

Soil physical
degradation due to
drip irrigation
environmental
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UNIVERSITY OF AGRICULTURE, FAISALABAD

DEPARTMENT OF: STRUCTURES & ENVIROMENTAL ENGINEERING. Synopsis

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ABSTRACT

Pakistan is a country in which these days water crises is a big and major problem due to which now a day's people moving towards modern water saving techniques e. g. high efficiency irrigation system (drip), but access of everything is bad so study is conduct on the effects of soil environment by drip irrigation. So after selecting site of drip irrigation take the sample after each 20 days and at the same time near this site soil sample also taken flood irrigated field and not irrigated field. Then check either the soil characteristics of field which is irrigated by drip irrigation is effected or not. Different physical and chemical parameter will be observed in which bulk density, penetration resistance, saturated hydraulic conductivity, pH, salinity and sodicity. After that we compare and find the impacts of drip irrigation on soil.

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TITLE: SOIL PHYSICAL DEGRADATION DUE TO DRIP IRRIGATION

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Introduction

The total geographical area of Pakistan is 79.6 million hectares. About 27 percent of the area is currently under cultivation. Of this area, 80 percent is irrigated. In this regard, Pakistan has one of the highest proportions of irrigated cropped area in the world. The cultivable waste lands offering good possibilities of crop production amount to 8.9 million hectares. Growth in cropped area is very impressive: from 11.6 million hectares in 1947 to 22.8 million hectares in 2007. Most of Pakistan is classified as arid to semi-arid because rainfall is not sufficient to grow agricultural crops, forest and fruit plants and pastures. About 68 percent of the geographical area has annual rainfall of 250 mm, whereas about 24 percent has annual rainfall of 251 to 500 mm. Only 8 percent of the geographical area has annual rainfall exceeding 500 mm. Thus supplemental water is required for profitable agricultural production, either from irrigation or through water harvesting. Agriculture is largely dependent on artificial means of irrigation. Of the total

cultivated area, about 82 percent or around 17.58 million hectares is irrigated, while crop production in the remaining 3.96 million hectares depends mainly upon rainfall. The Irrigation Canal Command Area (CCA) has been grouped into classes on the basis of the nature and severity of its limitations water logging, salinity, sodicity and texture. At present about one-fifth of the cultivated land in CCA is affected by water logging and salinity to varying degrees. An additional area of 2.8 million hectares suffers from sodicity. Notwithstanding huge investments, the water table was 0 to 1.5 m under 2.2 million hectares of irrigated land, 1.5 to 3 m under 6 million hectares and 0 to 3 m under 8 million hectares. Thus Pakistan needs to overhaul its entire drainage and reclamation strategy reduces its cost and makes it efficient. However, severe water shortages, in combination with salt-affected soils, soil erosion, low-yielding varieties, and the limited use of modern farming technologies, have resulted in relatively low crop yields (Alam and Naqvi 2003). In the meantime, Pakistan has one of the highest population growth rates in the Asia-Pacific region (2.4 percent annually or, in absolute numbers, an additional 3 to 4 million people each year). In order to attain food security for this fast-growing population, food production needs to grow by at least the same rate as the population. Agricultural growth rates of at least 5 to 6 percent are required to reduce the country's poverty at a substantial level. Because land and water resources are becoming increasingly scarce in Pakistan, this agricultural production growth will need to take place through increasing yields and crop intensification (Alam and Naqvi 2003). This will require the broad dissemination of new and improved technologies, and agricultural research and development (R&D) is the channel through which this can occur. Investments in agricultural R&D

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are, therefore, important in achieving higher agricultural growth in developing countries such as Pakistan. Most of Pakistan is classified as arid or semi-arid, so the agricultural sector is highly dependent on water supply through either irrigation or water harvesting. In 2003, 72 percent of Pakistan's agricultural area was irrigated (FAO 2006). Pakistan has the largest network of irrigation canals in the world, distributing water from the three major basins in Punjab province. To solve water shortage high efficiency irrigation system is introduced (drip irrigation system) Drip irrigation is the slow, even application outflow-pressure water to soil and plants using plastic tubing placed near the plants' root zone. There are two types of drip irrigation surface and sub surface irrigation which are mostly used in Pakistan. In surface irrigation system water is applied on the surface of soil on specific area around the plant through drippers so water is reaching in the root zone depth and plant use it less water use and maximum crop grow. In subsurface drip irrigation laterals of drip is buried under the soil in the root zone depth so directly water applied in the root zone. By such a way water is saved and more efficiently applied. Soil and water salinity in the arid regions are continuously increasing (Ruset al., 2002). Globally, more than 770, 000 km² of the lands are affected by secondary salinization, 20 % of the irrigated areas and about 2 % of the agricultural lands (FAO, 2000). In Tunisia, soils affected by salts cover about 1. 5 million hectares, around 10 % of the total country area. About 30 % of irrigated areas are affectedly salts in different degrees (Hachicha, 2007). Salinity is a major biotic factor limiting plant growth and fruit yield (Paradaet al., 2006). It induces osmotic and toxic effects leading physiological, morphological and biochemical modifications; it causes growth inhibition, <https://assignbuster.com/soil-physical-degradation-due-to-drip-irrigation-environmental-sciences-essay/>

crop yield reduction, lower photosynthesis and respiration, nutritional deficiencies and inhibition of protein synthesis (Ashraf and Foolad, 2007). So the excessive use of drip irrigation promote sodicity, alkalinity and such like other problems in aired and sub aired region.

1. 3 RESEARCH OBJECTIVES

1. Characterize the impact of drip irrigation on soil physical properties. 2. Study the effects of root zone and transpiration. 3. Check any physical degradation in the drip irrigated field.

1. 2 LITRATURE REVIW

Thomas et al.(2010) conduced study in USA on the classical ‘ leaching requirement’ approach for salinity management does not work well with subsurface drip irrigation (SDI), because irrigation with SDI results in no leaching above the depth of the drip tape, and salts will accumulate throughout the growing season. Irrigation with SDI can maintain suitable root-zone salinity, but surface salt accumulation will occur unless there is adequate leaching due to rainfall or supplemental surface irrigation.

Facilitating crop establishment with SDI will help to improve the long-term economic sustainability of SDI. Our research has shown that, in arid-region soils irrigated with SDI, very high soil salinity can occur at the soil surface. This can inhibit germination of small seeded, salt-sensitive crops. Growers have several options for managing salinity with SDI: 1) supplemental leaching using sprinklers or flood irrigation, 2) transplanting, and 3) bed shaping to allow planting into soil of low salinity. The most appropriate method will depend on equipment, the crop to be planted, and other factors.

In climates with > 450 mm of annual rainfall, leaching from rainfall will
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probably be sufficient to maintain soil salinity below harmful concentrations with SDI. Tan et al.(2009) conducted study at Reclamation of salt-affected land plays an important role in mitigating the pressure of agricultural land due to competitionWith industry and construction in China. Drip irrigation was found to be an effective method to reclaim salt-affected land. In order to improve the effect of reclamation and sustainability of salt-affected land production, a field experiment (with reclaimed 1-3 yr fields) was carried out to investigate changes in soil physical, chemical, and biological properties during the process of reclamation with cropping maize and drip irrigation. Results showed that soil bulk density in 0-20 cm soil layer decreased from 1.71 g cm⁻³ in un reclaimed land to 1.44 g cm⁻³ in reclaimed 3 yr fields, and saturated soil water content of 0-10 cm layer increased correspondingly from 20.3 to 30.2%. Both soil salinity and pH value in 0-40 cm soil layer dropped markedly after reclaiming 3 year. Soil organic matter content reduced, while total nitrogen, total phosphorus, and total potassium all tended to increase after cropping and drip irrigation. The quantities of bacteria, actinomycete, and fungi in 0-40 cm soil layer all greatly increased with increase of reclaimed years, and they tended to distribute homogeneously in 0-40 cm soil profile. The urease activity and alkaline phosphates activity in 0-40 cm soil layers were also enhanced, but the sucrose activity was not greatly changed. These results indicated that after crop cultivation and drip irrigation, soil physical environment and nutrients status were both improved. This was benefit for microorganism's activity and plant's growth. Burt et al,(2003) conducted study at ITRC conducted a reclamation leaching experiment in a drip-irrigated pistachio orchard south of Huron, California, during the winter of 2002-2003. The study was conducted to quantify the <https://assignbuster.com/soil-physical-degradation-due-to-drip-irrigation-environmental-sciences-essay/>

leaching water required to remove salts from the effective root zone of trees. This experiment tested a new reclamation leaching technique: multiple lines of low-flow drip tape were used to apply water to the area of salinity accumulation along a tree row. This new technique allows water to be applied where there is salt accumulation along the tree row, as opposed to putting water on the entire area of the field. Since reclamation leaching requires a relatively large depth of water, this technique offers the potential for significant water savings for reclamation leaching. Kahlaoui et al., (2011) conducted a study of a field experiment on the effects of drip irrigation (DI) and subsurface drip irrigation (SDI) with saline water (6.57 dS m⁻¹) on three tomato cultivars (*Lycopersicon esculentum* Mill., cvs. Río Tinto, Río Grande and Nemador) was carried out with the purpose to quantify physiological responses. The aim was to improve irrigation water management under saline conditions of Tunisia. The trial was established in a silt clayey soil with three regimes of irrigation: 100 %, 85 % and 70 % of crop water requirement. Results evidenced a significant difference between the two irrigation systems for the three cultivars. Growth parameters such as leaf area, chlorophyll content and mineral composition of leaves, petioles, stems and roots were affected significantly by the different treatments, particularly for Río Tinto and Nemador, being Río Grande the more adapted. The fruit was the organ less affected. Strong accumulation of Na⁺ and Cl⁻ accompanied a reduction in Ca²⁺, K⁺, Mg²⁺ and P content in the case of DI. The distribution of these last necessary elements for plants nutrition under a strong accumulation of Na⁺ and Cl⁻ depends on the cultivar and changes from one organ to another. SDI can be included as an effective option for tomato production in Tunisia. Palacios et al., (2009) conducted a <https://assignbuster.com/soil-physical-degradation-due-to-drip-irrigation-environmental-sciences-essay/>

study of In the Canary Islands, water scarcity is one of the constraints for agricultural activity. Non-conventional water resources generally represent more water volume than conventional ones. The distribution of these resources frequently permits the possibility of a conjunctive use of desalinated (DW) water and reclaimed municipal wastewater (RW).

Phosphorus speciation was performed both in irrigation waters and in soils (Olsen's inorganic, organic, and microbial). RW had large EC values (2.4 dS m^{-1}) with a remarkable nutrient load contribution and an average total P around 3 mg L^{-1} , predominantly hydrolysable forms, while FW had very low salinity and negligible amounts of P. For the RW treatment a salt gradient was established, causing plant mortality between the irrigation lines. The study of P speciation allows describing Distribution and plant uptake in terms of P forms. Large values of microbial P were produced for the two irrigation waters around the emitters, especially for FW. A faster P-cycling could have contributed to the significantly larger inorganic P contents observed in FW irrigated soils, in spite no external sources were added by the irrigation water. Ji Xia et al, (2012) conducted a study of A field experiment with five soil metric potential (SMP) treatments ($-5, -10, -15, -20$ and -25 kPa) was used to study the effects of drip irrigation on soil salinity, soil hydraulic properties and vegetation growth in coastal saline soils of north China. Irrigation water came from local groundwater with electrical conductivity of $1.7-2.1 \text{ dS m}^{-1}$. The experiment was conducted over three years: 2009-2011. Soil hydraulic properties (hydraulic conductivities, Gardner α , and the contribution of pore classes to water flow) were measured three times, i. e. the baseline value (CK) before experiment in 2009, and after one and two years of soil salinity leaching in 2010 and 2011, respectively. Gardner α , and <https://assignbuster.com/soil-physical-degradation-due-to-drip-irrigation-environmental-sciences-essay/>

the contribution of macropores (> 0.5 mm) and mesopores (0.5–0.25 mm) to water flow in the surface layer in all five SMP treatments were greater than those in the CK treatment, which indicated that the soil structure had improved. The native vegetation was reed [*Phragmites australis* (Cav.) Trin. ex Steud.] and sedge (*Suaeda glauca* Bge) community. After treatment, the average survival rate of low salt-tolerant plants (*Hibiscus syriacus*, *Prunus cerasifera* Ehrh., *Ilex buxoides* S. Y. Hu and *Ligustrum lucidum*) was 48.9% at the end of the third year of treatment. Overall, based on salt ratio of desalinization, the SMP above –5 kPa at a depth of 20 cm immediately under a drip emitter could be used as an indicator of irrigation scheduling for vegetation rehabilitation in north China coastal saline soils.

1.4 MATERIALS AND METHADODOLOGY

Select the site where we want to do our study work. Note there latitude longitude and before start study of required parameters of soil will take the soil sample. Then check the soil characteristics by analyzing soil samples from the different places of field. At the same time will check the quality of water which apply for irrigation either it is not cause to increase the sodcity and salinity. Sodic soils are characterized by a disproportionately high concentration of sodium (Na) in their cation exchange complex. They are usually defined as consisting an exchangeable sodium percentage greater than 15%. These soils tend to occur within arid to semiarid regions and are innately unstable, exhibiting poor physical and chemical properties, which impede water infiltration, water availability, and ultimately plant growth.

Alkalinity of soil a soil that gives a pH reaction of 8.5 or above, found espaisly in dry areas where the soluble salts, esp of sodium, have not been

leached away but have accumulated in the B horizon of the soil profile. Find the amount of organic matter at different depths of soil in the research field. Find the pH value of soil by taking samples from different places of field. To help and identify the soil degradation due to drip irrigation take three different sites one which is application of water by drip irrigation other field is flood irrigated and last one is not irrigated by any mean. The application rate of water through drip irrigation depends upon the season and crop requirements. Soil pits will establish in backhoe in both irrigated by drip, flood irrigated and not irrigated soils. They were located to enable the access of soil profile directly under the crop. There will be no traffic related compaction the crops of rows, so any structural changes will cause due to irrigation method. Soil cores were sampled from each pit using stainless steel rings. These soil samples will be taken from different soil depths, from dripper taking sample different distances for example 0, 50cm and 100cm along the row of crop. This sampling scheme will help find out the effects drip irrigation on soil at different distances. There will be difference because under the dripper 100% water saturation on the other hand less as far we move from dripper. Bulk density is a property of powders, granules and other "divided" solids, especially used in reference to mineral components (soil, gravel), chemical substances, (pharmaceutical) ingredients, foodstuff or any other masses of corpuscular or particulate matter. It is defined as the mass of many particles of the material divided by the total volume they occupy. The total volume includes particle volume, inter-particle void volume and internal pore volume. Penetration resistance is the resistance by a subsoil to penetration by pile, casing, or sampling device; measured by the number of blows of a hammer of specified weight, falling through a specified distance to <https://assignbuster.com/soil-physical-degradation-due-to-drip-irrigation-environmental-sciences-essay/>

drive it a specified distance. To check the changes which occur during the drying penetration measurement through the pointer meter this will be calculated 10 to 25 mm within the core depth for every one measurement. After that for finding the bulk density dried the sample (105°c at 24 hrs) weighed at the conclusion of penetration resistance and water retention measurement. Particle density the mass per unit volume of soil particles, usually expressed in grams per cubic centimeter. Particle density and bulk density is used to measure the porosity or volume of water contents by using this equation. Porosity or void fraction is a measure of the void (i. e., "empty") spaces in a material, and is a fraction of the volume of voids over the total volume, between 0-1, or as a percentage between 0-100percent. Porosity = 1- (bulk density/ particle density). Before the measurement penetration resistance (PR) of soil water will be applied and 36 hour is given to drain out completely, at the time of measurement normally field capacity will get the soil then by using cone penetrometer measure PR. The hydraulic conductivity of a soil is a measure of the soil's ability to transmit water when submitted to a hydraulic gradient. Hydraulic conductivity is defined by Darcy's law, which, for one-dimensional vertical flow, can be written as follows: $U = -k \frac{dh}{dz}$ Where U is Darcy's velocity (or the average velocity of the soil fluid through a geometric cross-sectional area within the soil), h is the hydraulic head, and z is the vertical distance in the soil. The coefficient of proportionality, K, in Equation 5. 1 is called the hydraulic conductivity. The term coefficient of permeability is also sometimes used as a synonym for hydraulic conductivity. On the basis of Equation 5. 1, the hydraulic conductivity is defined as the ratio of Darcy's velocity to the applied hydraulic gradient. The dimension of K is the same as that for velocity, that

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is, length per unit of time. Saturated hydraulic conductivity (K_{se}) is measured at 50cm depth from soil surface and sample will be taken from different places of field. There will be three application of each sample. The saturated hydraulic conductivity found by using the gulf perimeter. Then find the vertical infiltration rate of the soil. Chemical analysis of soil is done for average EC and SAR from saturated paste extract of sample which is taken from the field.

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