1. INTRODUCTION

Pearl millet [Pennisetum glaucum (L) R. Br.] is an important crop in semi-arid West Africa and also is a potential crop for some regions of the United States.

Crop Simulation Models have been used as a complementary tool for classical research of field experiments.

The goals of this study were:

- To evaluate the performance of the cropping system model CSM-CERES-Millet for two contrasting environments, in Nebraska, USA and Niger, West Africa,
- To use the CSM-CERES-Millet model for determining the optimum planting dates for these two environments.

2. MATERIALS AND METHODS

The CSM-CERES-Millet model of the DSSAT Version 4.0 (Jones, et al., 2003; Hoogenboom et al., 2004) was evaluated with experimental data that were collected in field experiments conducted in Kollo, Niger and Mead, Nebraska, USA during 1995 and 1996 growing seasons (Maman et al., 1999, 2000).

For Kollo, Niger, the varieties were: Heini Kirey, Zatib and 3/4HK and the two management factors were: a) traditional with low plant population (30,000 plants ha\(^{-1}\)) and without fertilizer and b) enhanced with an increased plant population (60,000 plants ha\(^{-1}\)) and 23 N kg ha\(^{-1}\). Daily weather records for the site were obtained from the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) at Kollo. The soil was a Pasammentic Paleustalf with a sandy texture.

For Nebraska the three pearl millet hybrids were 59022A x 89-083, 1011A x 086R and 1361M x 6Rm. The two management practices were a) 0 N and b) 78 kg ha\(^{-1}\) and the plant population was 100,000 plants ha\(^{-1}\).

Daily weather records were obtained from an automated weather station located at Mead, Nebraska. The soil was a Typic Argudoll with a silty clay loam texture.

Different planting dates were evaluated using the CSM-CERES-Millet model and long-term historical weather data.

3. RESULTS

Phenology was accurately predicted by the CSM-CERES-Millet model. Low values of prediction deviations (PD) between observed and simulated days from planting to anthesis and from anthesis to physiological maturity for both sites were obtained (Table 1).

Yield was also accurately simulated for both sites with RMSE varying between 434 and 674 kg ha\(^{-1}\) and index of agreement (d) between 0.85 and 0.93 (Fig. 1 and 2).

The planting date analysis using 20 years of weather records for Kollo, Niger indicated that the best planting dates for varieties like Heini Kirey (long season), were between April 23rd and May 13th. For the varieties like Zatib and 3/4HK (short season) the planting dates that resulted in high simulated yields were somewhat later, between May 3rd and May 23rd (Fig. 3). There was not a significant increase in simulated yield when 23 N kg ha\(^{-1}\) was applied.

The planting date analysis using 35 years of weather records for Mead, Nebraska showed that the highest simulated yield was obtained for the planting dates between June 19th and June 29th (Fig.4). Millet planted later than July 9th showed a significant decrease in simulated yields. When 78 N kg ha\(^{-1}\) N was applied, the simulated yields increased considerably. However, there was a high inter-annual variability.

4. CONCLUSIONS

The CSM-CERES-Millet model was able to accurately simulate phenology and yield for millet grown in two contrasting environments, e.g., Mead and Kollo and under different management practices.

The CSM-CERES-Millet model was useful tool to identify the best planting dates for the two study sites. Results found using the CSM-CERES-Millet in general agreed with previous reported observations, showing that crop simulations models can have a complementary role to the classical experimental approach.

Table 1. Simulated and observed phenology and PD(%) for varieties and hybrids grown in Kollo, Niger and in Mead, Nebraska, USA.

<table>
<thead>
<tr>
<th>Varieties grown in Kollo</th>
<th>Observed (days from planting)</th>
<th>Simulated (days from planting)</th>
<th>PD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heini Kirey Anthesis</td>
<td>97</td>
<td>97</td>
<td>0.0</td>
</tr>
<tr>
<td>Zatib Anthesis</td>
<td>88</td>
<td>88</td>
<td>0.0</td>
</tr>
<tr>
<td>3/4HK Anthesis</td>
<td>54</td>
<td>54</td>
<td>0.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Varieties grown in Mead</th>
<th>Observed (days from planting)</th>
<th>Simulated (days from planting)</th>
<th>PD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>59022A x 089-083 Anthesis</td>
<td>55</td>
<td>57</td>
<td>-3.6</td>
</tr>
<tr>
<td>1011A x 086R Anthesis</td>
<td>62</td>
<td>62</td>
<td>0.0</td>
</tr>
<tr>
<td>1361M x 6Rm Anthesis</td>
<td>70</td>
<td>70</td>
<td>0.0</td>
</tr>
</tbody>
</table>

5. REFERENCES

