Agronomic Spotlight

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Watermelon Nutrient Analysis

- Tissue analysis for nutrient levels can help optimize watermelon production.
- Tissue samples need to be collected early enough in the season to allow time for effective treatment.
- Nutritional requirements vary with location, production system, and variety.

Basic nutrient requirements

Other than carbon, hydrogen, and oxygen, plants get most of their elemental nutrients from the soil through their root systems, and soil conditions can have a significant impact on the nutrient availability. Soil nutrient concentrations, soil pH, drainage properties, and compaction all affect the plant's ability to obtain needed nutrients. For watermelons, soil pH levels should be between 6.0 and 6.5.

Nitrogen (N) deficiency is the most common nutrient problem for watermelon production. N deficiencies at any time during the season can affect crop yield and quality, and deficiencies when fruit size ranges from 4- to 6-inches in diameter can be the most damaging. N uptake from the soil is usually low early in the season, before the runner stage. The uptake of N rapidly increases from early runner to 3-inch melon stages, when N uptake reaches its peak. When fruit reach the 6- to 10-inch stage the uptake of N starts to decline, and this decline continues through to the final harvest.[2]

Fertilizer recommendations

Recommended rates of fertilizer for watermelon vary depending on the soil type, the system of production (bare ground vs. plasticulture), planting populations, previous management, and the results of soil nutrient assays. In general, watermelons require between 80 and 120 lb of N per acre, as approximately 4.8 lb of N are removed for each ton of fruit harvested.[1]

Fertilizer (especially N) applications are usually split into pre-plant and post-plant applications. One recommendation is to apply N, phosphorus (P), and postassium (K) at 40:50:50 lb/acre pre-plant or banded at planting, followed by 30:50:50 lb/acre applied as a sidedress or injected during irrigation after planting.[3] Another recommendation calls for pre-plant applications of 40-60 lb N, 0-150 lb P_2O_5, and 0-200 lb K_2O/acre, followed by sidedress applications of N at 45 lb/acre when plants are rapidly vining.[4]

Tissue nutrient analysis

Analyzing plant tissues for nutrient levels is done for several reasons. Results can be used to determine rates of post-plant fertilizer applications, to test for nutrient deficiencies, and to determine rates of fertilizer needed for subsequent crops. Detecting nutrient deficiencies before the appearance of deficiency symptoms helps prevent or minimize reductions in yield and fruit quality. When fertilizers are applied through an irrigation system (fertigation) regular tissue analysis allows for adjustments in fertigation rates.[5]

The appropriate time to collect tissue samples will depend on the purpose of the analysis. For in-season corrections, detecting deficiencies early in the season is better, as any corrective applications will have time to be effective. Late season applications have little effect on yield and quality.[5] Because watermelon plants have low rates of N uptake early in the season, tissue collection for analysis should begin when plants reach the 3- to 4-leaf stage.[2]

For many crops, the leaf is the standard reference tissue used to determine nutrient status, but it depends on where the samples will be sent for analysis and the tissue used to develop the reference information. For watermelons, petioles are commonly used for analysis.[5] For most nutrient tests, tissue from the most recently matured leaf provides the best indication of a plants nutrient status. These are leaves that have changed from lighter-green to a mature dark-green color, and the leaves have reached the fully expanded size. For elements that are relatively immobile in the plant [calcium (Ca), boron (B), and copper (Cu)], tissues from younger leaves are better indicators of deficiencies.

Collect whole leaves or petioles without including any stem or root tissues. Collect tissues of the same physiological age and position (most recently matured). If sampling from very young plants, the whole above-ground part of the plant can be collected. Samples should consist of 25 to 100 leaves (or petioles), with larger samples providing more accurate estimates of the average plant nutrient status. Avoid

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collecting from plants damaged by disease, insects, chemicals, etc. Samples contaminated with soil, dust, or pesticide residue should be briefly washed and rinsed with distilled (not tap) water and blotted dry before sending to the lab for analysis.[5]

If test results will be used to diagnose nutrient deficiency symptoms, collect one sample (25 to 100 petioles) from the affected/symptomatic plants and another sample from healthy, normal looking plants. Keep the samples separate, and label them properly to avoid mixing up the results.[5]

Samples should be stored in a cool, dry place until they can be shipped to the testing laboratory and sent as soon as possible. Air dry samples for several hours before shipping. If not using shipping materials supplied by the lab, wrap samples in dry paper towel and place them in a large paper envelope. Do not put them in a plastic bag. It is best to collect and ship samples early in the week so that samples do not sit in a shipping facility over the weekend.[5]

INTERPRETING THE RESULTS

Different labs can use different analytical methods for evaluating nutrient content. Some tests are based on dry-ash or acid digested samples. The values returned from these different assays may use different units of measure and not be directly comparable. Growers should select labs that offer assays intended for agricultural purposes, and the labs should indicate the types of assays used as well as the accuracy and precision of their tests. There are quick tests based on plant sap samples that can be done in the field. Sap-based assays may be faster and less expensive but are usually not as accurate or precise as the whole tissue assays. The sap based assays are most useful for evaluating levels of N, P, and K.[5]

TABLE 1. DEFICIENCY VALUES, ADEQUATE RANGES, AND HIGH VALUES FOR MACRONUTRIENTS IN WATERMELON MOST-RECENTLY -MATURED, WHOLE LEAF PLUS PETIOLE SAMPLES AT FIRST FLOWER.[4]

	% Dry Matter					
Status	**N**	**P**	**K**	**Ca**	**Mg**	**S**
Deficient	<2.5	0.3	2.7	1.0	0.25	0.2
Adequate range	2.5	0.3	2.7	1.0	0.25	0.2
	3.5	0.5	3.5	2.0	0.5	0.4
High	>3.5	0.5	3.5	2.0	0.5	0.4

Measurements of macronutrients [N, P, K, Ca, magnesium (Mg), sulfur (S)] are often reported as a % of dry matter (Table 1), while levels of micronutrients [iron (Fe), B, manganese (Mn), Cu, zinc (Zn), molybdenum (Mo), chlorine (Cl)] are usually reported as parts per million (PPM). In addition to reporting the nutrient levels detected, some labs provide interpretations of the results and recommendations for the grower. These interpretations can be based on crop averages or the range of values detected in samples processed by that lab. However, to be most useful, interpretations of results and recommendations should be based on the specific local conditions, varieties planted, time of the season, etc. It is most important to understand if the results indicate nutrient deficiencies or toxicities.[5]

Information on regionally appropriate interpretations of nutrient analysis results and recommend actions may be available from local extension publications. An example of N recommendations for watermelons in Arizona shows the changing needs of the crop during the season (Table 2).[2] Nutrient requirements for crops in other regions or grown in different systems may differ.

TABLE 2. RECOMMENDED NITROGEN APPLICATION RATES BASED ON TISSUE ANALYSIS RESULTS[2]

Stage of growth	Petiole NO_3-N ranges (ppm)	Apply this amount of N fertilizer (lb/acre)
3- to 4-leaves	>12,000	None
	4,000 to 12,000	25 to 50
	<4,000	50 to 75
Early runner	>14,000	None
	4,000 to 14,000	50 to 75
	<4,000	75 to 100
2-inch melons	>9,000	None
	4,000 to 9,000	0 to 40
	<4,000	40 to 60
Full-sized melons	>6,000	None
	4,000 to 6,000	0 to 20
	<4,000	20 to 30

Sources:
[1] Warncke, D. 2007. Nutrient management for cucurbits: Melons, pumpkin, cucumber, and squash. Department of Crop and Soil Sciences, Michigan State University. 2007 Indiana CCA Conference Proceedings.
[2] Doerge, T., Roth, R., and Gardner, B.1991. Nitrogen management guide for watermelon. In *Nitrogen Fertilizer Management in Arizona*. The University of Arizona.
[3] Orzolek, M., Lamont, W., Kime, L., Bogash, S., and Harper, J. 2010. Watermelon production. Ag Alternatives. Penn State Extension. UA381.
[4] Egel, D., Foster, R., Maynard, E., Weller, S., Babadoost, M., Nair, A., Rivard, C., Kennelly, M., Hausbedk, M., Hutchinson, B., Eaton, T., Welty, C., and Miller, S. 2017. Midwest vegetable production guide for commercial growers 2017.
[5] Hochmuth, G., Maynard, D., Vavrina, C., Hanlon, E., and Simonne, E. 2004. Plant tissue analysis and interpretation for vegetable crops in Florida. University of Florida, IFAS Extension. HS964.

For additional agronomic information, please contact your local seed representative. Developed in partnership with Technology, Development & Agronomy by Monsanto.

Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible.
The recommendations in this article are based upon information obtained from the cited sources and should be used as a quick reference for information about watermelon production. The content of this article should not be substituted for the professional opinion of a producer, grower, agronomist, pathologist and similar professional dealing with these crops.
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