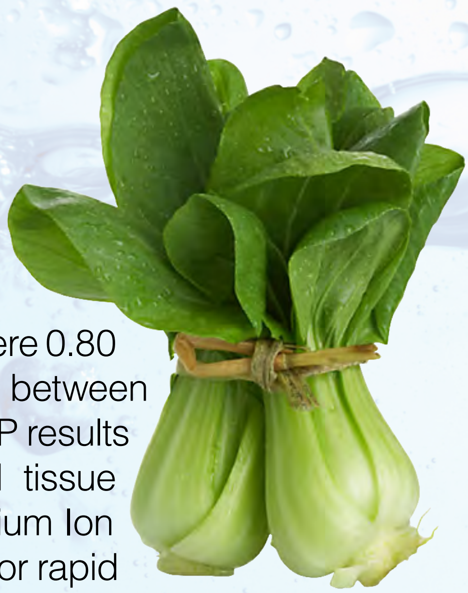
HORIBA

LAQUAtwin K+

Potassium Determination In Plant Tissue

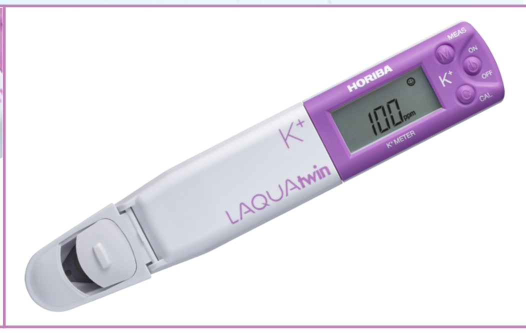
Comparison of LAQUAtwin Potassium Ion Meter and ICP Spectrometry

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.



Application Note

04-2015



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.

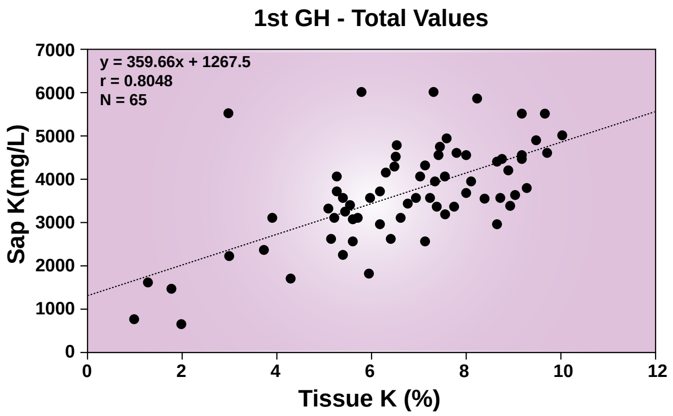


Figure 1: Relationship between K concentrations in fresh petiole sap and dried tissue of pak choi plant measured by LAQUAtwin Potassium Ion meter and ICP Spectrometry respectively for 1st greenhouse trial (n= 65)

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Continued from the front

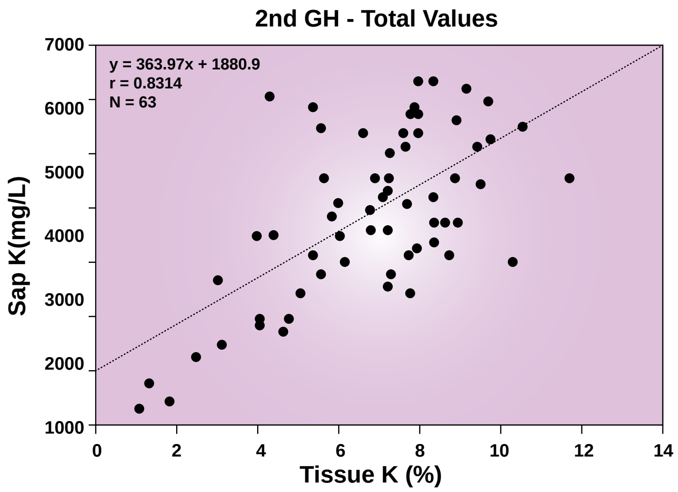

Figure 2: Relationship between K concentrations in fresh petiole sap and dried tissue of pak choi plant measured by LAQUAtwin Potassium Ion meter and ICP Spectrometry respectively for 2nd greenhouse trial (n= 63)

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

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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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