

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

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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
Firing
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/Detoxifying 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 Tillth

(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
Drying
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

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Sat, 17 May 2025 09:36:54 +0000