OIL CROPS: SESAME AND SUNFLOWER SUBNETWORKS

PROCEEDINGS OF THE JOINT SECOND WORKSHOP HELD IN CAIRO, EGYPT,

9–12 SEPTEMBER 1989
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La présente série est réservée aux documents issus de colloques, aux rapports internes et aux documents techniques susceptibles d'être publiés plus tard dans une série de publications plus soignées. D'un tirage restreint, le rapport manuscrit est destiné à un public très spécialisé.

Esta serie incluye ponencias de reuniones, informes internos y documentos técnicos que pueden posteriormente conformar la base de una publicación formal. El informe recibe distribución limitada entre una audiencia altamente especializada.
OIL CROPS:
SESAME AND SUNFLOWER SUBNETWORKS

Proceedings of the Joint Second Workshop
held in Cairo, Egypt, 9–12 September 1989

Edited by
Abbas Omran
Technical Adviser, Oil Crops Network

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Food and Agriculture Organization, Industrial Crops and European Office, Rome
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International Development Research Centre, Canada

Scientific and Organizing Committee
Dr Abbas Omran
Dr Badr A. El-Ahmar
Dr Eglal Rashed
In September 1989, the Sunflower and Sesame subnetworks held their bi-annual meetings in Cairo, Egypt. The meetings were well attended and papers, presented in these proceedings, provide a very informative overview of some of the cropping systems, management practices, production constraints and research highlights for both crops in several countries.

Chronic edible oil deficit is a major problem facing many developing countries in Africa and Asia where most countries are forced to import large quantities to satisfy the requirements of their growing populations. With the present rates of population increase and the improvement of nutrition standards it is likely that the consumption of edible oil will rise over the years, increasingly drawing on scarce foreign exchange for the importation of this vital food staple. For this reason, several countries have opted to increase self-sufficiency in edible oil.

Production deficits are due to a number of factors, among which neglect in oilcrops research, in both developed and developing countries has been a major one. This is particularly true for minor crops such as sesame. In the context of the IDRC oilcrops network, initiated in 1981, the interchange of information and the sharing of results between scientists have proved to be very useful and beneficial for the generation of scientific knowledge and the stimulation of research in this important area. It is hoped that conclusions and recommendations of this meeting will stimulate further research and development in the future.

A second important reason for limited national production has been the exceptionally low levels of world prices for oils and fats in the 1980's and the comparative advantage of importation over production for developing countries. The description of a case study using a system's approach to analysis the Vegetable Oil/Protein System of Kenya has stirred much interest during the Cairo meetings and it is hoped that similar work can be carried out in other countries in the future.

The Cairo meetings will also unfortunately be remembered as the one which has witnessed the diagnosis of the fatal disease of late Dr. Hiruy Belayneh, Chairman of the Brassica Subnetwork. We will all regret his absence.

On behalf of IDRC and of all participants, I would like to thank the Government of Egypt for its hospitality, the organizers for the excellent arrangements and all those who contributed to the success of these meetings by their presentations and discussions.

Eglal Nached,
Senior Program Officer,
IDRC, Cairo
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SESAME IRRIGATION IN EGYPT
Ahmed Mohamed El-Wakil

Abstract

For best seed production, sesame should be irrigated when the available soil moisture depletion in root zone reaches 50-60%. The differences in water quantities consumed by the same sesame entries (1550, 2276 and 2616 &/fed.) grown at Bahtim (South Delta), Fayoum (Middle Egypt) and Shandawil (Upper Egypt) might be attributed to variation in soil and meteorological factors. Water use efficiency was 0.30-0.32 kg/m² at Bahtim and Fayoum, while at Shandawil it was 0.10 kg/m² due to the more water consumption. No significant difference was found in water quantities consumed by sesame entries in all experiments.

Sesame (Sesamum indicum L.) is one of the oldest crops known to man and might be the oldest cultivated oilseed crop. The leading countries in the production of sesame are: India (2.5 million ha), China (one million ha) and Burma (about 400,000 ha). The Sudan ranks third as world producer and first as exporter (1). In Egypt, 30% of the present oil consumption comes from domestic raw materials, mainly from cotton seed. The remaining is imported to compensate the shortage of edible oils. To fill the gap, oil crops should be given great attention by research workers and crop growers. In this respect, sesame is one of the main promising crops. Its seed is a rich source of oil and protein.

Irrigation management is very important nowadays in Egyptian farms due to the shortage in water resources and the expansion of agriculture in the newly reclaimed areas. Further, too much or too little watering causes serious crop damage. Therefore, it is necessary to determine the optimum water requirement and to plan the best irrigation schedules for maximum crop production. Studying evapotranspiration (consumptive use) either empirically or by developing formulae has been given a great attention, to meet the above purpose for all crops. In Egypt, little information is available about sesame water requirements. Therefore, three field experiments were conducted with major objectives to:

I. determine the best schedule of irrigation application(2),
II. determine the critical growth stage as affected by drought (3), and
III. study the effect of two various locations and three sesame varieties on water consumptive use and water use efficiency (4).

Experiment I

Field work and laboratory techniques were carried out at Bahtim Agricultural Research Station during 1980-1982 seasons. The first aim of this study was to determine its consumptive use under four soil available moisture depletion (ASMD) viz., 30, 50, 70 and 90% ASMD, and the best schedule of irrigation application as well as water use efficiency. The white seeded variety, Giza-25 was used in the three seasons. The results, Table 1, could be summarized as follows:

1. Plant height was significantly decreased with increasing ASMD before irrigation.
2. Height to first capsule decreased with increasing ASMD level.
3. Branch number, capsule number, seed yield per plant, 1000-seed weight and seed yield decreased with increasing ASMD levels.
4. Oil content was significantly decreased by increasing ASMD levels.
Table 1. Effect of irrigation treatments on sesame characters, water consumptive use and water use efficiency at Bahtim.

<table>
<thead>
<tr>
<th>Irrigation treatments (ASMD)</th>
<th>Height (cm)</th>
<th>No. of branches/ number/capsule (cm)</th>
<th>Capsule length (cm)</th>
<th>Seed yield (g)</th>
<th>Seed index (g/plant)</th>
<th>Seed oil yield (g/plant)</th>
<th>Seed oil content (%)</th>
<th>Feed. consumption (fed.) (m³/fed.)</th>
<th>Water use efficiency (kg/m³) (m³/fed.) (kq/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>157.92</td>
<td>71.66</td>
<td>4.83</td>
<td>87.31</td>
<td>10.81</td>
<td>3.11</td>
<td>5.14</td>
<td>52.26</td>
<td>1903 0.32</td>
</tr>
<tr>
<td>50%</td>
<td>133.42</td>
<td>63.50</td>
<td>4.47</td>
<td>60.88</td>
<td>9.07</td>
<td>3.51</td>
<td>4.79</td>
<td>52.21</td>
<td>1621 0.34</td>
</tr>
<tr>
<td>70%</td>
<td>125.75</td>
<td>63.67</td>
<td>3.88</td>
<td>43.36</td>
<td>7.71</td>
<td>3.23</td>
<td>3.69</td>
<td>51.24</td>
<td>1524 0.29</td>
</tr>
<tr>
<td>90%</td>
<td>125.25</td>
<td>64.25</td>
<td>3.79</td>
<td>41.35</td>
<td>6.25</td>
<td>3.07</td>
<td>3.23</td>
<td>50.95</td>
<td>1334 0.27</td>
</tr>
<tr>
<td>Mean</td>
<td>135.59</td>
<td>66.27</td>
<td>4.24</td>
<td>59.63</td>
<td>8.45</td>
<td>3.23</td>
<td>4.21</td>
<td>51.77</td>
<td>1608 0.30</td>
</tr>
</tbody>
</table>

L.S.D.(0.05) 13.57 4.85 6.80 7.34 - 0.13 0.66 0.47

*One feddan (fed.) = 4200 m³. One ardab = 120 kg.

5. Water consumptive use (WCU) was increased as the ASMD decreased in the root zone.

6. The highest water use efficiency (WUE) was obtained from irrigation at 50% ASMD.

Experiment II

Two field experiments were carried out at Bahtim Experiment Station during 1984 and 1985 crop seasons to study the effect of drought at different growth stages, Table 2, on sesame characters, consumptive use and water use efficiency, Table 3. The results could be summarized as follows:

1. Seed yield and its components: Table 3, indicates that treatment (d) gave the highest plant height, height of the first capsule, number of branches, capsule number, seed yield/plant and seed yield/feddan. The highest seed index was obtained from the third treatment (c). Treatment (b) gave the lowest average of these characters, indicating that, drought during flowering stage was very dangerous, because drought in that time caused abrupt drop in yield and its components. It was found that treatments (a) and (c) did not differ significantly in yield and its components, although the two treatments were given different amounts of water. Therefore, it could be concluded that, treatment (a) was economical under water deficient conditions.

2. Oil content decreased with drought at flowering stage.

3. WCU increased by increasing number of irrigations.

4. The highest values of WUE were observed with treatment (d), while the lowest were obtained...
Table 3. Effect of drought on sesame growth stages on yield and its components, oil content, water consumptive use and water use efficiency at Bahtim.

<table>
<thead>
<tr>
<th>Irrigation treatments</th>
<th>Height (cm)</th>
<th>No. of Capsule to 1st branches/plant</th>
<th>Seed yield (g)</th>
<th>Seed index</th>
<th>Seed oil yield (g)</th>
<th>Oil content (%)</th>
<th>Water consumptive use (m³/plant)</th>
<th>Water use efficiency (kg/m³)</th>
<th>LSD (0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>136.4</td>
<td>65.0</td>
<td>4.1</td>
<td>55.2</td>
<td>8.2</td>
<td>3.42</td>
<td>3.79</td>
<td>53.10</td>
<td>1306</td>
</tr>
<tr>
<td>b</td>
<td>117.6</td>
<td>64.6</td>
<td>3.4</td>
<td>51.2</td>
<td>5.9</td>
<td>2.68</td>
<td>3.35</td>
<td>50.90</td>
<td>1'420</td>
</tr>
<tr>
<td>c</td>
<td>136.2</td>
<td>68.0</td>
<td>4.1</td>
<td>57.2</td>
<td>8.2</td>
<td>3.32</td>
<td>4.49</td>
<td>53.10</td>
<td>1'533</td>
</tr>
<tr>
<td>d</td>
<td>155.8</td>
<td>72.4</td>
<td>4.3</td>
<td>63.0</td>
<td>9.6</td>
<td>2.86</td>
<td>5.38</td>
<td>53.80</td>
<td>1'714</td>
</tr>
<tr>
<td>Mean</td>
<td>147.0</td>
<td>67.0</td>
<td>4.0</td>
<td>54.2</td>
<td>8.0</td>
<td>3.08</td>
<td>4.23</td>
<td>52.80</td>
<td>1'493</td>
</tr>
</tbody>
</table>

*One feddan (fed.) = 4200 m², One ardbab = 120 kg.

with treatment (b). The data in different treatments took the following order: d > c = a > b.

From economic point of view, it could be concluded that the best irrigation schedule for WUE (saving irrigation water as well as yield production) is to irrigate plants every 15 days up to maturity, as in treatment (d).

Experiment III

Three sesame entries i.e., two mutant lines (No. 8 and 48) and a local variety ("Giza-25") were examined under three available soil moisture depletions (ASMD) 40, 60 and 80% ASMD at Fayoum (Middle Egypt) and Shandawil (Upper Egypt) during 1985 and 1986 crop seasons.

Data in Table 4 indicates that the first treatment of irrigation (40% ASMD) gave, in most cases, the highest means for growth characters as well as seed yield and its components. Although Giza 25 produced higher number of branches/plant, the two mutant lines surpassed its seed yield due to their superiority in number of capsules/plant.

Sesame consumptive use of water was positively affected by the available soil moisture in the root zone. The differences in water quantities consumed by the same entries grown at both Fayoum and Shandawil might be attributed to variation in soil and meteorological factors, Table 5. WUE was increased under drought conditions at Shandawil and soil moisture at Fayoum. Mutant line 8 was the most efficient entry in making use of water.

References


Table 4. Effect of irrigation treatments and varieties on sesame characters, water consumptive use and water use efficiency at Shandawil.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Length of Plant (cm)</th>
<th>No. of fruiting branches/ capsule/ plant</th>
<th>No. of yield/ plant</th>
<th>Seed index</th>
<th>Seed* yield/ oil fed. content</th>
<th>Water consumptive use Efficiency (m³/fed)(kg/m³)</th>
<th>Water use efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation treatments (ASMD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. 40%</td>
<td>228.25</td>
<td>121.33</td>
<td>4.33</td>
<td>241.08</td>
<td>42.60</td>
<td>3.45</td>
<td>2.28</td>
</tr>
<tr>
<td>2. 60%</td>
<td>188.08</td>
<td>121.33</td>
<td>4.27</td>
<td>186.92</td>
<td>34.60</td>
<td>3.59</td>
<td>2.12</td>
</tr>
<tr>
<td>3. 80%</td>
<td>178.92</td>
<td>114.33</td>
<td>3.97</td>
<td>156.92</td>
<td>32.70</td>
<td>3.05</td>
<td>1.88</td>
</tr>
<tr>
<td>LSD at (.05)</td>
<td>29.21</td>
<td>8.10</td>
<td>-</td>
<td>-</td>
<td>5.00</td>
<td>0.32</td>
<td>0.21</td>
</tr>
</tbody>
</table>

| Varieties or lines | | | | | | | |
| 1. Giza-25 | 159.95 | 140.07 | 5.71 | 135.88 | 21.54 | 3.97 | 5.45 | 55.42 | 222.3 | 0.30 |
| 2. Mut. 8 | 143.33 | 105.63 | 4.42 | 152.21 | 28.99 | 3.76 | 5.90 | 55.25 | 225.0 | 0.32 |
| 3. Mut. 48 | 146.45 | 109.10 | 3.75 | 157.13 | 29.62 | 3.82 | 6.49 | 53.50 | 236.1 | 0.33 |
| LSD at (.05) | 10.83 | 12.81 | - | 43.33 | 7.32 | - | 1.32 | - | |

| Irrigation treatments (ASMD) | | | | | | | |
| 1. 40% | 162.80 | 131.97 | 4.15 | 183.73 | 32.67 | 3.67 | 7.25 | 55.50 | 247.3 | 0.35 |
| 2. 60% | 152.98 | 124.15 | 4.12 | 159.21 | 28.99 | 3.76 | 5.90 | 55.25 | 225.0 | 0.32 |
| 3. 80% | 133.95 | 98.68 | 3.61 | 102.29 | 16.92 | 3.74 | 5.22 | 52.25 | 209.7 | 0.30 |
| LSD at (.05) | 10.83 | 12.81 | - | 43.33 | 7.32 | - | 1.32 | - | |

| Varieties or lines | | | | | | | |
| 1. Giza-25 | 159.95 | 140.07 | 5.71 | 135.88 | 21.54 | 3.97 | 5.45 | 55.42 | 222.3 | 0.30 |
| 2. Mut. 8 | 143.33 | 105.63 | 4.42 | 152.21 | 28.99 | 3.76 | 5.90 | 55.25 | 225.0 | 0.32 |
| 3. Mut. 48 | 146.45 | 109.10 | 3.75 | 157.13 | 29.62 | 3.82 | 6.49 | 53.50 | 236.1 | 0.33 |
| LSD at (.05) | 4.56 | 1.22 | 0.66 | 18.09 | 6.35 | - | 0.95 | - | |

*One feddan (fed.) = 4200 m², One ardab = 120 kg.

Table 5. Mechanical analysis and some physical properties of the soil at Bahtim, Shandawil and Fayoum experimental sites.

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Sand (%)</th>
<th>Silt (%)</th>
<th>Clay (%)</th>
<th>Bulk density</th>
<th>Field Capacity (%)</th>
<th>Wilting Capacity (%)</th>
<th>Available water (g)</th>
<th>Seed oil (g)</th>
<th>Seed (%)</th>
<th>Yield (g)</th>
<th>Yield/ oil fed. content (g)</th>
<th>Water consumptive use Efficiency (m³/fed)(kg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahtim (Clay loam)</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>0-20</td>
<td>21.99</td>
<td>29.95</td>
<td>40.71</td>
<td>1.16</td>
<td>47.76</td>
<td>25.95</td>
<td>21.81</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-40</td>
<td>23.74</td>
<td>28.80</td>
<td>41.22</td>
<td>1.32</td>
<td>35.48</td>
<td>19.28</td>
<td>16.20</td>
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<tr>
<td>40-60</td>
<td>22.13</td>
<td>28.50</td>
<td>39.54</td>
<td>1.33</td>
<td>34.49</td>
<td>18.74</td>
<td>15.75</td>
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<tr>
<td>Shandawil (Sandy loam)</td>
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<td>0-20</td>
<td>40.80</td>
<td>30.30</td>
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<td>28.30</td>
<td>11.20</td>
<td>17.10</td>
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<td>20-40</td>
<td>33.30</td>
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</tr>
<tr>
<td>40-60</td>
<td>44.40</td>
<td>30.70</td>
<td>19.90</td>
<td>1.60</td>
<td>22.80</td>
<td>8.40</td>
<td>14.40</td>
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<tr>
<td>Fayoum (Clay)</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>0-20</td>
<td>20.02</td>
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