

**ELUCIDATION OF SPATIAL VARIABILITY OF SALINITY
OF SOILS IN A RICE - OTHER FIELD CROPS CROPPING SYSTEM
USING PROXIMAL SOIL SENSING**

R.A.C.J. PERERA¹, U.W.A. VITHARANA² AND N.R.A. NAWARATHNE¹

¹*Field Crops Research and Development Institute Mahailuppallama, Sri Lanka*

²*Faculty of Agriculture, University of Peradeniya, Sri Lanka*

INTRODUCTION

A large extent of paddy lands in coastal areas and major irrigation schemes in the island are becoming low productive due to high soil salinity. Information on the spatial variability of soil salinity is important to adopt reclamation measures. Soil salinity is measured on the basis of the electrical conductivity of the soil (EC_e). However, EC_e measurement is laborious and thus not practically feasible for spatial characterization which requires large number of observations. The proximal sensing is an evolving technology to quantify soil parameters in quick, reliable and cost effective manner. Electromagnetic Induction (EMI) based soil apparent electrical conductivity (EC_a) measurement is one of widely used soil proximal soil sensing methods (Corwin and Lesch, 2005). Geonics EM 38 (G-EM 38) and Dualem 1S (D-1S) sensors are used frequently for assessment of soil salinity and other soil characteristics by electromagnetic induction technique in agriculture and could be used interchangeably with similar results (Urdano and Aragues, 2012). This study was conducted to assess the potential of using proximal sensing of EC_a for spatial characterization of salinity of soils in a rice - OFCs cropping system in the Dry zone of Sri Lanka.

MATERIALS AND METHODS

A site of approximately five hectares was selected ($8^{\circ} 14' 12.87''$ N, $80^{\circ} 17' 41.50''$ E) where rice - OFCs cropping system has been practicing nearly thirty years. The Dualem-1S proximal soil sensor was used to measure the apparent electrical conductivity (EC_a) and the measurements were taken at the selected land block before the commencement of *Maha* 2014-15 season. Surface (0 - 40 cm) and

* See "*Tropical Agriculturist*" Volume 163 for details.

sub (40 - 80 cm) soil samples were collected at 30 locations identified using Conditional Latin Hypercube sampling technique which accounted the variability of EC_a . Geographical Information System (GIS) maps showing the spatial variability patterns of EC_a measured with perpendicular (EC_{aPRP}) and horizontal (EC_{aHCP}) co-planner modes of the Dualem-1S sensor at a 2 m x 2 m measurement density were constructed using Ordinary Kriging procedure using Idrisi Kilimanjaro software (Vitharana, 2008). The Regression Kriging procedure was used to develop the EC_e maps. Independent samples of top and subsoils ($n = 10$, each) were collected randomly and their EC_e were measured for the validation of the EC_e prediction models of both top and sub soils. The Mean Estimation Error (MEE), Mean Square Estimation Error (MSEE) and Root Mean Squared Estimation Error (RMSEE) were used as validation indices (Vitharana, 2008; Cockx, 2010).

RESULTS AND DISCUSSION

EC_a survey resulted in 30,586 measurements of perpendicular (EC_{aPRP}) and horizontal (EC_{aHCP}) co-planner modes. Descriptive statistics of EC_a measurements measured in mS/ m are given in the Table 1.

Table 1. Summary statistics of EC_a (mS/ m) measurements ($n = 30,586$).

	Mean	Median	Min	Max	Stdev	CV (%)	Skewness
EC_{aPRP}	38.5	34.7	0.2	123.7	19.1	49.6	0.87
EC_{aHCP}	50.3	47.4	8.6	134.2	22.9	45.5	0.63

The Kolmogorov-Smirnov test for normality indicated normal distributions (< 0.01 level of probability) associated with both EC_{aPRP} and EC_{aHCP} measurements. This was confirmed by the relatively smaller (< 1.0) coefficients of skewness boundaries (Vitharana, 2008). A strong correlation ($r = 0.96$) was observed between EC_{aPRP} and EC_{aHCP} indicating similar patterns of spatial variability in conductivity of both top and subsoils within the field.

The prediction models with linear regression relationships, ' $EC_e = 0.5 EC_{aPRP} + 0.248$ ' and ' $EC_e = 0.3 EC_{aHCP} + 0.238$ ' were found best for the prediction of topsoil and subsoil EC_e respectively, using proximally sensed EC_a . The

predicted EC_e of both top and subsoils ranged from 0.30 dS/ m to 0.80 dS/ m. Strong correlations were found between both topsoil EC_e and EC_{aPRP} ($r = 0.89$) and subsoil EC_e and EC_{aHCP} ($r = 0.80$). Strong correlations were found between predicted and observed EC_e both in top and subsoils combined with very low values for validation indices; MEE, MSEE and RMSEE showing a great potential of using the developed models for the prediction of EC_e in both top and subsoils. Fuzzy k-mean classification algorithm was used to demarcate the potential salinity hazard zones using the GIS based FuzMe software (Vitharana, 2008) and three optimal salinity classes were identified for both top and subsoils.

The study indicates a strong potential of proximal sensing of apparent electrical conductivity as a promising tool for spatial prediction of salinity in rice - other field crops cropping system in the Dry zone of Sri Lanka. Proximal soil sensing can be used to identify salinity hazard zones in soil with a minimum effort of field sampling.

REFERENCES

- Cockx, L. 2010. High resolution soil inventory using a dual signal electromagnetic induction sensor. PhD thesis, Ghent University. Belgium.
- Corwin, D.L. and S.M. Lesch (2005). Apparent soil electrical conductivity measurements in agriculture. *Comp. Electron. Agric.*, 46 : 11 - 43.
- Urdano, V. and R. Aragues. 2012. Comparison of Geonics EM 38 and Dualem 1S electromagnetic induction sensors for the measurement of salinity and other soil properties. *Soil Use and Management. British Society of Soil Science Journal*.28: 108 -112.
- Vitharana, U.W.A. 2008. Spatial inventory techniques in support of site specific soil management. PhD thesis, Ghent University. Belgium