## The Complete Book on Cultivation and Manufacture of Tea (2nd Revised Edition)

Author:- H. Panda Format: paperback Code: NI242 Pages: 574 Price: Rs.1625US\$ 150 Publisher: NIIR PROJECT CONSULTANCY SERVICES Usually ships within 5 days

Tea is one of the most popular beverages that are being consumed all over the world. Tea is known as a soothing drink and a way of life. Owing to its increasing demand, tea is considered to be one of the major components of world beverage market. Tea is very beneficial for health and is also known as anticarcinogenic properties. Green tea acts as an antiviral agent. Growing tea requires sufficient amount of work and there is additional level of work that must be incorporated to harvest it. Tea is cultivated in tropical and sub tropical regions. There are various kinds of tea such as black tea, green, oolong tea that can be obtained from real tea plant, Camellia sinensis. The making of different varieties of tea mainly depends upon plucking and rolling, spreading, storing process.

The handbook describes aspects of tea cultivation, ranging from the history of old crop, machinery & equipment for various Tea, biological control, organic tea- and many more. This is a sincere attempt to open up the world of this wonderful beverage, its cultivation methods, types of tea available worldwide, manufacturing process, to the common man.

Some of the fundamentals of the book are growth of tea in other countries, tea in Indian economy, biochemical constituents, pharmacological properties, selection, pollination and propagation, nutritional requirements, growth, photosynthesis and respiration, nursery management, water theory, oxidative degradation of protein, biological effect of polyphenols, analysis of tea, tea processing, green tea processing, tea bag production etc.

This book will be a mile stone for its readers who are new to this sector, will also find useful for entrepreneurs, tea scientists and tea research establishments.

1. HISTORICAL EVIDENCES Tea in India Growth of Tea in Other Countries Tea in Indian Economy 2. RELATION WITH HEALTH The Core Compounds Flavonoids in Tea Infusion Antioxidant Activity of Tea Flavonoids Tea Flavonoids and Cancer Caveats 3. IMPORTANCE OF THERAPEUTIC COMPOUNDS Polyphenols Caffeine

Vitamins Carbohydrates Lipids Triterpenoids Carotenoids and Pigments **Minerals Overall Distribution of Compounds** 4. PRODUCTION OF THERAPEUTIC COMPOUNDS Polyphenols Variations in Specific Compounds **Changes During Processing** Theaflavins and Thearubigins Discussion 5. BIOCHEMICAL CONSTITUENTS **Biochemical Constituents** Enzymes **Polyphenolic Compounds** Amino-acids Phosphate Esters, Nucleotides and Caffeine Carbohydrates Lipids Chlorophyll and Carotenoids Volatile Compounds **Biochemical Changes during Leaf Processing** Withering Rolling Fermentation **Development of Aroma** Changes in Carotenes and Fatty Acid Firina **Biochemical Basis of Tea Quality** 6. PHARMACOLOGICAL PROPERTIES **Pharmacological Actions** Pharmacological Aspects Associated with Tea Consumption Cardiovascular System Cancer Tea and Dental Health Tea and Fluid Replenishment Gastrointestinal System Skin and Topical wound Healing Activity Antimicrobial Action Angiogenesis Inhibition Absorption of Tea Flavonoids Potential Health Concerns Associated with Tea Consumption Tea and Iron Absorption Conclusion 7. IMPORTANCE OF BLACK TEA Composition and Chemistry of Tea Pharmacological Properties of Tea Antioxidative Effects of Tea Modulation of Metabolizing/Detoxifiying Enzymes Modulation of Immune Function Antimutagenic Activity

Anticarcinogenic Activity Prevention of Coronary Heart Disease Germicidal and Antiviral Activity **Regulation of Intestinal Microflora Prevention of Dental Caries** Conclusion 8. TAXONOMICAL PROPERTIES **Tea Varieties** (1) The China variety (2) The Assam Variety (3) The Cambod Variety **Biology of the Plant** Phasic and Vegetative Growth Tea Flowers and Reproductive Phase Dormancy Longevity Tea Gene Pool Cytotaxonomy and Chromosome Numbers Wild Populations of Tea **Germplasm Collection** 9. SELECTION, POLLINATION AND PROPAGATION **Development of Seed Varieties** Vegetative Propagation and Development of Clones Selection for Yield and Quality **Hybridisation** Interspecific Hybridisation **Polyploid Breeding** Mutation Breeding **Tissue Culture and Genetic Engineering Breeding Strategies** Seed and Clone Techniques of Vegetative Propagation and Clonal Selection The Nucleus Plot Manuring of Mother Bushes Type of Cuttings Time of Taking Cuttings Nursery Bed and Shade Use of Hormone in V.P. **Clonal Selection Procedure** Mother Bush Selection Technique of the Seed Bari and Grafting Bringing into Bearing Collection Sorting Storage and Transport Upgrading a Seed Bari (Seed Nursery) Vegetative Propagation (V.P.) The Mother Bush The Nucleus Plot **Taking Cuttings** Setting the Cutting **10. CHARACTERISTICS OF SOIL BIOLOGY** Origin and Characteristics of Tea Soils

Soil: Physical Properties The Basis of Soil Nutrition Soil Acidity Soil Physical Properties Soil Texture Soil Aggregate Soil Compactness Soil Management for Tilth (a) Drainage (b) Land Levelling (c) Cultivation (d) Lime or Dolomite Applications (e) Soil Improvement Soil Biology **Physical Environment** Rainfall Temperature Humidity Wind Speed Day Length **11. NUTRITIONAL REQUIREMENTS** Nutrient Composition of the Tea Plant Assimilation of Various nutrients by Parts of the Plant Individual Nutrients Nitrogen Basis of Nitrogen Absorption and Uptake Sources of Nitrogen Determination of Quantity for N: K ratio Phosphorus Increasing Phosphate Efficiency Phosphate Uptake and Mycorrhiza Phosphate Solubilising Microorganisms **Rock Phosphate: Amendments** Interactions of Phosphorus with Other Nutrients Fertiliser with Soluble Phosphorus Potash Potassium Reactions in the Soil Potassium in Growth Stages of Tea Factors Affecting Potassium Uptake **Potassium Interactions** Nitrogen: Potash interactions Interaction with Other Nutrients Collateral Effects of Potassium Sulphur Sulphur Containing Fertilisers Zinc Other Micronutrients **Organic Fertilizers** Nutrition and Crop Quality **Deficiency Symptoms** 12. GROWTH, PHOTOSYNTHESIS AND RESPIRATION Carbon Input; Sink Source Ratio Limitation of CO2 Assimilation

CO2 Assimilation and Light Limitation **Regulation of Photosynthesis** Regulation of Photosynthesis by Transport and Partitioning Effect of Leaf Age on Photosynthesis Photorespiration and Dark Respiration Dry Matter Partitioning and Productivity **13. NURSERY MANAGEMENT** Nursery Management Planting Land Preparation Planting Density **Field Planting Planting Operations** Bringing up of Young Tea and Bush Formation 14. THEORY OF PRUNING, PLUCKING AND MAINTENANCE FOLIAGE Theory of Pruning Types of Pruning **Collar Pruning** Medium Pruning Top or Light Pruning Lung Pruning Skiffing Choice of Pruning System Tipping Shoot Growth Leaf and Bud Dynamics Plucking **Plucking System Plucking Standard Plucking Interval Plucking and Maintenance Foliage** (1) Pruning: definitions (2) Requirements before Pruning (3) Pruning Administration (4) Factors Affecting Pruning Time (5) Crop Distribution (6) Pruning Cycles **15. HISTORICAL PERSPECTIVE OF SHADE TREES** Historical Perspective of Shade Problem The Genesis of Shade Problem Effect of Shade per se Shade and Light Intensity Shade and Tea Leaf Temperature Effect of Shade Trees on Light Climate Shade and Partition of Growth Shade Effect on Quality of Made Tea **Current Perspective** Sylviculture of Shade Trees Mixture of Shade Tree Species Intimate Mixtures (a) Square Planting (b) Triangular Planting

Non-Intimate Mixtures (1) Tea and Shade Square Planted Spacing of Shade (i) Suggested Spacings (ii) Planting of Shade Trees **Propagation of Shade Trees 16. WATER THEORY** Theory of Drainage Approach to Drainage Problem **Problems in Tea Areas** Models of Drainage Systems and Water-table **Objective of Drainage Diagnosis of Drainage Problems** A. Growth Pattern B. Physical Indicators of Waterlogging Outline of the Drainage Designing the Main Drain The Field Drains and Removal of Surface Water The Drainage System **Construction of Drains** Pipe Drainage Rationale of Irrigation Parameters of Irrigation Irrigation Requirement: Net and Gross Irrigation Requirements Irrigation Frequency Scheduling of Irrigation **Rainfall Deficit** Types of Irrigation Irrigation Efficiency Significance of Irrigation in Total Water Management Soil Conservation Criteria for Water Relation Between Soil and Tea Plants Moisture Soil Water Moisture Extraction Pattern by Tea Roots Effect of Drainage and Irrigation Weed Effect Effects of Weeds on Tea **Biology of Weeds** Weed Reproduction Weed Density Growth **Dispersal of Weeds** Weed Dispersal Methods of Weed Control: The Manual Aspect **Chemical Weed Control** Herbicides in Tea Herbicide Mixtures **Application Technology** Perspectives on Weed Management Common Weeds of Tea A. Dicotyledonous or Broad Leaved Weeds B. Monocotyledonous and Grass Weeds

**Outline of Weed Control** Manual Control Mechanical Control **Chemical Weed Control** Preplanting Control of Thatch Additives for Herbicides Herbicide Mixtures 'Cocktails' Weed Control Outside the Tea Area Equipment **Climatic Factors Affecting Weedicide Application** Safety Precautions Herbicide Damage to Tea **17. DISEASES OF SEEDS AND CUTTINGS** Diseases of Tea Seeds and VP Nursery diseases Leaf Diseases Stem Diseases **Root Diseases** Strategies for Controlling Diseases **Outline of Disease Control** Leaf Diseases **Root Diseases** Secondary Stem Diseases **18. PESTICIDE MANAGEMENT Crop Losses** Mite Phytophagy **Defoliators** Sap Feeding Insects Root Damaging and Soil-borne Pests Pests of Shade Tree and Ancillary Crops Leaf and Petiole Eaters Stem Borers Seasonal Abundance of Pests Pesticide Specifications for Tea Pesticides: Applications and Management Management of Pesticide Residues Strategies in Pest Management Outline of Pest Control Mite Damage Insect Attacks Young Tea Sick or Dying New Flush Stunted **19. BENEFICIAL IN CANCER** Lifestyle and Diet in Cancer Effect of Tea in Animal Systems Prevention of Cancer in Man Effects of Tea on the Incidence of Human Cancer Interaction of Genetic Actions in Carcinogenesis in Humans **20. CANCER PREVENTION** Cancer-an Overview Cancer and the Intrinsic Defense Machinery of the Host: A Tug-of-War Why Cancer Therapy Fails **Dietary Therapy** Why Tea?

Tea and Its Constituents - A Historic view **Hypothesis** (1) Direct Effect of Tea in Tumor Regression (2) Indirect Effect of Tea in Cancer Prevention: Tea-induced Tumor Regression by Rejuvenation of Host's Intrinsic Defense Machineries Conclusion 21. OXIDATIVE DEGRADATION OF PROTEIN Materials and Methods Results Discussion 22. BIOLOGICAL EFFECT OF POLYPHENOLS **Biological Effects** Chemoprevention An Overview 23. PREVENTING BONE LOSS Functions of Marketing **Promotional Techniques** The Product Concept The Sales Process 24. ANALYSIS OF TEA Analysis of Green Tea Leaf Sampling Polyphenols **Determination of Total Polyphenols** Separation and Identification of the Individual Polyphenols **Determination of Flavonol Glycosides** Determination of Flavylogens **Determination of Phenolic Acids** Amino Acids Carbohydrates Chlorophyll Carotenoids Minerals Enzymes Analysis of Manufactured Black Tea **Traditional Methods** Alkaloids Polyphenols Separation of the Polyphenols Analysis of Theaflavins and Thearubigins Determination of Total Tannin Cream The Aroma Complex Analysis of Instant Tea 25. TEA PROCESSING Types of Tea Brief Outline of Tea Manufacturing Process Withering Rolling Fermentation/Oxidation Drying Sorting and Grading

Storage and Packaging Tea Manufacturing Process Flow Diagram-CTC CTC Orthodox Withering Rolling Fermentation/Oxidation Drving Sorting and Grading Storage and Packaging Tea Manufacturing Process Flow Diagram-Orthodox **Tea Manufacturing Process Quality Control Oolong Tea Oolong Tea Process** White Tea Source of Technology Machinery and Equipment **CTC** Tea Processing **26. GREEN TEA PROCESSING Green Tea Ingredients** Green Tea Processing Pan Firing or Steaming Rolling Drying/Firing Sorting/Grading/Packing Tea Manufacturing Process Flow Diagram - Green Tea Machinery and Equipment Green Tea Processing (Moroccan Type) 27. TEA BAGS Tea Bag Processing **Tea Bag Filter Papers** Non-Heat Sealable Filter Papers Heat Sealable Filter Papers Withering Rolling Drying Milling Blending Measuring Tea Bag Assembly Tea Manufacturing Process Flow Diagram - Tea Bag Process of Tea Bag Manufacturing Machinery and Equipment 28. MACHINERY & EQUIPMENT FOR CTC TEA/ **ORTHODOX TEA/OOLONG TEA/TEA BAGS** 1. Withering Axial Flow & Centrifugal Fans **Technical Data** Centrifugal Fans (Hot Air, Induced Draft and Fermenting Fans) **Technical Data Direct Fired Oil/Gas Heaters** 2. Rolling

Rotovanes (Rolling Solutions For CTC Tea) **Technical Data** Sifter-CTC Machines Technical Data **Balanced Green Leaf Sifter** 'Rotomax' Rolling Tables for Orthodox Tea 3. Fermenting/Oxidation Continuous Fermenting Machines (The Ideal Fermenting Solution) **Technical Data** 4. Drying Fluidized Bed Tea Dryers **Technical Specification** Advanced Conventional Tea Dryers **Technical Specifications** Indirect Fired Coal/LECO/Firewood Heaters (The Most Efficient Solid Fuel Based Indirect Fired Heaters for the Tea Industry) **Technical Specifications Chain Grate Stokers Technical Specification** Ghoogie 5. Sorting & Grading 'Fibro' Slow Speed Fibre Extractor (Horizontal Design Vibratory Sifter & Grader for Tea) Vibro Screen Sorter (Vertical Design Vibratory Sifter & Grader for Tea) Pulverizer Powdering Machine for Tea 6. Packaging Range of Packaging Machine (Menu Driven Computerized Pneumatically Controlled) Vertical Form-Fill-Seal Machines Pillow Pack FFS Machines for Granules **Technical Specification Tea Bag Packaging Machine Technical Specification** 28. MACHINERY & EQUIPMENT FOR CTC TEA/TEA/ OOLONG TEA/ TEA BAGS

## About NIIR

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Fri, 09 May 2025 08:22:28 +0000