

S. K. Tyagi  
Arun R. Khire



# *Vegetable Crops* at a Glance

For JRF, SRF, NET, ARS, SAU's M.Sc.  
& Ph. D. Entrance Examinations

  
Competition  
Tutor



# **Vegetable Crops**

---

at a Glance

## ABOUT THE AUTHORS



**S. K. Tyagi** is working as Scientist (Horticulture) at Krishi Vigyan Kendra, Khargone (M. P.). He did his B.Sc. (Ag) and M.Sc. (Ag.) in Horticulture during the year 1999 and 2001, respectively from JNKVV, Jabalpur (M.P.). He has more than 13 years of experience in the field of horticulture research and extension and contributed 15 research papers published in international and national peer reviewed research journals, 25 papers presented in international and national Conferences/ Symposiums/Seminars. He has contributed 10 books and 135 popular articles.



**Arun R. Khire** is M.Sc. (Ag) in 1980 (Genetics and Plant Breeding) with honours from JNKVV, College of Agriculture, Indore. Spanning over the career of 33 years he contributed 2 varieties of Groundnut namely JGN 3 and JGN 23 and contributed nearly 50 articles in the reputed magazines & journals. Currently, he is working at RVSKVV, ZARS, Khargone (M.P.) as Senior Breeder for Groundnut and Pigeonpea.

# **Vegetable Crops**

---

## **at a Glance**

**For JRF, SRF, NET, ARS, SAU's M.Sc.  
& Ph.D. Entrance Examinations**

**S. K. Tyagi**

*Scientist (Horticulture)*

*Krishi Vigyan Kendra, Khargone (M.P.)*

**Arun R. Khire**

*Senior Scientist (Plant Breeding and Genetics)*

*Zonal Agriculture Research Station, Khargone (M.P.)*



---

An imprint of Scientific Publishers (India)

*Published by*

Competition Tutor  
5-B, New Pali Road, P.O. Box 91  
Jodhpur - 342 001 (India)

E-mail: [competitiontutor@gmail.com](mailto:competitiontutor@gmail.com)  
Website: [www.competitiontutor.co.in](http://www.competitiontutor.co.in)

© 2018, Authors

---

All rights reserved. No part of this publication or the information contained herein may be reproduced, adapted, abridged, translated, stored in a retrieval system, computer system, photographic or other systems or transmitted in any form or by any means, electronic, mechanical, by photocopying, recording or otherwise, without written prior permission from the publisher.

---

**Disclaimer:** Whereas every effort has been made to avoid errors and omissions, this publication is being sold on the understanding that neither the editors (or authors) nor the publishers nor the printers would be liable in any manner to any person either for an error or for an omission in this publication, or for any action to be taken on the basis of this work. Any inadvertent discrepancy noted may be brought to the attention of the publisher, for rectifying it in future editions, if published.

This book contains information obtained from authentic and highly regarded sources. Reasonable efforts have been made to publish reliable data and information, but the editors and publisher cannot assume responsibility for the validity of all materials or the consequences of their use. The editors and publisher have attempted to trace and acknowledge the copyright holder of all material reproduced in this publication and apologize to copyright holders if permission and acknowledgement to publish in this form have not been obtained. If any copyright material has not been acknowledged please write and let us know so that we may rectify it.

**Trademark Notice:** Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

ISBN: 978-93-86652-47-8  
eISBN: 978-93-87991-88-0

Visit the Scientific Publishers (India) website at  
<http://www.scientificpub.com>  
Printed in India

# Preface

Precise database pertinent to related subject is an essential prerequisite to get through competitive examinations. The competitive examinations have become procedure of recruitment and admission for higher studies such as **JRF, SRF, NET, ARS, SAU's M. Sc. & Ph. D. entrance examinations**. All these examinations are mostly based, on objective type questions' and students always look for study material that is realty to use and. easy to grasp. Thus, one has to prepare him/her very strongly for these competitive exams and for the success there is a need to read authentic and authorized reading materials. It was long felt need of the aspirants that there should be a vast collection of recent information and data related to **Vegetable Crops** in a single book. Keeping this in mind the manuscript has been prepared Humble efforts have been made here to compile basic and applied knowledge of these crops, which will be of immense value and help for all those who want, to pursue career in this field.

This book, is a single compendium which deals with all aspects and facts of Vegetable Crops which may meet the requirements of all those who are preparing for JRF, SRF, NET, Ph.D., ARS, and other competitive examinations.

The book has been compiled on the basis of available information for guidance and not for legal purposes. Readers are also advised to visit, the latest botanical and zoological names site [www.sp2000.org](http://www.sp2000.org).

However, I have put my best efforts in preparing this book, but if any error or whatsoever has been skipped out, I. will by heart, welcome your suggestions with the hope that this book, will be extremely useful for the students.

**S.K. Tyagi**  
**A.R. Khire**



# Syllabus

**National Eligibility Test Conducted by ASRB, New Delhi**

## **SUBJECT: VEGETABLE SCIENCE**

### **Unit 1. Production Technology of Cool Season 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 potato, Cole crops, cabbage, cauliflower, knoll kohl, sprouting broccoli, Brussels sprout, root crops: carrot, radish, turnip and beetroot, bulb crops: onion, garlic, peas and broad bean, green leafy cool season vegetables.

### **Unit 2. Production Technology of Warm Season 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, economics of crop production and seed production of: tomato, eggplant, hot and sweet peppers, okra, beans, cowpea, and cluster bean, cucurbitaceous crops, tapioca and sweet potato, green leafy warm season vegetables.

### **Unit 3. Breeding of Vegetable Crops**

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. Potato and tomato, eggplant, hot pepper, sweet pepper, and okra, peas, beans, amaranth, chenopods and lettuce, gourds, melons, pumpkins and squashes, cabbage, cauliflower, carrot, beetroot, radish, sweet potato and tapioca.

## **Unit 4. Growth and Development**

Cellular structures and their functions; definition of growth and development, growth analysis and its importance in vegetable production; physiology of dormancy and germination of vegetable seeds, tubers and bulb; role of auxin, 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; role of light, temperature and photoperiod on growth, development of underground parts, flowering and sex expression in vegetable crops; apical dominance, physiology of fruit set, fruit development, fruit growth, flower and fruit drop; parthenocarpy in vegetable crops; phototropism, ethylene inhibitors, senescence and abscission; fruit ripening and physiological changes associated with ripening; plant growth regulators in relation to vegetable crops. Sex expression in cucurbits and checking flower and fruit drops and improving fruit set in solanaceous vegetables; growth analysis techniques in vegetable crops.

## **Unit 5. Seed Production**

Introduction; modes of propagation in vegetables; seed morphology and development in vegetable seeds; floral biology of these plant species; classification of vegetable crops based on pollination and reproduction behaviour; steps in quality seed production; identification of suitable areas/locations for seed production of these crops; classification based on growth cycle and pollination behaviour; methods of seed production; comparison between different methods e.g. seed to seed vs. root to seed method in radish; seed multiplication ratios in vegetables; pollination mechanisms; sex types, ratios and expression and modification of flowering pattern in cucurbits; nursery raising and transplanting stage; seed production technology of vegetables viz. solanaceous, cucurbitaceous, leguminous, malvaceous, cole crops, leafy vegetables, root, tuber and bulb crops and spices; harvesting/picking stage and seed extraction in fruit vegetable; clonal propagation and multiplication in tuber crops e.g. potato, sweet potato, colocasia, tapioca; seed- plot technique in potato, tuber seed production; hybrid seed production technology of vegetable crops, TPS (true potato seed) and its production technique; hybrids in vegetables; maintenance of parental lines; use of male sterility and self incompatibility in hybrid seed production, environmental factors related to flowering/bolting in vegetable crops; Share of vegetable seeds in seed industry; importance and present status of vegetable industry; intellectual property rights and its implications, impact of PVP on growth of seed industry.

## **Unit 6. Systematics of Vegetable Crops**

Principles of classification; different methods of classification; salient features of international code of nomenclature of vegetable crops; Origin, history, evolution and distribution of vegetable crops, botanical description of families, genera and species covering various tropical, subtropical and temperate vegetables; Cytological level of various vegetable crops; descriptive keys for important vegetables; Importance of molecular markers in evolution of vegetable crops; molecular markers as an aid in characterization and taxonomy of vegetable crops.

## **Unit 7. Production Technology of Underexploited 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, intercropping operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures and seed production of: Asparagus, artichoke and leek; Brussels sprout, Chinese cabbage, broccoli, kale and artichoke; Amaranth, celery, parsley, parsnip, lettuce, rhubarb, spinach, basella, bathua (chenopods) and chekurmanis; Elephant foot yam, lima bean, winged bean, vegetable pigeon pea, jack bean and sword bean; Sweet gourd, spine gourd, pointed gourd, Oriental pickling melon and little gourd (kundru).

## **Unit 8. Post Harvest Technology of Vegetable Crops**

Importance and scope of post harvest management of vegetables; Maturity indices and standards for different vegetables; methods of maturity determinations; biochemistry of maturity and ripening, enzymatic and textural changes, ethylene evolution and ethylene management, respiration, transpiration, regulation methods; Harvesting tools, harvesting practices for specific market requirements; post-harvest physiological and biochemical changes, disorders-chilling injury in vegetables, influence of pre-harvest practices and other factors affecting post harvest losses, packaging house operations, commodity pre-treatment's- chemicals, wax coating, pre-packaging and irradiation; packaging of vegetables, post harvest, diseases and prevention from infestation, principles of transport; Methods and practices of storage- ventilated, refrigerated, MA, CA storage, hypobaric storage, pre-cooling and cold storage, zero energy cool chamber; storage disorders.



# Contents

<i>Preface</i>	(v)
<b>1. Importance of Vegetable Crops</b>	<b>1—11</b>
Introduction, current scenario of vegetable production in India, importance of vegetable crops, area, production and productivity of vegetables in leading states of India, global scenario of vegetable production, major fruits and vegetables producing countries in the world, scope of vegetable production, export and processing of vegetable crops and future thrust	
<b>2. Classification of Vegetable Crops</b>	<b>12—18</b>
Botanical classification, according to the part consumed, life cycle, season/ climatic area/area of cultivation, photoperiod, growing season, methods of raising, hardiness, rate of respiration, soil reaction (pH), rooting depth, classification on the basis of production and utilization of the products	
<b>3. Vegetable Plant Nutrients</b>	<b>19—28</b>
Plant nutrients, criteria of essentiality, classification of plant nutrients on the basis of quantity of nutrient require, mobility of nutrient in the soil, mobility with in plant, functions in the plant and roles of the essential nutrients in crop development	
<b>4. Manures and Fertilizers</b>	<b>29—33</b>
Classification of fertilizers, composition of fertilizers, manures, average nutrient content of bulky organic manures, percent nutrient contents of oil cakes, some green manure crops and their N contribution	
<b>5. Water Management in Vegetable Crops</b>	<b>34—41</b>
Water requirement of crops, suitability of water for irrigation, water requirement of different crops, critical stages of irrigation requirement, water use efficiency, drip irrigation, fertigation and sprinkler irrigation	

- 6. Growth and Development** **42—49**
- Growth, differentiation, and development, cell cycle and cell division, plant growth regulators for vegetable crops, classes of plant hormones, list of growth regulators along with their, concentration, time of application and purpose in vegetable crops
- 7. Breeding of Vegetable Crops** **50—246**
- Definition, History and development of plant breeding, scientific contributions of eminent scientists, concepts of breeding of self-pollinated, cross pollinated and asexually propagated crops, breeding populations, history of vegetable breeding, centre of origin of crop plants, biodiversity and conservation, germplasm conservation, plant quarantine, modes of reproduction, pollination, self-incompatibility, male sterility, breeding methods, mass selection, pure line selection, pedigree breeding, hybridization, backcross breeding method, ploidy breeding, mutation, heterosis breeding, biometrics, crop biotechnology, molecular markers and breeding of vegetable crops
- 8. Basic Information on Vegetable Crops** **247—251**
- Common name, scientific name, family, origin, chromosome number, inflorescence type and fruit type of vegetables crops
- 9. Climate and Soil Requirements for Vegetable Crops** **252—256**
- Amaranth, ash gourd, beet root, bitter gourd, bottle gourd, brinjal, Broccoli, Brussels sprout, cabbage, capsicum, carrot, cauliflower, chilli, cow pea, cucumber, French bean, knol-khol, muskmelon, okra, onion, pea, pumpkin, radish, ridge gourd, round melon, tomato, turnip and watermelon
- 10. Improved Varieties and Hybrids of Vegetable Crops** **257—313**
- Tomato, brinjal, chilli, capsicum, cauliflower, cabbage, knol khol, pea, cowpea, lab lab bean, broad bean, French bean, carrot, radish, turnip, beet root, bottle gourd, bitter gourd, sponge gourd, ridge gourd, cucumber, long melon, muskmelon, watermelon, round melon, pumpkin, ash gourd, summer squash, onion, palak, amaranths, fenugreek, vegetable mustard, lettuce, parsley, okra, garlic, potato, cassava, yams and taro
- 11. Production Technology of Vegetable Crops** **314—396**
- Amaranthus, beetroot, spinach/vilayati palak, beet leaf/ palak, onion, coriander, celery, carrot, colocasia/ taro, elephant foot yam, asparagus, globe artichoke, lettuce, ceylon spinach/ malabar spinach/ Indian spinach, cole crops, sprouting broccoli, Brussels sprouts, cabbage, cauliflower, knol-khol, radish, turnip, sweet potato, cucurbitaceous vegetables, ash gourd, bitter gourd, bottle gourd, cucumber, ivy gourd, muskmelon, pointed gourd, pumpkin, ridge gourd, round gourd, snake gourd, spine gourd, sponge gourd, summer squash, watermelon, yams, cassava/tapioca, broad bean, cluster bean, cowpea, French bean, lablab bean/ Indian bean,

garden pea, fenugreek, Chinese potato, okra, arrowroot, drum stick, chekkurmanis, rhubarb, curry leaf, brinjal or eggplant, capsicum (sweet pepper / bell pepper), chilli (hot pepper), potato and tomato

- 12. Seed Production of Vegetable Crops** **397—412**
- Seed, category of seed, seed certification standards, isolation distance, seed standards of genetic purity, seed processing, seed germination, cultivation practices, important roguing stages & permitted off types for production of different vegetable seeds and seed standards for different vegetables
- 13. Pesticides and its Uses** **413—421**
- Definition, pesticide consumption in India and other countries, classification of pesticides, pesticide dose calculations and list of pesticides which are banned, refused registration and restricted in use
- 14. Major Diseases of Vegetable Crops** **422—426**
- Leafy vegetables, onion and garlic, carrot, colocasia, cole crops, radish, sweet potato, cucurbits, yams, cassava, beans, pea, okra, brinjal, capsicum and chilli, potato and tomato
- 15. Major Insect Pests of Vegetable Crops** **427—431**
- Amaranth and spinach, beet root, onion and garlic, carrot, cole crops, radish, sweet potato, cucurbitaceous vegetables, yams, cassava, cluster bean, cowpea, French bean, pea, okra, moringa, brinjal, capsicum and chilli, potato and tomato
- 16. Physiological and Nutritional Disorders in Vegetable Crops** **432—435**
- Beet root, sugar beet, onion, carrot, colocasia, cauliflower, radish, turnip, cucumber, French bean, potato and tomato
- 17. Post-Harvest Technology of Vegetable Crops** **436—465**
- Introduction, post-harvest technology, procedures, harvesting and field handling, harvesting factors, maturity indexes for vegetables and root crops, packaging, storage, recommended storage temperatures, post-harvest losses in vegetable crops, vegetable preservation, production and processing scenario of fruits and vegetables in India and world, principles of preservation- drying /dehydration-process-types pre-treatment's required-factors affecting rate of dehydration-reconstitution - coefficient of rehydration, sterilization, canning and storage
- 18. Recent Advances in Crop Improvement** **466—490**
- Crop-improvement programme focuses on development of new crop varieties and hybrids, potato genome sequencing, potato germplasm repository, gene prospecting through somatic hybridization, marker assisted pre-breeding, gene cloning, transgenics for tailor-made variety

development, development of multiple disease resistant potato hybrids, gene stacking for multiple disease resistance, development of heat tolerant genotypes, transcriptome analysis of bitter melon and genetic improvement of solanaceous vegetables

**19. Recent Advances in Crop Production** **491—504**

Recent advances in tomato, tuber crops, capsicum, onion, garlic, cassava, sweet potato, elephant-foot yam, intercropping systems, agro-techniques for processing potatoes, micro-irrigation and fertigation in potato, variety specific tissue culture, Protocols developed, development of seed production technology for hybrid bitter melon, design of partial root zone deficit (PRD) and regulated deficit irrigation (RDI) techniques for greenhouse tomato, design and installation of solar energy operated greenhouse, development of two bed and eight- row carrot planter, design and development of pneumatic precision planter for vegetable crops

**20. Recent Advances in Crop Health Management** **505—519**

Recent advances in cabbage, detection of seed borne tobamoviruses in vegetable crops, pumpkin yellow vein mosaic disease (PYVMD), molecular characterization of begomoviruses in French bean, promising bioagents identified, agricultural acarology, development of molecular diagnostics of potato pathogens, molecular profiling of potato pathogens, management of vegetable diseases, seed health testing, incidence of viral disease on vegetables, management of viral diseases, viral and phytoplasmal diagnosis, Garlic common latent virus (GarCLV), dual antigen construct for simultaneous diagnosis of potato virus Y (PVY) and potato virus X (PVX), insect pest management and metham sodium for the management of root knot nematode in polyhouse

**21. Glossary of Common Horticultural Terms** **520—551**

**22. Objective Type Questions** **552—587**

**Appendix I: ICAR Institutions, Deemed Universities, National Research Centres, National Bureaux, Directorate Project Directorates** **588—593**

**Appendix II: International Agricultural Organizations** **594—596**

**Appendix III: List of Agricultural Universities** **597—602**

**Appendix IV: List of Authorities, Agencies, Institutions, Functionaries** **603**

**Appendix V: List of Various Boards and Organizations** **604—606**

**Appendix VI: List of Various Acts and Rules** **607—609**

<b>Appendix VII: Area, Production and Productivity of Horticulture Crops—All India</b>	<b>610–612</b>
<b>Appendix VIII: Conversation Chart</b>	<b>613–615</b>
<b>References</b>	<b>616–626</b>
<b>List of Contributors</b>	<b>627–628</b>

