This article was listed in Forest Nursery Notes, Summer 2007

39. Time for a spring makeover. Peters, C. and Kackley, K. Greenhouse Management and Production 27(5):30-32, 34. 2007. A look at your fertility program to avoid problems that can result in poor quality plants.

2ND IN A 2-PART SERIES

Ensure your spring crop is a success with an extreme makeover of your fertility program.

By Cari Peters and Karen Kackley

Time for a spring makeover

In April GMPRO, *Page 43, we discussed how to do a thorough checkup of your water sources and growing media. This month we look at your fertility program to avoid problems that can result in poor-quality plants.*

A FERTILITY CHECKUP should include:

1. A review of your fertilizer program.
2. Selecting a fertilizer.
3. Proper fertilizer injector operation.

1. A review of your fertilizer program.

The chemical makeup of your water directly affects the type of fertilizer you use as well as the types of plants you will have the most success producing. Matching the water quality to the right water-soluble fertilizer formula can help to optimize the plant-growing potential. Water quality changes, so don't assume that last year's fertilizer formula is right for this year's crop.

Water-soluble fertilizers can be divided into three groups according to the formula's calcium carbonate equivalent.

Calcium carbonate equivalent is the value calculated from the raw materials used in the fertilizer formula that indicates if a fertilizer will raise or lower the growing medium solution pH over time. Formulas with a high concentration of nitrogen as nitrate tend to be more basic; formulas with a high ammoniacal or urea content tend to be more acidic.

Choosing a fertilizer formula with a high calcium carbonate equivalent value will influence the medium pH, especially if there is little to no buffering capacity in the irrigation water (low alkalinity). This effect is increased when growing in small containers or plug trays.

It is best to use technical support from a testing laboratory, cooperative extension service or a fertilizer manufacturer to help you to decide which fertilizer formula is best for your growing conditions and crops.

2. Selecting a fertilizer.

Select a fertilizer that supplies the nutrients that are missing from your water source as well as one that best suits the plants you are growing. For example, a grower who has a water source with moderately high alkalinity (around 120-140 parts per million calcium carbonate) would use a potential acidic fertilizer, especially

Calcium carbonate equivalent

	Fertilizer formula	Calcium carbonate equivalent (pounds)
Potentially acidic	21-7-7	1,539
	20-3-19	420
	20-10-20	401
	15-15-15	151
Neutral	17-4-17	0
	20-0-20	0
Potentially basic	15-0-15	319
	13-2-13	319
	15-5-15	69

if he was producing a large crop of petunia and calibrachoa. A fertilizer such as Petunia Feed 20-3-19 that contains double the amount of iron from three chelate sources would keep the pH of the medium down and make *iron available*.

Segregation by crop may be necessary if the same grower also plans to produce geraniums or marigolds. A 15-15-15 fertilizer would be a good choice for these crops.

3. Proper fertilizer injector operation.

Once a proper fertilizer program has been designed for you, check your fertilizer-delivery equipment. Most growers mix concentrates of water-soluble fertilizers and use a fertilizer injector system to deliver a nutrient solution to the crop. Proper maintenance and calibration is vital.

To check the function of your fertilizer injector, you must know the setting of the injector and the parts per million of nitrogen you plan to deliver to the plants. It is important to know that your injector does not deliver a fixed number of parts per million nitrogen. You must determine the amount of fertilizer to dissolve per gallon of water to make the appropriate concentrate for a specific injector setting.

Calculating stock solutions

Once you have selected an injector setting and determined the ppm of nitrogen to deliver to plants, consult the

Injection table for 100 parts per million fertilizer solution

Directions for using this chart:
Select percentage of nitrogen, phosphorus and potassium of fertilizer to be used in the left-hand column. Read across to the column with the injector settings listed at the top. The number in the intersecting box is the weight (in ounces) of fertilizer required for i gallon in concentrate. Multiply this amount by the number of gallons of concentrate to be made.

Percent Nitrogen (N), Phosphate (P205), Potash (K20)	Ounces of fertilizer per gallon of concentrate					
	Siphon proportioner	Injector ratio	Injector ratio	Injector ratio	Injector ratio	Injector ratio
	1:15	1:100	1:128	1:150	1:200	1:300
1%	20.25	135.00	172.80	202.50	270.00	405.00
2%		67.50	86.40	101.25	135.00	202.50
3%		45.00	57.60	67.50	90.00	135.00
4%		33.75	*43.20*	50.63	67.50	101.25
5%		27.00	34.56	40.50	54.00	81.00
6%		22.50	28.80	33.75	45.00	67.50
7%		19.29	24.69	28.93	38.57	57.86
8%	2.53	16.88	21.60	25.31	33.75	50.63
9%	*2.25*	*15.00*	*19.20*	*22.50*	*30.00*	*45.00*
10%	2.03	13.50	17.28	20.25	*27.00*	*40.50*
11%	1.84	12.27	15.71	18.41	24.55	36.82
12%	1.69	11.25	14.40	16.88	22.50	33.75
13%	1.56	10.38	13.29	15.58	20.77	31.15
	1.45	9.64	12.34	14.46	19.29	28.93
15%	1.35	9.00	11.52	13.50	18.00	27.00
15.5%	1.31	8.71	11.15	13.06	17.42	26.13
16%	1.27	8.44	10.80	12.66	16.88	25.31
17%	1.19	7.94	10.17	11.91	15.88	23.82
18%	1.13	7.50	9.60	11.25	15.00	22.50
19%	1.07	7.11	9.09	10.66	14.21	21.32
20%	1.01	6.75	8.64	10.13	13.50	20.25
21%	0.96	6.43	8.23	9.64	12.86	19.28
22%	0.92	6.14	7.86	9.21	12.27	18.41
23%	0.88	5.87	7.51	8.80	11.74	17.61
24%	0.84	5.63	7.20	8.44	11.25	16.88
25%	0.81	5.40	6.91	8.10	10.80	16.20
26%	0.78	5.19	6.65	7.79	10.38	15.58
27%	0.75	5.00	6.40	7.50	10.00	15.00
28%	0.72	4.82	6.17	7.23	9.64	14.46
29%	0.70	4.66	5.96	6.98	9.31	13.97
30%	0.68	4.50	5.76	6.75	9.00	13.50

fertilizer bag or an injector chart (see table on Page 31) to determine the amount of fertilizer needed per gallon of concentrate.

To apply a 20-10-20 fertilizer at 200 ppm with an injector set at a ratio of 1:100 or 1 percent, the injector chart shows that 6.75 ounces per gallon of concentrate equals 100 ppm. Therefore, 6.75 ounces x 2 = 13.5 ounces per gallon of concentrate is needed to obtain a 200 ppm fertilizer solution.

Before mixing the fertilizer in a stock solution, it needs to be measured. Volumetric measurements can be problematic because the typical greenhouse measuring devices (i.e., coffee cans or 4-inch pots) used to mix fertilizers don't contain the same volume.

To measure an accurate volume of fertilizer, confirm the amount periodically by weighing out the volume on scales. Carefully mark the fertilizer concentrate tank in graduated increments (1 gallon, 2 gallons, etc.) so that fertilizer is not wasted and plants aren't deprived of nutrients.

How much water is needed to dissolve one bag of fertilizer? One 25-pound bag of fertilizer contains 400 ounces (25 pounds x 16 ounces). If you know the amount of fertilizer that you need per gallon of concentrate, divide 400 by that number to determine the number of gallons of water needed to make the concentrate with one bag of fertilizer.

To apply 100 ppm nitrogen using any 15 percent nitrogen fertilizer, dissolve 9 ounces of fertilizer per gallon of water and set the injector ratio to 1:100. If a 400-ounce fertilizer bag is divided by 9 ounces per gallon of concentrate (400 9 = 44.5), 44.5 gallons of water is needed to dissolve one bag of 15 percent nitrogen fertilizer to apply 100 ppm nitrogen at an injector setting of 1:100.

Carl Peters is manager of research and analytical services and Karen Kackley is technical specialist, I.R. Peters Inc., (866) 522-5752; kkackley@jrpeters.com; www.jrpeters.com.

Checking your injectors

An injector setting of 1:100 means that i gallon of fertilizer concentrate makes 100 gallons of final solution. It does not mean that the injector will automatically deliver a loo ppm nitrogen solution.

Injectors may also display percent settings. Here are some relationships between percent and ratio.

Injector ratio setting	Equivalent percent setting
1:200	0.5%
1:64	1.6%
1:128	0.8%
1:50	2.0%
1:100	1.0%

Changing the injector setting

You may want to change the injector ratio, but you need to use up a stock solution of fertilizer that you already have on hand.

Example:

The fertilizer injector has a 1:100 (1 percent) injection ratio and a stock solution has been mixed to yield zoo ppm nitrogen.

A 1:200 (o.5 percent) injector setting means that i gallon is injected into zoo gallons of final dilution, so 0.5 percent yields 0.5 X 200 ppm = 100 ppm.

Changing the injection ratio from 1:100 to 1:200 actually reduces the fertilizer delivered by ½.

By changing the injection ratio setting to 1.6 percent (1:64), the same 200 ppm stock solution would yield 1.6 x200 ppm = 320 ppm nitrogen.

Checking injector output

Fertilizer solution color is not a reliable gauge for fertilizer strength. Use a soluble salts meter to check the amount of fertilizer delivered. Fertilizer manufacturers should provide information on the soluble salts or electrical conductivity (EC) readings that correspond to ppm nitrogen fertilizer levels. Use a good conductivity meter that reads in millimhos per centimeter (mmhos/cm) or deci-Siemens per meter (dS/m). These two units of measurement represent the same number.

To check a fertilizer solution by EC:

1. Check the EC of the untreated water supply.
2. Check the EC of fertilizer water at the hose end.
3. Subtract the EC value of the untreated water from the electrical conductivity value of the fertilizer water.
4. Compare the results to an EC chart from the fertilizer manufacturer or fertilizer bag.

Add the EC of the raw water to the number expected from the fertilizer to determine the target EC. If two fertilizers are added together, add their corresponding ECs to the water EC and use that number as the target.

Anything added to the fertilizer concentrate has the potential to contribute to the final EC of the solution. Epsom salts and mineral acids will add to the EC.

Once you are satisfied that your injector is working properly, submit a sample of the fertilizer solution to an analytical laboratory to verify injector operation. Laboratory results will provide individual nutrients levels as well as other useful information including pH and alkalinity.