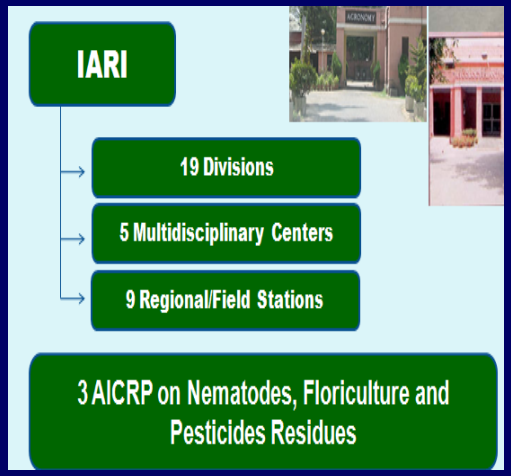
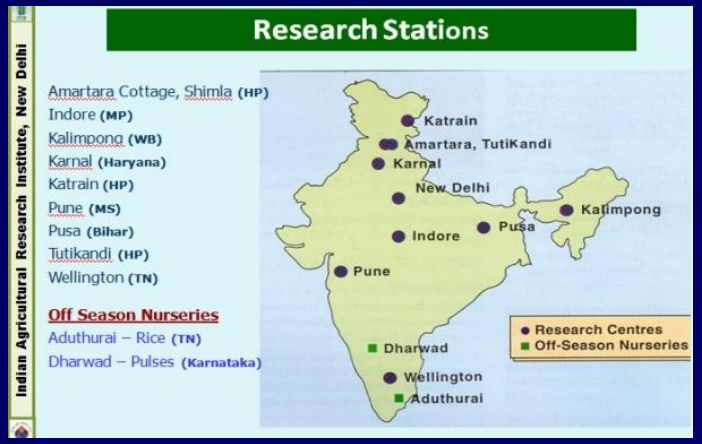
Research Status on Protected Cultivation at ICAR-IARI,New Delhi

Dr. P. K. Singh
Centre for Protected Cultivation Technology,
ICAR-IARI, New Delhi-110012, INDIA

Established in 1905 at Pusa, Bihar and shifted to New Delhi in 1935.
Indian Agricultural Research Institute (IARI) New Delhi





- Established in the year 1998-99 and commissioned as Indo-Israel project in January 2000
- After the completion of the project and the unit was re-designed as Centre for Protected Cultivation technology (CPCT) in 2004
- To demonstrate different technologies for intensive and commercially oriented peri-urban cultivation of horticulture crops for improved quality and productivity
- The centre acts as a nodal centre of R&D work, training and transfer of technology on protected cultivation aspects
- The centre also focuses on precision and controlled input agriculture using latest techniques of drip irrigation (fertigation) and protected cultivation of horticultural crops


-इज़रायल कृषि प्रौद्योगिकी मूल्यांकन एवं हस्तांतरण केन्द्र
का शिलान्यास इज़रायल के राष्ट्रपति
महामहिम इज़र वाइज़मैन
के कर-कमलों द्वारा सम्पन्न हुआ।
श्री चतुरानन मिश्र
माननीय कृषि मंत्री, भारत सरकार ने समारोह की अध्यक्षता की।
डॉ॰ राजेन्द्र सिंह परोदा
महानिदेशक, भा॰कृ॰अ॰प॰ एवं
सचिव, कृषि अनु॰ एवं शिक्षा विभाग
डॉ॰ राम बदन सिंह
निदेशक, भा॰कृ॰अ॰सं॰
31 दिसम्बर 1996
INDO-ISRAEL CENTRE FOR AGRICULTURAL TECHNOLOGY
ASSESSMENT AND TRANSFER
FOUNDATION STONE LAID BY
HIS EXCELLENCY EZER WEIZMAN
PRESIDENT OF THE STATE OF ISRAEL
SHRI CHATURANAN MISHRA
HON'BLE UNION MINISTER OF AGRICULTURE PRESIDED
DR.R.S.PARODA
DIRECTOR-GENERAL, ICAR
& SECRETARY, DARE
DR.R.B.SINGH
DIRECTOR, IARI
DECEMBER 31, 1996

We need Protected Cultivation

- Optimize Climate change: Drought, Frost, Hail storm, heavy rain
- Incidence of diseases and pests increased
- Reducing natural resources : land, water
- Low productivity and quality
- High demand for quality and fresh horticulture produce

Types of protected structures used for protected cultivation

Greenhouses

a) Climate controlled

b) Semi-climate controlled

c) Naturally ventilated

d) Raised arch

Net-houses:

a) Insect-proof nets

b) Shade nets

Other Temporary structure

a) Walk-in-tunnels

b) Plastic Low tunnels

c) Plastic mulches

Protected structures available at CPCT

Components	Total area (m2)	Crops
Climate Controlled polyhouse	4,200	Cucumber, Capsicum, Tomato & Cherry Tomato, rose and gerbera
Semi –climate controlled polyhouse	2,000	Tomato, Cherry Tomato, Cucumber, Capsicum , chrysanthemum and Gerbera
Naturally ventilated polyhouse	5,860	Tomato, Cherry Tomato, Cucumber, Capsicum , chrysanthemum and carnation
Nursery	1,000	Vegetables / flowers seedlings
Insect proof Net house	1,000	Vegetables
Shade net house	3000	Leafy vegetables and ornamental greens
Low tunnels/walk-in-tunnels	2,000	Cucurbits
Open fields	20,000	Seasonal Bulbous flowers and vegetables
Orchards	20,000	Lemon, Kinnow, Ber and Mango
Solar power operated polyhouse	200	Capsicum and cucumber.

Hi-Tech Horticulture

• Intensive Horticulture production using highly skilled techniques.

•Protected cultivation/ green house cultivation is one of them.

•Hi-Tech horticulture or Modern Horticulture involves different techniques which can be utilized in polyhouse or in open field conditions e.g. Soil Less cultivation

a. Using solid growing medium

b. Using liquid growing medium :

- Hydroponics
- Aeroponics
- Aquaponics

•Vertical farming (Vegetables,Fruits,Herbs,Foliage plants) is also part of Hi-tech Horticulture.

Protected Cultivation Technology

Microclimate surrounding the plant is modified partially or fully to suite its requirement for production.

Land and water requirement is minimized to yield plants better.

Two Major Components are involved in this Technology

Engineering :

Deals with structure, cladddding material,load calculations,irrigation system,tools,implements and other engineering inputs which insure optimal light, temperature,air,water and plant growth requirements.

Crop Production Technology :

It involves development of high yielding varieties / hybrids suitable for protected cultivation and economical and eco friendly production protocals / techniques

Polyhouse structure designs

Hi-tech Nursery Production

Crop Production

Crop Improvement

Seed Production

Human Resource Development

2. Poly houses in India

1980-1990

Quonset type

Naturally ventilated

1990 -2000

Multi-span

Gothic arch

Depends on cost

Year 2000 onwards

Low cost

Medium cost

High cost

Double-Wall Polyench

- Semi underground double walled greenhouse
- Suitable for: Cultivation of round the year leafy vegetables (Swiss Chard, Kale, Lettuce, Endive etc.)
- Working on the principle of zero energy chamber made from locally available unbaked bricks and wooden ballies
- It enhances 11–12 ^{0}C temperature and regulates diurnal variation
- 50% subsidy to local farmers for construction
- The cost benefit ratio is 1:4

Polyench

Introduction and background

✓ **India is second largest producer of vegetables and fruits, in the world, after China.**

✓ **Horticulture is the main source of livelihood for a large number of farmers but nursery management presents a challenge.**

✓ **Healthy seedlings are essential and prerequisites to achieve potential productivity and quality of crops.**

✓ **In open field, nurseries get affected by biotic and abiotic stresses and plants take long duration (45-60 days) in growing to a stage ready for transplant and their survival rate is also low (40-50%) after transplanting in open fields.**

✓ **These problems can be solved using hi-tech nursery raising technologies inside a protected structure.**

✓ **Growing nursery in protected environment using sterilized media in plug trays ensures highest germination count of costly hybrid seeds, yielding disease-free and vigorous seedling.**

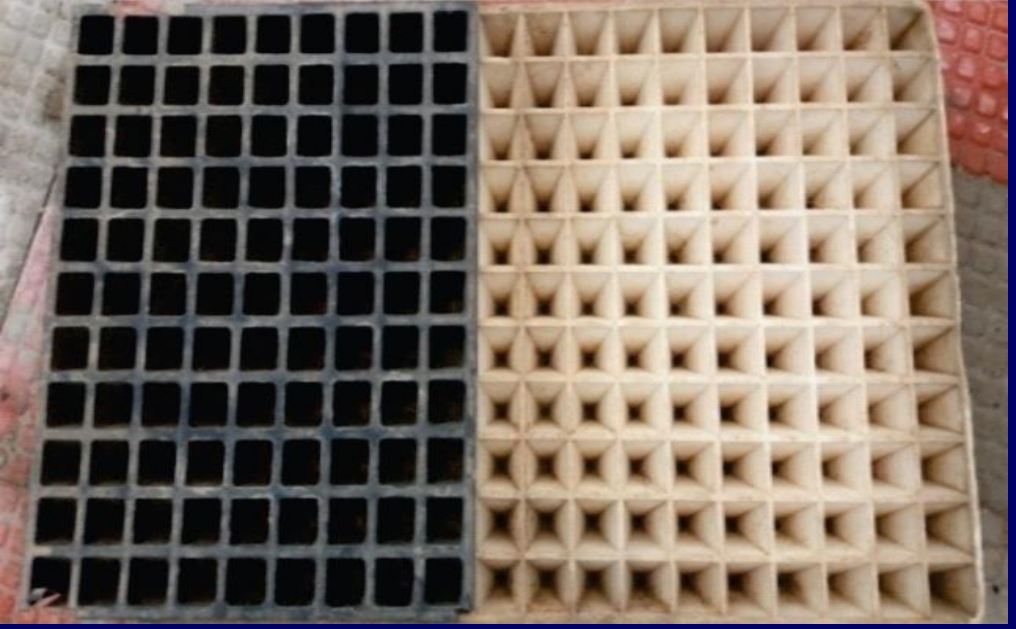
✓ **This technology also provides an excellent opportunity for developing entrepreneurship for round the year income.**

Shade net use for nursery raising

Plug tray Nursery Production

PLUG-TRAY NURSERY RAISING TECHNOLOGY

Developing seedlings 15 days earlier with minimal mortality also helps in earning extra benefit of USD 500 to 750 per ha to the grower



Sowing of seeds and Nutrients Management through fertigation

Hardening of seedlings and days required for transplanting

With holding water or minimal water supply are the best ways to harden a plant. Generally seedlings of all vegetables become ready for transplanting in 28-30 days after sowing in plastic pro-trays.

Packing of Seedlings

Advantages

1. Seedlings can be raised under adverse climatic conditions where it is not possible under open field conditions.
2. Healthy seedlings can be raised in short period as compared to the time taken under open field nursery raising.
3. There is no chance of soil borne fungus or virus infection to the seedlings as the nursery is grown in soil-less sterilized media and insects can not enter under the protected conditions.
4. Drastic reduction in the mortality in transplanting of the seedlings as compared to the traditional system of nursery raising. No mortality, no transplanting shock and quick establishment of the seedlings due to perfect development of root system.
5. Early planting is accomplished by raising such nursery.
6. It is suitable for raising the nursery of sexually and asexually propagated vegetables and ornamental crops.
7. Management of insect/pests and diseases under greenhouse/protected conditions is quite easy particularly the infection of viruses.

Vegetable nursery raising using plug tray at village level

GRAFTING OF VEGETABLE SEEDLINGS

- ✓ To increase yield and quality by combining a disease resistant rootstock with a genetically superior scion.

- ✓ To avoid soil-borne diseases such as Fusarium wilt in Cucurbitaceae (Cucumber, melon etc.) and bacterial wilt in Solanaceae (tomato, pepper etc.) and nematodes

- ✓ This techniques can also be used to overcome the vagaries of abiotic stress such as salinity and drought, low temperature, water logging, water and nutrient uptake etc.

Round melon grafted plant on bottle gourd at VNR Nursery

CROP CULTIVATION

Enrichment of FYM/Neem Cake with Bio-fertilizers and Biopesticides

Well decomposed FYM is thoroughly mixed with *Trichoderma harzianum* , *Azatobacter* or *Azospirillum* and Phosphate Solubilizing bacteria (PSB),, *Pseudomonas, Paecelomyces* all @ 1 kg/ton of FYM or 100 kg Powdered neem cake, moistened with sprinkling water and covered with plastic sheet or gunny cloth and kept to incubate for 15 to 20 days. This enriched FYM/Cake to be applied along with manures well before planting crop.

Choice of crops and Crop sequence








Growing Methods

1)Individual Grow bags

- 16 inch Individual Grow bags.
- White and Black
- Easy to Manage
- Suitable for all crops
- White has an advantage.

Growing Methods

- **2)One meter long Grow bags**
- Will have one meter long.
- Can accommodate three plants.
- Suitable for Cucumber and shallow root crops.
- Drainage becomes little difficult.
- EC goes up need to wash.
- Free Drainage.

Growing Methods

- 3)Permanent Cemente Through.
- High Investments.
- Long Lasting.
- Easy maintenance.
- Re circulation of drainage is also possible.

Soilless -Grow bags with coco peat

	Yield kg/m²	B:C ratio
FPP	22.7	1.99
NVP	17.20	2.10
IPNH	12.50	1.89
Average	16.07	1.83

Cherry tomato under FVP

Varieties	Yield, kg/m^2	B:C ratio
Pusa Cherry Sl. 1	17.60	3.91
Olleh	16.72	3.41
Conchita	14.80	2.96
Flavoring	14.20	2.96
Nagmoti	15.20	2.10






Capsicum Wooden Poly House

Comparison between Open and Protected cultivation yield

Crops	Open cultivation (t/ha)			Protected cultivation (t/ha)			Increase (%)
	Min.	Max.	Avg.	Min.	Max.	Avg.	
Capsicum	25	30	27.5	90	150	120	336
Tomato	40	45	42.5	180	250	215	406
Cucumber	15	20	17.5	80	100	90	414
Beans	10	15	12.5	24	32	28	124
Peas	10	15	12.5	20	25	22.5	80
Coriander	10	12	11.0	15	20	17.5	59
Spinach	10	15	12.5	20	25	22.5	80

Rose

Rose varieties namely, First Red, Nobeless, Golden Gate, Mercedes, Grand Gala, Buggati, Poison, Balance, Golden Strike and Tajmahal are grown for cut flowers. First Red, Grand Gala and Tajmahal are highly suitable for North Indian Plains under naturally ventilated polyhouse. Productivity may increased by three fold with a provision of evaporative cooling in summer months (May to September).

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- **8-10 no. of plants at 20cm x 40 cm spacing, 60-75 cm raised beds**
- **Yield: 270 flowers /m2/ year**
- **Cost Benefit Ratio : 1:3.5**

Chrysanthemum

Standard/single (Snowdon white, Zembla, Yellow Star, White Star and Thai Chen Queen) and spray varieties (Lemans, Yellow Bouquet, Pompon White, Ajay, Ravi Kiran, Haldi Ghati, Pusa Anmol and Bronze) are under polyhouse with two successive crops can be raised at a planting density of 64 plants/m^2 (single types) and 32 plants/m^2 (spray types) on one meter wide beds staked with nylon net 15cm x 15cm supported on angle iron stands equipped with drip system (16:2:30). Such crop can produce 40-50 cut stems/m^2.
Cost benefit ratio of 1:4.0

Gerbera:

Gerbera varieties, namely Balance, Cabana, Danna Ellen, Goliath, Pabeo, Prime Rose, Rosalin, Sangaria, Salvadore and Sunway are being grown for attractive colours having 6-9 plants may produce 45-60 flowers/year and approximately 400-450 flowers/m^2/year. Once planted a crop may last 5-7 years. A 1000 m^2 gerbera polyhouse/greenhouse structure may fetch a famers approximately ₹ 25,000-30,000 per month with a cost benefit ration 1: 3.5.

Carnation

Carnation is grown round the year in polyhouse/greenhouse under mild climatic conditions and prefers a day and night temperatures of 18-21 and 24-28 ^{0}C along with moderate levels (60-70 %) of relative humidity.

Crop geometry of 15cm x 15cm with nylon net for support on angle iron stands at a planting density of 48-64 plants/m^2. However, 32 plants/m^2 gives more sturdy and erect (>80 cm) stems with large flower size (9.2 cm diameter across).

Varieties, namely Ambrose (bicolour), Guadina (red), Liberty (creamy white), Master (red), Domingo (red) and White Liberty (white) are most commonly grown for good quality cut flowers (Fig. 13). Approximately 75,000 to 1.0 lakh flowers/1000 m^2/year can be harvested at cost benefit ratio of 1: 2.5.

High value vegetables and cut flowers grown under polyhouse

Crops	Planting density (cm x cm) as plant to plant and row to row spacings	Total number of plants / 1000 m^2	Fresh fruit/ flower yield (q or nos /acre/year)	Total crop duration (months)	Cost Benefit Ratio
Cucumber	30 x 50	4000-4200	600-700	3-4 (3 crops / year	1:3.5
Tomato	50 x 50	2800-3200	600-700	10-11 months	1:2.5
Capsicum	30 x 50	4000-4200	300-400	9-10 months	1:3.0
Rose	30 x 40	4500-5000	4-5 lakh stems/ha/year	5-7 years	1:3.0
Chrysanthemum	15 x 15	32,000-64,000	5-7 lakh stems/ha/year	3-4 months	1:4.0
Gerbera	30 x 40	4500-5000	10-12 lakh/ha/year	4-5 years	1:3.5
Carnation	15 x 15	32,000-36,000	6-9 lakhs	3-4 years	1:2.5

Studies on influence of PAR in various flowers crops for flower induction using smart LEDs

Characters	White	Blue	Red	Red+ Blue	Normal Day
Plant height (cm)	42.5	62.3	35.2	48.5	71.4
Stem diameter (cm)	0.32	0.22	0.55	0.44	0.45
No of leaves/plant	16	17	22	18	23
Internode length (cm)	2.1	3.3	1.8	2.4	3.3

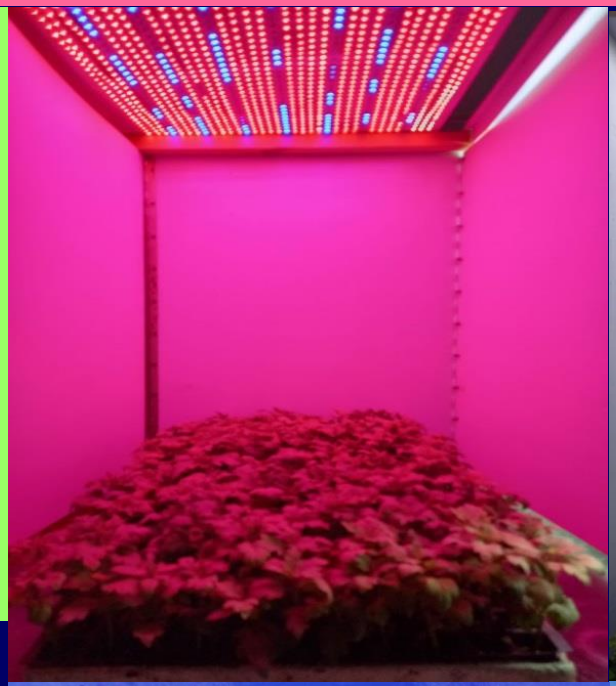
Chrysanthemum, gerbera and marigold were exposed to smart LEDS @ 120 μ moil sec^{-1} and shorten the process flower induction process significantly. However, the growth responses in gerbera and marigold were not significant.

Studies on rooting behavior of bio-film molecules on raising chrysanthemum plug nursery

Chrysanthemum
Variety: Zembla
Age of plants: 30 days in plugs
Amount of soil in pots:
Number of plants per pot : 3

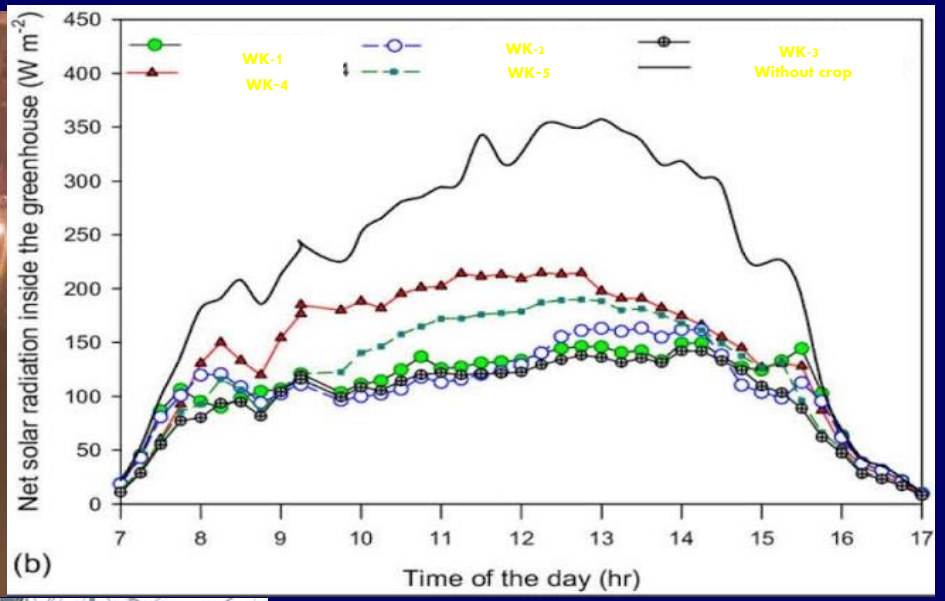
GROWING CONDITIONS :
With and with out LEDs @ 120 µ mol sec^{-1}

Treatments
T1 Control
T2 BioF1 An-Bs biofilm
T3 BioF2 An-PW5 biofilm
T4 BioF3 An-Tr biofilm
T5 BioF4 BF1-4 (Cyanobacterial consortium)



The best quality rooting was observed with an excellent root-shoot ratio in the self rooted cuttings amended with different bio-film molecules and exposed with LEDs as compared in those without LEDs

Studies on photoperiod and net solar radiation in Jan (12, 18, 26, and Feb (2 and 8) for off-season chrysanthemum.



Protected Cultivation Structures

Technologies Developed

Walk in tunnels

Low Tunnel Technology

Use of Plastic Mulches

Off season Vegetable Production

- A.) Plastic low tunnel

- B.) Walk-in tunnel

Low tunnels , usually of plastic, are miniature low cost protected structures meant to reduce the impact of high wind, rain, frost , snow and low temperatures

Plastic low tunnel

Plastic low tunnels – protect the crop from frost and enhance the yield

❖ Low tunnels are ideal for the early production of many vegetable crops

❖ The plastic covers protect the crop from frost

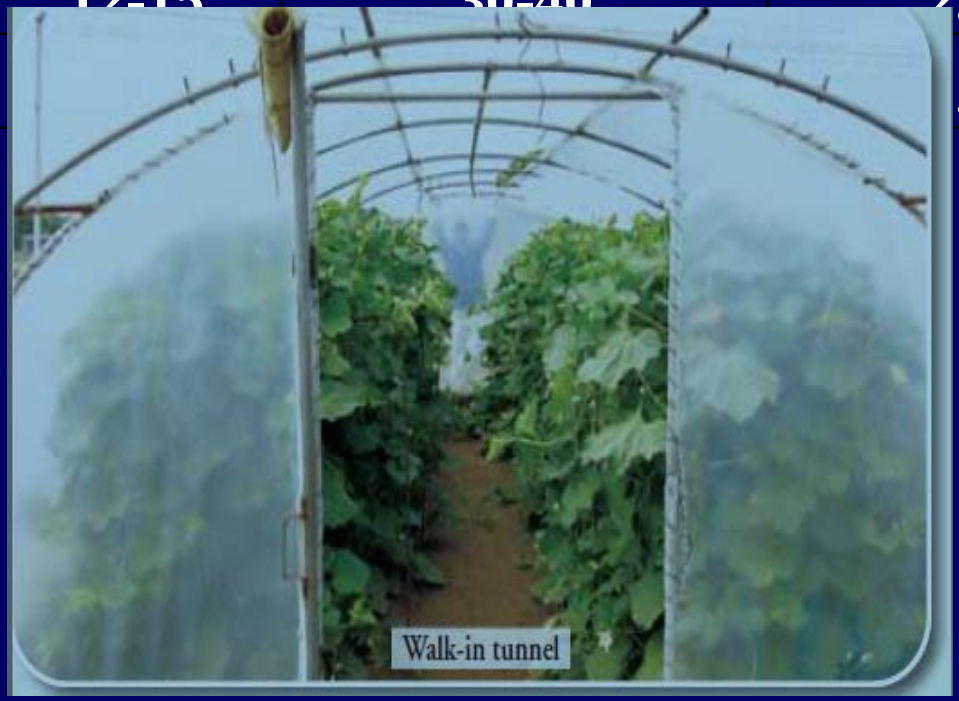
❖ Plant growth enhancement by the daily increments of solar heating

❖Temperature inside the low tunnels was 2 to 3 ^{0}C higher than the open field

❖Plastic covers (1.0 to 1.5 mm. thickness of plastic) are supported above the crop by wire hoops.

Economics of crops under low tunnels

Crop	Yield (t/ha)	Advancement of crop season (days)	Benefit-cost ratio
Summer squash	50-60	40-60	3:1
Bottle gourd	25-30	30-40	2.5:1
Bitter gourd	12-15	30-40	2.5:1
Muskmelon			.5:1



Walk-in tunnel

✓ **Under north Indian plains there is severe winter during December and January months.**

✓ **Walk-in tunnel for early summer vegetables (summer squash, bottle gourd, cucumber) to fetch high price**

✓**Covering material can be reused for 4-5 years**

100 square meter walking tunnel with double door facility (25 meter length, 4 meter width and 1.5 meter high) costing (USD 750) with low head drip irrigation system. Pay back period of one year with estimated life of 10 years for structure

Walk in Tunnel

Insect-proof net house

✓During peak (40-45 ^{0}C) a healthy nursery of early cauliflower, cabbage etc.

✓During winter's nursery of various vegetables like tomato, capsicum, brinjal, cucurbitaceous crops and cucumber can be raised by covering the insect-proof net house (40 mesh) with 200 micron thickness plastic sheet.

✓Cucumber, Summer squash, Bitter gourd, Musk melon, Sarada melon, and Sneaks melon.

View of plastics mulching in vegetables

Soil less technology

Soil less media used in the study

- Coco peat
- Perlite
- Vermiculite
- Sand

Properties of good soilless media

- ✓ Light Weight
- ✓ Free from pathogen
- ✓ Bulk Density <0.25 g/cc
- ✓ Porosity >30 %
- ✓ Water Holding Capacity >60%

We can either use one media or mixtures to get desirable properties

Vertical farming for urban vegetables production

Standardization of pot size, media and nutrients solution

Crop	Yield, kg/ m^2		
	Pot dia . 4 inch	Pot dia. 6 inch	Pot dia. 9 inch
Amaranths	9.5 kg	8.5	8.0
Spinach	5.7 kg	5.0	4.5
Lettuce	510 g	0.6	
Kale	5.0 kg	6.7	6.5
Garden mint	800 g	1.7	1.5
Pokchoi	7.2 kg	11.5	9.5
Swiss chard	5.0 kg	10.5	6.5
Tomato		2.5g	5.5
Broccoli		6.5	13.6
Cabbage		7.8	14.0

Design and Development of IoT and Sensor operated Greenhouse Vertical Farming system

- Six layers hydroponic NFT based vertical farming systems as A Type and Flat type with an without artificial LED light were installed inside 1000 sq meter climate controlled greenhouse.
- Each structure with 12 frames was designed with automatic fertigation and can accommodate 200 plants.
- Fertigation and climatic sensors were used for developing IoT based control system.
- Leafy green vegetables mainly lettuce and PokChoi were used for growing and evalauation of the structures.

Fig: IoT and Sensor Operated Greenhouse Hydroponics Vertical Farm

Development and Evaluation of Automated Sensors for a Highly-efficient Nutrition Management System In Indoor Vertical Farming. University of Applied Science HSWT, HAHN SCHICKARD FREISING GERMANY and Industrial Partners.

Research Projects

I. **Pre-breeding for biotic and abiotic stress resistance and quality in selected vegetable & flower crops.**

II. **Breeding Vegetables and Flowers for Protected Environment. (Institute Flagship Programme);**

Genetic enhancement of IARI tomato varieties using S. habrochaites (LA1777)

H-17-5-1-5-9(11)

Traits	Values
NOF	42
T.S.S	3.7
YPP(Kg)	4.2
Ty gene	3Hh

INDIAN AGRICULTURAL RESEARCH INSTITUTE

Genetic enhancement of IARI tomato varieties using S. habrochaites (LA1777)

H-17-5-1-7-3	NOF	T.S.S	YPP/Kg	AFW/g	*Ty* gene
P1	52	5	4.6	89	3HH
P11	57	4.3	4.5	85	3HH
P17	72	4.5	5.5	85-90	3HH

Performance of AICRP (VC) identified Pusa TOLCV Hybrid-6 in various zones (AICRP (VC) annual reports-2018-19 to 2020-21

Agro-climatic zone	States	Performance of Pusa TOLCV Hybrid-6 in various zones (5 zones; 14 centres; 17 states)			
		2018-19	2019-20	2020-21	Overall ranking
II. Humid Bengal – Assam Basin	West Bengal and Assam	I WB	I WB	I WB	I
IV. Sub-Humid Sutlej Ganga Alluvial Plain	Punjab, U.P., Bihar and Jharkhand	I UP	NR	I UP	I
V. Sub- Humid to Humid Eastern and South Eastern Uplands	Chhatisgarh, Orissa and Andhra Pradesh.	NR	I (OS) I (AP)	I (OS) I (AP)	I
VI. Arid Western Plain	Rajasthan, Gujarat, Haryana and Delhi	I DL	I DL I (GJ)	I DL	I
VIII. Humid to Semi – Arid Western Ghats and Karnataka Plateau	Karnataka, Tamil Nadu, Kerala and Pondicherry	NR	II	I KR	I

ICAR-Indian Agricultural Research Institute

Performance of AICRP (VC) identified Pusa TOLCV Hybrid-6 for processing quality traits during kharif/rainy season (Source: AICRP (VC); 2020-21

Traits	Performance	Traits	Performance
ToLCV (DSI %)	<7.5	Total flavonoids (mg/100g)	12.33
TOLCV resistance gene	*Ty-3*	Antioxidant activity (FRAP) mg AEAC/100g	6.94
Yield(t/ha)	65-103	Acidity % (citric acid equivalent)	0.38-0.44
Fruit weight(g)	75-100	Vitamin C (mg/100 ml of juice)	29.31
TSS (^{o}B)	3.8-4.5	Overall processing score	87.5
Brix yield (q/ha)	40.5	Total phenols (mg/100g)	39.44
Growing season	Rabi/ kharif	Total oxalate (mg/100g)	11.24
Carotenoids (mg/100g)	6.3	Lycopene (mg/100g)	3.28

Superiority over check (A. Apeksha) in processing score	26.8 %	Superiority over check (K. Aman) in Yield	46.3

Performance of MAS derived advanced backcross line: 414-3-1-9-P6

NOF	**89**
T.S.S	**5.1**
YPP(Kg)	**3.6**
AFW(g)	**50**
YIELD (t/h)	**72**
***Ty* gene**	***3-HH***

Performance of MAS derived advanced backcross line: 148-5-6	
NOF	45
T.S.S	4.1
YPP (Kg)	2.41
AFW(g)	50
Ty gene	3HH

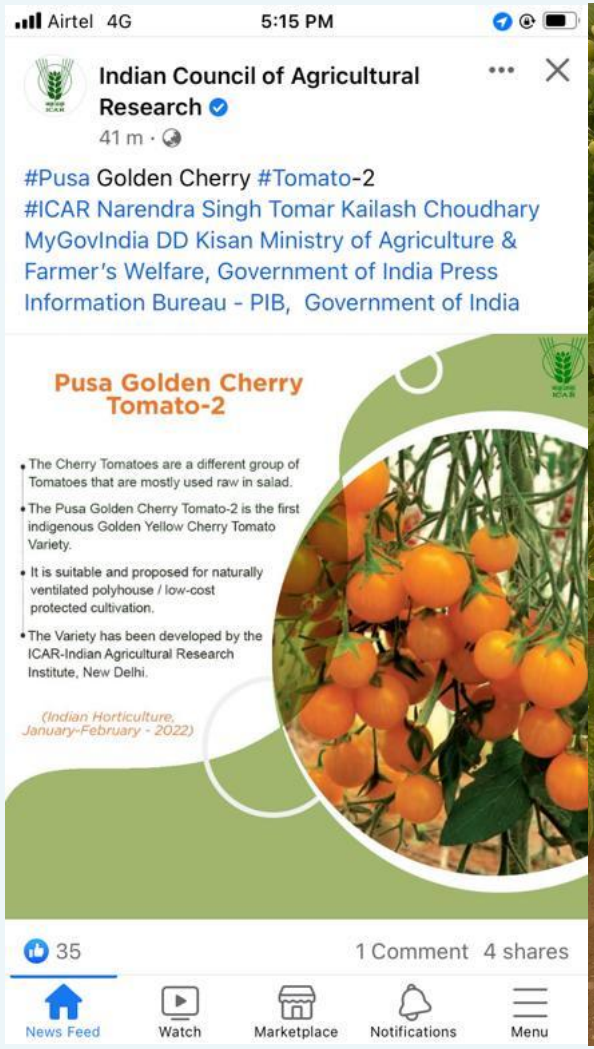
Pusa Cherry Tomato-1 released and notified by CVRC

Salient features

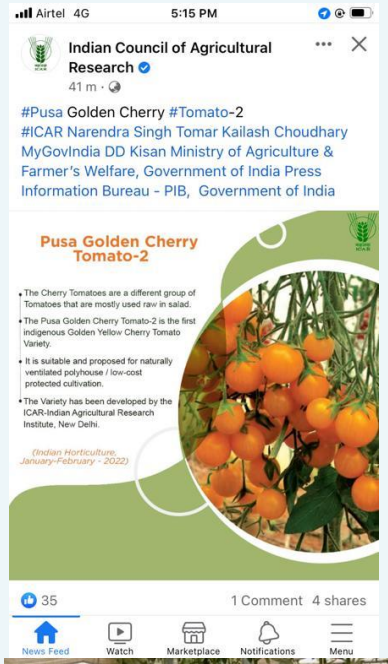
- First indigenous cherry tomato variety suitable for green house environment/ protected cultivation
- It is characterized by indeterminate growth habit and attains average vine length varying from 9-13 m
- It has 15-18 average flower truss per plant
- The average fruit weight is about 5-7 g with approximately average fruit yield 4-5 kg/plant with yield potential of 8-10 tonnes/1000 m^2
- The fruits get ready for first harvest is about 70-75 days and crop lasts for about 9-10 months
- It is tolerant to root-knot nematode
- Its fruits contain 5.4 mg/100 g FW lycopene, 20.7 mg/100g FW ascorbic acid, 0.43 acidity and 7.4 TSS

Varieties Developed for Protected Conditions

Pusa Golden Cherry Tomato-2



TSS: 9.0 brix
Acidity:0.33%
Carotene: 13.02mg/100g
Ascorbic acid:18.3 mg/100g
Yield:3.5-4 kg/plant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Indian Council of Agricultural Research
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#Pusa Golden Cherry #Tomato-2
#ICAR Narendra Singh Tomar Kailash Choudhary MyGovIndia DD Kisan Ministry of Agriculture & Farmer's Welfare, Government of India Press Information Bureau - PIB, Government of India
Pusa Golden Cherry Tomato-2
The Cherry Tomatoes are a different group of Tomatoes that are mostly used raw in salad.
The Pusa Golden Cherry Tomato-2 is the first indigenous Golden Yellow Cherry Tomato Variety.
It is suitable and proposed for naturally ventilated polyhouse / low-cost protected cultivation.
The Variety has been developed by the ICAR-Indian Agricultural Research Institute, New Delhi.
(Indian Horticulture, January-February - 2022)
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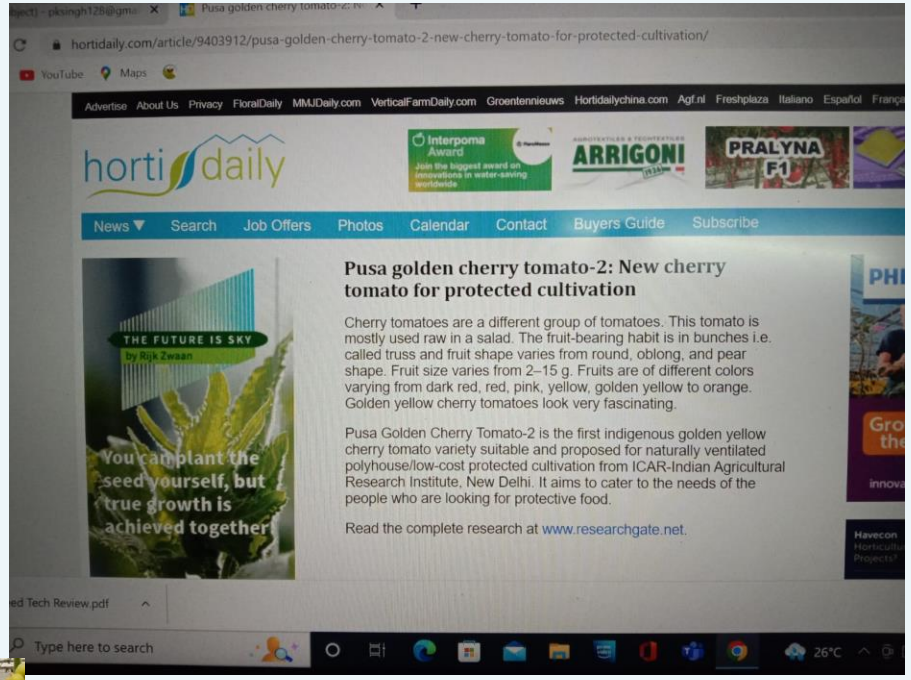
hortidaily.com/article/9403912/pusa-golden-cherry-tomato-2-new-cherry-tomato-for-protected-cultivation/
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THE FUTURE IS SKY by Rijk Zwaan
You can plant the seed yourself, but true growth is achieved together
Pusa golden cherry tomato-2: New cherry tomato for protected cultivation
Cherry tomatoes are a different group of tomatoes. This tomato is mostly used raw in a salad. The fruit-bearing habit is in bunches i.e. called truss and fruit shape varies from round, oblong, and pear shape. Fruit size varies from 2–15 g. Fruits are of different colors varying from dark red, red, pink, yellow, golden yellow to orange. Golden yellow cherry tomatoes look very fascinating.
Pusa Golden Cherry Tomato-2 is the first indigenous golden yellow cherry tomato variety suitable and proposed for naturally ventilated polyhouse/low-cost protected cultivation from ICAR-Indian Agricultural Research Institute, New Delhi. It aims to cater to the needs of the people who are looking for protective food.
Read the complete research at www.researchgate.net.
Type here to search
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Umarda, Uttar Pradesh, India
VPG4+56J, Umarda, Uttar Pradesh 209738, India
Lat 26.869833°
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Low Cost Polyhouse – An attractive option for youth
High income and low water use
Source: CAZRI, Jodhpur
Cost of construction is Rs. 1.28 Lac
Area of Polyhouse : 8X16 m = 128 sq m
Production : 1500 kg in 5 months
Rate of sale is Rs 100/kg
Can take 3 crops in one year – cucumber, tomato, capsicum
Net income > 4-5 lacs/annum

Tomato Pusa Protected-1

Suitable for low cost protected structures.
Round deep red fruits with av. wt. of 80-85g.
TSS:5.6 Brix,
Lycopene:8.0mg/ 100g
Yield: 120-140q/1000 Sqm.

New Varieties Identified

Pusa Cocktail Tomato

Av. Fruit wt.25-30g,fruits contain 7.14 mg/100g Lycopene content, 8.3 mg/100g fresh weight ascorbic acid, 0.52% acidity and TSS 6.5^0 brix, resistant to TOLCV (Ty3gene) , Yield 4.5-5.5kg /plant

Pusa Prasanskrit (For Processing)

Av. Fruit wt. 90g. TSS4.95, Acidity 0.51% lycopene 8.68 mg/100g, resistant to TOLCV (Ty3gene) , Yield 3.5-4.5kg/plant. Suitable for processing

Pusa Preet

Fruit wt. 85g,Red color, Ascorbic acid 155mg/100g,Yield 2.15-2.75kg/plant

Yellow Cherry-214, TSS-8.0, Acidity0.33

Promising Tomato genotypes are 206,123,177

Tomato hyb.217, TSS-5.6.Acidity0.32, Lycopene-8.5

RedCherry-263, TSS -7.5 Lycopene-10.01

Development of Parthenocarpic Gynoecious Lines of Cucumber

- **Protected cultivation is getting momentum in various states of the country as the area has already reached approximately 25,000 ha mainly due to efforts under different horticultural schemes.**
- **However, the growth of protected cultivation, particularly north Indian states remained far from success as the farmer had hardly been extended the complete knowledge about the production technology as well as due to non availability of improved variety suitable for protected cultivation**
- **Parthenocarpic gynoecious cucumber varieties are suitable for polyhouse cultivation as these varieties develop fruit automatically without any pollination.**
- **Present days many of the private seed companies are selling F_1 hybrid of parthenocarpic cucumber at a very exorbitant rate as this seeds are being sold per seed basis.**
- **Keeping in view the facts, the efforts are being under taken at division of vegetable science IARI, New Delhi development of parthenocarpic gynoecious varieties for protected cultivation.**

Breeding of parthenocarpic cucumber Selections and F_1 hybrid

- 15 gynoecious parthenocarpic F_1 hybrids of cucumber were broken by using silver thiosulphate for induction of male flowers and simultaneously selfing and individual plant selection were carried out on the basis of true gynoecious and parthenocarpic character.
- Sixteen gynoecious parthenocarpic hybrids were developed by utilizing four parthenocarpic true breeding lines as parent.
- Individual plant selection on the basis of multiple pistillate behaviour was carried out to develop multiple pistillate gynoecious parthenocarpic lines.
- In order to study inheritance of parthenocarpic trait and to introgress gynoecious parthenocarpic traits to our indigenous varieties crosses were attempted with five released varieties including Pusa Uday, Pusa Barkha as recurrent parent and Pusa Seedless Cucumber-6 as non recurrent parent (donor parent).
- They were further advanced to F_2 and BC_1F_1 to achieve the desired objective.


DPaC-9


DPaC-13


DPaC-10

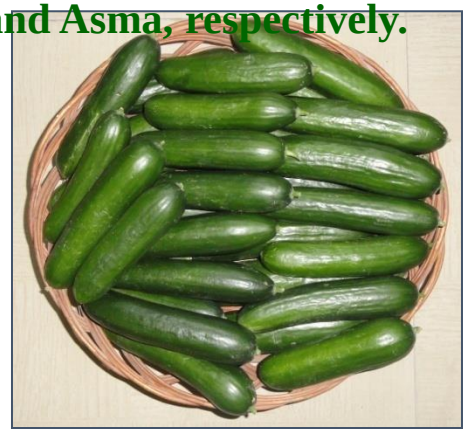

Pusa Uday X Pusa Seedless Cucumber-6

DPaC-6 Released as Pusa Parthenocarpic Cucumber-6

ICAR-Indian Agricultural Research Institute

Salient features

- **First extra early improved variety of parthenocarpic cucumber developed by ICAR-IARI**
- **Distinct advantage in yield and quality over commercial varieties and private sector hybrids**
- **Fruits become ready for first harvesting in 40-45 days after sowing during winter season**
- **Fruits have desirable marketable attributes viz., uniform, dark green, glossy, cylindrical, straight, slightly ribbed, non-hairy, non-warty, slightly striped at blossom end and has tender skin & crispy flesh**
- **Average fruit length is 14.24 cm and width 3.45 cm. Average fruit weight is 105 g.**
- **Average fruit yield 126.0t/ha (1260 kg/ 100 m2) during winter season (off-season, November-March) under low cost polyhouse which is 32.2%, 29.8% and 21.5 % superior over Pant Parthenocarpic Cucumber-2, Aviva and Asma, respectively.**



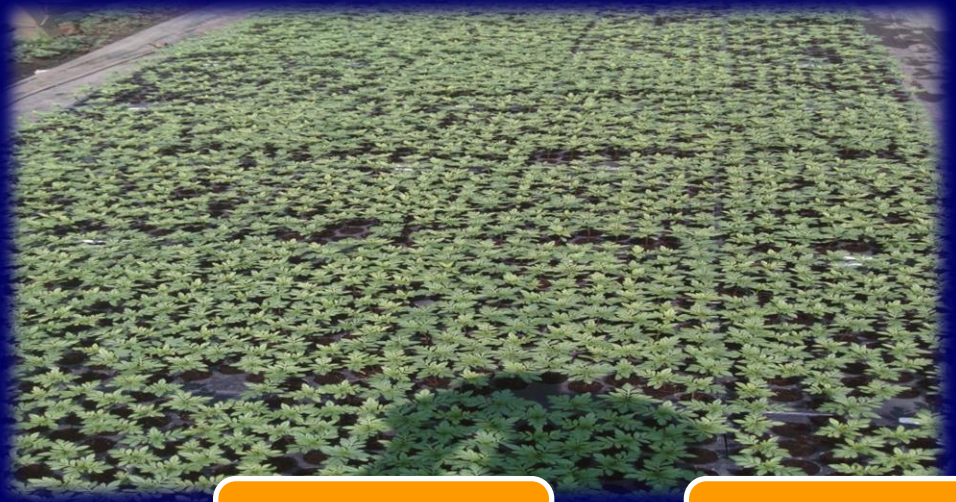
Licensing to Private Seed Companies through BPD and ZTMU,Unit ,ICAR-IARI-New Delhi

Pusa Golden Cherry Tomato-2 and Pusa pakchoi-1 in soilless culture

Hybrid seed production of Tomato under Low cost polyhouse

Quality seed production of indeterminate type hybrids/varieties of standard tomato, cherry tomato, sweet pepper and parthenocarpic cucumber, bittergourd, melon, summer squash etc can be done.The seed yield of such crops can be increased 2-3 times compared to the open field conditions

Healthy Seedlings



Good Nursery → Healthy Plant → Quality Seed

Development of hybrid seed production technology of gynoecious cucumber

Standardization of hybrid seed production technology of gynoecious cucumber hybrid; Pusa Cucumber Gynoecious Hybrid-18

Workplan : The pollination dynamics, fruit retention, seed yield and quality were studied in kharif and spring-summer season for optimisation of hybrid seed yield production.

Female parent : DGC 102

Male parent: Pusa long green

Bitter gourd (*Pusa Rasdar)* seed production in Insect Proof Net house

FEMALE PARENTAL LINE IN NET

FEMALE PARENTAL LINE IN OPEN FI

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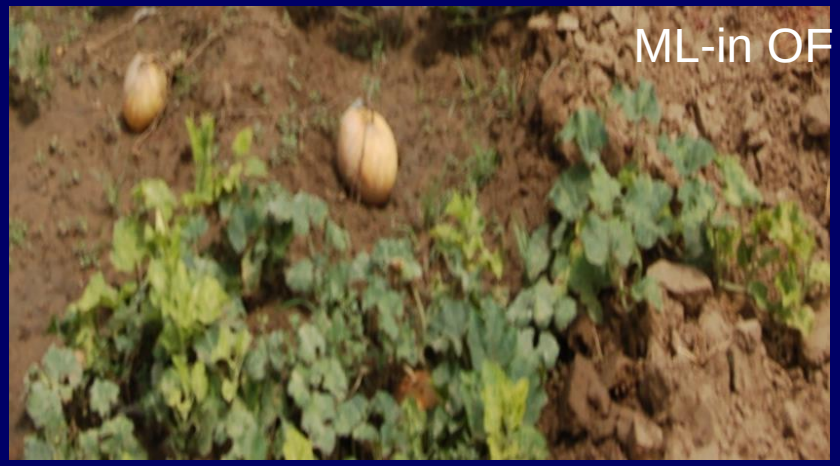


Protected cultivation provide employment opportunities to the unemployed youth making it an attractive agricultural option for the farmers as well as at the service provider level with the business expanding into rural areas.

A total of 0.132 man days/m^2 required

India's labour force consists of 459 million workers. Out of these, 433 million (94%) are in the unorganized sector and the remaining 260 million (6%) are in the organized sector, according to a survey conducted by NSSO

Success stories

From Engineering to Protected horticulture

Vishal Shaukeen and Vaibhav Rana (B.Tech.), Rohini,Delhi

NV polyhouse for vegetables

S. No.	Name of the farmers	Area, m^2
1.	Smt. Somati W/o Dhani Ram, Alawara	1008
2.	Smt. Kamla W/o Hari Ram, Langni	1008
3.	Shri. Budha Singh S/o Sharad Singh, Langni	1008
4.	Shri. Rajvir Singh S/o Munshi Ram, Chauma	1008
5.	Shri. Jagdish S/o Jivandaram, Tilwar	1008

Farmer field demonstration

S. No.	Particular	Detail
1	Name and Address of the Farmer	Mr. Budha Singh Nangli, Ramgargh Alwar District, Rajasthan
2	Area under technology	Poly house - 1008 m2
3	Crops grown	Cucumber and Tomato
4	Economics (2015-16)	Gross Income=275000 Cost of cultivation=174065 Net return=100935 (1500 USD)
5	Impact of technology	Water saving = 42.5% Yield increase = 38 %

Farmer field demonstration

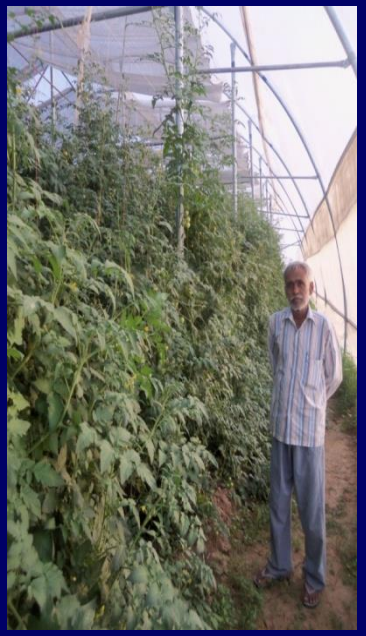
S.No.	Particular	Detail
1	Name and Address of the Farmer	Mr. Jitenrda Saini, Gujuki, Tahseel and District - Alwar, Rajasthan
2	Area under Technology	Poly house=7168 M2 Drip Irrigation =2.75 ha
3	Crops grown	Cucumber, Tomato, cauliflower, Capsicum.
4	Economics (2015-16)	Gross Income=3312935 Cost of cultivation=1165704 Net return=2147231 (32500 USD)
5	Impact of technology	Water saving = 48% Yield increase = 41 %

Farmer field demonstration

S.No.	Particular	Detail
1	Name and Address of the Farmer	Mr. Hari singh Village nangli District Alwar (Rajasthan)
2	Area under technology	Drip irrigation system= 1 ha Poly house= 1008 m2
3	Crops grown	Cucumber , Ber, Cotton and wheat
4	Economics (2015-16)	Gross Income=317400 Cost of cultivation=88,000 Net return=229400 (3444 USD)
5	Impact of technology	Water saving = 45 % Yield increase = 41 %

Farmer field demonstration

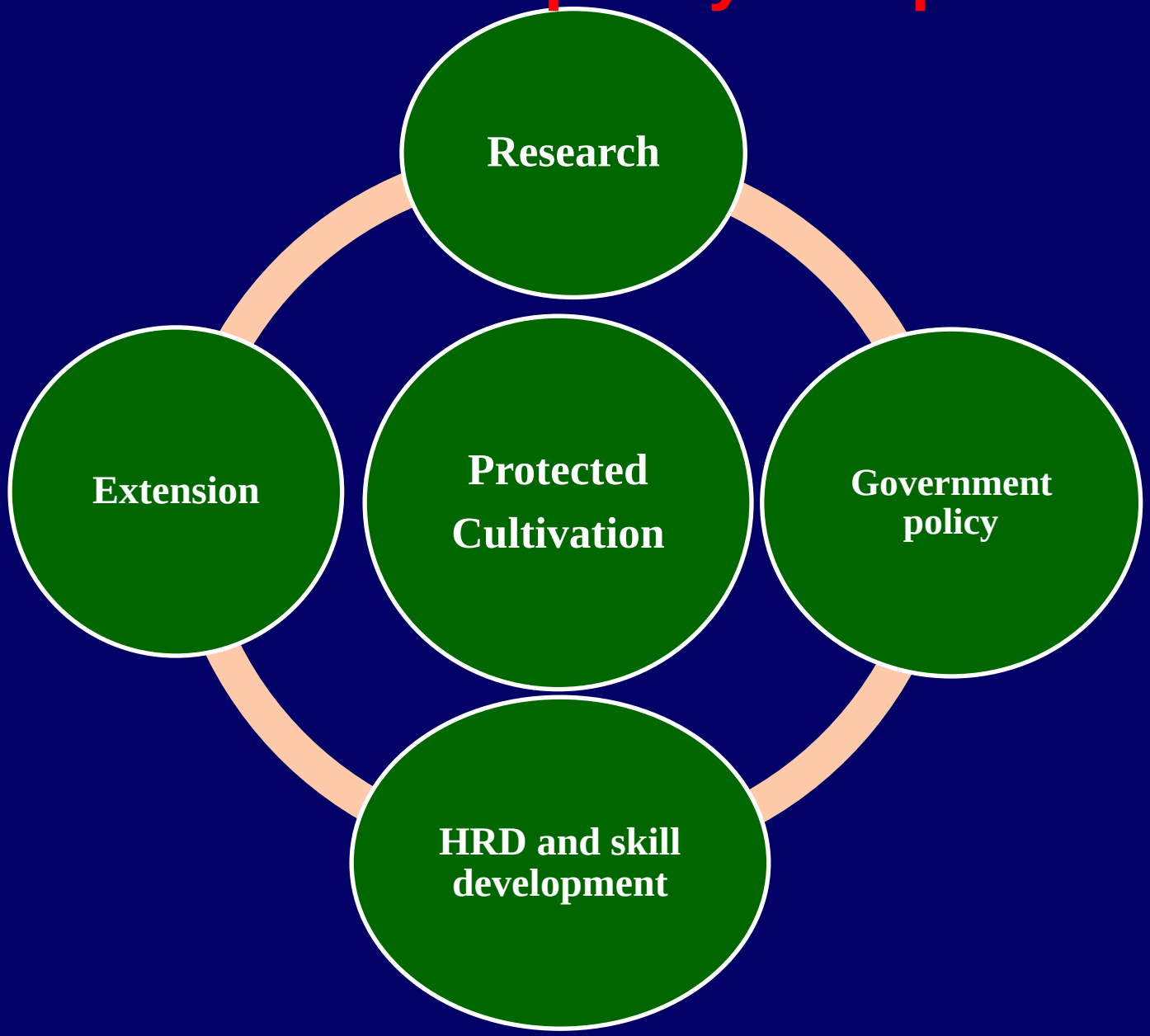
S.No.	Particular	Detail
1	Name and Address of the Farmer	Mr. Jagdeesh Rajput Village Tilwar District Alwar (Rajasthan)
2	Area under technology	Drip irrigation system= 0.04 ha Poly house= 1008 M2
3	Crops grown	Tomato, Potato and cucumber
4	Economics (2015-16)	Gross Income=1,85,000 Cost of cultivation=52,000 Net return=133000 (2000 USD)
5	Impact of technology	Water saving = 48 % Yield increase = 31 %



Farmer field demonstration

S.No.	Particular	Detail
1	Name and Address of the Farmer	Mr. Omprakash Village chauma District Alwar (Rajasthan)
2	Area under technology	Drip irrigation system= 1 ha Poly house= 1008 M2
3	Crops grown	Tomato, Wheat, cotton and cucumber
4	Economics 2015-16 (Rs.)	Gross Income=2,17,000 Cost of cultivation=95,000 Net return=1,22,000 (1830 USD)
5	Impact of technology	Water saving = 48 % Yield increase = 39 %

Government policy and plans



Trainings programmes conducted

S. No.	Training Details	No. of Participants	Duration
1	Training course on "High-Tech Horticulture Techniques and modern irrigation system for flower, fruit and vegetables production", Udaipur (Rajasthan)	50 Farmers	15-19 July, 2019
2	Training course on "Micro irrigation Technology", Himachal Pradesh	30 Farmers	3-6 January, 2020
3	Training course on " Installation and Operation of Micro Irrigation Technologies", Meerut, UP	28 farmers	5-7 March, 2020

Dissemination of Protected Cultivation Technologies to Different Stake Holders

Sl No.	Stakeholders	Number of visitors
1	Farmers	950
2	Students	2555
3	Entrepreneurs / Officers	350
4	Trainees	155
	Total	4,010

Acknowledgments

Director,
Joint Directors
Coordinator, School of Horticultural Sciences
In-charge, CPCT &
Scientific, Technical & Supporting staff at CPCT,
ICAR-IARI,New Delhi

Thank you

For partnership with CPCT,ICAR-IARI, New Delhi

Contact : Incharge_cpct@iari.res.in jd_research@iari.res.in