Nutrient Management for Cucurbits: Melons, Pumpkin, Cucumber, and Squash

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A fertile soil is more than just having adequate levels of the essential nutrients. For plants to take up adequate amounts of nutrients the soil must have good tilth or quality. The physical condition of the soil greatly influences the ability of plant roots to acquire nutrients from the soil. Cucurbits, as a group, can develop good root systems that proliferate in the top 12 inches with the taproot going down to three feet and that are able to effectively utilize nutrients and water available in the soil. The soil environment must be favorable for the roots to develop to their full potential. Soils that have been well conditioned through good crop rotation and the incorporation of organic matter in the form of cover crops, compost, or manure can provide this favorable environment. Cucurbits are sensitive to wet soil conditions so good drainage is essential. Loams, sandy loams, and loamy sands are generally most suitable for growing cucurbits. It is recognized that traffic over the soil under wet soil conditions results in soil compaction. This most often happens during harvest under wet conditions. Excessive tillage can also result in soil compaction and destruction of soil structure that is important for drainage and aeration. When seeding or transplanting cucurbits, only till the soil enough to allow good seed-soil contact or uniform setting of transplants. Also, consider the use of strip tillage.

Effective and economic nutrient management begins with an understanding of the nutrient requirements of the crops being grown and the nutrient status of the soil. The nutrient requirements may vary with management practices and with type or variety, especially with pumpkins and watermelons. Muskmelon, watermelon, pumpkin, and squash generally accumulate in the vegetation and fruit 145 to 160 lbs nitrogen (N), 30 to 45 lbs phosphate (P_2O_5) and 160 to 180 lbs potassium (K_2O) per acre. The actual amounts will vary with yield. Cucumber tends to accumulate about half those amounts. These values can be used as general guides for the amounts of supplemental nutrients to apply. Remember, the soil can supply a significant portion of the crop's nutrient requirements. Therefore, soil testing is very important. In many fields, available P and K levels have been improved by past additions. This is especially true for P because it is relatively immobile in the soil. In sandy soils P may leach out of the root zone from fall to spring, so build up may be limited.

Soil must have a good fertility status for cucurbits to produce good yields of quality produce. The first step to establishing and maintaining good soil fertility is to sample the soils in each field and have them analyzed. Collect 15 to 20 soil cores to a depth of 8 inches in a pattern that results in the composite sample being representative of the area sampled. Sampling areas should be delineated based on differences in soil types, topography, cropping history, or other features. On average ,one composite sample should be collected for about every 10 acres. For vegetable production, annual soil sampling is encouraged. Areas in a field that are not typical or where poor growth occurred should be sampled separately.

Maintaining a soil pH between 6.0 and 6.5 is very important for cucurbits, especially muskmelon. Watermelon is more tolerant of acid soil conditions, and pumpkins and squash are intermediate. Allowing the pH to decrease below 6.0 can adversely affect crop yield and quality. When lime is needed, apply it at least 3 months, preferably 6 months, prior to when the crop will be planted. The nutrients of importance to cucurbits that are most affected by soil pH are P and manganese (Mn) in the soil. P is most available between 6.0 and 6.5. Mn availability increases as the soil pH decreases; going from sometimes deficient above 6.5 to being excessive or toxic near pH 5.0. Muskmelon and cucumber are the most sensitive to Mn deficiency or toxicity. As the pH approaches 5.5, muskmelon growth will be reduced and some sign (black spots) of Mn toxic may occur. Magnesium (Mg) may also become limiting under acid conditions, especially in sandy soils. When the soil pH is above 6.5, spraying 0.5 to 1.0 lb Mn per acre two to three times may be necessary. Maintaining the soil pH in the 6.0 to 6.8 range improves the availability of Mg and calcium (Ca). Maintaining adequate soil moisture is helpful in minimizing blossom-end-rot, associated with inadequate Ca getting to the blossom end of the young developing fruit. Foliar application of 2 lbs Ca and/or Mg per acre per application may provide some in-season benefit, but long-term correction needs to come from application to the soil, 20 to 50 lbs Mg and more than 100 lbs Ca per acre. One ton of dolomitic limestone may provide over 400 lbs Ca and about 200 lbs Mg.

Cucurbits can effectively use nitrogen (N) that is released from organic materials in the soil. Soils may release up to 100 pounds of nitrogen per acre depending on the soil organic content, and how much and what kind of organic materials have been incorporated. However, this amount is more likely to be around 40 lbs N per acre. A previous legume cover may supply 40 to 60 lbs N per acre. Table 1 provides guidelines for adjusting N rate based on the previous crop or cover crop. A soil N test at tipover will give an indication of the soil N status and how much addition N to apply. Take soil cores to a depth of 12 inches. Supplying too much nitrogen can result in excess vegetative growth, reduced or delayed fruit set and reduced yields. When deciding how much nitrogen to apply, take into consideration how much the soil system can supply. Vine crops other than cucumbers will usually do well with a total of 80 to 120 pounds of supplemental N. When a crop, such as muskmelon, is grown on plastic, topdressing is not effective. The N requirement needs to be met by incorporating the N fertilizer prior to laying the plastic or by putting it through the trickle irrigation. N fertilizer applied under the plastic is not readily subject to leaching unless excess irrigation is applied.

Table 1. Adjustments in nitrogen for previous crop or cover crop.

Situation	N rate adjustment
Legume cover crop	subtract 40 to 60
Compost, 2 ton/ acre	subtract 20 to 25
Cereal Grain cover crop, < 8 inches	no change

Cereal Grain cover crop, > 8 inches	add	20
Corn grain as previous crop	add	20 - 30
Wheat grain as previous crop	add	30 - 40
Soil Organic matter, < 2 %	add	20
Soil Organic Matter, 2 – 4 %	no change	
Soil Organic Matter, > 4 %	subtract	20

P and potassium (K) additions are best based on a soil test. Without a soil test applying a maintenance amount (equal to crop removal) of each is suggested. The approximate amount of P_2O_5 and K_2O removed in each ton of harvested fruit is given in Table 2. When seeding vine crops, placing 25 to 40 lbs each of N, P_2O_5, and K_2O per acre in a band placed 2 inches to the side and 2 inches below the seed will improve early growth. For transplanted crops applying a starter solution high in P can benefit early plant development, but this may not be necessary if the transplant plugs are well fertilized before being set in the field. For cucurbits grown on plastic with trickle irrigation, N and K can be supplied with the water. Broadcast and incorporate, or apply in bands 4 to 6 inches on both sides of the row, all the needed phosphate plus 30% to 50 % of the N and K. From transplanting to fruit set and after harvest begins fertigate 4 to 5 lbs N and K_2O/A/week. During the fruit sizing period fertigate 7 to 9 lbs/A/week.

Table 2. Approximate amounts of nitrogen, phosphorus and potassium removed in fruit of selected cucurbit crops.

Crop	Nitrogen	Phosphate	Potassium
	lb N/ton	lb P_2O_5/ ton	lb K_2O/ ton
Cucumber	2.0	1.2	3.6
Muskmelon	8.4	2.0	11.0
Watermelon	4.8	0.4	2.4
Pumpkin	4.0	1.2	6.8
Squash (hard)	4.0	2.2	6.6

Sulfur (S) deficiency is not a common problem in these vine crops because they are planted after the soil has warmed up and mineralized sufficient S. Much of the S available in the soil comes from deposition with rain or from the decomposition of organic matter. Sandy soils low in organic matter are most likely to be low in available S. Plants will have a general yellowish color, similar to N deficiency, but on the newest leaves.

The responsiveness of the cucurbits to the various micronutrients is listed in Table 3. Zinc (Zn), copper (Cu), and boron (B) are not likely to be a concern for the growth and development of these cucurbit crops. Zn and Cu deficiencies are not common because of past and current use of fungicides that contain these elements. Soil testing can provide a guide the available levels of these nutrients in soil. Analysis of leaf tissue samples is probably a better guide as to the micronutrient status of plants. Low levels of available boron are most likely to occur on the sandiest soils, because it tends to leach downward from one year to the next. B plays an important role in the growth of the pollen tube and fruit set. Application of 0.5 lb B/A to the soil may provide some benefit for muskmelon and watermelon on sandy soils. Be carefully with foliar B application, some (0.1 lb B/A foliar) may provide benefit, but too much (> 0.5 lb B/A foliar) will definitely cause some injury.

Table 3. Response of cucurbits to application of micronutrients when the soil level is low.

Crop	B	Cu	Mn	Zn
Cucumber	L	M	H	M
Muskmelon	M	M	H	M
Watermelon	M	L	M	M
Pumpkin	M	L	H	M
Squash	L	L	H	M

L=low, M=medium, H=high

In summary, base your nutrient inputs on the yield potential of the soil and the production system being used and on the ability of the soil to supply needed nutrients. And, most importantly keep the soil pH above 6.0.