other routine laboratory procedures. From the presented evidence, it is difficult to distinguish among them.

In conclusion, the discussion concerning the estimation procedure of calculating $EC_g$ and $\theta_w$ with respect to their crucial importance is too short and superficial. The model (Rhoades et al., 1989) lacks the power of the previous ones (e.g., Waxman and Smits, 1968) that suggested possible electrical bridging of the charged solid-phase surfaces by ions in the adjacent liquid phase. No comparison was made with previous procedures; thus, the stated objective that more accurate salinity values will be obtained under conditions of low $EC_w$ and low $\theta_w$ was not attained.

Reply to “Comments on ‘Soil Electrical Conductivity and Soil Salinity: New Formulations and Calibrations’”

I see no need to separate the assumptions into two categories by salinity level. The value of the new model and its assumptions is that it covers the full range of salinities, whereas the previous one did not. I have previously recognized and stated that use of my previous linear model had to be restricted to salinities in excess of about 4 dS/m (e.g., Shainberg et al. 1980; Bottraud and Rhoades, 1985).

I feel the assumption that the electrical conductivity of the solid phase is essentially the same throughout the soil matrix while the solution phase may differ is a reasonable one for the intended purposes of the model. The results of Bottraud and Rhoades (1985) and Shainberg et al. (1980) both show that wide variations in solution composition do not appreciably alter the intercept of the linear part of the $EC_s-EC_w$ relation.

All four elements (a, b, c, and d) were taken into account in the model; it was not simplified to just Element c, as Nadler contends. As an insulator, Element d was appropriately cancelled and the other three were included (see Eq. [3]). However, as stated in the article, Element b is insignificant for most agricultural soils and may be eliminated—giving the generally practical version of the model (Eq. [4]). For cases where $EC_w \gtrsim 4$ dS/m, Eq. [4] may be simplified to Eq. [5]. Since the ratio $(\theta_c + \theta_w)/\theta_c$ is a number reasonably close to one; Eq. [5] may be simplified further to

$$EC_s \approx EC_g + (\theta_w - \theta_w)EC_{wc},$$

where $EC_s$ is the linear intercept of the $EC_s-EC_w$ relation.

The effect of dissolution of salts such as gypsum at water contents in excess of the field water range is irrelevant to the validity of the model. Such effects may cause errors in interpreting salinity using extract methods of appraisal, but the model is applicable even for such high moisture contents, as shown elsewhere (Rhoades et al., 1989b, 1990).

Both $\theta_w$ and $\theta_{wc}$ increase with an increase in water content because all of the pores are being filled.

The relatively good agreement found between $EC_s$ and $EC_w$ according to the newer and older models is accounted for because the previous model was restricted to values of $EC_s \gtrsim 4$ dS/m, where the relation between $EC_s$ and $EC_w$ is essentially linear, and because the ratio $(\theta_c + \theta_w)/\theta_c$ is close to the value of one, as explained above.

The data given in this and other studies (Rhoades et al., 1976) show that $EC_s$ is essentially constant with $\theta$. The value of $EC_s$ is somewhat dependent on $\theta$, since $EC_s = [\theta, + \theta_{wc}) / \theta_c] EC_w$.

The merit and practicality of the model for field appraisal purposes is demonstrated in Rhoades et al. (1990), where it was shown applicable to a wide range of soil types, tillage conditions, and moisture contents. The model is not perfect by any means, but I know of no other as appropriate for practical field assessment of salinity, for which it was intended. When a better one is developed, I'll be more than willing to adopt it. I will certainly not adopt a model that assumes that $EC_s$ increases with $EC_{wc}$, which requires lengthy measurements of soil moisture-release properties made on disturbed soil samples in the laboratory and which has been shown to give inaccurate appraisals of soil salinity when applied to field soils.

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References


