

COURSE OUTLINE

SPRING 2020

Course Title: **Salt-Affected and Waterlogged Soils**

Course Code: **SAES-7106**

Credit Hours: **3(3-0)**

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DESCRIPTION & OBJECTIVES

Aims of the course: This course will create awareness among the students about the problems, reclamation and management of salt-affected soils. This course also aims at understanding the problems of irrigation waters and strategic treatment/management options about the sustainable and safe use of such low quality waters in agriculture. In addition, the students will be equipped with pre-requisite knowledge and skills necessary to become a good researcher. This will in turn help develop research aptitude among the graduates which will go long way in their practical carrier.

Objectives of the course: Implications of excess salts and water in soil and their mitigation options will be studied in this course. After studying this course a student should be able to understand:

1. Issues related to salt-affected soils and low quality waters.
2. Mathematical relationships to calculate SAR of soil solution from SAR of irrigation water
3. Calculate average root zone salinity and salt balance.
4. Strategies for the reclamation and management of salt-affected soils.
5. Management of reclaimed soils.
6. Irrigation water quality and guidelines/options for brackish water use on sustainable basis.
7. Selection of salt tolerant crops for profitable crop production.

INTENDED LEARNING OUTCOMES

After learning this course students will be able to know about properties, classification and types of salt-affected soils. Students will also be able to learn various techniques of soil reclamation to bring salt-affected soils under cultivation and thus will be able to provide necessary guidelines to the farmers related to this particular problem of soils.

READINGS

1. Ghafoor, A., M. Qadir and G. Murtaza. 2004. Salt-Affected Soils: Principles of Management. Allied Book Centre, Urdu Bazar, Lahore, Pakistan.
2. Mohammad Zaman, Shabbir A. Shahid and Lee Heng. 2018. Guideline for Salinity Assessment, Mitigation and Adaptation Using Nuclear and Related Techniques. Springer, Switzerland. <https://doi.org/10.1007/978-3-319-96190-3>
3. Maliwal, G.L. and L.L. Somani. 2010. Nature, Properties and Management of Saline and Alkali Soils.

Agrotech Publishing Academy, Udaipur, India.

4. Pessaraki, M. (ed.). 2010. Hand Book of Plant and Crop Stress. 3rd Ed. Marcel & Dekker Inc., NY, USA.
5. Pierzynski, G.M., J.T. Sims and G.F. Vance. 2000. Soils and Environmental Quality. CRC Press. Boca Raton, FL, USA.
6. Schjonning, P., S. Elmholt and B.T. Christensen. 2004. Managing Soil Quality Challenges in Modern Agriculture. CABI Publisher Cambridge, MA, USA.
7. Singh, N.T. 2005. Irrigation and Soil Salinity in the Indian Subcontinent: Past and Present. Lehigh University Press, Bethlehem, Israel.

CONTENTS

1. Salt-affected and waterlogged soils in Pakistan and global perspective
2. Genesis of saline and sodic soils
3. Classification systems of salt-affected soils
4. Effects of salinity and sodicity on soil characteristics
5. Derivation and applications of Gapon equation
6. Plant responses to saline and sodic conditions
7. Amelioration strategies and economic feasibility for salt-affected soils
8. Water requirements for reclamation
9. Concept of leaching fraction and its applications
10. Soil waterlogging
 - 10.1. Causes
 - 10.2. Soil and plant responses
 - 10.3. Amelioration strategies
11. Environmental and economic impacts of salinity and waterlogging

COURSE SCHEDULE

Week	<i>Topics and Readings: Give Reading No from your list of readings above and its Page Nos. relevant to the topic(s) covered each week</i>			
	Lecture	Topics	Name of Book	Pages
1	1	Introduction and importance of the course	Salt-affected soils: Principles of management	1-13
	2	Extent of Salt-affected soils in Pakistan	Through internet: website of statistical bureau of Pakistan	-
	3	Extent of Salt-affected soils in Gulf States	Guideline for Salinity Assessment, Mitigation and Adaptation Using Nuclear and Related Techniques by Mohammad Zaman, Shabbir A. Shahid and Lee Heng	43-55
2	1	Extent of Salt-affected soils in global perspective	Guideline for Salinity Assessment, Mitigation and Adaptation Using Nuclear and Related Techniques by Mohammad Zaman, Shabbir A. Shahid and Lee Heng	43-55
	2	Genesis of saline soils	Salt-affected soils: Principles of management	38-44
	3	Genesis of sodic soils	Salt-affected soils: Principles of management	38-44
3	1	Classification criteria of salt-affected soils	Salt-affected soils: Principles of management	38-45
	2	International classification systems of salt-affected soils	Salt-affected soils: Principles of management	44-47
	3	National classification systems of salt-affected soils	Salt-affected soils: Principles of management	47-50

4	1	Effects of salinity on various soil characteristics	Salt-affected soils: Principles of management	61-69
	2	Effects of sodicity on various soil characteristics	Salt-affected soils: Principles of management	61-69
	3	Chemistry of soil solution	Salt-affected soils: Principles of management	72-91
5	1	Chemistry of soil solution and different terms relating to soil solution	Salt-affected soils: Principles of management	72-73
	2	Introduction to different exchange equations and their importance in soil chemistry	Salt-affected soils: Principles of management	92
	3	Derivation of Gapon equation	Salt-affected soils: Principles of management	92-95
6	1	Derivation of Gapon equation	Salt-affected soils: Principles of management	92-95
	2	Importance of Gapon equation	Salt-affected soils: Principles of management	92-106
	3	Applications of Gapon equation	Salt-affected soils: Principles of management	92-106
7	1	Plant responses to saline conditions	Salt-affected soils: Principles of management	125
	2	Plant responses to sodic conditions	Salt-affected soils: Principles of management	125
	3	Physiology of plants in salt-affected environment	Salt-affected soils: Principles of management	117-121
8	1	Chemistry of soil solution	Salt-affected soils: Principles of management	72-91
	2	Ion pairing	Salt-affected soils: Principles of management	72-91
	3	Root zone salinity, determination of average root zone salinity	Salt-affected soils: Principles of management	72-91
9	1	Reclamation of salt-affected soils	Salt-affected soils: Principles of management	124-144
	2	Physical methods of reclamation	Salt-affected soils: Principles of management	145-165
	3	Chemical methods of reclamation	Salt-affected soils: Principles of management	145-165
10	1	Chemical reactions of amendments	Salt-affected soils: Principles of management	126-130
	2	Do	Salt-affected soils: Principles of management	126-130
	3	Biological methods of reclamation	Salt-affected soils: Principles of management	145-165
11	1	Hydro-technical method, Electro-reclamation, synergistic approach	Salt-affected soils: Principles of management	145-165
	2	Management of salt-affected soils: Management of reclaimed soils	Salt-affected soils: Principles of management	140-142

	3	Measures for reducing ground water evaporation	Water quality for agriculture	130-46
12	1	Crop selection for salt-affected soils	Salt-affected soils: Principles of management	140-142
	2	Water requirements for reclamation	Salt-affected soils: Principles of management	128-130
	3	Quality of water required for reclamation	Salt-affected soils: Principles of management	183-210
13	1	Concept of leaching fraction	Salt-affected soils: Principles of management	88-89
	2	Applications of leaching fraction	Salt-affected soils: Principles of management	88-89
	3	Introduction to waterlogging	Water quality for agriculture; Salt-affected soils: Principles of management	174-180
14	1	Presentations by students	-	-
	2	Causes and extent of waterlogging	Water quality for agriculture; Salt-affected soils: Principles of management	125-126 142
	3	Amelioration strategies for waterlogged soils	Water quality for agriculture; Salt-affected soils: Principles of management	176-180
15	1	Presentations by students	-	-
	2	Soil and plant responses to waterlogging	Water quality for agriculture; Salt-affected soils: Principles of management	26,174
	3	Environmental impacts of salinity	Salt-affected soils: Principles of management	216-240
16	1	Presentations by students	-	-
	2	Environmental impacts of sodicity	Salt-affected soils: Principles of management	216-240
	3	Environmental impacts of waterlogging	Salt-affected soils: Principles of management	216-240

RESEARCH PROJECT

Short research projects and laboratory assignments will be assigned to the students during the semester

ASSIGNMENT CRITERIA

Sessional: 20 % of the total theory marks (Project, Presentation, Participation and Assignment)
 Project: -
 Presentation: -
 Participation: -
 Mid Exam: 30 % of the total theory marks
 Final Exam: 50 % of the total theory marks

RULES AND REGULATIONS

75 % attendance is mandatory for the students to appear in the final examination.
 No class assignments after due date will be entertained.