

# 16 ESSENTIAL SOIL NUTRIENTS

C H O P K N S Ca Fe Mg B Mn Cu Zn Mo Cl

## From water and air

Carbon **C**  
Hydrogen **H**  
Oxygen **O**

## Primary Nutrients

Nitrogen **N**  
Phosphorous **P**  
Potassium **K**

## Secondary Nutrients

Sulfur **S**  
Calcium **Ca**  
Magnesium **Mg**

## Micro-nutrients

Zinc **Zn**  
Iron **Fe**  
Copper **Cu**  
Manganese **Mn**  
Boron **B**  
Molybdenum **Mo**  
Chlorine **Cl**

|  |                          |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                          |                          |                           |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                         |                          |                          |                          |                          |                          |                          |                          |                           |                           |                           |                           |
|--|--------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|--------------------------|--------------------------|---------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| 1<br>IA  |                          |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                          |                          | 18<br>VIIIA               |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                         |                          |                          |                          |                          |                          |                          |                          |                           |                           |                           |                           |
| 1<br><b>H</b><br>1.01  | 2<br>IIA                 |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           | 13<br>IIIA                | 14<br>IVA                 | 15<br>VA                  | 16<br>VIA                | 17<br>VIIA               | 2<br><b>He</b><br>4.00    |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                         |                          |                          |                          |                          |                          |                          |                          |                           |                           |                           |                           |
| 3<br><b>Li</b><br>6.94   | 4<br><b>Be</b><br>9.01   |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           | 5<br><b>B</b><br>10.81    | 6<br><b>C</b><br>12.01    | 7<br><b>N</b><br>14.01    | 8<br><b>O</b><br>16.00   | 9<br><b>F</b><br>19.00   | 10<br><b>Ne</b><br>20.18  |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                         |                          |                          |                          |                          |                          |                          |                          |                           |                           |                           |                           |
| 11<br><b>Na</b><br>22.99   | 12<br><b>Mg</b><br>24.31 | 3<br>IIIB                 | 4<br>IVB                  | 5<br>VB                   | 6<br>VIB                  | 7<br>VIIB                 | 8                         | 9<br>VIIIB                | 10                        | 11<br>IB                  | 12<br>IIB                 | 13<br><b>Al</b><br>26.98  | 14<br><b>Si</b><br>28.09  | 15<br><b>P</b><br>30.97   | 16<br><b>S</b><br>32.07  | 17<br><b>Cl</b><br>35.45 | 18<br><b>Ar</b><br>39.95  |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                         |                          |                          |                          |                          |                          |                          |                          |                           |                           |                           |                           |
| 19<br><b>K</b><br>39.1   | 20<br><b>Ca</b><br>40.08 | 21<br><b>Sc</b><br>44.96  | 22<br><b>Ti</b><br>47.88  | 23<br><b>V</b><br>50.94   | 24<br><b>Cr</b><br>52.00  | 25<br><b>Mn</b><br>54.94  | 26<br><b>Fe</b><br>55.85  | 27<br><b>Co</b><br>58.93  | 28<br><b>Ni</b><br>58.69  | 29<br><b>Cu</b><br>63.55  | 30<br><b>Zn</b><br>65.39  | 31<br><b>Ga</b><br>69.72  | 32<br><b>Ge</b><br>72.61  | 33<br><b>As</b><br>74.92  | 34<br><b>Se</b><br>78.96 | 35<br><b>Br</b><br>79.90 | 36<br><b>Kr</b><br>83.80  |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                         |                          |                          |                          |                          |                          |                          |                          |                           |                           |                           |                           |
| 37<br><b>Rb</b><br>85.47   | 38<br><b>Sr</b><br>87.62 | 39<br><b>Y</b><br>88.91   | 40<br><b>Zr</b><br>91.22  | 41<br><b>Nb</b><br>92.91  | 42<br><b>Mo</b><br>95.94  | 43<br><b>Tc</b><br>(98)   | 44<br><b>Ru</b><br>101.07 | 45<br><b>Rh</b><br>102.91 | 46<br><b>Pd</b><br>106.42 | 47<br><b>Ag</b><br>107.87 | 48<br><b>Cd</b><br>112.41 | 49<br><b>In</b><br>114.82 | 50<br><b>Sn</b><br>118.71 | 51<br><b>Sb</b><br>121.76 | 52<br><b>Te</b><br>127.6 | 53<br><b>I</b><br>126.9  | 54<br><b>Xe</b><br>131.29 |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                         |                          |                          |                          |                          |                          |                          |                          |                           |                           |                           |                           |
| 55<br><b>Cs</b><br>132.9   | 56<br><b>Ba</b><br>137.3 | 57<br><b>La*</b><br>138.9 | 72<br><b>Hf</b><br>178.5  | 73<br><b>Ta</b><br>180.9  | 74<br><b>W</b><br>183.9   | 75<br><b>Re</b><br>186.2  | 76<br><b>Os</b><br>190.2  | 77<br><b>Ir</b><br>192.2  | 78<br><b>Pt</b><br>195.1  | 79<br><b>Au</b><br>197.0  | 80<br><b>Hg</b><br>200.6  | 81<br><b>Tl</b><br>204.4  | 82<br><b>Pb</b><br>207.2  | 83<br><b>Bi</b><br>209    | 84<br><b>Po</b><br>(209) | 85<br><b>At</b><br>(210) | 86<br><b>Rn</b><br>(222)  |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                         |                          |                          |                          |                          |                          |                          |                          |                           |                           |                           |                           |
| 87<br><b>Fr</b><br>(223)   | 88<br><b>Ra</b><br>(226) | 89<br><b>Ac^</b><br>(227) | 104<br><b>Rf</b><br>(261) | 105<br><b>Db</b><br>(262) | 106<br><b>Sg</b><br>(263) | 107<br><b>Bh</b><br>(264) | 108<br><b>Hs</b><br>(265) | 109<br><b>Mt</b><br>(268) | 110<br><b>Ds</b><br>(271) | 111<br><b>Rg</b><br>(272) |                           |                           |                           |                           |                          |                          |                           |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                         |                          |                          |                          |                          |                          |                          |                          |                           |                           |                           |                           |
| <table border="1"> <tr> <td>58<br/><b>Ce</b><br/>140.1</td> <td>59<br/><b>Pr</b><br/>140.9</td> <td>60<br/><b>Nd</b><br/>144.2</td> <td>61<br/><b>Pm</b><br/>(145)</td> <td>62<br/><b>Sm</b><br/>150.4</td> <td>63<br/><b>Eu</b><br/>152.0</td> <td>64<br/><b>Gd</b><br/>157.3</td> <td>65<br/><b>Tb</b><br/>158.9</td> <td>66<br/><b>Dy</b><br/>162.5</td> <td>67<br/><b>Ho</b><br/>164.9</td> <td>68<br/><b>Er</b><br/>167.3</td> <td>69<br/><b>Tm</b><br/>168.9</td> <td>70<br/><b>Yb</b><br/>173.0</td> <td>71<br/><b>Lu</b><br/>175.0</td> </tr> <tr> <td>90<br/><b>Th</b><br/>232.0</td> <td>91<br/><b>Pa</b><br/>(231)</td> <td>92<br/><b>U</b><br/>238.0</td> <td>93<br/><b>Np</b><br/>(237)</td> <td>94<br/><b>Pu</b><br/>(244)</td> <td>95<br/><b>Am</b><br/>(243)</td> <td>96<br/><b>Cm</b><br/>(247)</td> <td>97<br/><b>Bk</b><br/>(247)</td> <td>98<br/><b>Cf</b><br/>(251)</td> <td>99<br/><b>Es</b><br/>(252)</td> <td>100<br/><b>Fm</b><br/>(257)</td> <td>101<br/><b>Md</b><br/>(258)</td> <td>102<br/><b>No</b><br/>(259)</td> <td>103<br/><b>Lr</b><br/>(260)</td> </tr> </table> |                          |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                          |                          |                           | 58<br><b>Ce</b><br>140.1 | 59<br><b>Pr</b><br>140.9 | 60<br><b>Nd</b><br>144.2 | 61<br><b>Pm</b><br>(145) | 62<br><b>Sm</b><br>150.4 | 63<br><b>Eu</b><br>152.0 | 64<br><b>Gd</b><br>157.3 | 65<br><b>Tb</b><br>158.9 | 66<br><b>Dy</b><br>162.5 | 67<br><b>Ho</b><br>164.9 | 68<br><b>Er</b><br>167.3 | 69<br><b>Tm</b><br>168.9 | 70<br><b>Yb</b><br>173.0 | 71<br><b>Lu</b><br>175.0 | 90<br><b>Th</b><br>232.0 | 91<br><b>Pa</b><br>(231) | 92<br><b>U</b><br>238.0 | 93<br><b>Np</b><br>(237) | 94<br><b>Pu</b><br>(244) | 95<br><b>Am</b><br>(243) | 96<br><b>Cm</b><br>(247) | 97<br><b>Bk</b><br>(247) | 98<br><b>Cf</b><br>(251) | 99<br><b>Es</b><br>(252) | 100<br><b>Fm</b><br>(257) | 101<br><b>Md</b><br>(258) | 102<br><b>No</b><br>(259) | 103<br><b>Lr</b><br>(260) |
| 58<br><b>Ce</b><br>140.1   | 59<br><b>Pr</b><br>140.9 | 60<br><b>Nd</b><br>144.2  | 61<br><b>Pm</b><br>(145)  | 62<br><b>Sm</b><br>150.4  | 63<br><b>Eu</b><br>152.0  | 64<br><b>Gd</b><br>157.3  | 65<br><b>Tb</b><br>158.9  | 66<br><b>Dy</b><br>162.5  | 67<br><b>Ho</b><br>164.9  | 68<br><b>Er</b><br>167.3  | 69<br><b>Tm</b><br>168.9  | 70<br><b>Yb</b><br>173.0  | 71<br><b>Lu</b><br>175.0  |                           |                          |                          |                           |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                         |                          |                          |                          |                          |                          |                          |                          |                           |                           |                           |                           |
| 90<br><b>Th</b><br>232.0   | 91<br><b>Pa</b><br>(231) | 92<br><b>U</b><br>238.0   | 93<br><b>Np</b><br>(237)  | 94<br><b>Pu</b><br>(244)  | 95<br><b>Am</b><br>(243)  | 96<br><b>Cm</b><br>(247)  | 97<br><b>Bk</b><br>(247)  | 98<br><b>Cf</b><br>(251)  | 99<br><b>Es</b><br>(252)  | 100<br><b>Fm</b><br>(257) | 101<br><b>Md</b><br>(258) | 102<br><b>No</b><br>(259) | 103<br><b>Lr</b><br>(260) |                           |                          |                          |                           |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                         |                          |                          |                          |                          |                          |                          |                          |                           |                           |                           |                           |

See (C) HOPKINS CaFe  
Managed By Mine  
CuZins Mo and Claude