

New

M.Sc. (Ag.)

(Agronomy)

(Under Semester System as Per ICAR Recommended)

Syllabus

Academic Session- 2022-24



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Preamble

Agronomy is a discipline which deals with various processes such as cultivation, intercultural management of field through various measures like weed management, soil fertility development, and proper use of water resources and so on. Agronomy has a major component of agro ecology which includes several activities that affect the environment and human population. An Agronomist remains in the centre of effort to work with issues related to environmental and ecological concerns and to increase the production of food, feed, fuels and fiber for growing population in world. Agronomists today are involved with many issues including producing food, creating healthier food, managing environmental impacts and creating energy from plants. Research activities in Agronomy focus on system analysis and simulation modeling of environmental and management impacts on agricultural production, these are key to the sustainability of agricultural production system.

Hence, it is very much essential to revise the course curriculum of Agronomy so that students and teachers may be well acquainted with the present concept of development of the discipline. This will help bringing competency in students along with confidence so as to develop himself/herself for being tackling field problems and management of land. The existing M.Sc. (Ag) courses of Agronomy have been modified taking into account of present day needs by incorporating the necessary and important topics in the respective courses.

Minor changes have been made in most of the existing courses. As a part of course curriculum, M. Sc.(Ag) Agronomy was restructured to equip students to tackle emerging issues by inclusion of one new course on "Conservation agriculture". All the Ph.D. courses of Agronomy was slightly revised by adding/ deleting some portion in the existing courses. The course "Fundamentals of Meteorology" is dropped from Agronomy department and interested students can take the course from department of Agri. Meteorology. The course "Agro ecology" offered by the department for Ph.D. programme is also dropped. Similarly, the Ph.D. course "Crop production and system modeling" is also deleted and the contents are merged with Agron 601, i.e. "Current trends in Agronomy".

It was proposed by some members to include new courses like "Seed production technology", "Experimental technique in Agronomy" and "Management of Problem soils and water". But finally, it was decided that these courses should be offered by the core departments such as Department of Seed Technology, Department of Statistics and Department of Soil Science, respectively. There are few courses in the existing syllabus which are not offered by in many universities. Hence these courses are merged and thereby reduced the number of courses to limit choices that complete knowledge of the subject can be given to the students. In all the courses, the practical aspects are strengthened.

Topics such as automated irrigation systems, value chain addition/post-harvest processing, variable rate application, precision farming, protected agriculture, soil less farming, farm mechanization of practical operations, practical applications of advanced tools for big data analysis and interpretation, artificial intelligence, drones etc are included in the revised syllabus so that students can show competency at national and international level.



M.Sc. (Ag.) Agronomy

Course Code	Course Title	Credit Hours
Agron 501*	Modern Concepts in Crop Production	3+0
Agron 502	Agronomy of Major Cereals and Pulses	2+0
Agron 503	Organic Fruit Culture	2+1
Agron 504	Intellectual Property and Its Management	1+0
Agron 505	Experimental Design	2+1
Agron 506*	Principles and Practices of soil fertility and nutrient management	2+1
Agron 507	Agronomy of oilseed, fibre and sugar crops	2+1
Agron 508	Principle of vegetable breeding	2+1
Agron 509	Basic concepts in laboratory techniques	0+1
Agron 510	Information Technology in agriculture	1+1
Agron 511*	Principle and practices of water management	2+1
Agron 512	Agronomy of fodder and forage crops	2+1
Agron 513	Seed production in flower crops	1+1
Agron 514	Technical writing and communication skills	0+1
Agron 515	Agricultural research, research ethics and rural development programmes	0+1
Agron 516*	Principles and practices weed management	2+1
Agron 517	Library and information services	1+0
Agron 550	Seminar	1
Agron 560	Thesis research	30

*Indicates core course which is Compulsory course for MSc.(Agri.)

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1 st Semester						Evaluation Marks
Code No.	Course Title	Credit Hours	Mid Term	End Term	Practical	Total
Agron 501	Modern Concepts in Crop Production	3+0	25	50	25	100
Agron 502	Agronomy of Major Cereals and Pulses	2+0	25	50	25	100
Agron 503	Organic Fruit Culture	2+1	25	50	25	100
Agron 504	Intellectual Property and Its Management	1+0	25	50	25	100
Agron 505	Experimental Design	2+1	25	50	25	100
Total Credits		12			-	

2 nd Semester						Evaluation Marks
Code No.	Course Title	Credit Hours	Mid Term	End Term	Practical	Total
Agron 506	Principles and Practices of soil fertility and nutrient management	2+1	25	50	25	100
Agron 507	Agronomy of oilseed, fibre and sugar crops	2+1	25	50	25	100
Agron 508	Principle of vegetable breeding	2+1	25	50	25	100
Agron 509	Basic concepts in laboratory techniques	0+1	25	50	25	100
Agron 510	Information Technology in agriculture	1+1	25	50	25	100
Total Credits		12			-	

3 rd Semester						Evaluation Marks
Code No.	Course Title	Credit Hours	Mid Term	End Term	Practical	Total
Agron 511	Principle and practices of water management	2+1	25	50	25	100
Agron 512	Agronomy of fodder and forage crops	2+1	25	50	25	100
Agron 513	Seed production in flower crops	1+1	25	50	25	100
Agron 514	Technical writing and communication skills	0+1	25	50	25	100
Agron 515	Agricultural research, research ethics and rural development programmes	0+1	25	50	25	100
Total Credits		10			-	

4 th Semester						Evaluation Marks
Code No.	Course Title	Credit Hours	Mid Term	End Term	Practical	Total
Agron 516	Principles and practices weed management	2+1	25	50	25	100
Agron 517	Library and information services	1+0	25	50	25	100
Agron 550	Seminar	1				
Agron 560	Thesis research	30				
Total Credits		35			-	
Total Semester Credit Hours		70				

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M.Sc. (Ag.) Agronomy

First Semester

I. Course Title : Modern Concepts in Crop Production

II. Course Code: Agron 501

III. Credit Hours : 3+0

IV. Need of the course

To teach the basic concepts of soil management and crop production.

V. Theory

Unit I

Crop growth analysis in relation to environment; geo-ecological zones of India.

Unit II

Quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield equation, its interpretation and applicability; Baule unit.

Unit III

Effect of lodging in cereals; physiology of grainy yield in cereals; optimization of plant population and plant geometry in relation to different resources; concept of ideal plant type and crop modeling for desired crop yield.

Unit IV

Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress, use of growth hormones and regulators for better adaptation in stressed condition.

Unit V

Integrated farming systems, organic farming, and resource conservation technology including modern concept of tillage, dry farming; determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture. Modern crop production concepts: soilless cultivation, Aeroponic, Hydroponic, Robotic and terrace farming, use of GIS, GPS and remote sensing in modern agriculture, precision farming and protected agriculture.

VI. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and class discussion

VII. Learning outcome

Basic knowledge on soil management and crop production

VIII. Suggested Reading

- Balasubramaniyan Pand Palaniappan SP. 2001. Principles and Practices of Agronomy. Agrobios.
- Fageria NK. 1992. Maximizing Crop Yields. Marcel Dekker.
- Havlin JL, Beaton JD, Tisdale SL and Nelson WL. 2006. Soil Fertility and Fertilizers. 7

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- E.d.PrenticeHall.
- ParodaR.S.2003.SustainingourFoodSecurity.KonarkPubl.
 - ReddySR.2000.PrinciplesofCropProduction.KalyaniPubl.
 - SankaranSandMudaliarTVS.1997.PrinciplesofAgronomy.TheBangalorePrinting&Publ.
 - SinghSS.2006.PrinciplesandPracticesofAgronomy.Kalyani.
 - AlvinPTandkozowskiTT(ed.).1976.Eco physiologyofTropicalCrops.AcademiaPul.,NewYork.
 - GardnerPP,PearceGRandMitchellRL.1985.PhysiologyofCropPlants.ScientificPub.Jodhpur.
 - LalR.1989.Conservationtillageforsustainableagriculture:TropicsversusTemperate Environments.AdvancesinAgronomy42:85-197.
 - WilsicCP.1961.CropAdaptationandDistribution EuresiaPub.,NewDelhi.

I. Course Title :AgronomyofMajorCerealsandPulses

II. Course Code :Agron502

III. Credit Hours :2+0

IV. Need ofthecourse

To impart knowledge of crop husbandry of cereals and pulse crops.

V. Theory

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of:

UnitI:Rabicereals

UnitII:Kharifcereals

UnitIII:Rabipulses

UnitIV:Kharifpulses



VI.Practical

- Phenological studies at different growth stages of crop
- Estimation of crop yield on the basis of yield attributes
- Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
- Working out growth indices (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLW etc)
- Assessment of land use and yield advantage (Rotational intensity, Cropping intensity, Diversity Index, Sustainable Yield Index, Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative Crowding Coefficient, Competition Ratio and ATER etc)
- Estimation of protein content in pulses
- Planning and layout of field experiments
- Judging of physiological maturity in different crops
- Intercultural operations in different crops
- Determination of cost of cultivation of different crops
- Working out harvest index of various crops
- Study of seed production techniques in selected crops
- Visit to field experiments on cultural, fertilizer, weed control and water management aspects
- Visit to nearby villages for identification of constraints in crop production

VII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and class discussion

VIII. Learning outcome

Basic knowledge on cereals and pulse growing in the country.

IX. Resources

- Das NR. 2007. Introduction to Crops of India. Scientific Publ.
- Hunsiga G and Krishna KR. 1998. Science of Field Crop Production. Oxford & IBH.
- Jeswani L and Baldev B. 1997. Advances in Pulse Production Technology. ICAR.
- Khare D and Bhale MS. 2000. Seed Technology. Scientific Publ.
- Kumar Ranjeet and Singh NP. 2003. Maize Production in India: Golden Grain in Transition. IARI, New Delhi.
- Pal M, Deka J and Rai RK. 1996. Fundamentals of Cereal Crop Production. Tata McGraw Hill.
- Prasad Rajendra. 2002. Text Book of Field Crop Production. ICAR.
- Singh C, Singh P and Singh R. 2003. Modern Techniques of Raising Field Crops. Oxford & IBH.
- Singh SS. 1998. Crop Management. Kalyani.
- Yadav DS. 1992. Pulse Crops. Kalyani.
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I. Course Title :Organic Fruit Culture

II. Course Code:Agron503

III. Credit Hour :(2+1)

IV. Need of the course?

Considering threats to environment and human health on account of excessive use of chemicals and synthetic fertilizers, organic farming is looked upon as an alternative. Though the organic and other natural farming practices are in evolving phase and are yet to be time scale tested, there is a general perception that these would hold good. As such a course is customized to educate the graduates on various issues related to organic farming.

V. Objective of the course

To develop understanding on organic production of fruit crops.

The course is structured as under:-

No. Blocks	Units
1 General Aspects	Principles and Current Scenario
2 Organic Culture	Farming System and Practices
3 Certification	Inspection, Control Measures and Certification

VI. Theory

Block1: General Aspects

Unit 1: Principles and Current Scenario: Organic horticulture, scope, area, production and world trade, definition, principles, methods and SWOT analysis.

Block2: Organic Culture

Unit

I: Farming System and Practices: Organic farming systems including biodynamic farming, natural farming, home organic farming, rishikrishi, EM technology, cosmic farming; on-farm and off-farm production of organic inputs, role of bio-fertilizers, bio-enhancers, legumes, intercropping, cover crops, green manuring, zero tillage, mulching and their role in organic nutrition management. Organic seeds and planting materials, soil health management in organic production, weed management practices in organic farming, biological management of pests and diseases, trap crops, quality improvement in organic production of fruit crops.

Block3: Certification

Unit1: Inspection, Control Measures and Certification: Inspection

and certification of organic produce, participatory guarantee system (PGS), NPOP, documentation and control, development of internal control system (ICS), Concept of group certification, constitution of furrower group as per NPOP, preparation of ICS manual, internal and external inspection, concept of third party verification, certification of small farmer groups (Group Certification), transaction certificate, group certificate, critical control points (CCP) and HACCP, IFOAM guidelines on certification scope and chain of custody, certification trademark -The Logo, accredited certification bodies under NPOP. Constraints in certification, IFOAM and global scenario of organic movement, postharvest management of organic produce. Economics of organic fruit production.

VII. Practical's

- Design of organic orchards/farms management(1);
- Conversion plan(1);
- Nutrient management and microbial assessment of composts and bio-enhancers(2);
- Preparation and application of composts, bio-enhancers and bio-pesticides(2);
- Organic nursery raising(1);
- Application of composts, bio-enhancers, bio-fertilizer's and bio-pesticides, green manure, cover, mulching(2);
- Preparation and use of neem based products(1);

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- Biodynamic preparations and their role in organic agriculture, EM technology and products, biological/natural management of pests and diseases (2);
- Soil solarisation (1);
- Framework for GAP (1);
- Documentation for certification (1).

VIII. Teaching Methods/Activities

- Classroom Lectures
- Laboratory/Field Practical's
- Student Seminars/Presentations
- Field Tours/Demonstrations
- Assignments

IX. Learning outcome

On successful completion of the course, the students are expected to be able to familiarize zenith the concepts and practices of organic and other natural farming systems. Generate knowledge on procedures, policies and regulation for inspection and certification of organic produce.

X. Suggested Reading

- Claude A. 2004. The Organic Farming Sourcebook. Other India Press, Mapusa, Goa, India. Dabholkar SA. 2001. Plenty for All. Mehta Publishing House, Pune, Maharashtra.
- Das HC and Yadav AK. 2018. Advances in Organic Production of Fruit Crops. Westville Publishing House, New Delhi.
- Deshpande MS. 2003. Organic Farming with respect to Cosmic Farming. Mrs. Pushpa Mohan Deshpandey, Kolhapur, Maharashtra.
- Deshpande WR. 2009. Basics of Organic Farming. All India Biodynamic and Organic Farming Association, Indore, MP.
- Gaur AC, Neblakantan Sand Dargan KS. 1984. Organic Manures. ICAR, New Delhi. Lampkin N. and Ipswich, S. 1990. Organic Farming. Farming Press, London, UK.
- Lind K, Lafer G, Schloffer K, Innerhofer G and Meister H. 2003. Organic Fruit Growing. CAB International.
- Palaniappan SP and Annadurai K. 2008. Organic Farming - Theory and Practice. Scientific Publishers, Jodhpur, Rajasthan, India.
- Palekar S. 2004. The Technique of Spiritual Farming. Chandra Smaritee, Sai Nagar, Amravati, Maharashtra.
- Proctor P. 2008. Biodynamic Farming and Gardening. Other India Press, Mapusa, Goa. Ram RA and Pathak RK. 2017. Bioenhancers. Lap Lambert Academic Publishing, AP.

Course Title : Intellectual property and management In agriculture

Course Code : Agron504

Credit Hours : 1+0

Objective of Course

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

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPS and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamental of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, 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, 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

1. Erbisch F and Maredia K. 1998 Intellectual Property Rights in Agricultural Biotechnology CABI
2. Ganguli P. 2001 Intellectual Property Rights Unleashing Knowledge Economy McGraw-Hill.
3. Intellectual Property Rights: Key to New Wealth Generation 2001. NRDC and Aesthetic Technologies.
4. Ministry of Agriculture, Government of India. 2004 State of Indian Farmer Vol. V. Technology Generation and IPR Issues. Academic Foundation.
5. Rothschild M and Scott N. (Ed.). 2003 Intellectual Property Rights in Animal Breeding and Genetics. CABI.
6. Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium 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; The Biological Diversity Act, 2002.

I. Course Title : Experimental Designs

II. Course Code : Agron 505

III. Credit Hours : 2+1

IV. Need of the course

This course is meant for students of agricultural and animal sciences other than Agricultural Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

V. Theory

Unit I

Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.

Unit II

Uniformity trials, size and shape of plots and blocks, Analysis of variance, Completely randomized design, randomized block design and Latin square design.

Unit III

Factorial experiments, (symmetrical as well as asymmetrical), orthogonality and partitioning of degrees of freedom. Concept of confounding.

Unit IV

Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications, Lattice design, alpha design - concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis.

VI. Practical

- Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law, Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments,
- Analysis with missing data,
- Split plot and strip plot designs.

VII. Suggested Reading

- Cochran WG and Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley.
- Dean AM and Voss D. 1999. Design and Analysis of Experiments. Springer.
- Montgomery DC. 2012. Design and Analysis of Experiments, 8th Ed. John Wiley.



- Federer WT. 1985. Experimental Designs. MacMillan.
- Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd.
- Nigam AK and Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ.
- Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley.

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UnitV

Ideotype breeding-

Ideotype breeding, varietal release procedure, DUS testing in vegetable crops, Application of In-vitro and molecular techniques in vegetable improvement.

VIII. Practical

- Floral biology and pollination behaviour of different vegetables;
- Techniques of selfing and crossing of different vegetables, viz., Cole crops, okra, cucurbits, tomato, eggplant, hot pepper, etc.;
- Breeding system and handling of filial generations of different vegetables;
- Exposure to biotechnological lab practices;
- Visit to breeding farms.

IX. Teaching Methods/Activities

- Classroom Lectures
- Assignment (written and speaking)
- Student presentation
- Hands on training of different procedures
- Group discussion
- After successful completion of this course, the students are expected to:
 - Acquire knowledge about the principles of vegetable breeding
 - Improve yield, quality, abiotic and biotic resistance, other important traits of vegetable crops
 - Understand how the basic principles are important to start breeding of vegetable crops

X. Suggested Reading

Allard RW. 1960. Principle of plant breeding. John Wiley and Sons, USA. Kalloo G. 1988. Vegetable breeding (Vol. I, II, III). CRC Press, FL, USA.

Kole CR. 2007. Genomic mapping and molecular breeding in plants-vegetables. Springer, USA. Peter KV and Pradeep Kumar T. 1998. Genetics and breeding of vegetables. ICAR, New Delhi, p. 488.

Prohens J and Nuez F. 2007. Handbook of plant breeding- vegetables (Volland II). Springer, USA.

Singh BD. 2007. Plant breeding-principles and methods (8th edn.). Kalyani Publishers, New Delhi.

Singh Ram J. 2007. Genetic resources, chromosome engineering and crop improvement- vegetable crops (Vol. 3). CRC Press, FL, USA.

- **Course Title** : Basic concepts in laboratory techniques
- **Course Code** : HOR509
- **Credit Hours** : 0+1

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

- Safety measures while in Lab;
- Handling of chemical substances;
- Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vacupettes;
- Washing, drying and sterilization of glassware;
- Drying of solvents/chemicals;
- Weighing and preparation of solutions of different strengths and their dilution;
- Handling techniques of solutions;
- Preparation of different agro-chemical doses in field and pot applications;
- Preparation of solutions of acids,

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Second Semester

I. Course Title: Principles and Practices of Soil Fertility and Nutrient Management

II. Course Code :Agron506

III. Credit Hours :2+1

IV. Objective of the course

To impart knowledge of fertilizers and manures as sources of plant nutrients and apprise about the integrated approach of plant nutrition and sustainability of soil fertility.

V. Theory

Unit I

Soil fertility and productivity - factors affecting; features of good soil management; problems of supply and availability of nutrients; relation between nutrient supply and crop growth; organic farming - basic concepts and definitions.

Unit II

Criteria of essentiality of nutrients; Essential plant nutrients - their functions, nutrient deficiency symptoms, transformation and dynamics of major plant nutrients.

Unit III

Preparation and use of farmyard manure, compost, green manures, vermicompost, biofertilizers and other organic concentrates; their composition, availability and crop responses; recycling of organic wastes and residue management. Soil less cultivation.

Unit IV

Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency; agronomic, chemical and physiological, fertilizer mixtures and grades; methods of increasing fertilizer use efficiency, nutrient interactions.

Unit V

Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic nutrients; economics of fertilizer use; integrated nutrient management; use of vermicompost and residue wastes in crops.

VI. Practical

- Determination of soil pH and soil EC
- Determination of soil organic C
- Determination of available N, P, K and S in soil
- Determination of total N, P, K and S in plant
- Computation of optimum manure and economic yield

VII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and class discussion

VIII. Learning outcome

Basic knowledge on soil fertility and management

IX. Suggested Reading

- Brady NC and Weil RR. 2002. The Nature and Properties of Soils. 13th Ed. Pearson Edu.
- Fageria NK, Baligar VC and Jones CA. 1991. Growth and Mineral Nutrition of Field Crops. Marcel Dekker.
- Havlin JL, Beaton JD, Tisdale SL and Nelson WL. 2006. Soil Fertility and Fertilizers. 7th Ed. Prentice Hall.
- Prasad R and Power JF. 1997. Soil Fertility Management for Sustainable Agriculture. CRC Press.
- Yawalkar KS, Agrawal JP and Bokde S. 2000. Manures and Fertilizers. Agri-Horti Publ.

I. Course Title :Agronomy of Oilseed, Fibre and Sugar Crops

II. Course Code :Agron 507

III. Credit Hours :2+1

IV. Aim of the course

To teach the crops husbandry of oilseed, fiber and sugar crops

V. Theory

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality component, handling and processing of the produce for maximum production of:

Unit I

Rabi oilseeds - Rapeseed and mustard, Linseed and Niger

Unit II

Kharif oilseeds - Groundnut, Sesame, Castor, Sunflower, Soybean and Safflower

Unit III

Fiber crops - Cotton, Jute, Ramie and Mesta.

Unit IV

Sugar crops - Sugar-beet and Sugarcane.

VL Practical

- Planning and layout of field experiments
- Cutting of sugarcane sets, its treatment and methods of sowing, tying and propping of sugarcane
- Determination of cane maturity and calculation on purity percentage, recovery percentage and sucrose content in cane juice phenological studies at different growth stages of crop
- Intercultural operations in different crops

- Cottonseed treatment
- Working out growth indices (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLWetc)
- Assessment of land use and yield advantage (Rotational intensity, Cropping intensity, Diversity Index, Sustainable Yield Index, Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative Crowding Coefficient, Competition Ratio and ATE etc)
- Judging of physiological maturity in different crops and working out harvest index
- Working out cost of cultivation of different crops
- Estimation of crop yield on the basis of yield attributes
- Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
- Determination of oil content in oilseeds and computation of oily yield
- Estimation of quality of fibre of different fibre crops
- Study of seed production techniques in various crops
- Visit to field experiments on cultural, fertilizer, weed control and water management aspects
- Visit to nearby villages for identification of constraints in crop production

VIII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and class discussion

IX. Learning outcome

Basic knowledge on production of oilseed, sugar and fibre crops.

X. Suggested Reading

- Das NR. 2007. Introduction to Crops of India. Scientific Publ.
- Das PC. 1997. Oilseed Crops of India. Kalyani.
- Lakshmi Kantam N. 1983. Technology in Sugarcane Growing. 2nd Ed. Oxford & IBH.
- Prasad Rajendra. 2002. Text Book of Field Crop Production. ICAR.
- Singh C, Singh P & Singh R. 2003. Modern Techniques of Raising Field Crops. Oxford & IBH.
- Singh SS. 1998. Crop Management. Kalyani.
- Group discussion

IX. Learning outcome

After successful completion of this course, the students are expected to:

- Acquire knowledge about the principles of vegetable breeding
- Improve yield, quality, abiotic and biotic resistance, other important traits of vegetable crops
- Understand how the basic principles are important to start breeding of vegetable crops

X. Suggested Reading

- Allard RW. 1960. Principles of plant breeding. John Wiley and Sons, USA. Kalloo G. 1988. Vegetable breeding (Vol. I, II, III). CRC Press, FL, USA.
 Kole CR. 2007. Genomic mapping and molecular breeding in plants - vegetables. Springer, USA. Peter K V and Pradeep Kumar T. 1998. Genetics and breeding of vegetables. ICAR, New Delhi, p. 488.
 Prohens J and Nuez F. 2007. Handbook of plant breeding - vegetables (Vol I and II). Springer, USA.
 Singh BD. 2007. Plant breeding - principles and methods (8th edn.). Kalyani Publishers, New Delhi.
 Singh Ram J. 2007. Genetic resources, chromosome engineering, and crop improvement - vegetable crops (Vol. 3). CRC Press, FL, USA.

I. Course Title : Principles of Vegetable Breeding

II. Course Code : Agron 508




III. CreditHours : (2+1)**IV. Need of the course?**

Plant breeding has been practiced for thousands of years, since beginning of humancivilization. Vegetablebreeding, which is an art and science of changing the traits of plants in order to produce desired traits, has been used to improve the quality of nutrition in products for human beings. A breeding programme, which is needed if current varieties are not producing up to the capacity of the environment, can be accomplished through many different techniques ranging from simply selecting plants with desirable characteristics, make use of knowledge of genetics and

chromosomes to more complex molecular techniques. When different genotypes

exhibit differential responses to different sets of environmental conditions, a genotype \times environment (GXE) interaction is said to occur. Breeding high yielding open pollinated varieties and hybrids, and exploitation of location specific component of genotypic performance are the only options left to reduce this increasing gap between the production and requirements in view of decreasing land resources. Nevertheless, vegetable breeding is an integral part of plant breeding but this will be re-modeled to suit to breeding of different vegetables crops. The students of vegetable science who are having breeding as major subject need to have an understanding of vegetable breeding principles.

V. Objective of the course

To teach basic principles and practices of vegetable breeding

The course is constructed given as under:

No. Block	Unit
1. Principles of vegetable breeding	I. Importance and history II. Selection procedures III. Heterosis breeding IV. Mutation breeding V. Polyploid breeding VI. Ideotype breeding

VII. Theory**Unit I**

Importance and history- Importance, history and evolutionary aspects of vegetable breeding and its variation from cereal crop breeding.

Unit II

Selection procedures- Techniques of selfing and crossing; Breeding systems and methods; Selection procedures and hybridization; Genetic architecture; Breeding for biotic stress (diseases, insect pests and nematode), abiotic stress (temperature, moisture and salt) resistance and quality improvement; Breeding for water use efficiency (WUE) and nutrient use efficiency (NUE).

Unit III

Heterosis breeding-

Types, mechanisms and basis of heterosis, facilitating mechanisms like male sterility, self-incompatibility and sex forms.

Unit IV

Mutation and Polyploidy breeding; Improvement of asexually propagated vegetable crops and vegetables suitable for protected environment.

- Neutralisation of acids and bases;
- Preparation of buffers of different strengths and pH values;
- Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath, water bath, oil bath;
- Electric wiring and earthing;
- Preparation of media and methods of sterilization;
- Seed viability testing, testing of pollen viability;
- Tissue culture of crop plants;
- Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

1. Furr AK. 2000. CRCHandBookofLaboratorySafety. CRCPress.
2. Gabb M Hand Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

I. Course Title : Information Technology in Agriculture

II. Course Code : HOR 510

III. Credit Hours : 1+1

IV. Need of the course

This is a course on Introduction to Networking and Internet Applications that aims at exposing the students to understand analogy of computer, basic knowledge of

bifz

ICM

MS Office. Also to understand Internet and WWW, use of IT application and different IT tools in Agriculture

V. Theory

Unit I

Introduction to Computers, Anatomy of computer, Operating Systems, definition and types, Applications of MS Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions,

Unit II

Database, concepts and types, uses of DBMS in Agriculture, World Wide Web
Statistical Sciences: Computer Application

765

(WWW): Concepts and components, Introduction to computer programming languages, concepts and standard input/output operations. e-Agriculture, concepts and applications,

Unit III

Use of ICT in Agriculture, Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computercontrolled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc.,

Unit IV

Geospatial technology for generating valuable agri-information. Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting Farm decisions, Preparation of contingent crop-planning using IT tools.

VI. Suggested Reading

- Vanitha G. 2011. Agro-informatics
- <http://www.agrimoon.com>
- <http://www.agriinfo.in>
- <http://www.eagri.org>
- <http://www.agriglance.com>
- <http://agritech.tnau.ac.in>

THIRD SEMESTER

I. Course Title	: Principles and Practices of Water Management
II. Course Code	: Agron511

III. CreditHours :2+1

IV. Aimofthecourse

To teach the principles of water management and practices to enhance the water productivity

V. Theory

UnitI

Water and its role in plants; Irrigation: Definition and objectives, water resources and irrigation development in India and concerned state, major irrigation projects, extent of area and crops irrigated in India and in different states.

UnitII

Field water cycle, water movement in soil and plants; transpiration; soil-water-plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition. Water availability and its relationship with nutrient availability and losses.

UnitIII

Soil, plant and meteorological factors determining water needs of crops, scheduling, depth and methods of irrigation; microirrigation systems; deficit irrigation, fertigation; management of water in controlled environments and polyhouses. Irrigation efficiency and water use efficiency.

UnitIV

Water management of crop and cropping system, Quality of irrigation water and management of saline water for irrigation, water use efficiency. Crop water requirement estimation of ET and effective rainfall; Water management of the major crops and cropping systems. Automated irrigation system.

UnitV

Excess of soil water and plant growth, water management in problem soils, drainage requirement of crops and methods of field drainage, their layout and spacing; rainwater management and its utilization for crop production.

UnitVI

Quality of irrigation water and management of saline water for irrigation, water management in problem soils

UnitVII

Soil moisture conservation, water harvesting, rainwater management and its utilization for crop production.

UnitVIII

Hydroponics,

UnitIX

Water management of crops under climate change scenario.

VI. Practical

- Determination of Field capacity by field method
- Determination of Permanent Wilting Point by sunflower pot culture technique
- Determination of Field capacity and Permanent Wilting Point by Pressure Plate Apparatus
- Determination of Hygroscopic Coefficient
- Determination of maximum water holding capacity of soil
- Measurement of matric potential using gauge and mercury type tensiometer

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KHCN

- Determination of soil-moisture characteristics curves
- Determination of saturated hydraulic conductivity by constant and falling head method
- Determination of hydraulic conductivity of saturated soil below the water table by auger hole method
- Measurement of soil water diffusivity
- Estimation of unsaturated hydraulic conductivity
- Estimation of upward flux of water using tensiometer and from depth ground water table
- Determination of irrigation requirement of crops (calculations)
- Determination of effective rainfall (calculations)
- Determination of ET of crops by soil moisture depletion method 16. Determination of water requirements of crops
- Measurement of irrigation water by volume and velocity-area method
- Measurement of irrigation water by measuring devices and calculation of irrigation efficiency
- Determination of infiltration rate by doubling infiltration meter

VII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and field visit

VIII. Learning outcome

Basic knowledge on water management for optimization of crop yield

IX. Suggested Reading

- Majumdar DK. 2014. Irrigation Water Management: Principles and Practice. PHL Learning private publishers
- Mukund Joshi. 2013. A Text Book of Irrigation and Water Management Hardcover, Kalyani publishers
- Lenka D. 1999. Irrigation and Drainage. Kalyani.
- Michael AM. 1978. Irrigation: Theory and Practice. Vikas Publ.
- Paliwal KV. 1972. Irrigation with Saline Water. IARI Monograph, New Delhi.
- Panda SC. 2003. Principles and Practices of Water Management. Agrobios.
- Purihar SS and Sandhu BS. 1987. Irrigation of Food Crops - Principles and Practices. ICAR.
- Reddy SR. 2000. Principles of Crop Production. Kalyani.
- Singh Pratap and Malviwal PL. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publ.

I. Course Title : Agronomy of Fodder and Forage Crops

II. Course Code : Agron 512

III. Credit Hours : 2+1

IV. Aim of the course

To teach the crop husbandry of different forage and fodder crops along with their processing.

V. Theory

Unit 1

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like sorghum, maize, bajra, guar, cowpea, oats, barley, berseem, senji, lucerne, etc.

UnitII

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important forage crops/grasses like Napiergrass, Panicum, Lasiurus, Cenchrus, etc.

UnitIII

Year-

round fodder production and management, preservation and utilization of forage and pasture crops.

UnitIV

Principles and methods of hay and silage making; chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage; use of physical and chemical enrichments and biological methods for improving nutrition; value addition of poor quality fodder. Fodder production through hydroponics. Azolla cultivation.

UnitV

Economics of forage cultivation uses and seed production techniques of important fodder crops.

VI. Practical

- Practical training of farm operations in raising fodder crops;
- Canopy measurement, yield, Leaf: Stem ratio and quality estimation, viz. crude protein, NDF, ADF, lignin, silica, cellulose and IV DMD, etc. of various fodder and forage crops
- Anti-quality components like HCN in sorghum and such factors in other crops
- Hay and silage making and economics of their preparation.

VII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and field visit

VIII. Learning outcome

Acquainted with various fodder and forage crops and their commercial base for developing entrepreneurship.

IX. Suggested Reading

- Chatterjee BN. 1989. Forage Crop Production - Principles and Practices. Oxford & IBH.
- Das NR. 2007. Introduction to Crops of India. Scientific Publ.
- Narayanan TR and Dabaghao PM. 1972. Forage Crops of India. ICAR.
- Singh Pand Srivastava AK. 1990. Forage Production Technology. IGFRI, Jhansi.
- Singh C, Singh P and Singh R. 2003. Modern Techniques of Raising Field Crops. Oxford & IBH.
- Tejwani KG. 1994. Agroforestry in India. Oxford & IBH.

I. Course Title : Seed Production in Flower Crops

II. Course Code : AGRON:513

III. Credit Hours : (1+1)

IV. Need of the course?

Seed production of flowers is a highly remunerative enterprise. The students need to have knowledge of seed industry, seed production methods and seed certification. This course provides hands on training on seed production of important flower crops.

V. Objective of the course

To impart basic knowledge about the importance of seed production in important flower crops.

The course is organized as follows

No	Blocks	Units
1	Seed Industry	1 Scenario of Seed industry
2	Hybrid Seed Production	1 Seed Production methods II Population improvement III F1 Hybrid production
3	Regulations	1 Seed certification and standards

VI. Theory

Block1: Seed Industry

Unit I: Scenario of Seed Industry: Scope, scenario and importance of seed production in flower crops. Constraints in flower seed production. Marketing and economics of flower seeds.

Block2: Hybrid Seed Production

Unit I: Seed production-Methods: Methods of seed production, agrotechniques for production of nucleus, breeder and certified seeds. Harvesting, seed processing, seed priming, seed chain, packaging and storage.

Unit II: Population improvement: Mass selection, progeny selection. Use of incompatibility and male sterility, maintenance of variety and seed production in flower crops.

Unit III: F1 hybrids: F1 hybrid seed production advantages, steps involved in hybrid seed production, pollination behaviour and isolation, pollination management methods in production of F1/ hybrids in different flower crops.

Block3: Regulations

Unit I: Seed certification and standards: Seed certification, Seed standards, seed act, plant breeders rights and farmers' rights, Bio safety, handling of transgenic seed crops, importing of seeds and OGL, trade barriers in seed business, sanitary and phytosanitary issues, custom clearance and quarantine.

Crops

Marigold, petunia, antirrhinum, zinnia, pansy, lupin, calendula, phlox, vinca, dianthus, sunflower, annual chrysanthemum, poppy, cornflower, rice flower.

VII. Practical

- Seed production of open pollinated varieties(2);
- Seed production of cross pollinated varieties(2);
- Steps involved in hybrid seed production(2);
- Hybrid seed production in different flower crops like marigold, petunia, antirrhinum, zinnia, pansy, lupin, calendula, phlox, vinca, dianthus, sunflower, annual chrysanthemum, etc.(6);
- Visit to seed industry(3);
Visit to quarantine facility(1).

VIII. Teaching Methods/Activities

- Lectures
- Group discussions
- Flip classes
- Assignment and group seminars
- Hands on training of different techniques
- Exposure visits

IX. Learning outcome

After successful completion of this course,

- The students will get a thorough knowledge on seed industry, principles and methods of seed production in flower crops.
- Students will get awareness on seed standards, certification and law in flower crops.

X. Suggested Reading

- Bhattacharjee SK. 2018. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publ.
Reprint, pp. 2065.
- Bose TK, Yadav LP, Pal P, Parthasarathy V A and Das, P. 2003. Commercial Flowers. Vol. I & II. Naya Udyog, Kolkata, India.
- Davies, Fred Jr., Geneve RL, Wilson SB, Hartmann HT, Kester DL. 2018. Hartmann and Kester's Plant Propagation: Principles and Practices. Pearson Publ. 9th Edition.
- Larson RA and Armitage AM. 1992. Introduction of Floriculture. International Book Distributing Co., Lucknow, India.

Course Title

: Technical writing and communications skills



Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR); International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels. International fellowships for scientific mobility.

UNIT II Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group-Area Specific Programme, Integrated Rural Development Programme (IRDP); Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

1. Bhalla GS and Singh G. 2001. Indian Agriculture-Four Decades of Development. Sage Publ.
2. Punia MS. Manual on International Research and Research Ethics. CCS Haryana Agricultural University, Hisar.
3. Rao BSV. 2007. Rural Development Strategies and Role of Institutions-Issues, Innovations and Initiatives. Mittal Publ.
4. Singh K. 1998. Rural Development-Principles, Policies and Management. Sage Publ.

FOURTH SEMESTER

I. Course Title : Principles and Practices of Organic Farming

II. Course Code : Agron 516

III. Credit Hours : 2+1

IV. Aim of the course

To study the principles and practices of organic farming for sustainable crop production.

V. Theory

UnitI

Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; principles of organic agriculture; organic standards, organic farming and sustainable agriculture; selection and conversion of land, soil and water management - land use, conservation tillage; shelter zones, hedges, pasture management, agro-forestry.

UnitII

Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures, bio-fertilizers and biogastechnology.

UnitIII

Farming systems, selection of crops and crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.

UnitIV

Control of weeds, diseases and insect pest management, biological agents and pheromones, bio-pesticides.

UnitV

Socio-economic impacts, marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.

VI. Practical

- Method of making compost by aerobic method
- Method of making compost by anaerobic method
- Method of making vermicompost
- Identification and nursery raising of important agro-forestry trees and shrubs for shelter belts
- Efficient use of biofertilizers, technique of treating legume seeds with Rhizobium cultures, use of Azotobacter, Azospirillum, and PSC cultures in field
- Visit to a biogas plant
- Visit to an organic farm
- Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms

VII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment exposure visit

VIII. Learning outcome

Basic knowledge on organic farming for sustainable agriculture and development

of entrepreneurship on organic inputs.

IX. Suggested Reading

- Ananthakrishnan TN (Ed.). 1992. Emerging Trends in Biological Control of Phytophagous Insects. Oxford & I BH.
- Gaur AC. 1982. A Manual of Rural Composting. FAO/UNDP Regional Project Document, FAO.
- Joshi M. 2016. New Vistas of Organic Farming. Scientific Publishers.
- Lampin N. 1990. Organic Farming. Press Books, Ipswich, UK.
- Palaniappan SP and Anandurai K. 1999. Organic Farming - Theory and Practice. Scientific Publ.
- Rao BV Venkata. 1995. Small Farmer Focused Integrated Rural Development: Socio-economic Environment and Legal Perspective. Publ. 3. Parisaraprajna Parishatana, Bangalore.
- Reddy MV (Ed.). 1995. Soil Organisms and Litter Decomposition in the Tropics. Oxford & IBH.
- Sharma A. 2002. Hand Book of Organic Farming. Agrobios.
- Singh SP (Ed.). 1994. Technology for Production of Natural Enemies. PDBC, Bangalore.
- Subba Rao NS. 2002. Soil Microbiology. Oxford & IBH.
- Trivedi RN. 1993. A Text Book of Environmental Sciences. Anmol Publ.
- Veeresh GK, Shivashankar Kand Suiglachar MA. 1997. Organic Farming and Sustainable Agriculture. Association for Promotion of Organic Farming, Bangalore.
- WHO. 1990. Public Health Impact of Pesticides Used in Agriculture. WHO.
- Woolmer PL and Swift MJ. 1994. The Biological Management of Tropical Soil Fertility. TSBF & Wiley.

I. Course Title : Library and information services

II. Course Code : HOR 517

III. Credit Hours : (0+1)

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines, etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information - Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CAB Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques / Preparation of bibliography; Use of CD- ROM databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

Seminar 0+1

Thesis Research 30

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Key