

## Vegetable Science Lab



### DEPARTMENT OF VEGETABLE SCIENCE

**Course No.-** H/VS – 232

**Course title:-** Tropical and sub-tropical vegetables

**Credit hours:** (2+1) 3

**Semester-** III

**Theroy-** Area, production, economic importance, scope and export potential of tropical and sub-tropical vegetable crops. Types of Vegetable Farming, Classification of vegetables, Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, nursery practices; transplanting of vegetable crops and planting for directly sown/transplanted vegetable crops. Spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvest, yield, post-harvest handling, economics and marketing of tropical and sub-tropical vegetable crops such as tomato, brinjal, chillies, capsicum, okra, amaranthus, cluster beans, cowpea, lab-lab, snap bean, cucurbits, moringa, curry leaf, agathi, portulaca, basella, sorrel and roselle.

**Practical-** Identification and description of tropical and sub-tropical vegetable crops; nursery practices and transplanting, preparation of field and sowing/planting for direct sown and planted vegetable crops. Herbicide use in vegetable culture; top dressing of fertilizers and intercultural; use of growth regulators; identification of nutrient deficiencies. Physiological disorder. Harvest indices and maturity standards, post-harvest handling and storage, marketing, cost of cultivation for tropical and sub-tropical vegetable crops), project preparation for commercial cultivation.

**Lesson / Course Plan-** Theory

Lectures No.	Particulars	Weightages (%)
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1	Introduction, scope and importance of vegetable.	8
2	Area, production, economic importance and export potential of tropical and subtropical vegetables and tuber crops.	5
3	Types of vegetable farming.	5
4	Vegetable classification.	5
	Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, nursery practices; transplanting of vegetable crops and planting for directly sown/transplanted vegetable crops. Spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvest, yield, post-harvest handling, economics and marketing of	
5-10	Tomato, chilli, brinjal, capsicum.	10
11	Okra	5
12	Cucumber	8
13	Pumpkin and squashes.	
14-18	Bitter gourd, ridge gourd snake, gourd, bottle gourd, sponge gourd.	8
19-20	Musk melon and water melon	8
21-24	Beans-French bear, cluster bean cowpea, yard long bean and dolichos Bean	10
25-26	Leafy vegetables - Amaranthus, Mustard, Coriander, Methi.	5
27	Under exploited cucurbits - sweet gourd, pointed gourd, little gourd.	5
28-29	Moringa and curry leaf,	8
30	Agathi, Basella, Portulaca.	4
31	Sorelle and Rooselle	3
32	Recommendations of joint Agresco.	3
<b>Total</b>		<b>100</b>

### Practical programme

Practical.No.	Particulars
1	Identification of tropical vegetable crops
2	Identification of subtropical vegetable crops
3	Raising vegetable seedlings of improved varieties
5	Field preparation and lay out for vegetable crops
6	Seed treatment and sowing of vegetable crops.
7	Planting and transplanting of vegetables crops
8	Integrated weed management in veg crops.
9	Methods of irrigation and manuring
10	Use of plant growth regulators in veg. production.
11	Identification of nutritional deficiencies in veg. crops and remedies.
12	Identification of physiological disorders in veg. crops.
13	Harvesting indices and maturity standards.
14	Harvesting of vegetables.
15	Packaging and storage of vegetable crops.
16	Project preparation and cost of cultivation of any two vegetables.

### Suggested readings:

#### Text book:

B.R.Choudhary, 2009. *A Text book on production technology of vegetables*. Kalyani Publishers. Ludhiana.

S. Thamburaj, 2014. *Text book of vegetable, tuber crops and Spices*. ICAR, New Delhi

#### Reference Books:

Choudhury, B. (ICAR). 1990. *Vegetables*. 8th edition, National Book Trust, New Delhi.

Haldavnekar, P.C.; Parulekar, Y.R.; Mali, P.C. and Haldankar, P.M, 2015. *Vegetables – Production Technology*, Astral International.

K S Yawalkar, 2008. *Vegetable crops in India*. Agri-Horticultural Pub. House. Nagpur. 2004

K.L.Chadha, 1993. *Advances in Horticulture*. Malhotra publishing house. New Delhi

K.V.Kamath, 2007. *Vegetable Crop Production*. Oxford Book Company. Jaipur

M.K.Rana, 2008. *Olericulture in India*. Kalyani Publishers. Ludhiana

M.S.Dhaliwal, 2008. *Handbook of Vegetable Crops*. Kalyani Publishers. Ludhiana

Nath Prem, 1994. *Vegetables for the Tropical Regions*. ICAR New Delhi

P.Hazra, 2011. *Modern Technology in Vegetable Production*. New India Publishing Agency. New Delhi.

Pratibha Sharma, 2007. *Vegetable : Disease Diagnosis and Biomanagement*. Avishkar Publishers. Jaipur

Premnath, Sundari Velayudhan and Singh, D.P., 1987. *Vegetables for the tropical region*. ICAR, New Delhi. Publishing Co. Pvt. Ltd, New Delhi.

Shanmugavelu, K.G., 1989. *Production Technology of Vegetable Crops*. Oxford & IBH

Singh, D.K., 2007. *Modern Vegetable varieties and production*. IBN publishers, Technology International Book Distributing Co, Lucknow.

Singh, Umashankar, 2008. *Indian Vegetables*. Anmol Publications. Pvt.Ltd .New Delhi.

T.K.Bose, 2002. *Vegetable Crops*. Nayaprakash. Kolkata

T.R.Gopal Krishnan, 2007. *Vegetable Crops*. New India Publishing Agency. New Delhi.

**e-reading:** <http://ecourses.iasri.res.in/>

**Course No.-** H/VS-243

**Title:** Spices and condiments

**Credit hours**–(2+1) 3

**Semester-** IV

**Theory** - History, scope and importance, Present status, area and production, uses, export potential and role in national economy. Classification, soil and climate, propagation-seed, vegetative and micropropagation, systems and methods of planting. Nutritional management, irrigation practices, weed control, mulching and cover cropping. Training and pruning practices, role of growth regulators, shade crops and shade regulation. Harvesting, post-harvest technology, packaging, storage, value added products, methods of extraction of essential oil and oleoresins. Economics of cultivation, role of Spice Board and Pepper. Export Promotion Council, institutions and research centers in R&D. Crops: Cardamom, pepper, ginger, turmeric, clove, nutmeg, cinnamon, all spice, curry leaf, coriander, fenugreek, fennel, cumin, dill, celery, bishops weed, saffron, vanilla, thyme rosemary, Oregano, Mint- Sweet and Sour.

**Practicals** - Identification of varieties: propagation, seed treatment – sowing; layout, planting; hoeing and earthing up; manuring and use of weedicides, training and pruning; fixing maturity standards, harvesting, curing, processing, grading and extraction of essential oils and oleoresins. Visit to commercial plantations.

**Lesson/Course plan-** Theory

Lecture No.	Topics	Weightage (%)
1-2	History, difference in spices and condiments, importance of spices and condiments. Scope of spices and condiments in India and their export potential	15
	Climate and soil requirements, area, production, propagation method including micro propagation, varieties, planting, aftercares, irrigation, nutrient and weed management, cover cropping mulching, training and pruning, use of growth regulators, shade	

	regulation, harvesting, curing, packaging, storage, extraction of oil and oleoresins, economics of the following crops	
3-8	Tree Spices: Black pepper, Clove, Nutmeg, Cinnamon, Allspice	10
9-10	Cardamom	10
11-14	Condiments: Turmeric Ginger	10
15-16	Kokum,	5
17	Curry leaf	05
18-22	Seed spices: Coriander, Fenugreek, Fennel, cumin, Celery Bishop's weed, Dill	10
23-24	Saffron, Vanilla	10
25-26	Herbal specis: Thyme, Rose merry, Oregano	5
27	Mint Sweet and Sour	5
28-29	Role of spice board and pepper export promotion	5
30-31	Institutions and Research stations in R & D of spice crop	5
32	Recommendations of Joint Agresco	5
<b>Total</b>		<b>100</b>

### Practical programme-

Practical No.	Topic
1	Identification and description of different spices.
2	Identification and description of different condiments
3	Study of varieties of different spices and condiments
4	Propagation methods and nursery management in spices.
5	Propagation methods and nursery management in condiments
6	Special horticultural practices in spices and condiments
7	Intercultural Operations in spice gardens
8	Intercultural Operations in condiments gardens
9	Harvesting, maturity indices, grading of spices
10	Harvesting, maturity indices, grading of condiments
11	Storage of spices and condiments
12	Processing of spices and condiments
13	Extraction of essential oil and oleoresin from spices and condiments.
14	Integrated pest management of spices and condiments
15	Integrated disease management of spices and condiments
16	Visit to commercial plantations of spices and condiments.

### Suggested Reading:

#### Reference Books:

- Kumar, N. J.B. M. Md. Abdul khaddar, Ranga Swamy, P. and Irulappan, I., 1997. *Introduction to Spices, Plantation Crops, and aromatic crops*. Oxford & IBH, New Delhi.
- Pruthi, J.S., 1980. *Spices and Condiments*. Academic Press, New York.
- Pruthi, J.S., 1993. *Major Spices of India- Crop Management Postharvest Technology*. ICAR, New Delhi.
- Pruthi, J.S., 2001. *Minor Spices and Condiments-Crop Management Post Harvest Technology*. ICAR, New Delhi.
- Purseglove, Brown, E.G. Green, G.Z. Robbins, S.R.J. London, Longman, 1981. *Spices Vol.I & II*.
- Shanmugavelu, K.G. and Madhava Rao, 1977. *Spices and Plantation Crops*. Madras Popular Book Depot.

Shanmugavelu, K.G. Kumar, N and Peter, K.V., 2005. *Production technology of spices and plantation crops*. Agrosis, Jodhpur.

**e-reading:** <http://ecourses.iasri.res.in/>

**Course No** : H/VS-356

**Course title**: Breeding of Vegetable, Tuber and Spice Crops

**Credit hours** : ( 2+1) 3

**Semester** : V

**Theory**- Breeding objectives and important concepts of breeding self pollinated cross pollinated and vegetatively propagated crops. Plant genetic resources, their conservation and utilization in crop improvement. Breeding for insect resistance, breeding for disease resistance, breeding for abiotic resistance, Male sterility and incompatibility and their utilization in development of hybrids. Origin, distribution of species, wild relatives and forms of vegetable crops viz., Solanaceous vegetables: Tomato, Brinjal, Capsicum, Chilli, Okra, Cucurbits: Cucumber, Watermelon, Bitter gourd, Bottle gourd, Cole crops: Cabbage, Cauliflower, Tuber crops: Potato, Sweet potato, Cassava, Discordia, Root crops: Carrot, Radish, Spice crops: Ginger, Turmeric, Leafy vegetables: Amaranthus, Fenugreek and Spinach, Legume vegetables: Pea, Dolichus bean, Cluster bean. Breeding procedures for development of hybrids/varieties in various crops viz., Introduction, Selection, Hybridization, Mutation, Polyploidy and Heterosis. Application of biotechnology in vegetable crop improvement. Genetic basis of adoptability and stability.

**Practical** - Breeder kit, Floral biology and pollination mechanism in self and cross pollinated vegetables, tuber crops and spices. Working out phenotypic and genotypic heritability, genetic advance. GCA, SCA, combining ability, heterosis, heterobeltosis, standard heterosis, G x E interactions (stability analysis). Preparation and uses of chemical and physical mutagens. Polyploidy breeding and chromosomal studies. Techniques of F<sub>1</sub> hybrid seed production. Maintenance of breeding records.

### **Lesson plan- Theory**

<b>Lecture No.</b>	<b>Topic</b>	<b>Weightage (%)</b>
1	Breeding objectives	5
2	Important concepts of breeding self pollinated cross pollinated and vegetatively propagated crops.	10
3	Plant genetic resources, their conservation and utilization in crop improvement.	5
4-5	Breeding for insect resistance, breeding for disease resistance	5
6-7	Breeding for abiotic resistance	5
8-9	Male sterility and incompatibility and their utilization in development of hybrids.	10
	Origin, distribution of species, wild relatives and forms and breeding procedures for development of hybrids/varieties in various crops	
10-12	Solanaceous vegetables: Tomato, Brinjal, Capsicum, Chilli	10
13	Okra	5
14-17	Cucurbits: Cucumber, Watermelon, Bitter gourd, Bottle gourd	5
18-19	Cole Crops: Cabbage, Cauliflower	05
20	Tuber crops: Potato, Sweet potato, Cassava, Discordia	05
21-22	Bulb Crops : Onion and Garlic	5
23-24	Root crops: Carrot, Radish	5
25-26	Leafy vegetables- Amaranthus, Fenugreek and Spinach	5
27	Legume Vegetables: Pea, Dolichus bean, Cluster bean.	5
28-29	Spice crops: Ginger, Turmeric	5
30-31	Genetic basis of adoptability and stability	5
32	Recommendations of Joint Agresco	5

**Practical programme**

Practical No.	Topics
1	Field equipment for Plant Breeders, Breeder kit
2	Selfing Methods
3	Floral Biology and Hybridization Techniques in solanaceous vegetable
4	Floral Biology and Hybridization Techniques in crucifers
5	Floral Biology and Hybridization Techniques in cucurbitaceous
6	Floral Biology and Hybridization Techniques in leguminous vegetable
7	Floral Biology and Hybridization Techniques in root vegetables
8	Floral Biology and Hybridization Techniques in alliums
9	Floral Biology and Hybridization Techniques in tuber crops
10	Floral Biology and Hybridization Techniques in spices
11	Working out phenotypic and genotypic heritability, genetic advance. GCA, SCA, combining ability.
12	Heterosis, heterobeltosis, standard heterosis, GxE interactions (stability analysis)
13	Preparation and uses of chemical and physical mutagens.
14	Polyploidy breeding and chromosomal studies.
15	Techniques of F <sub>1</sub> hybrid seed production.
16	Maintenance of breeding records.

**Suggested Reading:****Reference Books:**

- Fageria, M.S., 2011. *Vegetable Crops- Breeding and Seed Production*. Kalyani Publishers, Ludhiana.
- H.P. Singh, 2009. *Vegetable Varieties of India*. Studium Press (India) Pvt Ltd. New Delhi.
- Hari Hara Ram, 2013. ***Vegetable Breeding: Principle and Practices***. Kalyani Publishers. Ludhiana.
- Kallo G, 1998. *Vegetable Breeding (Vol.I to IV)*. CRC Press. Florida. 1988.
- M.S. Dhaliwal.2012. [Techniques of Developing Hybrids in Vegetable Crops](#). Agrobios. Jodhpur.
- M.S.Dhaliwal, 2009. *Vegetable Seed Production & Hybrid Technology*. Kalyani Publishers. Ludhiana.
- P.K.Singh, 2005. *Hybrid Vegetable Development*. CRC Press. Florida.
- Vishnu Swaroop, 2014. *Vegetable Science & Technology in India*. Kalyani Publishers. Ludhiana.

e-reading: <http://ecourses.iasri.res.in/>

**Theroy-** Introduction and history of seed industry in India. Definition of seed, classes-types of seed. Differences between grain and seed. Importance and scope of vegetable seed production in India. Principles of vegetable seed production. Role of temperature, humidity and light in vegetable seed production, land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage of cole crops, root vegetables, solanaceous vegetables, cucurbits, okra, leafy vegetables, bulb crops, leguminous vegetables and exotic vegetables. Seed germination and purity analysis. Field and seed standards. Seed drying and extraction. Seed legislation.

**Practical-** Study of seed structure, colour size, shape and texture. Field inspection of seed crops. Practices in rouging. Harvesting and seed extraction. Germination and purity analysis. Methods of seed production, Seed certification in cole crops, root vegetables, bulb crops, solanaceous vegetables, cucurbits, okra, leafy vegetables, leguminous vegetables and exotic vegetables. Seed processing machines. Visit to seed production units.

### Lesson/course plan

Lecture No.	Topics	Weightage (%)
1-2	History of seed industry in India, Definition of seed and difference between grain and seed and classes, types of seed	8
3-4	Importance and scope of seed production in india, Principles of seed Production	8
5-6	Role of climate (Light, humidity, temp. etc) on vegetable seed production.	4
7	Agencies of pollination and isolation distance in vegetable seed production.	4
8	Field standards and seed standards.	4
9-10	Seed production methods in cole crops. (cabbage, cauliflower, knolkhol, broccoli)	8
11-12	Seed production methods in solanaceous crops (tomato, chilli, brinjal, bellpeper)	8
13-15	Seed production methods in cucurbits (cucumber, Bitter gourds, pumpkin, Watermelon)	8
16-17	Seed production methods in leafy vegetables (fenugreek, amaranthus, palak)	4
18-21	Seed production methods in beans and peas (pea, french bean, dolichos bean)	4
22-23	Seed production methods in bulb crops (onion, garlic)	7
24-25	Seed production methods in tuber crops (potato, sweet potato)	4
26-27	Seed production in root vegetables (radish, carrot)	4
28-29	Seed extraction, drying, processing and storage of seed.	7
30	Seed testing for germination, viability and purity.	7
31	Seed production in seed spice crops (Coriander)	7
32	Seed act / legislation Recommendations of Joint Agresco.	4
<b>Total</b>		<b>100</b>

### Practicals programme

Practical No.	Topics
1	Study of seed structure, size, shape etc.
2	Objectives and practices of field inspection.
3	Objectives and practices in rouging.
4	Seed sampling techniques and types of seed samples
5	Seed testing techniques for determination of percent germination, viability, purity.



6	Seed classes or types on the basis of physical and genetical purity
7	Harvesting, extraction, processing, drying of seeds.
8	Packaging, labelling and storage of Seeds.
9	Methods of seed production in cole crops.
10	Methods of seed production in root vegetables.
11	Methods of seed production in bulb crops.
12	Methods of seed production in solanaceous crops
13	Methods of seed production in cucurbitaceous crops.
14	Methods of seed production in leafy vegetables.
15	Methods of seed production in leguminous vegetables.
16	Visit to seed production plots, seed processing units and seed testing laboratory.

### Suggested Reading:

### Reference Books:

- Agarwal, P. K. 2010. *Techniques in Seed Science and Technology*. South Asian Agrawal R. L. 1999. *Seed Technology*. Oxford and IBH Publicity Company, New Delhi. Arya, Prem Singh. 2003. *Vegetable seed Production Principles*. Kalyani Publishers.
- Fageria, M. S. 2011. *Vegetable Crops- Breeding and Seed Production*. Kalyani G.N. Kulkarni, 2002. *Principles of Seed Technology*. Kalyani Publishers, Ludhiana. Geetharani, P. 2007. *Seed Technology in Horticultural Crops*. NPH Publications. Jodhpur. Khare, D. and Bhole, M.S. 2000. *Seed Technology*. Scientific Publishers (India) Jodhpur. L.O. Copeland, 1999. *Principles of Seed Science and Technology*. Springer Publications. Ludhiana.
- N.P. Nema, 1988. *Principles of seed certification and Testing*. Allied Publications. Nemgal Singh, P.K. Singh, Y.K. Singh and Virendrakumar, 2006. *Vegetable Seed Production Technology*. International book distributing co., Lucknow. P. Hazra and M.G. Som, 2009. *Vegetable seed production and Hybrid Technology*. Kalyani Publishers, Ludhiana. Prem Singh Arya, 2003. *Vegetable breeding, production and seed production*. Kalyani publishers, New Delhi.
- Rattan LalAgarwal, 1995. *Seed technology*. Oxford & IBH, New Delhi
- [Raymond A.T.](#), 2000. *Vegetable Seed Production*. Oxford University Press, USA
- Singh, Prabhakar.2015.*Seed Production Technology of vegetable*.Daya Publishing House. New Delhi.
- Singh, S.P. 2001. *Seed Production in Commercial Vegetables*. Agrotech Publishing Academy, Udaipur.
- Vanangamudi, K. 2006. Natarajan, P. Srimathi, N.Natarajan, T. Saravanan, M.Bhaskaran, A. Bharathi, P. Nateshan, K. Malarkodi. *Advances in Seed Science*. Agrobios (India), Jodhpur. Vanangamudi, K.2010. *Vegetable Hybrid Seed Production and Management*. Agrobios. Jodhpur.

**e-reading:** <http://ecourses.iasri.res.in/>

**Course No.- H/VS-245**

**Credit hours: (1+1) 2**

**Course title:- Temperate Vegetable crops**

**Semester- IV**

**Theory** – Scope and Importance of cool season vegetable crops in nutrition and national economy. Area, production, export potential, description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of cabbage, cauliflower, knol-khol, sprouting broccoli, Brussels 'sprout, lettuce, palak, Chinese cabbage, spinach, garlic, onion, leek, radish, carrot, turnip, beet root, peas, broad beans, rhubarb, asparagus, globe artichoke, Vegetable kale, fenugreek and coriander.

**Practical** - Identification and description of varieties/hybrids; propagation methods, nursery management; preparation of field, sowing/transplanting; use of plant growth regulators; identification of physiological and nutritional disorders and their corrections; important pest and diseases; post-harvest handling; cost of cultivation and field visits to commercial farms.

**Lesson/Course Plan - Theory**

Lecture No.	Particulars	Weightages (%)
1	Scope and Importance of cool season vegetable crops in nutrition and national economy.	10
2	Area, production, export potential, description of Temperate Vegetables	10
	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and marketing of	
3	Cabbage	8
4	Cauliflower	8
5	Sprouting Broccoli	8
6	Chinesse cabbage	4
7	Knol Khol	4
8	Brussel's Sprout, Lettuce	4
9-10	Radish, Carrot, Turnip, Beet root	8
11	Pea, Broad Bean	8
12	Palak, Spinach, coriander, fenugreek	8
13	Onion	8
14	Garlic	4
15	Asparagus, Leek, Globe artichoke, Kale, fenugreek, coriander	4
16	Recommendations of Joint Agresco	4
	<b>Total</b>	<b>100</b>

**Practical Programme**

Practical No.	Particulars
1	Identification temperate Vegetables
2	Botanical description of temperate vegetables
3	Identification and description of commercially important varieties of temperate vegetables.
4	Botanical description commercially important varieties of temperate vegetables.
5	Propagation methods, nursery management Raising seedlings of temperate

	vegetables,
6	Use of Plant Growth Regulators in temperate vegetables
7	Land preparation and layout of planting
8	Transplanting of temperate vegetables
9	Identification of physiological disorders in temperate vegetables and remedies
10	Methods of irrigation
11	Manures and Fertilizer application
12	Identification of nutritional deficiencies in temperate vegetables and their control measures
13	Maturity indices and harvesting of temperate vegetables, Packaging and storage of temperate vegetables.
14	Estimation of cost of cultivation of temperate vegetables.
15	Important Pest and diseases in vegetables
16	Field visit to vegetable farms and vegetable market

### Suggested Reading:

#### Text books:

B.R.Choudhary 2009. *A Text book on production technology of vegetables*. Kalyani Publishers. Ludhiana.

S. Thamburaj. 2014. *Text book of vegetable, tuber crops and Spices*. ICAR, New Delhi.

#### Reference Books:

Bose, T.K. 2003. *Vegetable Crops*. Naya udyog publishers, Kolkata. 2002. Naya Prakash, Calcutta.

Choudhery, B., 1990. *Vegetables*. 8th edition. National Book Trust, New Delhi.

Haldavnekar, P.C.; Parulekar, Y.R.; Mali, P.C. and Haldankar, P.M, 2015. *Vegetables – Production Technology*, Astral International.

K S Yawalkar, 2004. *Vegetable crops in India*. Agri-Horticultural Pub. House. Nagpur.

K.L.Chadha. 1993. *Advances in Horticulture*. Malhotra publishing house. New Delhi

K.V.Kamath. 2007. *Vegetable Crop Production*. Oxford Book Company. Jaipur

M.K.Rana, 2008. *Olericulture in India*. Kalyani Publishers. Ludhiana

M.S.Dhaliwal, 2008. *Handbook of Vegetable Crops*. Kalyani Publishers. Ludhiana

Nath Prem. 1994. *Vegetables for the Tropical Regions*. ICAR New Delhi

P.Hazra. 2006. *Vegetable science*. Kalyani Publishers .Ludhiana

P.Hazra. 2011. *Modern Technology in Vegetable Production*. New India Publishing Agency. New Delhi.

Pratibha Sharma, 2007. *Vegetables: Disease Diagnosis and Biomanagement*. Avishkar Publishers. Jaipur

Prem Singh Arya, 1999. *Vegetable Seed Production Principles*. Kalyani Publishers, New Delhi.

Shanmugavelu, K.G. 1989. *Production technology of vegetable crops*. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.

Singh, Umashankar, 2008. *Indian Vegetables*. Anmol Publications. Pvt.Ltd.

New Delhi. T.K.Bose. 2002. *Vegetable Crops*. Nayaprakash. Kolkata

T.R.Gopal Krishnan, 2007. *Vegetable Crops*. New India Publishing Agency. New Delhi.

Uma Shankar. 2008. *Vegetable Pest Management Guide for Farmers*. International Book Distribution Co. Publication. Lucknow.

**e-reading:** <http://ecourses.iasri.res.in/>

**Course No.- H/VS -121**

**Course title:- Potato and Tuber Crops**

**Credit hours: (1+1) 2**

**Semester- II**

**Theory** - Origin, area, production, economic importance and export potential of potato and tropical, sub-tropical and temperate tuber crops; description of varieties and hybrids. Climate and soil requirement, season; seed rate; preparation of field; planting practices; spacing; water, nutrient and weed management; nutrient deficiencies. Use of chemicals and growth regulators; cropping systems. Harvesting practices, yield; economic of cultivation. Post-harvest handling and storage, field and seed standards, marketing. Crops to be covered – potato, sweet potato, arrow root, cassava, colocasia, xanthosoma, amorphophallus, dioscorea, Jerusalem artichoke, horse radish and other under exploited tuber crops.

**Practical** - Identification and description of potato and tropical, sub-tropical and temperate tuber crops; planting systems and practices; field preparation and sowing/planting. Top dressing of fertilizers and interculture and use of herbicides and growth regulators; identification of nutrient deficiencies, physiological disorders; harvest indices and maturity standards, post-harvest handling and storage, marketing. Seed collection, working out cost of cultivation, project preparation of commercial cultivation.

**Lesson/Course Plan -Theory**

Lectures No.	Particulars	Weightages (%)
1	Scope and importance of potato and other tuber crops	10
2	Nutritional importance of Potato and tuber crops.	4
3	Area, Production and export potential of various tuber crops, cultivation practices including soil and climate, season, seed rate, preparation of field planting, spacing, water, nutrient and weed management. Deficiencies and their management, Use of PGR'S and chemicals, Special intercultural operations, cropping system, Harvesting and yield. Economics of cultivation, Post-harvest handling, field and seed standards and marketing Of	10
4-5	Potato	10
6	Sweet potato	10
7	Cassava	8
8	Colocasia	4
9	Xanthosoma	4
10	Amorphophallus	8
11	Greater yam	4
12	Aerial Yam	8
13	Lesser yam	8
14-15	Jerusalem artichoke, Horse Raddish, Yam bean, Arrow root and Chinese potato and other under exploited tubers	8
16	Recommendations of Joint Agresco.	4
<b>Total</b>		<b>100</b>

## Practical programme

Practical No.	Particulars
1	Identification and description of various tuber crops.
2	Study of various propagation methods in tuber crops
3	Field preparation and planting of Sweet potato, Potato,
4	Field preparation and planting of Amorphophallus, Colocasia,
5	Field preparation and planting of Cassava,
6	Field preparation and planting of Aerial Yam, Lesser yam etc.
7	Nutrient management in tuber crops.
8	Intercultural operations in potato.
9	Intercultural operations in tuber crops
10	Nutrient deficiencies and physiological disorders in tuber crops.
11	Study of maturity indices and harvesting of various tuber crops
12	Post-harvest handling curing to storage of tuber crops.
13	Marketing of tuber crops.
14	Working of cost of cultivation of important tubers.
15	Preparation of commercially viable project proposal.
16	Visit to tuber research station /farmers field.

### **Suggested Reading:**

#### **Text books:**

- S. Thamburaj. 2014. *Text book of vegetable, tuber crops and Spices*. ICAR, New Delhi.  
B.R.Choudhary 2009. *A Text book on production technology of vegetables*. Kalyani Publishers. Ludhiana.

#### **Reference Books:**

- T.K.Bose. 2002. *Vegetable Crops*. Nayaprakash. Kolkata  
P.Hazra. 2011. *Modern Technology in Vegetable Production*. New India Publishing Agency. New Delhi.  
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**e-reading:** <http://ecourses.iasri.res.in/>

**Course No** : H/VS- 244    **Course title** -Precision Farming and Protected Cultivation

**Credit hours** : ( 2+1)3    **Semester** : IV

**Theory**-Precision farming – laser levelling, mechanized direct seed sowing, seedling and sapling transplanting, mapping of soils and plant attributes, site specific input application, weed management, insect pests and disease management, yield mapping in horticultural crops. Green house technology, Introduction, Importance,scope,advantages and dis-advantages, Types of Green Houses; Plant response to Greenhouse environment, Planning and design of greenhouses, Design criteria of greenhouse for cooling and heating purposes.Green house equipment, materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses, Typical applications, passive solar green house, hot air greenhouse heating systems, green house drying. Cost estimation and economic analysis. Choice of crops for cultivation under greenhouses, problems / constraints of greenhouse cultivation and future strategies. Growing media, soil culture, type of soil required, drainage, flooding and leaching, soil pasteurization in peat moss and mixtures, rock wool and other inert media, nutrient film technique (NFT) / hydroponics.

**Practical**- Study of different types of greenhouses based on shape, utility,construction and cladding materials; Calculation of air rate exchange in an active summer winter cooling system; Calculation of rate of air exchange in an active winter cooling system; Estimation of drying rate of agricultural products inside green house; Testing of soil and water to study its suitability for growing crops in greenhouses; The study of fertigation requirements for greenhouses crops and estimation of E.C. in the fertigation solution; The study of various growing media used in raising of greenhouse crops and their preparation and pasteurization / sterilization; Visit to commercial greenhouses; Economics of protected cultivation.

**Lesson/Course Plan- Theory**

Lecture No.	Topics	Weightage (%)
1	Precision farming – Introduction and history	8
2	Precision farming – Importance and Scope	
3	Laser leveling, mechanized direct seed sowing seedling and sapling transplanting	3
4	Mapping of soils and plant attributes	4
5	Site specific input application	8
6	Weed management	4
7	Insect pests and disease management	4
8	Yield mapping in horticultural crops.	4
9	Green house technology – Introduction viz. Importance,scope, advantages and dis-advantages.	8
10	Types of Green Houses based on shape, utility, construction and cladding materials;	
11	Plant response to Greenhouse environment	4
12	Planning and design of greenhouses	4
13	Design criteria of greenhouse for cooling and heating purposes	8
14	Green house equipment	
15	Materials of construction for traditional and low cost green houses.	
16	Irrigation systems used in greenhouses	
17	Net house cultivation	8
18	Passive solar green house	3
19	Hot air greenhouse heating systems	
20	Green house drying	
21-25	Choice of crops for cultivation under greenhouses Tomato, Capsicum,	16

	Cabbage, Cauliflower, Cucumber, Broccoli, Chinese cabbage, Spinach, Lettuce	
26-27	Cost estimation and economic analysis	4
28	Problems / constraints of greenhouse cultivation and future strategies.	4
29	Growing media, Soil culture- type of soil required	3
30	Drainage - flooding and leaching	
31	Soil pasteurization in peat moss and mixtures, Rock wool and other inert media	3
32	Nutrient film technique (NFT) Hydroponics Recommendations of joint Agresco	
<b>Total</b>		<b>100</b>

### **Practical programme**

<b>Practical No.</b>	<b>Topics</b>
1	Study of different types of greenhouses based on shape, utility,
2	Study of different types of greenhouses based on construction and cladding materials
3	Calculation of air rate exchange in an active summer winter cooling system;
4	Estimation of drying rate of agricultural products inside green house;
5	Testing of soil and water to study its suitability for growing crops in greenhouses;
6	The study of fertigation requirements for greenhouse crops and estimation of E.C. in the fertigation solution;
7	The study of various growing media used in raising of greenhouse crops and their preparation and pasteurization / sterilization;
8	Visit to commercial greenhouses;
9	Cultivation of Capsicum under protected cultivation
10	Cultivation of Tomato under protected cultivation
11	Cultivation of Cucumber under protected cultivation
12	Cultivation of Cucurbits under protected cultivation with mulches
13	Cultivation of Summer squash under protected cultivation with mulches
14	Cultivation of melons and beans under protected cultivation with mulches
15	Cultivation of spinach, coriander
16	Economics of protected cultivation

### **Suggested Reading:**

#### **Reference Books:**

- Aldrich R A and Bartok J W. 1994. NRAES, Riley, Robb Hall. Green House Engineering. Cornell University, Ithaca, New York.
- Balraj Singh. 2006. Protected cultivation of vegetable crops. Kalyani Publishers, Ludhiana.
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