

COURSE OUTLINE

PROGRAMME TITLE	Unlocking Soil Nutrients Through Biology: Practical Soil & Nutrient Management for Oil Palm
OVERVIEW (Brief introduction Of the topic)	Oil palm plantations face increasing pressure from rising fertilizer and input costs, while many estates also experience declining soil condition, weak nutrient-use efficiency and inconsistent productivity. Applying more fertilizer does not necessarily mean that nutrients are efficiently retained, cycled or accessed by palm roots. Soil physical condition, acidity, organic matter, moisture, root health and biological activity all influence how nutrients behave within the root zone. This two-day Industry Specific programme provides plantation managers and technical personnel with a practical framework for understanding and improving soil and nutrient management through biological and regenerative approaches. Participants will examine how the Soil Food Web, bacteria, fungi, arbuscular mycorrhizal fungi (AMF), organic matter and stable carbon contribute to decomposition, nutrient cycling, soil aggregation, root-zone function and nutrient availability. Biological approaches are presented as complementary to sound agronomy and responsible fertilizer management, not as a guaranteed replacement for fertilizer. The programme places strong emphasis on field application. Participants will assess a selected plantation area, identify soil and root-zone constraints, establish baseline observations, design an appropriate biological/regenerative treatment and prepare the materials and application method. For an in-house plantation programme, participants will establish an approximately 100-palm demonstration area, including treatment and comparison/control palms where site conditions permit. Through hands-on soil assessment, biological-input preparation, field application, documentation and monitoring-plan development, participants will leave with a practical demonstration and a structured 90-day / 180-day monitoring framework that management can use to evaluate results before considering wider block or estate implementation. A defining feature of the programme is a substantial supervised field practical. For an in-house plantation programme, approximately 3-4 hours will be devoted to preparing and applying the agreed Soil Food Web (SFW) treatment to an approximately 100-palm demonstration area. The training team will have the

	biological consortium, inoculated biochar, water and pump/application equipment ready for use. Every participant is expected to take an active role in treatment preparation, equipment setup, palm allocation, field application, quality control and application recording under trainer supervision. Where site conditions permit, treatment and comparison/control palms will be identified so that subsequent observations can support a structured management review.
LEARNING OUTCOME	Upon completion of this course, participants will be able to: 1. Explain how physical, chemical and biological soil conditions influence nutrient availability, root access and fertilizer-use efficiency in oil palm. 2. Identify common indicators of degraded soil and nutrient-cycling constraints through structured field and soil observations. 3. Explain the Soil Food Web concept and the roles of beneficial bacteria, fungi, mycorrhizal associations, organic matter and stable carbon in soil function and nutrient cycling. 4. Evaluate suitable regenerative soil and nutrient-management interventions that complement responsible fertilizer management in oil palm plantations. 5. Prepare an agreed Soil Food Web field treatment using the biological consortium, inoculated biochar, water and pump/application equipment in accordance with the practical protocol and safety requirements. 6. Participate in the supervised 3.5 hour field application of the agreed treatment to an approximately 100-palm demonstration area, including palm allocation, application consistency, quality control and field recording. 7. Establish baseline, treatment/comparison records and a practical monitoring plan to evaluate soil, palm and operational responses before recommending wider implementation.
DURATION (days)	2 days (14 hours)
TARGET PARTICIPANTS (position/level)	• Plantation Managers • Estate Managers • Assistant Managers • Agronomists • Plantation Executives • Field Executives • Sustainability Managers • Agronomy / Soil Management Personnel • Plantation Supervisors • Technical Officers involved in fertilizer, soil health or productivity management • Plantation Owners • Smallholder Cooperative Leaders
COURSE CONTENT (with submodules)	DAY 1 – UNDERSTAND, DIAGNOSE & DESIGN Module 1 – Nutrient Efficiency, Soil Degradation & Oil Palm

	Productivity • 1.1 Rising Fertilizer Cost and Productivity Pressure • 1.2 Nutrient Supply versus Nutrient Availability • 1.3 Physical Constraints: Compaction, Structure, Moisture and Rooting • 1.4 Chemical Constraints: pH, Nutrient Retention, Leaching and Fixation • 1.5 Biological Constraints and Weak Nutrient Cycling • 1.6 Integrating Biology with Responsible Fertilizer Management Module 2 – Soil Food Web & Biological Nutrient Cycling • 2.1 Soil as a Living System • 2.2 Bacteria, Fungi and Decomposition • 2.3 Mycorrhizal Associations and Root Access • 2.4 Organic Matter, Stable Carbon and Microbial Habitat • 2.5 Rhizosphere Processes, Soil Aggregation and Nutrient Cycling • 2.6 What Biology Can and Cannot Do Module 3 – Practical Soil, Root-Zone & Palm Assessment • 3.1 Selecting a Representative Demonstration Area • 3.2 Soil Structure, Compaction, Moisture and Ground Cover • 3.3 Root-Zone and Palm Condition Observation • 3.4 Basic pH / Moisture / Soil Condition Checks Where Equipment Is Available • 3.5 Establishing Baseline Field Records PRACTICAL 1 – Field Soil, Root-Zone & Palm Assessment Module 4 – Designing the 100-Palm Soil Food Web Demonstration • 4.1 Matching the Intervention to Diagnosed Soil Constraints • 4.2 Organic Matter, Mulch and Biomass Management • 4.3 Inoculated Biochar and Biological Inputs • 4.4 Integrating the Existing Fertilizer Programme • 4.5 Treatment / Comparison Layout Where Site Conditions Permit • 4.6 Preparing the 100-Palm Treatment Protocol and Field Work Plan PRACTICAL 2 – Demonstration Plot Design, Palm Allocation & Treatment Planning DAY 2 – PREPARE, APPLY, RECORD & MONITOR Module 5 – Preparing the Soil Food Web Treatment for Field Application • 5.1 Biological Consortium: Identification, Handling and Application Purpose • 5.2 Inoculated Biochar: Handling and Field Application Role • 5.3 Water, Mixing, Dilution and Treatment Preparation • 5.4 Pump / Application Equipment Setup and Calibration • 5.5 PPE, Worker Safety, Hygiene and Field Handling PRACTICAL 3 – Hands-On SFW Treatment Preparation & Pump Setup
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	Module 6 – 100-Palm Soil Food Web Field Application • 6.1 Marking / Confirming Treatment and Comparison Palms • 6.2 Confirming Baseline and Application Records • 6.3 Preparing Treatment Batches for Field Use • 6.4 Supervised Application of SFW Treatment to Approximately 100 Palms • 6.5 Correct Placement, Dosage / Coverage and Application Consistency • 6.6 Field Quality Control, Troubleshooting and Documentation PRACTICAL 4 – Approximately 3-4 Hours Hands-On Field Application. Every participant participates in preparing and/or applying the biological consortium and inoculated biochar treatment using the pump/application system under trainer supervision. Module 7 – Monitoring Soil, Palm & Operational Response • 7.1 What to Measure and Why • 7.2 Soil and Root-Zone Indicators • 7.3 Palm Health and Growth Indicators • 7.4 Fertilizer / Input and FFB Records Where Appropriate • 7.5 Photographic and Field Record Keeping • 7.6 Monitoring Frequency and Responsibilities PRACTICAL 5 – Establishing the Monitoring Record Module 8 – From Demonstration to Management Decision • 8.1 Comparing Treatment and Business-as-Usual • 8.2 Cost per Palm and Operational Feasibility • 8.3 90-Day / 180-Day Review Framework • 8.4 Interpreting Results Carefully • 8.5 Criteria for Adjusting, Extending or Scaling the Programme PRACTICAL 6 – Team Implementation, Monitoring & Management Review Plan
LEARNING METHODOLOGIES	Learning Methodologies 1. Interactive Icebreaker and Participant Experience Sharing 2. Interactive Instructor-led Presentations 3. Oil Palm Soil and Nutrient Management Case Studies 4. Guided Group Discussions and Soil Food Web Concept Review 5. Practical Field Soil, Root-Zone and Palm Assessment 6. Demonstration Plot Design and Baseline Recording 7. Hands-On Preparation of Biological Consortium and Inoculated Biochar Treatment 8. Pump / Application Equipment Setup and Calibration 9. Supervised 3-4 Hour Field Practical Applying the SFW Treatment to Approximately 100 Palms, with Every Participant Actively Involved 10. Field Quality Control and Application Documentation 11. Monitoring Framework and 90-Day / 180-Day Management Review Planning 12. Knowledge Checks, Reflection and Question & Answer (Q&A)

