

Investigation of Alternate Irrigation Strategies Using Saline and Non-saline Water on Yield and Water Productivity of Grain Maize in Drip Irrigation

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ABSTRACT

A field experiment was conducted using a completely randomized block design, in three replications with seven treatments in three replications for two successive growing seasons of corn crop. Treatments were comprised of: T₁ and T₂ (50% of T₁): full and deficit irrigation with non-saline water, respectively; T₃ and T₄: variable and fixed full irrigation with saline-non saline water in every other row, respectively; T₅ and T₆: fixed and variable deficit irrigation with non-saline water in every other row, respectively and T₇: full irrigation with saline water. Irrigation water salinity for non-saline vs. saline treatments were 8 and 1.5 dS/m, respectively. The results showed that instead of deficit irrigation with non saline water using alternate furrow irrigation, if not irrigated furrows are irrigated with saline water, are more effective when they are compared with deficit irrigation. In deficit irrigation treatments 29 and 36 % and in T₃ and T₄ about 50 % of fresh water was saved in 2012 and 2013, respectively. The quantitative comparison have shown a significant reduction in maize yield by 22% with deficit irrigation scenarios (T₂, T₅ & T₆) when compared with salinity treatments (T₃ & T₄). In terms of water use efficiency, the results indicate that if fresh and saline water are of the same worth, deficit irrigation treatments have the highest water productivity and not significantly different from T₁ treatment. However, water use efficiency is assessed as on the basis of fresh water, treatments T₃ and T₄ are of higher water use efficiency than the others and, therefore the criteria above have been selected as the preferred option. However, water use efficiency is evaluated as on the basis of fresh water, the efficiencies of water use in treatments T₃ and T₄ are higher than those in the others and therefore, they will be selected as the most acceptable options.

Keywords: Alternate irrigation, Deficit irrigation, Drip irrigation, Corn, Saline water

Evaluation of Corn Forage Yield and Yield Components under Alternate Furrow Irrigation

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ABSTRACT

Different deficit irrigation management scenarios as alternate furrow irrigation with regard to sensitive growth stages of corn were assessed in terms of the effects on yield and yield components. The research was performed as a randomized full block design with six treatments and three replications. The treatments were comprised of: full furrow irrigation within whole growing season, alternate furrow irrigation in whole growing season, full irrigation at the establishment stage and alternate irrigation at the other stages, full irrigation at flowering stage while alternate irrigation at the other stages, full irrigation at establishment and flowering stage accompanied by alternate irrigation at the other stages, full irrigation at flowering and ripening stages and alternate irrigation in other stages. Overall, the effect of deficit irrigation on yield and yield components was statistically significant ($p < 0.01$). Full irrigation in the whole growing season led to the highest wet forage yield (67022 kg/ha) and while alternate furrow irrigation in the whole growing season, the lowest wet forage yield (50064 kg/ha). The most desirable treatment was recorded as: full irrigation at the flowering stage and alternate irrigation in the other stages. With this treatment, the reduction in wet and dry forage yields, leaves wet and dry weights as well as stem wet and dry weights in comparison with control were about 8 to 14 %. This is quiet acceptable as it saves 39% irrigation water. The highest irrigation water use efficiency (1.88 kg/m³) was achieved through full irrigation at flowering stage with alternate irrigation of the other stages.

Keywords: Alternative irrigation, Furrow irrigation, Yield, Corn, Water use efficiency.

Introduction and Assessment of a New Drought Monitoring Index, MRDI – Case Study: Gorganroud Basin, Iran

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ABSTRACT

In order to avoid drought effects, it is essential to detect and monitor the spatial and temporal changes of the phenomenon. In General, drought indices are made use of to achieve the goals. The main aim followed in this paper is to introduce and assess a new drought index termed MRDI. MRDI (Modified Reconnaissance Drought Index) is then compared with Modified Standardized Precipitation Index (MSPI), as based on the Standardized Precipitation Index (SPI) and the Reconnaissance Drought Index (RDI), involving a well-known statistical technique named Principal Component Analysis (PCA). Gorganroud basin, Iran, is taken as a Case Study. According to the obtained results, the new MRDI and also MSPI multivariate indices have shown to be of more accurate results and are also easier to use than the SPI and RDI univariate indices. A comparison of MRDI and MSPI results, as based upon the non-parametric Kolmogorov–Smirnov test in Gorganroud basin, has revealed that, there is no significant difference between them with their behavior similar in more than 90% of the cases. An evaluation and verification of the results of the study needs to be repeated in other representative basins.

Keywords: Drought, Time Multivariate Index, Principal Component Analysis.

Investigation of Hydraulical and Chemical Behavior of Dual Drain Envelopes (Organic and Synthetic) in Paddy Conditions with Two Different Water Qualities

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ABSTRACT

Drain envelopes play significant roles in the performance of drainage systems due to their reduction in letting sediments into the drainpipes and also because of an increase in the hydraulic conductivity of soil around the drainpipes. Throughout the present research, the effect of a one 1000 hour flow on dual envelopes consisting of geotextile as a means of improving the hydraulic gradient and rice husk as bio-sorbent, on the hydraulic and chemical trends under paddy field conditions, with no rice crop, was considered. Towards this end, a drainpipe covered with two different thicknesses of geotextile at a depth of 40 cm was installed on a physical model. Then the drain pipe was filled, using a 5 cm thickness of rice husk. A thousand hour flow test, under two different water qualities of 0.7 and 1.9 dS/m was carried out, and while flow of drainage, EC, sodium absorption ratio and pH of drained water being assessed. Results showed that the reduction of flow rate of treatments of rice husk & thin geotextile with saline water (RNs), rice husk & thin geotextile with water of ordinary quality (RN), rice husk & thick geotextile with ordinary water quality (RV), as well as rice husk & thick geotextile with saline water (RVs) were 44, 94, 21 and 75 percent, respectively. But, in total, RN and RNs treatments presented the maximum and minimum cloggings, respectively. Thickness of geotextiles affected the flow rate and chemical trends, while the performance of rice husk, for all treatments, and in saline conditions wasn't appreciable.

Keywords: Flow rate, Geotextile, Rice husk, Salinity, SAR.

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Application of Variable- Speed Pumps in Design and Operation of on- Demand Irrigation Systems

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ABSTRACT

In most irrigation systems in our country, the pumping stations are equipped with fixed speed pumps. These pumps in addition to causing water waste, demand extra energy. Providing a method for adjusting the pumps to function according to obligations of operation can improve efficiency of water distribution as well as energy efficiency. One of the choices toward this aim, is to employ the variable speed pumps which adjust with the variable demand of system. In this study, by coding in MATLAB software, design of pumping stations equipped with variable- speed pumps was done for a drip irrigation system. Then with regard to variable demand of discharge and pressure during irrigation season, the designed system was evaluated and compared with some ordinary operation methods based on constant speed pumps. The results show that the performance of variable- speed pumps to supply the pressure head and discharge is largely definitely acceptable; while water losses in ordinary pumping stations, depending on the type of station, amount to from 16 to 36 percent.

Keywords: Irrigation system, Water loss, Design of pumping station, Pump performance.

Lysimeter study of Fecal Coliform Transport in Treated Wastewater under Drip Irrigation

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ABSTRACT

Shortage of fresh water resources is a major worldly concern. Accessibility of water for irrigation purposes is also one of the most important concerns in arid and semiarid regions. This is why treated domestic wastewater is thought of as an important water source. Even following treatment, wastewater may contain a great many kinds of microorganisms hazardous to humans and environment. Therefore the potential transmission of pollution is a principle problem associated with the use of treated wastewater in agriculture. Various irrigation techniques can be employed, associated with treated wastewater used in agriculture. Accordingly, the present study was conducted on Fecal Coliform in the wastewater treatment in some laboratory columns of 30 cm diameter and 60 cm height irrigated, using surface Drip Irrigation (DI) vs Subsurface Drip Irrigation system (SDI). Samples of the effluent and soil solutions were collected from each column after each irrigation event. Results revealed that crowds of bacteria rose in either column. There were no significant differences observed between crowds of bacteria in the effluents of columns in the two irrigation systems. It was also observed that contamination in the 15 cm layer, in SDI was lower than that in the DI column.

Keywords: Soil column, Surface Drip Irrigation, Subsurface Drip Irrigation, Microbial contamination

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Laboratory Study of Vertical and Inclined Sheet Pile Effects on Seepage Control and Sand Boiling Phenomenon through Alluvial Foundation of Hydraulic Structures

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ABSTRACT

So far, for an analysis of seepage under hydraulic structures much research has been conducted in the form of numerical models. However, few field and laboratory works have been performed to study the boiling phenomena for evaluating numerical models. Throughout the present work, a laboratory model was built to simulate seepage and its controlling measures under sheet piles. The model consisted of a 2.2 m long, 0.8 m deep and 0.4 m wide flume, in which vertical sheet piles were provided by Perspex sheets. The flume was made up of a steel frame, Perspex as well as thick glass sheets. The effect of position and depth of the sheet pile on the seepage flow, exit gradient and uplift pressure have been demonstrated in the form of dimensionless curves. The results indicate that the ratios $d/D=0.44$ and $d/D=0.34$ with a maximum upstream water level of $h/h_m=1.0$ form the best possible depths, for both vertical and inclined sheet piles in the depth of the foundation sheet pile. In other words, inclined sheet piles are much more effective in reducing and controlling seepage, uplift pressure and hydraulic gradient than the vertical ones.

Keywords: Alluvial Foundation, Boiling, Hydraulic Structures, Sheet pile, Seepage.

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Effect of Pore Water Quality on the Mechanical Behavior of an Expansive Soil during Wetting and Drying Cycles

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ABSTRACT

Expansive soils are considered a worldwide problem as they cause extensive damage to civil engineering structures. An important characteristic of expansive soils is their susceptibility to volume change due to the phenomenon of wetting and drying. This paper presets the effect of pore water quality on the swelling and shrinkage behavior of an expansive soil during wetting and drying cycles. Thirty three soil samples were prepared through static compaction with various pore water qualities consisting of distilled water, sodium chloride (50g/lit) and calcium chloride (250gr/lit). Wetting and drying cycles were conducted on samples in a modified odometer apparatus under the surcharge pressure of 10 kPa using distilled water as the reservoir fluid during the process of wetting. Results indicated that samples prepared with calcium chloride show more swelling potential as compared with distilled water and sodium chloride. Furthermore, swelling and shrinkage potential, specific volume and dry unit weight for soil samples reach equilibrium after 5 cycles for distilled water and sodium chloride and while 3 cycles for calcium chloride.

Keywords: Pore water, Swelling and shrinkage potential, Specific volume, Dry unit weight

Effect of Zayandehrood River Dry Becoming on Najafabad Aquifer Oscillations During Past Two Decades

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ABSTRACT

A study of changes in groundwater resources of Najafabad plain is an important issue as regards water resources management, especially after dry becoming of Zayandehrood River. In the present study trend analysis was conducted on groundwater level of 33 piezometric stations, located in Najafabad plain during 1374-1391 while using Mann-Kendall non-parametric test. The slope of trend line was estimated through Sen's estimator method for each time series. Homogeneity of trends was tested using Van Belle and Hughes method. Results indicated that trends of groundwater level for all the stations (except stations located out of drainage and irrigation networks) were significantly negative. Significantly negative trends ($P < 0.1$) were exhibited for above 52 percent of stations. Results of trend line slopes revealed that on the average, groundwater level of Najafabad plain declined for about 32 cm/year. The strongest decline belonged to Kahriz-sang-jadid Station, which declined for about 5.92 m/year. Results of homogeneity of the trends indicated that trends were homogeneous for monthly periods, but heterogeneous for stations. Results of trend maps showed that a maximum level of groundwater changes occurred on drainage and irrigation network sites. The isopiz maps showed that some stations located on the drainage and irrigation network range sites had declined for about 50 to 100 meters in the recent 17-years. The results of MK4 method (significant at 1% level) were chosen for Pettitt Test. Pettitt Test was done on data series which showed that during 1999-2002 and year 2007 a maximum downward jump occurred in Najafabad groundwater level series and knowing that in these years Zayandehrood river had be dried for political reasons. Diagram of Pettitt Test was plotted with the mean before jump and that after jump as specified on the diagram. The diagram revealed that the difference between mean before vs. after jump of the groundwater level series, was 50-100 meters, indicating the phenomenon as being a disaster for Najafabad plain.

Keywords: Trend analysis, Groundwater level, Homogeneity of trend, Najafabad plain, Zayandehrood River, Mann-Kendall, Sen's estimator.

Estimation and Analysis of Soil Hydraulic Properties Using Beerkan Infiltration Experiment

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ABSTRACT

A Study of water and contaminants transport in the vadose zone demands for a determination of soil hydraulic properties. The current study aimed at estimating and analysing the soil hydraulic parameters through an inexpensive experiment of Beerkan within six sample points of various soil textural classes, in Asalem region, Guilan (Iran). Shape and scale parameters of the hydraulic characteristic curves were estimated from particle size distribution analysis and infiltration experiment respectively. Four fitting methods were employed and copmaired including BEST-slope (B/s), BEST-intercept (B/i), Derivative Linearization (DL) and Cumulative Linearization (CL). Although scale parameters were estimated through DL and CL methods easier than through B/s and B/i methods, but the estimated values did not come out to be valid in any of the experimental point. On the other hand, B/s and B/i methods acted as complementary to each other and estimated accurate values for scale parameters of all the six experimental points. The estimated values of sorptivity through B/s and B/i method were not significantly different, but saturated hydraulic conductivity values estimated through B/i exceeded the B/s values. Also a comparison of these two methods through relative error showed that B/s is more accurate than B/i. It seems that B/i method leads to an overestimation of the saturated hydraulic conductivity. It is recommended therefore to make use of B/s method for estimating soil hydraulic properties.

Keywords: Infiltration, Beerkan method, Shape and scale parameters, Saturated hydraulic conductivity, Sorptivity.

Effects of Water Quality on Trend of Desodification of Heavy Soils by Continuous Leaching

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ABSTRACT

Huge amounts of drainage water are disposed from operating irrigation and drainage networks in Khuzestan, SW Iran, that need to be managed and/or reused. One of the low risk methods of reusing drainage water is to reuse it in land reclamation. To investigate the effects of water quality on desodification of clay soils of this area, leaching experiments were done in 1.5×1.5 meter plots in “Salman Farsi” sugarcane agro industry, South Khuzestan. Leaching with three different water qualities; 2.61 dS/m (fresh water from Karun River), 6.0 and 9.0 dS/m (a mixture of agro industry drainage water and Karun River water) in three treatments; T1, T2 and T3 respectively, and six replications ad based on a completely randomized blocks design were experimented. Rate of desodification was decreased with increase in leaching water salinity. Using drainwater with salinity of 6.0 dS/m led to increasing dissolved Ca⁺⁺ and Mg⁺⁺ in soil following leaching. The SAR, in 0-30 cm soil layer that was initially 84 (meq/lit)^{1/2}, following application of treatments T1, T2 and T3 decreased to 9, 10 and 18 (meq/lit)^{1/2} respectively. So the sodicity problem was partly solved through leaching by drainage water with salinity of 6.0 dS/m, excluding the need for use of fresh water. The soil pH was not in the basic range either before or following leaching.

Keywords: Drainage water, Land reclamation, pH, SAR, Khuzestan

Runoff Generation in Kerosene and Gas Oil Contaminated Soils

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ABSTRACT

A quantitative evaluation of the effects of contamination of soil with petroleum, on the soil physical properties, is required for optimal soil and water resources management. The objective followed in the present study was to investigate runoff generation in soils contaminated with Kerosene and Gas Oil. Towards this end, variables of runoff commencement, runoff coefficient, variations in runoff duration time as well as cumulative runoff were determined for the contaminated soils. The experimental treatments consisted of two concentrations of Kerosene and Gas Oil. The results indicated that Kerosene and Gas Oil contaminated soil plots significantly influenced the commencement of runoff, so that, the runoff commencement for non-contaminated plots occurred 128 seconds later than that for the contaminated plots. However, different types of petroleum of the same quantities did not significantly influence the runoff commencement. In addition, a maximum runoff coefficient was obtained for higher concentrations of contaminants. The results further indicated that the runoff coefficient in contaminated plots was about 3 to 3.5 times that of non-contaminated plots. The contaminated soil plots exerted a significant influence on an increasing of the cumulative runoff in comparison with the non-contaminated plots.

Keywords: Hydrophobicity; Infiltration; Petroleum compounds; Rainfall; Soil and water contamination

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Influence of pH and Ionic Strength on Cadmium Sorption by Some Biosorbents

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ABSTRACT

To study the effect of pH and ionic strength on the sorption behavior of cadmium by biosorbents, a batch experiment was conducted with various initial concentrations of Cd^{2+} ($0 - 200 \text{ mg.L}^{-1}$) with two biosorbents (sunflower stalks and apple pruning residues) in two pH (4, 8) levels and two ionic strengths (0.1 and 0.03 M). Sorption data were fitted to Langmuir, Temkin and Freundlich Equations. Results showed that both pH and ionic strength (IS) had significantly affected Cd sorption. Langmuir maximum mono layer adsorption (q_{max}) and binding energy value (K_L) increased with increasing pH by two biosorbents. Sorption coefficients of Freundlich (K_F , n) and Temkin (K_T , A) indicated similar trends as well. But by increase in IS (from 0.03 to 0.1 M) all the sorption parameters decreased significantly. As for the case of sunflower stalks; with increase in ionic strength, q_{max} on the average, decreased from 8505 to 8150 mg/kg and K_L from 0.14 to 0.08 L/mg; and as for apple pruning residues, q_{max} decreased from 7550 to 7300 mg/kg and K_L from 0.09 to 0.06 L/mg, respectively.

Keywords: Cadmium, Ionic strength, pH, Biosorbents, Adsorption Isotherm

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Experimental Assessment of Soil-cement Mechanical Behavior Incorporated with Organic Pollution

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ABSTRACT

Soil-cement has been widely used, as a basic material, in the foundation of many such projects, as pavement of highways as well as lining of channels and reservoirs. This paper presents the effect of an organic additive component (Glycerol) on the mechanical behavior and on the properties of soil and soil-cement mixtures. Soil samples were prepared by static compaction at maximum dry density and optimum moisture content for various percentages of cement and Glycerol as well for various curing durations. Results indicated that contaminated soil with Glycerol (3%, 6% and 9%) show lower compressive strength as compared with natural soil. Furthermore the decrease in compressive strength is seen to be a function of Glycerol percentage. In addition, the use of cement (3% and 6%) on natural soil will cause an increase in the compressive strength. Furthermore an increase in the compressive strength of different soil-cement samples was observed to be a function of cement percentages and curing durations. In all, soil-cement mixtures in addition with 3% of Glycerol show greater compressive strengths as compared with uncontaminated soil-cement mixtures. However the use of higher percentages of Glycerol (6% and 9%) resulted in a noticeable decrease in strength as compared with uncontaminated soil-cement mixtures.

Keywords: Soil-cement, Glycerol, strength, curing duration

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Indigenous Making of DGT Techniques in Iran and Their Application in the Measurement of Phosphorus Content in Soil and Water

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ABSTRACT

Next to nitrogen, among the crop essential nutrients, phosphorus is the most important limiting factor as far as yield in agricultural production is concerned, throughout the world. There are different methods of assessing phosphorus status in soil and in solutions. One of the new techniques in this regard is the techniques of Diffusive Gradient in Thin films (DGT). This method is based upon ion transport in a diffusion layer and its absorption by a resin layer. In manufacturing the gels in DGT, the material used is among the monopolies and patented ones. Throughout the present study, acrylamide - alyl agarose gel was used as the diffusion layer and ferrylhydrite in acrylamide - alyl agarose gel as the resin layer in DGT assembly. The effect of diffusion coefficient in diffusive gel, diffusive gel reactivity, and phosphorus desorption kinetics from resin gel, phosphorus recovery efficiency from the resin gel as well as DGT performance in soil and water were then examined. The results revealed that the diffusion coefficient of phosphorus ions in the gel with a 0.3% of alyl agarose at 25 °C was $8.2 \times 10^{-6} \text{ cm}^2/\text{s}$, decreasing with increased alyl agarose concentrations. Phosphorous recovery efficiency from resin gel measured by use of 10 ml H_2SO_4 0.15 M was almost 100 percent. The assessed P, using DGT, revealed a strong linear correlation ($r=0.98^{**}$) with the actual phosphorus concentration in the examined solution. Throughout the study, an excellent correlation ($r=0.99^{**}$) was observed between P measured through DGT and the available P detected through the traditional Olsen method. This was observed in three types of calcareous soils, implying that DGT could be a suitable alternative for a rapid available P determination in calcareous soils.

Keywords: Acrylamide, Alyl agarose, DGT, Phosphorous, Soil

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