Nutrients and Nutrient Sources

Nitrogen - N

Fertilizer sources

1. $NaNO_3$ (sodium nitrate) - Not a good N source for either pines or hardwoods.

2. KNO_3 (potassium nitrate) - Not a good N source, but a possible K source.

3. NH_4NO_3 (ammonium nitrate) - Good source of N. Most common source used.

4. $(NH_4)_2SO_4$ (ammonium sulfate) - Excellent source of N. Adds S as well as N. Does acidify soil (sometimes that is desirable and sometimes it isn't). Drawback is low N content (20%).

5. $CO(NH_2)_2$ (urea) - Good source of N. Possible loss of N by volatilization of ammonia.

6. SCU (sulfur-coated urea) - Excellent slow release source, but is expensive. Very little loss of N by volatilization. Must watch the solubility score to determine the rate of N release. It may be too fast or too slow to be synchronized with the trees needs.

TYPICAL NUTRIENT BALANCE FOR THE GROWTH OF PINES

NUTRIENT	RELATIVE ABUNDANCE
N	100
K	60
S	50
P	13
Ca	6
Mg	4
Fe	1.5
Mn	0.4
Cl	0.3
B	0.2
Cu	0.03
Zn	0.03
Mo	0.006

From Tim White's NAUTILIS

7. Organics - Highly variable in make-up. Bulky to transport. Source of organic matter and nutrients as well as N. Various sources range from excellent to useless to toxic.

8. Soluble sources of N. There are several chemicals used in these products. They include things like ammonium thiosulfate, and mixtures of urea and ammonium nitrate or sulfate. All are applied as a liquid.

Phosphorus - P

Fertilizer sources

1. Ordinary superphosphate (OSP) - Low P content but does contain S.

2. Triple superphosphate (TSP) - High P content but lacks S.

3. Diammonium phosphate (DAP) - More soluble than either OSP or TSP and does contain a little N.

4. H_3PO_4 (phosphoric acid) - Very soluble source of P. Is used to acidify irrigation water. It must be greatly diluted or trees will be damaged.

Potassium

Fertilizer sources

1. KCl (potassium chloride or muriate of potash) Most common source of K.

2. K_2SO_4 (potassium sulfate or sulfate of potash) - Excellent source of K. The K content is the same as in KCl and it does contain S.

3. Sul-Po-Mag (or K-Mag or sulfate of potash - magnesia) - A mixture of K_2SO_4 and $MgSO_4$. The three common names vary from location to location, but they are all the same material.

Calcium - Ca

Sources

1. Calcitic lime (calcite) - Mostly calcium carbonate ($CaCO_3$). Used principally for soil acidity (pH) adjustment. Does provide plenty of Ca. Must be incorporated with soil.

2. Gypsum (calcium sulfate - $CaSO_4$) - Moderately soluble and does not change soil pH value. Provides both Ca and S and can be applied as a topdressing.

3. Dolomitic lime (dolomite) - A mixture of calcium and magnesium carbonates ($CaCO_3$ and $MgCO_3$). Used principally for soil acidity (pH) adjustment. Does provide plenty of Ca and Mg. Must be incorporated with soil.

4. Calcium nitrate ($Ca(NO_3)2$ - A very soluble source of Ca. Thus, it can be used as a topdressing.

Magnesium

Sources

1. Dolomitic lime - A mixture of calcium and magnesium carbonates ($CaCO_3$ and $MgCO_3$). Used principally for soil acidity (pH) adjustment. Does provide plenty of Ca and Mg. Must be incorporated with soil.

2. Magnesium sulfate ($MgSO_4$ or Epsom Salts) - Provides Mg but does not change soil acidity. Plenty soluble. Thus, it can be used as a topdressing.

3. Sul-Po-Mag (or K-Mag or sulfate of potash - magnesia) - A mixture of K_2SO_4 and $MgSO_4$.

4. Magnesium carbonate ($MgCO_3$) - Called "Mag - car." Useful when Mg is needed to balance a high Ca level. Not available everywhere. Must be incorporated with the soil. Does raise the soil pH value.

Minor elements

Mixtures

1. S.T.E.M. (Soluble Trace Element Mix) - A mixture of soluble sources of the minor elements.

2. FTE (Fritted Trace Elements) - A slow-release form of minor elements. Various mixes are available. Should be incorporated with soil.

Individual elements

1. Boron (B) - Available in several forms (borax, fertilizer borate, Solubor). All are forms of sodium borate. Solubor is convenient to use as a foliar spray.

2. Copper (Cu) - Available as copper sulfate (blue vitriol) ($CuSO_4 \cdot 7H_2O$) Can be used as a foliar spray or as a soil application.

3. Iron (Fe) - Available in several forms (Sequestrene, Tracite, Claw-L, etc.). These can be used as a foliar spray or as a soil application. During hot weather, the foliar spray is more effective.

4. Manganese (Mn) - Available as manganese sulfate ($MnSO_4$). A chelated form is sometimes available. These can be used as a foliar spray or as a soil application.

5. Zinc (Zn) - Available as zinc sulfate ($ZnSO_4$). Can be used a foliar spray or as a soil application.

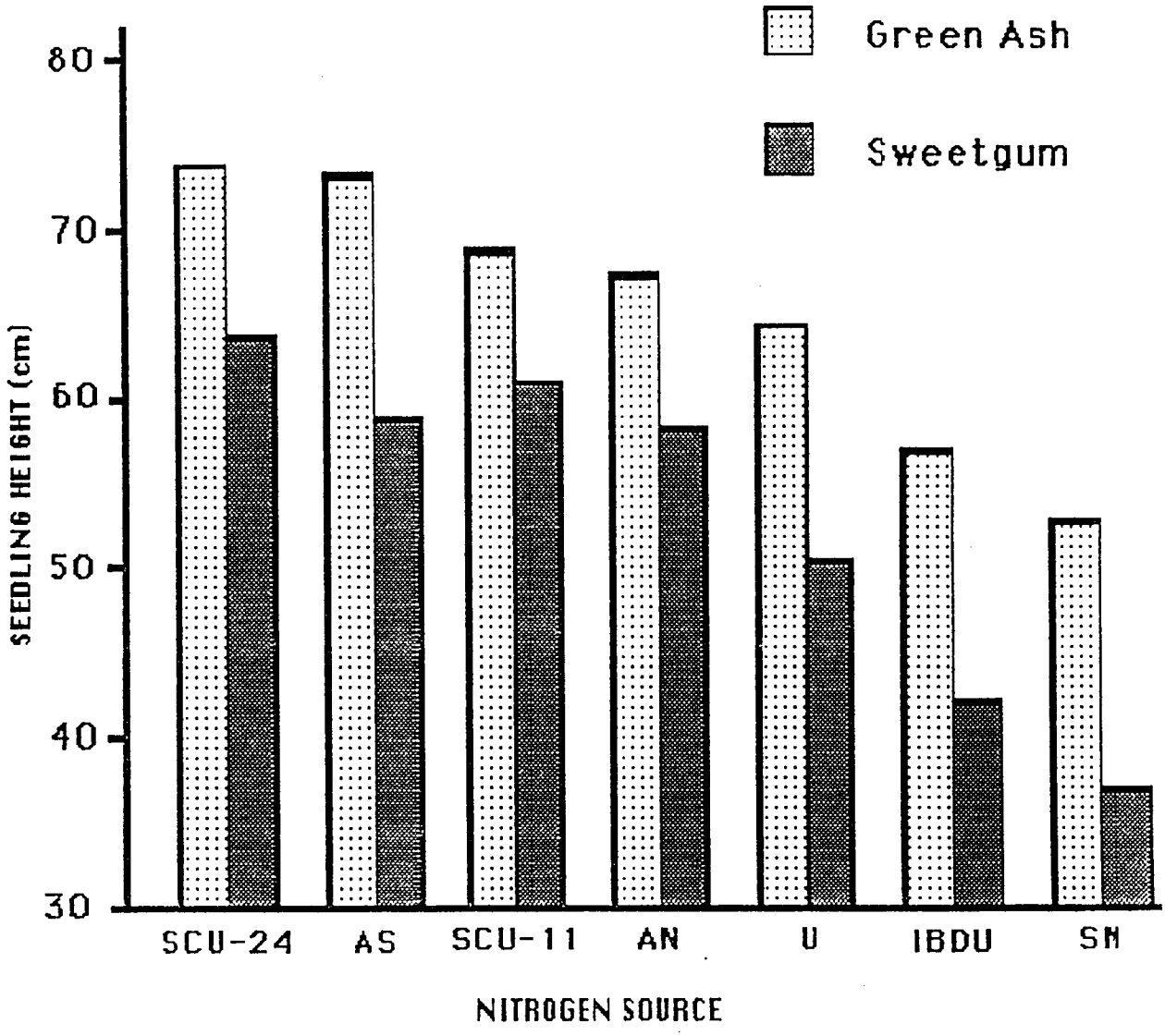

Figure 1. Effect of nitrogen source on height of green ash and sweetgum seedlings at lifting (data summarized from Villarrubia, 1980).

Nitrogen source	Applications (#)	Pines	Hardwoods
Ammonium nitrate (lbs/acre)	5	90	135
	6	75	115
	7	65	95
Ammonium sulfate (lbs/acre)	5	150	225
	6	125	190
	7	110	160

Cover crop and organic matter

Sawdust depth (in.)	Plowdown	Summer topdressing
0	300 AN (500 AS)	150 AN (250 AS)
1/2	500 AN (800 AS)	same
3/4	700 AN (1000 AN)	same

Sawdust (etc.) with seedlings (if necessary)

1/4	300 AN (500 AS)	regular summer N

Minor elements

Boron -	B @ 1 lb/acre requires	B @ 2 lbs/acre requires
as borax (11% B)	9	18
as Borate 46 (14% B)	7	14
as Solubor (20% B)	5	10

Gypsum ($CaSO_4 \cdot 2\ H_2O$) (FW 172 - 23% Ca, 18% S) (some is 20 and 16 %)
commonly added @ 500 lbs/acre

Epsom salts ($MgSO_4 \cdot 7\ H_2O$) 10% Mg
commonly added @ 250 lbs/acre

Sul-Po-Mag (K-Mag; sulfate of potash magnesia)
11% MG, 18% K, 23% S
commonly added @ 200 lbs/acre (also 250)

Manganese from manganese sulfate·4 H_2O 20 -24% Mn

20 lbs/acre foliar or 35 - 55 lbs/acre preplant on soil

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Iron from Sequestrene 330 (10% Fe chelated iron)

two foliar applications @ 20 lbs/acre each = 4 lbs actual iron
There are other, less expensive, iron sources used in some places. These go by such names as Tracite and Claw-L. Check the Fe % and form before making suggestions.

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Copper from $CuSO_4$·5 H_2O (blue vitriol) 25% Cu

commonly applied at 12 lbs/acre (3 lbs actual Cu)
may be applied either to foliage or soil

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Elemental S - 600 -800 lbs/acre reverses 1 ton of lime effect on pH value

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Zinc from $ZnSO_4$·7 H_2O (ca 20% Zn)

commonly applied @ 20 lbs/acre

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Minor element mixes

1. S.T.E.M. (Soluble Trace Element Mix)

B	1.45 %	Peters Fertilizer Products
Cu	3.2	
Fe	7.5	
Mn	8.15	
Mo	0.046	
S	15.0	
Zn	4.5	

commonly added at 70 lbs/acre. At that rate, you get the following lbs/acre of the elements: B, 1.0; Cu, 2.25; Fe, 5.25; Mn, 5.7; Mo, 0.03; S, 10.5; and Zn, 3.15.

Peters also sells fritted trace elements, known as FTE 555

B	0.8 %
Cu	1.5
Fe	14.0
Mn	5.0
Mo	0.07
Zn	4.5

commonly added to soil, preplant at 150 lbs/acre. At that rate you get the following lbs/acre of the elements: B, 1.2; Cu, 2.25; Fe, 21.0; Mn, 7.5; Mo, 0.1; and Zn, 7.5.

There is also a different mix known as FTE 503. I presume all of the FTE products are made by Frit Industries of Ozark, Arkansas.

Nitrogen for corn cover crop -

40 lbs N/acre plowdown
110 lbs N/acre 5 weeks after planting

40 N = 125 AN or 200 AS
110 N = 350 AN or 550 AS (AS = 20% N and 24% S)

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PINE SEEDLING
FOLIAGE ELEMENTAL CONCENTRATIONS AND RATIOS

C. B. DAVEY AND J. B. JETT

Element	Unit	Low	Medium	High
N	%	1.0	1.5	3.0
P	%	0.12	0.18	0.30
K	%	0.50	1.00	2.00
Ca	%	0.20	0.30	0.60
Mg	%	0.06	0.10	0.20
S	%	0.05	0.08	0.16
Na	%	0.01	<0.05	0.15
Al	ppm	200	<500	4000
Fe	ppm	100	400	2000
Mn	ppm	100	300	1000
Zn	ppm	25	50	100
B	ppm	15	20	50
Cu	ppm	2	6	12

Ratio: %/%		Ratio: %/%		Ratio: ppm/ppm	
N/P	8-9	P/Zn	30-40	Fe/Mn	1.3-1.7 (<3)
N/K	1.2-1.5	K/Mg	8-12		
N/S	18-20	K/Mn	30-40		
P/K	0.16-0.20	Ca/B	150-200		
P/S	2.0-2.5				