

M.Sc. (Agri) – Seed Science and Technology (GGPB22)

Programme Outcome

1. Learn the meaning of seed, its structure, development and maturation and their importance in crop production
2. students will acquire knowledge and basic principles related to quality seed production of varieties and hybrids in agricultural and horticultural crops
3. To promulgate knowledge about mechanism involved in dormancy and stress management for quality seed production
4. To initiate basic methods and principle related to seed quality testing and seed standards
5. To disseminate the knowledge on seed laws related to quality control programme for the needy fast growing seed sector
6. To set forth basic knowledge on various processing operations and principles involved in successful seed storage.
7. To encourage the students to become an entrepreneurship in seed production & seed business.

COURSE OBJECTIVES AND OUTCOMES

GGPB22 611 FLORAL BIOLOGY, SEED DEVELOPMENT AND MATURATION (2+1)

Objective

- To impart basic knowledge of seed development and its structures.
- To appraise students with its relevance to production of quality seed.

Theory

UNIT I : Introduction

Floral types, structure and biology in relation to pollination mechanisms. Sporogenesis, microsporogenesis and megasporogenesis. Gametogenesis-development of male and female gametes and their structures; effect of environmental factors on floral biology.

UNIT II : Mode of pollination

Pollination-types –self and cross pollination- mechanism in promoting self and cross pollination- cleistogamy- chasmogamy-dicliny – dichogamy- protogyny –protandry – factors affecting pollination

UNIT III : Sexual reproduction

Fertilization – embryo sac structure – process- barriers to fertilization-incompatibility and male sterility – factors affecting fertilization - Embryogenesis-development of typical monocot and dicot embryos; endosperm development, modification of food storage structures with reference to crop plants. Different types of embryos, endosperm and cotyledons; development and their structure in representative crop plants with reference to food storage.

UNIT IV : Seed development and maturation

External and internal features of monocot and dicot seed; seed coat structure and development in representative crop plants – Germination – types, phases – factors affecting germination – dormancy, causes – breaking methods.

UNIT V : Asexual reproduction

Apomixes – identification, classification, significance and its utilization in different crops for hybrid seed production; polyembryony - parthenocarpy – types and significance; haplontic and diplontic sterility, causes of embryo abortion, embryo rescue and synthetic seeds.

Practical

Study of floral biology of monocots and dicots. microsporogenesis and megasporogenesis. study of pollen grains – pollen morphology, pollen germination and pollen sterility- types monocot and dicot embryos. External and internal structures of

monocot and dicot seeds. seed coat structures; preparation of seed albums and identification.

Theory schedule

1. Flower and fruit types, floral structure in relation to seed development
2. Microsporogenesis, megasporogenesis, development and structure of microsporangium and megasporangium.
3. Male and female gametophyte, developing ovule, structure and type.
4. Effect of environmental factors on floral biology.
5. Pollination and its types with reference to crop plants
6. Mechanism in promoting self pollination in crop plants
7. Mechanism in promoting cross pollination in crop plants
8. Factors responsible for pollination control
9. Fertilization –embryo sac structure and development.
10. Embryosac development process in monocot and dicot plants.
11. Barriers to fertilization incompatibility and male sterility.
12. Factors affecting fertilization.
13. Embryogenesis –development of typical monocot and dicot embryos and its types.
14. Endosperm development and types modification of food storage structure with reference to crop plants
15. Germination, types, phases and factor affecting germination
16. Dormancy, dormancy classification and breaking treatments / methods
17. **Mid Semester Examination**
18. External and internal features of dicot seeds
19. Seed coat structure and development in representative monocot seed
20. Seed coat structure and development in representative dicot seed
21. Mechanism of translocation into developing seeds of various crops
22. Deposition of reserves in the storage tissue of seeds
23. Synthesis and deposition of starch, fat and storage protein
24. Changes in the growth regulators of developing seeds composition and location
25. Changes in the physiological and biochemical characters during seed development
26. Maturity indices in agricultural crops
27. Maturity indices in horticultural crops
28. Influence of season, climate and nutrition on seed development and maturation in different kinds of seeds
29. Apomixis identification and classification
30. Significance and its utilization in different crops for hybrid seed production
31. Polyembryony types and significance
32. Influence of haplontic and diplontic sterility on hybrid production
33. Causes of embryo abortion and embryo rescue in hybrid production
34. Synthetic seeds– achievements

Practical schedule

1. Study of flower and fruit types
2. Floral biology of agricultural crops – monocots and dicots
3. Floral biology of horticultural crops – monocots and dicots
4. Microsporogenesis and megasporogenesis
5. Study of gametogenesis and pollen grains
6. Pollen morphology in monocot and dicot
7. Pollen viability testing
8. Physiological and Harvestable Maturity of various agricultural and horticultural crops
9. Chemical analysis of Carbohydrate, Fat and amino acids in various seeds
10. Influence of seed polymorphism on seed quality
11. Types of embryo in monocot
12. Types of embryo in dicot
13. External and internal structure of monocot
14. External and internal structure of dicot
15. Seed development and maturation study of monocot and dicot
16. Preparation of seed album and identification
- 17. Final practical examination**

References

1. Bewley, J.D., Bradford, K., Hilhorst, H., Nonogaki, H., 2013. Physiology of Development, Germination and Dormancy, 3rd Edition. Springer-Verlag New York
2. Brian A. Larkins and Indra K. Vasil, 2012, Cellular and Molecular Biology of Plant Seed Development, Springer Netherlands
3. Bhojwani, S.S. & Bhatnagar, S.P. 1999. The embryology of Angiosperm. Vikas Publishing House, New Delhi.
4. Black M, Bewley D & Halmer, P. 2006. The encyclopedia of seeds: Science, Technology and uses. CABI, Wallingford, UK.
5. Chhabra, A.K. 2006. Practical Manual of floral biology of crop plants; Dept. of Plant Breeding, CCS HAU, Hisar.
6. Copeland, L.O. & McDonald, M.B. 2001. Principles of Seed Sciences and Technology. 4th Ed. Chapman & Hall, New York.
7. Frankel, R. & Galun, E. 1977. Pollination Mechanisms, Reproduction and Plant Breeding. Springer Verlag, New York.
8. Vanangamudi, K. 2014. Seed Science and Technology – An illustrated text book. New India Publishing Agency, New Delhi.

Outcomes

- Student gain knowledge about meaning of seed and its structure
- Student will get knowledge on seed development and maturation of various crop plants
- Student will get knowledge on pollination behavior and food reserves accumulation pattern of crop plant

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4						
CO2	3						
CO3							

GGPB22 612 PRINCIPLES OF SEED PRODUCTION (2+1)

Objective

- To introduce the basic principles of quality seed production
- To impart knowledge about various factor in relation to seed quality control during seed production

Theory

UNIT I : Introduction

Introduction: Seed as basic input in agriculture; seed development in cultivated plants; seed quality concepts and importance of genetic purity in seed production; types

of cultivars, their maintenance and factors responsible for deterioration; seed production in self, cross and often cross pollinated crops.

UNIT II : Principles

Mode of pollination and reproduction in crop plants and their modification in relation to hybrid seed production. Principles of hybrid seed production, isolation distance, synchronization of flowering, roguing etc. male sterility and incompatibility system in hybrid seed production, role of pollinators and their management.

UNIT III : Seed production

Seed multiplication ratio-seed replacement rate, demand and supply; suitable areas of seed production and storage, agronomy of seed production- agro climatic requirements and their influence on quality seed production; generation system of seed multiplication; maintenance of nucleus seed, production of breeder, foundation and certified seed – criteria involved; life span of a variety and causes for its deterioration; certification standards for self, cross and often cross pollinated and vegetatively propagated crops.

UNIT IV : Hybrid seed production

Hybrid seed – methods of development ; use of male sterility, self- incompatibility and CHA in hybrid seed production; one, two and three line system; maintenance of parental lines of hybrids; planning and management of hybrid seed production technology of major field crops and vegetables.

UNIT V : Seed quality control

Planning of seed production for different classes of seeds for self, cross and often cross pollinated crops, seed quality control system and organization, seed village concept; seed production agencies, seed industry and custom seed production in India

PRACTICALS

Identification of seeds- plants- characteristics of varieties –hybrids- seed multiplication ratios- seed replacement rate- demand and supply forecast- methods of nucleus and breeder seed production-identification of rogues and off types- pollen management – rogueing techniques-planning for seed production in varieties and hybrids- cost benefit ratio- visit to seed production area- seed processing unit- seed production agencies- seed village concept.

Theory schedule

1. Seed basic input in agriculture- seed development and maturation in cultivated plants
2. Importance and characteristics of quality seed
3. Differences between seed and grain, seed production and crop production
4. Difference between angiospermic seed and gymnospermic seed – importance of quality seeds
5. Different types of cultivars and their maintenance
6. Varietal deterioration their maintenance- factors responsible for deterioration
7. Maintenance of genetic purity in seed production
8. Methods of seed production in self- pollinated crops
9. Methods of seed production in cross and often cross pollinated crops
10. Pollination and reproduction techniques and their modifications in relation to hybrid seed production
11. Principles of hybrid seed production- isolation distance-synchronization of flowering, rogueing etc.
12. Male sterility and self incompatibility in hybrid seed production
13. Role of pollinators and their management
14. Seed multiplication ratio and seed replacement rate
15. Seed demand and seed forecasting
16. Selection of suitable area for seed production and storage.
17. **Mid-semester examination**
18. Agronomy of seed production- agro-climatic requirements and their influence on quality seed production

19. Generation system of seed multiplication- maintenance of nucleus and breeder seed
20. Criteria for foundation and certified seed production
21. Life span of variety, seed deterioration – factors causing seed deterioration
22. Certification standards for self, cross and vegetatively propagated crops
23. Hybrid seeds – methods and developments
24. Different sex forms and hybrid seed production
25. Transgenic male sterility
26. Harvest indices for agricultural and horticultural crops
27. Seed harvesting and threshing techniques
28. Supplementary pollination and pollen management in seed production
29. Planning of seed production for varieties
30. Planning of seed production for hybrids
31. Seed quality control system and organizations
32. Seed village concept
33. Seed production agencies and seed industry in India
34. Custom seed production in India

Practical Schedule

1. & 2. Identification of seed characteristics of agricultural crops
3. & 4. Identification of morphological features of horticultural crops
5. Visit to breeder seed production unit
6. & 7. Planting design and identification of rogues and off types in varieties and hybrids of agricultural crops
8. Study of supplementary pollination and pollen management techniques in seed production.
9. Hybrid seed production techniques in agricultural crops.
10. Study of physiological maturity indices for crops
11. Influence of grading techniques on seed quality characters.
12. Planning seed production for different classes of seeds in varieties of agricultural crops
13. Planning seed production for different classes of seeds in hybrids of agricultural crops
14. Cost benefit ratio for seed production
15. Visit to seed production field and processing unit
16. Visit to private seed industry
17. **Final practical examination**

References

1. Agarwal, R.L. 1997. Seed Technology. 2nd Ed. Oxford & IBH, New Delhi.
2. Chhabra, A.K. 2006. Practical Manual of Floral Biology of Crop Plants. Dept. of Plant Breeding, CCS HAU, Hisar.
3. Desai, B.B. 2004. Seeds Handbook. Marcel Dekker, New York.
4. McDonald, M.B. & Copeland, L.O. 1997. Seed Production: Principles and Practices. Chapman & Hall, New York.
5. Poehlman, L.M. & Sleper, D.A. 2006. Breeding of Field Crops. Blackwell Publishing, Ames, IA, USA.
6. Singh, B.D. 2005. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
7. Singhal, N.C. 2003. Hybrid Seed Production in Field Crops. Kalyani Publishers, New Delhi.
8. Thompson, J.R. 1979. An Introduction to Seed Technology. Leonard Hill, UK.
9. Tunwar, N.S. & Singh, S.V. 1985. Handbook of Cultivars. CSCB, GOI. New Delhi.
10. Bhaskaran, M., A. Bharathi, K. Vanangamudi, N. Natarajan, P. Natesan, R. Jerlin and K. Prabhakar. 2003. Principles of seed production, Kaisher Graphier, Coimbatore.

Outcomes

- To believe the role of good quality seed in agriculture
- To grasp the significance of basic principles of seed production in crop plants
- To know the systems involved in seed production

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1		3					
CO2		4					
CO3							

GGPB22 613 SEED PHYSIOLOGY (1+1)

Objective

- To provide an insight into physiological processes regarding seed germination, dormancy.
- To give basic information on biotic and abiotic stress management in relation with physiological process governing seed quality and seed survival

Theory

Unit I : Introduction

Introduction, importance of seeds, seed structure and function, chemical composition of seed, seed development and maturation – physiological aspects; hormonal regulation of seed development, desiccation tolerance and sensitivity in relation to seed longevity, LEA protein.

Unit II : Physiology of germination

Seed germination; factors affecting germination; role of embryonic axis; growth hormones and enzyme activities, effect of age, size and position of seed on germination. Physiological processes during seed germination; seed respiration, breakdown of stored reserves in seeds, mobilization and interconversion pathways. Physiological aspects and control of germination and dormancy.

Unit III : Physiology of dormancy

Seed dormancy- types, significance, mechanism, endogenous and exogenous factors regulating dormancy, role of phytochrome and PGR, genetic control of dormancy

Unit IV : Physiology of seed deterioration

Seed viability and longevity, pre and post-harvest factors affecting seed viability; physiology of seed deterioration; biochemical of seed deterioration; means to prolong seed viability; seed viability and its evaluation.

Unit V : Seed vigour

Seed vigour and its concept, vigour test methods, factors affecting seed vigour, physiological basis of seed vigour in relation to crop performance and yield.

Practical

Proximate analysis of chemical composition of seed; methods of testing viability; Kinetics of seed imbibitions and solute leakage; seed germination and dormancy breaking methods; Seed invigoration and priming treatments and its physiological basis; accelerated ageing and controlled deterioration tests; enzymatic activities and respiration during germination; effect of accelerated ageing; prediction of seed dormancy using mathematical models, seed respiration, vigour testing methods etc.

Theory Schedule

1. Introduction, importance of seeds, seed structure and function
2. Chemical composition of seed, seed development and maturation – physiological aspects
3. Hormonal regulation of seed development, desiccation tolerance and sensitivity in relation to seed longevity, LEA protein
4. Seed germination; factors affecting germination; role of embryonic axis related to seed germination.
5. Growth hormones and enzyme activities related to seed germination
6. Physiological processes during seed germination; seed respiration, breakdown of stored reserves in seeds, mobilization and interconversion pathways
7. Sugar and abscisic acid regulation of germination and transition to seedling growth
8. Physiological aspects and control of germination and dormancy

9. Mid- Semester Examination

10. Seed dormancy- types, significance, mechanism, endogenous and exogenous factors regulating dormancy
11. Role of phytochrome and PGR, genetic control of dormancy
12. Seed viability and longevity
13. Post-harvest factors affecting seed viability
14. Physiology and biochemical aspects of seed deterioration; means to prolong seed viability
15. Seed viability and its evaluation
16. Seed vigour and its concept, vigour test methods
17. Factors affecting seed vigour, physiological basis of seed vigour in relation to crop performance and yield

Practical Schedule

1. Proximate analysis of chemical composition of seed
2. Methods of testing viability
3. Kinetics of seed imbibitions and solute leakage
4. Effect of different enzymes on physiology of seed germination
5. Role of plant growth hormone on physiology of seed germination
6. Dormancy breaking methods
7. Effect of age, size and position of seed on germination
8. Prediction of seed dormancy using mathematical models
9. Seed invigoration treatment on seed germination and its physiological basis
10. Priming treatments on seed germination and its physiological basis
11. Accelerated ageing test
12. Controlled deterioration tests
13. Enzymatic activities and respiration during germination
14. Effect of accelerated ageing on seed viability
15. Seed respiration
16. Vigour testing methods

17. Practical Examination

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1. Agrawal PK & Dadlani M. (Eds.). 1992. *Techniques in Seed Science and Technology*. South Asian Publication.

2. Baskin CC & Baskin JM. 1998. *Seeds: Ecology, Biogeography and Evolution of Dormancy and Germination*. Academic Press.
3. Basra AS. 2006. *Handbook of Seed Science and Technology*. Food Product Press.
4. Bench ALR & Sanchez RA. 2004. *Handbook of Seed Physiology - Application to Agriculture*. CRC Press.
5. Bewley JD & Black M. 1982. *Physiology and Biochemistry of Seeds in Relation to Germination*. Vols. I, II. Springer Verlag.
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9. Khan AA. 1977. *Physiology and Biochemistry of Seed Dormancy and Germination*. North Holland Co.
10. Kent. J. Bradford and Hiroyuki Nonogaki . 2007. *Seed Development, Dormancy and Germination*. Blackwell Publishing Ltd.
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12. Murray DR. 1984. *Seed Physiology*. Vols. I, II. Academic Press.
13. Nicolas, G., Bradford, K.J., Come, D. and Pritchard, H.W. 2003. *The Biology of Seeds, Recent Research Advances*. CABI.
14. Sadasivam S & Manickam A. 1996. *Biochemical Methods*. 2nd Ed. New Age.
15. Vanangamudi, K. and Mallika Vanangamudi. 2015. *Seed Physiology and Biochemistry*. Vol. 1: Seed Development and Maturation. Agrobios (India).

Outcomes

- To enjoy the physiological processes involved in seed
- To understand the physiological mechanism involved in dormancy and germination
- To compare the role of growth regulators in seed germination

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1							
CO2			3				
CO3							

GGPB22 621 SEED PRODUCTION IN FIELD CROPS (2+1)

Objectives

- To impart knowledge of basic principles involved in seed production
- To impart comprehensive knowledge of seed production in field crops with adequate practical training.

Theory

UNIT I : Principles of seed production

Basic principles in seed production and importance of quality seed. Floral structure, breeding and pollination mechanism in self-pollinated cereals and millets viz., wheat, barley, paddy & ragi. Methods and techniques of quality seed production in self-pollinated cereals and millets.

UNIT II : Floral biology and harvesting mechanism of cereals

Floral structure, breeding and pollination mechanism in cross-pollinated cereals and millets viz., maize, sorghum and bajra; Methods and techniques of quality seed production in cross-pollinated cereals and millets.

UNIT III : Floral biology and harvesting mechanism of pulses & oil seeds

Floral structure, breeding and pollination mechanism in Pulses viz., pigeon pea, chick pea, green gram, black gram, field beans and peas ; Methods and techniques of seed

production in pulses, groundnut, castor, sunflower and sesame.

UNIT IV : Floral biology and harvesting mechanism of oil seeds

Floral structure, breeding and pollination mechanism in oil seeds viz., groundnut, castor, sunflower, safflower, rape and mustard, linseed and sesame ; Methods and techniques of seed production in major oil seeds.

UNIT V : Floral biology and harvesting mechanism of horticultural crops

Floral structure, breeding and pollination mechanism in tomato, bhendi, brinjal, chilies, cucurbits and flower crops

Practical

Planning of seed Production, requirements for different classes of seeds in field crops - unit area and rate; Seed production in cross pollinated crops with special reference to land, isolation, planting ratio of male and female lines, synchronization of parental lines and methods to achieve synchrony; supplementary pollination, pollen storage, hand emasculation and pollination in Cotton, detasseling in maize, identification of rogues and pollen shedders; Pollen collection, storage, viability and stigma receptivity; gametocide application and visits to seed production plots etc.

Theory Schedule

1. Basic principles in seed production
2. Importance of quality seed and its production.
3. Floral structure, breeding and pollination mechanism in cereals and pulses.
4. Methods and techniques of quality seed production in Wheat.
5. Methods and techniques of quality seed production in self-pollinated crop – Paddy.
6. Methods and techniques of quality seed production in self-pollinated crop – Barley.
7. Methods and techniques of quality seed production in self-pollinated crop – Ragi.
8. Floral structure, breeding and pollination mechanism in cross-pollinated crops.
9. Methods and techniques of quality seed production in cross-pollinated crop - Maize
10. Methods and techniques of quality seed production in cross-pollinated crop - Sorghum
11. Methods and techniques of quality seed production in cross-pollinated crop –Bajra.
12. Floral structure, breeding and pollination mechanism in Pulses.
13. Seed production and harvesting techniques in pigeonpea.
14. Seed production and harvesting techniques in chickpea
15. Seed production and harvesting techniques in greengram
16. Seed production and harvesting techniques in blackgram
- 17. Mid semester examination**
18. Seed production and harvesting techniques in fieldbean
19. Seed production and harvesting techniques in peas
20. Seed production and harvesting techniques in soyabean.
21. Seed production and harvesting techniques in cowpea
22. Floral structure, breeding and pollination mechanism in oilseeds.
23. Seed production and harvesting techniques in groundnut.
24. Seed production and harvesting techniques in castor.
25. Seed production and harvesting techniques in sunflower
26. Seed production and harvesting techniques in sesame.
27. Seed production and harvesting techniques in cotton
28. Seed production and harvesting techniques in tomato and brinjal
29. Floral structure, breeding and pollination mechanism in bhendi and chilly
30. Methods and techniques of quality seed production in bitter gourd and ashgourd
31. Methods and techniques of quality seed production in cucumber and snake gourd.

32. Methods and techniques of quality seed production in watermelon.
33. Methods and techniques of quality seed production in marigold and petunia.
34. Methods and techniques of quality seed production in turmeric and ginger.

Practical schedule

1. Planning of Seed Production in self pollinated cereals
2. Planning of Seed Production in cross pollinated cereals
3. Planning of Seed Production in pulses
4. Planning of Seed Production in oilseeds
5. Planning of Seed Production in fibres and sugars.
6. Seed production in self pollinated crops with special reference to land, isolation, planting ratio of male and female lines.
7. Seed production in cross pollinated crops with special reference to land, isolation, planting ratio of male and female lines.
8. Synchronization of parental lines and methods to achieve synchrony for hybrid seed production in self pollinated crops
9. Synchronization of parental lines and methods to achieve synchrony for hybrid seed production in cross pollinated crops
10. Supplementary pollination.
11. Hand emasculation and pollination in Cotton
12. Detasseling in maize
13. Identification of rogues and pollen shedders
14. Pollen collection, storage, viability and stigma receptivity
15. Gametocide application for quality seed production
16. Visits to seed production plots
17. **Practical Examination.**

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1. Agarwal, R.L. 1997. Seed Technology. 2nd Ed. Oxford & IBH, New Delhi.
2. Desai, B.B., Katecha, P.M. & Salunke, D.K. 1997. Seed Hand Book: Biology, Production, Processing and Storage. Marcel Dekker, New York.
3. Kelly, A.F. 1988. Seed Production of Agricultural Crops. John Wiley, New York.
4. McDonald, M.B. & Copeland, L.O. 1997. Seed Production: Principles and Practices. Chapman & Hall, New York.
5. Singhal, N.C. 2003. Hybrid Seed Production in Field Crops. Kalyani Publishers, New Delhi.

Outcomes

- To really understand the principles of seed production and the importance of seed labels
- To impart knowledge about various tools involved in hybrid seed production of crop plants
- To build private seed farms.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1		2					
CO2		3					
CO3							1

GGPB22 622 SEED LEGISLATION AND CERTIFICATION (2+1)

Objective

- To apprise students with the legislative provisions and processes and the mechanisms of seed quality control.

Theory

UNIT I : History of seed certification

Historical development of Seed Industry in India; Seed quality: concept and factors affecting seed quality during different stages of production, processing and handling; seed quality control- concept and objectives; Central seed certification board (CSCB).

UNIT II : Seed legislation in India

Regulatory mechanisms of seed quality control- organizations involved in seed quality control programme; seed legislation and seed law enforcement as a mechanism of seed quality control; The Seeds Act (1966), Seed Rules (1968), Seed (Control) Order 1983; Essential Commodities Act (1955); Plants, Fruits and Seeds Order (1989); National Seed Development Policy (1988) and EXIM Policy regarding seeds, plant materials; New Seed Bill-2004. Introduction, objectives and relevance of plant quarantine, regulations and plant quarantine set up in India.

UNIT III : Seed certification

Seed Certification- history, concept and objectives of seed certification; seed certification agency/organization and staff requirement; legal status and phases of seed certification; formulation, revision and publication of seed certification standards; Indian Minimum Seed Certification Standards (I.M.S.C.S.)- general and specific crop standards including GM varieties, field and seed standards; planning and management of seed certification programmes- eligibility of a variety for certification, area assessment, cropping history of the seed field, multiplication system based on limited generation concept, isolation and land requirements etc.

UNIT IV : Seed testing

Field Inspection- principles, phases and procedures; reporting and evaluation of observations; pre and post-harvest control tests for genetic purity evaluation (grow-out tests); post harvest inspection and evaluation; seed sampling, testing, labeling, sealing and grant of certificate; types and specifications for tags and labels; maintenance and issuance of certification records and reports; certification fee and other service charges; training and liaison with seed growers. OECD seed certification schemes.

UNIT V : Seed law enforcement

Introduction to WTO and IPRs; Plant Variety Protection and its significance; UPOV and its role; DUS testing- principles and applications; essential features of PPV & FR Act, 2001 and related Acts.

Practical

General procedure of seed certification ; identification of weed and other crop seeds as per specific crops; field inspection at different stages of a crop and observations recorded on contaminants and reporting of results; inspection and sampling at harvesting/threshing, processing and after processing for seed law enforcement; testing physical purity, germination and moisture; specifications for tags and labels to be used for certification purpose; grow-out tests for pre and post-harvest quality control; visits to regulatory seed testing laboratory, including Plant quarantine lab and Seed Certification agency.

Theory schedule

1. Historical development of Seed Industry in India & world
2. Seed quality: concept and factors affecting seed quality during different stages of production
3. Factors affecting seed quality during processing and handling
4. Seed quality control- concept and objectives
5. Central Seed Certification Board and its function
6. Regulatory mechanisms of seed quality control
7. Organizations involved in seed quality control programmes
8. The Seeds Act (1966) and Seed Rules (1968)
9. The Seed (Control) Order 1983 and Essential Commodities Act (1955)
10. The Plants, Fruits and Seeds Order (1989) and National Seed Development Policy (1988)
11. EXIM Policy regarding seeds, plant materials and New Seed Bill-2004 etc.
12. Introduction, objectives and relevance of plant quarantine.
13. Plant quarantine set up in India.
14. Seed Certification- history, concept and objectives of seed certification
15. Seed certification agency/organization and staff requirement
16. Legal status and phases of seed certification; formulation, revision and publication of seed certification standards
- 17. Mid semester examination**
18. Indian Minimum Seed Certification Standards (I.M.S.C.S.)- general and specific crop standards including GM varieties,
19. Field and seed standards.
20. Eligibility of a variety for certification, area assessment, cropping history of the seed field, multiplication system based on limited generation concept
21. Isolation and land requirements for seed certification

22. Field Inspection- principles, phases and procedures
23. Pre and post-harvest control tests for genetic purity evaluation (grow-out tests)
24. Post harvest inspection and evaluation
25. Testing of seed sample
26. Maintenance and issuance of certification records and reports
27. Certification fee and other service charges for seed certification
28. Training and liaison with seed growers.
29. OECD seed certification schemes
30. Introduction to WTO and IPRs
31. Plant Variety Protection and its significance
32. UPOV and its role
33. DUS testing- principles and applications
34. Essential features of PPV & FR Act, 2001

Practical schedule

1. General procedure of seed certification
2. Field inspection at different stages of a crop and observations recorded on contaminants and reporting of results.
3. Preparation of Field Inspection report
4. Field counting procedure for different crops
5. Seed processing
6. Seed sampling, methods, equipments-mixing and dividing
7. Testing for seed physical purity,
8. Testing for seed germination and evaluation
9. Moisture test-equipments used and Methods
10. Seed vigour tests
11. Seed viability test
12. Grow-out tests
13. Varietal Identification-methods
14. Visits to seed testing laboratory
15. Visit to plant quarantine laboratory
16. Visit to seed certification agency.

17. Final Practical examination

References

1. Agarwal, R.L. 1997. Seed Technology. Oxford & IBH, New Delhi.
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4. Tunwar, N.S. & Singh, S.N. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.

Outcomes

- To understand legal procedures related to seed quality control
- To really understand the procedure for seed certification
- To grasp the importance of Indian minimum seed certification standards

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1					3		
CO2					3		
CO3							

GGPB22 623 SEED PROCESSING AND STORAGE (2+1)

Objective

- To impart knowledge on the principles and techniques of seed processing for quality up gradation.

- To provide understanding of the mechanism of seed ageing during storage, factors affecting it and its control and comprehensive knowledge about various storage methods.

Theory

UNIT I : Seed Processing and Equipments

Introduction: Principles of seed processing; methods of seed drying including dehumidification and its impact on seed quality - Seed cleaning equipment and their functions: Preparing seed for processing; functions of scalper debearder, scarifier, huller, seed cleaner and grader - Screen cleaners, specific gravity separator, indented cylinder, velvet, spiral, disc separators, colour sorter, delinting machines.

UNIT II : Seed processing plant

Mechanical injury, assembly line of processing and storage, receiving, elevating and conveying equipments - plant design and layout, requirements and economic feasibility of seed processing plant - Concept of seed ageing and deterioration, its causes, symptoms, mechanisms and related theories.

UNIT III : Seed classification and storage

Life span of seeds of plant species; classification of seeds on the basis of storage behavior - orthodox and recalcitrant seeds; types of storage; kinds of seed storage - Factors affecting seed storability- biotic and abiotic and pre- and post-harvest factors affecting seed longevity- Thumb rules of seed storage; loss of viability in important agricultural and horticultural crops, viability equations and application of nomograph.

UNIT IV : Seed longevity and its Maintenance

Maintenance of viability and vigour during storage – Relative humidity and equilibrium moisture content of seed; Seed treatments-methods of seed treatment, Packaging: principles, practices and materials; bagging and labeling - mid storage corrections and seed blending.etc.

Unit V : Seed storage methods

Storage methods and storage structures available in the country and their impact on short and long term storage - Storage methods and godown sanitation - Storage problems of recalcitrant seeds and their conservation-Cryo preservation – Storage of synthetic seed –vegetative propagated materials – storage pests identification and management – seed borne disease – detection and management

Practical

Operation and handling of mechanical drying equipments; effect of drying temperature and duration on seed germination and storability with particular reference to oil seeds; seed extraction methods; seed processing equipments; seed treating equipments; treatment and fumigation. visit to seed processing plant. To study the effect of storage environmental factors (RH, SMC and temperature) on seed longevity; to study the effect of packaging materials, seed on storability; prediction of storability and longevity of seed-lots standardization of accelerated ageing (AA) technique for assessing the seed storability of various crops; estimation of carbohydrates, proteins, fats, enzyme activities, respiration

rate and nucleic acids in fresh and aged seeds; use of eco-friendly products and amelioration techniques to enhance quality of stored seeds, visit to seed stores.

Theory Schedule

1. Introduction: Principles of seed processing.
2. Processing plant design and layout
3. Seed drying including dehumidification and its impact on seed quality.
4. Preparing seed for processing and Seed cleaning equipment and their functions
5. Functions of scalper debearder, scarifier and huller.
6. Functions of specific gravity separator, indented cylinder, velvet-spiral separator and magnetic separator.
7. Functions of disc separators, colour sorter, delinting machines
8. Seed blending concept
9. Mechanical injury and its detection techniques
10. Basic principles of processing and storage
11. Economic feasibility of seed processing plant
12. History and method of seed treatments
13. Special seed treatment techniques
14. Devices in seed treatment
15. Packaging, bagging and labeling of seed materials
16. Various seed classification on the basis of storage behavior and Life span of seeds of plant species.
17. **Mid-semester examination**
18. Factors affecting seed storability- biotic and abiotic factors affecting seed longevity.
19. Thumb rules on seed moisture and relative humidity with relation to seed storage
20. Loss of viability in important agricultural and horticultural crops
21. Viability equations and application of nomograph
22. Concept of seed ageing and deterioration its causes, symptoms, mechanisms and Various seed deterioration theory
23. Seed longevity and factors affecting seed longevity
24. Traditional seed storage techniques
25. Effect of drying temperature and duration on storability
26. Concepts and significance of moisture equilibrium
27. Methods to minimize the loss of seed vigour and viability, Factors influencing storage losses.
28. Effects of packaging materials, storage fungi and insects on seed longevity
29. Seed treatment and fumigation and storage environmental conditions on seed storability
30. Types of storage and kinds of seed storage (open, bulk, controlled, hermetic, germplasm, cryopreservation)
31. Storage methods- Types of storage structure and their impact on storage. and godown sanitation
32. Storage problems of recalcitrant seeds and their conservation
33. Cryo preservation techniques and Storage of synthetic seed
34. Storage of vegetative propagated materials

Practical Schedule

1. Seed processing equipments and layout of seed processing for various crops.
2. Operation and handling of mechanical drying equipments
3. Seed extraction methods
4. Visit to seed processing plant
5. Seed blending
6. Classification of seeds based on their longevity
7. Effect of packaging materials on seed quality
8. Standardization and Prediction of storability by accelerated ageing and controlled deterioration tests
9. Detection techniques for mechanical injury
10. Effect of mid storage correction on seed storability
11. Study of Seed treating equipments.
12. Effect of seed treatment and fumigation on seed storability
13. Estimation of carbohydrates, fats and proteins in fresh and aged seeds
14. Use of eco-friendly products to enhance quality of stored seeds
15. Use of amelioration techniques to enhance and mid storage correction of stored seeds.
16. Visit to seed stores / warehouse
- 17. Final Practical examination.**

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8. Sahay, K.M. & Singh, K. K. 1991. Unit Operations in Food Engineering. Vikas Publisher, New Delhi.
9. Viridi, S.S. & Gregg, B.G. 1970. Principles of Seed Processing. National Seed Corporation, New Delhi.

Outcomes

- To impart knowledge on processing sequence for various crop plants
- Students will get knowledge principles and mode of action of various seed processing equipments
- Students will get knowledge on seed storage methods and seed treatment procedures

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1						3	
CO2						2	
CO3						4	

GGPB22 624 SEED QUALITY TESTING (2+1)

Objective

- To provide a comprehensive guide on exploring the different facets of seed quality
- Equipped the students with highly insightful and key importance on seed quality

Theory

UNIT I : History of Seed Testing

Introduction: Structure of monocot and dicot seeds; seed quality: objectives, concepts and components and their role in seed quality control; Instruments, devices and tools used in seed testing. ISTA and its role in seed testing. Seed Sampling: definition, objectives, seed-lot and its size; types of samples; sampling devices; procedure of seed sampling; sampling intensity; methods of preparing composite and submitted samples; sub-sampling techniques, despatch, receipt and registration of submitted sample in the laboratory, sampling in the seed testing laboratory.

UNIT II : Testing for purity and Moisture

Physical Purity: definition, objectives and procedure, weight of working samples for physical purity analysis; components of purity analysis and their definitions and criteria; pure seed definitions, applicable to specific genera and families; multiple seed units; general procedure of purity analysis; calculation and reporting of results, prescribed seed purity standards; determination of huskless seeds; determination of weed seed and other crop seeds by number per kilogram; determination of other distinguishable varieties (ODV); determination of test weight and application of heterogeneity test. Seed moisture content: importance of moisture content; equilibrium moisture content; principles and methods of moisture estimation - types, instruments and devices used; pre-drying and grinding requirements, procedural steps in moisture estimation; calculation and reporting of results.

UNIT III : Germination, Vigour and Viability testing

Germination: importance; definitions; requirements for germination, instruments and substrata required; principle and methods of seed germination testing; working sample and choice of method; general procedure for each type of method; duration of test; seedling evaluation; calculation and reporting of results; dormancy: definition, importance, causal mechanisms, types and methods for breaking dormancy. Viability and Vigour Testing: definition and importance of viability tests; different viability tests; quick viability test (TZ- test) - advantages, principles, preparation of seeds and solutions, procedure, evaluation and calculation of test results. Vigour testing: concept, historical development, definitions, principles and procedures of different methods used for testing vigour.

UNIT IV : Test for Genetic purity and Seed health

Genetic purity testing : objective and criteria for genetic purity testing; types of test; laboratory, growth chamber and field testing based on seed, seedling and mature plant morphology; principles and procedures of chemical, biochemical and molecular tests. Seed health Testing: field and seed standards ; designated diseases, objectionable weeds - significance of seed borne disease vis-a-vis seed quality - seed health testing and detection methods for seed borne fungi, bacteria, viruses and nematodes.

UNIT V : Storage of Seed sample

Testing of GM seeds and trait purity, load of detection (LOD). preparation and despatch of seed testing reports; storage of guard samples; application and use of seed standards and tolerances.

Practical

Structure of monocot and dicot seeds of important plant species; identification and handling of instruments used in seed testing laboratory; identification of seeds of weeds and crops; physical purity analysis of samples of different crops; estimation of seed moisture content (oven method); seed dormancy breaking methods, requirements for conducting germination test, specifications and proper use of different substrata for germination; seed germination testing in different agri-horticultural crops; seedling evaluation; normal and abnormal seedling, viability testing by tetrazolium test in different crops; seed and seedling vigour tests applicable in various crops; species & cultivar identification; genetic purity testing by chemical, biochemical and molecular methods; seed health testing for designated diseases, blotter methods, agar method and embryo count methods; testing coated/pelleted seeds.

Theory Schedule

1. Seed quality: objectives, concepts and components
2. National and International agencies involved in seed testing
3. Instruments, devices and tools used in seed testing
4. ISTA and its role in seed testing.
5. Seed Sampling: definition, objectives and procedure
6. Physical Purity: definition, objective and procedure of purity analysis
7. Heterogeneity test
8. Seed moisture content: importance, principles and methods of moisture estimation, Instruments and devices used for moisture estimation calculation and reporting of results
9. Testing of coated seeds
10. Germination: importance; definitions; types - requirements for germination,
11. Methods of seed germination testing
12. Seedling evaluation, calculation and reporting of results
13. Determination of huskless seeds, weed seeds and other crop seeds
14. Determination of other distinguishable varieties (ODV)
15. & 16. Determination of test weight for different agri and horti crops
- 17. Mid Semester examination**
18. Dormancy: definition, importance, causal mechanisms, types
19. Methods for breaking dormancy.
20. Definition and importance of viability tests; different viability tests
21. Quick viability test (TZ- test) - advantages, principle.
22. Vigour testing: concept, historical development, definitions
23. Procedures of different methods used for testing vigour.
24. Genetic purity testing : objective, types of test
25. Principles and procedures of chemical, biochemical and molecular tests
26. Modern varietal identification techniques
27. Seed health Testing: field and seed standards
28. Significance of seed borne disease vis-a-vis seed quality
29. Seed health testing and detection methods for seed borne fungi and bacteria.

30. Seed health testing and detection methods for viruses and nematodes.
31. Testing of GM seeds and trait purity, load of detection (LOD)
32. Preparation and despatch of seed testing reports
33. Storage of guard samples
34. Application and use of seed standards and tolerances

Practical Schedule

1. Physical purity analysis of samples of different crops
2. Estimation of seed moisture content (oven method)
3. Seed dormancy breaking methods
4. Requirements for conducting germination test, specifications and proper use of different substrata for germination
5. Seed germination testing in different agricultural crops
6. Seed germination testing in different horticultural crops
7. Seedling evaluation in agricultural crops
8. Seedling evaluation in horticultural crops
9. Viability testing by tetrazolium test in different crops
10. Seed vigour tests
11. Grow out test
12. Genetic purity testing by chemical, biochemical and molecular methods
13. Varietal identification through electrophoresis
14. Seed health testing for designated diseases, blotter methods, agar method and embryo count methods
15. Testing coated/pelleted seeds.
16. Visit to Seed Testing laboratory

17. Final Practical examination

References

1. Agarwal, R.L. 1997. Seed Technology. Oxford & IBH, New Delhi.
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5. ISTA, 2006. Seed Testing Manual. ISTA, Switzerland.
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Outcomes

- To grasp the significance of seed quality testing
- To afford knowledge on various organization involved in seed testing
- To provide knowledge about various seed testing procedure with tolerance

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1				2			
CO2							
CO3				3			

OPC- GGPB22 621 CONCEPTS OF CROP PHYSIOLOGY (2+1)

Objectives

- To impart knowledge in understanding the physiological processes taking place during growth and development of plants.
- To understand source sink relationship in different groups of plants and also hormonal, environmental and stress physiology in crop plants.

Theory

Unit I : Photo physiology

Role of physiology in different branches of agriculture. Physiological processes on productivity – Photosynthesis – Mechanism of light interaction. Physiological processes influenced by radiation. Light and phytochrome mediated processes. – CO₂ reduction – utilization of assimilatory power and carbohydrate synthesis - C₃, C₄ and CAM mechanisms – Major differences.

Unit II : Growth and Development

Growth Vs Development.. Dry Matter Accumulation and Harvest Index – components of Dry Matter Accumulation and Harvest Index and their role in productivity. Growth analysis. Photorespiration and dark respiration.

Unit III : Source sink relationship

LAI and its components –interception of solar energy. Photosynthates partitioning – source – sink relationship – mode of partitioning at different stages in different species. Role of growth regulators in monitoring source and sink.

Unit IV : Environmental physiology

Green house effect and Global warming. Ozone layer depletion - Causes, effects. CO₂ enrichment and plant productivity. Physiology of crops under high altitude and flooding – air pollution and plant growth – effect of effluent on plant growth.

Unit V : Stress physiology

Mechanisms of drought, salt, cold, heat and UV radiation stress tolerance – adaptation of crop plants – crop management practices under unfavourable situations – Importance of selection indices for crop productivity – recent advances in physiological research.

Practical

Leaf Area measurement – measurement of leaf angle and interception of solar radiation – light transmission ratio – measurement of photosynthesis – difference in the photosynthetic rate between the leaves at different position – photosynthetic efficiency of C₃ and C₄ plants – estimation of chlorophyll – RuBP case and PEP case – Measurement of respiration – Growth regulation – response to source and sink relationship – Measurement of water potential and its component. Measurement of leaf temperature, diffusive resistance and transpiration rate – use of antitranspirants – yield component analysis – study of selection indices.

Lecture Schedule

Theory

1. Role of physiology in different branches of agriculture
2. Physiological processes on productivity
3. Photosynthesis – Mechanism of light interaction
4. Photo Physiology
5. Physiological processes influenced by radiation
6. Light and phytochrome mediated processes
7. Utilization of assimilatory power and CH₂O synthesis
8. C₃-C₄ and CAM mechanisms and major differences
9. Photosynthetic measurements
10. Germination, growth and development
11. DMA and HI. Components of DMA and HI.
12. Role of DMA, LAI and HI in crop productivity
13. Growth analysis
14. Photorespiration and dark respiration
15. Oxidative phosphorylation.
16. Release and utilization of energy for various metabolisms.
- 17. MID-SEMESTER EXAMINATION**
18. Interception of solar energy

19. Source-sink relationship
20. Photosynthate partitioning
21. Mode of partitioning at different stages and different species
22. Role of growth regulators in monitoring source-sink relationship
23. Growth regulators – auxins, gibberellins and cytokinins, biosynthesis, functions and agricultural role.
24. Abscisic acid and ethylene. Biosynthesis, functions and agricultural role.
25. Growth retardants. Role in agricultural and horticultural crops
26. Green house effect and plant productivity.
27. CO₂ enrichment and plant productivity.
28. Water stress, effect of water stress on various physiological processes
29. Mechanisms of adaptation to stress condition.
30. Salt stress, classifications and its effects on physiological processes of plant
31. Temperature stress – cold tolerance – adaptation
32. Heat stress – Heat shock proteins – heat tolerance – adaptation.
33. Physiology of crops under high altitude flooding, air and water pollution
34. Recent advances in physiological research

Practical Schedule

1. Leaf area index measurement. Measurement of leaf angle and interception of solar radiation
2. Measurement of photosynthesis
3. Determination of Photosynthetic efficiency of various crop plants
4. Estimation of soluble protein content
5. Estimation of chlorophyll contents
6. Estimation of water potential
7. Determination of chlorophyll stability index
8. Estimation of relative water content
9. Estimation of leaf proline content
10. Measurement of leaf temperature, diffusive resistance and transpiration
11. Growth analysis of field crops
12. Determination of nitrate reductase activity
13. Determination of IAA oxidase activity
14. Estimation of total phenolics
15. Estimation of peroxidase activity
16. Estimation of catalase activity

17. FINAL PRACTICAL EXAMINATION

References

1. Devlin, B. 1983. Plant Physiology. Narosa Publishing House, New Delhi.
2. Franklin P. Gardner, R. Brent Pearce and Roger L. Mitchell, 1988. Physiology of crop plants. Scientific Publishers, Jodhpur.
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11. Salisbury, F.B. and C.M.Ross. 2004. Plant Physiology. Thomson and Wadsworth publications, Belmont, California.

Outcomes

- Students will get knowledge on growth and development on C3, C4 and CAM plants
- Students will get knowledge on growth hormones, flowering hormones, plant science etc.
- Students will get knowledge on biotic and abiotic stress physiology its crop plants

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
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CO1							
CO2							
CO3			2				

OPC- GGPB22 711 SEED PRODUCTION TECHNIQUES IN CROPS (2+1)

Objective

- To introduce the basic principles of quality seed production
- To inculcate the students with the importance of various classes of seeds and their standards

Theory

UNIT I Introduction

Introduction: Seed as basic input in agriculture; Seed multiplication ratios-seed replacement rate, generation system of seed multiplication; variety and causes for its deterioration;

UNIT II Principles

Mode of pollination and reproduction in crop plants and their modification in relation to hybrid seed production. Principles of hybrid seed production, isolation distance, synchronization of flowering, roguing etc. male sterility and incompatibility system in hybrid seed production, role of pollinators and their management.

UNIT III : Classes of seeds and their production techniques

Seed multiplication ratio-seed replacement rate, demand and supply; suitable areas of seed production and storage, agronomy of seed production- agro climatic requirements and their influence on quality seed production; generation system of seed multiplication; maintenance of nucleus seed, production of breeder, foundation and certified seed – criteria involved; life span of a variety and causes for its deterioration; certification standards for self, cross and often cross pollinated and vegetatively propagated crops.

UNIT IV hybrid seed production

Hybrid seed – methods of development ; use of male sterility, self- incompatibility and CHA in hybrid seed production; one, two and three line system; maintenance of parental lines of hybrids; planning and management of hybrid seed production technology of major field crops

UNIT V Seed quality control

Planning of seed production for different classes of seeds for self, cross and often cross pollinated crops, seed quality control system and organization, seed village concept; seed production agencies, seed industry and custom seed production in India

Theory schedule

1. Seed basic input in agriculture
2. Importance and characteristic of quality seed
3. Different types of cultivars and their maintenance
4. Difference between seed and grain, seed production and crop production
5. Varietal deterioration their maintenance- factors responsible for deterioration
6. Maintenance of genetic purity in seed production
7. Pollination and reproduction techniques and their modifications in relation to hybrid seed production
8. Principles of hybrid seed production- isolation distance-synchronization of flowering, roguing etc.
9. Seed multiplication ratios and seed replacement rate
10. Agronomy of seed production- agro-climatic requirements and their influence on quality seed production
11. Generation system of seed multiplication- maintenance of nucleus and breeder seed
12. Floral structure, breeding and pollination mechanism in cross-pollinated cereals

and millets.

13. Methods and techniques of quality seed production in cross-pollinated crop –Rice
14. Methods and techniques of quality seed production in cross-pollinated crop -Maize
15. Methods and techniques of quality seed production in -Sorghum
16. Methods and techniques of quality seed production in–Bajra.

17. Mid semester examination

18. Methods and techniques of quality seed production in pigeonpea.
19. Methods and techniques of quality seed production in Chickpea
20. Methods and techniques of quality seed production in greengram
21. Methods and techniques of quality seed production in blackgram
22. Methods and techniques of quality seed production in soyabean.
23. Methods and techniques of quality seed production in cowpea
24. Floral structure, breeding and pollination mechanism in Oilseeds.
25. Methods and techniques of quality seed production in groundnut.
26. Methods and techniques of quality seed production in castor.
27. Methods and techniques of quality seed production in sunflower
28. Methods and techniques of quality seed production in sesame
29. Methods and techniques of quality seed production in cotton.
30. Methods and techniques of quality seed production in Sugarcane.
31. Seed quality control system and organizations
32. Genetic purity testing- GOT
33. Seed village concept
34. Seed production agencies, seed industry and customs in India

Practical Schedule

1. & 2. Identification of seed structure of agricultural crops
3. Visit to seed production unit
4. Hybrid seed production techniques in agricultural crops
5. Planting design and identification of rogues and off types in varieties and hybrids of agricultural crops
6. Study of supplementary pollination and pollen management techniques in agricultural crops.
7. Identification of physiological maturity for agricultural crops
8. Influence of grading techniques on seed quality characters.
9. Planning seed production for different classes of seeds in varieties of agricultural crops
10. Planning seed production for different classes of seeds in varieties of horticultural crops
11. Visit to seed production field and processing unit
12. Visit to private seed industry
13. Seed enhancement techniques
14. Detasseling in maize
15. Identification of rogues and pollen shedders
16. Gametocide application for hybrid seed production

17. Practical Examination.

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Outcomes

- To really understand the basic principles of seed production in varieties and hybrids
- To know the concept of and methods of hybrid seed production
- To understand the importance of field standards and seed standards in quality seed production

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1		3					
CO2		2					
CO3				3			

OPC- GGPB22 712 SEED QUALITY TESTING AND CERTIFICATION (2+1)**Objective**

- To provide a comprehensive knowledge on all aspects of seed quality evaluation and their relevance to crop performance.
- To impart knowledge on seed certification

Theory**UNIT I : History of Seed Testing**

Introduction: Structure of monocot and dicot seeds; seed quality: objectives, concept and components and their role in seed quality control; Instruments, devices and tools used in seed testing. ISTA and its role in seed testing. Seed Sampling sampling in the seed testing laboratory.

UNIT II : Testing for purity and Moisture

Physical Purity: definition, objective and procedure, weight of working samples for physical purity analysis; components of purity analysis and their definitions and criteria; pure seed definitions applicable to specific genera and families; multiple seed units; general procedure of purity analysis; calculation and reporting of results, prescribed seed purity standards; determination of huskless seeds

UNIT III : Germination, Vigour and Viability testing Test for Genetic purity

Germination: importance; definitions; requirements for germination, instrument and substrata required; principle and methods of seed germination testing; dormancy: definition, importance, causal mechanisms, types and methods for breaking dormancy. Viability and Vigour Testing: definition and importance of viability tests; different viability tests; quick viability test (TZ- test) - advantages, principle, preparation of seeds and solutions, procedure, evaluation and calculation of test results. Vigour testing: Genetic purity testing : objective and criteria for genetic purity testing; types of test; laboratory

UNIT IV : Seed legislation in India

Seed legislation and seed law enforcement as a mechanism of seed quality control; The Seed Act (1966), Seed Rules (1968), Seed (Control) Order 1983; Essential Commodities Act (1955); Plants, Fruits and Seeds Order (1989); National Seed Development Policy (1988) and EXIM Policy regarding seeds, plant materials; New Seed Bill-2004. Introduction, objectives and relevance of plant quarantine, regulations and plant quarantine set up in India.

UNIT V : Seed Certification aspects

Seed Certification- history, concept and objectives of seed certification; seed certification agency/organization and staff requirement; legal status and phases of seed certification; formulation, revision and publication of seed certification standards; Indian Minimum Seed Certification Standards (I.M.S.C.S.)- general and specific crop standards including

Theory Schedule

1. Seed quality: objectives, concept and components
2. Instruments, devices and tools used in seed testing
3. National and International agencies involved in seed testing
4. ISTA and its role in seed testing.
5. Seed Sampling: definition, objectives and procedure
6. Physical Purity analysis
7. Seed moisture content: importance, principles and methods of moisture estimation
8. Germination: importance; definitions; types - requirements for germination,
9. Methods of seed germination testing for agricultural crops
10. Methods of seed germination testing for horticultural crops
11. Seedling evaluation, calculation and reporting of results for agricultural crops
12. Seedling evaluation, calculation and reporting of results for horticultural crops
13. Dormancy: definition, importance, causal mechanisms, types
14. Methods for breaking dormancy.
15. Quick viability test (TZ- test) - advantages, principle.
16. Vigour testing: concept, historical development, definitions

17. Mid Semester examination

18. Procedures of different methods used for testing vigour.
19. Genetic purity testing : objective, types of test
20. Historical development of Seed Industry in India
21. Seed quality: concept and factors affecting seed quality during different stages of production
22. Seed quality control- concept and objectives
23. Central Seed Certification Board and its function
24. Organizations involved in seed quality control programmes
25. The Seed Act (1966) and Seed Rules (1968)
26. The Seed (Control) Order 1983 and Essential Commodities Act (1955)
27. EXIM Policy regarding seeds, plant materials and New Seed Bill-2004 etc.
28. Introduction, objectives and relevance of plant quarantine.
29. Seed Certification- history, concept and objectives of seed certification
30. Indian Minimum Seed Certification Standards (I.M.S.C.S.)- general and specific crop standards
31. Field Inspection- principles, phases and procedures
32. Pre and post-harvest control tests for genetic purity evaluation (grow-out tests)
33. Post harvest inspection and evaluation
34. Essential features of PPV & FR Act, 2001

Practical Schedule

1. Identification and handling of instruments used in seed testing laboratory
2. Seed sampling and sampling procedure
3. Physical purity analysis of samples of different crops

4. Estimation of seed moisture content (oven method)
5. Seed dormancy breaking methods
6. Seed germination testing in different agri-horticultural crops
7. Seedling evaluation
8. Viability testing by tetrazolium test in different crops
9. Seed vigour tests
10. Grow out test
11. Varietal identification through electrophoresis
12. Visit to Seed Testing laboratory
13. General procedure of seed certification
14. Field inspection at different stages of a crop and observations recorded on contaminants and reporting of results.
15. Field counting procedure for different crops
16. Preparation of Field Inspection report
- 17. Final Practical examination**

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Outcomes

- To have a faith in seed certification procedure and importance of IMSCS
- To sort out the rogues and off types from the seed production area and to understand the importance of seed testing
- Will be in a position to emphasis on Seed Legislation, certification, labelling of different seed classes and truthfully labelled seeds

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1					2		
CO2				2			
CO3					4		