Supplemental Light Increases Milk Yield in Michigan Dairy Herds

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AG FACTS

HIGHBUSH BLUEBERRY NUTRITION

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Blueberry plants grow most satisfactorily on an acid soil (pH 4.5 - 5.0) with adequate moisture and high organic matter. Compared to other fruit crops, blueberries have very low nutrient requirements (Table 1). Nitrogen must be applied every year, but other nutrients, such as potassium and phosphorus, are often present in sufficient quantities, particularly on sites that have received a complete fertilizer for a number of years. Therefore, both soil and leaf analysis should be done at least once every three years to guide fertilizer programs. Instructions for collecting and submitting soil and leaf samples can be found in Extension bulletins E-498, *Sampling Soils for Fertilizer and Lime Recommendations* and E-449, *Plant Tissue Analysis for Determining Fertilizer Needs of Michigan Fruit Crops*.

New plantings

Have soil tests done before planting to determine nutrient levels. When levels of phosphorus (P), potassium (K) and magnesium (Mg) are adequate (P greater than 70 lb/A; K greater than 100 lb/A; Mg greater than 75 lb/A), sprinkle urea or ammonium sulfate 12 to 18 inches from newly set plants approximately 4 weeks after planting. One-half ounce of actual nitrogen per plant is usually adequate. Apply a 2-1-1 ratio fertilizer if phosphorus and potassium are limiting.

Established plantings

Nitrogen (N). Adequate foliar levels in mature plantings range from 1.65 to 2.1 percent. Levels above 2.3 percent are excessive and can lead to yield declines. If a leaf analysis indicates that all nutrients except nitrogen are adequate and the pH is greater than 5.0, apply ammonium sulfate (21-0-0). If the pH is less than 5.0, use urea (45-0-0). Avoid nitrates and chlorides—they can be toxic to blueberries.

Nitrogen requirements vary with plant age. Apply 6 to 8 lb of actual nitrogen per acre for each year of age up to age 8 (Table 2). These rates should be doubled or tripled if bark or sawdust mulches are used.

Table 1. Standard values for Michigan fruit crops.*

Nutrient	Blueberry	Apple	Cherry	Peach	Grape
Nitrogen, %	1.65	2.33	2.95	3.87	0.82
Potassium, %	0.35	1.53	1.67	1.68	2.01
Phosphorus, %	0.10	0.23	0.25	0.26	0.20
Calcium, %	0.34	1.40	2.09	2.12	1.75
Magnesium, %	0.12	0.41	0.68	0.67	0.44
Manganese, ppm	168	98	150	151	650
Iron, ppm	150	220	203	166	30
Copper, ppm	15	23	47	18	23
Boron, ppm	49	42	50	48	41
Zinc, ppm	20	30	30	30	30

*Modified from Kenworthy, A. L. *Nutrient trends in Michigan Fruit Plantings.* Research Report 379, 1979: Michigan State Agricultural Experiment Station

Table 2. Recommended rates of nitrogen. (lb/A).

Age	Urea	Ammonium sulfate	Actual N
8	150	300	65
6	100	215	45
4	70	150	31
2	35	75	15

Where organic matter content is high, make a single application of fertilizer just before bud break or when growth begins in the spring. On more sandy sites, it may be beneficial to fertilize both at bud break and at petal fall with half the recommended N (Table 3). The fertilizer should be scattered in a broad strip on each side of the bush.

Table 3. Effect of single and split applications of nitrogen on blueberry yields (lb/bush). Values are averages of three fields of 'Jersey,' one field of 'Bluecrop,' and one field of 'Rubel'.

Year	Yield (lb/bush) One application Urea-150 lb/A[a]	Two applications Urea-75 lb/A[b]	Differences
1982	7.1	7.0	– 1%
1983	21.0	22.5	+ 7%
1984	13.5	15.5*	+ 15%
1985	10.9	11.4*	+ 5%
1982-1985 (Mean)	13.1	14.1*	+ 8%

[a]Applied once at bud break.
[b]Applied at bud break and petal fall.

Potassium (K). Potash, like nitrogen, is water soluble but is used in much smaller quantities by blueberries. Few fields have shown deficiency symptoms for this element, but at some sites, soil levels (K less than 100 lb/A) and foliar levels (0.35 percent) have dropped below the point considered adequate for high yields.

Potassium can be applied as a mixed fertilizer with potassium sulfate as the source or as straight potassium sulfate (Table 4). Sul-Po-Mag can also be used, but avoid chlorides, such as muriate of potash—they can be toxic.

An excess of potassium can interfere with the uptake of other elements, particularly magnesium. Therefore, potassium **should not** be added unless soil and foliar analyses suggest that levels are deficient. Excesses are much more difficult to correct than deficiencies.

Table 4. Recommended rates of potassium sulfate.

Soil test (lb K/A)	K_2O lb/A (mineral and organic soils)
0 - 24	100
25 - 49	75
50 - 74	50
75 - 99	25
100 +	0

Phosphorus (P). Phosphorus deficiencies are extremely rare. Desired standard foliar levels are 0.07 to 0.1 percent. If phosphorus does become deficient, a 2-1-1 ratio fertilizer or superphosphate (0-46-0) can be used.

Continual application of too much phosphorus fertilizer can lead to iron deficiency symptoms and poor growth. Adjusting levels once every 5 to 10 years is adequate in most plantings. Leaf analysis is the best measure of phosphorus need.

Table 5. Recommended rates of phosphorus.

Soil test (lb P/A	P_2O_5 lb/A Mineral soils	Organic soils
0 - 19	150	75
20 - 39	100	50
40 - 69	75	25
70 +	0	0

Magnesium (Mg). Magnesium is needed if:

- foliar levels are below this range and soil test magnesium is less than 75 lb/A on mineral soils or 150 lb/A on organic soils;

or

- the percent of total bases that are magnesium is less than twice the percent that are potassium;

or

- magnesium is less than 4 percent of the total bases.

Magnesium deficiencies are usually corrected by applying dolomitic limestone (Table 6). However, limestone can be added safely only when the pH is less than 4.5 and calcium is less than 10 percent of the cation exchange capacity (the available nutrient pool). Otherwise, Ca will interfere with the uptake of other elements, such as potassium. (Values for pH are included in the standard soil test.)

When limestone cannot be used, magnesium should be added as finely ground magnesium oxide (Mg0, 55 percent Mg), magnesium sulfate (Epsom salts, 10 percent Mg), Sul-Po-Mag (11 percent Mg), or as a supplement to complete fertilizers. Apply sufficient Mg to bring soil level to 75 lb/A.

Calcium (Ca). Deficiencies in this nutrient only rarely have been reported. The standard foliar ranges are from 0.34 to 0.8 percent. If Ca becomes limiting and the pH is less than 4.5, dolomitic limestone can be applied (Table 6).

Iron (Fe). Iron deficiencies are uncommon, although they sometimes appear on sites where the pH is above the optimal blueberry range or phosphorus is especially high. The soil pH can be lowered by applying elemental sulfur or aluminum sulfate (Table 7). If the problem cannot be corrected in this manner, soil application of ferric sulfate (2 lb/A) or iron chelate (6 lb/A) can help. Where phosphorus levels are high, soil-applied iron may not be effective and yearly foliar sprays may be necessary. The optimal times for foliar application are at petal fall and first cover (use rates recommended by the manufacturer).

Other nutrients. Manganese, copper, boron and zinc are rarely, if ever, deficient in blueberries.

Soil vs. foliar fertilization

Studies at Michigan State University have shown that soil fertilization is the most economical means of providing blueberries with their necessary nutrients. Foliar fertilization does not significantly increase yield or fruit quality except when soil nutrient levels are critically deficient.

Table 6. Recommended rates of dolomitic limestone.

Soil test (lb/A	Mineral soils	Organic soils
0 - 200	2000	4000
200 - 299	1000	2000
300 - 399	500	1000

Table 7. Pounds of elemental sulfur needed to lower pH to 4.5.

	Soil type	
Current pH	Sand	Loam
5.5	250*	1050
6.0	530	1540
6.5	660	2020
7.0	840	2550

*To substitute aluminum sulfate, multiply by 6.

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