



ROHINI
COLLEGE OF ENGINEERING & TECHNOLOGY
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Department of Agricultural Engineering

Course Name : **Protected Cultivation**
Course Code : **AI3015**
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Faculty : **Mr. ARUNPANDIAN N (Asst. Professor)**

UNIT - II

PROTECTED CULTIVATION OF VEGETABLE CROPS

PART 1 : INTRODUCTION TO PROTECTED CULTIVATION TECHNOLOGY

Philosophical and Technical Foundation

Protected cultivation represents a paradigm shift from traditional farming to precision agriculture, where the microclimate becomes a manageable production input rather than a limiting factor. This approach transforms agriculture from weather-dependent to technology-driven enterprise, enabling year-round production, geographical independence, and resource optimization.

Detailed Structural Analysis:

1. Greenhouses – The Epitome of Control

- Structural Engineering:
 - Gutter-connected systems: Multi-span structures with shared walls (1000-5000 m² complexes)

 - Load calculations: Wind load (up to 150 km/hr), snow load (50-100 kg/m²), and crop load considerations

 - Frame materials: Galvanized steel (GI), aluminum alloys, or bamboo for low-cost options

 - Cladding materials evolution:
 - > Glass (4mm horticultural): 92% light transmission, 30-year lifespan
 - > Polycarbonate (multi-wall): Twin-wall (16mm) with 80% light transmission, excellent insulation
 - > Polyethylene (UV-stabilized): 200-micron thickness with EVA/anti-drip additives

2. Environmental Control Systems – The Nervous System

• Heating Systems:

- Hot air heaters: 50,000-200,000 kcal/hr capacity with heat distribution pipes
- Soil heating cables: 15-20 W/m² for root zone warming in nurseries
- Geothermal systems: Underground heat exchange for energy efficiency

• Cooling Systems:

- Pad and fan system:
 - > Design ratio: 1.5 m² pad area per 100 m³/min air flow
 - > CELdek pads (100mm thickness) with 10°C temperature depression
- Fogging systems: High-pressure (70 bar) creating droplets <10 microns
- Shading systems: Movable screens with 40-80% shade factor

• Climate Computers:

- Sensor networks: Air/soil temperature (PT100 sensors), RH (capacitive sensors), PAR (quantum sensors), CO₂ (NDIR sensors)
- Control algorithms: PID controllers maintaining ±0.5°C accuracy
- Integration: SCADA systems with cloud-based monitoring and SMS alerts

3. Root Zone Management Systems

• Substrate cultivation:

- Media components: Cocopeat (60-70%), perlite (20-30%), vermiculite (10-20%)
- Physico-chemical properties:
 - > Bulk density: 0.2-0.8 g/cm³
 - > Total porosity: 60-80%
 - > Cation Exchange Capacity: 20-100 meq/100g
- Container systems: Grow bags (50L capacity), slabs (100×20×10cm), pots

• Hydroponic systems:

- NFT (Nutrient Film Technique): 1-2% slope, flow rate 1-2 L/min
 - Drip hydroponics: 2-4 L/h drippers with individual stake tubes
 - Deep Water Culture: 20-30 cm deep channels with air stones (2-4 W/m²)
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