

berry mg

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***This advisory is focused on: 1) encouraging you to get underway with a nitrogen (N) fertilizer injection very soon; 2) getting you to take an immediate tissue sample; 3) demonstrating several possible fertility programs and relative advantages and disadvantages, 4) providing a few pointers on injection cycles, and 5) "safe" boron usage***

1. Emphasis on Nitrogen Injection for this Week

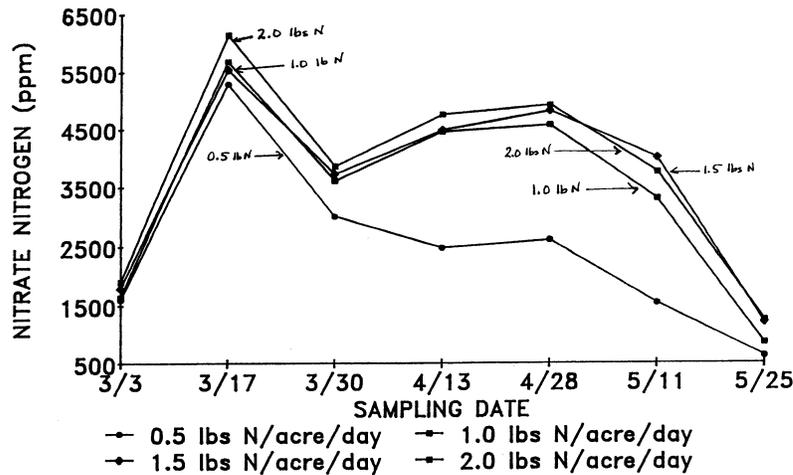
The total amount of nitrogen recommended for the "entire" pre-bloom, bloom and harvest period is about 60 pounds of nitrogen (assuming you applied about 60 lb N/A in the preplant period). If you distribute 60 lbs of N over an 11 week spring season (e.g. mid-March through 1st week of June), that would be approximately 5 1/2 lb N/A/week. But, very often growers end up using about 5.25 lb N/A/week, which is based on a daily feeding rate of 0.75 lb N/A/day. At the beginning of the season you may be advised to go with 7 lb N/A/week (1 lb N/A/day) if petiole nitrates are low (see next table). **Our experience for the first injection of the season is that the N- rate can vary from 5.25 -7 lb/A/week. BUT, what is most critical is that you start before the plants reach the open blossom stage! And, the crop in many areas will be approaching 10% open blossom very soon.** <Editor note March 11, 2011 – we are ahead of 2009 crop, and this stage has already been "passed" in most areas except the mountains>

**NCDA&CS Petiole Nitrate Nitrogen (NO<sub>3</sub>-N) Sufficiency Range and Nitrogen (N) Rate Recommendations by Growth Stage and Week**

Growth Stage <sup>1</sup>	Week	Petiole NO <sub>3</sub> -N Sufficiency Range (ppm)	Nitrogen Rate Recommendation when Petiole NO <sub>3</sub> -N is:		
			Below—	Within— the Sufficiency Range	Above—
B	1	600–1500			
B	2	4000–6000			
B	3	4000–6000	7 lb N/a/wk	5.25 lb N/a/wk	None
B	4	3500–6000			
B	5	3000–5000			
F	1	3000–5000			
F	2	3000–5000			
F	3	3000–5000			
F	4	2000–4500	7 lb N/a/wk	5.25 lb N/a/wk	None
F	5	2000–4000			
F	6	1500–3000			
F	7	1000–2000			

1. B = Bloom F = Fruit (harvest begins)

INFLUENCE OF N-RATE ON PETIOLE NITRATE  
STRAWBERRY PRODUCTION



2. Taking an immediate tissue sample

Even before you inject any nitrogen fertilizer, be sure you take a plant tissue sample to establish your crop's baseline nutrient levels for nitrogen (N), potassium (K), calcium (Ca), magnesium (Mg) and boron (B). Also, low sulfur (S) can be a real concern in strawberries, and a high concentration of N in the leaf tissues during the bloom and harvest period causes an imbalance between N and S (N:S ratio). Also, please read the NCDA&CS website for instructions on

mailing: <http://www.agr.state.nc.us/agronomi/SampleTrack/>. Also, you have 3 options on getting forms: <http://www.agr.state.nc.us/agronomi/supplies.htm>.

3. Demonstrating several possible fertility programs

Nitrogen (N) is the element required in the largest amount in the pre-bloom, bloom and harvest period, and so it should not be a big surprise that a standard strawberry fertigation program includes some amount of N each week through the 11-12 week season. You can use the NCDA & CS Agronomic Division Plant Tissue Reports to help you decide whether you need to "go up" on weekly N, or "go down".

Generally, growers are advised to use either 5.25 lb N/A/week or 7.0 lb N/A/week. So, in the fertility programs shown below, you will note that I have indicated programs that will deliver either 5.25 lb N/A/week or 7.0 lb N/A/week.

*The Potash Question?* Secondly, in some crops like tomatoes, there is a definite need to consider injecting larger amounts of potash relative to nitrogen each week (or each day in the case of tomatoes). There will be soon be a helpful new information sheet available from the NCDA & CS Agronomic Division for growers in Eastern NC that discusses the importance of using 2x as much potash as nitrogen. This would technically be called a 1:2 ratio (N:K).

Several years ago a revision showed up the NC Strawberry Plasticulture Guide's Fertility Chapter, "Strawberry Fertility and Nutrient Management," by Shaun N. Casteel (formerly with Plant/Waste/Solution Section, NCDA & CS), and it states: "Miner et. al. (1997) found no improvements in yield and fruit quality from spring potash injections through the drip system. The study concluded that the recommended amount of fall applied potash was sufficient (Clayton Central Crops - Wagram Sandy Loam) at 120 lb/acre. It was further recommended that a good rule of thumb is to adhere to NCDA & CS soil test recommendations for potash and to make adjustments as needed according to tissue analysis.

But, the research that was published in 1997 from Clayton Central Crops did not "mesh" with the reality that strawberry crops in the Sandhills and ENC have been benefiting from elevated amounts of potash, and growers have been achieving firmer and sweeter tasting berries by using these added amounts of potash in each weekly fertigation. I have personally spoken with highly respected and seasoned growers in other regions and states (Mid-South), who all seem to concur that you do run the risk of producing lower quality fruit without the added potash. I am personally familiar with a producer who is achieving excellent quality with a 1:1 ratio (N:S). Unfortunately, it would take 2-3 years of additional research to fully "sort this issue out." I see my role in extension as one of making you aware of the various programs and options, and the table below simply "spells out" two basic programs that involve using: Program 1- calcium nitrate and potassium sulfate; and Program 2 - calcium nitrate and potassium nitrate. [Just to let you know, the second program \(calcium nitrate and potassium nitrate\) is the program that most growers should probably use for reasons stated below.](#)

Hopefully, growers will find this table to be a quick and easy reference tool for determining how to combine these fertilizer materials to achieve different N:S ratios (1:1 or 1:2) and amounts of N/A/week (5.25 or 7.0).

#### 1. Weekly Amounts of Fertilizers for Plasticulture Strawberries ( CaNO<sub>3</sub>, K<sub>2</sub>SO<sub>4</sub> )

Ratio N:K	lb/a N	lb/a K <sub>2</sub> O	lb/a CaNO <sub>3</sub>	lb/a K <sub>2</sub> SO <sub>4</sub>	gallons H <sub>2</sub> O
1-0-1	7	7	45	13.5	19
1-0-1	5.25	5.25	34	10	14
1-0-2	7	14	45	27	32
1-0-2	5.25	10.5	34	20	24

#### 2. Weekly Amounts of Fertilizers for Plasticulture Strawberries ( CaNO<sub>3</sub>, KN<sub>03</sub> )

Ratio N:K	lb/a N	lb/a K <sub>2</sub> O	lb/a CaNO <sub>3</sub>	lb/a KN <sub>03</sub>	gallons H <sub>2</sub> O
1-0-1	7	7	31.8	15.9	19
1-0-1	5.25	5.25	23.9	11.9	14
1-0-2	7	14	18.5	31.8	32
1-0-2	5.25	10.5	13.8	23.9	24

You can generate your own values if you wish to use different ratios of N:S, but

the table above gives you a choice of either a 1:1 or 1:2 ratio.

It is easy to calculate how much fertilizer is needed per acre by simply dividing the amount of nutrient required per acre/week by the % nutrient composition of the fertilizer material.

An Example:

If you are using calcium nitrate (15.5%-0-0 + 22% Ca) as your nitrogen source, and you wish to "end up with" **5.25 lb N/A/week**, then just divide 5.25 by 15.5%, and then be sure to multiply by 100 (if you don't, you will be only applying about 1/3 lb/acre).

$$(5.25 \text{ lb N} / 15.5\%) \times 100 = \mathbf{33.9 \text{ lbs of calcium nitrate}}$$

**Or**, its simpler to just divide 5.25 lb N/ 0.155 = 33.9

Thus, 34 lbs of calcium nitrate will furnish the equivalent of 5.25 lb N/acre/week.

If you do not wish to provide any additional potash, then you are basically done (for the first injection of the season I don't believe it is that critical to include potash, but it is very important to get some N injected before you reach blossom stage!).

On the second injection you may then wish to start adding potash, and you could elect to use potassium nitrate (13-0-44 or 46) as your source of K as well as some N. You can refer to the second program in the table for CaN03 and KN03. Let's say you don't see the need to do more than a 1:1 ratio of N:S, and that you have gotten your first tissue report back and the lab says you are "low" on nitrogen and they suggest a 7 lb N/A/week program.

**USE THE TABLE:** The simple way to determine how much CaN03 and KN03 you need to inject would be to simply look at the first row of numbers in the second table or the 1-0-1 ratio and 7 lb/a N and 7 lb/a K20: 31.8 lbs of calcium nitrate plus 15.9 lb potassium nitrate.

**WATER SOLUBILITY:** Keep in mind If you attempt to dissolve more fertilizer than is soluble in a given volume of water, "salting out" can occur, meaning that a mass of fertilizer can settle to the bottom of the tank (barrel). The solubility of calcium nitrate is about 8.5 lbs/gallon water. Thus, if you are needing to inject 31.8 lbs of calcium nitrate, then you would require 3.74 gallons of water to dissolve 31.8 lbs of this fertilizer material (calculation: 31.8 lbs calcium nitrate / 8.5 = 3.74 gallons). In addition, if you are needing to inject 15.9 lbs of potassium nitrate, then you would require 14.7 gallons of water to dissolve 15.9 lbs of this

fertilizer material (calculation:  $15.9 \text{ lbs calcium nitrate} / 1.08 = 14.7$  gallons). Thus,  $3.74 \text{ gallons} + 14.7 \text{ gallons} = 18.4 \text{ gallons}$ , and this has been rounded off to 19 gallons in the final column of the table (to save you the trouble of calculating how much water is needed to dissolve these dry fertilizers). [The whole point of the above table is to save you time in calculating the exact amounts of fertilizer materials needed to achieve different N and K rates and ratios, AS WELL AS TO TELL YOU HOW MUCH WATER WILL BE NEEDED TO DISSOLVE THESE MATERIALS.](#)

COMPATIBILITY ISSUES: Another convenience associated with using calcium nitrate with potassium nitrate (SECOND PROGRAM) is that you can mix both of these fertilizers together without any compatibility issues. As one berry mg reader and strawberry grower wrote to me the other day:

**"Do not simultaneously inject sulfate or phosphate containing materials with calcium nitrate as a precipitate could form in the lines."**

[Certified Crop Advisor, George D. Simpson, Jr., recommends a combination of calcium nitrate and potassium nitrate to get the required N, followed by a flush with just water then the injection of Epsom salts followed by a flush of just water.](#) Fortunately, P fertilizers are generally needed in the spring season if 30-60 lb of phosphate is fall applied. But, if you are using any phosphates, then do not mix Mg, Zn, Fe, or Cu products with products that contain phosphates.

I guess one basic take home message from George Simpson is that if you want to completely avoid problems with forming insoluble precipitates that can plug the emitters and cause considerable misery for you, then you may wish to stick with the basic calcium nitrate and potassium nitrate program.

If you are willing to do a separate run to avoid problems with forming insoluble precipitates with calcium nitrate, then you do have the option of using potassium **sulfate** (the first table). Growers are already accustomed to running Epsom salts (containing 14% sulfur) in a second run - the same idea applies with potassium sulfate which contains 18% sulfur.

COSTS FAVOR THE 2ND PROGRAM (calcium nitrate and potassium nitrate). I checked the prices for these several fertilizers this morning, and with potassium sulfate now costing \$0.96/lb compared to \$0.90/lb for potassium nitrate, I really do not see much advantage to using the potassium sulfate program unless you really need to achieve some other production objective (which I will talk about in a moment). But with calcium nitrate running around \$0.46/lb, I discovered that using a 1-0-2 ratio calcium nitrate + potassium sulfate program to achieve 7 lb N and 14 lb K20, it would cost \$46.62 per application. You can deliver the same amounts of N and K20 for \$39.04 by using the second program (calcium nitrate + potassium nitrate), and not be concerned about precipitates forming.

INCREASING CALCIUM: Under what circumstances would the calcium nitrate + potassium sulfate program be attractive? If you glance at the tables above you will note how much more CaNO<sub>3</sub> is being used in the upper table vs. lower table. For example, if I wish to deliver 7.0 lb N/A/week in a 1-0-1 ratio, then in the upper table I would need to use 45 lbs CaNO<sub>3</sub>, which contains 19% calcium, or 8.55 lbs of Ca will be delivered per acre if I use this program vs. only about 6 lbs Ca would be delivered by using the second program with CaNO<sub>3</sub> and KN0<sub>3</sub> (31.8 lbs x .19 = 6 lb Ca). There may be times during the season when you need to try to boost Ca, and perhaps it would be a good thing to use the first program that includes potassium sulfate with calcium nitrate.

#### 4. Injection pointers

- a) Fertigation should occur near the end of the irrigation cycle to prevent leaching
- b) Be sure the system is fully charged before any fertilizer is introduced. When the system is not fully charged, air surges occur and cause erratic application rates of fertilizer
- c) The amount of time it takes to inject fertilizer should be at least as long as the time it takes to charge the system (usually 10 to 15 minutes). This will allow for the most uniform distribution of the fertilizer materials
- d) Flush lines thoroughly between different fertilizers to avoid incompatibility problems (do not simultaneously inject sulfate or phosphate containing materials with calcium nitrate)

\* To determine if chemicals are compatible, shake them together in jar to determine if precipitation occurs

#### 5. Boron questions

This helpful note came in yesterday from David Dycus, Regional Agronomist:

"I keep getting asked about Boron in strawberries and how to calculate it. We only apply Boron thru the drip IF the tissue report calls for it. On real sandy soils, where Boron deficiency is most likely to occur, we do oftentimes apply 1 pound of Boron broadcast prior to bedding in a blended fertilizer. Our tissue recommendation will say to add .125 lb Boron/acre. (This is 1/8th of a pound, which is the amount we apply thru the drip in a single application). We suggest using Solubor and Dr. Poling sent out an email that says Solubor is 20% B so it takes 10 ounces. [Solubor is not easy to find in my area](#) so we always end up at the grocery store in the laundry section buying Borax (like 20 mule team). The orange book tells us this is 11 % B. So the following calculations are good to know or refer to:

For Solubor: 0.125 lbs divided by 0.20 = 0.625 x 16 ounces (in a pound) equals **10 ounces per acre**

For Borax 0.125 lbs. divided by 0.11 = 1.136 x 16 ounces (in a pound) equals **18 ounces per acre"**

## **6. Reprint of 2 fertility tables from berry mg on March 17, and some further comments on Nitrogen, Potash and Sulfur**

I received a request to reprint 2 of the tables from March 17 Fertility update, and I have done that below. The first table is for Calcium Nitrate plus Potassium Nitrate (the more common program). The second table below is for the use of Calcium Nitrate and Potassium Sulfate (be aware that you must inject calcium nitrate and potassium sulfate in separate runs)

Before you can use either table, you must first decide if you wish to maintain a 1:1 or 1:2 ratio of N:K. I generally advise a 1:1 ratio, but others will recommend going to 1:2 (it would be excellent to do some more research on this whole topic of how much potash is beneficial for berry quality in another year).

You may wish to experiment with different potash feeding levels and see how your customers respond?

So, if you wish to use a 1:1 ratio (N:K) by using Calcium Nitrate and Potassium Nitrate, then go to this first table (this is our most commonly followed program - using these 2 fertilizer materials). And, if you wish to provide 7 lbs N/A/week, then you would need to inject approximately 32 lbs CaNO<sub>3</sub> with 16 lbs KNO<sub>3</sub>. You would also need about 19 gallons of water to dissolve these fertilizer materials.

### First Program (most commonly followed)

#### **1. Weekly Amounts of Fertilizers for Plasticulture Strawberries ( CaNO<sub>3</sub>, KN0<sub>3</sub> )**

Ratio N:K	lb/a N	lb/a K <sub>2</sub> O	lb/a CaNO <sub>3</sub>	lb/a KN0 <sub>3</sub>	gallons H <sub>2</sub> O
<b>1-0-1</b>	<b>7</b>	<b>7</b>	<b>31.8</b>	<b>15.9</b>	<b>19</b>
1-0-1	5.25	5.25	23.9	11.9	14
1-0-2	7	14	18.5	31.8	32
1-0-2	5.25	10.5	13.8	23.9	24

Many growers are also getting reports stating that there is a problem with nitrogen to sulfur ratio (N:S) and if this number is 17 or higher you will be advised to add some Epsom salts.

Add Epsom Salts for Sulfur (and Magnesium): After you have injected the calcium nitrate and potassium nitrate, and have flushed the lines with just

water, then you are ready to inject Epsom salts, followed by another flush of just water.

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POTASSIUM SLFATE AS SOURCE OF SULFUR: As several growers attending the Rudd Farm program on Wednesday noted, you could use a program of calcium nitrate and potassium sulfate to increase sulfur levels (instead of Epsom salts). You will note that Potassium Sulfate is 18% in S content (below)

MORE DETAILS:	percent N	percent Ca	percent K20	percent Mg
Calcium nitrate (CaNO3)	15	19	0	.
Potassium sulfate (K2SO4)	0	0	50	.

You could then refer to the table below (second program) to determine your weekly amounts of Calcium Nitrate and Potassium Sulfate to achieve various ratios of N:K and actual amounts of nitrogen and potash. For example if you want to have a 1:2 ratio of N:K and also want 7 lbs N/A/week, then you would need to use 45 lb CaNO3 as well as 27 lbs of Potassium Sulfate, but here's the catch --> do not mix the Calcium Nitrate with the Potassium Sulfate -- these must be separate runs.

So, for dissolving 45 lbs of Calcium Nitrate in water you would need 5.29 gallons of water ( the solubility of CaNo3 is 8.5 lbs per gallon, thus 45/8.5=5.29 gallons). Then for 27 lbs of Potassium Sulfate you would need 27 gallons of water. I am assuming that the solubility of Potassium Sulfate is 1 lb/gallon of water (at 77 F). Again, these two fertilizers are not to be mixed together, and must be injected in separate runs with a flush of water between the two fertilizers.

Second Program

Weekly Amounts of Fertilizers for Plasticulture Strawberries ( CaNO<sub>3</sub>, K<sub>2</sub>S0<sub>4</sub> )

Ratio N:K	lb/a N	lb/a K <sub>2</sub> O	lb/a CaNO <sub>3</sub>	lb/a K <sub>2</sub> S0 <sub>4</sub>
1-0-1	7	7	45	13.5
1-0-1	5.25	5.25	34	10
<b>1-0-2</b>	<b>7</b>	<b>14</b>	<b>45</b>	<b>27</b>
1-0-2	5.25	10.5	34	20