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Answers to Common Nutrition Questions

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ANSWERS TO COMMON NUTRITION QUESTIONS

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I. Nitrogen

A. *What is Nitrogen used for?* Nitrogen in the ammonium form is used in the formation of amino acids. Amino acids are assembled in appropriate order to form proteins. Enzymes that mediate plant metabolism and regulate uptake and movement through membranes are proteins. Proteins as enzymes are essential for energy capture and sugar formation via photosynthesis.

B. *Do N fertility guidelines vary by cultivar?* The optimum tissue level is the same. The optimum rate for Stevens is 20 lbs N/a. The optimal rate for Stevens in Wisconsin research was different for different soils. A sand soil did best at one year at 40 pounds and a peat-based bed did best at 20 pounds. In all cases 20 pounds was better than 0 pounds N/a. Stevens appears to be a bit more forgiving of above optimal N than Searles.

C. *What is the optimum timing for N application?* Research in Wisconsin has shown that the best time to apply N on Stevens is: budbreak, peak bloom, fruit set, and preharvest. Data for Searles were inconclusive. The optimal rate for bearing beds was 20 lbs/A. Interestingly, there were no treatment effects the first year as the buds for that crop were already in place. The treatment effects appeared in year 2 as a result of N fertilization in year 1. This is common in fertility experiments.

D. *How much N comes from thunderstorms?* In rural Wisconsin precipitation amounts to about 10-15 lbs N/A. However, this N is NO_3^-, not NH_4^+ and so is not useful for cranberries. Further, this natural precipitation is also present in all fertility studies, so this should not be counted as part of the 20 lbs N/A.

E. *After application how long does it take for the N to be in the young fruit?* Actually you don't want it in the fruit, you want it in the leaves so it can be used to make sugars that will cause the fruit to grow. In field studies using ^{15}N we can find ^{15}N in the uprights by 24 hours after application. It takes about 1 week before this levels off, depending on the air (soil?) temperature.

F. *Can I estimate N release from organic soils?* Mineralization, the process through which organic N is released as ammonium, is microbe mediated and therefore the process is temperature dependent. Further the soils must not be "wet", just moist. During hot weather (>85°F) postpone or eliminate N applications to peat beds as much N will be mineralized. There is no "formula" to determine mineralization.

G. *N released from peat below a 6-8" sand lift?* Cranberries are relatively shallow rooted. In my opinion little to no N would be available to cranberries under a 6-8" sand lift.

H. *Foliar applications*? Foliar N applications have their place. They are most effective when uprights are growing poorly or look pale. Foliar applications are expensive, but will "green" vines up in a short time. However, cranberry uprights cannot absorb sufficient N through the leaves to meet their full N requirement.

I. *Fall applications to enhance bud set?* A fall application is included in the best fertilizer timing protocol described above.

J. *What about drainage and leaching?* Ammonium N does not leach appreciably (but may leach or run off in surface water if a significant rain event quickly followed application). When pH is 5.5 or below there is no significant nitrification. Drainage is important because NH_4 uptake is energy dependent and oxygen is required for this process. When soils are saturated air is excluded and the root zone becomes anaerobic→no N uptake.

K. *What about slow release products for new beds?* We have recently done that research using Ammonium sulfate, SCU, MEU, Milorganite and composted chicken manure. All treatments were adjusted to provide the same amount of N, P, & K. Our results show that **none** of the slow release products performed as well as ammonium sulfate, not even close. We did not test osmocote as it is very expensive.

L. *At what soil temp does N uptake begin?* About 50°F.

M. *Are there guidelines for optimum growth of current season uprights?* Some of this work has been done in MA. We have not done that work here. My opinion is that it would be highly variable based on location, crop load, etc. However, the MA recommendations are:

Cultivar	**Optimum growth before early bloom**
Early Black	50-60 mm (2-2.5 in)
Howes	45-55 mm (1.75-2 in)
Ben Lear	55-65 mm (2-2.5 in)
Stevens	60-70 mm (2.5-2.75 in)

II. Phosphorus

A. *What is the role of P in cranberry plants?* P is very important to plant metabolism. P is a primary constituent of the genetic material of plants and animals (DNA). It is also critical in energy transfer (ATP→ADP). It is critical to transferring three carbon sugars from the chloroplast into the cytoplasm where it can be used for metabolism or growth or can be exported to other organs.

B. *Do we have guidelines about P timing?* There are some guidelines, but the research behind them is tenuous. The recommendation is no P until late spring, and then apply 20 lbs in 2-3 doses (I'd prefer 3). We also know that $H_2PO_4^-$ reacts readily with iron, aluminum and manganese ions in soils to form insoluble compounds and that these reactions occur rather quickly. Frequent light application of P is better than one or two large doses.

C. *About how much P should be applied during a year?* Research shows no response to added P fertilizer beyond 20 lbs P/a/yr. This is about 45 lbs P_2O_5/a/yr. Sandy soils may need more P. I believe we are over-applying P by using fertilizers like 6-24-24. Materials like 14-14-14 would be preferable in my opinion.

D. *Are there cultivar differences in P requirements or timing?* Not that I know of. There is no research in this area.

E. *Do sandy soils require more P than organic soils?* Because phosphorus is an anion (negatively charged) soil type is less critical. The current thinking is that sand beds will

need more P than peat beds. The amount and availability of iron, aluminum and manganese are more important in my opinion. (But I also don't know of any way to alter the availability of these cations.)

F. *Should I worry about leaching or runoff?* Phosphorus does not leach and would not be any more likely to go through a sandy than a mineral or organic soil. Runoff is a concern if a significant rain event quickly followed a fertilizer application. There is some evidence (although not strong) that there is less P in outflow than inflow water. There is also some evidence that P can leach from uprights when a bed is flooded (as for harvest).

G. *Should P fertilizer be added after spring frost season?* Yes, that is the right timing, but irrigation for frost protection is only peripherally involved. P is released as soils begin to dry out but are still cool after the winter flood melts. Once the soils warm P is not released as quickly. It is coincidental that frost protection ending and soils warming occur at the same time.

H. *Do large levels of natural iron disrupt P uptake?* They don't directly disrupt P uptake, but rather the iron forms insoluble compounds with the P and makes it unavailable for uptake by cranberry roots.

I. *What available fertilizers contain P?* See the table below. Phosphoric acid can be used as a foliar P source, but should not be applied during flowering or on fresh fruit plantings. Rock phosphate is almost insoluble and, in my opinion, is not a good P source.

Fertilizer	***Chemical formula***	Analysis	Solubility
Triple superphosphate	$Ca(H_2PO_4)_2$	0-46-0	87%
Diammonium phosphate	$(NH_4)_2HPO_4$	18-46-0	100
Monoammonium phospate	$NH_4H_2PO_4$	11-48-0	100
Ammonium polyphosphate (dry)	$NH_4H_2PO_4$+$(NH_4)_3HP_2O_7$	10-34-0	100
Ammonium polyphosphate (liquid)	$NH_4H_2PO_4$+$(NH_4)_3HP_2O_7$	15-62-0	100
Ordinary superphosphate	$Ca(H_2PO_4)_3$ + $CaSO_4$	0-20-0	85
Phosphoric acid	HPO_4		
Rock phosphate			

III. Potassium

A. *What is the role of K in plant growth?* Potassium does not have a direct role in plant metabolism. It is not involved in proteins or membranes. It is primarily used to balance charges and as an osmoticant (used to move water from place to place). K is important to stomata opening and closing and in the movement of sugars from one place to another.

B. *What is the optimum timing for K application?* Because K+ will leach it is important to have frequent light applications of K as opposed to 2-3 large applications at "critical" times. In Wisconsin research different timings for K fertilizer did not affect yield or rot.

C. *Do I need more K on sand than peat beds?* Probably. I don't know of research on this question, however.
D. *How much K is required annually?* Research showed yield differences related to K rate in only 1 of 4 years. There was no relationship between K rate and tissue K. Interestingly, yield was reduced at high K rates (240 lbs K/a). 60-100 lbs K/a/yr appears sufficient. High K was correlated with decreased Ca, Mg, & Fe. Apparently, high K applications exchanged other cations off the exchange sites in the soil. I would determine that through tissue testing in the late summer. If you know how much K you have applied and what the tissue concentration is then you can adjust up or down as needed the following year.
E. *Are there cultivar differences in K requirement?* Not that I am aware of. However, substantial amounts of K are removed in the crop so I would feed a heavy producing bed more K than a light producing bed.
F. *Can I minimize K leaching on sandy soils?* The only approach I know of is to be cautious with other cation nutrients (Ca, Mg, Fe) and then over time an organic duff layer will form. This layer will have more exchange sites and will hold onto K (& other cations) better than sand.
G. *What forms of K are available?* See J. Is one better than another on sandy soils or new plantings? In all cases potassium sulfate is preferred over potassium chloride.
H. *Can I optimize K uptake in soils with high Ca & Mg?* Frequent light applications of K would allow it to be more available than 1-2 heavy applications. K will compete with Ca & Mg for exchange sites. Overapplication of Ca & Mg will reduce K availability. However, see the answer in D above.
I. *Foliar applications of K during bloom & early fruit set?* Research shows no effect of timing on yield. Research also shows no effect of different products when applied at the same rate of K.
J. *What is the difference between 0-0-50 and 0-0-60?* 0-0-50 is potassium sulfate (KSO_4) and 0-0-60 is potassium chloride (muriate of potash, KCl). Cranberries are sensitive to chloride, so the sulfate form is far preferred.
K. *Will early applications of 0-0-60 vs. 0-0-50 adversely affect production?* Since cranberries are sensitive to Cl, at high rates 0-0-60 may cause some injury. There isn't research to support this that I know of, but grower experience does. Always choose the sulfate form. There are no data to support early application of potassium causing better fruit set or yield.

IV. Calcium and Magnesium

A. *What role does calcium play in cranberry production?* Calcium is known to be important in holding cell walls together in plants. It is also important in membrane integrity and permeability. Calcium is immobile in plants once it reaches its "final resting spot". A constant low level supply of calcium is important. Plants get calcium from other fertilizers (triple or ordinary superphosphate), water, and from the mineral fraction of soils.
B. *What does Magnesium do for cranberry production?* Magnesium is essential to create and maintain chlorophyll for photosynthesis and it is involved in several enzyme systems. Mg is required, but at low levels compared to N, P, or K.

C. *Will I see a yield response to added Ca?* One research project showed increased yield with applications of CaB at fruit set. However, they did not separate applications of Ca & B, so we can't tell which element caused the response. Boron is known to be critical for flower development and pollen germination and growth. In my opinion, B was the limiting nutrient in these studies. However, when we look at several years of tissue test results submitted to the UW soils lab we found very few samples that were below the critical value—suggesting that calcium is seldom a limiting factor. The same is true for magnesium.

D. *How much calcium and magnesium are required in a season?* There is not a good answer to this other than to say not very much. The requirement is likely met through water and other fertilizers.

E. *Will calcium applications during bloom increase fruit set?* See C above. I know of no research data suggesting that applications of calcium alone during bloom will increase fruit set or yield (fruit set ≠ yield).

F. *Is gypsum an excellent form of calcium and will it lower soil pH and enhance soil drainage?* 1) gypsum ($CaSO_4$) is an excellent source of calcium for cranberries, 2) gypsum will **NOT** lower soil pH, 3) gypsum will enhance soil drainage on sodic soils by exchanging Ca^{++} for Na^{+} ions on the soil. I don't know of any sodic cranberry soils in Wisconsin.

G. *What soils will benefit most from calcium applications?* Sodic soils. *What are the effects on soil?* Gypsum will enhance soil drainage on sodic soils by exchanging Ca^{++} for Na^{+} ions on the soil. This reduces soil clumping and opens channels through the soil. I don't know of any sodic cranberry soils in Wisconsin.

H. *What calcium forms are available?* See the table below. Which are cheapest? Lime is cheapest, but has the unwanted effect of raising pH.

Material	Formula	% Ca
Calcitic lime	$CaCO_3$	40
Dolomitic lime	$CaCO_3 + MgCO_3$	22
Gypsum	CaSO4 · 2H2O	22
Ordinary superphosphate	$Ca(H_2PO_4)_3 + CaSO_4$	54
Triple Superphosphate	$Ca(H_2PO_4)_2$	14

I. *Is there an optimum timing for calcium and magnesium applications?* I know of no research data indicating an optimum timing for Ca or Mg application for cranberry.

J. *What options are available to supplement magnesium?* Dolomitic limestone is the cheapest, but has the unwanted effect of increasing soil pH. Epsom salts (MsSO4 · 7H2O) or potassium magnesium sulfate (SulPoMag) are acceptable.

K. *Does soil pH affect Ca or Mg availability?* Mg is less available as soil pH declines. If tissue tests indicate low or declining Mg in tissue you'll want to check the soil pH. If it is much below 5.0 you can make the Mg more available by applying a little bit of lime to increase the pH to 5.0 to 5.5.

V. Micronutrients

A. *Should I consider applying micronutrients such as zinc, manganese, copper and boron?* As the class name suggests, these elements are required in very small amounts. You should add them if a tissue test suggests they are low or dropping. I have not seen tissue test reports showing deficiencies in any of these elements. The one exception may be boron during flowering to fruit set.

B. *Have there been any studies showing the benefits of applying the above micronutrients?* There is very little field research with micronutrients. It is difficult to do and unless replicated many times the effects are usually too small to find with the natural variability of cranberries. There have been some laboratory studies to determine the critical tissue value for these elements. These values are reflected in our current tissue test recommendations. We have also looked at toxicity of these elements and while they may become toxic, the concentrations that affect vegetative growth are 100 fold higher than what we have found in routine tissue tests.

C. *About how much of these elements are needed for optimum crop production?* I'm not sure that is the correct question. Much of these elements are retained in the perennial portions of the vines and little is harvested with the crop. Further, our soils typically contain adequate amounts of these elements. The question isn't how many pounds per acre, but how many ounces per acre. Further, if your tissue tests show sufficient levels of micronutrients adding micros probably is not necessary (with the possible exception of B).

VI. pH management

A. *When is the best time to apply sulfur for pH management?* Small doses of no more than 100 lbs/a are best. These can be effective once the soils have dried and warmed in the spring. Fall applications of sulfur would be less effective (depending on the length of fall and the temperatures after harvest) because the reactions that release H^+ ions are microbe mediated and thus are temperature dependent. Early spring applications would not have an effect until the soils warm.

B. *Is there a general rule for calculating the number of pounds of sulfur per acre required to reduce soil pH by 1 point?* There are some general rules, but all of these are mediated by the soil type and carbonate concentration in the soil. The table that follows gives some guidelines.

Initial pH	Sand or Loamy Sand	Sandy Loam or Loam
	lb./acre	lb./acre
7.0	800	2500
6.5	650	2000
6.0	525	1500
5.5	350	1000
5.0	170	500

C. *How many pounds of sulfur per acre should I apply to maintain my current soil pH?* That depends on how alkaline your water supply is. Eric Hanson had a great discussion of that in the cranberry school proceedings from 1999. If your water does not contain

much carbonate it won't take much if any sulfur to manage pH. This question would need to be answered on a bed by bed basis.

VII. General Questions

A. *Each season I see many small aborted berries at harvest time. What do I need to do to set more fruit & size these berries for harvest? Is there a problem with pollination, fertility (amount/timing), heat stress or blossom injury?*
While all of the above factors can affect fruit set and size, in my opinion it is not any of these that limits fruit set and production. My research clearly showed that most of the carbohydrates that support fruit set and growth come from leaves on the current season growth above the fruit. When we measure photosynthesis on these leaves through a season and then do some math it appears that on average, a cranberry upright produces enough carbon to set and grow to maturity, 2 fruit. Good overall management will give you the best chance of setting and keeping as much fruit as possible. Having enough, but not too much N is important. Good pollination is critical, as is frost protection. But none of these individually will increase production. In my opinion this phenomenon is not a fertility issue.

B. *Each season (especially hot, dry years) I see "yellow areas" appear in producing beds (mostly Stevens, sometimes Ben Lears), is this a sign of poor fertility, drainage, or leaching concern, heat stress or disease? What is suggested for treatment?* In my opinion this is not strictly a fertility issue, but is a sign of stress. I have also seen it in hot periods. We typically don't see the symptoms in spring or in cool years. Being careful with irrigation and using the sprinklers to cool the vines during the heat of the day can reduce the stress. Applying a light dose of ammonium sulfate has also been effective. However, time and cool weather are also effective at reducing symptoms.

C. *Have you ever heard of manganese deficiency on cranberry?* I have not. I don't recall seeing manganese deficient in tissue tests. *Is it possible and under what conditions?* It is possible. Conditions that would favor manganese deficiency are high pH and organic soils. The condition could be exacerbated by heavy doses of Calcium as the calcium would fill up the cation exchange sites in the soil and Mn could be lost. How do I know if I have it? By taking a tissue test.

D. *Growers in BC plant into sawdust. Is this a reasonable alternative? Will the sawdust hold water and nutrients better? Will herbicides work better?* BC growers use sawdust because it is cheap and readily available. This is aged softwood sawdust. In my experience it does not hold water or nutrients any better or worse than other organic soils. It might be useful for growers planting into alkaline soils, but in those sites the water is typically alkaline so I don't think this is a long-term solution. The biggest drawback to sawdust is keeping it from floating when beds are flooded. BC growers are in the process of sanding heavily to keep their bogs from floating. They don't flood to make ice in the winter. I don't know if herbicides would work better or worse.

E. *Why soil & tissue tests in Aug/Sept. rather than spring?* There are two reasons to take tissue tests in the late summer as opposed to spring. The first is that tissue concentrations of elements (particularly N) change rapidly in the spring. That means that the date or stage of development at which the sample is taken has a large effect on the tissue concentrations found in the uprights. In the summer these elements don't change much

so the exact date or stage of development is much less critical. The second reason is that you should think of fertility as a July-to-July process rather than a May to August process. A fall tissue test tells you if your fertility program was effective for the year and points out areas where adjustments may have to be made for the following year. If you make this "paradigm shift" then the fall collection makes more sense than a spring sample.

F. *Should I irrigate after a fertilizer application?* I think it is prudent to irrigate after applying fertilizer, especially fertilizer with K (the possible exception being a foliar application of micronutrients that may be best absorbed through the leaves). About 1/10 of an inch of water should be sufficient to wash granules off the vines, solubilize the fertilizer and get it into the top soil layer, yet not enough to leach nutrients through the soil.

G. *Should I consider using blended rather than manufactured fertilizer?* Blended fertilizers are less expensive than manufactured fertilizers. The primary drawback is that blended fertilizers have different particle sizes/densities and some elements may settle out in shipping and they may behave differently in the delivery tubes on booms. I think the cost savings exceed this minor drawback. Be careful that when a dealer blends a fertilizer for you that they use ammonium nitrogen and sulfate forms of potash.