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Effect of mulching on growth and Yield of chilli under drip fertigation.

Rasika Burghate, Bioresource Engineering

ABSTRACT

A field experiment was conducted to study the effect of mulching on growth and yield of chilli under drip fertigation at Dr. P.D.K.V., Akola during August 2013 to February 2014. The experiment was laid out in randomized block design with five treatment which included four irrigation level (100 %, 80 %, 60 % and 40 %) with plastic mulch and (100 % ET) without mulch replicating four times. The study indicated higher plant growth, more number of fruits per plant and enhancement in the yield under all drip irrigation with mulch. Yield of green chilli was maximum in the treatment of drip irrigation at 80 % ET with mulching (335.16 q/ha) and found to be at par with the treatment of drip irrigation at 100 % ET with mulching (319.50 q/ha) directly reflects 17.01 per cent water saving with comparable yield. Minimum yield of chilli was found in the treatment drip irrigation at 100 % ET without mulching (201.95 q/ha). Irrigation water use efficiency 9.58 q/ha-cm was found in the treatment of 80 % ET with mulching. Highest weed count and weed weight was observed in control treatment of 100 % ET without mulch and negligible weed growth was found in all mulching treatment. On the basis of benefit cost ratio it is economically viable for the farmers to adopt drip irrigation at 80 % ET with mulching for green chilli which shows BC ratio 2.71.

Keywords: chilli, mulch, drip irrigation, water use efficiency, benefit cost ratio

Remediation of trichloroethene contaminated water using rhamnolipid coated palladium doped nanoscale zerovalent iron particles

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Abstract:

Trichloroethene (TCE) is a carcinogenic solvent which is found in polluted groundwaters as an aqueous fraction as well as a non-aqueous phase liquid (NAPL). Nanoscale zerovalent iron (NZVI) particles are often coated with polymeric surface modifiers for improved colloidal stability and transport during remediation of such contaminated aquifers while doping the NZVI surface with palladium (Pd-NZVI) increases its reactivity to TCE substantially. We investigated the effects of a biosurfactant, rhamnolipid (RL) on the rates of aqueous TCE degradation by palladium-doped nanoscale zerovalent iron (Pd-NZVI). Pd deposition on NZVI and access to Pd sites were critical factors in determining the TCE degradation rate. RL coatings in the range of 13 to 133 mg TOC/g NZVI, inhibited deposition of Pd in a concentration-dependent manner, and decreased the TCE degradation rate constant from 0.144 h-1 to 0.021 h-1. Additionally, presence of unadsorbed RL in solution had an inhibitory effect on the reactivity of Pd-NZVI. There was only a small impact of Pd-NZVI aggregate size on TCE degradation rates, suggesting that the porous structure of the aggregates may allow Pd-NZVI aggregates to retain their reactivity. We also implemented the RL coated Pd-NZVI in a novel approach by modifying solution properties to directly degrade the organic liquid phase of TCE as opposed to targeting aqueous phase reactions. We observed a 50% increase in the extent of NAPL TCE degradation at a 7 fold faster rate compared to the degradation of TCE in the aqueous phase by RL coated Pd-NZVI.

N2O Emissions from Onion Fields Cultivated on Organic Soils under Sprinkler Irrigation in Quebec

Kaitlin Lloyd and Chandra A. Madramootoo, Bioresource Engineering

Agricultural practices contribute to greenhouse gas emissions. A four year field study was conducted to quantify and compare N2O fluxes from sprinkler irrigated and non-irrigated onion fields in southern Quebec, Canada. Irrigation practices influence GHG emissions by changing the soil moisture content and thus impacting the soil microbial activity. The experimental plots were located on three organic soils with different degrees of stabilization. The static chamber method was used to obtain the in-situ gas fluxes. Meteorological and soils data were also collected. Results showed that sprinkler irrigation had minimal effects on N2O gas fluxes. Maximum N2O fluxes were observed primarily in the spring after snow melt and fertilizer application. Emissions were also influenced by heavier rainfalls (>10 mm) and wetter soils (WFPS between 70 and 100%). Since N2O fluxes above the baseline level were seldom linked to irrigation events, it is concluded that sprinkler irrigation had a limited impact on the N2O gas emissions from the organic soils in this study.

Wormhole generation in carbonate zones during CO2-acidized water flow - An added consideration for defining geological storage security

Cyrille-B Couture, Civil Engineering and Applied Mechanics

Abstract

The implicit assumption in concepts for the geologic storage of greenhouse gases is that the host rock will maintain its integrity throughout the lifetime of the storage activity. Most storage horizons are identified as inert geologic formations consisting largely of sandstones and, on occasions, limestones. Carbonate rocks and carbonate zones in sandstone formations are prone to chemical alteration during reaction with CO2-acidized water; this can erode the fabric of the carbonate rock leading to the formation of defects that are referred to as wormholes. The experimental research shows that once a wormhole is formed in a carbonate zone, the retention capabilities of the storage medium can be compromised, leading to unrestricted flow of the injected fluids through wormholes in the reservoir and caprock carbonate seems. Collateral effects of such erosion processes is the accumulation of dissolved solids in remote locations that can promote permeability reduction causing potential zones for the initiation of hydraulic fracture and void-collapse-induced distress to the caprock barriers. My research documents the results of CO2-acidized water flow experiments in laboratory samples of Indiana Limestone that are also subjected to geostatic stress states comparable to those encountered in typical geological sequestration settings. I also compare experimental results with computer simulations reconstructed from X-ray tomographic scans.

Characterizing components of the organophosphorus pool in Histosols of the Holland Marsh

Aidan De Sena, Bioresource Engineering

Eutrophication is one of the leading threats to freshwater ecosystems throughout the world. Superfluous nutrient availability results in uninhibited algal growth that can release harmful cyanotoxins and shade benthic vegetation. In addition, during the decomposition of this algal biomass, microorganisms can deplete the available dissolved oxygen, killing off aquatic fauna. One of the main sectors involved in the release of nutrients to waterways, is the agricultural industry, via application of fertilizers to farmland. Various efforts have been made to mitigate the ingress of macronutrients to waterways, with particular focus aimed at phosphorus, the limiting nutrient of most freshwater bodies. However, there is a general lack of knowledge on the forms of phosphorus in agricultural settings beyond its particulate and dissolved phases. This is especially true of the organophosphorus pool and attempts to discern this compound group have primarily occurred in mineral soils. This study aims to qualitatively and quantitatively assess the main organophosphorus functional classes in the Histosol soils of three farms in the Holland Marsh agricultural area. Through sequential extraction and enzyme hydrolysis, the identification, labiality and availability of these compounds will be determined at different depths in the soil profile as well as in agricultural tile drainage effluent.

Streamflow variability in Canada's pristine rivers and its linkages to climate oscillations

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Abstract

Analyzing the influence of large-scale climate oscillations on Canada's hydrological systems can provide useful information about how the changing climate is affecting our water resources. This study aims to assess the influence of ENSO, NAO, and PDO – which are considered the dominant oscillations affecting Canada's climate – on trends and variability in streamflow in Canada. Average monthly discharges from a total of 73 pristine rivers, which had at least 40 years of continuous data, were analyzed using a combination of wavelet transforms, the Mann-Kendall trend test and Spearman's rank correlation.

This study showed that Canada's river was dominated by positive streamflow trends, and that streamflow variability was characterized by strong intra-annual to annual variability concentrated at 6-12 month periodicities. These strong periodicities could represent strong seasonality effects. They were also found to conceal the influence of other periodicities at larger scales because wavelet spectra of the reconstructed streamflow data (without the 6-12 month periodicities) showed significant periodicities at scales greater than 12 months up to 192 months. Correlation analyses between ENSO/NAO/PDO and streamflow revealed that the amount of time streamflow activities lagged behind the climate oscillations ranged from 0-48 months for ENSO and NAO, and 0-45 months for PDO. These variable lag times indicated that the influence of ENSO, NAO and PDO was variable in both time and space. This study also observed that NAO and PDO individually exert a stronger influence on monthly streamflow variability compared to ENSO.

Title: Combating estrogenic endocrine disruptors in untreated wastewater irrigation using a sustainable green technology

Christopher Nzediegwu, Shiv Prasher, Eman Elsayed, and Jaskaran Dhiman

Bioresource Engineering

Abstract:

Heightened studies on the use of biochar for soil amendment and carbon sequestration has repeatedly reported that the potency of biochar depends greatly on the type of feedstock. Identifying a sustainable feedstock from a wide list of feedstocks available globally is not as easy as it appears. Therefore, the focus of this study is to introduce plantain peel feedstock, and show how plantain peel biochar (PPB) has helped in immobilization of two estrogenic hormones, Estradiol (E2) and Estrone (E1), in a soil irrigated with untreated wastewater. Plantain, a staple food in Asia, Africa and South America, has a global production of hundred thousand tonnes per year. Its peel account for about 40% by weight of the fruit. Estrogenic hormone E2 and its primary metabolite E1 are endocrine disruptors capable of causing reproductive organ disorder in wildlife. In untreated wastewater, concentration of 8150 and 634 ng/L for E1 and E2, respectively have been reported. A four month study in a lysimeter field located at Macdonald campus of McGill University has shown that PPB can be a good sorbent material that will encourage the use of untreated wastewater in developing countries where wastewater receives little or no treatment upon utilization as irrigation water.

Use of Super Absorbent Polymers (SAP or hydrogels) and Plantain Peel Biochar (PPB) to Reduce Bioavailability of Cadmium in Potato Plants

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Super absorbent polymers (SAPs) are network of loosely crosslinked polymer chains which are highly hydrophilic in nature and can absorb and retain aqueous solutions up to hundred times their own weight (Buchholz & Graham, 1998). In our experiment we investigated the effect of incorporating SAP in the soil on cadmium heavy metal bioavailability for potato plants. Heavy metals can be introduced to soils from a variety of sources such as industrial emissions, mining, petrochemical spillage, sewage sludge application as well as irrigation with wastewater (Khan et al. 2008, Zhang et al. 2010). Cadmium is one of the common heavy metal contaminants found in environment (Evanko & Dzombak, 1997). Heavy metals such as Cd, pose a threat to ecosystem, animal and human health (Wuana & Okieimen, 2011). In our study, hydrogels and plantain peel biochar (PPB) amendments to the soil was able to reduce Cd bioavailability for potato tubers.

Keywords: Hydrogels, Super Absorbent Polymers, Heavy metals in soil, Environment, Cadmium

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Testing various subsurface drainage prediction approaches in an agricultural system model

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Abstract:

Using model to simulate main processes and to predict development of an agricultural system is a very popular method to explore agriculture science. The hydrology component in agricultural model is essential, it not only concerns the water table management practice for the farmland, but also predict the effect to environment since the drain water contains chemicals. Many cases with subsurface drainage are already simulated by models and give acceptable result, however, some shortages still exist. In this study, we used RZWQM model to simulate subsurface drainage base on the collected data during 2006-2008 in Iowa, by modifying the code of RZWQM, we replaced Hooghoudt's equation in the drainage component with Integrated Hooghout's equation and van Schilfgaarde equation, which are under transient condition, and used the modified models to simulate subsurface drainage with a same set of data. Also, we modified the daily output module in the RZWQM model to get an hourly base drainage output. The objectives of this study were: 1) to compare simulation results from different equations and evaluate the modified models; 2) to see whether the transient equations can perform better in catching the peaks of drainage volume; 3) to see how the different equations affect the simulation in different time spans. According to daily result, the simulation by Hooghout's equation has PBIAS=13.5%, NSE=0.39, IoA=0.69, while Integrated Hooghout's equation and van Schilfgaarde equation have PBIAS=2.5% and 2.3% respectively, both of their NSE are 0.19, and their IoA are 0.64. In hourly scale, Hooghout's equation is proved to perform better in catching drainage peaks and simulate a more similar distribution to observed drainage, compared with other two equations.

STATISTICAL MODELLING OF EXTREME RAINFALL EVENTS:

A DECISION-SUPPORT TOOL FOR RAINFALL FREQUENCY ANALYSES

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ABSTRACT:

Information on the probability of extreme rainfall occurrence and amount is of critical importance for the design and management of various hydraulic structures. This information is commonly obtained using frequency analysis method, a statistical approach where an appropriate probability distribution is selected based on the best fit to the observed data. The common issue is that many probability distributions are available for describing the distribution of extreme rainfalls, however, there is no general agreement as to which distribution should be used. Therefore, in practice, a number of popular distributions are often selected and their descriptive and predictive abilities are then investigated and compared. This task requires a significant investment of time due to the availability of an excessive amount of observed data from different sites and of different temporal scales and record lengths. This paper describes the development of a decision-support tool in assisting users and decision makers performing rainfall frequency analysis and analyzing, comparing, and deciding the most appropriate distribution(s). The tool is equipped with more than twelve probability models of two-to-five parameters with three popular parameter estimate methods. It is also designed to allow users to investigate and compare up to 12 distributions simultaneously. The comparisons of distribution descriptive ability can be performed through the utilization of graphical displays and four statistical criteria, while those of predictive ability can be carried out through the employment of bootstrap technique and modified boxplots. The tool was applied to selecting the best distribution(s) for a set of 63 annual maximum rainfall series of three distinct durations from a network of 21 rain-gaged stations located in Ontario as an illustrated application.

Assessment of agricultural stream designs used in maintenance operations in Quebec

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Several agricultural streams have been heavily modified through straightening and dredging to improve drainage efficiency. These streams require frequent maintenance operations to dredge them to their initial profiles and dimensions based on a hydraulically efficient section design: usually an oversized channel of trapezoidal cross-section with relatively uniform longitudinal slope. Although the geomorphological and economic impacts associated with this design are widely acknowledged, efforts in implementing more sustainable approaches and management strategies in Quebec have been challenging. The objectives of this research are to: 1) analyze the impact of current trapezoidal channel design on the stream's morphological response and sediment dynamics, and 2) propose alternative channel designs that considers the natural processes of a river. Thirteen streams in the Montérégie region, where one quarter of Quebec's cultivated land is located, were surveyed and their database was analyzed using GIS data. The morphological response to channelization results in channel bank erosion, channel incision, or bed aggradation depending on the characteristics of the reach. Self-forming streams are those that have not been maintained for over 30 years and have naturally formed a bench within the original cross-section and have developed sinuosity. The dimensions of these self-formed channels compare well with calculations based on regional curves for a two-stage channel design, and could be used to design equilibrium channels which would require less maintenance. The stream response to the traditional trapezoidal channel design proves the design to be unsustainable and costly. There is clearly a need to incorporate hydrogeomorphological concepts in future designs.

Participatory Modelling of Agricultural Systems in Guatemala,

Julien Malard, Bioresource Engineering

The modelling of the impacts of climate change on agriculture requires the inclusion of socio-economic factors. However, while cropping models and economic models of agricultural systems are common, dynamically coupled socio-economic-biophysical models have not received as much success. A promising methodology for modelling the socioeconomic aspects of coupled natural-human systems is participatory system dynamics modelling, in which stakeholders develop mental maps of the socio-economic system that are then turned into quantified simulation models. However, this modelling framework is ill-suited for representing crop growth and other biophysical processes.

This research demonstrates a new methodology for the analysis of agroecosystems, using dynamically coupled system dynamics (socio-economic) and biophysical (cropping) models to represent both physical and socioeconomic aspects of the agricultural system. Two case studies are presented (intensive market-based agricultural development versus subsistence crop-based development) from rural Guatemala. The system dynamics model component is developed with relevant governmental and NGO stakeholders from rural and agricultural development in the case study regions and includes such processes as education, poverty and food security. Common variables with the cropping models (yield and agricultural management choices) are then used to dynamically couple the two models together, allowing for the analysis of the agroeconomic system's response to and resilience against various climatic and socioeconomic shocks. Results suggest that the market-based system is more resilient to weather extremes but is more vulnerable to social challenges (such as dietary choices), while both systems remain vulnerable to deforestation.

Characterization of Silver Nanoparticles in Wastewaters and Understanding their Interaction with the Green Alga, Chlamydomonas reinhardtii

Agil Azimzada, Chemical Engineering

As a result of the burgeoning nanotechnology industry, the number of uses of engineered silver nanoparticles (Ag NPs) in consumer products has risen significantly in recent years. Despite their utility as anti-bacterial agents, the 'nano-scale' properties of these nanoparticles also raise potential exo-toxicological implications when they end up in the environment. Wastewater effluents represent one of the main routes through which Ag NPs can reach aquatic environments, such as lakes and rivers, where they may potentially interact with the aquatic life. In wastewaters, Ag NPs may undergo different chemical and physical transformations, which may alter the potential toxicity of these NPs towards aquatic organisms. The main objectives of our study are to characterize the Ag NPs in wastewater effluents and then assess their interactions with a model organism, the green alga Chlamydomonas reinhardtii. We are going to present the results that show the dissolution patterns of Ag NPs for different types of media; investigate the potential bioavailability of dissolved silver species and assess the bioavailability and uptake of Ag NPs by C. reinhardtii.

Permeability Evolution in Carbonate Rocks Subjected to Triaxial Stresses

by A. Głowacki1

Abstract

Cobourg Limestone is an argillaceous limestone encountered in Southern Ontario, Canada. This particular formation is considered as a suitable medium for the construction of a Deep Geologic Repository for storing low to intermediate level nuclear waste. Indiana Limestone is quarried in Bedford, IN, USA, it is a monomineralic rock, mostly composed of calcium carbonate (CaC03). The current presentation summarizes the research done on both rocks by examining the evolution of permeability at different stress states, including post-failure (for Indiana Limestone). Permeability was estimated from hydraulic pulse tests for Cobourg Limestone and by steady flow tests for Indiana Limestone. A modified Obert-Hoek Cell was used to apply the varying axial stresses (5 MPa ≤ □ ≥ 120 MPa) and ra
conduct the permeability tests.

Keywords: Cobourg Limestone, Indiana Limestone, permeability of rocks, triaxial stress state

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