

GUY SELA

# FERTILIZATION AND IRRIGATION

THEORY AND BEST PRACTICES

2019 EDITION

© All rights reserved



## About the Author

Guy Sela was born in 1973, in Rehovot, one of the first agricultural towns in Israel. Mr. Sela graduated, with a BSc. degree from the Hebrew University as an agronomical engineer with specialization and expertise in irrigation, fertilization and water treatment.

His work in large scales, nationally and internationally, enabled him to lead comprehensive research programs on crop fertilization, underwater desalination and cut edge agriculture.

His specialization in plant nutrition is the combination of the vast knowledge in water treatment and agriculture.

Guy Sela observed many growers who mainly rely on trial and error, estimation and past experience, either of their own or of consultants in the industry. The broad misuse of fertilizers and pesticides is a global phenomenon which results in decreased yields, waste, and damage to crops and the environment. This led him to establish his innovative venture Smart Fertilizer in 2008, Cropaia in 2018 and yieldsApp in 2019, all are start-up companies that are dedicated to innovation in agriculture.

Guy Sela is a internationally renowned speaker in conferences, symposiums and online webinars, which are brought to thousands of growers, has allowed him to share his knowledge, expertise world-wide



# Table of Contents

Table of Contents .....	2
<b>Chapter 1.....</b>	<b>5</b>
<b>Plant Nutrition.....</b>	<b>5</b>
Plant Nutrients - Introduction.....	6
Nitrogen.....	9
Potassium .....	13
Phosphorus .....	18
Calcium.....	22
Magnesium.....	24
Sulfur.....	27
Iron.....	30
Zinc .....	33
Boron.....	36
Chloride - an Essential Nutrient or Harmful Element? .....	38
The Electrical Conductivity.....	41
The pH.....	45
Mineral Nutrition and Plant Disease .....	46
Ammonium/Nitrate Ratio.....	49
<b>Chapter 2.....</b>	<b>51</b>
<b>Water Quality .....</b>	<b>51</b>
Irrigation Water Quality.....	52
Water Alkalinity and Buffering Capacity.....	56
Hardness.....	58
Effect of Water Salinity on Soil .....	60
Managing Irrigation Water Quality Problems.....	62
Testing Your Irrigation Water.....	64
Water Disinfection with Chlorine .....	67
Chlorine Chemicals for Water Disinfection.....	70
<b>Chapter 3.....</b>	<b>74</b>
<b>Soils.....</b>	<b>74</b>
Soil Fertility .....	75
Soil acidity .....	78
Soil Salinity.....	81
How to Prevent and Manage Soil Salinity .....	83
Cation Exchange Capacity of Soils .....	86
Understanding PPM in soil.....	89

<u>Soil Chemical Analysis as a Tool for Evaluating Nutrient Availability .....</u>	<u>91</u>
<u>How to Interpret Soil Test Results .....</u>	<u>94</u>
<u>Soil Testing – The Extraction Methods.....</u>	<u>98</u>
<u>Soil Test Interpretation Guide .....</u>	<u>101</u>
<u>Cation-Anion Balance in Water and Soil.....</u>	<u>103</u>
<u>Sodic soils and their management.....</u>	<u>107</u>
<u>How to Raise Soil pH.....</u>	<u>110</u>
<u>How to Choose a Liming Material .....</u>	<u>112</u>
<b>Chapter 4.....</b>	<b>115</b>
<b>Fertilizer Management.....</b>	<b>115</b>
<u>Approaches For Giving Fertilizer Recommendations .....</u>	<u>116</u>
<u>Optimizing Fertilizer Application Rates .....</u>	<u>118</u>
<u>Timing and Frequency of Fertilizer Application .....</u>	<u>122</u>
<u>Pre-plant fertilizer application.....</u>	<u>125</u>
<u>Nitrogen Management.....</u>	<u>127</u>
<u>Chelated Fertilizers and Their Use.....</u>	<u>130</u>
<u>Visual Identification of Nutrient Deficiencies .....</u>	<u>132</u>
<u>Understanding Plant Tissue Analysis .....</u>	<u>136</u>
<u>Foliar Feeding .....</u>	<u>139</u>
<b>Chapter 5.....</b>	<b>142</b>
<b>Fertigation and Hydroponics .....</b>	<b>142</b>
<u>Fertigation .....</u>	<u>143</u>
<u>Fertigation Best Practices.....</u>	<u>144</u>
<u>Hydroponic Systems .....</u>	<u>147</u>
<u>Hydroponic Nutrient Solutions .....</u>	<u>149</u>
<u>Balancing Nutrient Solutions .....</u>	<u>152</u>
<u>The challenges of growing in a closed hydroponic system.....</u>	<u>154</u>
<u>Preparation of Fertilizer Stock Solutions .....</u>	<u>156</u>
<u>Fertilizer Solubility .....</u>	<u>160</u>
<u>Fertilizer Injectors .....</u>	<u>164</u>
<u>How to Calibrate &amp; Test Your Fertilizer Injectors.....</u>	<u>166</u>
<u>pH Adjustment in Fertigation and Hydroponics .....</u>	<u>169</u>
<u>How to Successfully Choose Growing Media.....</u>	<u>176</u>
<u>Physical Properties of Growing Media.....</u>	<u>179</u>
<u>Fertility Management in Container Plants.....</u>	<u>183</u>
<u>Plug plants – Testing and Monitoring Nutritional Status.....</u>	<u>186</u>
<b>Chapter 6.....</b>	<b>190</b>
<b>Irrigation.....</b>	<b>190</b>

<u>Water Requirements of Crops .....</u>	<u>191</u>
<u>Irrigation Scheduling Using Tensiometers .....</u>	<u>195</u>
<u>Irrigation scheduling using Evapotranspiration and soil moisture evaluation.....</u>	<u>198</u>
<u>Drip Irrigation Systems .....</u>	<u>202</u>
<u>Clogging of Emitters in Drip Irrigation Systems .....</u>	<u>206</u>
<u>How to Prevent Clogging in Drip Systems .....</u>	<u>209</u>
<u>Irrigation Management in Soilless Culture.....</u>	<u>212</u>