Cornell University
College of Agriculture and Life Sciences

New York Berry News

Volume 11, Number 8b August 15, 2012

Leaf and Soil Analysis Special Edition

Commercial berry growers in the Northeast have traditionally made standardized fertilizer applications based on crop age. This practice continues today, some 10 years or more after commercial berry crop guidelines for analysis-based fertilization programs became widely available. Adoption of soil health improving practices by berry growers has also been slow.

Research demonstrates an analysis-based approach to berry crop nutrition provides increased yields along with better fruit quality and plant health. Use of soil health management practices (i.e. cover cropping) has been shown to reduce weed, nematode and soil-borne disease pressure, along with improving soil tilth, organic matter and nutrient content. Rising costs of products and concerns about environmental impacts of fertilizers make a whole farm approach to berry crop nutrient and soil management highly desirable.

So where do you start when it comes to developing a whole farm approach to berry crop soil and nutrient management? Begin by making leaf and soil analysis a part of your management tool box for existing plantings. Now is the time for leaf analysis; consider including a basic soil test if you haven't done one in the past or it's been a couple of years. More information, sampling instructions and forms follow below, along with articles on interpreting your test results.

Establishing a new planting? Consider using the Cornell soil health test prior to planting to identify any soil health constraints and develop a plan to improve soil health prior to plant establishment. More information: http://soilhealth.cals.cornell.edu/.

Need help understanding your test results? Contact your local CCE office or call Cathy Heidenreich, 315-787-2367.

Want to learn more on berry soil and nutrient management? View an in-depth series of 12 recorded webinars on the topic here: http://www.fruit.cornell.edu/berry/production/soilnutrientmgmt/webinararchive.html.

Late Summer is the Time for Leaf Analysis - *Marvin Pritts and Cathy Heidenreich, Dept. of Horticulture, Cornell University, Ithaca, NY*

Are you wasting money on fertilizer your berries don't need? Or losing money by not applying fertilizer when they do need it? How do you know?

Why Leaf Analysis is Important

Plant tissue analysis is used to measure directly the amount of nutrients in various plant parts, and for established perennial crops, is usually a better indicator of nutrient status than a soil test. Recommendations are based on the levels of 13 essential nutrients in your leaves at a specific time of the year (usually mid-summer).

Unlike visual diagnoses, foliar nutrient analysis can alert the grower when nutrient levels are approaching deficiency so corrective action can be taken before problems occur. They also alert the grower if fertilizer is being over-applied. Unlike soil tests, foliar analysis provides accurate results for all essential mineral nutrients, not just for the 4 or 5 reported in soil tests.

Many nutrients can be applied in fall, and the recommendations will provide details on when to apply particular nutrient fertilizers and in what quantities.

Do I Need a Soil Test to Accompany the Leaf Analysis?

It is not required, but it is helpful. Regardless, it is critical that the soil pH is in the correct range for the foliar analysis results to have meaning.

When and How Do I Collect the Leaf Samples?

Other sampling times or plant parts may prove to be more appropriate for certain nutrients, but until more detailed studies are done, foliar samples collected in mid-summer are the standard because nutrient levels fluctuate little then.

For strawberries, recommendations are based on newly expanded leaves collected after renovation in late July or early August. For raspberries and blackberries, select fully expanded primocane leaves in early August. For blueberries, select young newly matured leaves exposed to full sun in late July. **Want to learn more?** Watch a video of berry leaf sampling:

Collect at least 50 leaves from across the planting. Samples should be representative of the entire field. If a particular area of the field looks poor or has been fertilized differently from the rest, sample it separately.

I have the Leaves, Now What?

Remove petioles, and wash leaves in distilled water. Dry them, place them in a paper bag, and send them to the laboratory for analysis. If leaves cannot be washed immediately after collection, store them in a refrigerator or cooler until they may be processed; they should not be allowed to wilt prior to washing.

Once leaves are dry, place in sample bags; label bags appropriately. Fill out the form completely and use the proper crop code from the chart provided. Be sure to indicate on the test submission form that the recommendations requested are for an established planting.

Agro-One provides soil and nutrient testing services previously available through the Cornell Nutrient Analysis Laboratory along with additional analytical services. Key input regarding analytical methods and quality control is provided by Cornell, and Cornell nutrient management guidelines are provided by Cornell through Agro-One.

A leaf analysis, including nitrogen, costs $24. A basic soil test, with a water soluble boron test added, costs $22. Results should return from the lab within 10 - 14 days.

To obtain basic soil test and leaf analysis sampling instructions and sample boxes/bags contact: Agro-One–Dairy One, 730 Warren Road, Ithaca, NY 14850 or calling 1-800-344-2697, or visiting http://www.dairyone.com/AgroOne/.

In Conclusion

Conduct a foliar tissue analysis every other year. Monitor soil pH regularly, and do a basic soil test every three years. Remember, the leaf analysis is accurate only if the soil pH is within an acceptable range (5.5 - 7.0 for raspberries and strawberries; 4.0 - 5.0 for blueberries). Always be alert for any unusual appearance of leaves, and for unexplained reductions in growth or yield.

Want to learn more? Watch a recorded webinar on berry crop soil and leaf analysis: Berry Soil and Nutrient Management – The Basics

---

Questions or comments about the New York Berry News?

Ms. Cathy Heidenreich, Cornell University Dept. of Horticulture, 630 W. North Street, Geneva, NY 14456

Phone: 315-787-2367 *Email*: mcm4@cornell.edu

Dairy One

Cornell University
College of Agriculture and Life Sciences

Agro-One Soils Laboratory

Instructions for leaf sample collection from Vineyards, Small Fruit and Tree Fruit pt062811jbf

SMALL FRUIT

1. Time to sample.

***Strawberries*:** Sample the first fully expanded leaves after renovation or within the first 6 weeks after harvest.
***Raspberries*:** Sample healthy leaves on non-fruiting canes between August 1st and 20th.
***Blueberries*:** Sample healthy leaves between July 1st and August 30th.

2. What to sample.

Sample healthy leaves that are well exposed to light. These should represent the average condition of the planting and should not be damaged by: disease; insects; weather or mechanical injury.

AVOID mixing leaves from different cultivars.
DO NOT mix leaves from plants of different ages.

A minimum of 50 grams (~ 2 oz) fresh weight from a minimum of 30 leaves are needed per sample. If possible, each leaf should be taken from a different plant within the sampled area. Since an accurate recommendation is dependant upon a pH reading, we strongly suggest that you test the pH at this time and record it on the appropriate line of the information sheet.

Plants sampled should represent the average condition within the planting unless samples are being taken to determine cause(s) of a distinct problem or condition.

3. Soil conditions, past fertilizer practices and spray program.

Soil conditions, past fertilizer practices and spray program should be uniform (similar) over the entire sample area. If any of these conditions differ in different parts of the planting, it will be necessary to sample these areas separately.

4. Collecting and handling samples.

Detach leaves and remove the petioles. Place leaves in a dry paper bag or perforated plastic bag and immediately label the bag so that you will know the area this sample represents. Wash the leaves before they wilt to remove spray residues and dirt. Gently rub the leaves together in a mild detergent solution (dish washing detergent in tap water). See **Washing leaf samples** below for washing instructions**.** Place sample into dry paper bag with the top open and let dry at room temperature until the leaves are brittle.

5. Submission Form.

Fill out the information sheet and work sheet completely. Keep the work sheet for your own records to aid in interpretation at a later date. Be sure that the leaf sample bag and the information sheet are marked with the same ID#.

6. Packaging, payment, and mailing instructions.

The 180 Package cost per sample is $24. It includes Total N, P, K, Ca, Mg, Zn, Cu, Fe, B and Mn.

Please make check or money order payable to**:** Dairy One, 730 Warren Road, Ithaca NY 14850

7. Washing leaf samples.

Wash the leaf samples while still fresh, **before they wilt**. If a large number of samples need to be prepared, they may be stored overnight in a cold storage, refrigerator or ice chest to keep them drying out.

Use distilled water, available at most drug stores, for washing and rinsing the samples. Change the water if it becomes dirty **or** after 8 to 10 samples (whichever occurs first). **Gently** and **lightly** scrub the leaves together in distilled water.

Shake to remove excess water and immediately rinse the sample in clean distilled water. Again shake to remove excess water and immediately rinse the sample in clean distilled water. Again shake to remove excess water. Transfer sample to paper bag, with top open and dry at room temperature until the leaves are brittle.

NOTE: DO NOT let leaves to stand in water – complete the washing and rinsing process in one minute or less.

Additional submission forms for download are available on our website: www.dairyone.com

Dairy One

Cornell University
College of Agriculture and Life Sciences

P

P 091311 jbf

Agro-One Soils Laboratory

730 Warren Road, Ithaca, NY 14850 • Ph:800-344-2697 ext. 2179 • Fax: 607-257-1350
Email: soils@dairyone.com • Web: www.dairyone.com
Nutrient Guidelines provided by Cornell University

Plant Tissue Analysis Tree Fruit, Small Fruit and Vineyards (180) - $24 per sample (includes Total N, P, K, Ca, Mg, Zn, Cu, Fe, B, Mn)

Customer & Billing Information (Required) - Name and address information on front. Use front for a single sample and reverse side for multiple samples.

CUSTOMER NAME	COMPANY / CORNELL COOPERATIVE EXT. OFFICE / EDUCATOR
STREET	STREET
CITY STATE ZIP COUNTY (required)	CITY STATE ZIP COUNTY (required
FAX / EMAIL RESULTS TO:	FAX / EMAIL RESULTS TO:

For prompt processing enclose a check payable to Dairy One, credit card information or valid Agro-One account number

Payment by Check

Amt $ _____ Check No. _____

Bill to Agro-One Account No. _____

Payment by Credit Card [ ] Visa [ ] Mastercard [ ] American Express

Card Number: _____ Expiration Date: _____

Signature: _____ 3-digit verification code: ____ ____ ____

(located on back of card)

Sample Information (Required for lab use)

Leaf sample No. _____ Date Sampled: _____

Field Name / No. _____ Collected by. _____

If soil sample submitted for this area:

Topsoil sample ID No. _____

Subsoil sample ID No. _____

Crop Information (Required for lab use)

Crop Code: _____

Check one:
[ ] Fresh market
[ ] Processing

This sample represents: (check one)
[ ] An average condition
[ ] A problem area

Apples Only

Variety: _____

[ ] Hard [ ] Soft

Age of Planting: (check one)
[ ] 1-3 yrs [ ] 4-7 yrs
[ ] >8 yrs

Crop Codes for Fruit **** NOTE A MINIMUM 50 GRAMS FRESH WEIGHT IS REQUIRED***

Code	Crop	Code	Crop	Code	Crop
APP	Apple	ELD	Elderberry	PAR	Pear
ACT	Apricot	GOO	Gooseberry	PCH	Peach
BKB	Blackberry	GPA	Grape – American	PLM	Plum
BLB	Blueberry	GPF	Grape – French American	PRN	Prune
CHS	Cherry – Sweet	GPV	Grape Vinifera	RSS	Raspberry – Spring
CHT	Cherry – Tart	NEC	Nectarine	RSF	Raspberry – Fall
CUR	Currents	NUR	Nursery	STS	Strawberry – Spring
* Recommendations not available for NUR code at this time.				STE	Strawberry - Everbearin

Soil Name if known:

Soil pH if known:

Sampled area (acres)

Soil Texture (check one)

[ ] Sandy [ ] Gravelly

[ ] Clay [ ] Loam

Soil Drainage (check one)

[ ] Very Good [ ] Fair

[ ] Good [ ] Poor

Comments:

Agro-One Soils Laboratory • 730 Warren Road, Ithaca, NY 14850 • Ph:800-344-2697 ext. 2179 • Fax: 607-257-1350
Email: soils@dairyone.com • Web: www.dairyone.com

Form P2 – Plant Tissue Analysis Multiple Sample Input Sheet (to Accompany Form P)

Farm Name

Dairy One

Cornell University
College of Agriculture and Life Sciences

Account No.

GENERAL INFORMATION				CROP	APPLES ONLY			MARKET TYPE		SOIL INFORMATION – For your records only		
Lab ID For lab use only	**Sample ID** Ie. Leaf or Field ID. (Should match ID on sample bag)	**Date Taken**	**Sampled By**	**Code** See list on Form P	**Variety** (see list on www.agro-on.com/)	Type: 1 = hard 2 = soft	**AGE** 1 = 1-3 yrs 2 = 4-7 yrs 3 = >8 yrs	1 = fresh 2 = processing	**Rec's Requested** Y / N	**Soil Name**	**Texture** 1 = Sandy 2 = Gravel 3 = Clay 4 = Loam	**Drainage** 1 = Very Good 2 = Good 3 = Fair 4 = Poor

Standard Foliar Nutrient Ranges

	Strawberries		Raspberries		Blueberries	
Nutrient	**Deficient below**	**Sufficient**	**Deficient below**	**Sufficient**	**Deficient below**	**Sufficient**
Nitrogen	1.9%	2.0 - 2.8 %	1.9%	2.0 - 2.8%	1.7%	1.7 - 2.1%
Phosphorus	0.2	0.25 - 0.4	0.2	0.25 - 0.4	0.08	0.1 - 0.4
Potassium	1.3	1.5 - 2.5	1.3	1.5 - 2.5	0.35	0.4 - 0.65
Calcium	0.5	0.7 -1.7	0.5	0.6 - 2.0	0.13	0.3 - 0.8
Magnesium	0.25	0.3 - 0.5	0.25	0.6 - 0.9	0.1	0.15 - 0.3
Boron	23	30 -70 ppm	23	30 - 70 ppm	20	30 - 70 ppm
Manganese	35	50 - 200	35	50 - 200	25	50 - 350
Iron	40	60 - 250	40	60 - 250	60	60 - 200
Copper	3	6 - 20	3	6 - 20	5	5 - 20
Zinc	10	20 - 50	10	20 - 50	8	8 - 30

Dairy One
730 Warren Road Ithaca NY
14850 1-800-344-2697 x 2172
www.dairyone.com

How to take a soil sample

Taking a representative soil sample is a needed to determine lime and fertilizer requirements and avoid costly over or under fertilization. Follow the guidelines below to help ensure the best results.

Order Your Soil Test Supplies

There are 3 ways to order soil sample boxes and sample information sheets:

- Call 1-800-344-2697 ext. 2172
- Email supply@dairyone.com. Be sure to include your account number and/or name, street address and daytime phone number plus items and quantity needed. Specify the type of sample information sheet needed.
- Directly from our website http://www.dairyone.com/Forage/OrderSupplies/

Establish a Sampling Schedule

Most soils should be sampled every 2 - 3 years; more often for sandy soils, high value crops or problem areas.

To avoid seasonal variation, try to sample at the same time every year for a given field or garden. Fall is generally considered to be the most reliable time to pull samples, especially when it comes to pH. Soil pH fluctuates and tends to be lower in the summer when temperatures are higher and soils are dryer. When soils dry out, salt concentrations increase allowing Ca^{++}, Mg^{++}, K^{+} to replace H^{+} and Al^{+++} on the soil surface. The extra H^{+} and Al^{+++} in the soil solution will temporarily decrease soil pH hence pH determination is more reliable in the Fall when soil moisture is a bit higher.

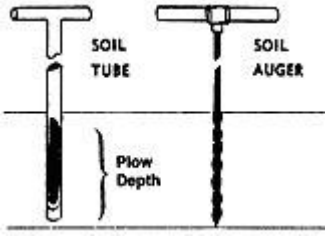
Use the Right Tool

Use tools that are clean and free of rust. Avoid brass or galvanized tools or containers that can contaminate samples with zinc or copper. Stainless steel probes or augers are best because they collect a continuous core through the entire sampling depth with a minimum disturbance of the soil (see Figure 1.). Avoid shovels or trowels.

.

Collect samples in a clean plastic bucket or plastic bag. Avoid collecting or shipping wet samples in plain commercial paper bags or boxes that are often treated with a product containing boron. Wet samples can leach boron out of the paper and contaminate the sample. If possible, send air dried samples in and Agro-One sample box.

Figure 1. Use a stainless steel probe or auger for best results.



Sample at the Proper Depth Based on Tillage

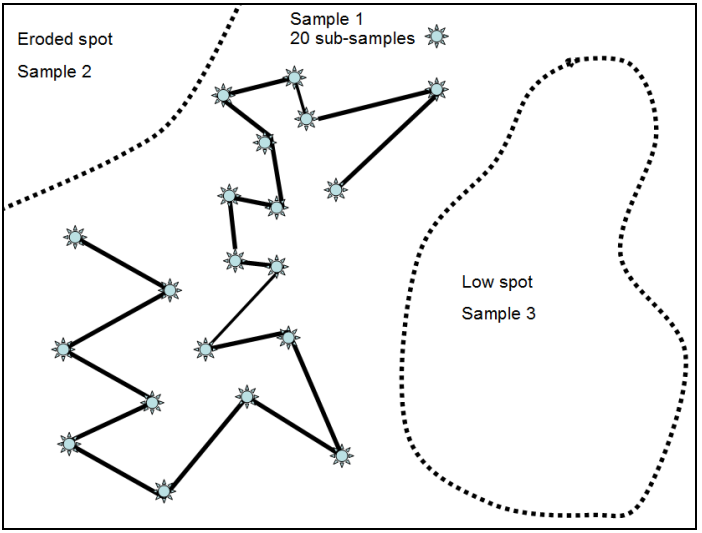
- **Moldboard plow** – surface to tillage depth (usually 6-7 inches).
- **Chisel plow and offset disk** – sample before tillage to ¾ of the tillage depth.
- **Reduced tillage systems** – No Till, Ridge till, Zone Till etc.
  Two Samples may be required. Sample between rows to avoid disturbed soil or fertilizer band.
    - Sample to 6 inch depth for pH and nutrient content.
    - Take a second sample to a 1 inch depth to determine if surface applied N has resulted in an acid layer that can reduce the effectiveness of triazine herbicides.

Identify the Sampling Area

Commercial Field

- Take 15-20 plow depth core sub-samples using a zig-zag pattern in a management area representing < 20 acres (see Figure 2.).
- Avoid unusual areas such as dead furrows, old hedge rows, fence lines, old manure piles, lime piles or burn piles. Avoid wet areas or severely eroded areas.
- Take separate samples from areas within the field that vary widely from the rest of the field in color, slope, soil texture, drainage, productivity or crop history.
- Sample each contour strip separately if it is > 5 acres.
- Mix the 15-20 subsamples completely in a clean plastic bag or plastic bucket.
- Avoid sampling under extremely wet soil conditions. Wet samples usually leak in transit and some nutrients in very wet soils may undergo rapid biological transformations.

Figure 2. Suggested Sampling Pattern in a Commercial Field



Prepare Samples for Shipment.

If possible, spread wet samples in a thin layer on a clean surface and dry at room temperature. Do not use heat but a fan is acceptable to assist in drying. Remove large stones or sticks and break up large lumps or clods before mixing the sample thoroughly.

Complete the required information on the sample box before assembling and make sure that it matches the information on the sample information sheet. Place about ¾ - 1 pint of the mixed sample in the sample box then close it securely.

Fill Out the Sample Information Sheet Completely.

A completed sheet must accompany each sample. Required information includes;

- Customer name, address and contact information.
- Consultant/Extension Educator name, address and contact information
- Method of reporting results – fax, email or US Mail.
- Type of report required – with or without recommendations.
    - All Commercial NY samples must include a valid soil name if results are needed
    - All Home, Garden Landscape NY samples must include soil texture and soil drainage if results are to be reported.
    - All VT samples require soil drainage class if results are to be reported
- Method of payment – Dairy One or Agro One account number, DHIA herd code, credit card information or a check. Results will not be released until payment or billing information has been received.
- Sample information – sample identification, soil name (NY commercial samples), soil drainage & soil texture (NY Home, garden and landscape samples, soil drainage class (VT samples), and other required information should be filled in completely. Recommendations may not be generated if the information sheet is incomplete.
- KEEP A RECORD OF ALL SAMPLES SHIPPED including method and date of shipment. Dried ground samples will be stored at the lab for approximately 4 weeks to allow for additional test requests.
- Maintain records of your soil test results to assist in monitoring changes in soil fertility over time. This may be useful to adjust soil management to meet crop demands without costly over or under application of nutrients.

Ship Your Samples to:
Dairy One
730 Warren Road
Ithaca NY 14850
Phone: 1-800-344-2697 ext. 2172

Samples can be shipped via U.S. Mail, UPS, Fed Ex, DHL, etc. Selecting these carriers will require additional packaging and will incur additional shipping and handling costs. If using the USPS, the flat rate boxes will be your most economical way to ship samples.

In some areas, samples can be left at milk pick-up points by prior arrangement. Where available, samples will be picked up three times a week and delivered to the Dairy One facility in Ithaca the following morning.There is no shipping or handling charge for this service. Complete information on pick-up point locations, procedures and schedules can be found at: http://98.159.209.20/Truck_Stops.html

F

F100511 jbf

Agro-One Soils Laboratory

730 Warren Road, Ithaca NY 14850 • Phone: 800-344-2697 • Fax: 607-257-1350
Email: soil@dairyone.com • Web: www.dairyone.com
Nutrient guidelines provided by Cornell University

Dairy One
Cornell University
College of Agriculture and Life Sciences

Multiple Sample Submission Form for NEW YORK State: Commercial Fruit Crops and Christmas Trees

(855) Modified Morgan Soil Test Package with Cornell Generated Nutrient Guidelines, $12 per sample

Go to http://www.dairyone.com/SoilLaboratories/ForageInfoSoil.pdf for other soil testing services available in NY, PA, VT, NH and MD

Nutrient guidelines will be reported ONLY if a valid soil name is provided.
For soil maps and soil names visit http://websoilsurvey.nrcs.usda.gov/app/

Grower Information:		**Commercial respresentative or CCE Educator:**		**Sample Origin**	
Name:		Name:		County:	
Street:		Street:			
City, ST, ZIP:		City, ST, ZIP:			
Email / Fax:		Email / Fax:			

# samples_____x cost per sample $_____ = Amount Due $_____		Credit Card Check One: [ ] VISA [ ] MasterCard [ ] American Express	3 digit CVC no. (on back of card) ___ ___ ___
[ ] Check payable Dairy One	[ ] Pre-Paid CNAL Bag	Card Number:	
Check No. _____	[ ] Bill Dairy One Account _____	Signature:	Expiration Date ___ ___/___ ___

SOIL INFORMATION

Visit http://websoilsurvey.nrcs.usda.gov/app/ for soil maps & names

LAB ID For Lab Use Only	CNAL Bag No.	**Sample ID Circle paired surface & subsurface samples**	Surface or Sub-surface [1]	Other tests (See Back)	Sample date	**Soil Name** *Required* [2]	Crop Code [3]	**Crop Name or Variety**	**Recommendations for (check one)**		**Maintenance Only Ground Cover?**	
									PRE-PLANT	MAINTENANCE	**Yes**	**No**
LAB USE ONLY												
LAB USE ONLY												
LAB USE ONLY												
LAB USE ONLY												
LAB USE ONLY												
LAB USE ONLY												

[1] **Indicate SR for Surface or SB for Sub-surface sample** [2] **Visit http://websoilsurvey.nrcs.usda.gov/app/ for soil maps & names** [3] **Crop Codes provide on back of this sheet**

GENERAL SOIL TEST INFORMATION

Standard tests and lime requirement are determined on all samples and are included in the analysis fee. Nutrient guidelines will be provided if a valid soil name is included.

The Modified Morgan Soil Test includes:
pH, Modified Mehlich Buffer pH (lime requirement), organic matter and extractable phosphorus (colorimetric), potassium, calcium, magnesium, aluminum, iron, zinc and manganese plus Cornell generated nutrient guidelines if a valid soil name is provided.

Sample Submission Instructions: Place about 1 cup of your well-mixed soil sample into the sample box, close the box and label. For deep rooted tree fruits, a surface (SR) soil sample from the 0 - 8 inch depth and a sub-surface (SB) soil sample from the 8 - 24 inch depth is needed since these crops obtain many of their nutrients from the subsoil. Samples should be sent in separate mailing boxes. Indicate paired surface and subsurface samples on the front of this sheet by circling the paired samples.

Fill out the submission form, fold & submit it with soil samples. Ship to Dairy One, 730 Warren Road, Ithaca NY 14850 by US Mail, UPS, Fed Ex, etc. Go to the Agro-One tab at www.dairyone.com for information about free overnight shipping and handling available in some locations. Results and nutrient guidelines are returned by US Mail, fax or email.

Supplies: Additional forms can be downloaded from www.dairyone.com under the Agro-One tab. Order soil test kits, manure sample kits, forage sample kits and sample sheets at 1-800-344-2697x 2142 or email: supply@dairyone.com

CROP CODES FOR FRUIT CROPS AND TREES

CODE	✔	Requires surface & sub-surface samples at establishment	CODE	✔	Requires surface & sub-surface samples at establishment
APP	✔	Apples	GPV	✔	Grapes, Vinifera
ACT	✔	Apricots	NEC	✔	Nectarines
BKB		Blackberries	NUR	✔	Nursery stock
BLB		Blueberries	PAR	✔	Pears
CHS	✔	Cherries, Sweet	PCH	✔	Peaches
CHT	✔	Cherries, Tart	PLM	✔	Plums
CUR		Currants	PRN	✔	Prunes
ELD		Elderberries	RSF		Raspberries, Fall
GOO		Gooseberries	RSS		Raspberries, Spring
GPA	✔	Grapes, American	STE		Strawberries, Ever bearing
GPF	✔	Grapes, French-American	STS		Strawberries, Spring

MISCELLANEOUS

CODE	CROP NAME	CODE	CROP NAME
TRT	Christmas Tree Topdressing (Maintenance)	IDL	**Idle land -** *Results only. No interpretation or nutrient guidelines provided.*
TRE	Christmas Tree, Establishment (Pre-plant)	OTH	**Other** - *Results only. No interpretation or nutrient guidelines provided.*

OPTIONAL TESTS, Results only. No interpretations will be provided for optional tests. *(Please enclose check for the total cost of all tests requested)*

Test	Cost per sample ($)
(836) pH in 0.01M $CaCl_2$	$5.00
(837) Soluble salts	$5.00
(838) No-till pH (0-1 inch)	$5.00
(861) Nitrate	$6.00
(840) Boron (Hot water)	$10.00

NOTE: Heavy metal and cation exchange capacity (CEC) testing are available through the Cornell Nutrient Analysis Lab (CNAL) Please contact CNAL directly at 1-607-255-4540, soiltest@cornell.edu or http:cnal.cals.cornell.edu

F

F100511 jbf

Cornell University Cooperative Extension

SCNYAG South Central New York Agriculture Team

FRUIT & VEGETABLE PRODUCTION

Schuyler Tompkins Cortland Chemung Tioga

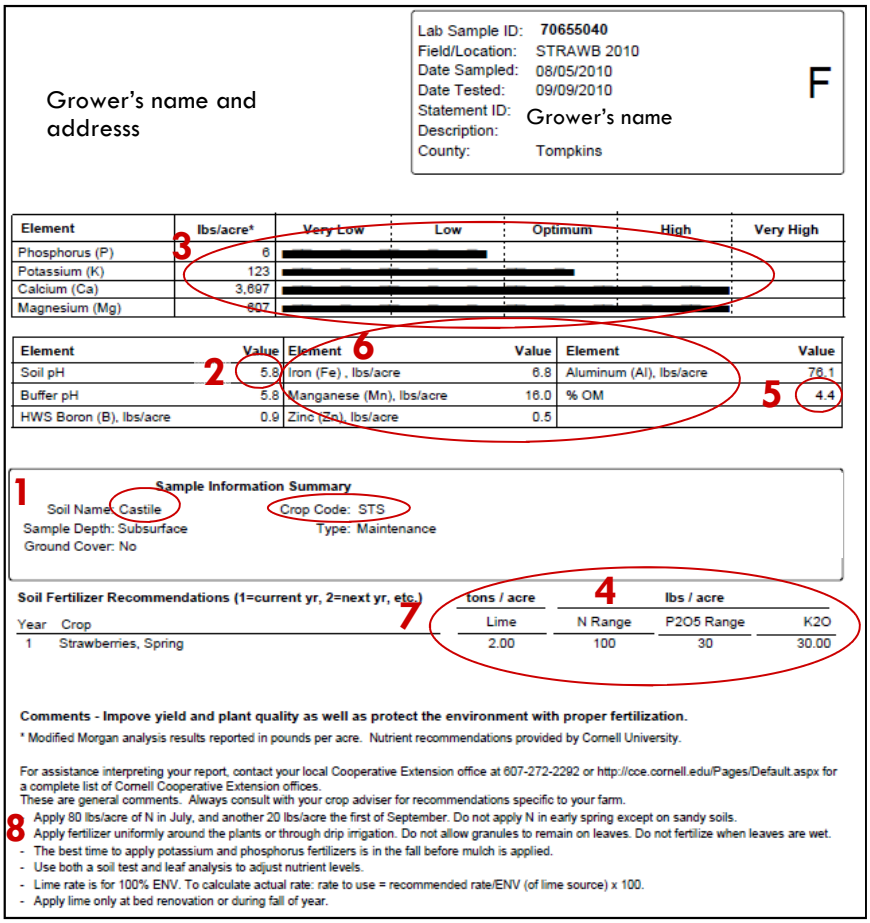
Understand your Agro-One Soil Test Results

1. Check the crop and soil name

Agro-One uses the soil name and cropping plans you report on your submission form to generate fertilizer recommendations specifically for your field, so it's important that they're accurate. Look up your soil's name on the Web Soil Survey, websoilsurvey.nrcs.usda.gov/, and don't leave the future crop plan blank on the form. If you're not sure what you're going to grow, at least list "mixed vegetables" as the upcoming crop. Also remember that the recommendations are only as good as the sample you took in your field. Your sample should be composed of a mixture of at least ten 8-inch soil cores from around the field.

2. Look at the soil pH

pH is a measure of soil acidity and affects the availability of most soil nutrients. For most crops, a pH between 6.0 and 7.0 gives the best nutrient availability. If the pH is too high or too low, adding more fertilizer won't fix the resulting nutrient deficiency. pH must first be corrected by adding lime (to raise pH) or sulfur (to lower pH). Check the fertilizer recommendations to see how much lime to add to your field. pH adjustments take time, up to a year, so amend the soil well in advance.



Grower's name and addresss

Lab Sample ID: 70655040
Field/Location: STRAWB 2010
Date Sampled: 08/05/2010
Date Tested: 09/09/2010
Statement ID: Grower's name
Description:
County: Tompkins

F

Element	lbs/acre*	Very Low	Low	Optimum	High	Very High
Phosphorus (P)	6					
Potassium (K)	123					
Calcium (Ca)	3,697					
Magnesium (Mg)	607					

Element	Value	Element	Value	Element	Value
Soil pH	5.8	Iron (Fe) , lbs/acre	6.8	Aluminum (Al), lbs/acre	76.1
Buffer pH	5.8	Manganese (Mn), lbs/acre	16.0	% OM	4.4
HWS Boron (B), lbs/acre	0.9	Zinc (Zn), lbs/acre	0.5		

Sample Information Summary
Soil Name: Castile
Crop Code: STS
Sample Depth: Subsurface
Type: Maintenance
Ground Cover: No

Soil Fertilizer Recommendations (1=current yr, 2=next yr, etc.)

Year	Crop	tons / acre Lime	lbs / acre N Range	lbs / acre P2O5 Range	lbs / acre K2O
1	Strawberries, Spring	2.00	100	30	30.00

Comments - Impove yield and plant quality as well as protect the environment with proper fertilization.
* Modified Morgan analysis results reported in pounds per acre. Nutrient recommendations provided by Cornell University.

For assistance interpreting your report, contact your local Cooperative Extension office at 607-272-2292 or http://cce.cornell.edu/Pages/Default.aspx for a complete list of Cornell Cooperative Extension offices.
These are general comments. Always consult with your crop adviser for recommendations specific to your farm.
- Apply 80 lbs/acre of N in July, and another 20 lbs/acre the first of September. Do not apply N in early spring except on sandy soils.
- Apply fertilizer uniformly around the plants or through drip irrigation. Do not allow granules to remain on leaves. Do not fertilize when leaves are wet.
- The best time to apply potassium and phosphorus fertilizers is in the fall before mulch is applied.
- Use both a soil test and leaf analysis to adjust nutrient levels.
- Lime rate is for 100% ENV. To calculate actual rate: rate to use = recommended rate/ENV (of lime source) x 100.
- Apply lime only at bed renovation or during fall of year.

pH details

pH can be measured using different methods, but for most samples, "water" extraction most closely mimics what plant roots feel. Calcium chloride is sometimes used to measure pH in very sandy soils, and is available for an extra fee. "Buffer pH" is the measure the lab uses to calculate how much lime your particular soil needs, since heavy soils have more buffering capacity and need more lime to change their pH than sandy soils.

3. Major nutrients: P, K, Ca, and Mg

The soil levels of these nutrients are reported in pounds per acre (lbs/A). If you prefer to use parts per million (ppm), convert by dividing in half (ppm = lb/A ÷ 2). The **relative levels** of the soil nutrients to the right of the lbs/A results are the most important to notice, since the same nutrient lb/A may be high for one soil type or crop while for another it is medium. "High" is considered to be a good level and may not generate a fertilizer recommendation. A "medium" level is considered to be adequate for the short term but nutrient supplementation may be recommended to maintain or build soil test levels for the future. Note that due to differences in extractants and lab procedures, the lbs/A nutrient levels are not comparable between labs. However, the *relative* levels of nutrients (high, medium, or low) should be similar between different labs.

"Morgan" versus "Mod Morgan"

Agro-One will use one of two chemicals to extract the nutrients in your soil sample before they are measured, either "Morgan" solution or "Modified-Morgan" solution. Cornell field crops experts prefer the Morgan solution because it reports P levels that correlate more accurately with recommendation database when soil P is low, allowing for more accurate P fertilizer recommendations for field crops. For fruits, vegetables, lawns and gardens, the more economical Modified Morgan solution will be used because the nutrient recommendations are, in almost all cases, identical to those based on the Morgan test.

Fact sheet prepared in 2011 by Molly Shaw, and reviewed by Steve Reiners (Cornell Veg Crops) and Janet Fallon (Agro-One)

4. Nitrogen: Nitrogen is not routinely reported on soil tests because it cycles quickly between chemical forms (ammonium, nitrate, nitrite, organic N), and is very sensitive to weather changes and leaching. Measuring nitrate-N (using a pre-sidedress nitrogen test) gives a snap-shot of plant-available nitrogen on the day the soil was sampled, but does not predict the season-long nitrogen supply. The nitrogen recommendation at the bottom of the test is the amount of nitrogen normally applied to grow the crop you listed on the submission form. You can reduce the nitrogen application by the amount of N you expect to get from soil organic matter (see sidebar at right) and from previous crops such as legumes. Leaf tests can be used to determine if your fertilizer program is adequate during the season.

Estimating soil-supplied N

You can expect 10-20 lbs of plant-available N to be released during the growing season for each percentage organic matter, depending upon temperature and moisture.

Remember that past cover crops, manures and composts contribute nitrogen.

5. Organic Matter: Though it makes up only a small percentage of the soil, the organic matter (made of molecules that contain carbon) is critical for healthy soil function. High organic matter feeds soil microbes and leads to good soil structure, nutrient cycling and retention, improved water holding capacity, and other perks. Low organic matter means soil organisms are hungry and less active, leading to less nutrient cycling and a structurally degraded soil. How much organic matter a soil is capable of maintaining depends largely on the soil texture (inherent to the soil) and on past tillage (management). Soil organic matter increases, albeit slowly over many years, with compost/manure applications, long term cover crops, and reduced tillage.

Soil Organic Matter (%)

	High	Medium	Low
Sand	> 3.2	2.3-3.2	1.8-2.3
Silt	> 3.3	2.6-3.3	2.2-2.5
Clay	> 4.5	3.2-4.5	2.6-3.1

From Cornell's Soil Health Manual

6. Other nutrients: Na, Al, S, Zn, Mn, Fe, Cu, B, Mo. Agro-One routinely reports only Al, Zn, Mn, and Fe, but does not interpret the results as "high, medium, or low." The other nutrients can be tested upon request, for an additional fee. For fruit crops, the normal soil range for most of these nutrients is unclear, and B is best assessed with a leaf test. For vegetables only Zn and B have established levels. Soil test levels of Fe, Al and Mn are more useful for diagnosing a toxicity problem than for developing fertilizer recommendations. If Mn + Fe + Al = >150 lbs/acre, plant toxicity could result.

Zn and B levels for most vegetable crops (lbs/A)

	High	Medium	Low
Zinc	> 1.0	0.5-1.0	<0.5
Boron	> 0.75	0.35-0.75	< 0.35

7. Fertilizer recommendations: These are generated by the Cornell Recommendations Engine using the major nutrient results at the top of the test. The recommendations are in pounds of nutrient, *not pounds of fertilizer*. For instance, 10-10-10 (N-P-K) fertilizer is only 10% nitrogen by weight, so to apply 100 lbs of nitrogen, you need 100/0.10 = 1000 lbs of fertilizer. In this example you also get 100 lbs of phosphate (P_2O_5) and 100 lbs potash (K_2O), which you may or may not need. Choose nutrient sources that minimize over-applying nutrients that you have in ample supply.

Fertilizing small areas

For areas less than an acre, you can convert the recommendations to fit your needs.

There are 43560 ft²/A

8. Comments: These are important to read, as they will contain nutrient recommendations related to the minor elements, as well as instructions on application timing.

9. Additional tests: Some tests are not routinely done but are available upon request. Soluble Salt level is generally used as a diagnostic tool if road salt injury or high salinity due to fertilizers is suspected. No Till pH focuses on the pH in the top inch of soil, since all nutrients and herbicides are applied to the soil surface. Na, S, Cu, B, and Mo can be requested for an additional fee, see "other nutrients" above.

10. Missing information: If the major nutrient soil test levels chart or the fertilizer recommendations are missing it is because the soil name or this year's crop was missing on your submission form. Call the lab and make the correction so an amended report can be generated.

11. More information: Soil science is complicated and this fact sheet only scratches the surface. For more information, see the Cornell Nutrient Spear Program's extensive fact sheet collection at http://nmsp.cals.cornell.edu/guidelines/factsheets.html

Fact sheet prepared in 2011 by Molly Shaw, and reviewed by Steve Reiners (Cornell Veg Crops) and Janet Fallon (Agro-One)

Cornell University Cooperative Extension
SCNYAG South Central New York Agriculture Team
FRUIT & VEGETABLE PRODUCTION
Schuyler Tompkins Cortland Chemung Tioga

Leaf and soil tests on local berry farms: Lessons from summer 2010

Molly Shaw, CCE South Central NY Agriculture Team

This past summer we sampled soils and leaves for nutrients on many of the local berry farms, and the results taught us quite a few lessons. The highlights are reviewed here.

For perennial crops like berries, the standard recommendations are to assess their fertilizer needs on a yearly basis with leaf tests, and to use soil tests periodically mainly to check the pH. Leaf tests are considered a more accurate view of what the plant has managed to take in than soil tests. The soil represents the "potential bank" of nutrients that the plant *ought* to have access to, while the leaf test tells you what it actually managed to get. We've found that having *both* the soil and leaf test side-by-side is necessary to really tease out what's going on with berry crop nutrients.

How to take a leaf test:
Leaf tests are taken during the main growing season and consist of about 50 leaves. For strawberries, sample the first full-sized leaves regrowing after renovation. For blueberries, take leaves in full sun from the middle of this year's growing shoot during or just after harvest. For raspberries, take the youngest full-sized leaves from primocanes before fruit is formed, in August. If you've used any sprays, you should wash the leaves in a dilute detergent solution, then rinse them with distilled water (use distilled so the water itself isn't adding minerals to the sample). Leaves are then sent to the lab where are dried out and ground up, and analyzed for the nutrient levels they contain. Soil tests can be taken at the same time as leaf tests, or any time the soil isn't frozen.

Reconciling soil and leaf tests

Ideally, the leaf test and the soil test would tell the same story. If the potassium level is low in leaves and also in the soil, simply follow the nutrient recommendations on one of the tests (or average them), and add more potassium in the fertilizer program. Similarly, it's a no-brainer when calcium is low in the leaf test, low in the soil test, and the soil pH is 5.6—add lime according to the soil test and you'll be good to go. **See figure 1.** The complications occur when the soil test and the leaf test seem to be telling a conflicting story.

When soil tests low for a nutrient, yet leaves test normal

There are times when the soil test levels of certain nutrients may be "medium" or even "low," but the leaf test levels of these same nutrients are normal. Normal leaf nutrient levels indicate that the plants are feeling well fed, despite the low soil levels.

First make sure that the leaf levels of the macronutrients (N, P, K, Ca, Mg) and boron are *all* adequate—that one low nutrient isn't the key holding back the rate of plant growth. ("Low" leaf levels of Mn, Cu, and Zn are not so worrisome because we don't have adequate research to determine what leaf level actually limits plant growth—keep reading below.) If leaf testing shows that the plants

Strawberries

Nutrient	Soil (lb/A)	Leaf (%, ppm)
Nitrogen	---------	Normal
Phosphorus	High	Normal
Potassium	High	Normal
Calcium	Low	Low
Magnesium	Medium	Low
Manganese	25.6	Normal
Iron	9	Normal
Copper	-----	Normal
Boron	-----	Normal
Zinc	5.7	Low
pH	5.6	-----
Organic Matter	2.4%	-----

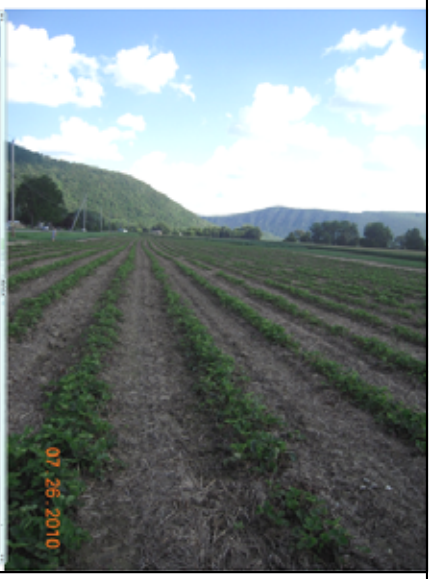


Figure 1: When soil and leaf tests tell the same story:
In these samples, soil test showed low pH, as well as less than adequate soil Ca and Mg. Not surprisingly, leaf Ca and Mg were also low. This grower will add 1.5 tons/acre of dolomitic lime, according to the soil test.

have adequate nutrients and the plants are growing well, no need to worry. Perennials fruits, unlike vegetable crops, can store nutrients within their bodies and have permanent root systems to scavenge in the soil. Believe the leaf test and don't add fertilizer that the plant doesn't need.

If the plants aren't growing vigorously but leaf tests show that the plants are getting adequate nutrients, you should look for something besides nutrients that is holding them back—winter injury, root rots, insect infestation, etc. Cyclamen mites on strawberries have been found to be more wide spread than previously thought, and are probably taking an invisible toll on strawberries yields at many farms. Plants whose growth is slowed by non-nutrient factors can find low soil nutrient levels adequate for their slow growth rate, while if they were growing faster, perhaps these same levels would not sustain their needs. **See figure 2.**

How can you know if your plants are growing "vigorously"? Particularly on the plant vigor end of things, it's hard to tell if your plants are smaller than they ought to be until you see a comparison. I learned a tremendous amount by simply visiting many different berry farms and comparing their plant health and their past management practices. As hard as it is in the height of the season, it's well worth a few hours to check out nearby berry farms.

Strawberries

Nutrient	Soil (lb/A)	Leaf (%, ppm)
Nitrogen	---------	Normal
Phosphorus	Low	Normal
Potassium	High	Normal
Calcium	High	Normal
Magnesium	High	Normal
Manganese	16	Normal
Iron	6.8	Normal
Copper	-----	Normal
Boron	-----	Normal
Zinc	0.5	Normal
pH	6.1	-----
Organic Matter	5.3%	-----

Figure 2: When soil tests low for a nutrient, yet leaf tests are normal: Phosphorus is low in the soil, yet adequate in the leaves—no phosphorus fertilizer is needed. These berries aren't particularly vigorous—in this case I think cyclamen mites are to blame.

Blueberries

Nutrient	Soil (lb/A)	Leaf (%, ppm)
Nitrogen	---------	Normal
Phosphorus	Medium	Normal
Potassium	High	Normal
Calcium	High	Normal
Magnesium	Medium	Normal
Manganese	36	Normal
Iron	28	Low
Copper	-----	Low
Boron	-----	Normal
Zinc	1.2	Low
pH	5.2	-----
Organic Matter	5.3%	-----

Figure 3: Improper pH can make soil nutrients unavailable to plants At 5.2, the pH is a bit too high for blueberries, inducing an iron deficiency. This grower will topdress with 200 lbs of sulfur each spring and fall until the pH comes down closer to 4.5 Adding sulfur faster than this runs the risk of burning plant roots. Two pictures illustrate the classic yellowing between the veins that you see with iron deficiency in blueberries caused not by lack of iron in the soil, but by the soil pH being too high.

When soil tests high for a nutrient, yet leaf test is low

Other times, the soil test can show adequate nutrient levels while one or more nutrients are low in the leaves. In this case, the puzzle is to determine what is preventing the plant from taking up the nutrient in the soil; adding more soil nutrient is not going to fix the problem.

1. Improper pH can make soil nutrients unavailable to plants. The classic example of this happening is when pH is too high for blueberries, leaf iron is usually low. Iron-deficient blueberries will show "interveinal chlorosis," green veins with yellowing between the veins. Blueberries are adapted to a low pH soil (about 4.5), and when pH creeps up two things happen that induce iron deficiency: 1) the higher the pH, the less soil iron is in a chemical form that the plant can use, and 2) within the plant itself, blueberries aren't very good at managing their iron supplies when calcium and nitrate are abundant as they are at higher pH's, so higher levels of Ca and NO_3

interfere with blueberries' use of iron in their leaves. In blueberries, iron deficiency (as shown by the leaf test) is caused by pH being too high, not low iron levels in the soil. The solution is to lower soil pH with sulfur. **See figure 3.**

2. Drought can interfere with plant nutrient uptake. We saw this quite a bit in 2010 with calcium and strawberries. We saw several strawberry fields where pH was fine as were soil calcium levels, but leaf calcium was low. Calcium has to be dissolved in the soil solution to move into plant roots, so when water is scarce, the plant roots can't reach the calcium present in the soil. Same deal with blossom end rot on tomatoes and peppers. In 2010 in central NY we had a dry spell in July, and many times after renovation strawberries got a little neglected on the watering end of things. We saw the same thing with potassium—lack of water was limiting its uptake. The solution is to water after renovation! **See figure 4.**

3. Low boron. Boron is important for plant growing tips, including roots. When it's limiting, roots don't grow adequately and the plant can't reach the other nutrients that are present in the soil. In these cases, you can see adequate soil levels of a nutrient while the leaves still test hungry. Strawberries seem particularly sensitive to low boron, and many of the strawberry fields showed low boron in the leaf tests as well as the soil tests. In these fields, applying boron according to the leaf test will probably fix the other nutrient deficiencies.

Strawberries

Nutrient	Soil (lb/A)	Leaf (%, ppm)
Nitrogen	---------	Normal
Phosphorus	High	Normal
Potassium	High	Low
Calcium	High	Low
Magnesium	High	Normal
Manganese	11.0	Normal
Iron	5.5	Normal
Copper	-----	Low
Boron	0.9	Low
Zinc	0.9	Low
pH	6.2	
Organic Matter	3.9%	

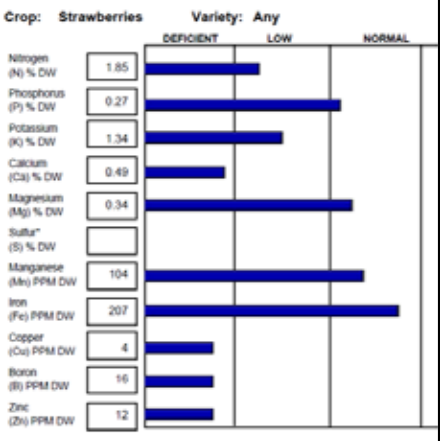


Figure 4: Drought can interfere with plant nutrient uptake
Calcium and Potassium are low in the leaf test although soil levels are fine and pH is good. Low P and K are probably due to drought, though in this case boron is also low, and this could be limiting root growth. This grower will fall fertilize with boron (5 lbs/A solubor) according to the leaf test recommendations. In addition, this farm had been using 15-15-15 to fertilize strawberries, but since soil levels of P and K are high, they can switch to an all-nitrogen fertilizer like urea and save money.

Raspberries

Nutrient	Soil (lb/A)	Leaf (%, ppm)
Nitrogen	---------	Normal
Phosphorus	Medium	Normal
Potassium	High	Low
Calcium	High	Normal
Magnesium	High	Normal
Manganese	27.4	Normal
Iron	2.4	Normal
Copper	-----	Normal
Boron	-----	Normal
Zinc	1.0	Normal
pH	6.2	
Organic Matter	4.9%	

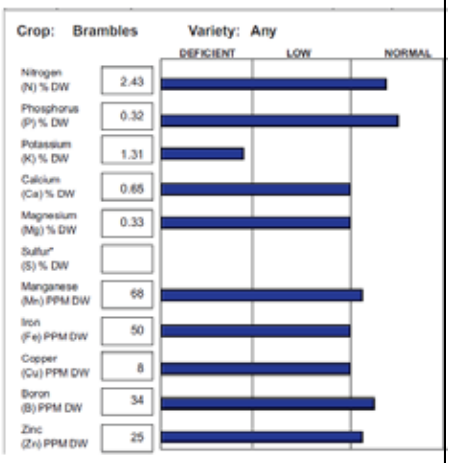


Figure 5: Plants are fruiting and sucking K from plant leaves
Almost all the raspberry leaf samples we took in 2010 had low K in leaves, while soil levels were fine. Leaf samples are supposed to be taken before fruiting, but raspberry fruiting happened earlier than we expected in 2010 because of the warm summer. Developing fruit was pulling K from the leaves at the time of sampling, resulting in low K in the leaves. There is no need to fertilize with K when soil levels are high.

Plants are fruiting. 2010 was a warm year, and raspberry season was advanced. We planned to sample fall-bearing raspberries in mid-August before fruit set, but this year fruiting came early, so we ended up sampling individual primocanes that didn't yet have any berries while other canes on the same plant were beginning to develop fruit. Berries have high K levels, so we see lower K levels in leaves as they feed developing fruit. By sampling a little late, when resources were being put to fruit, we got low K levels in leaves while we had adequate K in the soil. **See figure 5.**

What about micronutrients?

Many of our leaf tests show low zinc and low copper. Soil tests report a number for Cu and Zn, but don't give an interpretation about whether that level is high, medium or low. Marvin Pritts, Cornell Berry specialist, says that research hasn't been done on berries to definitively determine what levels of Cu and Zn limit yield. That would take a study where micronutrient levels were varied and yield responses measured. The "adequate" levels have been determined by sampling extremely healthy plants, noting their micronutrient levels, and assuming that levels lower that those measured were "low". Leaf tests tend to recommend micronutrient applications to bring up levels of zinc and copper, but Marvin suspects that it's not worth the fertilizer investment in most cases. We saw plenty of berry fields in our survey whose leaf tests reported "low" levels of Zn and Cu but which were performing admirably, so at this time we recommend not worrying about reportedly low Zn and Cu levels.

It's worth it to soil and leaf test

Each farm's unique soil/leaf tests provide a different puzzle with different questions to answer. The observations above applied to several farms, and there were other scenarios besides these. Of the 14 local berry farms that did soil/leaf tests this summer, changes is fertilization practices were recommended for 12 of them. A soil test costs about $16, leaf test $24—$40 well spent considering the value of your berry crop!

Many thanks to the NY Berry Growers' Association for partially funding this project.