American-Eurasian J. Agric. & Environ. Sci., 15 (6): 1059-1066, 2015
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2015.15.6.12689

Performance of Electromagnetic Induction Meter (EM38-MK2-1) under Different Working Conditions in a Sandy Loam Soil

[1,2]Samy Marey and [3]El-Kamil Tola

[1]Sciences, Technology and Innovation Unit, Rector's for Graduate Studies & Scientific Research King Saud University, P.O. Box: 2454, Riyadh 11451, Saudi Arabia
[2]Agricultural Engineering Research Institute (AENRI), Agricultural Research Center, P.O. Box: 256 Dokki, Giza, Egypt
[3]Precision Agriculture Research Chair, King Saud University, 11451 Riyadh, Saudi Arabia

Abstract: The objective of this study was to identify the optimum conditions at which the Electromagnetic Induction Meter (EM38-MK2-1) can be used for precision measurements of the apparent soil electrical conductivity (EC_a) measurements in a sandy loam soil of a 50 ha experimental field located in the eastern region of Saudi Arabia. A total of 25 locations were selected for apparent electric conductivity (EC_a) and extracted soil paste electric conductivity (EC_e) measurements with EM38 and Laboratory measurements. At all sampling points, observations were taken with EM38 device in both the horizontal and vertical orientation to the soil surface. Measurements were recorded for three EM38 heights above the ground: on the soil surface (i.e. 0.00 cm, 20 cm and 40 cm). These readings were recorded at soil moisture contents of 24.5, 21.9, 18.6 and 15.3%. Also, the EM38 device was tested at three different surveying speeds (21.22, 17.33 and 12.69 km h^{-1}) at 20 and 40 cm heights above the ground for both vertical and horizontal orientations. The results revealed that the height of EM38 device above the ground induced significant differences ($P<0.05$) in the measured EC_a under all the tested soil moistures for both the vertical and horizontal EM38 orientations. It was observed that placing EM38 on the soil surface induced the highest R^2 between EC_a and EC_e compared with other heights. The errors in predicting EC from the EM38 measured EC_a increased with the decrease in soil moisture and indicated that the highest measurement accuracy was obtained at the highest tested soil moisture (24.5%), except for 0.00 cm height above the ground, EC_a values for vertical mode were higher than that produced by horizontal mode at all moisture contents. The results also indicated that there was no definite trend associated to the tested surveying speeds at both EM38 heights above the ground (20 and 40 cm) for both vertical and horizontal modes.

Key words: Soil salinity · Electrical conductivity · EM38 · Precision agriculture

INTRODUCTION

Soil salinity mapping is one of the most precision agriculture requirements. Measurement of soil salinity in the laboratory is time consuming, expensive and labor intensive, especially for large scale measurements. Using EM38 with the help of vehicles and a Global Positioning System (GPS) for geo-referenced electrical conductivity (EC) measurements allows covering large area in a short time. Electrical conductivity (EC) measured by electromagnetic induction (EMI) using EM38 is inexpensive and rapid for precision agriculture purposes [1, 2, 3, 4]. EM38 device is appropriate to assess the temporal and spatial variability of several soil properties such as salinity, water content, texture and depth-to-clay mapping, width of soil boundaries and in applications for precision agriculture [5]. There are several factors affecting the accuracy of the EM38 device signal such as salinity level, soil moisture content, soil structure (porosity and clay percent), temperature and the position of the instrument (horizontal, vertical and height above the soil surface). O'Leary *et al*. [6] used EM38 for identifying sub-soil properties and concluded that, the electrical conductivity was well correlated with high soil

Corresponding Author: El-Kamil Tola, Precision Agriculture Research Chair, King Saud University, 11451 Riyadh, Saudi Arabia.