UNIVERSITY OF SARGODHA

DEPARTMENT OF PLANT BREEDING & GENETICS

COURSE OUTLINE SPRING 2020

Course Tittle: Genomics in Agriculture

Course Code: PBG-408

Credit Hours: 2(1-1)

Instructor: Dr. Saeed Rauf

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DESCRIPTION& OBJECTIVES

To enable students to understand:

Emerging trends of genomics in relation to Agriculture and Crops Breeding

READINGS

Text Books

1. Brown, T.A. 2006. Gene Cloning and DNA Analysis, and Introduction. (5th ed.). Blackwell Science Ltd. UK. 2.
2. Brown, T.A. 1989. Genetics: A Molecular Approach, Van Nostrand Reinhold (International) Co. Ltd. London.
3. Evans, D.E., J.O.D. Coleman and A. Kearns. 2003. Plant Cell Culture, BIOS Scientific Publishers, USA.
4. Gardner, E. J., M. J. Simmons and D. P. Snustad. 1991. Principles of Genetics. 8th ed. John Wiley and Sons, Inc., New York, USA.
5. Lesk, A.M. 2000. Introduction to Bioinformatics. Oxford University Press, Inc. New York, USA.
6. Orengo, C., Jones, D. and Thornton, J. 2003. Bioinformatics: Genes, Proteins and Computers. BIOS Scientific Publishers Limited. Cornwmwell Press, Trowbridge, UK.
7. Singh, B.D. 2004. Plant Breeding: Principals and Methods, Kalyani Publishers, India.
8. Slater, A., N. Scott, and M. Fowler. 2004. Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press Inc., USA.

**Reference Materials**

1. Hodges, E., Z. Xuan1, V. Balija, M. Kramer, M. N. Molla, S. W. Smith, C. M. Middle, M. J. Rodesch, T. J. Albert, G. J. Hannon and W. R. 37 McCombie. 2007. Genome-wide In Situ Exon Capture for Selective Resequencing. Nature Genetics, 39:1522 – 1527
2. Ronaghi, M. 2001. Pyrosequencing Sheds Light on DNA Sequencing. Genome Res.,11:3-11 3.
3. Shendure J., R. D.Mitra, C. Varma and G.M. Church. 2004. Advanced Sequencing Technologies: Methods and Goals. Nature Genetics, 5: 335-344

CONTENTS

Emerging trends of genomics in relation to Agriculture and Crops Breeding ,Theory Genomics: Introduction, scope and application in agriculture. Genome organization and structure. Methods of DNA sequencing. Construction of DNA libraries, gene identification in a genome sequence. Transcriptome analysis: Microarray and DNA chip, genomic variation analysis. Application of genomics in forward and reverse genetics, metabolomics, phylogenomics, and proteomics.

COURSE SCHEDULE

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| Week | Topics and Readings | Dates |
| 1. | Introduction to genetics and genomics. Central Dogma of biology. Emergence of genetics as science. Book 2  Basic concepts of genetics. DNA structure. DNA packaging Genetic codon etc.  Reference material:1, 6 & 4; Power point presentation | 13-1-2020 to 17-1-2020 |
| 2. | Emerging trends of genomics in relation to Agriculture and Crops Breeding.  Branches of Genomics, Functional Genomics, Bioinformatics, Reverse Genetics, DNA chip or microarrays | 20-1-2020 to 24-2-2020 |
| 3. | Gene cloning , genomic libraries and polymerase chain reaction | * + 1. to 31-1-2020 |
| 4. | Genome organization and structure: Distinct components of genomes, Abundance and complexity of mRNA | * + 1. to 7-2-2020 |
| 5. | Genome organization and structure: Normalized cDNA libraries and ESTs, Genome sequences: gene numbers, Comparative genomics | * + 1. 14-2-2020 |
| 6. | Methods of DNA sequencing: Maxam/Gilbert chemical sequencing, Sanger chain termination sequencing | 17-2-2020 to 21-2-2020 |
| 7. | Methods of DNA sequencing: Maxam/Gilbert chemical sequencing, Sanger chain termination sequencing, Pyrosequencing, | 17-2-2020 to 21-2-2020 |
| 8. | Construction of DNA libraries, gene identification in a genome sequence. | 2-3-2020 to 6-3-2020 |
| 10. | Genome annotation  Identifying the genes in a genome sequence  Searching for open reading frames  Simple ORF scans are less effective at locating genes in  eukaryotic genomes  Gene location is aided by homology searching | 24-2-2020 to 28-2-2020 |
| 11. | Comparing the sequences of related genomes  Determining the function of an unknown gene  Assigning gene function by experimental analysis requires a  reverse approach to genetics  Specific genes can be inactivated by homologous recombination | 3-3-2020 to 7-3-2020 |
| 12. | Studies of the transcriptome and proteome  Studying the transcriptome  Studying a transcriptome by sequence analysis  Studying transcriptomes by microarray or chip analysis | 10-3-2020 to 14-3-2020 |
| 13. | Studying the proteome  Separating the proteins in a proteome  Identifying the individual proteins after separation  Studying protein–protein interactions  Phage display  The yeast two hybrid system | 16-3-2020 to 20-3-2020 |
| 14. | Production of Protein from Cloned Genes  Special vectors for expression of foreign genes in E. coli  The promoter is the critical component of an expression vector  The promoter must be chosen with care  Examples of promoters used in expression vectors  Cassettes and gene fusions | 23-3-2020 to 27-3-2020 |
| 15. | General problems with the production of recombinant protein in  E. coli 234  13.2.1 Problems resulting from the sequence of the foreign gene 235  13.2.2 Problems caused by E. coli 236  13.3 Production of recombinant protein by eukaryotic cells 237  13.3.1 Recombinant protein from yeast and filamentous fungi 237 | 30-3-2020 to 3-4-2020 |
| 16. | Saccharomyces cerevisiae as the host for recombinant protein  synthesis  Other yeasts and fungi  13.3.2 Using animal cells for recombinant protein production  Protein production in mammalian cells | 6-4-2020 to 10-4-2020 |
| 17. | Protein production in insect cells  Pharming—recombinant protein from live animals and plants  Pharming in animals  Recombinant proteins from plants  Ethical concerns raised by pharming | 13-4-2020 to 17-4-2020 |
| 18. | The gene addition approach to plant genetic engineering 265  Plants that make their own insecticides  The 1-endotoxins of *Bacillus thuringiensis*  Cloning a 1-endotoxin gene in maize  Cloning 1-endotoxin genes in chloroplasts  Countering insect resistance to 1-endotoxin crops  Herbicide resistant crops  “Roundup Ready” crops  A new generation of glyphosate resistant crops  Other gene addition projects  Gene subtraction  Antisense RNA and the engineering of fruit ripening in tomato  Using antisense RNA to inactivate the polygalacturonase gene  Using antisense RNA to inactivate ethylene synthesis  Other examples of the use of antisense RNA in plant genetic engineering  Problems with genetically modified plants  Safety concerns with selectable markers  The terminator technology The possibility of harmful effects on the environment | 20-4-2020 to 24-4-2020 |
| 19. | **Final Examination** | 27-4-2020 to 1-5-2020 |

RESEARCH PROJECT

* Primer designing sequencing
* Genotyping of sunflower germplasm

ASSESSMENT CRITERIA

Sessional: 4 (Class Attendance: 1,Assignments: 3)

Mid Term Test: 6

Final Term Test: 10

RULES AND REGULATIONS

1. Bonus marks according to student contributions in class/lecture discussions

2: Students have to complete all assignments within Targets