UNIVERSITI PUTRA MALAYSIA

SPATIAL APPARENT ELECTRICAL CONDUCTIVITY OF PADDY SOIL AS INDICATOR OF SELECTED SOIL PHYSICAL PROPERTIES

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By

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of of Master of Science

SPATIAL APPARENT ELECTRICAL CONDUCTIVITY OF PADDY SOIL AS INDICATOR OF SELECTED SOIL PHYSICAL PROPERTIES

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Institute: Advanced Technology

Efficient and accurate methods of measuring within-field variations of soil physical properties are important in precision farming. Soil sensors that can collect data across the field will provide several advantages over traditional measurement methods that involve soil sample collection and laboratory analysis. The study on sensor-based measurement such as Veris 3100 and soil physical properties (soil particle distribution, dry bulk density, porosity, soil water retention, saturated hydraulic conductivity, soil organic matter and soil compaction (CI)) has been done. The main reason for the study is to determine whether the on-the-go sensor-based soil apparent electrical conductivity (EC_a) can be used as an indicator of soil physical properties.

The EC_a sensor was pulled across 380 ha paddy fields in Sawah Sempadan, Tanjung Karang, Selangor, Malaysia. The sensor provides values of deep (EC_ad) and shallow EC_a (EC_as). The soil samples were taken from two depths, topsoil (0 to 15 cm) and subsoil layer (16 to 30

cm). The readings of cone index values were taken by using cone penetrometer at the same point as the soil sampling locations.

Most properties were found to have significant correlation with EC_a, in Zone 3. The soil physical properties were found to have more significant correlation in topsoil compared to subsoil layer. At topsoil layer, estimated Ks, sand, clay and porosity were significantly correlated with EC_ad while only estimated Ks, sand and clay had significant correlation with EC_as. At subsoil layer, sand, silt and clay had significant correlation with both EC_ad and EC_as. Results show that the models for the topsoil can use shallow EC_as as an indicator (constant) and deep EC_a for subsoil layer.

The analysis for soil CI was run by correlating the CI at 4 depths of soil with EC_a and found EC_ad can be used as an indicator to determine the most compacted layer in the paddy field which had negative correlation with CI at depth 2 (13-26 cm) and had significance with EC_ad in mid range EC_ad (zone 2). The study show only moisture content at saturation (0 kPa) had significant positive correlation with EC_a**.** So that, EC_a can be used as an indicator to determine soil moisture content when the field is in saturation stage.

The Paddy Soil Physical Properties Calculator (PSPPC) was developed to ease users in estimating soil physical properties based on EC_a values. JavaScript language was used to develop the GUI and the results using the calculator in web base feature. Textural class, sand percentage, silt percentage, clay percentage, bulk density, soil organic matter and saturated hydraulic conductivity can be calculated. This application can help users to estimate values of soil physical properties based on easily derived values of EC_a. This calculator is only recommended for the Sawah Sempadan area because the program was developed based on data taken in that area.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

SPATIAL KONDUKTIVITI ELEKTRIK BERKELIHATAN SEBAGAI PENUNJUK BAGI CIRI FIZIKAL TANAH SAWAH YANG TERPILIH

By

MASTURA MOHAMED

September 2011

Pengerusi: Profesor Ir. Mohd Amin Mohd Soom, PhD

Institut: Teknologi Maju

Kaedah yang cekap dan tepat untuk mengukur sifat fizik tanah di lapangan adalah penting dalam pertanian persis. Penderia tanah yang boleh mengumpul data di lapangan akan memberikan beberapa kelebihan berbanding dengan kaedah pengukuran secara tradisional yang melibatkan pengambilan sampel tanah dan analisis di makmal. Kajian telah dijalankan dalam pengunaan penderia tanah seperti Veris 3100 dan sifat fizik tanah seperti jumlah relatif pasir, kelodak, lempung, ketumpatan pukal, bahan organik, kelembapan, keupayaan pegangan air, konduktiviti hidraulik tepu, dan kemampatan tanah (CI). Tujuan utama kajian ini adalah untuk menentukan sama ada penderia konduktiviti elektrik tanah pukal (EC_a) boleh digunakan sebagai petunjuk untuk sifat fizik tanah.

Penderia EC_a dibawa merentasi tanah sawah seluas 380 ha di Sawah Sempadan,Tanjong Karang, Selangor, Malaysia. Penderia memberi nilai EC_a dalam (EC_ad) dan EC_a cetek (EC_ad). Terdapat dua kedalaman sampel tanah yang diambil iaitu lapisan atas (dari 0 ke 15

cm) dan lapisan bawah (16 ke 30 cm). Pembacaan indeks kon diambil dengan menggunakan alat penetrometer pada lokasi yang sama dengan pensampelan tanah.

Lebih banyak ciri ditemui mempunyai perkaitan dengan EC_a dalam zone 3. Sifat fizik tanah yang ditemui mempunyai hubungan lebih signifikan bagi tanah lapisan atas berbanding tanah lapisan bawah. Di lapisan atas, Ks anggaran, pasir, lempung dan porosity mempunyai perkaitan dengan EC_ad manakala Ks anggaran, pasir dan lempung mempunyai perkaitan dengan EC_as. Bagi tanah lapisan bawah, pasir, lumpur dan lempung, mempunyai perkaitan kepada kedua-dua EC_ad dan EC_as. Keputusan kajian menunjukkan model bagi tanah lapisan atas boleh menggunakan EC_as sebagai penunjuk (pemalar) dan EC_ad untuk lapisan tanah bawah.

Analisis untuk kemampatan tanah dijalankan dengan mencari perkaitaan CI pada 4 kedalaman dengan EC_a. Keputusan analisis menunjukkan EC_ad dan EC_as mempunyai perkaitan negatif dengan CI pada kedalaman 2 (13-26 cm) di mana kemampatan tanah tertinggi terjadi dan nilai CI mempunyai perkaitan dengan EC_ad dalam zon pertengahan (zon 2). Kajian menunjukkan hanya lembapan pada peringkat tepu mempunyai kaitan dengan EC_a. Oleh itu EC_a boleh dijadikan sebagai penunjuk dalam menentukan lembapan tanah semasa sawah dalam keadaan tepu.

Pengira Sifat-sifat Fizikal Tanah Sawah (PSPPC) telah dibangunkan untuk memudahkan pengguna dalam mengangarkan nilai sifat fizikal tanah berdasarkan nilai EC_a. Bahasa JavaScript telah digunakan untuk membangunkan program antara muka dan pengira yang berasaskan web. Jumlah kandungan relatif pasir, kelodak, lempung, kelas tekstur tanah, ketumpatan pukal, bahan organik dan konduktiviti hidraulik tepu boleh dikira. Ini dapat membantu pengguna menganggar nilai ciri fizik tanah berdasarkan nilai EC_a yang mudah

diperolehi. Pengira ini hanya dicadangkan untuk kegunaan kawasan Sawah Sempadan kerana ia dibangunkan berdasarkan data yang diperoleh dari kawasan tersebut.

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I certify that an Examination Committee has met on **28 September 2011** to conduct the final examination of **Mastura Mohamed** on her **Master Degree** thesis entitled "**Spatial Apparent Electrical Conductivity Of Paddy Soil As An Indicator Of Selected Soil Physical Properties**" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the student be awarded the (Degree of Master of Science). Members of the Examination Committee were as follows:

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master. The members of the Supervisory Committee were as follows:

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or other institutions.

MASTURA MOHAMED

Date: 28 September 2011

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