Senior Science Research Forum

Friday, April 21, 2006 • 2:00 P.M.
Melhorn Hall
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McPherson College
Precision agriculture technology was used to find and explain variations in plant and soil data within a sandy, irrigated field of corn in south-central Kansas. The field was mapped into grids with a data-collecting point located at the center of each cell. These points provided the basis for collection of plant, soil, and yield data. Upon completion of data collection, surface interpolation was used to create surface maps for each test. Many strong correlations were found to exist between the soil properties and soil nutrients. Stalk nitrate tests indicated that some areas of the field received more or less nitrogen than was needed. Input efficiency could possibly be maximized in the future with further testing and variable rate application of plant nutrients.
Salinity is a growing problem for farmers around the world. The soil becomes saline by using poor irrigation water, and the evaporation of irrigation water. When the water evaporates it leaves behind ions on the surface of the soil. Plants have a difficult time surviving in the saline environment. Triticum aestivum (wheat) is an important cultivated species. Its ability to get water has a direct correlation with how saline the soil is. In order to determine the importance of salinity, seeds were germinated and grown in five different concentrations of NaCl. My research showed that growth was inhibited with a higher salinity. The germination was delayed with a rise in salinity. I studied five different varieties of wheat that are planted in Kansas. I put them under five different concentrations of NaCl (0 ppt, 2.5 ppt, 5 ppt, 8 ppt, and 10 ppt NaCl). I germinated them in a 25°C incubator and recorded shoot length every 24h period. The Karl 92 variety proved to be the most tolerant in the highest saline conditions. I conclude that the five varieties show diversity for being salt tolerant.

Keywords: Germination, Salinity, Wheat, Salinization, Triticum aestivum
Historical diamond synthesis of Henry Moissan and Dr. J. W. Hershey are recreated. By using a carbon arc furnace to melt iron samples with dissolved carbon, the molten iron was thought to trap excessive carbon in the iron lattice when it is quenched in water. This contraction was believed to compress carbon into diamond. Current research in chemical vapor deposition and thermal activation of graphite has shown that earlier diamond synthesis methods, using electric arcs, may be plausible due to the species generated in the carbon plasma of the arc. Under conditions, much lower in temperature and pressure carbon electrodes, while arcing, will generate different allotropes of carbon, including diamond. An initial experiment was run involving molten iron in an open graphite crucible under an argon blanket. Digestion of the samples from this experiment gave no visible diamond. For the subsequent experiments, an electric arc furnace was constructed making use of a V shaped electrode configuration. Experiments were run using AC and DC current, focusing on soot generation and characterization. Characterization of soot was done using Soxhlet extraction and IR spectroscopy. Soot generated from an unshielded (no argon) AC current yielded a peak match at 1384 cm⁻¹ and several other overlapping regions when compared with an IR spectrum of a known sample of C₆₀. Design modifications of the electric arc furnace are proposed for further experimentation.
Research has been done on the doubling time and population dynamics of Eschericia coli in multiple environments of lactose. As the percent of lactose increases and dextrose decreases in the Soy-broth, the Eschericia coli strains (lac+ and lac-) have longer lag times. The growth rate was measured by a Spectonic Genesys 2 spectrophotometer over 24 hours. Population estimates on growth was measured by colony counts on Soy-agar plates taken at time 0, 6, 18, and 24 hours. The Eschericia coli strain that lacked the lactose gene B-galactosidas (lac-) had a higher absorbance in 60%, 80%, and 100% indicating a higher growth rate. These results have yet been studied. It was concluded that the E. coli lac- strain grows better than the lac+ in all lactose environments. An extended stationary phase was shown in both strains of E. coli past 24 hours.

Keywords: B-galactosidase, Eschericia coli, lag time
A strictly anaerobic, Gram-positive, spore forming, short rod-shaped bacterium was isolated from Kansas marshland and shown to be capable of mediator-free electricity generation. A dual-chambered fuel cell was constructed using carbon fiber as the electrode material. After a ten day period, the isolated bacteria produced a peak current level of 13.68 microamperes. Though a current was produced, the studied bacteria yielded much lower current levels than other bacteria prominent in fuel cell studies.

Keywords: microbial fuel cell, electricity generation, carbon fiber electrode, Quivira National Wildlife Refuge
The DYFORMON is an accommodating-resistance exercise machine which was used to measure human momentum generation. This quantity was calculated by integrating the user force output over time. Momentum was determined to be a better measure of effort in this study rather than work since the exercise bar moves at the same constant speed regardless of applied force. The goal of this study was to consider momentum increases or decreases with respect to recovery time with multiple subjects. Four subjects completed the exercise protocols to the end of the experiment. The subjects were divided into two groups. Each workout session consisted of three sets of ten repetitions of bench press. The exercises were preformed with one set at a rep every four seconds, the second set at a rep every eight seconds, and the third also at a rep every eight seconds but with the subjects pushing one and resting one and so on until they pushed for ten repetitions. Results showed that working out once a week typically increased momentum generation from one week to the next. Working out twice a week showed mixed results.

Keywords: Isometric, accommodating weight resistance, isokinetic, concentric, eccentric, recovery time