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HS1197

How to Calculate Fertigation Injection Rates for Commercial Blueberry Production[1]

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Introduction

Florida's commercial blueberry industry has increased significantly in acreage and value, going from approximately 1,000 acres in 1993 to more than 4,000 acres in 2010 (Braswell 2010), and from $39 million in 2007 to $72 million in 2009 (Strange 2007). Per capita consumption of blueberries has increased by 400% during the last decade (Braswell 2010). Florida produced approximately 17.7 million pounds of fresh blueberries in the 2010 season. However, Florida only contributed 4.2% of total U.S. fresh blueberry production, which was more than 416.5 million pounds (USDA-NASS 2011). The value of blueberries destined for processing has also increased. The total U.S. value of processed blueberries grew from $62.3 million in 2009 to $136.0 million in 2010 (USDA-NASS 2011).

Florida's subtropical climate allows for early blueberry production during a historically profitable marketing window. The industry is expected to continue to grow and expand. To increase nutrient and water use efficiencies and reduce nutrient leaching and environmental concerns, fertigation is recommended for commercial blueberry production. In fact, successful fertigation can enhance sustainability and maximize profitability for commercial blueberry enterprises. One of the key factors in fertigation is the correct calculation of fertilizer injection rate and time for the acreage. This publication helps blueberry growers correctly calculate fertigation injection rates and times and provides reference tables for checking injection rates and times needed for a variety of production scenarios.

Calculation of injection rate and time

Fertigation rate and time depend on the irrigation water flow rate and fertilizer application rate. To simplify the calculation, we will use nitrogen (N) fertilizer as an example. For other nutrients, such as phosphorus, potassium, and the like, the principle is the same. For most cases, 0.1% of the irrigation flow rate is a proper injection rate (Burt, O'Connor, and Ruehr 1995). Six steps are needed to calculate the injection rate and time for fertigation if a solution N fertilizer is used.

Step 1: Determine the total amount of N needed for the fertigation event. Calculate the total amount needed by multiplying the farm size in acres by the N rate to be applied in pounds per acre. If you know your total linear feet of bed and width of row spacing, the linear feet of bed can also be used. Only the band area needs to be fertilized. For example, for a blueberry farm with a 4-foot band and 8-foot row spacing, the actual linear feet of bed per acre can be calculated as follows (Equation 1):

$$\frac{43560\,SquareFeet}{Acre} \div 8\,Feet = \frac{5445\,Feet}{Acre}$$

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In other words, the rate of N divided by the linear feet of bed gives you the amount of N per linear foot of bed to be applied. Multiplying the total linear feet of bed and the amount of N per linear foot of bed provides the total amount of N for the fertigation event. For calculating recommended fertilizer rates in raised-bed, mulched cultural systems, see http://edis.ifas.ufl.edu/ss516.

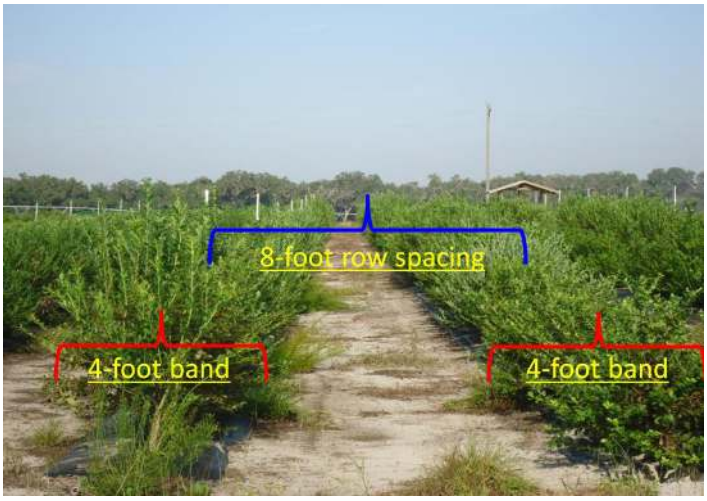

Figure 1. For a 4-foot irrigated band within an 8-foot row spacing, the area that receives fertigation is half of the total, or "real estate," area. Thus, the actual band area of the farm equals 50% of the farm area. However, all IFAS-recommended fertilizer rates are given on a "real estate" acre basis. The amount of fertilizer to apply is calculated based on the entire area of the blueberry farm, regardless of the width of the band to which the fertilizer is applied.
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Step 2: Calculate the total weight of liquid fertilizer needed for fertigation. The total weight depends on both total N to be applied and the grade of the selected N fertilizer solution. For instance, UAN-32 (urea-ammonium nitrate solution, 32-0-0) contains 32% N by weight. The total weight of the fertilizer solution to apply is equal to the total N needed (from Step 1) divided by the N concentration (0.32 in this example). For example, if you need 100 pounds of N for a particular fertigation event, how much UAN-32 do you need? Divide 100 pounds by 0.32. You need 312.5 pounds of UAN-32.

Step 3: Calculate the number of gallons of liquid N fertilizer. This number is determined by the density of liquid N fertilizer. Every solution fertilizer has a density that is listed on the fertilizer label. For example, 1 gallon of UAN-32 weighs 11.05 pounds; thus, the density of this particular fertilizer is 11.05 pounds per gallon. The amount of fertilizer in gallons to apply is calculated by dividing the total weight of solution fertilizer (from Step 2) by the density.

Step 4: Calculate the dilution factor. The dilution factor is determined using the N concentration of the solution N fertilizer and the target N concentration in the irrigation water (parts per million [ppm]) for the fertigation event. The fertilizer grade (e.g., 32%) should first be converted into ppm by multiplying by 1,000,000. The fertilizer concentration in ppm (e.g., 320,000 ppm) is then divided by the target N concentration (e.g., 150 ppm). The result is the dilution factor.

Step 5: Calculate the injection rate. The injection rate is determined by dividing the irrigation water flow rate (e.g., 1,000 gallons per minute) by the dilution factor (from Step 4).

Step 6: Calculate the injection time. Injection time is determined by dividing the number of gallons of solution N fertilizer needed (from Step 3) for the fertigation event by the injection rate (from Step 5).

Practical example

We will use UAN-32 (32% N, 11.05 pounds per gallon) to apply 5 pounds N per acre to a 5-acre blueberry field with 8-foot spacing. The irrigation flow rate is 1,000 gallons per minute and the target N concentration in the irrigation line is 150 ppm. To calculate the injection rate and time:

Step 1: Total N: 5 lb/acre N × 5 acres = 25 lb N

Step 2: Pounds of UAN-32: 25 lb N ÷ 0.32 = 78.1 lb UAN-32

Step 3: Gallons of UAN-32: 78.1 lb ÷ 11.05 lb/gal = 7.0 gal

Step 4: Dilution factor: 0.32 × 1,000,000 ppm ÷ 150 ppm = 2,133.3

Step 5: Injection rate: 1000 gal/min ÷ 2133.3 = 0.47 gal/min

Step 6: Injection time: 7.0 gal ÷ 0.47 gal/min = 15 min

Therefore, in this particular case, 7.0 gallons of UAN-32 are needed for the fertigation event.

For different-sized blueberry farms with 1,000 gallons per minute irrigation flow rate at target N concentration of 150 ppm N and using UAN-32 as the N source, the corresponding gallons of UAN-32 and injection time can be found in Table 1. Here, 150 ppm N is recommended because if the N concentration is too low, the plants may not be able to get sufficient N. If more than 150 ppm N is used, it may cause N leaching. The fertigation time is also important to avoid water pollution from agriculture. The type of irrigation system has a significant effect on injection time. Generally, if

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the irrigation is drip, any given irrigation cycle in pine bark beds should not exceed 12–15 minutes. This time should be even shorter for younger plantings. In straight pine bark culture with mature plants, the irrigation wetting frontage moves below the root zone (i.e., below the 9–12-inch depth) in 12–15 minutes. Irrigation cycles can be longer (up to about 1 hour) with microsprinklers. The run times for bark incorporated into the soil or straight soil can be longer per cycle. This example uses UAN-32. Other soluble fertilizers can also be used in fertigation. If using double drip tape per bed, the injection time can be shortened by up to 50%.

For a 10-acre field using UAN-32 with a target N concentration of 150 ppm but with different water flow rates, the corresponding injection rate and time are shown in Table 2.

Why is it important to calculate the fertigation rate correctly? Because we need to make sure that blueberry plants receive sufficient—but not excessive—nutrients. We must avoid plant damage by not introducing too much salt at one time. We want to avoid overapplying fertilizer to save money in fertilizer cost, thus maximizing profitability. We should prevent or minimize potential nutrient contamination of nearby water resources.

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Table 1. Injection rate and time needed to apply 5 pounds of N per acre (in a 150 ppm N solution made from UAN-32 liquid fertilizer with 32% N) to a 1- to 100-acre farm with a 1,000-gallon per minute irrigation water flow rate

Farm size	Total N needed	UAN-32 fertilizer needed		Dilution factor	Fertilizer injection rate	Fertilizer injection time
(acres)	(lb)	(lb)	(gal)		(gal/min)	(min)
1	5	15.6	1.4	2133.3	0.5	3
2	10	31.3	2.8	2133.3	0.5	6
3	15	46.9	4.2	2133.3	0.5	9
4	20	62.5	5.7	2133.3	0.5	12
5	25	78.1	7.1	2133.3	0.5	15

Note: To prevent any nutrient contamination of nearby water sources and maximize profitability of commercial blueberry production, fertigation time should NOT be more than 15 minutes. If you have a blueberry farm with more than 5 acres, you may need to use a pump with great capacity to perform your fertigation.

Table 2. Calculation of injection rate if applying 5 pounds of N per acre (in a 150 ppm N solution made from UAN-32 liquid fertilizer with 32% N) to a 10-acre farm with 500-, 1,000-, 1,500-, or 2,000-gallon per minute flow rate from the pump

Water flow rate	Total N	UAN-32		Dilution factor	Injection rate	Injection time
(gal/min)	(lb/acre)	(lb)	(gal)		(gal/min)	(min)
500	50	156.3	14.1	2133.3	0.2	60
1,000	50	156.3	14.1	2133.3	0.5	30
1,500	50	156.3	14.1	2133.3	0.7	20
2,000	50	156.3	14.1	2133.3	0.9	15