

**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBAJINAGAR.**



CIRCULAR NO.SU/Revised B.Sc./NEP/72/2024

It is hereby inform to all concerned that, the Revised syllabi prepared by the Board of Studies/Ad-hoc Boards and recommended by the Dean, Faculty of Science & Technology, **Academic Council at its meeting held on 08 April 2024 has accepted** the following **Revised syllabi of Bachelor of Science** under the Faculty of Science & Technology **as per Norms of National Education Policy-2020 and as per Government Letter dated 13 March 2024** run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1.	B.Sc.Botany	Ist and IInd semester
2.	B.Sc.Biotechnology	Ist and IInd semester
3.	B.Sc.Zoology	Ist and IInd semester
4.	B.Sc.Agrochemical and Fertilizer	Ist and IInd semester
5.	B.Sc.Geology	Ist and IInd semester
6.	B.Sc.Environmental Science	Ist and IInd semester
7.	B.Sc.Home Science	Ist and IInd semester
8.	B.Sc.Diary Science and Technology	Ist and IInd semester
9.	B.Sc.Automobile Technology	Ist and IInd semester
10.	B.Sc.Physics	Ist and IInd semester
11.	B.Sc.Chemistry	Ist and IInd semester
12.	B.Sc.Analytical Chemistry	Ist and IInd semester
13.	B.Sc.Polymer Chemistry	Ist and IInd semester
14.	B.Sc.Electronics	Ist and IInd semester
15.	B.Sc.Forensic Science & Cyber Security	Ist and IInd semester
16.	B.Sc.Microbiology	Ist and IInd semester
17.	B.Sc.Fisheries Science	Ist and IInd semester
18.	B.Sc.Mathematics	Ist and IInd semester
19.	B.Sc.Forensic Science	Ist and IInd semester
20.	B.Sc.Information Technology	Ist and IInd semester
21.	B.Sc.Horticulture	Ist and IInd semester
22.	B.Sc.Networking & Multimedia	Ist and IInd semester
23.	B.Sc.Biochemistry	Ist and IInd semester
24.	B.Sc.Industrial Chemistry	Ist and IInd semester
25.	B.Sc.Bioinformatics	Ist and IInd semester


26.	B.Sc.Instrumentation Practice	Ist and IInd semester
27.	B.Sc.Non-Conventional and Conventional Energy	Ist and IInd semester
28.	B.Sc.Statistics	Ist and IInd semester
29.	Bachelor of Computer Application	
30.	B.Sc.Computer Science (Degree)	Ist and IInd semester
31.	B.Sc.Computer Science (Optional)	Ist and IInd semester

This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/2024/25588-96
Date:- 29.04.2024.

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Deputy Registrar,
Academic Section

Copy forwarded with compliments to :-

- 1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

- 1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 2] The Section Officer,[B.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 6] The Public Relation Officer, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 7] The Record Keeper, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

Dr. Babasaheb Ambedkar Marathwada University
Chhatrapati Sambhajanagar- 431001



B.Sc. Degree Programme

(Three Year / Four Years (Hons) / Four Years (Hons with Research))

Course Structure and Syllabus for B. Sc. First Year

(AS PER NEP-2020)

Subject (Major): Botany

Effective from 2024-25

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Prof. Dr. ARVIND S. DHABE
Chairman
Board of Studies in Botany,
Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad - 431004

PREFACE

As we stand on the threshold of a new era in education, the dawn of the National Education Policy 2020 illuminates our path toward a holistic, inclusive, and progressive educational landscape. The Bachelor of Science (B. Sc.) curriculum outlined herein reflects the ethos and aspirations of this transformative policy, aiming to equip learners with the knowledge, skills, and values necessary to thrive in the dynamic world of the 21st century.

At its core, the National Education Policy 2020 envisions an educational framework that is learner-centric, multidisciplinary, and geared towards fostering creativity, critical thinking, and innovation. It emphasizes the integration of knowledge across disciplines, breaking down traditional silos to encourage holistic understanding and application of concepts. The Bachelor of Science (B. Sc.) curriculum embodies these principles by offering a diverse array of courses spanning various scientific domains, while also incorporating interdisciplinary studies to nurture well-rounded graduates capable of addressing complex challenges with agility and insight.

Furthermore, the curriculum is designed to promote experiential learning, research, and hands-on exploration, recognizing the importance of practical engagement in deepening understanding and cultivating real-world skills. Through laboratory work, field experiences, internships, and project-based learning opportunities, students will have the chance to apply theoretical knowledge in practical settings, develop problem-solving abilities, and cultivate a spirit of inquiry and discovery.

Integral to the National Education Policy 2020 is the commitment to inclusivity, equity, and access to quality education for all. The Bachelor of Science (B. Sc.) curriculum reflects this commitment by embracing diversity in perspectives, backgrounds, and experiences, and by fostering an inclusive learning environment where every student feels valued, supported, and empowered to succeed.

Moreover, the curriculum emphasizes the cultivation of ethical values, social responsibility, and global citizenship, instilling in students a sense of accountability towards society and the environment. By integrating courses on ethics, sustainability, and social sciences, the Bachelor of Science (B. Sc.) program aims to produce graduates who are not only proficient in their respective fields but also compassionate, ethical leaders committed to making a positive impact on the world.

As we embark on this journey of educational transformation guided by the National Education Policy 2020, the Bachelor of Science (B. Sc.) curriculum stands as a testament to our collective vision of a more equitable, inclusive, and enlightened society. It is our hope that through rigorous academics, innovative pedagogy, and unwavering dedication to excellence, we can inspire the next generation of scientists, scholars, and change-makers to realize their full potential and contribute meaningfully to the advancement of knowledge and the betterment of humanity.

**Illustrative Credit distribution structure for three/ fours year Honours/ Honours with
Research Degree Programme with Multiple Entry and Exit options-
(Discipline Specific Core in Subject: Botany)**

Class: B.Sc. First Year Semester: I Semester

Subject: Botany

Course type	Course Code	Course Name	Teaching Scheme (Hrs./week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory M1 Botany	DSC 1	Morphology of Angiosperms	2	-	2	-	4
	DSC 2	Lab course based on DSC-I	-	4	-	2	
Major Mandatory M2	DSC 1	DSC – I -----	2	-	2	-	4
	DSC 2	Lab course I	-	4	-	2	
Major Mandatory M3	DSC 1	DSC 1 -----	2	-	2	-	4
	DSC 2	DSC I	-	4	-	2	
Generic Electives (GE) /Open Elective (OE)	GE/OE-1	To be chosen from other faculty	2	-	2	-	2
SEC (Skill enhancement Courses) (Choose any one from pool of Courses)	SEC-1	i) Fungal Diseases of Crop Plants and their management ii) Kitchen Pharmacy-I	1	-	1	-	2
	Lab course based of SEC-1	i) Practicals based on Fungal Diseases of Crop Plants and their management ii) Practicals based on Kitchen Pharmacy-I	-	2	-	1	
AEC,VEC,IKS Ability Enhancement Course	AEC-1	AEC-1- English (Common across faculty)	2	-	2	-	2+2= 04
	IKS –I	Choose any one from pool of courses	2	-	2	-	
OJT,FP.CEP. CC.RP	CC- I	CC- 1. Health and wellness (Common across faculty)	-	4	-	2	02
			16	12	16	06	22 credits

Ge/OE-1: Seed Production and Preservation Techniques (This course will be available for the students from other faculty)

B. Sc. I Year Semester II

Course type	Course code	Course name	Teaching Scheme (Hrs./week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major (Core) Mandatory M1 Botany	DSC 3	Cryptogamic Botany – I	2	-	2	-	2+2 = 4
	DSC4	Lab Course 2 based on DSC3	-	4	-	2	
Major (Core) Mandatory M2	DSC 3	-----	2	-	2	-	2+2 = 4
	DSC4	-----		4	-	2	
Major (Core) Mandatory M3	DSC 3	-----	2	-	2		2+2 = 4
	DSC4	-----		4	-	2	
Generic /Open Elective (GE/OE)	GE/OE-2	To be chosen from other faculty	2	-	2	-	2
VSC (Choose any one from pool of courses)	VSC -1	i) Biofertilizer Techniques ii) Organic Composting	1	-	1	-	1+1=2
	VSC -2	i) Practicals based on Biofertilizer Techniques ii) Practicals based on Organic Composting	-	2	-	1	
AEC,VEC, IKS (Ability Enhancement Course) (Common across faculty)	AEC-2	AEC-2-English	2	-	2	-	2+2=04
	VEC-1	Constitution of India	2	-	2	-	
OJT, FP, CEP, CC, RP (Choose any one from pool of courses)	CC-2	CC-2 Yoga Education/ sports and fitness (Common across faculty)	-	4	-	2	2
Total			16	12	16	06	22 Credits
Exit Option: Award of UG certificate in major with 44 credits and an additional 4 credits core NSQF course/Internship or continue with Major and Minor							

GE/OE-2 : Pomology (This course will be available for the students from other faculty

Programme Educational Objectives (PEOs) :

Programme Educational Objectives (PEOs) for the Bachelor of Science Curriculum under the National Education Policy 2020:

1. **Mastery of Discipline-Specific Knowledge:** Graduates of the Bachelor of Science program will demonstrate a deep understanding of fundamental principles, theories, and methodologies in their chosen scientific discipline, enabling them to analyze complex problems, propose innovative solutions, and contribute to advancements in their field.
2. **Interdisciplinary Proficiency:** Graduates will possess the ability to integrate knowledge and skills from multiple scientific disciplines, fostering a holistic approach to problem-solving and innovation. They will be equipped to address multifaceted challenges by drawing upon diverse perspectives and methodologies.
3. **Critical Thinking and Analytical Skills:** Graduates will develop strong critical thinking abilities, enabling them to evaluate information rigorously, analyze data effectively, and make informed decisions based on evidence. They will demonstrate proficiency in applying logical reasoning and scientific methods to solve problems and generate new knowledge.
4. **Leadership and Innovation:** Graduates will demonstrate leadership qualities and entrepreneurial mind set, capable of initiating and driving positive change in their organizations and communities. They will exhibit creativity, resilience, and adaptability, harnessing innovation to address complex challenges and seize opportunities for growth and advancement.
5. **Global Citizenship and Cultural Sensitivity:** Graduates will possess a global perspective and cultural sensitivity, recognizing the interconnectedness of diverse communities and the importance of collaboration across borders. They will engage in cross-cultural dialogue, embrace diversity, and contribute to the advancement of knowledge and understanding on a global scale.

These Programme Educational Objectives serve as guiding principles for the Bachelor of Science curriculum, reflecting our commitment to nurturing well-rounded graduates who are prepared to excel in their careers, contribute to society, and lead meaningful lives in a rapidly changing world.

Programme Outcomes (POs) :

The National Education Policy (NEP) 2020 for India emphasizes several key aspects for Bachelor of Science (B.Sc.) programs, aiming to produce graduates who are not only well-versed in their respective disciplines but also equipped with skills necessary for holistic development and employability. While specific program outcomes may vary between institutions and disciplines within B.Sc. programs, here are some common outcomes aligned with NEP 2020:

- **PO1. The citizenship and society:** Apply broad understanding of ethical and professional skill in science subjects in the context of global, economic, environmental and societal realities while encompassing relevant contemporary issues.
- **PO2. Environment and sustainability:** Apply broad understanding of impact of science subjects in a global, economic, environmental and societal context and demonstrate the knowledge of, and need for sustainable development.
- **PO3. Ethics:** Apply ability to develop sustainable practical solutions for science subject related problems within positive professional and ethical boundaries.
- **PO4. Individual and team work:** Function effectively as a leader and as well as team member in diverse/ multidisciplinary environments.
- **PO5. Communication:** Communicate effectively on complex science subject related activities with the scientific community in particular and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO6. Project management and finance:** Demonstrate knowledge and understanding of the first principles of science and apply these to one's own work as a member and leader in a team, to complete project in any environment.
- **PO7. Life-long learning:** Recognize the need for lifelong learning and have the ability to engage in independent and life-long learning in the broadest context of technological change.

These program outcomes align with the broader goals of NEP 2020 to transform higher education in India and prepare students for the challenges and opportunities of the 21st century. Board of Studies designing B.Sc. curricula are encouraged to incorporate these outcomes into their program objectives and learning outcomes.

Programme Specific Outcomes (PSOs):

Botany specific PSOs

PSO1. **Domain knowledge:** Apply the knowledge of fundamental and advanced areas of Plant Science for the wellbeing of the human.

PSO2. **Understanding the various Plant Groups:** The basic knowledge and evolution of different plant groups like Bacteria, Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms will be given to students.

PSO3. **Understanding structures of plant body:** The detailed morphological, anatomical, palynological, embryological structures will give the understanding about the plant body.

PSO4. **Understanding processes in plant body:** The mechanism of anabolic and catabolic activities, cell divisions and growth in plant bodies will be explained to increase the production of Crop plants.

PSO5. **Understanding properties and uses of plants to maintain health:** The properties and uses of common medicinal plants, spices, Vegetables etc. will be explained to maintain the good health.

PSO6. **Enriching knowledge related with Agriculture:** Use of established knowledge regarding manuring, composting, use of Biofertilizers and ecofriendly Insecticides and pesticides for the sustainable development.

B. Sc. I Year, Semester – I

Theory Course Code: DSC1

Course name: MORPHOLOGY OF ANGIOSPERMS

Course type: Major Mandatory Discipline Specific Course

Credits: 2, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 50

Learning Objectives: The mandatory course ‘MORPHOLOGY OF ANGIOSPERMS’ in semester I includes the theory-based units on Morphology of Angiosperms i.e. Basic vegetative body parts Root, Stem, leaves, and reproductive organs of the flowering plants.

- The course aims to expose the students to the plant parts and variations in it.
- The course will teach systematics, general characteristics of angiosperms, peculiarities of floral part, fruit and seed dispersal strategies adopted by the angiosperms.

Course outcome: On the successful completion of the course, student will be able to-

- Describe morphological peculiarities of vegetative organs of angiosperms.
 - Describe morphological peculiarities of reproductive organs in angiosperms.
 - Know the diagnostic features of plant species
-

Unit- 1

10 Hrs

1.1- Basic body plan of flowering plant, modular type of growth, diversity of plant forms – Herbs, Shrubs, Trees, Climbers; annuals, biennials and perennials.

1.2- Morphology of vegetative organs:

- a) **Root:** Characteristics, functions, regions of root, types – tap and adventitious roots, modification of root for storage, mechanical support (stilt root) and vital functions.
- b) **Stem:** Characteristics, functions, modification – underground, sub aerial and aerial.
- c) **Leaf:** Parts of typical leaf, phyllotaxy, types (simple and compound), diversity in shape and size, venation and modifications of leaf.

Unit- 2 :

10 Hrs

Morphology of reproductive organs:

2.1 Inflorescence: Racemose, Cymose and special types

2.2 Flower: Definition, parts of typical flower, structure, function and modification of calyx, corolla, androecium, gynoecium.

Unit- 3 :

10 Hrs

3.1 Aestivation and Placentation

3.2 Fruit: Types of fruits

3.3 Fruit and Seed dispersal strategies

Continuous Internal Assessment (CIA): Tutorial and Assignments

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of 10 marks and one Tutorial of 10 marks and consider two best performances out of three. In assessment you are free to use different assessment methods.

Suggested Readings:

1. Bhojwani S. S. and Bhatnagar S. P. 1978 **The Embryology of Angiosperms**, Vikas Publication Pvt. Ltd. New Delhi.
2. Bhojwani S. S. and Bhatnagar S. P. 1981 **Embryology of Angiosperms**, Vikas Publication Pvt. Ltd. New Delhi.
3. Eams A. J. and Mae Daniel. **An Introduction to Plant Anatomy**, TMH Edition , Tata MC. Graw Hill Publishing Co. Ltd. Mombay- New Delhi.
4. Easu, **Plant Anatomy**, 1965 Wiles Eastern, New Delhi.
5. Johri, B. M. 1984 **Embryology of Angiosperms**, Springer-Verlag.
6. Jones S. (1987). **Plant systematics**, Tata-MacGraw Hill Publishers, Co. Ltd.
7. Lawrence G. H. M. (1967), **Taxonomy of Vascular plants**, Oxford and IBH publishers.
8. Maheshwari P. 1971. **An Introduction to Embryology of Angiosperms**, Tata MC. Graw New Delhi.
9. Mondal A. K. (2005). **Advanced plant taxonomy**, New Central book agency (p) Ltd, London.
10. Naik V. N. (1999). **Taxonomy of Angiosperms**, Tata-MacGraw Hill Publishers, Co. Ltd.
11. Pande, B. P. 1979. **Plant Anatomy**, S. Chand & Co. Ram Nagar, New Delhi.
12. Pande, B. P. 2007. **Botany for Degree Students**, S. Chand & Co. Ram Nagar, New Delhi.
13. Pande, B. P. 2009. **Taxonomy of Angiosperms**, S. Chand & Co. Ram Nagar, New Delhi.
14. Sharma O. P. (1993). **Plant Taxonomy**. Tata-MacGraw Hill Publ.
15. Sharma, O. P. **Plant Taxonomy 2E**. (2009). India: McGraw-Hill Education (India) Pvt Limited.
16. Singh, V. and Jain D. K. **Taxonomy of Angiosperms**, Rastogi Publications, Meerut.
17. Singh, V. P. C. Pande and Jan D. K. 2003 **Embryology of Angiosperms**, Rastogi Publications, Meerut.
18. Vashista, P. C. 1974 **Taxonomy of Angiosperms**, S. Chand & Co. Chennai.
19. https://herba.msu.ru/shipunov/school/biol_154/textbook/intro_botany.pdf
20. <https://ncert.nic.in/textbook/pdf/kebo105.pdf>
21. <https://www.wikipedia.org/>
22. <https://www.easybiologyclass.com/topic-botany/>
23. <https://www.biologyexams4u.com/211/09/botany-notes.html>
24. <https://ncert.nic.in/>

25. <https://www.kew.org/>

26. <https://bsi.gov.in/bsi-units/en?rcu=140>

DSC2 Lab Course based on DSC1
Practical Course Code: DSC2

LABORATORY WORK OF MORPHOLOGY OF ANGIOSPERMS

Course type: Major Mandatory Discipline Specific Course

Credits: 2, Contact Hours: 60 clock hours, 4 hours/ week

Marks: 50

- 1) Morphology of Root and its modifications
- 2) Morphology of Stem and its modifications
- 3) Morphology of Leaves and their modifications
- 4) Morphology of Inflorescences and their types
- 5) Morphology of Flower and floral parts
- 6) Study of Aestivation and Placentation
- 7) Morphology of Fruits and their types

SEC1 - A
Course type: Skill Enhance Course

Theory Course Code: SEC1

i) FUNGAL DISEASES OF CROP PLANTS AND THEIR MANAGEMENT

Credits: Theory – 1; Contact Hours: 15,
Total - 15 hours; 1 hour/ week; Marks - 50

Learning Objectives: - To generate overall knowledge about the Fungal diseases of Crop Plants and their management with special reference to etiology, disease cycle, perpetuation, epidemiology and management. Post-harvest diseases in transit and storage; aflatoxins and other mycotoxins and their integrated management.

Course Outcome: After learning this course, students will

- 1) Identify Fungal Diseases of Crop plants of the region
- 2) Treat the fungal diseases of the crop plants
- 3) Manage the crops in their agriculture field from fungal diseases

Unit-I **(5 Hrs)**

1. Classification of plant diseases according to causal agents.

2. Fungal Diseases

- a) **Major cereals:** -**Wheat** (Rust, Bunt, Karnal Bunt, Loose Smut, *Helminthosporium* Leaf Spots and *Alternaria* Leaf Blight) **Maize** (Stalk Rots of, Downy Mildews of Maize, *Helminthosporium* Leaf Spots); **Sorghum** (Smut, Downy Mildew); **Bajra;** (Green Ear, Ergot).

Unit-II **(5 Hrs)**

Fibre crops: - Cotton (Anthracnose of Cotton, Vascular Wilt).

- a) **Pulses** – Pigeon pea (Wilt); Bengal gram (*Ascochyta* Blight, Wilt); Cowpea (Anthracnose); Pea (Rust, *Ascochyta* Blight, Powdery Mildew); Lentil (Wilt).
- b) **Oilseed crops-** Mustard and rapeseed (Club Root , *Alternaria* Leaf Spot ,Downy Mildew, White Rust); Groundnut(Tikka, Rust); Linseed (Rust), Soybean (Rust).

Unit-II **(5 Hrs)**

- c) **Cash crops** – Sugarcane (Red rot, Whip smut, Wilt)

d) Fodder legumes: - Lucerne (Rust, Smut).

Suggested Readings: -

1. Agrios, G. N. (2010). *Plant Pathology*. Acad. Press
2. Chaube, H. (2018). *Plant disease management: principles and practices*. CRC Press.
3. Mehrotra, R. S. (1998). *Plant Pathology*. Tata MC Grow Hill Pub. Co. Ltd., New Delhi.
4. Pandey, B. P. (2018). *Plant pathology (Pathogen and Plant disease)*. S. Chand Publishing.
5. Rangaswami, G., & Mahadevan, A. (1998). *Diseases of crop plants in India*. PHI Learning Pvt. Ltd.
6. Ravichandra, N. G. (2013). *Fundamentals of plant pathology*. PHI Learning Pvt. Ltd.
7. Singh, R. S. (2018). *Plant diseases*. Oxford and IBH Publishing.

Theory Course: SEC1

ii) KITCHEN PHARMACY – I: SPICES

Course type: Skill Enhancement Course

Credit: 1; Contact Hours: 15 clock hours; 1 hour/ week

Marks: 50

Learning objectives:

- To know the status of Spices and condiments production in world and particularly to Indian scenario.
- To learn spices commonly used in various culinary and food products.
- To study the biochemical and phytoconstituents of various spices.
- To use the spices as medicine in common ailments

Course outcome: On the successful completion of the course, student will be able to-

- Learn skills regarding identification of various spices and condiments used in our region.
- To learn the techniques for estimation of phytochemicals of different spices and condiments.
- Use the Spices as medicine in the common ailments

Unit – I

(03 hrs)

Basic information and differences between Spices and Condiments. India's share in Spices production. Export of Spices to Foreign countries, revenue generation of spices in global market.

Unit – II

(12 hrs)

Phytochemistry, Economic importance, Medicinal properties and uses of Following Spices:

- a) Rhizome Spices: Zinger, Turmeric
- b) Bulb Spices: Onion, Garlic
- c) Leafy Spices: Mint, Coriander, Bay leaf
- d) Bark Spices: Cinnamon
- e) Flower Spices: Cloves, Saffron
- f) Fruit Spices: Chilli, Coriander, Black pepper, Star anise, Cumin, Fennel, Caraway, Bishops weed,
- g) Seed Spices: Cardamom, Nutmeg
- h) Gum/Resin Spices: Asafoetida

Suggested Reading:

1. Arachchige U., Ranavira S. and A.A.L.T. Ampemohotti , 2021, Spices and Herbs, University JaywardhanaPura, Sri Lanka
2. Samba Murty A. V. S. S., 1991, Economic Botany, Wiley Eastern Publication, New Delhi
3. Subnis S. B. and Daniel M., 1990, Phytochemical Approach to Economic Botany, Kalyani Publisher, New Delhi
4. Peter K. V., 1998, Hand Book of Herbs and Spices, Woodhead Publishing Limited, Cambridge London

SEC2

Course type: Skill Enhance Course

Practical Course Code: SEC2 (i)

i) FUNGAL DISEASES OF CROP PLANTS AND THEIR MANAGEMENT

Credits: Practical – 1; Contact Hours: Practical 30 clock hours,

Total - 30 hours; 2 hours/ week; Marks - 50

Identification and histopathological studies of selected Fungal diseases of field crops covered in theory. Collection and preservation of disease specimen
(Note: Students should submit at least 10 pressed and well-mounted specimens)

Identification and histopathological studies of selected Fungal diseases of field crops covered in theory. Collection and preservation of disease specimen

(Note: Students should submit at least 10 pressed and well-mounted specimens)

1. Methods of Studying Plant Diseases (Macroscopic and Microscopic)
2. Koch's Postulates
3. Preparation of PDA, Sterilization, Pouring, Inoculation and Culturing of Fungi.
4. Staining Techniques in Fungi.
5. Identification of different groups of fungi occurring on substrates.
6. Study of the following diseases:
 - a) Rust of Wheat
 - b) *Helminthosporium* Leaf Spots
 - c) *Alternaria* Leaf spot of Mustard
 - d) Grain smut of Sorghum
 - e) Rust of Maize
 - f) Downy Mildew of Bajra
 - g) Wilt of Pigeon pea
 - h) Anthracnose of Cotton
 - i) Red Rot of Sugarcane

Practical Course: SEC2 (ii)

ii) KITCHEN PHARMACY – I: SPICES

Course type: Skill Enhancement Course

Credit: 1; Contact Hours: 30 clock hours; 2 hour/ week

Marks: 50,

- 1) Preservation of Ginger rhizomes in to dried form (Sunth)
- 2) Isolation of Curcuminoids from *Curcuma longa*
- 3) Extraction of Essential oil from Cinnamon bark
- 4) Extraction of Essential oil from Garlic
- 5) Extraction of essential oil from Clove
- 6) Test of Saffron
- 7) Isolation of Alkaloids from Chilli
- 8) Extraction of Essential oil from Cumin, Fennel, Caraway, Bishops weed

This course will be available for the students for other faculty

GE/ OE-1 Seed Production and Preservation Techniques

Course type: General/ Open Elective Course

Credits: 2, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 50

Learning Objectives:

1. To promote the students belonging to the Farmers family to insist on the quality Seed production
2. To promote the students belonging to the Farmers family to increase the quality Seed production
3. To promote the students belonging to the Farmers family to preserve the good quality seeds for longer period.

Course Outcome: After completion of this course, the students will:

1. Insist on the quality Seed production
2. Increase the production of quality Seeds
3. Will know the best natural practices to store the seeds for longer period

Unit – I

15 Hrs

History and importance of seed technology. Classes of seeds. Characteristics of quality seeds and their importance. General technique of seed production in important agricultural crops followed in our region:-

- (i) Cereals: Jowar, Wheat, Rice, Pearl millet, Maize
- (ii) Pulses: Chick pea, Pigeon pea, Lentil, Green gram, Black gram
- (iii) Oil Seeds: Sunflower, Safflower, Ground nut, Soybean, Mustard, Sesame
- (iv) Commercial crops – Cotton, Castor, Onion, Sunhemp and various Vegetable and fruit crops.

Unit II

15 hrs

Seed preservation techniques followed in past, Seed drying, principle of seed drying, Equilibrium Moisture Content (EMC), Methods of drying and their advantage and disadvantages: - Natural drying, Artificial drying their advantages and disadvantages. Dryers – Batch dryers, Continuous flow dryer, Mixing type of dryers, Non mixing column dryer, Continuous flow grain dryer, Mix flow dryer, Tray dryer, Fluidize bed dryer, Pneumatic dryer, Rotary dryer, Chemical methods. Contribution of Rahibai Papere in Seed preservation.

Suggested Reading:

1. Agrawal, P.K. & M. Dadlani, 1995. Techniques In Seed Science And Technology (2nd Ed.) South Asian Publ. New Delhi.
2. Agarwal RL. 1997. Seed Technology (IInd Ed.) Oxford & IBH Publ. Co. Daryaganj, New Delhi.

3. Baill R Gregg, Alvin, G. Law, S.S. Virde and Balis, J.S. Seed Processing. Cooperatively published by NSC, New Delhi and Mississippi State University and UNSAID.
4. Barton LV. 1985. Seed Preservation and Longevity. International Books and Periodicals
5. Supply Service, New Delhi.
6. Chakravarty, A. Post-Harvest Technology of Cereals, Pulses and Oil Seeds.
7. Copeland, R.A. 1996. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis. VCH Publishers, New York.
9. Desai, B.B., Kotecha, PM and Salunkhe, D.K. 1997. Seeds Handbook. Marcel Decker Inc.,
- 10) Baadsgard, J. and F. Stubsgard 1989. Seed Collection. Lecture Notes No. C-4. Danida Forestry Service. Humlebæk, Denmark.

- 11) Briscoe, C.B. 1990. Field Trials Manual for Multipurpose Tree Species. No. 3, Second Edition. Winrock International. Arlington, USA.

- 12) Department of Environment and Natural Resources, International Institute of Rural Reconstruction, Ford Foundation 1990. Agroforestry Technology Information Kit. IIRR. New York and Silang, The Philippines.

- 13) Malakand Social Forestry Project 1990. Nursery Techniques Training Manual. DHV Consultants. The Netherlands.

- 14) Mbonye, Arsen and Kihisa Kiambe 1986. How to Collect, Handle, and Store Seeds. KENGO. Nairobi, Kenya.

- 15) Phothai, Monthee 1985. Reforestation. Reforestation Unit, Forest Industries Organization. Bangkok, Thailand.

- 16) United Nations International Labour Organization 1989. Tree Nurseries. Special Public Works Programme, Booklet No. 6. ILO. Geneva, Switzerland.

B. Sc. I Year, Semester – II

Theory Course Code: DSC3

Course name: DIVERSITY OF CRYPTOGRAMS - I

Course type: Major Mandatory Discipline Specific Course M1

Credits: 2, Contact Hours: 30 clock hours, 2 hours/ week

Learning Objectives: The mandatory course 'Diversity of Cryptogams -I' in semester I includes the theory based units on Viruses, Mycoplasma, Bacteria, Lower cryptogams viz. Lichen, Algae & Fungi & Plant Pathology.

- The course aims to expose the students to the classification of algae, fungi and up to order as per the system proposed by G. M. Smith (1950), Alexopoulos & Mims (1979).
- The course will teach systematics, general characteristics of Viruses, mycoplasma and Bacteria, and life cycles of some algae & fungi.
- The course will provide insight on economic importance of Lichens, Algae. It aims to make students aware about the fungal plant diseases and its management.

Course Outcomes: After completion of the course, the learners would be able to:

- Classify lichens, algae and fungi up to orders according to the system of classification proposed by G. M. Smith (1950), Alexopoulos & Mims (1979).
- Classify and describe the morphology, structure, life cycle of some Lichens, algae, fungi and gymnosperms.
- Exemplify lichens, algae and fungi of economic importance.
- Identify common plant diseases and devise the suitable control measures.

Unit – 1

08

Hrs

1.1 Viruses:

General characters, Plant Viruses, TMV – structure and multiplication

1.2 Mycoplasma:

General characters, little leaf of Brinjal disease, its pathogen and control

1.3 Bacteria:

General characters, ultra structure, economic importance, Citrus Canker disease, its pathogen and control

1.4 Cryptogams:

General characters, classification according to G. M. Smith up to class level

- 1.5 **Lichens:**
General characters, nature of association, forms of thalli, economic importance

Unit – II

08

Hrs

- 2.1 **Algae:**
General characters, classification according to F. E. Fritsch (1935) up to the class level, Economic importance
- 2.2 Systematic position, occurrence, thallus structure, reproduction: Vegetative, asexual and sexual (excluding development of sex organs) and graphic life cycle with respect to following types:
- i. Cyanophyceae – *Nostoc*
 - ii. Chlorophyceae – *Chara*
 - iii. Xanthophyceae – *Botrydium*
 - iv. Phacophyceae – *Sargassum*
 - v. Rhodophyceae – *Batrachospermum*

Unit – III

14

Hrs

- 3.1 **Fungi:**
General characters, classification according to Alexopoulos and Mims (1979) up to the class level, economic importance
- 3.2 Systematic position, occurrence, structure of mycelium, reproduction - asexual, sexual and graphic life cycle with respect to the following types:
- i) Oomycetes – *Albugo*
 - ii) Zygomycetes – *Mucor*
 - iii) Ascomycetes – *Eurotium*
 - iv) Basidiomycetes – *Agaricus*
 - v) Deuteromycetes – *Cercospora*

Suggested Reading:

1. Agrios, G. N. (2005). Plant Pathology. Netherlands: Elsevier Science.
2. Akatsuka I. (1990). Introduction to Applied Phycology. Netherlands: SPB Academic Publishing Ltd.

3. Alexopoulos C. J., C. W. Mims and M. Blackwell, 2007, Introductory mycology, IV Edition, Wiley India (Pvt.) Ltd, Daryaganj, New Delhi
4. Bilgrami K. S. and Saha, 2010, A text Book of Algae, CBS Publication , New Delhi
5. Bilgrami, K. S., Dube, H. (1998). Textbook of Modern Plant Pathology. India: Sangam Books Limited.
6. Biswas S. B. and Biswas Amita, 1989, An introduction to Viruses, Vikas Publishing House, New Delhi
7. Chapman, V. J. (2013). An Introduction to the Study of Algae. United Kingdom: Cambridge University Press.
8. Clifton A., 1958, Introduction to the Bacteria, Mc Graw Hill Company, Ne York
9. Dasgupta, M. K. (1988). Principles of Plant Pathology. India: Allied Publishers.
10. David Hawksworth and David Hill (1984), *The Lichen-forming Fungi* .
11. Dubey H. C., 1978, A text book of Fungi, Bacteria and Viruses, Vikas publishing House, New Delhi
12. Dubey H. C., 1978, An introduction to Fungi, Vikas publishing House, New Delhi
13. Fritsce F. E., 1945, Structure and Reproduction of algae, Vol. I & II, Cambridge University Press, London
14. George Baron (1999), Richmond. An approachable introduction to the study of lichens. Paperback, 92pp.
15. Gupta, R. k., Pandey, V. D. (2007). Advances in Applied Phycology. India: Daya Publishing House.
16. Kumar H. D. 1988, Introductory Phycology, East – West Press Ltd. New York
17. Kumar, A., Vashishta, B. R., Sinha, A. K. (2016). Botany for Degree Students: Fungi. India: S. Chand.
18. Mandahar C. L. 1998, Introduction to Plant Viruses, S. Chand Co. Ltd, Delhi
19. Mims, C. W., Alexopoulos, C. J. (1979). Introductory Mycology. United Kingdom: Wiley.
20. Mishra A. and Agarwal R. P., 1978, Lichens – A preliminary text, Oxford and IBH Publication, New Delhi
21. Pandey, B. P. (2001). Plant Pathology (Pathogen and Plant Disease). India: S. Chand Limited.
22. Powar and Daginawala (1982) General Microbiology, Vol. I & II, Himalaya Publishing House, New Delhi
23. Reddy S. M., 1996, University Botany – I (Algae, Fungi, Bryophyta, Pteridophyta), New age International Publisher Ltd. Delhi
24. Robert Edward Lee, Phycology, Cambridge University Press, London

25. S. Chand (1960) Botany for Degree Students: Algae. (1960). India: S. Chand Pvt. Limited.
26. Samba Murthy A. V. S. S., 2006, A text Book of Plant Pathology, I. K. International Pvt. Ltd. New Delhi
27. Sharma O. P. 2017, A text Book of Algae, Tata Mc Graw Hill Publication, New Delhi
28. Shukla, D. M. K., M.K.Shukla, A. K. K. (2020). A Text Book of Algae: For Degree Students. (n.p.): Amazon Digital Services LLC - KDP Print US.
29. Smith G. M., 1972, Cryptogamic Botany Vol. -I, Mc Graw Hill Publication, New Delhi
30. Smith, G. M. (1955). Cryptogamic Botany. Japan: McGraw-Hill.
31. T.H. Nash III (2008) *Lichen Biology* Cambridge University Press. Paperback, 486 pp.
32. Vashishta, B. R., Sinha, A. K., Kumar, A. (2016). Botany for Degree Students: Fungi. India: S. Chand.
33. Venkateshwaran V. A. A text Book of Algae, Marahi Book Depot Guntur
34. Webster, J. (1980). Introduction to Fungi. India: Cambridge University Press.

Practical Course Code: DSC4

Practical Course based on DSC3

Course name: DIVERSITY OF CRYPTOGRAMS - I

Course type: Major Mandatory Discipline Specific Course M1

Credit: 2; Contact Hours: 60 clock hours; 2 hours/ week

- 1) Electron micrographs of TMV and Types of Bacteria
- 2) Citrus Canker and Little leaf of Brinjal
- 3) Types of lichens (2 – 3 examples)
- 4) Algae: *Nostoc*, *Chara*
- 5) Algae: *Botrydium*, *Sargassum*
- 6) Algae: *Batrachospermum*
- 7) Plant Disease: White Rust of Crucifer: *Albugo*
- 8) Plant Disease: Tikka disease of Groundnut
- 9) Fungi : *Mucor*, *Eurotium*
- 10) Fungi : *Agaricus*

Theory Course: VSC1 (i)
BIOFERTILIZER TECHNIQUES

Course type: Vocational Skill Course

Credits Theory: 1; Contact Hours: 15 clock hours; 1hours/ week

Marks: 50

Learning objectives:

- To develop the understanding on the concept of bio-fertilizer
- Identify the different forms of biofertilizers and their uses
- Compose the Green manuring and organic fertilizers
- Develop the integrated management for better crop production by using both nitrogenous and phosphate bio fertilizers and vesicular arbuscular mycorrhizal

Course outcome: On the successful completion of the course, student will be able to-

- Acquire the knowledge of biofertilizers techniques.
- Learn laboratory skill, lab organization & nutritional importance of different biofertilizers.
- Understand about the bio fertilizer techniques - isolation, identification, screening and cultivation, method and its economic.

Unit-I:

(05 L)

Biofertilizers - Introduction, scope. A general account of Biofertilizers organisms - Cyanobacteria (BGA) biofertilizers -. Isolation of cyanobacteria. Formation of Fogg's medium. Mass cultivation of Azolla - Cyanobacterial biofertilizers - Symbiotic association of Cyanobacteria - Field application of Cyanobacterial inoculants. Cyanobacteria (blue green algae/ BGA) and Azolla as biofertilizer; Blue green algae and Azolla production; Application of BGA and Azolla in rice cultivation. Algalization.

Unit -II:

(05 L)

Isolation, mass production and application of Rhizobia, *Azospirillum* and *Azotobacter* as a biofertilizer; Actinorrhizal symbiosis (Organisms, hosts and general features). Plant growth promoting rhizobacteria (PGPR) and Phosphate solubilizing bacteria (PSB); PGPR traits; Stress hormone Ethylene and PGPR.

Unit- III:

(05 L)

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution; VAM fungi, and their influence on growth and yield of crop plants.

Anabaena, *Cylindrospermum*, *Gloeocapsa*, *Lyngbya*, *Nostoc*, *Plectonema* and *Tolypothrix*;
Azolla - *Anabaena* as biofertilizers

Suggested Readings :

1. Dubey, R. C., 2005 A Text book of Biotechnology S. Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4. Newton, W. E. et al. (1977). Recent Developments in Nitrogen Fixation. Academic Press, New York.
5. Sathe, T. V. 2004 Vermiculture and Organic Farming. Daya publishers.
6. Schwintzer, C. R. and Tjepkema, J. D. (1990). The Biology of Frankia and Actinorhizal Plants. Academic Press Inc., San Diego, USA.
7. Stewart, W. D. P. and Gallon, J. R. (1980). Nitrogen Fixation. Academic Press, New York.
8. Subha Rao, N. S. 2000, Soil Microbiology, Oxford & IBII Publishers, New Delhi.
9. Vayas, S. C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

Theory Course: VSC1 (ii)

Course name: ORGANIC COMPOSTING

Course type: Vocational Skill Course

Credits Theory: 1; Contact Hours: 15 clock hours; 1 hours/ week

Marks: 50

Learning objectives:

- Develop their understanding on the concept of organic composting
- Identify the different forms of organic composting systems and their uses
- Green manuring and organic fertilizers
- Develop the integrated management for better crop production by organic composts.

Course outcome: On the successful completion of the course, student will be able to-

- Acquire the knowledge of organic composting techniques.
- Learn laboratory skill, lab organization & nutritional importance of different organic composts.
- Understand about the composting techniques and its economics.

Unit – I (05 hrs)

Concepts of Organic Composting, Objectives, Size of organic food Market, Area under Organic Farming, Status of Organic farming in India, Ethics of organic farming,

Unit – II (05 hrs)

Recycling of bio-degradable municipal, agricultural and industrial wastes, Biocompost making- types: Green manure, Farm Yard Manure, Dung Manure, Vermi compost etc. and organic fertilizers, Panchakavya. Biological pest control (neem).

Unit – III (05 hrs)

Inspection – certification - labelling and accreditation procedures for organic products. Processing, - economic consideration and viability.

Marketing and export potential of organic products – National economy

National Standards of Organic Production (NSOP)

European Union Regulations, Certification agencies in India

Suggested Readings:

1. Sathe T.V. 2004. Vermiculture and Organic Farming. Daya Publishers. New Delhi.
2. Subha Rao N.S. 2000. Soil Microbiology, Oxford & IBH Publishers. New Delhi.
3. Vayas S.C, Vayas S. and Modi H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan. Nadiad.

4. Palaniappan, S.P and Annadurai, K.1999. Organic farming-Theory and Practice. Scientific publishers, Jodhpur, India.
5. Mukund Joshi and Prabhakarasetty, T.K. 2006. Sustainability through organic farming. Kalyani publishers, New Delhi.
6. Balasubramanian, R., Balakishnan, K and Siva Subramanian, K. 2013. Principles and practices of organic farming. Satish Serial Publishing House
7. Tiwari, V.N., Gupta, D.K., Maloo, S.R and Somani, L.L. 2010. Natural, organic, biological, ecological and biodynamic farming. Agrotech Publishing Academy, Udaipur
8. Panwar, J. D. S., & Jain, A. (2016). *Organic farming and biofertilizers: scope and uses of biofertilizers*. New India Publishing Agency.
9. Rao, S. (2002). A text book on biofertilizers.

Practical Course: VSC2 (i)

Course name: BIOFERTILIZER TECHNIQUES

Course type: Vocational Skill Course

Credits Practical: 1; Contact Hours: 30 clock hours; 2hours/ week

Marks: 50

1. Collection & Microscopic observation of BGA, Mycorrhizae Rhizobia, *Azospirillum* and *Azotobacter* as VAM, (3P)
2. Isolation, Identification, Inoculum development pilot scale production BGA, Mycorrhizae Rhizobia, *Azospirillum* and *Azotobacter* as VAM, (3P)
3. Characterization, cultivation and use of *Anabaena*, *Cylindrospermum*, *Gloeocapsa*, *Lyngbya*, *Nostoc*, *Plectonema* and *Tolypothrix*; *Azolla* - *Anabaena* as biofertilizers Qualitative/quantitative estimation of nitrogen contents from algae (4P).
4. Visit to industry actively engaged in biofertilizer technology. Market survey of various bio fertilizer and its products

Practical Course: VSC2 (ii)

Course name: ORGANIC COMPOSTING

Course type: Vocational Skill Course

Credits Practical: 1; Contact Hours: 30 clock hours; 2hours/ week

Marks: 50

- 1) Preparation and use of Green manure,
- 2) Preparation and use of Farm Yard Manure
- 3) Preparation and use of Dung Mnure,
- 4) Preparation and use of Vermicompost
- 5) Preparation and use of Panchgavya
- 6) Preparation and use of Neem based pesticides
- 7) N, P and K analysis of these organic compost
- 8) Visit to Farmers Organic Compost preparation site

This course will be available for the students from other faculty

GE/OE2 POMOLOGY

Course type: General/ Open Elective Course

Credits: 2, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 50, Internal assessment: 20, External assessment: 30

Course objective:

- i) To provide knowledge of the basic principles of the life cycle of fruit trees
- ii) To know the effect of environmental factors, physiological basis for nutrition and cultural practices in fruit crop cultivation.
- iii) To understand the basic propagation principles and techniques used in fruit growing technologies.

Learning outcomes: After completing this course, the students will

- i) Enrich the knowledge about horticultural principles and practices relevant to fruit cultivation and will take initiative to cultivate fruits
- ii) Will apply fundamental aspects of orchard operations and its management
- iii) Will become expert in plant propagation techniques.

Unit I

(15L)

Introductory Pomology: Role of fruits in human diet, and agricultural economy, Prospects of horticultural crops in India, General survey of fruits grown in Maharashtra and Marathwada region with special reference to climate. Employment opportunities in horticulture.

Orchard management practices: Orchard & estate management, importance, objectives, Selection of site for and orchards, merits and demerits. Orchard and Estate management, importance, objectives, merits and demerits, Clean cultivation, Weed management & Herbicides, Soil management in relation to nutrient and water uptake, Factors influencing the fruitfulness and unfruitfulness, Rejuvenation of old orchards, Fertility management in horticultural crops, manures and fertilizers, Integrated pest management.

Unit II

(15L)

Plant propagation technique- Grafting, Budding, Layering etc. their merits and demerits, Nursery management and plant growing structures, Fruit tree propagation, maintenance practices Pruning and Training of Horticultural plants water requirement (Irrigation unfruitfulness and Remedies fruits set and fruit drop), Irregular and alternate bearing harvesting, grading packing transport marketing and storage of fruits.

Cultural practices: Cultivation of importance fruit crops such as Mango, Banana, Citrus, Guava, Custard apple, Papaya, Grapes, Ber, Pomegranate, Sapota, etc. concept of high density orcharding.

Suggested readings:

- Bose, T.K., Mitra S.K. and Sanyal, D. (2001) Fruits- Tropical and Subtropical. Naya Udyog.
- Bose, T.K., Mitra, S.K. and Sanyol, D. (2002) Temperate Fruits. Naya Udyog.
- Chadha, K.L. and Pareek, O.P., (1996) Advance in Horticulture (Vol. II & VIII) Malhotra Publ. House.
- Crombie, E. (2016) Textbook of Pomology. Syrawood Publishing House.
- Misra, K.K. (2014) Textbook of Advance Pomology. Biotech.
- Nakasone, H.Y. and Puul, R.E. (1998) Tropical Fruits. CABI.
- Peter, K.V. (2008) Basic of Horticulture. New India Publ. Agency.
- Pradeep K.T., Suma B. J. and Satheesan, K.N. (2008) Management of Horticultural Crops (Parts I & II). New India Publ. Agency.
- Radha, T. and Mathew, L. (2007) Fruit Crops. New India publ. Agency.
- Singh, H.P., Negi, J.P. and Samuel, J.C. (2002) Approaches for Sustainable Development of Horticulture. National Horticultural Board.
- Singh, H.P., Singh, G., Samuel, J.C. and Pathak, R.K. (2003) Precision Farming in Horticulture NCPAH, DAC/ PFDC, CISH, Lucknow.
- Westwood, M. N. (1988). Temperate-zone Pomology. Timber Press.
- Westwood, M.N. (2009) Temperate-Zone Pomology: Physiology and Culture, Third Edition. Timber Press.

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