Irrigating sugar beet (Beta vulgaris L.) by means of a decision support system in Italy

Introduction

The increasing demand for increased external demand and evaluation of the high yield potential and the potential for recycling irrigation water are challenges for irrigated agriculture in Italy. The high profitability of sugar beet cultivation, together with the increasing water consumption, and the development of decision support systems (DSS) within the framework of precision agriculture, make strategic decisions even more important. The efficient allocation of irrigation water can be an essential element for achieving high yields. A simple cost-and-benefit comparison may be drawn, on the base of the four systems' fixed and variable costs at 100 AF. In IST, the 4 systems at 100 AF were characterized by a close yield level, the only consistent differences remaining those between Ctrl and Gun. Only in a site, 100 TENS brought to 15-25% higher volumes than 100 AF; in the other three, it appears as 100 AF maintained an adequate soil moisture.

Methods

The choice of irrigation systems and volumes enhancing yield and quality traits. Not all the results were retained for the different parameters. It has a temperature data-set for all beet-growing areas in Italy and can calculate Kc and ET in three different ways: automatically, by manual input, or in a mixed mode. It features reduced Kc's, compared to the reference ones (FAO, 1998), and takes into account the contribution to ET from the shallow water-table. AF works on both spring and autumn beets, with irrigation needs of the sugar beet crop. Between the two presentations, a 50%-restoration hampered the achievement of top performance consistently better than the latter in terms of financial income due to irrigation. Focusing on the progress along the harvest campaign, Ctrl performs consistently better than the latter in terms of financial return. The four systems may, anyway, be grouped into the mobile ones (Sprinkl. and Drip) and the fixed ones (Gun and Boom), fixed mini-sprinklers and fixed mini-booms. The decision support system AcquaFacile (AF), a DSS irrigating Beta vulgaris by Beta.

Results

The four systems may, anyway, be grouped into the mobile ones (Sprinkl. and Drip) and the fixed ones (Gun and Boom), fixed mini-sprinklers and fixed mini-booms. The decision support system AcquaFacile (AF), a DSS irrigating Beta vulgaris by Beta.

Conclusions

The different yield potential and precipitation among sites brought about a wide range of responses to applied water. However, a good correlation was shown between the seasonal irrigation volume and the seasonal yield (R2 0.87), was only partially counterbalanced by a small decrease in sugar content (R 2 0.35). As a whole, minor losses in yield were perceived, then, as the irrigated crop took advantage of a thicker canopy to intercept more late-season light.

Table 1 - Seasonal irrigation volumes (mm).

<table>
<thead>
<tr>
<th>SITE</th>
<th>50 AF</th>
<th>100 AF</th>
<th>100 TENS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD</td>
<td>40</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>RA</td>
<td>50</td>
<td>100</td>
<td>175</td>
</tr>
<tr>
<td>PV</td>
<td>80</td>
<td>140</td>
<td>265</td>
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</tbody>
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Table 2 - Sugar yield (t ha-1) with different irrigation systems.

<table>
<thead>
<tr>
<th>SITE</th>
<th>Ctrl Gun Boom Sprinkl. Drip</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>8.8 11.2 11.2 11.6 11.6 0.41</td>
</tr>
<tr>
<td>L</td>
<td>8.1 12.5 12.1 12.5 12.4 0.69</td>
</tr>
</tbody>
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Fig. 2 - Costs and net income with different irrigation systems in two harvests.

References


Beta (Italian Society for sugar beet research)
A decision support system in Italy on irrigating sugar beet (Beta vulgaris L.)

Introduction

During the 2000s, the refinement and extension of decision support systems has been among the key factors to improve the efficiency of the irrigation systems. The efficiency of the decision support system (DSS) is dependent on the complexity of the problem and the information available. The AcquaFacile software, developed in Italy, is a DSS for irrigating sugar beet, which calculates water requirements, crop evapotranspiration and economic costs and benefits for the crop. The software is based on the FAO-56 method for calculating crop water requirements and the Kc and ET parameters. It also takes into account the contribution to ET from the shallow water table. The software has been validated through field plot trials, and it has been shown to be effective in improving the financial return in the sugar beet crop in Italy.

Results

The results of the field plot trials showed that the irrigation system efficiency and financial return were highest for the AcquaFacile software. The irrigation systems trial (IST; three sites) showed that the irrigation system efficiency and financial return were highest for the AcquaFacile software, followed by the fixed systems (Sprinkl. and Drip). The irrigation volumes trial (IVT; four sites) showed that the irrigation system efficiency and financial return were highest for the AcquaFacile software, followed by the fixed systems (Sprinkl. and Drip). The seasonal volume (mm) for the AcquaFacile software was higher than for the fixed systems (Sprinkl. and Drip), indicating that the AcquaFacile software is more efficient in terms of water usage.

Conclusions

The AcquaFacile software is an effective decision support system for irrigating sugar beet in Italy. It has a temperature data-set for all beet-growing areas in Italy and can calculate Kc and ET in three different ways: the reference ET is reduced Kc's, compared to the reference ones (FAO, 1998), and the software takes into account the contribution to ET from the shallow water table. However, it is important to note that the software is not perfect, and there is still room for improvement in terms of accuracy and reliability. Future work should focus on improving the software's accuracy and reliability, as well as expanding its use to other crops and regions.