

# Contents

---

|   |             |
|---|-------------|
| <b>Foreword</b>   | <b>ix</b>   |
| <b>Messages</b>   | <b>xi</b>   |
| <b>Preface</b>  | <b>xiii</b> |
| <b>1 An Introduction to Plant Nutrition</b>                                       | <b>1</b>    |
| <b>2 How to Identify Plant Nutrient Deficiencies in Field Conditions</b>          | <b>9</b>    |
| <b>PART I NUTRIENT DEFICIENCIES IN CEREAL CROPS</b>                               | <b>23</b>   |
| <b>Maize (<i>Zea mays</i> Linn.)</b>  | <b>25</b>   |
| <i>Nitrogen deficiency</i>  | 25          |
| <i>Phosphorus deficiency</i>  | 27          |
| <i>Potassium deficiency</i>   | 29          |
| <i>Calcium deficiency</i>   | 31          |
| <i>Magnesium deficiency</i>   | 33          |
| <i>Sulphur deficiency</i>   | 35          |
| <i>Iron deficiency</i>  | 37          |
| <i>Manganese deficiency</i>   | 39          |
| <i>Zinc deficiency</i>  | 41          |
| <i>Boron deficiency</i>   | 43          |
| <b>Rice (<i>Oryza sativa</i> Linn.)</b>   | <b>45</b>   |
| <i>Nitrogen deficiency</i>  | 45          |
| <i>Phosphorus deficiency</i>  | 47          |
| <i>Potassium deficiency</i>   | 49          |
| <i>Sulphur deficiency</i>   | 51          |
| <i>Iron deficiency</i>  | 53          |
| <i>Zinc deficiency</i>  | 55          |
| <i>Boron deficiency</i>   | 57          |
| <b>Sorghum (<i>Sorghum vulgare</i> Pers.)</b>                                     | <b>59</b>   |
| <i>Nitrogen deficiency</i>  | 59          |
| <i>Phosphorus deficiency</i>  | 61          |
| <i>Potassium deficiency</i>   | 63          |
| <i>Calcium deficiency</i>   | 65          |
| <i>Sulphur deficiency</i>   | 67          |
| <i>Iron deficiency</i>  | 69          |
| <i>Zinc deficiency</i>  | 71          |
| <i>Manganese deficiency</i>   | 73          |
| <b>Pearl millet (<i>Pennisetum typhoides</i> (Burm.f) Stapf &amp; C.E. Hubb.)</b> | <b>75</b>   |
| <i>Nitrogen deficiency</i>  | 75          |
| <i>Phosphorus deficiency</i>  | 77          |
| <i>Potassium deficiency</i>   | 79          |

|   |            |
|---|------------|
| Calcium deficiency  | 81         |
| Sulphur deficiency  | 83         |
| Iron deficiency   | 85         |
| Zinc deficiency   | 87         |
| Manganese deficiency  | 89         |
| <b>Wheat (<i>Triticum aestivum</i> Linn.)</b>                         | <b>91</b>  |
| Nitrogen deficiency   | 91         |
| Phosphorus deficiency   | 93         |
| Potassium deficiency  | 95         |
| Sulphur deficiency  | 97         |
| Iron deficiency   | 99         |
| Zinc deficiency   | 101        |
| Copper deficiency   | 103        |
| <b>Barley (<i>Hordeum vulgare</i> (L.) emend. Bowden)</b>             | <b>105</b> |
| Nitrogen deficiency   | 105        |
| Phosphorus deficiency   | 107        |
| Potassium deficiency  | 109        |
| Sulphur deficiency  | 111        |
| Iron deficiency   | 113        |
| Zinc deficiency   | 115        |
| <b>PART II NUTRIENT DEFICIENCIES IN PULSE CROPS</b>                   | <b>117</b> |
| <b>Pigeon pea (<i>Cajanus cajan</i> (L.) Millsp.)</b>                 | <b>119</b> |
| Nitrogen deficiency   | 119        |
| Phosphorus deficiency   | 121        |
| Potassium deficiency  | 123        |
| Magnesium deficiency  | 125        |
| Sulphur deficiency  | 127        |
| Iron deficiency   | 129        |
| Manganese deficiency  | 131        |
| Zinc deficiency   | 133        |
| Copper deficiency   | 135        |
| <b>Green gram (<i>Vigna radiata</i> Linn.)</b>                        | <b>137</b> |
| Nitrogen deficiency   | 137        |
| Phosphorus deficiency   | 139        |
| Potassium deficiency  | 141        |
| Sulphur deficiency  | 143        |
| Iron deficiency   | 145        |
| Zinc deficiency   | 147        |
| <b>Black gram (<i>Phaseolus mungo</i> var. <i>radiatus</i> Linn.)</b> | <b>149</b> |
| Nitrogen deficiency   | 149        |
| Phosphorus deficiency   | 151        |
| Potassium deficiency  | 153        |
| Sulphur deficiency  | 155        |
| Iron deficiency   | 157        |
| Zinc deficiency   | 159        |
| <b>Cowpea (<i>Vigna sinensis</i> Linn.)</b>                           | <b>161</b> |
| Nitrogen deficiency   | 161        |
| Magnesium deficiency  | 163        |
| Sulphur deficiency  | 165        |
| Iron deficiency   | 167        |
| <b>Cluster bean (<i>Cyamopsis tetragonoloba</i> (L.) Taub)</b>        | <b>169</b> |
| Nitrogen deficiency   | 169        |
| Potassium deficiency  | 171        |
| Magnesium deficiency  | 173        |
| Sulphur deficiency  | 175        |
| Iron deficiency   | 177        |
| Zinc deficiency   | 179        |

|   |            |
|---|------------|
| <b>Chickpea (<i>Cicer arietinum</i> Linn.)</b>              | <b>181</b> |
| Nitrogen deficiency   | 181        |
| Phosphorus deficiency                                       | 183        |
| Potassium deficiency  | 185        |
| Sulphur deficiency  | 187        |
| Iron deficiency   | 189        |
| Zinc deficiency   | 191        |
| <b>Kidney bean (<i>Phaseolus vulgaris</i> Linn.)</b>        | <b>193</b> |
| Nitrogen deficiency   | 193        |
| Magnesium deficiency  | 195        |
| Sulphur deficiency  | 197        |
| Iron deficiency   | 199        |
| Zinc deficiency   | 201        |
| <b>Lentil (<i>Lens culinaris</i> Medik.)</b>                | <b>203</b> |
| Nitrogen deficiency   | 203        |
| Phosphorus deficiency                                       | 205        |
| Potassium deficiency  | 207        |
| Iron deficiency   | 209        |
| <b>Pea (<i>Pisum sativum</i> var. <i>arvense</i> Linn.)</b> | <b>211</b> |
| Nitrogen deficiency   | 211        |
| Potassium deficiency  | 213        |
| Magnesium deficiency  | 215        |
| Sulphur deficiency  | 217        |
| Iron deficiency   | 219        |
| <b>PART III NUTRIENT DEFICIENCIES IN OILSEED CROPS</b>      | <b>221</b> |
| <b>Castor (<i>Ricinus communis</i> Linn.)</b>               | <b>223</b> |
| Nitrogen deficiency   | 223        |
| Phosphorus deficiency                                       | 225        |
| Potassium deficiency  | 227        |
| Magnesium deficiency  | 229        |
| Sulphur deficiency  | 231        |
| Iron deficiency   | 233        |
| Zinc deficiency   | 235        |
| Manganese deficiency  | 237        |
| <b>Sesame (<i>Sesamum indicum</i> Linn.)</b>                | <b>239</b> |
| Nitrogen deficiency   | 239        |
| Phosphorus deficiency                                       | 241        |
| Potassium deficiency  | 243        |
| Sulphur deficiency  | 245        |
| Iron deficiency   | 247        |
| <b>Safflower (<i>Carthamus tinctorius</i> Linn.)</b>        | <b>249</b> |
| Nitrogen deficiency   | 249        |
| Potassium deficiency  | 251        |
| Sulphur deficiency  | 253        |
| Iron deficiency   | 255        |
| <b>Sunflower (<i>Helianthus annuus</i> Linn.)</b>           | <b>257</b> |
| Nitrogen deficiency   | 257        |
| Potassium deficiency  | 259        |
| Calcium deficiency  | 261        |
| Magnesium deficiency  | 263        |
| Sulphur deficiency  | 265        |
| Iron deficiency   | 267        |
| Boron deficiency  | 269        |
| <b>Groundnut (<i>Arachis hypogaea</i> Linn.)</b>            | <b>271</b> |
| Nitrogen deficiency   | 271        |
| Potassium deficiency  | 273        |
| Magnesium deficiency  | 275        |

|  |            |
|--|------------|
| <i>Sulphur deficiency</i>                                | 277        |
| <i>Iron deficiency</i>                                   | 279        |
| <i>Zinc deficiency</i>                                   | 281        |
| <i>Manganese deficiency</i>                              | 283        |
| <b>Soybean (<i>Glycine max</i> Linn.)</b>                | <b>285</b> |
| <i>Nitrogen deficiency</i>                               | 285        |
| <i>Phosphorus deficiency</i>                             | 287        |
| <i>Potassium deficiency</i>                              | 289        |
| <i>Magnesium deficiency</i>                              | 291        |
| <i>Sulphur deficiency</i>                                | 293        |
| <i>Iron deficiency</i>                                   | 295        |
| <i>Manganese deficiency</i>                              | 297        |
| <b>Mustard (<i>Brassica campestris</i> Linn.)</b>        | <b>299</b> |
| <i>Nitrogen deficiency</i>                               | 299        |
| <i>Phosphorus deficiency</i>                             | 301        |
| <i>Potassium deficiency</i>                              | 303        |
| <i>Sulphur deficiency</i>                                | 305        |
| <i>Iron deficiency</i>                                   | 307        |
| <b>PART IV NUTRIENT DEFICIENCIES IN CASH CROPS</b>       | <b>309</b> |
| <b>Cotton (<i>Gossypium hirsutum</i> Linn.)</b>          | <b>311</b> |
| <i>Nitrogen deficiency</i>                               | 311        |
| <i>Phosphorus deficiency</i>                             | 313        |
| <i>Potassium deficiency</i>                              | 315        |
| <i>Magnesium deficiency</i>                              | 317        |
| <i>Sulphur deficiency</i>                                | 319        |
| <i>Iron deficiency</i>                                   | 321        |
| <i>Zinc deficiency</i>                                   | 323        |
| <b>Sugarcane (<i>Saccharum officinarum</i> Linn.)</b>    | <b>325</b> |
| <i>Nitrogen deficiency</i>                               | 325        |
| <i>Phosphorus deficiency</i>                             | 327        |
| <i>Potassium deficiency</i>                              | 329        |
| <i>Calcium deficiency</i>                                | 331        |
| <i>Sulphur deficiency</i>                                | 333        |
| <i>Iron deficiency</i>                                   | 335        |
| <i>Zinc deficiency</i>                                   | 337        |
| <b>PART V NUTRIENT DEFICIENCIES IN TUBER CROPS</b>       | <b>339</b> |
| <b>Potato (<i>Solanum tuberosum</i> Linn.)</b>           | <b>341</b> |
| <i>Nitrogen deficiency</i>                               | 341        |
| <i>Phosphorus deficiency</i>                             | 343        |
| <i>Potassium deficiency</i>                              | 345        |
| <i>Sulphur deficiency</i>                                | 347        |
| <i>Iron deficiency</i>                                   | 349        |
| <i>Zinc deficiency</i>                                   | 351        |
| <i>Manganese deficiency</i>                              | 353        |
| <b>Sweet potato (<i>Ipomoea batatas</i> Linn.)</b>       | <b>355</b> |
| <i>Nitrogen deficiency</i>                               | 355        |
| <i>Phosphorus deficiency</i>                             | 357        |
| <i>Iron deficiency</i>                                   | 359        |
| <i>Manganese deficiency</i>                              | 361        |
| <b>PART VI NUTRIENT DEFICIENCIES IN FODDER CROPS</b>     | <b>363</b> |
| <b>Lucerne or Alfalfa (<i>Medicago sativa</i> Linn.)</b> | <b>365</b> |
| <i>Nitrogen deficiency</i>                               | 365        |
| <i>Potassium deficiency</i>                              | 367        |
| <i>Sulphur deficiency</i>                                | 369        |
| <i>Iron deficiency</i>                                   | 371        |
| <b>Index</b>   | <b>373</b> |