores establecer el uso óptimo de fertilizantes y comprobar la «salud» del suelo tras el daño provocado por el agua salada. Los medidores de conductividad LAQUAtwin hace que el análisis de la conductividad sea una tarea sencilla que se puede realizar en

Na+

Único medidor de bolsillo para medir rápidamente y con precisión el sodio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 23 a 2300 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

K+

Único medidor de bolsillo para medir rápidamente y con precisión el potasio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 39 a 3900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

NO3–

Único medidor de bolsillo para medir rápidamente y con precisión el nitrato con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 30 a 9900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

Ca2+

Único medidor de bolsillo para medir rápidamente y con precisión el calcio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 40 a 4000 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

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Determinación de la concentración de nutrientes en solución de suelo y savia de tomate

El manejo de la fertirrigación requiere método rápido y preciso para determinar la concentración de nutrientes en solución de suelo y savia de cultivo. Folegatti et al (2005) descubrieran que las concentraciones de nitrato, potasio y sodio en solución de suela y savia de planta de tomate medidas con los medidores LAQUAtwin muestran alta correlación con los analices realizados en laboratorio certificado. Este estudio valida la precisión de los medidores LAQUAtwin y confirma su utilidad como herramienta para el implementar una buena nutrición de su cultivo.

Introducción

Los cultivos toman los nutrientes del suelo para su crecimiento. Los niveles de nutrientes en suelo y savia dan indicaciones sobre las necesidades nutricionales en tiempo real del cultivo. Folegatti et al (2005) hicieron un estudio para evaluar la precisión de los medidores Cardy/LAQUAtwin para la determinación de Nitrato (NO3-), Potasio (k+) y Sodio (Na +) con muestra de solución de suelo y de savia para el manejo de la fertirrigación. El sodio no es un ion esencial para cultiva de tomate, al contrario, su presencia en alto nivel impacta el cultivo. Por eso su monitoreo en agua de riego es importante.

Los medidores Cardy fueran reemplazados por los modelos LAQUAtwin, que tienen un nuevo sensor, un software mejorado y una interfaz más sencilla. The LAQUAtwin Na-11, K-11 y NO3-11 miden el Sodio, Potasio y Nitrato. Como los medidores cardy, los modelos LAQUAtwin solo requieren unas gotas para realizar una medición y entregan un resultado en tan solo unos segundos. Eso permiten medir muestra de pequeño volumen como savia y realizar varios análisis en campo en poco tiempo, eso permiten también evitar la demora de entrega de resultados de los análisis de laboratorio.

Método

Se usó un cultivo de tomate en invernadero en Piracicaba, Brasil con soluciones de riego de diferentes niveles de nutrientes. Los fertilizantes y sales usados fueran nitrato de amonio (NH4NO3), Cloruro de Potasio (KCl), Cloruro de Calcio (CaCl2), Cloruro de Sodio (NaCl) que fueran aplicado con un sistema de gotero. Las soluciones de suelo fueran colectadas cada 15 días en promedio, 24 horas después de la irrigación usando lisímetro para absorber solución de suelo a una profundidad de 15 cm. Las concentraciones de Nitrato, Potasio y Sodio fueran medidas con los medidores de ion Cardy. Los resultados se compararon con los obtenidos por análisis de laboratorio certificado usando un fotómetro de flama (Na+/K+) y destilación de vapor (NO3-).

50 muestras de las ultimas hojas maduras fueran colectadas por cada sección del cultivo que recibieran diferentes tipos de fertilización. Las bases de los peciolos fueran exprimidas usando una prensa de ajo and las muestras de savia obtenidas fueran medidas con los medidores Cardy. En laboratorio las hojas fueran secadas en hornos a 60ºC por 48 horas y se determinaran las concentraciones de Nitrógeno, Potasio y Sodio total (estructural e intercelular). Las concentraciones medidas en peciolos fueran comparadas con los análisis de hoja seca en laboratorio.

Los medidores fueran calibrados en dos puntos cada 10 muestras y los sensores fueran limpiado con agua destilada entra cada medición.

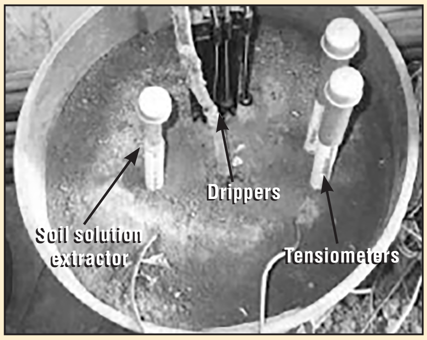

Figure 1A: Greenhouse experimental pot

Continued at the back

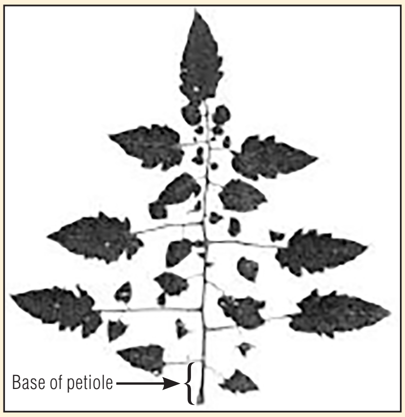

Figure 1B: Base of petiole used for sap nutrient determination

Beneficios y resultados

La figura 2 demuestra una alta correlación entre las concentraciones de NO3-, K+, Na+ medidas con los medidores Cardy y los análisis del laboratorio certificado. Las concentraciones de nitratos estaban 39% más bajas que los análisis de laboratorio, cuando las concentraciones de Potasio y Sodio estaban 21% y 67% más altas que los resultados de laboratorio. El coeficiente de determinación (r2) es alto para cada ion y la relación fue significante 1% (Tabla1).

Las concentraciones de NO3-, K+ y Na+ medidas en peciolos con los medidores Cardy muestran una buena correlación con los análisis en hoja seca de laboratorio and la correlación fue buena por cada ion (tabla 1).

Los valores r2 por las concentraciones de nutrientes en peciolos y hoja seca fueran cerco de los resultados observados en otros estudios.

Las discrepancias observadas entre los resultados de los medidores LAQUAwtin y los resultados del laboratorio certificado fueran probablemente causadas por la presencia de otros nutrientes en las soluciones de suelo y las muestras de savia. Sin embargo, Folegatti et al (2005) concluyeran que los medidores Cardy, ahora llamados LAQUAtwin, ofrecen buena correlación con análisis de laboratorio certificado, por esta razón esto medidores están adecuados para realizar mediciones directo de nutrientes en solución de suelo y sabia en campo.

Table 1 - Values of paired-t test for concentrations of NO_3^-, K^+ and Na^+ determined by CIM and by standard methods, in the soil solution and tomato petiole sap.

Statistic	NO_3^-	K^+	Na^+
	Soil solution		
t	-12.1**	12.3**	26.4**
	Petiole sap		
t	13.4** ξ	13.9**	14.0**

**Significant at 0.01.
ξNO_3^- in sap tested against total-N in leaf dry matter.

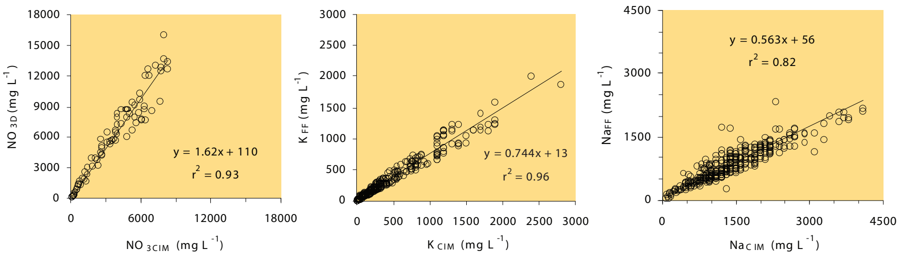

Figure 2 - Relationships between concentrations of nitrate, potassium and sodium in the soil solution measured by cardy-ion meters (CIM) and by standard methods. FF = flame fotometry; D = steam-distillation.

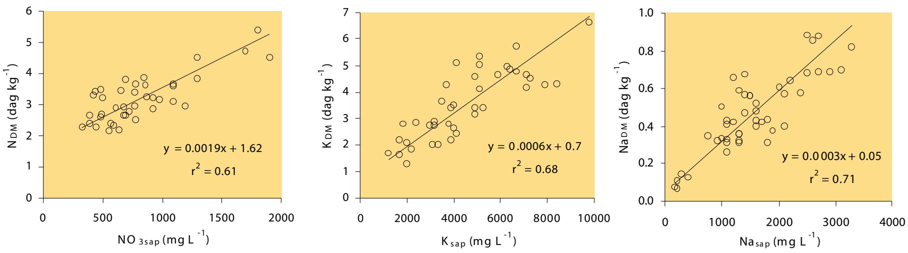

Figure 3 - Relationships between the concentrations of nitrate, potassium and sodium in petiole sap and total-N, potassium and sodium in the dry matter (DM) of tomato leaves, hybrid Facundo.

References and Suggested Readings

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Revision 1.0, 30 December 2016

Línea de medidores de bolsillo LAQUAtwin

pH COND / TDS Na^+ K^+ NO_3^- Ca^{2+} Salt EC

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Nota de aplicación

Medición de pH y conductividad en fibra de coco

La medición de fibra de coco supone extractar una solución de muestra con agua deionizada and medir el pH y la conductividad de este extracto y de usar un método por filtración. El valor de conductividad aceptable es con muestra diluida una vez (1:2) es de 0.26 a 0.75 mS/cm por dilución y de 1.0 a 2.6 mS/cm con método por filtración, el rango de pH optimo es de pH 5.4 a 6.2.

Introducción

El material fibroso encontrado entre la cáscara interna dura y la cáscara externa del coco su usa por varias aplicaciones. Los cocos maduros tienen una fibra marrón espesa y fuerte, que se utiliza normalmente en relleno de tapicería, saqueo para la horticultura. Los cocos verdes tienen una fibra fina, blanca o marrón claro, que se utiliza en la producción de productos para el doméstico, tales como esteras, cepillos, cuerdas y redes de pesca. Para cosechar esta fibra tradicionalmente, las cáscaras fibrosas son remojadas con agua dulce o agua de mar para ablandar las fibras antes de la extracción.

La fibra de coco marrón se ha convertido en popular sustrato de crecimiento o medio de cultivo en horticultura en razón de su alto contenido de lignina, que dura mucho tiempo, aguarda bien el agua, y no se encoge cuando está seco permitiendo una rehidratación fácil. La mayoría de la fibra de coco disponible comercialmente se lava para eliminar las concentraciones altas de sodio y potasio

Después de lavar, algunos proveedores tratan la fibra con solución de calcio para ajustar su capacidad de intercambio catiónico (se refiere a la capacidad del sustrato a absorber y liberar cationes cargados positivamente, de esta manera proteger el substrato contra cambios bruscos de pH o de concentración de nutrientes).

Tener una fibra de buena calidad es esencial para lograr un crecimiento óptimo para sus cultivos. Para determinar si la fibra de coco que usted compró es adecuada para su cultivo se puede medir el pH y la conductividad antes de usarlo.

Los medidores de pH y de conductividad LAQUAtwin permiten una medición directa de muestras aun micro-volumen en pocos segundos. Estos medidores a prueba de agua son programados con función de calibración automática y compensación de temperatura para asegurar una medición precisa. Ambos medidores se decline en tres modelos diferentes y cada uno viene con dos soluciones de calibración.

Método

Calibra el medidor de pH y de conductividad LAQUAtwin siguiendo las instrucciones del fabricante usando por lo menos dos soluciones de calibración para encerrar el valor esperado.

Preparación de la muestra y medición
Dos métodos descritos abajo

Método con dilución (1:2)

1) Pone 1 parte de fibra de coco con 2 partes de agua deionizada (pH neutral, sin mineral) en un vaso limpio. Por ejemplo, 50 g de fibra con 100 de agua deionizada.
2) Mesclar y dejar la muestra descansar 30 minutos.
3) Poner la muestra en embudo con conteniendo un papel filtrante.
4) Recoger el extracto en un vaso limpio, mesclar otra vez and poner unas gotas de muestra en el sensor de los medidores de pH y conductividad.

Método por filtración

5) Pone una vaso debajo de la muestra de fibra de coco y pone 100ml de agua deionizada.

6) Recoger 50ml del liquidó obtenido, mezclarlo y poner unas gotas sobre el sensor de los medidores de conductividad y pH después de calibrarlos.

Referirse a los consejos técnicos *01 LAQUAtwin pH Sensor Maintenance Procedures and Technical Tip 03 LAQUAtwin Conductivity Sensor Maintenance Procedures for conditioning, cleaning, and storing the sensors*. Estos consejos se pueden descargar en la parte *support* en el sitio www.horiba-

Resultado y Beneficios

Los sustratos y medios de cultivo sirven como un entorno para el sistema de raíces de una planta para crecer y funcionar. Las propiedades químicas del sustrato, tal como el pH y la conductividad, deben ser adecuadas para el cultivo que desea cultivar. Cada cultivo tiene valores de pH y conductividad específicos por el sustrato para lograr un crecimiento óptimo.

El pH afecta la cantidad de nutrientes disponibles para las plantas y todos están fácilmente disponibles a un pH de 5,4 a 6,2. La conductividad indica la cuantidad de nutrientes o de sal (salinidad) que afectan el desarrollo y la salud de la planta. El rango de conductividad del sustrato adecuados para plántulas, plantas de lecho y plantas sensibles a la sal es de 0.26 a 0.75 mS / cm con método por dilución y de 1.0 a 2.6 mS / cm con un método por filtración.
A medida que su cultivo crece, mide los valores de pH y conductividad del sustrato cada 2 a 3 semanas tomando la muestra de manera aleatoria porque su valor puede cambiar con el tiempo. En este caso, el método por dilución requiere tomar la muestra en la parte inferior de la maceta. Esto perturba las raíces y se debe tener cuidado. El método por filtración, permite de medir toda la fibra sin molestarla las raíces, pero los resultados son variables. Elije un método de muestreo y úselo a través de su programa de monitoreo.

Referencia y lecturas sugeridas

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Medidores de bolsillo de conductividad HORIBA LAQUAtwin

Características

Medición de conductividad y Solidos Totales Disueltos (TDS). Adjuste automático de rango y compensación de temperatura para análisis de alta precisión.

Aplicaciones

Agua dulce, acuario, suelo, contaminación del agua con sal, contaminación de superficie antes de la aplicación del revestimiento.

Medidores de bolsillo de pH HORIBA LAQUAtwin

Características

Sensor de pH plano con compensación de temperatura ofrece mediciones rápidas y confiables directamente a partir micromuestras de 100 µl.

Aplicaciones

Análisis de aguas dulces (lluvia, ríos, lagos, manantiales), acuarios, aguas residuales, análisis del suelo para una agricultura mejorada, análisis de la frescura de los alimentos. Fermentación y elaboración de la cerveza, laboratorios de investigación, controles de calidad de productos médicos y cosméticos, odontología preventiva, educación escolar, etc.

Rango de medidores de bolsillo HORIBA LAQUAtwin

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HORIBA LAQUAtwin pH COND Na^+ K^+ NO_3^- Ca^{2+} Salt

Application Note

03-2017

Quick Nutrient Analysis in Strawberry Production

Regular monitoring of nutrient levels such as nitrate (NO_3^-), potassium (K^+) and calcium (Ca^{2+}) in plant petioles, soil solution, irrigation water, and drain water produces not only good yield and fruit quality, but also reduces fertilizer cost and mitigates environmental hazards. The LAQUAtwin pocket meters are the perfect tools for testing as they directly measure samples and provide results in just few seconds, allowing growers to identify and correct any nutrient deficiency or excess immediately.

Introduction

Strawberry production requires a root environment with good availability of essential nutrients to achieve optimum plant growth, fruit quality, and yield. Soil pH influences the availability of nutrients such as nitrate (NO_3^-), potassium (K^+) and calcium (Ca^{2+}) ions, which have specific roles in strawberry fruit quality - NO_3^- determines the size, K^+ influences the taste, and Ca^{2+} affects the firmness. The nutrients should be present in a right balance to avoid competition or improper plant uptake. Aside from maintaining the correct soil pH for nutrient availability, the conductivity should also be closely and frequently monitored, as strawberry plants do not tolerate high conductivity value.

Plant sap analysis has been used by growers to manage crop nutrient content and fertilization strategies. A plant sap test gives a view of the nutrients available for the plant, at that time, for growth or development. It directly shows if a crop suffers from a nutrient deficiency or an excess. Soil solution analysis is also important for growers. It gives a view of the nutrient and salinity levels in the soil and nutrient leaching past the root zone. Soil solution is the water held in the soil, which contains a mixture of nutrients taken up by roots.

HORIBA offers LAQUAtwin pocket meters which provide reliable and accurate results for plant sap and soil testing parameters such as pH, conductivity (EC), nitrate (NO_3^-) / nitrate-nitrogen (NO_3-N), potassium (K^+), calcium (Ca^{2+}) and sodium (Na^+). Several research studies have proven that results obtained with LAQUAtwin pocket meters are strongly correlated with those of traditional laboratory analyses. With their unique and compact design, the LAQUAtwin pocket meters allow direct measurement of micro-volume sample (as low as 0.1ml) and deliver results in just a few seconds. These advantages enable growers to make fertilization and irrigation decisions quickly.

Method

Calibrate the LAQUAtwin pocket meters according to manufacturer's instructions.

A. Plant Sap Analysis

For sampling, it is critical to always follow the same protocol and collect the correct tissue in order to get consistent and reliable results. The most recent mature trifoliate leaf is the best indicator of the most essential nutrients for plant growth (e.g., P, K, Ca, etc.) and the petiole from this leaf is the best indicator of NO_3-N. Plant temperature should be within 20 to 25°C.

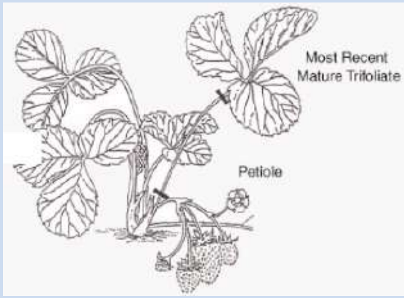

Figure 1: Proper leaf and petiole samples ensure reliable results.

Source: Casteel, S. (2004). Strawberry Fertility and Nutrient Management.

1. Collect 2 most recent mature trifoliate leaves and the associated petioles from 20 different strawberry plants to get a representative sample. The petiole must be detached from the plant near the crown.

2. Separate the petioles from the leaves and cut them into small pieces.

3. Load the small pieces of petioles into a garlic press or hydraulic sap press and squeeze them to extract sap.

Continued at the back

Continued from the front

4. Place the sap directly onto the respective sensors of LAQUAtwin nitrate and potassium pocket meters.

5. Compare the results with the reference values in Table 1 to evaluate the current nutritional condition of the plants and implement the best course of action.

6. Rinse the sensors with clean water before testing another sample or storing them.

Table 1: Reference Nutrient Levels for Petiole Sap in Strawberry Cultivation

Days after sowing	NO_3-N	P	K
	ppm		
30	500 – 700	150 – 350	4000 – 5000
60	550 – 750	150 – 350	4000 – 4500
90	400 – 600	150 – 350	4000 – 5000
110	500 – 300	150 – 350	4000 – 5000

Source: Carlos Cadahia, Ediciones Mundi-Prensa. La Savia como índice de fertilización, 2008, page 246

B. Soil Solution Analysis

Soil solution for pH, salinity (usually reported as conductivity), and nutrient analysis can be extracted through lysimeters installed in the field – at 15-20cm depth, where strawberries have the bulk of their roots and at 50-60cm depth below most of the roots. Lysimeters are installed under vacuum pressure and pull water from the soil similar to the root of the plant. To extract suitable samples, the soil must have been recently wetted with rainfall or irrigation water.

1. Place the sample of extracted soil solution directly onto the respective sensors of LAQUAtwin pH, conductivity, sodium, nitrate, potassium, and calcium meters.

2. Record the results and monitor the nutrients on a weekly basis.

3. Rinse the sensors with clean water before testing another sample or storing them.

Results should be interpreted by comparing trends from season-to-season and block-to-block with strawberry performance indicators such as yield and fruit quality. Irrigation and drain water can also be analysed directly with LAQUAtwin pocket meters.

Strawberries have salt tolerance threshold of 1.0 mS/cm and will grow best in soil pH range of 5.5 to 6.5.

Results and Benefits

Plant sap analysis provides information on the current nutritional status of the plant. This information makes it possible to fine-tune N application, to maximize yield and quality, and to extend the fruiting season. The plant sap analysis complements soil solution analysis.

Soil solution analysis can help growers make decisions about their irrigation and nutrient management program. It should be used to enhance nutrient management and not as a measure of overall soil nutrient status. Nitrate and salinity levels are the key focus of soil solution monitoring. As nitrate is a highly mobile nutrient, soil solution can help identify incorrect nitrogen application, which could result in nitrate accumulation within the root zone and nitrate leaching below the root zone. Potassium and calcium are bound to soil and their levels in soil solution do not provide a reliable indication of their supply and availability to the crop. However, potassium, calcium, and sodium levels in soil, irrigation water, and drain water should be checked regularly. Salinity levels measured in soil solution allow growers to perform corrective action (e.g., increase irrigation to maintain salinity levels) before symptoms appear on leaves, yields or crop quality. Overwatering leaches fertilizer out of the root zone and results in environmental hazard (e.g., groundwater contamination). Soil solution analysis can be tested throughout the growing season.

References and Suggested Readings

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Revision 1.0, 6 March 2017

Figure 2: Cutting of petioles into small pieces.

Figure 3: Loading of petioles into the chamber of garlic press for sap extraction.

Figure 4: Placing sap directly onto LAQUAtwin nitrate sensor.

Figure 5: pH and conductivity testing on soil solution.

Figure 6: Irrigation wáter testing with LAQUAtwin pocket meters.

LAQUAtwin Pocket Ion Meters Lineup

pH COND / TDS Na^+ K^+ NO_3^- Ca^{2+} Salt EC

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