

**Course Title with Credit Load
Ph.D. (Hort.) in Vegetable Science**

Course Code	Course Title	Credit Hours
	Major Courses (12 Credits)	
VSC 601	Recent Trends in Vegetable Production	3+0
VSC 602	Advances in Breeding of Vegetable Crops	3+0
VSC 603	Abiotic Stress Management in Vegetable Crops	2+1
VSC 604	Seed Certification, Processing and Storage of Vegetable Crops	2+1
VSC 605	Breeding of Special Traits in Vegetable Crops	2+0
VSC 606	Biodiversity and Conservation of Vegetable Crops	2+1
VSC 607	Biotechnological Approaches in Vegetable Crops	2+1
VSC 608	Advanced Laboratory Techniques for Vegetable Crops	1+2
	Minor Courses	06
	Supporting Courses	05
VSC 691	Seminar I	0+1
VSC 692	Seminar II	0+1
VSC 699	Research	0+75
	Total Credits	100

FSC 605: Arid and Dryland Fruit Production (2+0)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			THEORY		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teacher's Assessment*			
FSC 605	Arid and Dryland Fruit Production	60	00	40	00	00	2	0	2

Legends: L - Lecture; P – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To keep abreast with latest developments and trends in production technology of arid and dryland fruit crops.

Theory

Unit I:

General Concepts and Current Scenario: Characteristics features and major constraints of the arid and dryland region, distinguishing features of the fruit species trees for adaptation in adapting to the region.

Unit II

Nutritional and pharmaceutical importance, national problems

Unit III

Propagation, Planting Systems and Crop Regulation: Recent advances in propagation – root stocks, planting systems, High density planting, crop modelling, Precision farming, decision support systems.

Unit IV:

Aspects of crop regulation- physical and chemical regulation, effects on physiology and development, influence of stress factors.

Unit V:

Stress Mitigation and Integrated Approaches: Strategies to overcome stress effects, integrated and modern approaches in water and nutrient management, total quality management (TQM) – Current topics.

Crops

Aonla, Annonas, ber, bael, jamun, date palm, cactus pear, khejri, kair, pilu, lasoda, manila, tamarind, monkey jack, mahua, khirni, amra, seabuckthorn, chilgoza, cafel, rhododendron, box myrtle, chironji, phalsa,

Suggested Reading

Hiwale S. 2015. *Sustainable Horticulture in Semiarid Drylands*. Springer.

Krishna H and Sharma RR. 2017. *Fruit Production – Minor Fruits*. Daya Publishing House, Delhi.

More T A, Singh RS, Bhargava R and Sharma BD. 2012. *Arid Horticulture for Nutrition and Livelihood*. Agrotech Publishing Academy, Udaipur (Rajasthan).

Pareek OP, Sharma S and Arora RK. 2007. *Underutilised Edible Fruits and Nuts*, IPGRI, Rome.

Peter K.V. 2010. *Underutilized and Underexploited Horticultural Crops*. NIPA, New Delhi.

Saroj PL, Dhandar DG and Vashishta BB. 2004. *Advances in Arid Horticulture, Vol.-1 Present Status*. IBDC, Lucknow.

Saroj P L and Awasthi OP. 2005. *Advances in Arid Horticulture, Vol: II: Production Technology of Arid and Semiarid Fruits*. IBDC, Lucknow.

Sontakke MB. 2014. *Production and Management of Fruit crops in Arid/ Drylands*. Agrotech Publishing Academy, Udaipur (Rajasthan).

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PGS 502: TECHNICAL WRITING AND COMMUNICATIONS SKILLS (0+1)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*			
PGS 502	Technical Writing & Communications Skills	0	0	0	60	40	0	1	1

Legends: L - Lecture; P – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

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

- Various forms of scientific writings- theses, 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

- Barnes and Noble. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language.
- Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
- Collins' Cobuild English Dictionary. 1995.
- Harper Collins. Gordon HM and Walter JA. 1970. Technical Writing. 3rd Ed.
- Holt, Rinehart and Winston. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
- James HS. 1994. Handbook for Technical Writing. NTC Business Books.
- Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
- Mohan K. 2005. Speaking English Effectively. MacMillan India.
- Richard WS. 1969. Technical Writing.
- Sethi J and Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
- Wren PC and Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.

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PGS 503: INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE (1+0)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*			
PGS 503	Intellectual Property and Its Management in Agriculture	60	00	40	0	0	1	0	1

Legends: L - Lecture; P – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objectives

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.

UNIT II

Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties.

UNIT III

Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks etc.

UNIT IV

Protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection;

UNIT V

National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- Erbisch F H & Maredia K.1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
- Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
- *Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC & Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer. Vol. V. Technology Generation and IPR Issues*. Academic Foundation.
- Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.
- Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.
- *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.*

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Ph.D. Horticulture (Vegetable Science)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PHDAS 101	Research Methodology	60	00	40	00	00	3	0	3

1. Legends: L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

A1. Research Methodology (PHDAS101)

Module 1: Introduction to Research Methods: Role and objectives of research, types of research and various research design (exploratory, descriptive, experimental and diagnostic research), research process: Overview, Problems encountered by researcher. Experimental research design will comprise of Completely Randomized Design, Latin Square Design and Factorial Design. Limitations of RM: Ethics in Research, Philosophical issues in Research.

Module 2: Data and their Collection: Collection, Organization, Presentation, Analysis and Interrelation of Primary and Secondary Data. Measurement in research, measurement scales, sources of errors in measurement, Techniques of developing measurement tools, classification and testing (reliability, verification and validity) scales, Designing questionnaires and interviews Sampling, Sampling Methods, Sampling Plans, Sampling Error, Sampling Distributions : Theory and Design of Sample Survey, Census Vs Sample Enumerations, Objectives and Principles of Sampling, Types of Sampling, Sampling and Non-Sampling Errors.

Module 3: Numerical Methods and Statistical Analysis Curve fitting (least square), solution of polynomial equation, numerical integration (Trapezoidal rule, Simpson’s rule, Gaussian quadrature), solution of ordinary differential equations (Euler’s method, Runge-Kutta method, predictor-corrector method), matrix multiplication, inversion and diagonalisation.

References

- Kumar,R.(2006).Research Methodology-A Step- By- Step Guide for Beginners, Delhi: Pearson Education.
- Montgomery, D. C. (2007). Design & Analysis of Experiments. India: Wiley.
- Kothari, C. R. (2004). Research Methodology: Methods and Techniques. New Delhi: New Age International

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		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PHDA 102	Review of literature	60	00	40	00	00	2	0	2

1. Legends: L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

A.2. Review of Literature (PHDA102)

Course Overview: The objective of this course is to help the candidate to comprehend his/her broad field of research and be academically sound to carry out his research work. Understand the basic philosophical assumptions underlying research literature reviews for different purposes, including what, why, when, for whom, and how? Be able to manage the process of conducting a literature review, including reading, note taking strategies, coding/reference management, synthesizing and writing literature results. Be able to write a quality literature review with variations in references

Examination Scheme:

The candidate is required to write a Review paper based on the review of literature on his/her area of research in consultation with his supervisor. The paper has to be evaluated and approved by the panel constituted by Faculty of Doctoral studies and Research besides the assignments.

Course Content

Module 1: Understanding Review of literature: Relevance, Approach and Applications; Developing an outline for the literature review; Formulate key questions for a review. Organizing a literature search: Identify which literature bases to search; Developing the theoretical basis for the Research Question; Searching for, locating and organizing relevant professional literature

Module 2: Conducting the Review: Abstract relevant information from appropriate studies in a systematic manner; critically reviewing the literature; Rate the scientific quality of each study and the level of evidence for each question;

Module 3: Synthesizing the Review: Create evidence tables and summary tables; interpret the pattern of evidence in terms of strength and consistency; Summarize the studies' findings. Writing the review: Writing a first draft; Writing references and citations; Obtaining, giving, and making productive use of feedback; the redrafting process; Professional formatting.

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		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PHDA 103	Computer Application	60	00	40	00	00	2	0	2

1. Legends: L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

A.3. Computer Applications (PHDA103)

Course Overview: The candidate should gain sufficient practical knowledge for use of computer and computer software for use in research work.

Examination Scheme:

The faculty member will award internal marks out of 40 based on the assignments and minor project. The end semester examination will be 60 marks with weightage of (online exams 40% + practical 60%)

Contents

Module 1: Basic knowledge of application software's in MS- Office with focus on MS-Word- its features and applications related to presentation of text in decent format and saving the same for further use. The practical knowledge of this software should enable the candidate to type and prepare the thesis

in a presentable format. MS-Excel- construction of worksheet and inserting data according to its characteristics, use of statistical tools and their presentation in the form of charts and graphs.

Module 2: Use of Internet for research work and exploring various websites and search engines for collecting quality literature review and secondary data etc. related to thesis work.

Module 3: MS- Power point – create power point presentation on a topic related to the theme of thesis and use of different presentation techniques. Use of SPSS – method of preparing data sheet and entering data according to its characteristics, use of various statistical tools on SPSS.

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		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PHDA 104	Research and Publication Ethics	60	00	40	00	00	2	0	2

1. Legends: L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

A.4. Research and Publication Ethics (PHDA104)

Module 1: Philosophy and Ethics-Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgments and reactions.

Scientific Conduct- Ethics with respect to science and research. Intellectual honesty and research integrity. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP). Redundant publications: duplicate and overlapping publications, salami slicing. Selective reporting and misrepresentation of data

Module 2: Publication Ethics-Publication ethics: Definition, introduction and importance.

Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.Conflicts of interest.

Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types. Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journals.

Open Access Publishing- Open access publications and initiatives. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies. Software tool to identify predatory publications developed by SPPU. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

Module 3: Publication Misconduct, Group Discussions-Subject specific ethical issues, FFP, authorship. Conflicts of interest. Complaints and appeals: examples and fraud from India and abroad. Software tools- Use of plagiarism software like Turnitin, Urkund And Other Open Source Software Tools. Data Bases And Research Metrics, Databases- Indexing databases Citation databases: Web of Science, Scopus, etc.Research Metrics- Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score. Metrics: h-index, g index, i10 index, altmetrics.

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VSC 601: RECENT TRENDS IN VEGETABLE PRODUCTION (3+0)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teacher's Assessment*			
VSC 601	Recent Trends in Vegetable Production	60	00	40	00	00	3	0	3

Legends: L - Lecture; P – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

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

Theory

Unit I: Solanaceous crops: Tomato, brinjal, chilli, sweet pepper and potato

UNIT II: Cole crops: Cabbage, cauliflower and knol-khol, sprouting broccoli.

UNIT III: Okra, onion, peas and beans, amaranth and drumstick.

UNIT IV: Root crops and cucurbits: Carrot, beet root, turnip and radish and cucurbits

UNIT V: Tuber crops: Sweet potato, Cassava, elephant foot yam, Dioscorea and taro

Suggested Readings

- Bose TK and Som NG. 1986. Vegetable crops of India. Naya prokash.
- Bose TK, Kabir J, Maity TK, Parthasarathy VA and Som MG. 2003. Vegetable crops. Vols. I III. Naya Udyog.
- Brewster JL. 1994. Onions and other vegetable alliums. CABI.
- Chadha KL and 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 and Sons.
- Fageria MS, Choudhary BR and Dhaka RS. 2000. Vegetable crops: production technology. Vol. II. Kalyani.
- FFTC. Improved vegetable production in Asia. Book Series No. 36.

- Ghosh SP, Ramanujam T, Jos JS, Moorthy SN and Nair RG. 1988. Tuber crops. Oxford and IBH.
- Gopalakrishanan TR. 2007. Vegetable crops. New India Publ. Agency.
- Hazra P and Som MG. 2015. Seed production and hybrid technology of vegetable crops. Kalyani publishers, Ludhiana.
- Hazra P. 2016. Vegetable science. 2nd edn, Kalyani publishers, Ludhiana.
- Hazra P. 2019. Vegetable production and technology. New India publishing agency, New Delhi.
- Kallo G and Singh K. (Ed.). 2001. Emerging scenario in vegetable research and development. Research periodicals and Book Publ. House.
- Kurup GT, Palanisami MS, Potty VP, Padmaja G, Kabeerathuma S and Pallai SV. 1996. Tropical tuber crops, problems, prospects and future strategies. Oxford and IBH.
- Rana MK. 2008. Olericulture in India. Kalyani Publishers, New Delhi.
- Rana MK. 2008. Scientific cultivation of vegetables. Kalyani Publishers, New Delhi.
- Rubatzky VE and Yamaguchi M. (Eds.). 1997. World vegetables: principles, production and nutritive values. Chapman and Hall.
- Saini GS. 2001. A Text Book of oleri and flori culture. Aman Publishing House.
- Salunkhe DK and 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 and IBH.
- Sin MT and Onwueme IC. 1978. The tropical tuber crops. John Wiley and Sons.
- Singh DK. 2007. Modern vegetable varieties and production technology. International book distributing Co.
- Singh NP, Bhardwaj AK, Kumar A and Singh KM. 2004. Modern technology on Vegetable production. International book distr. Co.
- Singh PK, Dasgupta SK and Tripathi SK. 2006. Hybrid vegetable development. International book distr. Co.
- Singh SP. (Ed.). 1989. Production technology of vegetable crops. Agril. Comm. Res. Centre.
- Thamburaj S and Singh N. (Eds.). 2004. Vegetables, tuber crops and spices. ICAR.
- Thompson HC and Kelly WC. (Eds.). 1978. Vegetable crops. Tata McGraw-Hill.

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VSC 602: ADVANCES IN BREEDING OF VEGETABLE CROPS (3+0)

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		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teacher's Assessment*			
VSC 602	Advances in Breeding of Vegetable Crops	60	00	40	00	00	3	0	3

Legends: L - Lecture; P – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To impart knowledge on the recent research trends and advances in breeding of vegetable crops.

Theory

UNIT I

Solanaceous crops—Tomato, Brinjal, Hot Peeper, Sweet Pepper, Okra and Potato

UNIT II

Cucurbits and Cole crops

UNIT III

Legumes and leafy vegetables—Peas and Beans, Amaranth, Palak, Chenopods and Lettuce

UNIT IV

Root crops and onion—Carrot, Beetroot, Radish, Turnip, Onion

UNIT V

Tuber crops—Sweet potato, Tapioca, Elephant foot yam, Colocasia, Dioscorea

Suggested Readings

- Allard RW. 1999. Principle of plant breeding. John Willey and Sons, USA.
- Basset MJ. (Ed.). 1986. Breeding vegetable crops. AVI Publ.

- Dhillon BS, Tyagi RK, Saxena S and Randhawa GJ. 2005. Plant genetic resources: horticultural crops. Narosa Publ. House.
- Fageria MS, Arya PS and Choudhary AK. 2000. Vegetable crops: Breeding and seed production. Vol. I. Kalyani.
- Gardner EJ. 1975. Principles of genetics. John Wiley and Sons.
- Hayes HK, Immer FR and Smith DC. 1955. Methods of plant breeding. McGraw-Hill.
- Hayward MD, Bosemark NO and Romagosa I. (Eds.). 1993. Plant Breeding-principles and prospects. Chapman and Hall.
- Hazra P and Som MG. 2015. Vegetable science (Second revised edition), Kalyani publishers, Ludhiana, 598 p
- Hazra P and Som MG. 2016. Vegetable seed production and hybrid technology (Second revised edition), Kalyani Publishers, Ludhiana, 459 p
- Kalloo G. 1988. Vegetable breeding (Vol. I, II, III). CRC Press, Fl, USA.
- Kalloo G. 1998. Vegetable breeding. Vols. I-III (Combined Ed.). Panima Edu. Book Agency.
- Kumar JC and Dhaliwal MS. 1990. Techniques of developing hybrids in vegetable crops. Agro Botanical Publ.
- Paroda RS and Kalloo G. (Eds.). 1995. Vegetable research with special reference to hybrid technology in Asia-Pacific Region. FAO.
- Peter KV and Pradeepkumar T. 2008. Genetics and breeding of vegetables. Revised, ICAR.
- Peter KV and Hazra P. (Eds). 2012. Hand book of vegetables. Studium press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 678p.
- Peter KV and Hazra P. (Eds). 2015. Hand book of vegetables Volume II. Studium Press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 509p.
- Peter KV and Hazra P. (Eds). 2015. Hand book of vegetables Volume III. Studium Press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 634p.
- Rai N and Rai M. 2006. Heterosis breeding in vegetable crops. New India Publ. Agency.
- Ram HH. 1998. Vegetable breeding: principles and practices. Kalyani Publishers, New Delhi.
- Simmonds NW. 1978. Principles of crop improvement. Longman. Singh BD. 1983. Plant Breeding. Kalyani Publishers, New Delhi.
- Singh BD. 1983. Plant breeding. Kalyani Publishers, New Delhi.
- Singh PK, Dasgupta SK and Tripathi SK. 2004. Hybrid vegetable development. International Book Distributing Co.
- Swarup V. 1976. Breeding procedure for cross-pollinated vegetable crops. ICAR.

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