Integrated Organic Farming Handbook

Author:- Dr. H. Panda Format: paperback Code: NI248 Pages: 472 Price: Rs.1275US\$ 33.95 Publisher: NIIR PROJECT CONSULTANCY SERVICES Usually ships within 5 days

Organic agriculture has grown out of the conscious efforts by inspired people to create the best possible relationship between the earth and men. After almost a century of neglect, organic agriculture is now finding place in the mainstream of development and shows great promise commercially, socially and environmentally. Integrated organic farming is a commonly and broadly used word to explain a more integrated approach to farming as compared to existing monoculture approaches. It refers to agricultural systems that integrate livestock and crop production and may sometimes be known as Integrated Bio systems. It denotes a holistic system of farming which optimizes productivity in a sustainable manner through creation of interdependent agri-eco systems where annual crop plants (e.g. wheat), perennial trees (e.g. horticulture) and animals (including fishes where relevant) are integrated on a given field or property .This concept of organic farming is based on following principles: 1. Nature is the best role model for farming, since it does not use any inputs nor demand unreasonable quantities of water.2. The entire system is based on intimate understanding of nature's ways of replenishment. The system does not believe in mining of the soil of its nutrients and do not degrade it in any way. 3. The soil in this system is considered as a living entity 4. The soil's living population of microbes and other organisms are significant contributors to its fertility on a sustained basis and must be protected and nurtured, at all cost. 5. The total environment of the soil, from soil structure to soil cover is more important and must be preserved. Integrated Organic farming is a method of farming system, which primarily aims at cultivating the land and raising crops in such a way, so as to keep the soil alive and in good health. It is the use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials, mostly produced insitu- along with beneficial microbes (bio fertilizers) to release nutrients to crops, which connotes the 'organic' nature of organic farming. It is also termed as organic agriculture. In the Indian context it is also termed as 'Javik Krishi'. We have compiled all the relevant information regarding integrated organic farming in this book. This is first book of its kind which contains reliable details related to organic farming, green manuring, biological nitrogen fixation, uses of vermiculture bio-tech, organic fertilizers for flooded rice ecosystem, biological pest management, press mud as plant growth promoters, bio fertilizer for multipurpose tree species, rice- fish integration, response of crops to organic fertilizer and many more.

The book is very useful for farmers, agriculture, universities, consultants and research scholars.

1. NECESSITY OF ORGANIC FARMING Management of Autonomous Ecosystem Mixed Farming

Plants Animals Soils Biosphere **Crop Rotation** Benefits of Crop Diversification **Organic Cycle Optimization** In Partnership with Nature Basic Standards and General Principles for Organic Agriculture Crop and Soil Management Choice of Crops and Varieties **Crop Rotations Fertilization Policy** Management of Pests, Diseases and Weeds Wild Products **Pollution Control** Soil and Water Conservation Landscape Principle Requirements and Pre-conditions Conversion from Conventional to Organic Farming Farms with Plant Production and Livestock Limitations Initiating Organic Farming Medicinal Plants-the First Crops for Organic Farming Management of Permaculture Farm Permaculture Farm Use of Draft Animal Making Permanent Farm **Conservation of Soil** Protection of the Soil against Fires Protection form Water Erosion Protection from Wind Erosion Improvement of the Soil How to Bury Organic Matter Mixed Cropping Permaculture for Wastelands Soil and Water Conservation **Pioneers Pioneer Trees and Plants Secondary Species** Conclusion 2. GREEN MANURING-A BASIC COMPONENT OF **ORGANIC FARMING** Definition **Objectives of Green Manuring** Subsidiary Objective of Green Manures Catch Crops Shade Crops **Cover Crops** Forage Crops Advantages of Green Manuring Soil Structure and Tilth Improvement Fertility Improvement of Soils

Amelioration of Soil Problems Improvement in Crop Yield and Quality Pest Control **Classification of Green Manures** Legumes Non-Legumes Characteristics Desirable in Legume Green Manure Crops Leguminous Green Manures Non-Conventional Green Manures **Other Green Manures** Choice of Green Manure Species Forms of Green Manuring Agronomy of Green Manure Crops Sesbania Speciosa Sesbania Aculeata {Dhaincha} Sesbania Rostrata Crotalaria Juncea (Sunnhemp) Tephrosia Purpurea (Wild Indigo) Indigofera Tinctoria Calapogonium Mucunoides Phaseolus Trilobus (Phillipesara) Centrosema Pubescens Macroptilium Atropurpureum (Siratoo) Stylosanthes Hamata Pueraria Phaseoloides (Kudzu) Dolichos Lab Lab var. Lignosus Agronomy of Green Leaf Manure Shrubs and Trees Glyricidia (Glyricidia Maculata Syn. G. sepium) Ipomoea Cornea Cassia Auriculata Derris Indica (Syn. Pongamia Glabra) Azadirachta Indica (Neem) Thespesia Populnea Rhizobial Inoculation Conditions for Fixation of Nitrogen **Bacterial Inoculation of Legumes** Stage of Incorporation Time of Incorporation Method of Application of Green Manure **Decomposition of Green Manure** Aerobic Decomposition Changes in the Carbon Compounds Changes in Nitrogen Compounds **Changes in the Mineral Constituents** Anaerobic Decomposition Carbon Nitrogen Ratio on Decomposition Process Farmer Acceptance of Green Manuring Limitations in Raising Green Manure Crops Conclusions **Future Needs** 3. BIOLOGICAL NITROGEN FIXATION Definition Symbiotic and Non-Leguminous Symbiotic System

Azotobacter Beijerinckia Azospirillum Application Other Bacteria Blue Green Algae **Multiplication** Trough Method Pit Method Field Method for Large Scale Production Limitations Azolla Nursery **Azolla Application Methods** Green Manuring As Dual Crop Efficiency of Azolla Limitations Frankia Legume-Rhizobium Symbiosis Methods of Application Seed Inoculation Pelleting Other Symbiotic Nitrogen Fixing Systems Other Bioinoculants Phosphate Solubilising Microorganisms (PSM) Vesicular Arbuscular Mycorrhiza (VAM) **Inoculation Methods** Transplanted Crops **Direct Sown Crops** Seed Coating Pelleting Fluid Drillina **Furrow Inoculation** Precropping Plant Growth Promoting Rhizobia (PGPR) Conclusion **Future Needs** 4. APPLICATION OF VERMICULTURE BIOTECHNOLOGY Vermiculture Biotechnology Earthworm for Nutrient Management Effect on Soil Fertility Nitrogen Phosphorus Potassium Earthworms for Water Management Earthworm Castings Earthworms Act as Biopump Earthworms for Effective Waste Management Composting of Municipal and Industrial Wastes Earthworms for Disease and Pest Management Earthworms for Nutritional Crops

Earthworms for Sustainable Agriculture and Wasteland Development Earthworms as Vectors of Beneficial Microorganisms Successful Applications Harnessing Vermiculture Biotechnology Selection of Proper Species Use of Vermicastings for Inoculation Earthworms and Land Use Practices Effect of Organic Manure and NPK Fertilizers on Earthworm Activity Cultivation Mulching Irrigation **Biocides** Procedure to Prepare Vermicompost **Culturing Technique** Culture Bed **Feed Composition** Feed Application Wormcast Production and Collection Application of Vermicompost Conclusion **Future Research Needs** 5. ORGANIC FERTILIZERS FOR FLOODED RICE ECOSYSTEM Azolla Growth and N-Fixation Factors Affecting Growth and N-Fixation **Management Practices** Impact on Rice Yield and Soil Fertility **Economic Aspects** Suitable Agroclimatic Conditions Adoption Constraints and Future Research Needs Blue-Green Algae (BGA) Nitrogen Fixing Potential and N-input Factors Affecting Growth and N-fixation **Management Practices** Impact on Rice Yield and Soil Fertility **Economic Aspects** Suitable Agroclimatic Conditions Adoption Constraints and Future Research Needs Conclusions 6. PHOSPHATE SOLUBILIZING MICROORGANISMS : FUNGI AND BACTERIA Problems in Phosphorus Uptake **Phosphate Fixation in Different Soils Historical Developments Phosphate Solubilization** Factors Affecting Phosphate Solubilization Isolation Mechanisms of Action Role of Acids Other Mechanisms Effect on Crop Yield 7. PHOSPHATE SOLUBILIZING MICROORGANISMS :

MYCORRHIZAE Mycorrhizal Types and Their Structural and Nutritional Features Ectomycorrhizae Mechanism of ECM Formation Morphology and Structure Synthesis of Mycorrhiza Cutural Study Vesicular Arbuscular Mycorrhiza Introduction Evolution Taxonomy Classification Distribution Lifecycle Reproduction **Sexual Reproduction** Asexual Reproduction Method of Inoculum Production of VAM Some Important Steps in Production of VAM Host Plant/Growth Medium Fertilizations/Micronutrients **Chemical Application Control of Fungal Pathogens** Plant-Vesicular Arbuscular Mycorrhizal Fungal Interactions Vam and Soil Biota **Control of Root Diseases** Endomycorrhiza and Plant Disease Ectomycorrhizal Fungi and Tree Diseases Mechanism of Disease Control Outlook 8. APPLICATION AND EVALUATION **Different Methods for Biofertilizer Inoculation** Seed Inoculation Top Dressing of Biofertilizers **Granular Biofertilizers** Solarisation of FYM/Compost Granular Biofertilizer Mixed with Seed **Broadcasting of Granular Biofertilizers** Frequency of Inoculation Liquid Inoculation of Biofertilizers Methods of Application of Liquid Inoculation **Drenching By Sprayers** Application in Root Zone Culture Pellet Methods of Application of Other Biofertilizers Blue Green Algae Azolla As Green Manuring Azolla Dual Cropping Azotobacter Preparation and Use of Azotobacter Inoculant Application Azospirillum

Mycorrhizae Endomycorrhizae Ectomycorrhizae Techniques for Isolation of Vesicular Arbuscular Mycorrhizal Fungi (VAMF) from Soil in Laboratory Gerdemann and Nicolsion Technique Sutton and Barron Flotation Technique Method for Examination of Mycorrhizal Infection in Root Samples Foliar Biofertilizer Humar Humic Acid Introduction Application Soil Foliar Seed Treatment Soil Benefit Root Seeds Plants Precautions Different Media Used to Study Biofertilizer I. Growth Media for Rhizobium Media for Testing Nodulating Ability of Rhizobium Jenson's Plant Nutrient II. Isolation Of Frankia III. Selective Media For Blue Green Algae IV. Selective MEDIA For Azotobacter V. Selective Media for Azospirillum VI. Selective Media for Phosphate solubilizing organisms VII. Selective Medium for isolation of Pseudomonas fluorescens, a biocontrol agent (Subba Rao, 1986). VIII. Selective medium for isolation of Trichoderma - an antagonistic fungus. 9. BIOLOGICAL PEST MANAGEMENT Cultural Control Sanitation Tillage Application of Manures and Soil Amendments Habitat Diversification **Crop Rotation Trap Cropping** Intercropping Strip Farming Time of Planting Water Management **Crop Competition** Physical and Mechanical Control Manual Control Burning Solarization Flooding **Biological Control** Conservation of Biodiversity

Conservation of Natural Enemies Biopesticides Botanicals Host Resistance Increasing the Effectiveness of Bio-control **Autocidal Control Bheavioural Control** Pheromones Fairomones Success Rate of Ecological Management Other Related Approach **Integrated Pest Management Biologically Intensive Pest Control (BIPM)** Success with Biological Control Rice Sugarcane Tomato Tobacco Cotton Horticultural and Plantation Crops Future Thrust Conclusions **10. PRESSMUD AS PLANT GROWTH PROMOTER** Material and Methods **Results and Discussion 11. BIOFERTILIZER FOR MULTIPURPOSE TREE** SPECIES Material and Methods Species **Inoculum Preparation** Treatment Preparation of Soil-Vermiculite Mixture Inoculation of Acacia Nilotica Inoculation of Eucalyptus Hybrid Results Discussion Summary 12. TREE LEGUMES TO BIOINOCULATION OF **ENDOMYCORRHIZAE** Material and Methods **Results and Discussion** Summary 13. GROWTH RESPONSE OF CAJANUS CAJAN Material and Methods Growth Response of Cajanus Cajan to Glomus Aggregatum with Cement Dust Amendments Assessment of Percent Mycorrhizal Association Estimation of Dry Weight Results Infectivity Efficacv Discussion Summary

14. SALINE SOIL TOLERANCE OF SAPINDUS EMARGINATUS Material and Methods **Results and Discussion 15. SELF SUSTAINABILITY OF ORGANIC FARMING** Self Sustainable System Design of Self-Sustainable Agro-Ecosystems Ecological Processes to Optimize in Agro-Ecosystems Mechanisms to Improve Agro-Ecosystem Immunity Peripherals for Self-Sustainability **Bio-Diversified Agro-Ecosystems Crop Rotations** Polycultures Agroforestry Systems **Cover Crops** Animal Integration Integration of Livestock Integration of Aquaculture Indigenous Organic Farming Practices Soil and Water Conservation Arable Land Management **Agronomical Measures** Wind Erosion Control Water Erosion Control Measures **Engineering Measures** Non-Arable and Denuded Land Management Rain Water Conservation Mulches Essentiality of Mulching Mulch and Microlife Activities Activity of Earthworm Weed Suppression Birds and Mulch Disturbance Mulch and Retention of Moisture Increase in Crop Yield **Control of Temperature Protection Soil Against Erosion** Control of Pest and Disease Appearance Drawbacks of Mulching Types of Mulch Loose Organic and Non Organic Mulches Vertical Mulch Live Vegetative Barriers Agroforestry/Alternate Land Use Systems **Basic Principles** Types of Agroforestry Systems Alley farming Ley farming Silvipasture Aari-Horticulture Windbreaks and Shelterbelts Interactions Between Trees and Crops

Useful for Organic Farming Effects of Trees on Soils **Beneficial Effect** Soil Conservation Soil Fertility Management of Adverse Effects of Trees Management of Agroforestry for Organic Farming Conclusion **16. RICE ECOSYSTEM Rice Ecosystems of Kerala** Midland and Malayoram Rice Ecosystem **Chittoor Black Soil** Irrigated Rice Ecosystem Onattukara **Kuttanad** Karilands Karappadam Soils Kayal Lands Kole Lands The Coastal Saline Rice Eco Systems High Range Rice Eco System Koottumundakan System 17. "POKKALI"-WORLD ACCLAIMED FARMING SYSTEM MODEL Climate Crops and Crop Season **Reclamation of Saline Soils** Varieties Seeds and Sowing Seedling Establishment and Aftercare Rice-fish/prawn integration in Pokkali fields Selective Culture of Prawn **Rice Cum Fish Culture** Sustainable Farming System 18. NEEM : THE BEST EXAMPLE FOR ORGANIC FARMING Uses of Neem Neem for Pest Control Limonoids Azadirachtin Meliantriol Salannin Nimbin and Nimbidin Others Mode of Action Effectiveness Good Control Moderate Control Poor Control **Nontarget Species** Earthworms **Beneficial Insects** Preparations for Pest Control

Methods of Application Water Extraction Hexane Extraction Pentane Extraction **Alcohol Extraction Formulations** Additives **Practical Methods for Preparations Control of Stored Grain Pest** Uses of Neem Extract **Preparing Crushed Neem Seed** Neem to Control Stem Borers on Young Plants **Extracting Neem Oil** Controlling Bruchid Beetles in Stored Beans **Control of Soil-Borne Pests** Neem Water Extract for Plant Protection Water based Neem Spray to Control Cutworms **Success Stories** Desert Locust Cockroach **Brown Planthopper** Stored-Product Insects Armyworm Mosquitoes Aphids Fruit Flies Nematodes Snails Crustaceans Funai Aflatoxin **Plant Viruses** Propagation and Planting of Neem **Climatic Requirements** Rainfall Temperature **Raising Seedlings** Transplanting Conclusions **19. RICE-FISH INTEGRATION : A WIN-WIN FARMING** MODEL Externalities of Green Revolution Lowland Rice Ecologies **Diversification—IFS Approaches** Vanishing Rice Lands—Economic Sustainability Issues Pokkali System-the Classic Example **Rice-Fish**, Harnessing Complementarities Group Fish Farming (GFF) **Environmental Superiority Economic Sustainability** Win-Win Land Use Model 20. RICE SOILS IN COASTAL—AREA SUSTAINABLE SOIL NUTRIENT IN ORGANIC RICE FARMING

Organic Farming-the Truths vs. Myths Organics as a Source of Plant Nutrients Organic Farming and Food Security Organic Farming—A Lesson from China **Biodynamic Farming** System of Rice Intensification (SRI) Conclusions 21. UTILIZATION OF BENEFICIAL MICROORGANISMS FOR SUSTAINABLE ORGANIC RICE PRODUCTION **Biological Nitrogen Fixers** Legume - Rhizobium symbiosis Azospirillum Different Methods of Application of Azospirillum in the Field Cvanobacteria (Blue Green Algae - BGA) Mass Production of BGA in the Field Anabaena - Azolla Symbiosis Utilization of Azolla for Rice Mass Production of Azolla in the Field **Phosphorus Solubilising Microorganisms** Arbuscular Mucorrhizal Fungi (AMF) Silicate Solubilising Bacteria Zinc Solubilising Bacteria Plant Growth Promoting Rhizobacteria (PGPR) Efficacy of PGPR in Rice Methods of Application of Pseudomonas Fluorescens in Rice **Microbial Consortium for Rice** 22. BIOGAS POTENTIAL FROM WASTES AND ITS VALUE Manurial Value of Digested Slurry 23. RECYCLING OF ORGANIC MATERIALS AS **ORGANIC FERTILIZERS** Direct Incorporation of Organic Materials in Soil and Their Effects Maintenance of Organic Matter in Indian Soils Effect of Organic Matter on Soil Microorganisms **Organic Mulch** Effect of Crop Residues on Yield of Legume Crops Effect of Straw, Neem Cake and Farmyard Manure on Yield of Maize Crop Effect of Incorporation of Organic Matter on Paddy Crop Influence of Humic Substances on Crop Yields 24. RESPONSE OF CROPS TO ORGANIC FERTILIZERS Farmyard Manure and Compost **Oil-Cakes** Long-Term Effect of Organic Manures Effect of Organic Manures in Rotation Manurial Requirements of a Fixed Crop Rotation **Rice-Wheat Rotation Rice-Rice Rotation** Maize-Wheat Rotation Jowar-Wheat Rotation **Bajra-Wheat Rotation** Rotation-Jowar in Kharif-Bajra in Rabi Response of Crops to Bone-Meal

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Fri, 09 May 2025 08:50:44 +0000