

COURSE OUTLINE

PROGRAMME TITLE	Understanding Degraded Oil Palm Soils: Nutrient Lock-Up, Root Health & Biological Restoration
OVERVIEW (Brief introduction Of the topic)	Soil degradation is an increasingly important plantation management issue in mature oil palm, particularly where long-term production depends heavily on repeated fertilizer applications but nutrient response, root performance and soil condition continue to decline. Poor soil structure, low organic matter, soil acidity, nutrient fixation or leaching, compaction, weak biological activity and impaired root systems can reduce the efficiency with which applied nutrients are retained, accessed and used by the palm. Increasing fertilizer inputs alone may therefore fail to address the underlying causes of poor performance. This one-day Industry Specific programme provides estate managers, agronomists and plantation technical personnel with a practical framework for understanding degraded oil palm soils and diagnosing the relationships between soil condition, nutrient availability, root health and soil biology. Participants will examine how soil pH, organic matter, cation exchange capacity (CEC), physical condition, moisture, microbial activity and root-zone processes influence nutrient cycling and fertilizer efficiency. The programme gives particular attention to nutrient lock-up and nutrient loss, including phosphorus fixation under acidic soil conditions, potassium retention and leaching, and the role of organic matter, soil biology and root-associated microorganisms in improving nutrient accessibility. Participants will also examine visible and field-observable indicators of degraded soil and root systems and learn how to distinguish symptoms from possible underlying causes before selecting corrective actions. Biological and regenerative approaches are introduced as soil-restoration tools that can complement sound agronomic and fertilizer management. These include organic matter management, beneficial microorganisms, arbuscular mycorrhizal fungi (AMF), biochar and biologically active organic inputs. They are presented as components of an integrated soil-restoration strategy rather than as replacements for appropriate nutrient diagnosis and plantation management. Through soil and root observation exercises, soil-test interpretation, plantation scenarios, nutrient lock-up diagnosis and workplace action planning, participants will develop a practical soil-health assessment and biological restoration plan that can be adapted to their estate or plantation operation.
LEARNING OUTCOME	Upon completion of this course, participants will be able to: 1. Identify major physical, chemical and biological indicators of degraded oil palm soils and explain their implications for plantation performance. 2. Explain how soil pH, organic matter, CEC, compaction, moisture and biological activity influence nutrient retention, availability and root uptake.

	3. Explain common nutrient lock-up and loss mechanisms affecting phosphorus, potassium and other plant nutrients in oil palm soils. 4. Assess field and root-zone indicators and interpret basic soil information to identify likely constraints affecting nutrient efficiency and root health. 5. Explain Soil Food Web functions and evaluate practical biological restoration approaches involving organic matter, beneficial microorganisms, AMF, biochar and biological inputs. 6. Develop a controlled soil-restoration pilot and a practical 90-Day Workplace Soil Health Improvement Plan using baseline observations and measurable indicators.
DURATION (days)	1 day (7 hours)
TARGET PARTICIPANTS (position/level)	• Estate Managers • Plantation Managers • Assistant Managers • Agronomists • Plantation Technical Teams • Plantation Executives • Field Executives • Sustainability Managers • Plantation Supervisors • Technical Officers involved in soil, nutrition, crop health or field management • Plantation Owners • Smallholder Cooperative Leaders
COURSE CONTENT (with submodules)	Module 1 – Understanding Soil Degradation in Oil Palm Plantations • 1.1 What Is a Degraded Oil Palm Soil? • 1.2 Physical, Chemical and Biological Dimensions of Soil Health • 1.3 Common Causes of Soil Degradation in Long-Term Plantation Systems • 1.4 Soil Degradation, Fertilizer Efficiency and Palm Performance Module 2 – Soil Chemistry, Nutrient Availability & Nutrient Lock-Up • 2.1 Soil pH and Nutrient Availability • 2.2 Phosphorus Fixation and Reduced P Availability in Acidic Soils • 2.3 Potassium Retention, Leaching and Soil Exchange Capacity • 2.4 Cation Exchange Capacity (CEC) and Nutrient-Holding Capacity • 2.5 Distinguishing Nutrient Deficiency from Nutrient Inaccessibility Module 3 – Root Health & the Oil Palm Root Zone • 3.1 Understanding the Active Root Zone • 3.2 Soil Structure, Compaction, Aeration and Root Development • 3.3 Moisture Conditions, Drainage and Root Function • 3.4 Recognising Healthy and Stressed Root Systems • 3.5 Linking Root Condition to Nutrient Uptake and Palm Performance Module 4 – Soil Food Web & Biological Nutrient Cycling • 4.1 Understanding the Soil Food Web: Bacteria, Fungi, Protozoa, Nematodes and Other Soil Organisms • 4.2 Soil Organic Matter, Decomposition and Biological Nutrient Mineralisation • 4.3 Beneficial Microorganisms and Plant-Available Nutrient Transformation • 4.4 Arbuscular Mycorrhizal Fungi (AMF), Fungal Networks and Root–Nutrient Relationships

	• 4.5 How Soil Degradation Disrupts Biological Nutrient Cycling • 4.6 Soil Food Web Function, Fertilizer Efficiency and Root-Zone Resilience Module 5 – Diagnosing Degraded Soil: From Symptoms to Root Causes • 5.1 Field Indicators of Soil and Root-Zone Degradation • 5.2 Simple Soil and Root Observation Techniques • 5.3 Interpreting Basic Soil-Test Information • 5.4 Nutrient Lock-Up and Root-Health Case Diagnosis • 5.5 Establishing a Practical Soil-Health Baseline Module 6 – Biological & Regenerative Soil Restoration Approaches • 6.1 Restoring Organic Matter and Biological Function • 6.2 Beneficial Microbial Inputs and Biological Activation • 6.3 AMF and Root Establishment / Recovery Concepts • 6.4 Biochar as a Soil Amendment and Microbial Habitat • 6.5 Organic and Biologically Active Inputs • 6.6 Integrating Biological Restoration with Fertilizer and Plantation Management Module 7 – Designing a Controlled Soil-Restoration Pilot • 7.1 Defining the Soil / Nutrient Problem and Pilot Objective • 7.2 Establishing Baseline and Comparison Areas • 7.3 Selecting Practical Interventions and Treatment Protocols • 7.4 Defining Soil, Root, Palm and Operational Indicators • 7.5 Monitoring Results and Deciding Whether to Scale Module 8 – Workplace Soil Health & Restoration Action Planning • 8.1 Identifying Priority Blocks and Soil Constraints • 8.2 Selecting Immediate and Medium-Term Corrective Actions • 8.3 Assigning Responsibilities and Resources • 8.4 Developing a 90-Day Soil Health Improvement Plan • 8.5 Management Review, Monitoring and Continuous Improvement
LEARNING METHODOLOGIES	Learning Methodologies 1. Interactive Icebreaker and Participant Experience Sharing 2. Interactive Instructor-led Presentations 3. Visual Soil, Root and Plantation Scenario Review 4. Industry Case Studies and Soil-Degradation Examples 5. Guided Group Discussions 6. Practical Soil and Root Observation Exercise 7. Soil-Test Interpretation and Nutrient Lock-Up Diagnosis Exercise 8. Scenario-Based Problem Solving and Restoration Response Selection 9. Controlled Soil-Restoration Pilot Design Exercise 10. Workplace Soil Health and Biological Restoration Action Planning 11. Knowledge Checks, Reflection and Question & Answer (Q&A)