Prediction of Soil Erosion Under Three Tillage Systems Using RUSLE and GUEST Models

G. Esaïe KPADONOU1*, Samuel G.K. ADIKU1 and Dilys S. MACCARTHY2

1 Department of Soil Science (DSS), University of Ghana, Legon.
2 Soil and Irrigation Research Centre (SIREC), University of Ghana, Kpong

*Corresponding Author: e.kpadonou@yahoo.com
Background

- 30 t.ha\(^{-1}\) of soil is lost every year worldwide through erosion [1].
- From which 60\% is induced by human activities
- Expected increase of soil erosion: 17\% due to cropping [3]

Goal

- Find sustainable practices that can reduce soil erosion
Objectives

1. Quantify soil erosion from three tillage systems:
   - Flat tillage (FT)
   - Ridge and Furrow tillage (RF)
   - Tied-Ridge tillage (TR)

2. Predict soil erosion from the 3 tillage systems using:
   - RUSLE
   - GUEST

Data collection
RUSLE and GUEST models

- **RUSLE**: \( E = (a - b \times Cov + c \times Cov^2) \times LS \times K \times P \times \frac{Q}{10} \)
- **GUEST**: \( E = 2700 \times s \times \lambda \times (1 - cov) \times \frac{Q}{100} \)
- \( MAE = \sum_{i=1}^{n} \frac{|S_i - O_i|}{n} \), \( 0 = \) perfect fit

**Results: Experiments**

- Rainfall: Major season (482 mm) was double minor (292 mm)
- Runoff: RF > FT > TR, and TR reduced SE up to 43-100%
### Results: Modeling

#### Major season

<table>
<thead>
<tr>
<th>Tillage systems</th>
<th>Observed means</th>
<th>Predicted RUSLE</th>
<th>Predicted GUEST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Ton ha(^{-1}))</td>
<td>MAE</td>
<td>(Ton ha(^{-1}))</td>
</tr>
<tr>
<td>Flat Tillage</td>
<td>26.6±0.12</td>
<td>0.18</td>
<td>23.3±0.08</td>
</tr>
<tr>
<td>Ridge and Furrow</td>
<td>72.3±0.28</td>
<td>0.49</td>
<td>98.3±0.36</td>
</tr>
<tr>
<td>Tied-Ridge</td>
<td>30.9±0.15</td>
<td>0.23</td>
<td>35.6±0.17</td>
</tr>
</tbody>
</table>

#### Minor season

<table>
<thead>
<tr>
<th>Tillage systems</th>
<th>Observed means</th>
<th>Predicted RUSLE</th>
<th>Predicted GUEST</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>(Ton ha(^{-1}))</td>
<td>MAE</td>
<td>(Ton ha(^{-1}))</td>
</tr>
<tr>
<td>Flat Tillage</td>
<td>06.3±0.03</td>
<td>0.18</td>
<td>10.6±0.04</td>
</tr>
<tr>
<td>Ridge and Furrow</td>
<td>22.4±0.15</td>
<td>0.30</td>
<td>51.0±0.18</td>
</tr>
<tr>
<td>Tied-Ridge</td>
<td>00.0±0.00</td>
<td>0.00</td>
<td>00.0±0.00</td>
</tr>
</tbody>
</table>

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Results: Modeling

- RUSLE and GUEST adequately captured the effects of the 3 tillage on soil erosion
- Much better for minor season and for TR and FT, MAE = 0.0-0.30

Conclusion

- Soil erosion varied with rainfall and tillage practices
- TR tillage significantly reduced soil erosion
- RUSLE and GUEST can be applied for SE simulations from the 3 tillage.