Testing Fertilizing Injector and Stock Tank Preparation

In any fertilization program our goal is to make sure that plants receive the target rate of fertilizer that was requested. During the fertilizer calculation exercise we learned that we can measure the EC coming off the end of the hose and compare this to a table of values to check that the right amount of fertilizer is being used. If the measurement is not correct, then additional trouble shooting is necessary to determine if the problem is due to the injector not operating correctly or due to the stock solution being incorrectly mixed. In this exercise we will guide you through a series of steps to learn about this troubleshooting process (see Flowchart 1. Testing proper injection function).

STEP 1) TEST THE END OF HOSE SOLUTION

Your group has been provided with a solution of 21-5-20.

What is the target fertilizer concentration? _____ ppm N

What is the target EC of the fertilizer (based on the label below)? _____ mmhos/cm

Ounces of Peters EXCEL 21-5-20 Per Gallon of Concentrate

Nitrogen	Injector Ratios*					E.C.**
ppm N	1:15	1:100	1:128	1:200	1:300	mmhos/cm
25	0.24	1.61	2.06	3.22	4.83	0.16
50	0.48	3.22	4.12	6.43	9.65	0.32
75	0.72	4.82	6.17	9.65	14.48	0.48
100	0.96	6.43	8.23	12.86	19.29	0.64
150	1.45	9.65	12.35	19.29	28.94	0.96
200	1.93	12.86	16.46	25.72	38.58	1.28
300	2.89	19.30	24.69	38.58	57.90	1.92
400	3.86	25.72	32.92	51.44	77.16	2.56

Often our greenhouse fertilizers have added Epsom salts to provide magnesium which is not supplied in 21-5-20. Use the table below to determine the EC value that Epsom salts adds to our fertilizer.

PPM of Mg from	Contribution to EC

Epsom Salts ($MgSO_4 \cdot 7H_2O$)	(mmhos/cm)
10	0.08
20	0.16
30	0.25
40	0.33

What is the EC contribution of Epsom salts? _____

If other fertilizer additions are used, you will have use a lookup table to determine their addition to fertilizer EC.

What is the target fertilizer EC including Epsom salts? _____ mmhos/cm

Remember that the tap water you are using also has some level of salts dissolved in it (around 0.4 mmhos/cm for Cornell water). You can calculate what the final EC should be of the water hitting your plants from the equation below.

final EC = EC of tap water + EC of fertilizer **Equation 1**

What is the tap water EC? _____ mmhos/cm

What is the target fertilizer EC (use equation 1)? _____ mmhos/cm

Now check the EC of the fertilizer water coming off the end of the hose. Be sure to allow enough time for the hose to run so that new water is coming off the end. Then allow a decent volume of hose water to run into a bucket and collect a sample from this bucket (this ensures an accurate reading).

EC of water from end of hose? _____ mmhos/cm

How did the two values compare?

If they are nearly the same, then you can be assured that your fertilizer stock was mixed correctly and your injector is operating at the correct ratio. And you are finished! (But today you will complete the exercise even if it is correct so you can gain practice at calibrating the fertilizer injector and testing the stock solution.

If your hose value was less than the target EC, then:

- Your stock solution may be too dilute (i.e. not enough fertilizer was added), or
- Your injector may not be drawing up enough fertilizer stock

If your hose value was greater than the target EC, then:

- Your stock solution may be too concentrated, or
- Your injector may be drawing up too much fertilizer stock

STEP 2) TEST STOCK TANK BY DOING A MANUAL DILUTION

In this step, we take the injector out of the picture, we do the work of the injector, by manually conducting the dilution and then comparing this to the target EC to see if the stock solution was prepared correctly. (See Flowchart 2. Troubleshooting using Manual Dilution).

2A) Vigorously mix the fertilizer stock so that you will get a good reading – use a stirring stick that reaches all the way to the bottom of the container to vigorously mix the stock solution.

2B) Use a 10 mL graduated cylinder to collect 10 mL of stock concentrate. MEASURE CAREFULLY!

2C) Pour the 10 mL stock solution into a 1 Liter graduated cylinder. Fill to the one liter line with tap water. AGAIN MEASURE CAREFULLY!

2D) Mix the 1 liter solution very well, you may need a separate bucket or container to do this

2E) Take a sample and test

What was the manual EC reading? _____ mmhos/cm

Remember, this is a reading using a 1:100 dilution; you can compare this reading directly to the hose-end readings and target EC if you are using a 1:100 injector ratio. If you are using a different injector ratio you need to divide by the last number of the ratio and then multiply by 100. Examples:

- Using the manual dilution you measured EC to be 2.0, and you are using a 1:100 injector
  - No additional calculation is necessary because:
    EC → 2.0 / 100 (injector ratio) × 100 = 2.0 mmhos/cm
- Using the manual dilution you measured EC to be 2.0, but you are using a 1:200 injector
  - EC → 2.0 / 200 × 100 = 1 mmhos/cm
- Using the manual dilution you measured EC to be 2.0, but you are using a 1:64 injector
  - EC → 2.0 / 64 × 100 = 3.125 mmhos/cm

How does this compare to the target EC?

If the reading was not correct, then your fertilizer stock was mixed incorrectly.
If the reading was correct, then the solution was mixed correctly, but the injector is not operating correctly (check injector ratio setting, check for cracks or air leaks, it may need serving).
Continue to Part 3.

STEP 3) TEST INJECTOR CALIBRATION

In this step we will calculate the ratio that the injector is operating at. In some cases, this may not match the ratio setting on the machine (due to cracks, air leaks, machine age, etc.). (See Flowchart 3. Troubleshooting using Volume Calibration).

3A) Fill a graduated cylinder with water up to 500 mL.

3B) Make sure there are no bubbles in the suction tube, place injector suction tube into graduated cylinder.

3C) Open water valve at hose end into the 5 gallon bucket. Fill to line in bucket (20 L).

3D) Remove suction tube from graduate cylinder and determine how much solution was used from the graduate cylinder.

Solution used = 500 mL (initial reading) – final reading

What is the your solution used amount? _____ mL

3E) Calculate the injector ratio:

Proportion of irrigation water used = 1 / solution used (mL) × 20,000 mL

Example calculations:

- 200 mL used
  - Proportion = 1 / 200 × 20,000 = 100
- 100 mL used
  - Proportion = 1 / 100 × 20,000 = 200
- 400 mL used
  - Proportion = 1 / 400 × 20,000 = 50

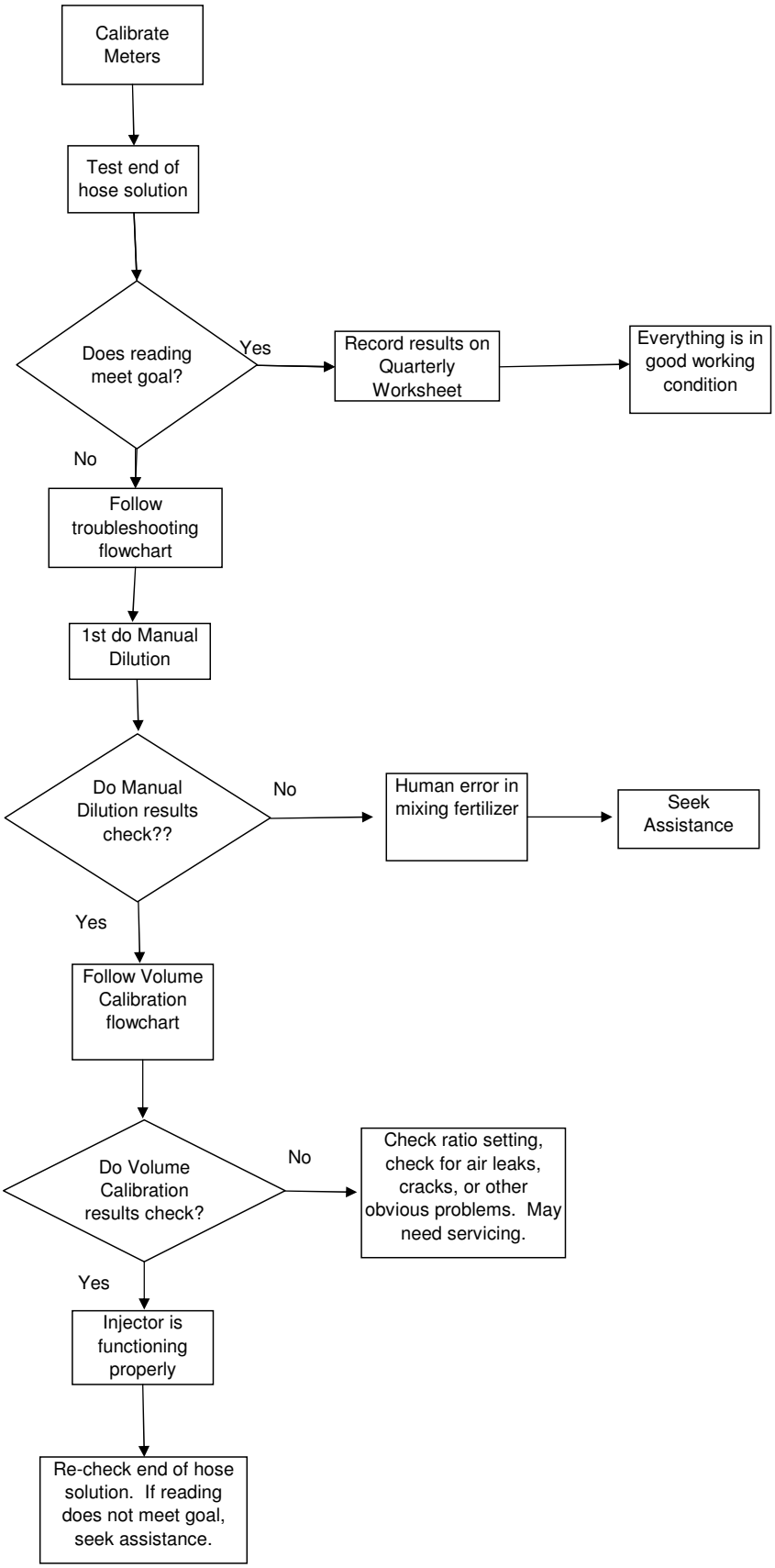
What is your proportion? _____

The injector ratio is 1:propotion (that you just calculated), ex: 1:100

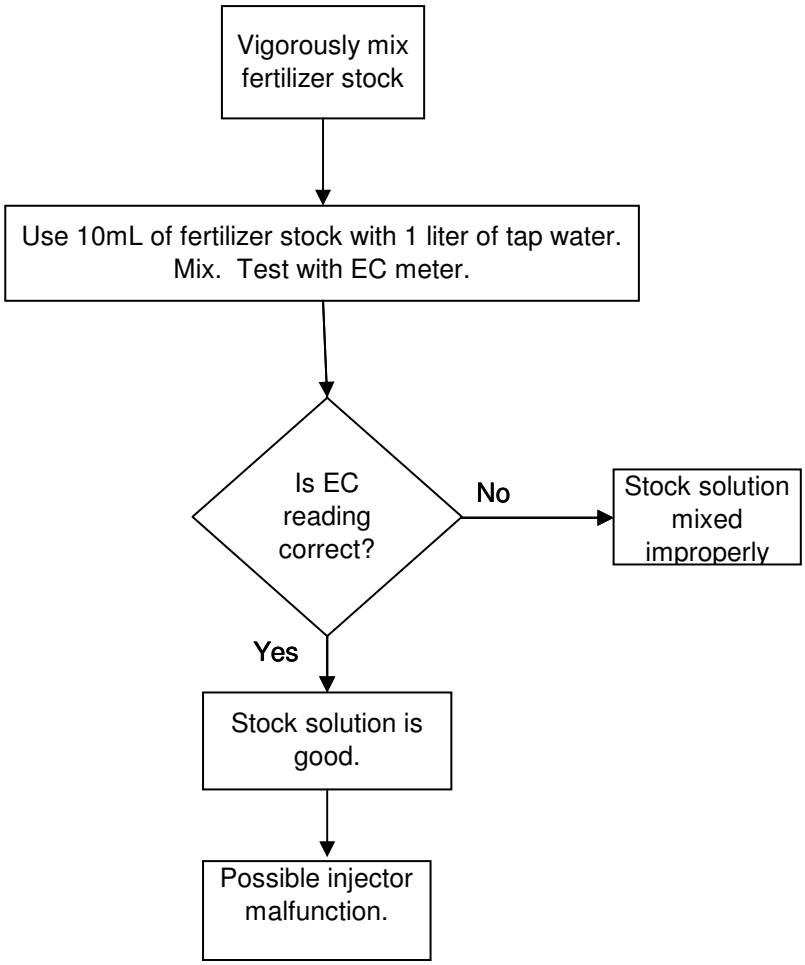
What is your injector ratio? _____

Now that you have calculated the actual injector ratio, you can adjust the ratio setting on the injector to achieve the desired ratio (you will then need to repeat step 3 to test). Service to the injector may be required if it is difficult to achieve a desired ratio or if other symptoms of wear are visible – seek assistance

Flowchart 1. Testing proper injector function



Flowchart 2. Troubleshooting using Manual Dilution



Flowchart 3. Troubleshooting using Volume Calibration