

Name of the Programme

M.Sc.(Ag.) Horticulture (Vegetable Science)

VSC 501 **Production Technology of Cool Season Vegetable Crops** **2+1**
Objective To educate production technology of cool 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 and seed production of

UNIT I 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 Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of winter vegetable crops and their economics

- Experiments to demonstrate the role of mineral elements, plant growth substances and herbicides
- Study of physiological disorders; preparation of cropping scheme for commercial farms;
- Visit to commercial greenhouse/ polyhouse.

Suggested Readings

- Bose TK & Som MG. (Eds.). 1986. Vegetable Crops in India. Naya Prokash.
 Bose TK, Som G & Kabir J. (Eds.). 2002. Vegetable Crops. Naya Prokash.
 Bose TK, Som MG & Kabir J. (Eds.). 1993. Vegetable Crops. Naya Prokash.
 Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. 2003. Vegetable Crops. Vols. I-III. Naya Udyog.
 Chadha KL & Kalloo G. (Eds.). 1993-94. Advances in Horticulture Vols.V-X. Malhotra Publ. House.
 Chadha KL. (Ed.). 2002. Hand Book of Horticulture. ICAR.
 Chauhan DVS. (Ed.). 1986. Vegetable Production in India. Ram Prasad & Sons.
 Decoteau DR. 2000. Vegetable Crops. Prentice Hall.
 Edmond JB, Musser AM & Andrews FS. 1951. Fundamentals of Horticulture. Blakiston Co.
 Fageria MS, Choudhary BR & Dhaka RS. 2000. Vegetable Crops Production Technology. Vol. II. Kalyani.
 Gopalakrishanan TR. 2007. Vegetable Crops. New India Publ. Agency.
 Hazra P & Som MG. (Eds.). 1999. Technology for Vegetable Production and Improvement. Naya Prokash.
 Rana MK. 2008. Olericulture in India. Kalyani Publ.
 Rana MK. 2008. Scientific Cultivation of Vegetables. Kalyani Publ.
 Rubatzky VE & Yamaguchi M. 1997. World Vegetables Principles, Production and Nutritive Values. C & Hl.
 Saini GS. 2001. A Text Book of Oleri and Flori Culture. Aman Publ. House.
 Salunkhe DK & Kadam SS. (Ed.). 1998. Hand Book of Vegetable Science and Technology Production, Composition, Storage and Processing.
 Marcel Dekker. Shanmugavelu KG. 1989. Production Technology of Vegetable Crops. Oxford & IBH.
 Singh DK. 2007. Modern Vegetable Varieties and Production Technology. IBD Co.
 Singh SP. (Ed.). 1989. Production Technology of Vegetable Crops. Agril. Comm. Res. Centre.
 Thamburaj S & Singh N. (Eds.). 2004. Vegetables, Tuber Crops and Spices. ICAR.
 Thompson HC & Kelly WC. (Eds.). 1978. Vegetable Crops. Tata McGraw- Hill.

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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 Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of summer vegetable crops and their economics.

- Study of physiological disorders and deficiency of mineral elements, preparation of cropping schemes for commercial farms.
- Experiments to demonstrate the role of mineral elements, physiological disorders.
- Plant growth substances and herbicides; seed extraction techniques.
- Identification of important pests and diseases and their control.
- Maturity standards; economics of warm season vegetable crops.

Suggested Readings

- Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. 2003. Vegetable Crops. Vols. I-III. NU
 Bose TK, Som MG & Kabir J. (Eds.). 2002. Vegetable Crops. Naya Prokash.
 Brown HD & Hutchison CS. Vegetable Science. JB Lippincott Co.
 Chadha KL & Kalloo G. (Eds.). 1993-94. Advances in Horticulture. Vols. V-X. Malhotra Publ. House.
 Chadha KL. (Ed.). 2002. Hand Book of Horticulture. ICAR.
 Chauhan DVS. (Ed.). 1986. Vegetable Production in India. Ram Prasad & Sons.
 Decoteau DR. 2000. Vegetable Crops. Prentice Hall.
 Edmond JB, Musser AM & Andrews FS. 1964. Fundamentals of Horticulture. Blakiston Co
 Fageria MS, Choudhary BR & Dhaka RS. 2000. Vegetable Crops Production Technology. Vol. II. Kalyani.
 Gopalakrishanan TR. 2007. Vegetable Crops. New India Publ. Agency.
 Kalloo G & Singh K (Ed.). 2000. Emerging Scenario in Vegetable Research and Development. Research Periodicals & Book Publ. House.
 Palaniswamy & Peter KV. 2007. Tuber Crops. New India Publ. Agency.
 Rana MK. 2008. Olericulture in India. Kalyani.
 Rana MK. 2008. Scientific Cultivation of Vegetables. Kalyani.
 Rubatzky VE & Yamaguchi M. (Eds.). 1997. World Vegetables Principles, Production and Nutritive Values. Saini GS. 2001. A Text Book of Oleri and Flori Culture. Aman Publ. House.
 Salunkhe DK & Kadam SS. (Ed.). 1998. Hand Book of Vegetable Science and Technology Production, Composition, Storage and Processing.
 Marcel Dekker. Shanmugavelu KG. 1989. Production Technology of Vegetable Crops. Oxford & IBH.
 Singh DK. 2007. Modern Vegetable Varieties and Production Technology. IBD Co.33
 Singh NP, Bharadwaj AK, Kumar A & Singh KM. 2004. Modern Technology on Vegetable Production. IBD
 Singh SP. (Ed.). 1989. Production Technology of Vegetable Crops. Agril. Comm. Res. Centre.
 Thamburaj S & Singh N. 2004. Vegetables, Tuber Crops and Spices. ICAR.

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VSC 503 Breeding of Vegetable Crops

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

- Selection of desirable plants from breeding population observations and analysis of various qualitative and quantitative traits in germplasm, hybrids and segregating generations.
- Induction of flowering, palanological studies, selfing and crossing techniques in vegetable crops.
- Hybrid seed production of vegetable crops in bulk. Screening techniques for insect-pests, disease and environmental stress resistance in above mentioned crops, demonstration of sib-mating and mixed population.
- Molecular marker techniques to identify useful traits in the vegetable crops and special breeding techniques. Visit to breeding blocks.

Suggested Readings

- Allard RW. 1999. Principles of Plant Breeding. John Wiley & Sons.
 Basset MJ. (Ed.). 1986. Breeding Vegetable Crops. AVI Publ.
 Dhillon BS, Tyagi RK, Saxena S. & Randhawa GJ. 2005. Plant Genetic Resources Horticultural Crops.
 Gardner EJ. 1975. Principles of Genetics. John Wiley & Sons.
 Hayes HK, Immer FR & Smith DC. 1955. Methods of Plant Breeding. McGraw-Hill.
 Hayward MD, Bosemark NO & Romagosa I. (Eds.). 1993. Plant Breeding- Principles and Prospects. Chapman & Hall.
 Kalloo G. 1988. Vegetable Breeding. Vols. I-III. CRC Press.
 Kalloo G. 1998. Vegetable Breeding. Vols. I-III (Combined Ed.). Panima Edu. Book Agency.
 Kumar JC & Dhaliwal MS. 1990. Techniques of Developing Hybrids in Vegetable Crops. Agro Botanical Publ.
 Paroda RS & Kalloo G. (Eds.). 1995. Vegetable Research with Special Reference to Hybrid Technology in Asia-Pacific Region. FAO.
 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.
 Ram HH. 1998. Vegetable Breeding Principles and Practices. Kalyani.
 Simmonds NW. 1978. Principles of Crop Improvement. Longman.
 Singh BD. 1983. Plant Breeding. Kalyani.
 Singh PK, Dasgupta SK & Tripathi SK. 2004. Hybrid Vegetable Development. IBD

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 abscissic 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; parthenocarp 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

- Preparation of solutions of plant growth substances and their application.
- Experiments in breaking and induction of dormancy by chemicals; induction of parthenocarp and fruit ripening.
- 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; growth analysis techniques in vegetable crops.

Suggested Readings

- Bleasdale JKA. 1984. Plant Physiology in Relation to Horticulture. 2nd Ed. MacMillan.
- Gupta US. (Ed.). 1978. Crop Physiology. Oxford & IBH.
- Krishnamoorti HN. 1981. Application Plant Growth Substances and Their Uses in Agriculture. Tata-McGraw Hill.
- Peter KV. (Ed.). 2008. Basics of Horticulture. New India Publ. Agency.
- Saini RS, Sharma KD, Dhankhar OP & Kaushik RA. (Eds.). 2001. Laboratory Manual of Analytical Techniques in Horticulture. Agrobios.
- Wien HC. (Ed.). 1997. The Physiology of Vegetable Crops. CABI.

Objective Theory

To educate production technology of underutilized vegetable crops.

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

UNIT I 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

- Identification of seeds.
- Botanical description of plants;
- Layout and planting; cultural practices;
- Short-term experiments of underexploited vegetables.

Suggested Readings

- Bhat KL. 2001. Minor Vegetables - Untapped Potential. Kalyani.
- Indira P & Peter KV. 1984. Unexploited Tropical Vegetables. Kerala Agricultural University, Kerala.
- Peter KV. (Ed.). 2007-08. Underutilized and Underexploited Horticultural Crops. Vols. I-IV. New India Publ. Agency.
- Rubatzky VE & Yamaguchi M. (Eds.). 1997. World Vegetables Principles, Production and Nutritive Values. Chapman & Hall
- Srivastava U, Mahajan RK, Gangopadhyay KK, Singh M & Dhillon BS. 2001. Minimal Descriptors of Agri-Horticultural Crops. Part-II Vegetable Crops. NBPGR, New Delhi. 38

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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

- Method of preparation of compost, vermicomposting, biofertilizers, soil solarization.
- Bio pesticides in horticulture, green manuring, mycorrhizae and organic crop production.
- Waster management, organic soil amendment for root disease, weed management in organic horticulture.
- Visit to organic fields and marketing centers.

Suggested Readings

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

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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.

UNIT V Food safety-Hazard analysis and critical control points (HACCP). Labeling and labeling act, nutrition labeling.

UNIT VI Major value added products from vegetables. Utilization of by products of vegetable processing industry; Management of waste from processing factory.

UNIT VII Investment analysis. Principles and methods of sensory evaluation of fresh and processed vegetables.

Practical

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

Suggested Readings

- Arthey D & Dennis C. 1996. Vegetable Processing. Blackie/Springer- Verlag.
- Chadha DS. 2006. The Prevention of Food Adulteration Act. Confed. of Indian Industry.
- FAO. 1997. Fruit and Vegetable Processing. FAO.
- Frazier WC & Westhoff DC. 1995. Food Microbiology. 4th Ed. Tata McGraw Hill.
- Giridharilal GS, Siddappa & Tandon GL. 1986. Preservation of Fruits and Vegetables. ICAR.
- Gisela J. 1985. Sensory Evaluation of Food–Theory and Practices. Ellis Horwood.
- Mahindru SN. 2004. Food Safety Concepts and Reality. APH Publ. Corp.
- Ranganna S. 1986. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 2nd Ed.
- Shapiro R. 1995. Nutrition Labeling Handbook. Marcel Dekker.
- Srivastava RP & Kumar S. 2003. Fruit and Vegetable Preservation Principles and Practices. 3rd Ed. IBD
- Verma LR & Joshi VK. 2000. Post-harvest Technology of Fruits and Vegetables Handling, Processing, Fermentation and Waste Management. Indus Publ. Co.

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AGRON- 512 PRINCIPALS AND PRACTICES OF SOIL FERTILITY AND NUTRIENT ANAGEMENT 3 (2+1)

Objective: To impart knowledge of fertilizers and manures as sources of plant nutrients and apprise about the integrated approach of plant nutrition and sustainability of soil fertility.

Theory

UNIT I

Soil fertility and productivity - factors affecting; features of good soil management; problems of supply and availability of nutrients; relation between nutrient supply and crop growth; organic farming - basic concepts and definitions.

UNIT II

Criteria of essentiality of nutrients; Essential plant nutrients – their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients.

UNIT III

Preparation and use of farmyard manure, compost, green manures, vermicompost, biofertilizers and other organic concentrates their composition, availability and crop responses; recycling of organic wastes and residue management.

UNIT IV

Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency, fertilizer mixtures and grades; agronomic, chemical and physiological methods of increasing fertilizer use efficiency; nutrient interactions.

UNIT V

Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic manures; economics of fertilizer use; integrated nutrient management; use of vermincompost and residue wastes in crops.

Practical

- Determination of soil pH, ECe, organic C, total N, available N, P, K and S in soils
- Determination of total N, P, K and S in plants
- Interpretation of interaction effects and computation of economic and yield optima

Suggested Readings

- Brady NC & Weil R.R 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Edu.
- Fageria NK, Baligar VC & Jones CA. 1991. *Growth and Mineral Nutrition of Field Crops*. Marcel Dekker.
- Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. *Soil Fertility and Fertilizers*. 7th Ed. Prentice Hall.
- Prasad R & Power JF. 1997. *Soil Fertility Management for Sustainable Agriculture*. CRC Press.
- Yawalkar KS, Agrawal JP & Bokde S. 2000. *Manures and Fertilizers*. Agri-Horti Pub.

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GP 503

PRINCIPLES OF PLANT BREEDING

2+1

Objective To impart theoretical knowledge and practical skills about plant breeding objectives, modes of reproduction and genetic consequences, breeding methods for crop improvement.

Theory

UNIT I History of Plant Breeding (Pre and post-Mendelian era); Objectives of plant breeding, characteristics improved by plant breeding; Patterns of evolution in crop plants- centres of origin-biodiversity and its significance.

UNIT II Genetic basis of breeding self- and cross- pollinated crops including mating systems and response to selection- nature of variability, components of variation; heritability and genetic advance, genotype environment interaction; general and specific combining ability; types of gene actions and implications in plant breeding; plant introduction and role of plant genetic resources in plant breeding.

UNIT III Self-incompatibility and male sterility in crop plants and their commercial exploitation.

UNIT IV Pure line theory, pure line selection and mass selection methods; line breeding, pedigree, bulk, backcross, single seed descent and multiline method; population breeding in self-pollinated crops (diallel selective mating approach).

UNIT V Breeding methods in cross pollinated crops; population breeding-mass selection and ear-to-row methods; S_1 and S_2 progeny testing, progeny selection schemes, recurrent selection schemes for intra and interpopulation improvement and development of synthetics and composites; hybrid breeding-genetical and physiological basis of heterosis and inbreeding, production of inbreds, breeding approaches for improvement of inbreds, predicting hybrid performance; seed production of hybrid and their parent.

UNIT VI Breeding methods in asexually/clonally propagated crops, clonal selection apomixes, clonal selection.

UNIT VII Concept of plant ideotype and its role in crop improvement; Transgressive breeding.

UNIT VIII Special breeding techniques-mutation breeding; breeding for resistance to abiotic and biotic stresses.

UNIT IX Cultivar development- testing, release and notification, maintenance breeding, participatory plant Breeding, plant breeders' rights and regulations for plant variety protection and farmers rights.

Practical Floral biology in self and cross pollinated species, selfing and crossing techniques; Selection methods in segregating populations and evaluation of breeding material; Analysis of variance (ANOVA); Estimation of heritability and genetic advance.; Maintenance of experimental records; Learning techniques in hybrid seed production using male-sterility in field crops.

Suggested Readings

- Allard RW. 1981. Principles of Plant Breeding..
 Chopra VL. 2001. Breeding Field Crops. IBH.
 Chopra VL. 2004. Plant Breeding. Oxford & IBH.
 Pohlman JM & Bothakur DN. 1972. Breeding Asian Field Crops. Oxford & IBH.
 Roy D. 2003. Plant Breeding, Analysis and Exploitation of Variation. Narosa Publ. House.
 Sharma JR. 2001. Principles and Practice of Plant Breeding. Tata McGraw-Hill.
 Simmonds NW. 1990. Principles of Crop Improvement. English Language Book Society.
 Singh BD. 2006. Plant Breeding. Kalyani.
 Singh S & Pawar IS. 2006. Genetic Bases and Methods of Plant Breeding. CBS.
 Singh S & Pawar IS. 2006. Genetic Bases and Methods of Plant Breeding. CBS.

PP 504

Hormonal Regulation of Plant Growth and Development

2+1

Objective

To apprise the students about structure function of plant growth regulator on growth and development of plant.

Theory

UNIT I Definition and classification of plant growth regulators-Hormones, endogenous growth substances and synthetic chemicals, Endogenous growth regulating substances other than hormones. triconanol, Phenols-polyamines, jasmonates, concept of death hormone.

UNIT II Site of synthesis, biosynthetic pathways and metabolism and the influence on plant growth development of individual group of hormones- Auxins, Gibberellins, cytokinins, Absciscic acid and Ethylene Brassinosteroids.

UNIT III Hormone mutants and transgenic plants in understanding role of hormones.

UNIT IV Signal perception, transduction, and effect at functional gene level of different hormones- Auxins- cell elongation, Gibberellins -, germination of dormant seeds, cytokinins- cell division. Retardation of senescence of plant parts, Absciscic acid-Stomatal closure and induction of drought resistance, Ethylene- fruit ripening.

UNIT V Interaction of hormones in regulation of plant growth and development processes. Rooting of cuttings- Flowering. Apical dominance, molecular aspects of control of reproductive growth and development.

UNIT VI Synthetic growth regulators- Classification, their effect on plant growth and development. Practical utility in agriculture and horticulture.

Practical

- Quantification of Hormones- Principles of bioassays, physico chemical techniques and immunoassay.
- Extraction of hormones from plant tissue. Auxins- bioassays- auxins effect on rooting of cuttings, abscission, apical dominance.
- Gibberellins- bioassays-GA effect on germination of dormant seeds, cytokinin- bioassays- estimation using immunoassay technique cytokinin effect on apical dominance and senescence, ABA bioassays estimation using immunoassay technique.
- ABA effect on stomatal movement, Ethylene bioassays, estimation using physico chemical techniques- effect on breaking dormancy in sunflower and groundnut.

Suggested Readings

Hopkins WG & Huner NPA. 2004. Introduction to Plant Physiology. John Wiley & Sons.

Salisbury FB & Ross C. 1992. Plant Physiology. 4th Ed. Wadsworth Publ.

Taiz L & Zeiger E. 2006. Plant Physiology. 4th Ed. Sinauer Associates.

STAT 511 Statistical Methods for Applied Sciences
**Supporting course
3+1**

Objective The student is exposed statistical methods and statistical inference to help them in understanding the concepts involved in data presentation, analysis and interpretation.

Theory

UNIT I Classification, tabulation and graphical representation of data. Box-plot, Descriptive statistics. Exploratory data analysis; Theory of probability. Random variable and mathematical expectation.

UNIT II Discrete and continuous probability distributions 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. Large sample theory.

UNIT III Introduction to theory of estimation and confidence-intervals. Correlation and regression. Simple and multiple linear regression model, estimation of parameters, predicted values and residuals, correlation, partial correlation coefficient, multiple correlation coefficient, rank correlation, test of significance of correlation coefficient and regression coefficients. Coefficient of determination. Polynomial regression models and their fitting. Probit regression analysis by least squares and maximum likelihood methods, confidence interval for sensitivity; Testing for heterogeneity.

UNIT IV Non-parametric tests - sign, Wilcoxon, Mann-Whitney U-test, Wald Wolfowitz run test, Run test for the randomness of a sequence. Median test, Kruskal- Wallis test, Friedman two-way ANOVA by ranks. Kendall's coefficient of concordance.

UNIT V Introduction to multivariate analytical tools- Hotelling's T^2 Tests of hypothesis about the mean vector of a multinormal population. Classificatory problems and discriminant function, D^2 -statistic and its applications; Cluster analysis, principal component analysis, canonical correlations and Factor analysis.

Practical

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

Suggested Readings

- Anderson TW. 1958. An Introduction to Multivariate Statistical Analysis. John Wiley.
 Dillon WR & Goldstein M. 1984. Multivariate Analysis - Methods and Applications. John Wiley.
 Goon AM, Gupta MK & Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I. The World Press.
 Goon AM, Gupta MK & Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press.
 Hoel PG. 1971. Introduction to Mathematical Statistics. John Wiley.
 Hogg RV & Craig TT. 1978. Introduction to Mathematical Statistics. Macmillan.
 Morrison DF. 1976. Multivariate Statistical Methods. McGraw Hill.
 Siegel S, Johan N & Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley.
 Learning Statistics <http://freestatistics.altervista.org/en/learning.php>.
 Electronic Statistics Text Book
<http://www.statsoft.com/textbook/stathome.html>.

STAT 512 Experimental Designs

1+1

Supporting course

Objective 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

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

Suggested Readings

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