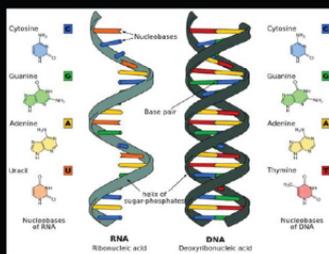


Basic Concepts of Plant Science

*JRF, SRF, BHU, SAU, ARS, NET, UPSC, PSCs
and other Competitive Examinations*

- Plant Breeding
- Genetics
- Seed Technology and
Intellectual Property Rights
- Statistics
- Plant Pathology and Microbiology
- Agricultural Biotechnology
- Father/Founders of Different Fields
- Multiple Choice Questions



Basic Concepts of Plant Science

Useful for JRF, SRF, BHU, SAU, ARS, NET,
UPSC, PSCs and other Competitive Examinations

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Published by
SCIENTIFIC PUBLISHERS (INDIA)

Jodhpur –

5 A, New Pali Road
P.O. Box 91
Jodhpur - 342 001 INDIA

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ISBN: 978-93-86652-08-9

eISBN: 978-93-87869-56-1

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

Printed in India

PREFACE

Plant Science is the subject which will give you name, fame and recognition in your life. Plant science is a broad subject. It comprising Genetics, Plant Breeding, Plant Pathology, Microbiology, Seed science and Technology and Genetic Resources. Most of the students are crazy about Genetics and Plant Breeding but it is the most important hurdle in the Plant Science group. Hence, to overcome this barrier, I suggest build up your own concepts and grasp the subject in logical way.

When I was pursuing my M.Sc., I desperately felt that there should be one book which will cover all the subjects of Plant Science in easily understandable, Pinpoint and concise way. When I discussed these things with my respected sir Dr. Dheeraj Singh who is the co-author of this book, he supported me and the work begins. Language seems to be too inadequate media to express my feelings of gratitude to Dr. Dheeraj Singh sir for extending valuable guidance, keen interest, timely and untiring help.

For the preparation of various agriculture competition examinations, students have to read all the basic books of Plant Science to cover syllabus. That time most of the students don't have all the books and too much time to read them.

Therefore, to overcome these problems the author tried his best to write this book through reading various books and other sources to covers brief and best information of all subjects of Plant science in one book.

The main objective of this book is to give ready, pinpoint wise, exam oriented material from all the subjects of Plant Science in the class note format. This book may be useful to those who are preparing for other competitive exams like JRF, SRF, BHU, ARS and SAUs entrance exams.

To covering all the subjects of Plant Science in one book is very hard task so some mistake may be left, therefore your suggestions are invited to further improvement of this book. I shall greatly appreciate if the comments and inaccuracies are brought to my notice.

I humbly dedicate my book at the feet of my parents and god whose grace and blessings, love, continuous support and encouragement made it possible for me.

Sandeep K. Bangarwa

Syllabus

ICAR JRF PLANT SCIENCE SYLLABUS

Subjects:

- 1. Plant Breeding & Genetics*
- 2. Plant Pathology*
- 3. Agricultural Microbiology*
- 4. Seed Science & Technology*
- 5. Plant Genetic Resources*

UNIT-I: Importance of Agriculture in national economy; basic principles of crop production; cultivation of rice, wheat, chickpea, pigeon-pea, sugarcane, groundnut, tomato, potato and mango. Major soils of India, role of NPK and their deficiency symptoms.

UNIT-II: Structure and function of cell organelles; mitosis and meiosis; Mendelian genetics; elementary knowledge of photosynthesis; respiration, and transpiration; structure and functions of carbohydrates, proteins, nucleic acids, enzymes and vitamins. Major pests and diseases of rice, wheat, cotton, chickpea, sugarcane and their management.

UNIT-III: Characteristics of prokaryotic and eukaryotic organisms, differences between fungi, bacteria, mycoplasmas and viruses; physical and chemical basis of heredity; chromosome structure; genes/operon concept; protein biosynthesis; transformation, recombination, heterosis; Elements of economic botany; integrated diseases management; sterilisation, disinfection and pasteurization; Koch's postulates; aetiological agents of rusts, smuts, powdery/downy mildews, wilts, yellows, mosaic, necrosis, enations, blights and witches broom; pH, buffer, vitamins, role of plant hormones in

seed germination and dormancy; pollination / fertilization in flowering plants; methods of seed testing; breeders, foundation and certified seeds; seed production in self and cross pollinated crops, nitrate assimilation; biological nitrogen fixation and other uses of microorganisms in agriculture.

UNIT-IV: Food and industry; composting and biogas production. Important rural development programmes in India; organizational set up of agricultural research, education and extension in India.

ICAR SRF (PGS) SYLLABUS (CROP SCIENCES)

Crop Sciences

1. *Genetics & Plant Breeding*
2. *Economic Botany & Plant Genetic Resources,*
3. *Seed Science & Technology*

1. GENETICS & PLANT BREEDING

Unit 1: General Genetics and Plant Breeding : Mendelian inheritance. Cell structure and division, Linkage, its detection and estimation. Epistasis. Gene concept, allelism and fine structure of gene. Extra chromosomal inheritance. DNA – structure, function, replication and repair. Genetic code. Gene-enzyme relationship. Replication, Transcription and Translation. Gene regulation in prokaryotes and eukaryotes. Nuclear and cytoplasmic genome organization. Spontaneous and induced mutations and their molecular mechanisms. Crop domestication, evolution of crops and centres of diversity. Emergence of scientific plant breeding. Objectives and accomplishments in plant breeding and the role of National and International institutes. Gametogenesis and fertilization. Modes of sexual and asexual reproduction and its relation to plant breeding methodology. Apomixes, incompatibility and male sterility systems and their use in plant breeding.

Unit 2: Economics Botany and Plant Breeding Methods: Origin, distribution, classification, description and botany of cereals (wheat, rice, maize, sorghum, pearl millet, minor millets); pulses (pigeonpea, chickpea, black gram, green gram, cowpea, soyabean, pea, lentil, horse gram, lab-lab, rice bean, winged bean, lathyrus, Lima bean; oilseeds (groundnuts, sesamum, castor, rapeseed mustard, sunflower, Niger, linseed); fibers and

sugar crops, fodder and green manures; Breeding methods for self-pollinated, cross-pollinated and clonally propagated crops. Component, recombinational and transgressive breeding. Single seed descent. Populations, their improvement methods and maintenance, Hybrid breeding and genetic basis of heterosis. Ideotype breeding. Mutation breeding. Concept of tree breeding.

Unit 3: Genome Organization and Cytogenetics of Crop Plants:

Chromosome structure, function and replication. Recombination and crossing over. Karyotype analysis. Banding techniques. *In situ* hybridization. Special types of chromosomes. Chromosomal interchanges, inversions, duplications and deletions. Polyploids, haploids, aneuploids and their utility. Wide hybridization and chromosomal manipulations for alien gene transfer. Pre- and post-fertilization barriers in wide hybridization. Genome organization and cytogenetics of important crop species- wheat, maize, rice, sorghum, Brassica, cotton, Vigna, potato and sugarcane. Principles and procedures of genome analysis. Cytogenetic techniques for gene location and gene transfer, Construction and use of molecular marker based chromosome maps. Comparative mapping and genome analysis.

Unit 4: Quantitative and Biometrical Genetics:

Quantitative characters. Multiple factors inheritance. Genetic control of polygenic characters. Genetic advance and types of selection and correlated response. Hardy Weinberg law. Linkage disequilibrium. Genetic load. Polymorphism. Breeding value, heritability. Response to selection, correlated response. Estimates of variance components and covariance among relatives. Mating designs with random and inbred parents. Estimation of gene effects and combining ability. Effects of linkage and epistasis on estimation of genetic parameters. Maternal effects. Genotype environment interactions and stability of performance. Heterosis and its basis. Mating system and mating design-diallel, line X tester, NC-1, NC-II and NC-III designs, approaches to estimate and exploit component of self and cross pollinated crops. Genotype X environment interaction and stability analysis.

Unit 5: Genetic Engineering and Biotechnological Tools in Plant

Breeding: Somatic hybridization, micropropagation, somaclonal variation in vitro mutagenesis. Artificial synthesis of gene. Genetic and molecular markers, generations of molecular markers and their application in genetic analyses and breeding. Molecular markers in genetic diversity analysis and breeding for complex characters. Gene tagging, QTL mapping and marker aided selection. Genome projects and utilization of sequence formation. Vectors. DNA libraries, DNA fingerprinting, DNA sequencing. Nuclei acid hybridization and immunochemical detection. Chromosome walking, Recombinant DNA technology, Gene cloning strategies. Genetic transformation and transgenics. Antisense RNA, RNAi and micro RNA techniques in crop improvement.

Unit 6: Plant Breeding for Stress Resistance and Nutritional Quality: Genetic basis and breeding for resistance to diseases and insect-pests. Breeding for vertical and horizontal resistance to diseases. Genetic and physiological basis of abiotic stress tolerance. Breeding for resistance to heat, frost, flood, drought and soil stresses. Important quality parameters in various crops, their genetic basis and breeding for these traits. Role of molecular markers in stress resistance breeding: MAS, MARS and MABB.

Unit 7: Plant Genetic Resources and their Regulatory System; Varietal Release and Seed Production: Plant exploration, germplasm introduction, exchange, conservation, evaluation and utilization of plant genetic resources. Convention on Biological Diversity and International Treaty on Plant Genetic Resources for Food and Agriculture. Intellectual Property Rights. Biodiversity Act. Plant Variety Protection and Farmers' Rights Act. System of variety release and notification. Types of seeds and seed chain. Seed production and certification.

Unit 8: Statistical Methods and Field Plot Techniques: Frequency distribution. Measures of central tendency, probability theory and its applications in genetics. Probability distribution and tests of significance. Correlation, linear, partial and multiple regression. Genetic divergence. Multivariate analysis. Design of experiments- basic principles, completely randomized design, randomized block design and split plot design. Complete and incomplete block designs. Augmented design, Grid and honeycomb design. Hill plots, unreplicated evaluation. Data collection and interpretation.

[NET / ARS SYLLABUS]

Genetics & Plant Breeding

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Section - 1
PLANT BREEDING

