Marilynn Hale 300

DAFFODIL BULB FERTILIZATION - 1981

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The suggestions on fertilizer applications and rates are based on data collected from a fertility survey on bulb production in western Washington, three years of fertilizer trials conducted at Northwestern Washington Research Unit (Table 1), and consideration of the nutrient removal of daffodil bulbs from the soil (Table 2).

The philosophy in developing this guide for fertilizer rates embraces the concept that equivalent amounts removed in crop productions should generally comprise the basal fertilization program. But this concept does provide lower rates of fertilizer to soils with higher soil test analysis.

NPK fertilizer trials were conducted to determine threshold fertilizer levels that affect yield. Experience with other crops grown in western Washington are heavily relied on for suggesting appropriate fertilizer rates.

Gross yields of daffodil bulbs may double after one year of growth and quadruple after two years of growth. Since a significant weight and volume of bulbs are planted, the amount of nutrients removed by the crop should be based on net bulb yield. Net bulb yield is calculated by subtracting planting stock weight from the gross yield.

The following fertilizer suggestions are based on planting: approximately five tons of planting stock placed in rows spaced 3.5 feet apart and in a two-year crop production cycle.

Table I
Effect of Banded NPK Fertilizer Rates on Yield and Grade of 1- and 2-Year Field-Grown Daffodil Bulbs[1,2]

Fertilizer Treatment[3] Lbs/Acre			Field Grown 1 Year[4] 1978-79	Field-Grown 1 Year[4] 1979-80		Field Grown 2 Years[4] 1979-81	
N	P_2O_5	K_2O	Yield Tons/Acre	Yield Tons/Acre	Average Grade[5]	Yield Tons/Acre	Average Grade[5]
0	0	0	6.89a	9.58a	3.13a	19.0abc	3.27a
Commercial 10-20-20							
80	160	160	6.96a	10.37a	3.02a	17.3 c	3.32a
Nitrogen							
0	160	160	8.10a	10.14a	3.16a	19.6ab	3.27a
40	160	160	7.94a	10.32a	3.20a	20.1ab	3.43a
80	160	160	9.43a	9.67a	3.19a	20.1ab	3.36a
120	160	160	9.12a	10.42a	3.16a	20.9a	3.28a
Phosphorus							
80	0	160	8.16a	10.08a	3.26a	18.6 bc	3.38a
80	80	160	8.64a	10.44a	3.18a	20.9a	3.29a
80	160	160	9.43a	9.67a	3.20a	20.1ab	3.36a
80	240	160	7.74a	10.12a	3.20a	20.6ab	3.42a
Potassium							
80	160	0	7.89a	10.47a	3.24a	20.1ab	3.33a
80	160	80	8.72a	10.03a	3.25a	20.7a	3.46a
80	160	160	9.43a	9.67a	3.20a	20.1ab	3.36a
80	160	240	8.45a	10.02a	3.23a	20.6ab	3.29a

(continued)

Table 1 (cont'd)

1. The Fortune planting stock, 15-17 cm, was acquired in 1978 and was planted into fertilizer trials. Severe freeze damage occurred during the winter, and therefore stock was dug in the summer of 1979. The fertilizer treatments were kept separated and the bulbs were graded in each treatment. In 1979 the bulbs were planted back to the same fertilizer treatments. The one-year grown crop was planted to 15-17 cm grade bulbs. The two-year grown crop was planted to less than 15 cm grade bulbs.

2. The density of bulbs planted was equivalent to five tons/acre in a band ten inches wide and the rows spread 42 inches apart.

3. The basal fertilizer rate was equivalent to 800 lbs/acre of 10-20-20. The test rates were made up with ammonium nitrate, treble super phosphate, and sulfate of potash. Commercial 10-20-20 is made up with sulfate of ammonia, mono-ammonium phosphate, and muriate of potash. The fertilizer was placed in two bands eight inches apart and two inches below the bulb furrow.

4. Average grade was calculated by multiplying weight in each size group by its grade number, summing their products, and dividing by the total weight.

Grade No.	Size (cm circumference)
1	19-21
2	17-19
3	15-17
4	less than 15

Table 2
Nutrient Absorption of Daffodil Bulbs from the Soil

Net Bulb Yield[1] Ton/Acre	Pounds of Nutrient Removal/Acre[2]				
	N	P_2O_5	K_2O	Ca	Mg
5	66	21	70	20	3
10	132	41	140	40	6
15	198	63	210	60	9

[1]Net bulb yield = gross yield minus weight of planting stock.

[2]Nutrient removal of Fortune bulbs grown in western Washington during the 1977-78 season. Bulb dry matter 37%.

Soil pH, Cation Exchange Capacity, and Base Saturation

The soil pH for good crop growth on western Washington mineral soils should be in the range of 5.8-6.2. The pH has a definite effect on the availability of essential elements required for plant growth and the activity and composition of microorganisms residing in the soil. Low soil test pH readings are correlated with high concentrations of iron and aluminum in daffodil plant tissue.

The amount of lime required to adjust the soil pH to the optimum range depends on the cation exchange capacity and the plow depth. Soils with high percentages of organic matter and clay have higher cation exchange sites in a given volume of soil and therefore require more lime to change the pH. A useful soil test is percent base saturation. Base saturation is determined by summing up the milli equivalents (meq) of calcium, magnesium, and potassium, dividing by the total meq of cation exchange capacity in the soil, and multiplying by 100. The ideal percent base saturation in mineral soils should be about 65%.

Another method to determine lime requirememts is to decide which soil texture group best describes the field, and use the following table for estimating the lime requirement:

Approximate Amount of Agricultural Limestone Needed to Raise the pH of a 10-Inch Layer of Soil*

Soil Texture	Lime Requirement (Tons/Acre)	
	from pH 4.5 to 5.5	from pH 5.5 to 6.2
Sandy and loamy sand	.7	.6
Sandy loam	1.1	1.3
Loam	1.7	1.7
Silt loam	2.1	2.0
Clay loam	2.7	2.3
Muck	5.4	4.3

*Adapted from Western Fertilizer Handbook - 1980.

Applications of 1-2 tons per acre can be made and annual soil tests used to monitor the rate of pH change and determine when the next applications are required. When liming, additional consideration should be given to fields with low soil tests of trace elements, since liming will cause a decrease in availability of these elements. Liming increases the need for diligent monitoring for trace element deficiencies.

Salts

The salt index of 10-20-20 is high because both N and K (particularly when Kcl is used) increase the osmotic pressure of the soil solution which can cause injury to plant roots. Salt concentrations in commercial bulb fields are higher in rows than between rows. Salt readings in the immediate vicinity of the fertilizer bands are very high.

For salinity reduction, complete fertilizers using sulfate of potash, instead of muriate, have shown positive yield response, and it is probably due to a significantly lower salt index. Another method of reducing the salinity effect in the fertilizer band would be to broadcast and incorporate potassium prior to planting.

Nitrogen

Nitrogen is an important element in the composition of daffodil bulbs. The N fertilization is complicated due to the leaching of nitrate during the winter. The percentage of N recovery from the fall-applied fertilizer is unknown. There is appreciable mineralization from the soil organic matter in the spring that may contribute to a significant amount of N for plant growth. Research results of N fertilizer applied at planting and in the spring of the second year have not shown positive bulb yield responses. Further research is required before a recommendation can be given.

A suggestion (until research can define the most effective use of nitrogen) is to band diammonium phosphate below bulbs based on phosphorus soil test requirement. Additional N could be supplied in the broadcast fertilizer program.

Phosphorus

Soil test results from the survey indicate that considerably more P is being added to the soil than crops are utilizing. Effective utilization of phosphorus under cold climatic conditions, such as occur in the growing period of February-May, require band placement for efficient nutrient absorption. A good source of phosphorus is diammonium phosphate that is placed below the bulb furrow in one or two fertilizer bands.

Appropriate P applications should be based on the soil test analyzed by Morgan's reagent extraction:

Soil Test for P Reads	Apply this Amount (lbs/A)	
PPM	P_2O_5	*P
0-3	160	70
3-6	120	55
6-10	90	40
10+	60	25

*P is expressed in the elemental form. To convert P_2O_5 to P, multiply by .44. P values rounded off to nearest 5 lbs.

Potassium

High K soil test results on soils intensely used for bulb production indicate considerably more K fertilizer is being applied than the crop is utilizing. Excessive amounts of potassium may be detrimental to production by contributing to a salinity problem, especially when banding muriate of potash. Broadcast applications of K and trace elements after plowing are recommended to reduce the high salinity in the fertilizer band. Potassium also provides the needed fertilizer volume for adequate mixing of the required trace elements.

Soil Test for K Reads	Apply this Amount (lbs/A)	
PPM	K_2O	K*
0 - 100	240	200
101 - 150	180	150
150 - 200	120	100
Above 200	60	50

*K is expressed in the elemental form. To convert K_2O to K, multiply by .83. K values are rounded off to the nearest 5 lbs.

Magnesium

Apply Mg if soil test is below .75 milli equivalents/gram of soil (Meq).

Soil Test for Mg Reads	Mg to Apply as Fertilizer (if Dolomite Lime not used)
Meq/100 g	(lbs/A)
0.0 - .25	45
.25 - .50	30
.50 - .75	15

*If both Mg and lime are needed, the simplest way to provide both is to apply dolomite limestone. If the lime requirement is over 1 ton/A, only the first ton of lime needs to be the dolomite type. Mg can also be provided by use of epson salts (magnesium sulfate), sulfate of potash magnesia, or magnesium oxide.

Sulfur

Sulfur is a difficult element to analyze by soil tests. Basic fertilizer mix should include a minimum of at least 30 lbs. S per acre.

Trace Elements

Trace elements are becoming an increasingly important part of the fertilizer programs due to continual cropping of farm land in western Washington. A boron deficiency is known to occur in bulb crops. Manganese and zinc deficiencies are frequent problems in the production of other crops in the Skagit area that are grown in rotation with bulb crops. Copper deficiencies are most likely to occur in high organic matter soils.

Trace element applications are best applied as part of the broadcast fertilizer. Mixing of fertilizer prills with different sizes and densities results in some separation; application of some trace elements (for example, boron and zinc) in the fertilizer band can result in serious

toxicity problems. The following test application rate recommendations are for use on mineral soils:

Soil Test PPM	Apply Broadcast lbs/A
Boron	
0.0 - 0.5	4
0.5 - 1.0	2
1.0+	0
Manganese	
(DPTA EXTRACTION)	
0.0 - 0.5	50
0.5 - 3.0	30
3.0 - 5.0	15
5.0+	0
Zinc	
(DPTA EXTRACTION)	
0.0 - 0.5	15
0.5 - 1.0	10
1.0 - 2.0	5
2.0+	0
Copper	
(DPTA EXTRACTION)	
0.0 - 1.0	2
1.0 - 2.0	1
2.0+	0

There are many different trace element fertilizer materials. Your fertilizer dealer will be helpful in suggesting the best and most economical sources available.

Steps in using the fertilizer guide:

1. Take soil sample and send to soil testing laboratory for analysis.
2. Compare soil test results with fertilizer guide (Section 1). Determine the amount of fertilizer elements (or oxides) required to satisfy fertilizer needs (Column A).
3. Determine the appropriate fertilizer materials (Column B) and amounts (Column C) to satisfy the fertilizer needs. Your fertilizer dealer will be helpful in suggesting the most economical fertilizer compounds readily available for use in your fertilizer program.
4. Determine the most appropriate method of application (i.e. broadcast, banded at planting, top dressing) and fill in Section 2 of the worksheet. This also provides an opportunity to determine the amount of essential fertilizer elements, like nitrogen and sulfur, that are not commonly included in field soil test analysis.

SECTION I

Sample Soil Test		(A) Amt. Recommended by Fert. Guide lbs./A	(B) Choice of Fertilier	(C) lbs/A
pH	5.9	No lime needed		
N	--	?		
P (ppm)	5.6	120 P_2O_5	18-46-0 (46% P_2O_5)	300
K (ppm)	157.0	120 K_2O	Muriate of potash (60% K_2O)	200
Ca (meq/100 g)	6.50	OK		
Mg (meq/100 g)	0.80	OK		
B (ppm)	0.63	2	Borate-68 (21% B)	10
Mn (ppm)	3.60	15	Man-Gro (28% MN)	50
Zn (ppm)	1.11	5	Zn M-N-S (15% Zn)	40
Cu (ppm)	2.40	OK		
S	--	30		

SECTION 2 -- Balance Sheet of Fertilizer Used

Method of Application	Fertilizer Form	Lbs/A	N	P_2O_5	K_2O	Ca	Mg	S	Mn	Zn	B	Cu
Broadcast	Muriate of Potash	200			120							
	Ammonium Sulfate	100	21					24				
	Man-Gro	50						8	14			
	Zn M-N-S	40						8	1	6		
	Borate-68	10									2	
Banded at Planting	18-46-0	300	54	138								
Top Dress (Spring)												
	Totals	700	75	138	120	0	0	40	15	6	2	0
Amount Fertilizer Needed Based on Guide			?	120	120	0	0	30	15	5	2	0