

**B. A. COLLEGE OF AGRICULTURE
ANAND AGRICULTURAL UNIVERSITY
ANAND - 388 110 (Gujarat)**



Dr. K. P. Patel
Principal and Dean

☎ / Fax : 02692-261076(O)
e-mail : deanagri@aau.in

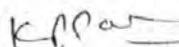
**“PG Programme in Horticulture Leading to
Ph. D. in Vegetable Science regarding”**

Read: Resolution of 49th meeting of the Academic Council held on 31-07-2018 at Anand Agricultural University, Anand vide item No. 49.11

NOTIFICATION

This is hereby notified to all the concerned that vide item No. 49.11 of the 49th Meeting held on 31-07-2016, the Members of Academic Council of the Anand Agricultural University, Anand has resolved as under.

"It is resolved that the Academic Council approves Ph. D. Programme in Vegetable Science under Horticulture Faculty adopting the existing syllabus as recommended by the ICAR, New Delhi (Appendix-I) for its implementation w.e.f. Academic Year 2018-19".


(K. P. PATEL)
Principal and Dean

No. BACA/TO Notification 2018 / 872 /2018
Dt. 16-07-2018

Copy fwrns to:

- (1) All the Members of Academic Council of AAU, for information
- (2) All the University Officers, AAU, Anand
- (3) All the Unit/sub-Unit Heads of University

Copy to:

- (1) PS to Hon'ble Vice-Chancellor, AAU, Anand for information
- (2) PA to Registrar, AAU, Anand
- (3) All the Heads of Department, B. A. College of Agriculture, AAU, Anand

Appendix - I

VEGETABLE SCIENCE

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VSC 601**	Advances in vegetable production	2+1
VSC 602**	Advances in breeding of vegetable crops	2+1
VSC 603**	Protected cultivation of vegetable crops	1+1
VSC 604**	Biotechnology in vegetable crops	2+1
VSC 605	Seed certification, processing and storage of vegetable crops	2+1
VSC 606	Abiotic stress management in vegetable crops	2+1
VSC 691	Doctoral seminar i	1+0
VSC 692	Doctoral seminar ii	1+0
VSC 699	Doctoral research	45

** Compulsory for Doctoral programme

Proposed Syllabus of courses in Vegetable Science

VSC 601 ADVANCES IN VEGETABLE PRODUCTION 2+1

Objective

To keep abreast with latest developments and trends in production technology of vegetable crops.

Theory

Present status and prospects of vegetable cultivation; nutritional and medicinal values; climate and soil as critical factors in vegetable production; choice of varieties; nursery management; modern concepts in water and weed management; physiological basis of growth, yield and quality as influenced by chemicals and growth regulators; role of organic manures, inorganic fertilizers, micronutrients and biofertilizers; response of genotypes to low and high nutrient management, nutritional deficiencies, disorders and correction methods; different cropping systems; mulching; containerized culture for year round vegetable production; low cost polyhouse; net house production; crop modeling, organic gardening; vegetable production for pigments, export and processing of:

UNIT I Tomato, brinjal, chilli, sweet pepper and potato

UNIT II Cucurbits, cabbage, cauliflower and knol-khol

UNIT III Bhendi, onion, peas and beans, amaranthus and drumstick

UNIT IV Carrot, beet root and radish

UNIT V Sweet potato, tapioca, elephant foot yam and taro

Practical

Seed hardening treatments; practices in indeterminate and determinate vegetable growing and organic gardening; portraits and ball culture; diagnosis of nutritional and physiological disorders; analysis of physiological factors like anatomy; photosynthesis; light intensity in different cropping situation; assessing nutrient status, use of plant growth regulators; practices in herbicide application; estimating water requirements in relation to crop growth stages, maturity indices; dryland techniques for rainfed vegetable production; production constraints; analysis of different cropping system in various situation like cold and hot set; vegetable waste recycling management; quality analysis; marketing survey of the above crops; visit to vegetable and fruit mals and packing houses.

Suggested Readings

Bose TK & Som NG. 1986. *Vegetable Crops of India*. Naya Prokash.

Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. 2003. *Vegetable Crops*. Vols. I-III. Naya Udyog.

Brewster JL. 1994. *Onions and other Vegetable Alliums*. CABI.

FFTC. *Improved Vegetable Production in Asia*. Book Series No. 36.

Ghosh SP, Ramanujam T, Jos JS, Moorthy SN & Nair RG. 1988. *Tuber Crops*. Oxford & IBH.

- Cropalakeshman IR. 2007. *Vegetable Crops*. New India Publishing Agency.
- Kaloo G & Singh K. (Ed.), 2001. *Emerging Scenario in Vegetable Research and Development*. Research Periodicals & Book Publ. House.
- Kurup GT, Palanisami MS, Potty VP, Padmaja G, Kabecrathuma S & Pallai SV. 1996. *Tropical Tuber Crops, Problems, Prospects and Future Strategies*. Oxford & IBH.
- Sin MT & Onwueme IC. 1978. *The Tropical Tuber Crops*. John Wiley & Sons.
- Singh NP, Bhardwaj AK, Kumar A & Singh KM. 2004. *Modern Technology on Vegetable Production*. International Book Distr. Co.
- Singh PK, Dasgupta SK & Tripathi SK. 2006. *Hybrid Vegetable Development*. International Book Distr. Co.

VSC 602 ADVANCES IN BREEDING OF VEGETABLE CROPS 2+1

Objective

To update knowledge on the recent research trends in the field of breeding of vegetable crops with special emphasis on tropical, subtropical and temperate crops grown in India.

Theory

Evolution, distribution, cytogenetics, genetic resources, genetic divergence, types of pollination and fertilization mechanisms, sterility and incompatibility, anthesis and pollination, hybridization, inter-varietal, interspecific and inter-generic hybridization, heterosis breeding, inheritance pattern of traits, qualitative and quantitative, plant type concept and selection indices, genetics of spontaneous and induced mutations, problems and achievements of mutation breeding, ploidy breeding and its achievements, *in vitro* breeding; breeding techniques for improving quality and processing characters; breeding for stresses, mechanism and genetics of resistance, breeding for salt, drought; low and high temperature; toxicity and water logging resistance, breeding for pest, disease, nematode and multiple resistance of:

UNIT I Tomato, brinjal, chilli, sweet pepper and potato

UNIT II Cucurbits, Cabbage, cauliflower and knol-khol

UNIT III Bhindi/okra, onion, peas and beans, amaranthus and drumstick

UNIT IV Carrot, beet root and radish

UNIT V Sweet potato, tapioca, elephant foot yam and taro

Practical

Designing of breeding experiments, screening techniques for abiotic stresses, screening and rating for pest, disease and nematode resistance, estimation of quality and processing characters, screening for quality improvement, estimation of heterosis and combining ability, induction and identification of mutants and polyploids, distant hybridization and embryo rescue techniques.

Suggested Readings

- Acta Horticulture*. Conference on Recent Advance in Vegetable Crops. Vol. 127.
- Chadha KL, Ravindran PN & Sahijram L. 2000. *Biotechnology in Horticultural and Plantation Crops*. Malhotra Publ. House.
- Chadha KL. 2001. *Hand Book of Horticulture*. ICAR.
- Dhillon BS, Tyagi RK, Saxena S & Randhawa GJ. 2005. *Plant Genetic Resources: Horticultural Crops*. Narosa Publ. House.
- Janick JJ. 1986. *Horticultural Science*. 4th Ed. WH Freeman & Co.
- Kaloo G & Singh K. 2001. *Emerging Scenario in Vegetable Research and Development*. Research Periodicals and Book Publ. House.
- Kaloo G. 1994. *Vegetable Breeding*. Vols. I-III. Vedams eBooks.
- Peter KV & Pradeep Kumar T. 2008. *Genetics and Breeding of Vegetables*. (Revised Ed.). ICAR.
- Ram PH. 2001. *Vegetable Breeding*. Kalyani.

VSC 603 PROTECTED CULTIVATION OF VEGETABLE CROPS 1+1

Objective

To impart latest knowledge in growing of vegetable crops under protected environmental condition.

Theory

Crops: Tomato, capsicum, cucumber, melons and lettuce

UNIT I Importance and scope of protected cultivation of vegetable crops; principles used in protected cultivation, energy management, low cost structures; training methods; engineering aspects.

UNIT II Regulatory structures used in protected structures; types of greenhouse/polyhouse/nethouse, hot beds, cold frames, effect of environmental factors, viz. temperature, light, CO₂ and humidity on growth of different vegetables, manipulation of CO₂, light and temperature for vegetable production, fertigation.

UNIT III Nursery raising in protected structures like poly-tunnels, types of benches and containers, different media for growing nursery under cover.

UNIT IV Regulation of flowering and fruiting in vegetable crops, technology for raising tomato, sweet pepper, cucumber and other vegetables in protected structures, training and staking in protected crops, varieties and hybrids for growing vegetables in protected structures.

UNIT V Problem of growing vegetables in protected structures and their remedies, insect and disease management in protected structures; soil-less culture, use of protected structures for seed production.

Practical

Study of various types of structures, methods to control temperature, CO₂ light, media, training and pruning, maintenance of parental lines and hybrid seed production of vegetables, fertigation and nutrient management, control of insect-pests and disease in greenhouse; economics of protected cultivation, visit to established green/polyhouse/net house/shade house in the region.

Suggested Readings

Anonymous 2003. *Proc. All India Seminar on Potential and Prospects for Protective Cultivation*. Organised by Institute of Engineers, Ahmednagar. Dec.12-13, 2003.

Chandra S & SomV. 2000. *Cultivating Vegetables in Green House*. *Indian Horticulture* 45:17-18.

Prasad S & Kumar U. 2005. *Greenhouse Management for Horticultural Crops*, 2nd Ed. Agrobios.

Tiwari GN. 2003. *Green House Technology for Controlled Environment*.

Narosa Publ. House.

VSC 604 BIOTECHNOLOGY IN VEGETABLE CROPS 2+1

Objective

To teach advances in biotechnology for improvement of vegetable crops.

Theory

Crops: Tomato, eggplant, hot and sweet pepper, potato, cabbage, cauliflower, tapioca, onion, cucurbits.

UNIT I *In vitro* culture methods and molecular approaches for crop improvement in vegetables, production of haploids, disease elimination in horticultural crops, micro grafting, somoclones and identification of somaclonal variants, *in vitro* techniques to overcome fertilization barriers, *in vitro* production of secondary metabolites.

UNIT II Protoplast culture and fusion; construction, identification and characterization of somatic hybrids and cybrids, wide hybridization, embryo rescue of recalcitrant species, *in vitro* conservation.

UNIT III *In vitro* mutation for biotic and abiotic stresses, recombinant DNA methodology, gene transfer methods, tools, methods, applications of rDNA technology.

UNIT IV Quality improvement, improvement for biotic and abiotic stresses, transgenic plants.

UNIT V Role of molecular markers in characterization of transgenic crops, fingerprinting of cultivars etc., achievements, problems and future thrusts in horticultural biotechnology.

Practical

Establishment of axenic explants, callus initiation and multiplication, production of suspension culture, cell and protoplast culture, fusion, regeneration and identification of somatic hybrids and cybrids; Identification of embryonic and non-embryonic calli, development of cell lines; *in vitro*

mutant selection for biotic and abiotic stresses, *In vitro* production and characterization of secondary metabolites, isolated microspore culture, isolation and amplification of DNA, gene transfer methods, molecular characterization of transgenic plants.

Suggested Readings

- Bajaj YPS. (Ed.). 1987. *Biotechnology in Agriculture and Forestry*. Vol. XIX, *Hitech and Micropropagation*. Springer.
- Chadha KL, Ravindran PN & Sahijram L. (Eds.). 2000. *Biotechnology of Horticulture and Plantation Crops*. Malhotra Publ. House.
- Debnath M. 2005. *Tools and Techniques of Biotechnology*. Pointer Publ.
- Glover MD. 1984. *Gene Cloning: The Mechanics of DNA Manipulation*. Chapman & Hall.
- Gorden H & Rubsell S. 1960. *Hormones and Cell Culture*. AB Book Publ.
- Keshavachandran R & Peter KV. 2008. *Plant Biotechnology: Tissue Culture and Gene Transfer*. Orient & Longman (Universal Press).
- Keshavachandran R et al. 2007. *Recent Trends in Biotechnology of Horticultural Crops*. New India Publ. Agency.
- Panopoulos NJ. (Ed.). 1981. *Genetic Engineering in Plant Sciences*. Praeger Publ.
- Parthasarathy VA, Bose TK, Deka PC, Das P, Mitra SK & Mohanadas S. 2001. *Biotechnology of Horticultural Crops*. Vols. I-III. Naya Prokash.
- Pierik RLM. 1987. *In vitro Culture of Higher Plants*. Martinus Nijhoff Publ.
- Prasad S. 1999. *Impact of Plant Biotechnology on Horticulture*. 2nd Ed. Agro Botanica.
- Sharma R. 2000. *Plant Tissue Culture*. Campus Books.
- Singh BD. 2001. *Biotechnology*. Kalyani.
- Skoog Y & Miller CO. 1957. *Chemical Regulation of Growth and Formation in Plant Tissue Culture in vitro*. Attidel. II Symp. On Biotechnology Action of Growth Substance.
- Vasil TK, Vasi M, White DNR & Bery HR. 1979. *Somatic Hybridization and Genetic Manipulation in Plants. Plant Regulation and World Agriculture*. Plenum Press.
- Williamson R. 1981-86. *Genetic Engineering*. Vols. I-V.

VSC 605 SEED CERTIFICATION, PROCESSING AND STORAGE OF VEGETABLE CROPS 2+1

Objective

To educate the recent trends in the certification, processing and storage of vegetable crops.

Theory

UNIT I Seed certification, objectives, organization of seed certification, minimum seed certification standards of vegetable crops, field inspection, specification for certification.

UNIT II 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 III 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.

UNIT IV

Seed testing; ISTA rules for testing, moisture, purity germination, vigor test, seed sampling, determination of genuineness of varieties, seed viability, seed health testing; seed dormancy and types of dormancy, factors responsible for dormancy.

UNIT V Seed marketing, demand forecast, marketing organization, economics of seed production; farmers' rights, seed law enforcement, seed act and seed policy.

Practical

Seed sampling, purity, moisture testing, seed viability, seed vigor tests, seed health testing, seed cleaning, grading and packaging; handling of seed testing equipment and processing machines; seed treatment methods, seed priming and pelleting; field and seed inspection, practices in rouging, seed storage, isolation distances, biochemical tests, visit to seed testing laboratories and processing plants, mixing and dividing instruments, visit to seed processing unit and warehouse visit and know about sanitation standards.

Suggested Readings

- Agrawal PK & Dadlani M. 1992. *Techniques in Seed Science and Technology*. South Asian Publ.
- Singh N, Singh DK, Singh YK & Kumar V. 2006. *Vegetable Seed Production Technology*. International Book Distr. Co.
- Singh SP. 2001. *Seed Production of Commercial Vegetables*. Agrotech Publ. Academy.
- Tanwar NS & Singh SV. 1988. *Indian Minimum Seed Certification Standards*. Central Seed Certification Board, GOI, New Delhi.
- Rajan S & Baby L Markose 2007. *Propagation of Horticultural Crops*. New India Publ. Agency.

VSC 606 ABIOTIC STRESS MANAGEMENT IN VEGETABLE CROPS 2+1

Objective

To update knowledge on the recent research trends in the field of breeding of vegetable crops with special emphasis on tropical, subtropical and temperate crops grown in India.

Theory

UNIT I Environmental stress and its types, soil parameters including pH, classification of vegetable crops based on susceptibility and tolerance to various types of stress; root stock, use of wild species, use of antitranspirants.

UNIT II Mechanism and measurements of tolerance to drought, water logging, soil salinity, frost and heat stress in vegetable crops.

UNIT III Soil-plant-water relations under different stress conditions in vegetable crops production and their management practices.

UNIT IV Techniques of vegetable growing under water deficit, water logging, salinity and sodicity.

UNIT V Techniques of vegetable growing under high and low temperature conditions, use of chemicals in alleviation of different stresses.

Practical

Identification of susceptibility and tolerance symptoms to various types of stress in vegetable crops, measurement of tolerance to various stresses in vegetable crops, short term experiments on growing vegetable under water deficit, water-logging, salinity and sodicity, high and low temperature conditions, and use of chemicals for alleviation of different stresses.

Suggested Readings

- Dwivedi P & Dwivedi RS. 2005. *Physiology of Abiotic stress in Plants*. Agrobios.
- Lerner HR (Ed.). 1999. *Plant Responses to Environmental Stresses*. Marcel Decker.
- Maloo SR. 2003. *Abiotic Stresses and Crop Productivity*. Agrotech Publ. Academy.