

**SWAMI VIVEKANAND UNIVERSITY,
SIRONJA, SAGAR (M.P.)**



SYLLABUS

Faculty of Agriculture Science & Technology

Department of Agriculture Science

Study & Evaluation Scheme

Of

M.Sc. (Ag.) Horticulture

(Vegetable Science)

(Applicable w.e.f Academic Session 2016-18, till revised)

SWAMI VIVEKANAND UNIVERSITY SIRONJA, SAGAR M.P.

Study and Evaluation Scheme

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M. Sc. (Ag) Horticulture
(Two Year Master Degree Programme)
Requirement of credit hours for award of the degree

S.No	Nature of courses	Credit
1	Major courses	41
2	Minor courses	10
3	Supporting courses	07
4	Master's Seminar	10
5	Master's Research	10
	Total credits	78

Major Subject: The subject (Department/Discipline) in which a student takes admission

Minor Subject: The subject closely related to a student's major subject.

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work or necessary for building his overall competence.

Non-Credit compulsory Courses: Six courses (PGS 1 –PGS 6) are of general nature and are compulsory



DEPARTMENT OF HORTICULTURE

Name of the Programme M.Sc. (Horticulture) Vegetable Science

Semester – I	Paper Code	Course Title	Credits
Major courses	HORTI -101	Production technology of cool season vegetable crops	3(2+1)
	HORTI -102	Organic vegetable production Technology	2(1+1)
	HORTI -103	Production technology of under exploited veg.	3(2+1)
Minor Courses	HORTI -104	Principals of Plant Physiology	4(3+1)
	HORTI -105	Dry land farming and watershed management	3(2+1)
Supporting Courses	HORTI -106	Statistical Methods for Applied Science	4(3+1)
Compulsory Non-Credit Courses	HORTI -107	Library and information services	N.C.
	HORTI -108	Basic concepts in laboratory techniques	N.C.
Semester -II	Paper Code	Course Title	Credits
Major courses	HORTI-201	Topic seminar	1(0+1)
	HORTI-202	Production technology of warm season veg.	3(2+1)
	HORTI-203	Breeding of vegetable crops	3(2+1)
	HORTI-204	Growth and development of vegetable crops	3(2+1)
	HORTI-205	Fundamentals of processing of vegetable	3(2+1)
Minor Courses	HORTI-206	Experimental Designs	3(2+1)
Supporting Courses	HORTI-207	Seed technology of vegetable crops and seed certification	3(2+1)
Compulsory Non-Credit Courses	HORTI-208	Agricultural Research Ethics and Rural Development programme	N.C.
	HORTI-209	Disaster Management	N.C.
Semester -III	Paper Code	Course Title	Credits
Major courses	HORTI-301	Master’s Research Seminar	10(0+10)
Compulsory Non-Credit Courses	HORTI-302	Technical writing and communication skill	N.C.
	HORTI-303	Intellectual property and its management in agriculture	N.C.
Semester -IV	Paper Code	Course Title	Credits
Major courses	HORTI-401	Master’s Research	10(0+10)



M.Sc. (Ag.) Horticulture

First Semester

Semester – I	Paper Code	Course Title	Credits
Major courses	HORTI-101	Production technology of cool season vegetable crops	3(2+1)
	HORTI-102	Organic vegetable production Technology	2(1+1)
	HORTI-103	Production technology of under exploited veg.	3(2+1)
Minor Courses	HORTI -104	Principals of Plant Physiology	4(3+1)
	HORTI -105	Dry land farming and watershed management	3(2+1)
Supporting Course	HORTI -106	Statistical Methods for Applied Science	4(3+1)
Compulsory Non-Credit Courses	HORTI -107	Library and information services	N.C.
	HORTI -108	Basic concepts in laboratory techniques	N.C.



**Course Title : HORTI-101 PRODUCTION TECHNOLOGY OF
COOL SEASON VEGETABLE CROPS**

3(2+1)

Objective

To educate production technology of cool season vegetables.

Theory

UNIT I

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures and seed production of: Potato

UNIT II

Cole crops: cabbage, cauliflower, knoll kohl, sprouting broccoli, Brussels sprout

UNIT III

Root crops: carrot, radish, turnip and beetroot

UNIT IV

Bulb crops: onion and garlic

UNIT V - Peas and broad bean, green leafy cool season vegetables

Practical

1. Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of winter vegetable crops and their economics
2. Experiments to demonstrate the role of mineral elements, plant growth substances and herbicides
3. Study of physiological disorders; preparation of cropping scheme for commercial farms
4. Visit to commercial greenhouse/ polyhouse.



Suggested Readings

1. Chadha KL. (Ed.). 2002. Hand Book of Horticulture. ICAR.
2. Chauhan DVS. (Ed.). 1986. Vegetable Production in India. Ram Prasad & Sons.
3. Edmond JB, Musser AM & Andrews FS. 1951. Fundamentals of Horticulture. Blakiston Co.
4. Fageria MS, Choudhary BR & Dhaka RS. 2000. Vegetable Crops: Production Technology. Vol. II. Kalyani.
5. Gopalakrishanan TR. 2007. Vegetable Crops. New India Publ. Agency.
6. Rana MK. 2008. Olericulture in India. Kalyani Publ.
7. Rana MK. 2008. Scientific Cultivation of Vegetables. Kalyani Publ.
8. A Text Book of Oleri and Flori Culture. Aman Publ.
9. Shanmugavelu KG. 1989. Production Technology of Vegetable Crops. Oxford & IBH.
10. Singh DK. 2007. Modern Vegetable Varieties and Production Technology.
11. Vegetables, Tuber Crops and Spices. ICAR.
12. Thompson HC & Kelly WC. (Eds.). 1978. Vegetable Crops. Tata McGraw-Hill



Course Title : HORTI-102 ORGANIC VEGETABLE

PRODUCTION TECHNOLOGY

2 (1+1)

Objective

To educate principles, concepts and production of organic farming in vegetable crops.

Theory

UNIT I

Importance, principles, perspective, concept and component of organic production of vegetable crops.

UNIT II

Organic production of vegetables crops, viz., solanaceous crops, cucurbits, cole crops, root and tuber crops.

UNIT III

Managing soil fertility, pests and diseases and weed problems in organic farming system; crop rotation in organic horticulture; processing and quality control for organic foods.

UNIT IV

Methods for enhancing soil fertility, mulching, raising green manure crops. Indigenous methods of compost, Panchagavya, Biodynamics, preparation etc Pest and disease management in organic farming; ITK's in organic farming. Role of botanicals and bio-control agents.

UNIT V

GAP and GMP- Certification of organic products; organic production and export - opportunity and challenges.



Practical

1. Method of preparation of compost, vermicomposting, biofertilizers,
2. Soil solarization, bio pesticides in horticulture, green manuring, mycorrhizae and organic crop production,
3. Waste management, organic soil amendment for root disease, weed management in organic horticulture.
4. Visit to organic fields and marketing centers.

Suggested Readings

1. Dahama AK. 2005. *Organic Farming for Sustainable Agriculture*. 2nd Ed. Agrobios.
2. Gehlot G. 2005. *Organic Farming; Standards, Accreditation Certification and Inspection*. Agrobios.
3. Palaniappan SP & Annadorai K. 2003. *Organic Farming, Theory and Practice*. Scientific Publ.
4. Pradeepkumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008. *Management of Horticultural Crops*. New India Publ. Agency.
5. Shivashankar K. 1997. *Food Security in Harmony with Nature*. 3rd IFOAMASIA, Scientific Conf.. 1- 4 December, 1997, UAS, Bangalore.



**Course Title: HORTI-103 PRODUCTION TECHNOLOGY OF
UNDER EXPLOITED VEGETABLE CROPS**

3 (2+1)

Objective

To educate production technology of underutilized vegetable crops.

Theory

UNIT I

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures and seed production of: Asparagus, artichoke and leek

UNIT II

Brussels's sprout, Chinese cabbage, broccoli, kale and artichoke.

UNIT III

Amaranth, celery, parsley, parsnip, lettuce, rhubarb, spinach, basella, bathu (chenopods) and chekurmanis.

UNIT IV

Elephant foot yam, lima bean, winged bean, vegetable pigeon pea, jack bean and sword bean.

UNIT V

Sweet gourd, spine gourd, pointed gourd, Oriental pickling melon and little gourd (kundru).



Practical

1. Identification of seeds; botanical description of plants;
2. Layout and planting; cultural practices;
3. short-term experiments of underexploited vegetables.

Suggested Readings

1. Bhat KL. 2001. *Minor Vegetables - Untapped Potential*. Kalyani.
2. Indira P & Peter KV. 1984. *Unexploited Tropical Vegetables*. Kerala Agricultural University, Kerala.
3. Peter KV. (Ed.). 2007-08. *Underutilized and Underexploited Horticultural Crops*. Vols. I-IV. New India Publ. Agency.
4. Rubatzky VE & Yamaguchi M. (Eds.). 1997. *World Vegetables: Principles, Production and Nutritive Values*. Chapman & Hall
5. Srivastava U, Mahajan RK, Gangopadyay KK, Singh M & Dhillon BS. 2001. *Minimal Descriptors of Agri-Horticultural Crops*. Part-II: *Vegetable Crops*. NBPGR, New Delhi.



Course Title : HORTI-104 PRINCIPLES OF PLANT PHYSIOLOGY

4 (3+1)

Objective: To acquaint the students with the basic concepts of plant physiology and their application in agriculture.

Theory

UNIT I

Soil and plant water relations, water and its role in plants, properties and functions of water in the cell water relations-, water potential of plant cells.

UNIT II

Mechanism of water uptake by roots-transport in roots, Transpiration, factor influencing transpiration rate and theory of transpiration.

UNIT III

Stomata structure and function–mechanism of stomatal movement, antitranspirants. The role of mineral nutrients in plant metabolism: Essential elements, classification based on function of elements in plants

UNIT IV

Photosynthesis and its importance in plant . Photochemical process, photochemical reactions, CO₂ reduction in Calvin cycle, Carbon fixation in C₄,C₃ and CAM plants and its significance.

UNIT V

Growth and differentiation. Hormonal concept of growth and differentiation, plant growth hormones and their physiological role. Plant growth regulators, growth retardants., physiology of flowering- Photoperiodism and Vernalisation



Practical

1. Measurement of soil waterstatus.
2. Measurement of transpiration rate.
3. Stomatal physiology, influence of ABA on stomatal closing.
4. Deficiency symptoms of nutrients.
5. To study about different growth regulators.
6. Demonstration of photoperiodic response of plants in terms of flowering.

Suggested Readings

1. Hopkins WG & Huner NPA. 2004. Introduction to Plant Physiology. John Wiley & Sons.
2. Salisbury FB & Ross C. 1992. Plant Physiology. 4th Ed. Wadsworth Publ.
3. Taiz L & Zeiger E. 2006. Plant Physiology. 4th Ed. Sinauer Associate



**Course Title : HORTI-105 DRYLAND FARMING AND WATERSHED
MANAGEMENT**

3 (2+1)

Objective

To teach the basic concepts and practices of dry land farming and soil moisture conservation.

Theory

UNIT I-

Definition, concept and characteristics of dry land farming; dry land versus rainfed farming; significance and dimensions of dry land farming in Indian agriculture.

UNIT II-

Soil and climatic parameters with special emphasis on rainfall characteristics; constraints limiting crop production in dry land areas; types of drought, characterization of environment for water availability; crop planning for erratic and aberrant weather conditions.

UNIT III-

Stress physiology and resistance to drought, adaptation of crop plants to drought, drought management strategies; preparation of appropriate crop plans for dry land areas; mid contingent plan for aberrant weather conditions.

UNIT IV-

Tillage, tith, frequency and depth of cultivation, compaction in soil tillage; concept of conservation tillage; tillage in relation to weed control and moisture conservation; techniques and practices of soil moisture conservation (use of mulches, kinds, effectiveness and economics); antitranspirants

UNIT V-

Soil and crop management techniques, seeding and efficient fertilizer use. Concept of watershed resource management, problems, approach and components.



Practical

1. Seed treatment, seed germination and crop establishment in relation to soil moisture contents
2. Moisture stress effects and recovery behaviour of important crops Estimation of moisture index and aridity index
3. Spray of anti-transpirants and their effect on crops
4. Collection and interpretation of data for water balance equations Water use efficiency
5. Preparation of crop plans for different drought conditions Study of field experiments relevant to dryland farming Visit to dryland research stations and watershed projects

Suggested Readings

1. Das NR. 2007. Tillage and Crop Production. Scientific Publishers. Dhopte AM. 2002. Agrotechnology for Dryland Farming. Scientific Publ.
2. Dhruv Narayan VV. 2002. Soil and Water Conservation Research in India. ICAR. Gupta US. (Ed.). 1995. Production and Improvements of Crops for Drylands. Oxford & IBH.
3. Katyal JC & Farrington J. 1995. Research for Rainfed Farming. CRIDA. Rao SC & Ryan J. 2007. Challenges and Strategies of Dryland Agriculture. Scientific Publishers.
4. Singh P & Maliwal PL. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publishing Company.
5. Singh RP. 1988. Improved Agronomic Practices for Dry land Crops. CRIDA. Singh RP. 2005. Sustainable Development of Dry land Agriculture in India. Scientific Publ.
6. Singh SD. 1998. Arid Land Irrigation and Ecological Management. Scientific Publishers.
7. Venkateshwarlu J. 2004. Rainfed Agriculture in India. Research and Development Scenario. ICAR.



Course Title : HORTI-106 - STATISTICAL METHODS FOR APPLIED SCIENCES 4 (3+1)

Objective

It would also help them in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, tests of significance, regression and multivariate analytical techniques.

Theory

UNIT I

Classification, tabulation and graphical, representation of data. Box-plot, Descriptive statistics. Exploratory data analysis;

UNIT II

Measures of central tendency- Mean, Median, Mode, Geometric mean, Harmonic mean.

UNIT III

Measures of Dispersion- Range, Quartile deviation, Mean deviation, Standard deviation.

UNIT IV

Theory of probability. Random variable and mathematical expectation. Discrete and continuous probability distributions. Correlation and regression

UNIT V

Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications. Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions.



Practical

1. Exploratory data analysis, Box-Cox plots; Fitting of distributions~Binomial, Poisson, Negative Binomial
2. Normal; Large sample tests, testing of hypothesis based on exact sampling distributions-chi square, t and F
3. Confidence interval estimation and point estimation of parameters of binomial, Poisson and Normal distribution
4. Correlation and regression analysis, fitting of orthogonal polynomial regression
5. Applications of dimensionality reduction and discriminant function analysis, Nonparametric tests.

Suggested Readings

1. Anderson TW. 1958. An Introduction to Multivariate Statistical Analysis. John Wiley.
2. Goon AM, Gupta MK & Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I
3. Goon AM, Gupta MK & Dasgupta B. 1983. Fundamentals of Statistics. Vol. I.
4. Hoel PG. 1971. Introduction to Mathematical Statistics. John Wiley.



Course Title : HORTI-107 Library and Information Services

Objective:

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical:

1. Introduction to library and its services; Role of libraries in education, research and technology transfer
2. Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources
3. Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.)
4. Tracing information from reference sources
5. Literature survey; Citation techniques/Preparation of bibliography
6. Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services
7. Use of Internet including search engines and its resources; ere sources access methods.



Course Title : HORTI-108 Basic Concepts in Laboratory Techniques

Objective:

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical:

1. Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccumets;
2. Washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution;
3. Handling techniques of solutions; Preparation of different agrochemical doses in field and pot applications; Preparation of solutions of acids; Neutralization of acid and bases; Preparation of buffers of different strengths and pH values.
4. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath, water bath, oil bath;
5. Electric wiring and earthing.
6. Preparation of media and methods of sterilization;
7. Seed viability testing, testing of pollen viability; Tissue culture of crop plants;
8. Description of flowering plants in botanical terms in relation to taxonomy

Suggested Readings

1. Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.
2. Gabb MH & Latchem WE.1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.8. FMPE 503: Testing and Evaluation of Tractors and Farm Equipment



M.Sc.Ag. Horticulture

Second Semester

Semester -II	Paper Code	Course Title	Credits
Major courses	HORTI-201	Topic seminar	1(0+1)
	HORTI-202	Production technology of warm season veg. crops	3(2+1)
	HORTI-203	Breeding of vegetable crops	3(2+1)
	HORTI-204	Growth and development of vegetable crops	3(2+1)
	HORTI-205	Fundamentals of processing of vegetable	3(2+1)
Minor Courses	HORTI-206	Stat. Experimental Designs	3(2+1)
Supporting Courses	HORTI-207	Seed production technology of vegetable crops and seed certification	3(2+1)
Compulsory Non-Credit Courses	HORTI-208	Agricultural Research Ethics and Rural Development programme	N.C.
	HORTI-209	Disaster Management	N.C.



M.Sc.Ag. Horticulture

Second Semester

Course Title: HORTI-201 Topic Seminar

1 (0+1)



**Course Title: HORTI-202 PRODUCTION TECHNOLOGY OF
WARM SEASON VEGETABLE CROPS**

3(2+1)

Objective

To teach production technology of warm season vegetables.

Theory

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures, economics of crop production and seed production of:

UNIT I Tomato, eggplant, hot and sweet peppers

UNIT II Okra, beans, cowpea and clusterbean

UNIT III Cucurbitaceous crops

UNIT IV Tapioca and sweet potato

UNIT V Green leafy warm season vegetables

Practical

1. Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of summer vegetable crops and their economics
2. Study of physiological disorders and deficiency of mineral elements, preparation of cropping schemes for commercial farms;
3. Experiments to demonstrate the role of mineral elements, physiological disorders; plant growth substances and herbicides
4. seed extraction techniques; identification of important pests and diseases and their control; maturity standards
5. Economics of warm season vegetable crops



Suggested Readings

1. Chadha KL. (Ed.). 2002. *Hand Book of Horticulture*. ICAR.
2. Chauhan DVS. (Ed.). 1986. *Vegetable Production in India*. Ram Prasad & Sons.
3. Decoteau DR. 2000. *Vegetable Crops*. Prentice Hall.
4. Edmond JB, Musser AM & Andrews FS. 1964. *Fundamentals of Horticulture*. Blakiston Co
5. Fageria MS, Choudhary BR & Dhaka RS. 2000. *Vegetable Crops: Production Technology*. Vol. II. Kalyani.
6. Gopalakrishanan TR. 2007. *Vegetable Crops*. New India Publ. Agency.
7. Hazra P & Som MG. (Eds.). 1999. *Technology for Vegetable Production and Improvement*. Naya Prokash.
8. Kalloo G & Singh K (Ed.). 2000. *Emerging Scenario in Vegetable Research and Development*. Research Periodicals & Book Publ. House.
9. Nayer NM & More TA 1998. *Cucurbits*. Oxford & IBH Publ.
10. Palaniswamy & Peter KV. 2007. *Tuber Crops*. New India Publ. Agency.
11. Rana MK. 2008. *Olericulture in India*. Kalyani. Rana MK. 2008. *Scientific Cultivation of Vegetables* Kalyani.
12. Singh SP. (Ed.). 1989. *Production Technology of Vegetable Crops*. Agril. Comm. Res. Centre.
13. Thamburaj S & Singh N. 2004. *Vegetables, Tuber Crops and Spices*. ICAR.



Course Title : HORTI-203 BREEDING OF VEGETABLE CROPS

3(2+1)

Objective

To educate principles and practices adopted for breeding of vegetable crops.

Theory

Origin, botany, taxonomy, cytogenetics, genetics, breeding objectives, breeding methods (introduction, selection, hybridization, mutation), varieties and varietal characterization, resistance breeding for biotic and abiotic stress, quality improvement, molecular marker, genomics, marker assisted breeding and QTLs, biotechnology and their use in breeding in vegetable crops-Issue of patenting, PPVFR act.

UNIT I Potato and tomato

UNIT II Eggplant, hot pepper, sweet pepper and okra

UNIT III Peas and beans, amaranth, chenopods and lettuce

UNIT IV Gourds, melons, pumpkins and squashes

UNIT V Cabbage, cauliflower, carrot, beetroot, radish, sweet potato and tapioca

Practical

1. Selection of desirable plants from breeding population observations and analysis of various qualitative and quantitative traits in germplasm,
2. Hybrids and segregating generations; induction of flowering, palanological studies, selfing and crossing techniques in vegetable crops;
3. Hybrid seed production of vegetable crops in bulk. screening techniques for insect-pests, disease and environmental stress resistance in above mentioned crops,
4. Demonstration of sib-mating and mixed population; molecular marker techniques to identify useful traits in the vegetable crops and special breeding techniques.
5. Visit to breeding blocks.



Suggested Readings

1. Allard RW. 1999. *Principles of Plant Breeding*. John Wiley & Sons.
2. Basset MJ. (Ed.). 1986. *Breeding Vegetable Crops*. AVI Publ. Dhillon BS, Tyagi RK,
3. Saxena S. & Randhawa GJ. 2005. *Plant Genetic Resources: Horticultural Crops*. Narosa Publ. House.
4. Fageria MS, Arya PS & Choudhary AK. 2000. *Vegetable Crops: Breeding and Seed Production*. Vol. I. Kalyani.
5. Gardner EJ. 1975. *Principles of Genetics*. John Wiley & Sons.
6. Hayes HK, Immer FR & Smith DC. 1955. *Methods of Plant Breeding*. McGraw-Hill.
7. Hayward MD, Bosemark NO & Romagosa I. (Eds.). 1993. *Plant Breeding-Principles and Prospects*. Chapman & Hall.
8. Kalloo G. 1988. *Vegetable Breeding*. Vols. I-III. CRC Press.
9. Peter KV & Pradeepkumar T. 2008. *Genetics and Breeding of Vegetables*. Revised, ICAR. Rai N & Rai M. 2006. *Heterosis Breeding in Vegetable Crops*. New India Publ. Agency.



Course Title : HORTI-204 GROWTH AND DEVELOPMENT

OF VEGETABLE CROPS

3(2+1)

Objective

To teach the physiology of growth and development of vegetable crops.

Theory

UNIT I

Cellular structures and their functions; definition of growth and development, growth analysis and its importance in vegetable production.

UNIT II

Physiology of dormancy and germination of vegetable seeds, tubers and bulbs; Role of auxins, gibberellins, cytokinins and abscisic acid; Application of synthetic hormones, plant growth retardants and inhibitors for various purposes in vegetable crops; Role and mode of action of morphactins, antitranspirants, anti-auxin, ripening retardant and plant stimulants in vegetable crop production.

UNIT III

Role of light, temperature and photoperiod on growth, development of underground parts, flowering and sex expression in vegetable crops; apical dominance.

UNIT IV

Physiology of fruit set, fruit development, fruit growth, flower and fruit drop; parthenocarpy in vegetable crops; phototropism, ethylene inhibitors, senescence and abscission; fruit ripening and physiological changes associated with ripening.

UNIT V

Plant growth regulators in relation to vegetable production; morphogenesis and tissue culture techniques in vegetable crops.



Practical

1. Preparation of solutions of plant growth substances and their application
2. Experiments in breaking and induction of dormancy by chemicals
3. Induction of parthenocarpy and fruit ripening
4. Application of plant growth substances for improving flower initiation, changing sex expression in cucurbits and checking flower and fruit drops and improving fruit set in solanaceous vegetables
5. Growth analysis techniques in vegetable crops.

Suggested Readings

1. Bleasdale JKA. 1984. *Plant Physiology in Relation to Horticulture*. 2nd Ed. MacMillan.
2. Gupta US. (Ed.). 1978. *Crop Physiology*. Oxford & IBH.
3. Krishnamoorti HN. 1981. *Application Plant Growth Substances and Their Uses in Agriculture*. Tata-McGraw Hill.
4. Peter KV. (Ed.). 2008. *Basics of Horticulture*. New India Publ. Agency.
5. Saini RS, Sharma KD, Dhankhar OP & Kaushik RA. (Eds.). 2001. *Laboratory Manual of Analytical*



**Course Title : HORTI-205 FUNDAMENTALS OF PROCESSING
OF VEGETABLES**

3(2+1)

Objective

To educate principles and practices of processing of vegetable crops.

Theory

UNIT I

History of food preservation. Present status and future prospects of vegetable preservation industry in India.

UNIT II

Spoilage of fresh and processed horticultural produce; biochemical changes and enzymes associated with spoilage of horticultural produce; principal spoilage organisms, food poisoning and their control measures. Role of microorganisms in food preservation.

UNIT III

Raw materials for processing. Primary and minimal processing; processing equipments; Layout and establishment of processing industry, FPO licence. Importance of hygiene; Plant sanitation.

UNIT IV

Quality assurance and quality control, TQM, GMP. Food standards – FPO, PFA, etc. Food laws and regulations. Food safety – Hazard analysis and critical control points (HACCP). Labeling and labeling act, nutrition labeling.

UNIT V

Major value added products from vegetables. Utilization of byproducts of vegetable processing industry; Management of waste from processing factory. Investment analysis. Principles and methods of sensory evaluation of fresh and processed vegetables.



Practical

1. Study of machinery and equipments used in processing of horticultural produce
2. Chemical analysis for nutritive value of fresh and processed vegetables
3. Study of different types of spoilages in fresh as well as processed horticultural produce
4. Classification and identification of spoilage organisms; Study of biochemical changes and enzymes associated with spoilage
5. Laboratory examination of vegetable products; Sensory evaluation of fresh and processed vegetables
6. Study of food standards – National, international, CODEX Alimentarius
7. Visit to processing units to study the layout, equipments, hygiene, sanitation and residual / waste management.

Suggested Readings

1. Arthey D & Dennis C. 1996. *Vegetable Processing*. Blackie/Springer-Verlag.
2. Chadha DS. 2006. *The Prevention of Food Adulteration Act*. Confed. of Indian Industry. Desrosier NW. 1977. *Elements and Technology*. AVI Publ. Co. International.
3. Frazier WC & Westhoff DC. 1995. *Food Microbiology*. 4th Ed. Tata McGraw Hill.
4. Giridharilal GS, Siddappa & Tandon GL. 1986. *Preservation of Fruits and Vegetables*. ICAR.
5. Gisela J. 1985. *Sensory Evaluation of Food – Theory and Practices*. Ellis Horwood.
6. Graham HD. 1980. *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. 2nd Ed. Tata-McGraw Hill.
7. Shapiro R. 1995. *Nutrition Labeling Handbook*. Marcel Dekker.
8. Srivastava RP & Kumar S. 2003. *Fruit and Vegetable Preservation: Principles and Practices*. 3rd Ed. International Book Distri. Co.
9. Verma LR & Joshi VK. 2000. *Post-harvest Technology of Fruits and Vegetables: Handling, Processing, Fermentation and Waste Management*. Ind



Course Title: HORTI – 206 STAT. EXPERIMENTAL DESIGNS

3(2+1)

Objective

This course is meant for students of agricultural and animal sciences other than Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

UNIT I

Need for designing of experiments, characteristics of a good design. Basic principles of designs-randomization, replication and local control.

UNIT II

Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.

UNIT III

Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.

UNIT IV

Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

UNIT V

Bioassays- direct and indirect, indirect assays based on quantal dose response, parallel line and slope ratio assays potency estimation.



Practical

1. Uniformity trial data analysis, formation of plots and blocks
2. Fairfield Smith Law; Analysis of data obtained from CRD, RBD, LSD
3. Analysis of factorial experiments without and with confounding
4. Analysis with missing data; Split plot and strip plot designs
5. Transformation of data; Analysis of resolvable designs
6. Fitting of response surfaces.

Suggested Readings

1. Cochran WG & Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley.
2. Dean AM & Voss D. 1999. Design and Analysis of Experiments. Springer.
3. Federer WT. 1985. Experimental Designs. MacMillan.
4. Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd.
5. Nigam AK & Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ. Pearce SC. 1983.
6. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley. Design Resources Server: www.iasri.res.in/design.



Course Title: HORTI-207 SEED PRODUCTION TECHNOLOGY

3(2+1)

OF VEGETABLE CROPS AND SEED CERTIFICATION

Objective

To educate principles and methods of quality seed and planting material production in vegetable crops and the recent trends in the certification, processing and storage of vegetable crops.

Theory

UNIT- I

Genetical and agronomical principles of seed production; methods of seed production; use of growth regulators and chemicals in vegetable seed production; floral biology, pollination, breeding behaviour, seed development and maturation; methods of hybrid seed production. Categories of seed; maintenance of nucleus, foundation and certified seed; seed certification, seed standards; seed act and law enforcement, plant quarantine and quality control.

UNIT- II

Physiological maturity, seed harvesting, extraction, curing, drying, grading, seed processing, seed coating and pelleting, packaging (containers/packets), storage and cryopreservation of seeds, synthetic seed technology. Agro-techniques for seed production in solanaceous vegetables, cucurbits, leguminous vegetables, cole crops, bulb crops, leafy vegetables, okra, vegetatively propagated vegetables.

UNIT- III

Seed certification, objectives, organization of seed certification, minimum seed certification standards of vegetable crops, field inspection, specification for certification. Seed processing, study of seed processing equipments seed cleaning and upgrading, Seed packing and handling, equipment used for packaging of seeds, procedures for allocating lot number.

UNIT- IV

Pre-conditioning, seed treatment, benefits, types and products, general principles of seed storage, advances in methods of storage, quality control in storage, storage containers, seed longevity and deterioration, sanitation, temperature and relative humidity control. Seed testing; ISTA rules for testing, moisture, purity germination, vigortest,

UNIT V

Seed sampling, determination of genuineness of varieties, seed viability, seed health testing; seed dormancy and types of dormancy, factors responsible for dormancy. Seed marketing, demand forecast, marketing organization, economics of seed production; farmers' rights, seed law enforcement, seed act and seed policy.



Practical

1. Seed sampling, purity, moisture testing, seed viability, seed vigor tests, seed health testing, seed cleaning, grading and packaging
2. Handling of seed testing equipment and processing machines
3. Seed treatment methods, seed priming and pelleting
4. Field and seed inspection, practices in rouging, seed storage, isolation distances
5. Biochemical tests, visit to seed testing laboratories and processing plants, mixing and dividing instruments
6. Visit to seed processing unit and warehouse visit and know about sanitation standards.

Suggested Readings

1. Agrawal PK & Dadlani M. 1992. *Techniques in Seed Science and Technology*. South Asian Publ.
2. Singh N, Singh DK, Singh YK & Kumar V. 2006. *Vegetable Seed Production Technology*. International Book Distr. Co
3. Singh SP. 2001. *Seed Production of Commercial Vegetables*. Agrotech Publ. Academy.
4. Tanwar NS & Singh SV. 1988. *Indian Minimum Seed Certification Standards*. Central Seed Certification Board, GOI, New Delhi.
5. Rajan S & Baby L Markose 2007. *Propagation of Horticultural Crops*. New India Publ. Agency.
6. Agrawal PK & Dadlani M. (Eds.). 1992. *Techniques in Seed Science and Technology*.
7. South Asian Publ. Agrawal RL. (Ed.). 1997. *Seed Technology*. Oxford & IBH



**Course Title : HORTI-208 AGRICULTURAL RESEARCH, ETHICS AND
RURAL DEVELOPMENT PROGRAMMES**

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT-I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NA RS) and Regional Agricultural Research Institutions

UNIT-II

Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centers (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels

UNIT III

International fellowships for scientific mobility. Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT IV

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group Area Specific Programme



UNIT-V

Integrated Rural' Development Programme (IROP) Panchayati Raj Institutions, Co-operatives. Voluntary Agencies/Non-Governmental Organizations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

1. Bhalla GS & Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.
2. Punia MS. *Manual on International Research and Research Ethics*. CCS, Haryana Agricultural University, Hisar.
3. Rao BSV. 2007. *Rural Development Strategies and Role of Institutions Issues, In/lovations and Initiatives*. Mittal Pub.
4. Singh K .. 199H. *Rural Development - Principles. Policies and Management*. Sage Pub.



Course Title: HORTI-209 DISASTER MANAGEMENT

Objectives

To introduce learners to the key concepts and practices of natural disaster management: to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT- I

Natural Disaster management and nature of natural disasters, their types and effect. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions,

UNIT- II

Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion
Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters

UNIT-III

Building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents. air accidents, sea accidents.

UNIT- IV

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements

UNIT-IV

Role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.



Suggested Readings

1. Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.
2. Hodgkinson PE & Stewart M. 199 J. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.
3. Sharma VK. 200 I. *Disaster Management*. National Centre for Disaster Management, India.



M.Sc.Ag. Horticulture

Third Semester

Semester -III	Paper Code	Course Title	Credits
Major courses	HORTI-301	Master's Research Seminar	10(0+10)
Compulsory Non-Credit Courses	HORTI-302	Technical writing and communication skill	N.C.
	HORTI-303	Intellectual property and its management in agriculture	N.C.



Swami Vivekanand University, Sagar (M.P.)



M.Sc.Ag. Horticulture

Third Semester

Course Title : HORTI-301 - Master's Research Seminar

10 (0+10)



Course Title : HORTI-302 Technical Writing and Communication Skill

Objective To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing Various forms of scientific writings- thesis, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech:

Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

1. English Dictionary. 1995. Harper Collins. Gordon HM & Walter JA. 1970.
2. Technical Writing. 3rd Ed. Holt, Rinehart & Winston. Hornby AS. 2000. Comp.
3. James HS. 1994. Handbook for Technical Writing. NTC
4. Mohan K. 2005. Speaking English Effectively.
5. High School English Grammar and Composition. S. Chand & Co.



Course Title : HORTI-303 Intellectual Property and Its management in Agriculture

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge based economy.

Theory

UNIT-I

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property rights (IPR), benefits of securing IPRs

UNIT-II

Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection;

UNIT-III

Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives;

UNIT-IV

Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture

UNIT-V

Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.



Suggested Readings

1. Erbisch FH & Maredia K.1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
2. Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
3. *Intellectual Property Rights: Key to New Wealth Generation. 2001*. NRDC & Aesthetic Technologies.
4. Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V.
5. *Technology Generation and IPR Issues*. Academic Foundation. Rothschild M & Scott N. (Ed.). 2003
6. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.
7. Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.
8. *The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003*.



M.Sc.Ag. Horticulture

Forth Semester

Semester -IV	Paper Code	Course Title	Credits
Major courses	HORTI-401	Master's Research	10(0+10)



M.Sc.Ag. Horticulture

Forth Semester

Course Title : HORTI-401

Master's Research

10 (0+10)