PUMPKIN AND SQUASH FERTILITY MANAGEMENT

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With fertilizer costs always rising, growers can't afford to over apply. The first rule in fertility management is don't guess – soil test. A reliable soil test should be performed at least every three years. For the price of a test ($12) you will learn the soil pH and the level of soil nutrients. Not knowing these figures leaves you blind and wastes the dollars spent on fertilizers.

Pumpkins and squash grow best when the soil pH is close to 6.5. When soil pH is adequate, the availability of both major and minor nutrients is maximized. Clearly, one cannot expect to maximize dollars spent on nitrogen, phosphorus and potassium fertilizers when soil pH is suboptimum. Because of this, many people consider the soil pH to be the most important part of the soil test.

A soil test will provide growers with both the soil's pH and its exchange acidity or buffer pH. Both of these are necessary to determine the amount of lime that is needed. Soils with a high exchange acidity (loams) may require 3 to 4 times more lime than low exchange acidity soils (sands, gravels) to achieve the same change in pH. You will also need to know the Effective Neutralizing Value (ENV) of the limestone that you plan to use. With this information, you will be able to apply just the right amount of limestone for each field. See Table 1 for recommendations.

Table 1. Lime and sulfur recommendations for pumpkins and squash

GENERAL LIME RECOMMENDATION (tons/acre[1] needed to raise pH to 6.5)				
Initial Soil pH	**Sands/ Gravels**	**Sandy loams**	**Loams/ silt loams**	**Silty clay loams**
4.5	4.0	7.0	12.0	15.0
4.6-4.7	3.5	6.5	10.0	13.0
4.8-4.9	3.0	6.0	9.0	12.5
5.0-5.1	2.5	5.5	8.5	12.0
5.2-5.3	2.0	4.5	6.5	8.0
5.4-5.5	1.5	3.0	4.0	6.0
5.6-5.7	1.0	2.0	3.0	5.5
5.8-5.9	0.8	1.8	2.5	3.5
6-6.1	0.6	1.5	2.0	3.0
6.2-6.3	0.5	1.0	1.5	2.5

GENERAL SULFUR RECOMMENDATION (pounds/acre of sulfur to lower pH to 6.5)			
Initial Soil pH	**Sands/ Gravels**	**Loams**	**Clays**
8.5	2000	2500	3000
8.0	1200	1500	2000
7.5	500	800	1000
7.0	100	150	300

It takes at least two plowings to get the lime thoroughly mixed with the entire plow layer. For this reason, it is recommended that lime be applied in the fall of the year prior to when the crop will be planted. If lime must be applied in the spring prior to planting, it is recommended that the application be split. Plow half of the lime down and disk the remainder into the surface. This will encourage a favorable pH near the seed and encourage a good stand.

On some soils, it may be necessary to apply sulfur to lower the pH. Like limestone, it requires six months to a year to lower pH to the desirable range. Remember that many common fertilizers, especially those containing ammonium will often lower soil pH while nitrate fertilizers tend to raise pH. See Table 1 for sulfur recommendations.

There are 12 essential nutrients that all plants require to grow. All of the nutrients are absorbed from the soil. Six of these are needed by plants in relatively large amounts and are called macronutrients. These include nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur. The other six are called micronutrients or minor elements and include iron, copper, zinc, boron, manganese, and molybdenum. Although these are considered minor and may be needed in amounts of less than one pound per acre, there is nothing unimportant about them. The level of crop production can be no greater than that allowed by the most limiting of the essential nutrients.

Nitrogen is perhaps the most limiting nutrient in crop production. Deficiency symptoms include yellow plants and stunted, weak growth. Pumpkins and squash are able to absorb nitrogen in two forms, ammonium (NH_4) and nitrate (NO_3), but they do prefer the nitrate form. In soils, nitrogen may be tied up in organic matter (crop residues, soil organic matter, humus, microbes, etc.), which in this form is totally unavailable to plants. This organic nitrogen is first converted to ammonium and then to nitrate by soil bacteria. These microbes will be most active when the soil is warm, soil moisture is optimum and pH is optimum. Cool conditions, dry or waterlogged soils, or compacted soils will all slow the conversion of nitrogen to available forms.

About 75 - 100 pounds of N are recommended per acre. Higher rates may push foliar growth at the expense of flowers and fruit. A large canopy seems to shade female flowers and make it difficult for bees to find them for pollination. Either way, it reduces fruit set. Be especially careful if planting pumpkins into fields where a legume cover crop has been grown or high rates of manure applied. Little if any additional nitrogen may be needed.

Like nitrogen, phosphorus can be found in organic and inorganic portions of the soil. The typical deficiency symptom is a purplish color on leaf undersides. Soil tests may reveal high levels of phosphorus in soils yet deficiency symptoms may still be observed. Phosphorus is found in three forms in soil, two of which are unavailable to plants. The unavailable forms include phosphorus in organic matter and phosphorus fixed or bound to iron and aluminum at low pH, and calcium and magnesium at high pH. Added fertilizer phosphorus is fixed with other elements and is only very slowly made available. Since this is a chemical reaction, it occurs quicker in warmer soils as compared to cooler ones. Banding phosphorus rather than broadcasting is a more efficient way to apply this nutrient.

Potassium is the third of the "primary elements". Deficiency symptoms are categorized as "hidden hunger", meaning that a potassium deficiency does not usually show obvious signs. In severe cases, leaf edges may be scorched. Plants absorb potassium in the ion form K^+. Potassium can be leached from sandy or gravely soils and be fixed and unavailable in the clay portion of soil.

Calcium is absorbed by roots in the ion form Ca^{++}. Deficiency symptoms include young leaves that are stunted, distorted and spotted and necrotic at the leaf edge. Blossom-end rot has been seen in watermelon and cucumber and could potentially occur in pumpkin. Although calcium may be present in high levels in the soil, dry conditions will limit its uptake by plants and cause deficiency symptoms. High levels of sodium, potassium, magnesium and ammonium may also cause deficiency.

Magnesium is absorbed in the Mg^{++} form. Look for yellow regions between leaf veins, sometimes a reddish color progressing to brown. Deficiency is most common on acid, highly leached soils that are high in potassium or calcium. Sulfur is cycled through soil in a very

complex fashion, similar to nitrogen. Deficiency symptoms are not normally observed in the Northeast.

In general, micronutrients are not normally added. There may be specific conditions when plants would benefit from additions of micronutrients but in most cases, adjusting the pH to the optimum level will solve most micronutrient deficiencies. For pumpkins and squash, the fertilizer program in Table 2 is recommended.

Table 2. Fertility recommendations for pumpkins grown in the Northeast.

N (lbs/A)	P_2O_5 lbs/A Soil Phosphorus Level			K_2O lbs/A Soil Potassium Level			Comments
	low	medium	high	low	medium	high	
80 - 100	120	80	40	120	80	40	TOTAL RECOMMENDED
40	80	40	0	80	40	0	Broadcast and disk-in[1]
20 - 30	40	40	40	40	40	40	Band place with planter
20 - 30	0	0	0	0	0	0	Sidedress when vines run

[1]If P_2O_5 and K_2O levels are high, skip the broadcast application and apply 50 lbs/A P_2O_5 and K_2O and 40 lbs/A of N in the band at planting and 60 pounds of N sidedressed.

When banding fertilizer on wide row spacing (6 feet or greater), avoid placing more than 40 lbs per acre of nitrogen and K_2O combined, to avoid salt damage to the developing seedling. Remember, 40 pounds per acre at a 6-foot spacing is equivalent to 80 pounds per acre at a 3-foot spacing. Bands placed further away from the seed furrow than the two inch standard have less likelihood of burning plants. Some growers place one band two inches from the seed furrow, and a second band four inches from the seed furrow.

When sidedressing, most growers prefer using ammonium sulfate or urea. Both are efficient but care should be taken if sidedressed fertilizer remains on the soil surface and is not incorporated. Left on the surface, has a tendency to volatize and nitrogen will be lost. If the sidedressed fertilizer is incorporated into the soil, either with irrigation or mechanically, little will be lost.

Some growers fertilize vine crops through their trickle irrigation systems. If fertigation is to be used, it is recommended that growers apply 40 - 50 pounds per acre of N, P_2O_5, and K_2O in a band at planting, at least 2 inches below and to the side of the seed. Nitrogen may then be applied once or twice through the season not exceeding 100 pounds total for the season. Sidedressings can occur as the vines begin to run and 2 to 3 weeks after the first application.

In pumpkin studies conducted in 2011 and 2012, yield was maximized with a total of 100 pounds of N per acre. Rates of 150 pounds showed no increase in yield. For pumpkins, there was no yield advantage by spoon-feeding crops weekly with small doses of nitrogen compared to traditional applications of banding and a single sidedress.