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OIL CROPS:
PROCEEDINGS OF THE THREE MEETINGS HELD AT
PANTNAGAR AND HYDERABAD, INDIA, 4-17 JANUARY 1989

1. The Brassica Subnetwork-II
2. The Other Oil Crops Subnetwork-I
3. The Oil Crops Network Steering Committee-I

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Safflower research work at Indore (Madhya Pradesh) started in 1979 with financial support from IDRC, Canada, indicated that safflower has considerable scope in the non-traditional states, particularly Madhya Pradesh. The contributions made by the project in safflower research are as follows:

### Varietal Improvement

The first high yielding variety developed in the project was JSF-1, which was released in 1984 in the name of Jawahar Safflower-1. This white flowered variety has potential to yield 1500 kg/ha under dry condition and is suitable for the entire Madhya Pradesh and is also doing well in the near-by state of Rajasthan. Quite a few of the new varieties such as JSI-8, 9, 10, 12 & 46 have been developed in recent years and are superior in performance to JSF-1 in different yield trials including multilocation varietal trials conducted in Madhya Pradesh at Indore, Khandwa, Khargone, Dindori, Jaora and Morena. The most promising varieties are given in Table 1.

#### Table 1. Performance of the new improved varieties of safflower at Indore

<table>
<thead>
<tr>
<th>Variety</th>
<th>Grain yield* (kg/ha)</th>
<th>1000 grain Wt.(g)</th>
<th>Days to flowering</th>
<th>Plant height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>JSI-9</td>
<td>2019</td>
<td>56</td>
<td>94</td>
<td>78.4</td>
</tr>
<tr>
<td>JSI-46</td>
<td>1837</td>
<td>61</td>
<td>85</td>
<td>75.5</td>
</tr>
<tr>
<td>JSI-10</td>
<td>1814</td>
<td>62</td>
<td>88</td>
<td>78.0</td>
</tr>
<tr>
<td>JSF-1</td>
<td>1747</td>
<td>75</td>
<td>88</td>
<td>68.4</td>
</tr>
</tbody>
</table>

*Based on the last 4 years.

### Development of Spineless Varieties

Unlike the traditional areas, the farmers here desire to have spineless varieties as they are not accustomed to the harvesting and threshing of the traditional spiny varieties. In view of this, spineless variety, JSI-7, has been evolved at this centre. It equals the spiny variety JSF-1 in yield and other characters and yields as high as the national spiny check variety, A-1, Table 2. It has been recommended by the All India Rabi Oilseeds Workshop held at Pune in 1988 for release at a state level.

#### Table 2. Yield comparison of spineless variety JSI-7 with high yielding spiny check varieties JSF-1 (local check) and A-1 (national check) during 1982-84.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of trials</th>
<th>Average yield (kg/ha)</th>
<th>% less yield than</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>JSF-1</td>
<td>A-1</td>
<td>JSF-1</td>
</tr>
<tr>
<td>1982</td>
<td>3</td>
<td>2024</td>
<td>1768</td>
</tr>
<tr>
<td>1983</td>
<td>3</td>
<td>1867</td>
<td>1576</td>
</tr>
<tr>
<td>1984</td>
<td>4</td>
<td>1756</td>
<td>-</td>
</tr>
<tr>
<td>Average</td>
<td>1882</td>
<td>1672</td>
<td>1617</td>
</tr>
</tbody>
</table>
An Exquisite Spineless Safflower Collection

As a result of intensive hybridization amongst 16 diverse spineless types reported earlier (4), several hundred diverse spineless lines have been evolved at Indore.

Table 3. Promising new spineless lines identified during 1987-88.

<table>
<thead>
<tr>
<th>Entry</th>
<th>Pedigree</th>
<th>Plant height (cm)</th>
<th>No. of branches/plant</th>
<th>No. of capitula/plant</th>
<th>100 grain weight (g)</th>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spp. No. 33</td>
<td>WSM-1SP-3 x JSI-7</td>
<td>82</td>
<td>10</td>
<td>36</td>
<td>3.00</td>
<td>3600</td>
</tr>
<tr>
<td>Spp. No. 227</td>
<td>JSI-41 x JSI-7</td>
<td>89</td>
<td>5</td>
<td>25</td>
<td>3.55</td>
<td>2222</td>
</tr>
<tr>
<td>Spp. No. 228</td>
<td>JSI-41 x JSI-7</td>
<td>81</td>
<td>8</td>
<td>22</td>
<td>4.15</td>
<td>2222</td>
</tr>
<tr>
<td>SPP. No. 294</td>
<td>JSI-42 x JSI-7</td>
<td>77</td>
<td>7</td>
<td>17</td>
<td>5.75</td>
<td>2089</td>
</tr>
<tr>
<td>SPP. No. 330</td>
<td>JSI-42 x WSM-1-SP-2</td>
<td>84</td>
<td>6</td>
<td>19</td>
<td>4.55</td>
<td>1899</td>
</tr>
</tbody>
</table>

Development of Varieties with High Oil Content

Development of "high oil" varieties (containing more than 35% oil) was started with the introduction of exotic high oil lines from Dr. P.F. Knowles. Good selections showing desirable plant expression were identified from this material and were further crossed to the high yielding spiny varieties. The technique of selection of "high oil" individual plants in the field and testing of their progenies in subsequent season was reported for 2-3 cycles (2). As a result of this recurrent selection for high oil and yield, few promising lines have been developed recently (Table 4).

Table 4. Promising high oil lines identified during 1987-88

<table>
<thead>
<tr>
<th>Plant height (cm)</th>
<th>Flower color</th>
<th>100 grain weight (g)</th>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPP. No. 40</td>
<td>Red</td>
<td>3.60</td>
<td>2289</td>
</tr>
<tr>
<td>SPP. No. 2029</td>
<td>Yellow</td>
<td>5.00</td>
<td>2178</td>
</tr>
<tr>
<td>SPP. No. 2000</td>
<td>Yellow</td>
<td>3.35</td>
<td>2133</td>
</tr>
<tr>
<td>SPP. No. 2027</td>
<td>Yellow</td>
<td>4.05</td>
<td>1956</td>
</tr>
</tbody>
</table>

The most promising among them are presented in Table 3. All these spineless materials form the excellent base population for further improvement of spineless safflower.

Development of Disease Resistant Varieties

It was observed that, too early planting (1st week of September to mid September) increases the incidence of foliar diseases particularly *Alternaria*. Using the specific nursery in the off-season suggested for screening against foliar diseases 1985) cultures, viz., ESI-31, ESI-24, ESI-21, O.P. (II) No. 10, ESI-22-5 and ESI-19, having tolerance to foliar diseases have been identified (3).

Certain exotic lines resistant to *Phytophthora* root rot and rust were obtained from California, U.S.A. Few selections showing desirable characters and stabilized plant expression have been isolated from this material. These selections are further being evaluated and are used as a source of resistance for the development of resistant varieties.

Development of Aphid Tolerant Varieties

*Aphid* (*Uroleucon compositae, Theobald*) is the most serious and
by far the only major insect problem in safflower in this region. Too late planting (end of October to 1st week of November) increases aphid infestation due to greater succulence of plants at the time of aphid infestation where as early planting is less prone to aphid attack (3). A specific nursery is being used for screening safflower lines in the field against aphid (4).

Field screening of the entire breeding material failed to identify the genotype completely resistant to aphid attack. However, certain level of resistance was noticed in few genotypes. The criteria suggested

Table 5. Evaluation of certain insecticides as regards aphid control (Indore, 1984 to 1986)

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Decline in aphids (%)</th>
<th>Yield (kg/ha)</th>
<th>Total return (Rs/ha)</th>
<th>Cost of cultivation (Rs/ha)</th>
<th>Net return (Rs/ha)</th>
<th>Benefit cost ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimethoate 30 EC</td>
<td>66.1</td>
<td>1534</td>
<td>6136</td>
<td>1914</td>
<td>4222</td>
<td>2.20</td>
</tr>
<tr>
<td>Phosphomidon 76 EC</td>
<td>54.2</td>
<td>1343</td>
<td>5372</td>
<td>1856</td>
<td>3516</td>
<td>1.89</td>
</tr>
<tr>
<td>Quinalphos 20 EC</td>
<td>58.7</td>
<td>1435</td>
<td>5740</td>
<td>2158</td>
<td>3582</td>
<td>1.85</td>
</tr>
<tr>
<td>Endosulfan 35 EC</td>
<td>42.5</td>
<td>1414</td>
<td>5656</td>
<td>2008</td>
<td>3648</td>
<td>1.81</td>
</tr>
<tr>
<td>Control</td>
<td>1059</td>
<td>4236</td>
<td>1664</td>
<td>2572</td>
<td>1.54</td>
<td></td>
</tr>
</tbody>
</table>

Control of Aphids by Chemicals

Out of the 4 insecticides viz., Quinolphos, Endosulfan, Phosphomidon and Dimathoate tested for three years (1984 to 1986). Dimethoate 0.05% appeared to be the best as regards effective aphid control and high benefit cost ratio (Table 5).

Economies of Different Management Practices

1. The complete package of practices followed in safflower (full recommended fertilizers and complete plant protection for aphids) gave highest yield and highest net return (Table 6). Although fertilizer has higher yield and total return than those with plant protection measure for aphids, the latter gave higher net return and benefit-cost ratio. The yield losses due to aphids ranged from 14 to 17%.

2. Provision of only one protective irrigation for germination in the soil moisture stress situation increased the crop yield by about 21% because of optimum plant stand, which is difficult to attain under dry (stress) condition.

Intercropping of Safflower in Gram and Linseed

Sole crop of safflower and intercropping of safflower in linseed or gram appeared to be more remunerative than the traditional sole cropping of gram or linseed
Two rows of safflower could be alternated with 4 to 6 rows of linseed or gram. Here field operation viz., weeding, spraying, harvesting, etc. could be easily done in safflower rows compared to those in sole crop. Hence, such intercropping is particularly useful to farmers who are hesitant to grow sole crop of safflower because of spines.

Table 6. Economics of different management practices (Indore, 1984 to 1986)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Total treatments</th>
<th>Yield (kg/ha)</th>
<th>Yield losses over protected plots (%)</th>
<th>Cost of cultivation (Rs/ha)</th>
<th>Total return (Rs/ha)</th>
<th>Net return (Rs/ha)</th>
<th>Benefit cost ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low monetary input (L.M.I.)</td>
<td>228.3</td>
<td>1305</td>
<td>14.10</td>
<td>1071</td>
<td>5212</td>
<td>4141</td>
<td>3.86</td>
</tr>
<tr>
<td>L.M.I. + Plant protection</td>
<td>31.3</td>
<td>1517</td>
<td>-</td>
<td>1321</td>
<td>6068</td>
<td>4747</td>
<td>3.60</td>
</tr>
<tr>
<td>L.M.I. + fertilizer</td>
<td>228.9</td>
<td>1574</td>
<td>17.37</td>
<td>1606</td>
<td>6296</td>
<td>4690</td>
<td>2.92</td>
</tr>
<tr>
<td>L.M.I. + Fertilizer + Plant protection</td>
<td>29.4</td>
<td>1905</td>
<td>-</td>
<td>1856</td>
<td>7620</td>
<td>5764</td>
<td>3.10</td>
</tr>
</tbody>
</table>

NOTE: 1. Low monetary inputs include timely planting, recommended variety, spacing, seeding rate etc.
2. Dimethoate 0.05% spray was applied once/twice for plant protection against aphids.
3. Fertilizer (full recommended dose) was applied at the rate of N40:P40:K20 kg/ha.

A new parameter for intercropping studies

A new parameter, RYE (Relative Yield Efficiency) has been suggested for studies on intercropping experiments (1). It has the following relationship:

\[
\text{RYE} = \frac{\text{Yield per unit row of intercrop}}{\text{Yield per unit row of sole crop}} \times 100
\]

The new parameter estimated the yield potential of a given crop in intercropping system compared to that under sole cropping. The higher the RYE, the greater is the yield efficiency of that crop under intercropping. In general RYE values were higher for safflower intercropped with linseed than those for safflower intercropped with gram (Table 7). This shows that, yield efficiency of safflower is higher when intercropped with linseed.

Development of New Research Techniques

The following new research, techniques/equipments were developed for safflower research.

1. Quick method of oil estimation.
2. Technique for the selection of "high oil" genotypes in the field.
4. New parameter, RYE for intercropping studies.
5. Specific off-season nursery for screening for resistance to foliar diseases.
6. Specific nursery for screening lines against aphids.
8. Electric single plant thresher for threshing of individual plants.
Table 7. Economics of Gram/Linseed: Safflower intercropping

<table>
<thead>
<tr>
<th>Treatments**</th>
<th>Total cost of cultivation (Rs/ha)</th>
<th>Total return (Rs/ha)</th>
<th>Net return (Rs/ha)</th>
<th>Benefit cost ratio</th>
<th>RYE***</th>
</tr>
</thead>
<tbody>
<tr>
<td>B:S 2:2</td>
<td>1787</td>
<td>4606</td>
<td>2855</td>
<td>2.13 (6)</td>
<td>102.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(S) 107.3</td>
<td>(6)</td>
</tr>
<tr>
<td>B:S 4:2</td>
<td>1817</td>
<td>4405</td>
<td>2588</td>
<td>1.99 (6)</td>
<td>103.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(S) 98.2</td>
<td>(6)</td>
</tr>
<tr>
<td>B:S 6:2</td>
<td>1833</td>
<td>4548</td>
<td>2646</td>
<td>2.03 (6)</td>
<td>82.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(S) 100.3</td>
<td>(6)</td>
</tr>
<tr>
<td>L:S 2:2</td>
<td>1703</td>
<td>5442</td>
<td>3674</td>
<td>2.82 (L)</td>
<td>38.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(S) 157.8</td>
<td>(L)</td>
</tr>
<tr>
<td>L:S 4:2</td>
<td>1765</td>
<td>5801</td>
<td>3969</td>
<td>2.96 (L)</td>
<td>46.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(S) 155.7</td>
<td>(L)</td>
</tr>
<tr>
<td>L:S 6:2</td>
<td>1790</td>
<td>6035</td>
<td>4176</td>
<td>3.14 (L)</td>
<td>65.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(S) 157.0</td>
<td></td>
</tr>
<tr>
<td>Safflower (sole)</td>
<td>1761</td>
<td>6707</td>
<td>4870</td>
<td>3.22</td>
<td></td>
</tr>
<tr>
<td>Gram (sole)</td>
<td>1699</td>
<td>2428</td>
<td>733</td>
<td>0.21</td>
<td></td>
</tr>
<tr>
<td>Linseed (sole)</td>
<td>1363</td>
<td>2830</td>
<td>1428</td>
<td>1.76</td>
<td></td>
</tr>
</tbody>
</table>

* based on 4 years (1984 to 1987),
** G = Gram; S = Safflower and L = Linseed, 2:2 = 2 rows of base crop (gram or linseed) alternated with 2 rows of intercrop (safflower).
*** RYE = Relative Yield Efficiency.

References


