GUIDELINES FOR EFFECTIVE NUCLEUS AND BREEDER SEED PRODUCTION

SAFFLOWER

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Citation

Guidelines for Effective Nucleus and Breeder Seed Production in Safflower, Directorate of Oilseeds Research, Rajendranagar, Hyderabad-500 030

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Guidelines for Effective Nucleus and Breeder Seed Production in Safflower

Safflower is predominantly a self-pollinated crop but cross-pollination generally occurs to an extent of 10-20% through insects. The inflorescence is a capitulum or head borne terminally on the main stem, primary branches, secondary branches and on tertiary branches. Each head consists of a group of small individual flowers called florets, ranging from 20 to 200. Flowering beings at the inflorescence that terminates main plant axis. In an inflorescence, florets at the periphery of the capitula open first and proceeds centripetally and requires 3-5 days to complete. The total flowering period of a whole plant varies from 3 to 4 weeks and usually takes about 25 days.

The disc florets usually begin to open in the morning and the process goes till mid-day. A few, however, open in the afternoon. They remain for one or two days before fading. The stigma is receptive for three days. With the availability of both open-pollinated varieties and hybrid cultivars in safflower, the seed production methods followed in the two types are distinct. However, the common practices which need to be strictly followed to produce quality seed of both an open-pollinated variety and a hybrid are described below:

Nucleus seed production of varieties and male parents

☐ Plant the original seed of the variety or the male parent produced by breeder with a minimum isolation distance of
500–600m from other safflower fields during optimum period of planting (second fortnight of September to end of October).

- Select about 100-150 uniform looking plants having true to type characteristics of the variety or male parent.

- Self about 50% capitula in each selected plant and leave the remaining capitula for open pollination.

- Collect seed from these 100-150 plants separately from self and open pollinated capitula.

- Weigh self and open pollinated seeds from each selected plants separately.

- Retain the selfed-seed weighing higher than the general mean +/- 2 SE. Plant-wise selection for self-seed need to be done.

- Grow progeny rows of selected selfed plants in the consecutive crop season.

- After every five progeny rows, plant one check row from the seeds collected from open pollinated capitula for evaluation of progenies for different morphological characteristics.

- Based on the designated morphological characteristics of the variety or male parent, the off-types need to be rogued in time.

- Select only the uniform progeny rows showing similar attributes as that of check.
Discard the progeny rows showing off-type plants.

Selected progeny rows should be harvested separately.

Compare the seed yield, oil content and other seed characters of each progeny row with that of check rows.

Bulk the seed of rows having higher seed yield than the checks to form the nucleus seed.

Utmost care should be taken in selecting uniform progenies during nucleus seed production, which affects the quality of the seed during subsequent generations.

**Breeder seed production of varieties and male parents**

Use only nucleus seed to produce breeder seed. The recommended package of practices are adopted to produce the breeder seed. Breeder seed is expected to be genetically pure and all off-type plants are to be removed as soon as they are identified in the field and measures to be taken to avoid outcrossing and mechanical mixtures. To prevent outcrossing, a minimum isolation distance of 400 m from the nearby safflower crop shall be maintained.

**Nucleus seed production of female parents**

Nucleus seed production of genetic male sterile (GMS) line constitutes an important part of seed production and determines the purity and quality of seed in subsequent years of seed production.
- Use the original seed of the genetic male sterile or female parent available with the breeder to produce nucleus seed.

- For nucleus seed production in genetic male sterile lines, pair-wise selection of male sterile and male fertile plants with characteristics similar to each other and to the original genetic male sterile line is carried out for crossing of male sterile plant with the fertile one for maintenance.

- The crossing is carried out by hand under caged conditions to avoid any chance pollination with alien pollen. At least 50 such pair-wise crosses of male sterile and fertile plants having similar characteristics are made under caged conditions in the original genetic male sterile line.

- Harvest the seeds from male sterile plant of each pair separately and raise plant progeny rows along with the original genetic male sterile line after every 10 progenies as a check.

- This enables the evaluation of progenies for different morphological characteristics and determination of segregation ratio of male sterile and fertile plants.

- Cover the uniform individual progenies exhibiting similarity for different traits with the check and segregating for 1 MS : 1 MF plants with the nylon net cages separately at flower initiation stage and maintain them by crossing of male sterile plants with fertile sib counterparts by hand pollination.
- Harvest and thresh the male sterile plants of all the selected progeny rows separately for screening for oil content, seed yield and seed characteristics.

- Bulk the seeds of the progenies exhibiting similarity with the check and giving higher seed yield than the check to form the nucleus seed. The progenies with off-type plants are discarded at flowering stage itself.

- The selection of progenies of genetic male sterile lines for nucleus seed production is to be very strict and hence bulk the seed from only genetically pure and uniform lines to maintain originality of the genetic male sterile line in the subsequent generations of seed production.

**Breeder seed production of female parent**

- Use nucleus seed to produce breeder seed.

- The genetic male sterile line in safflower as mentioned earlier segregates into 50% male sterile (MS) and 50% male fertile (MF) plants, hence collect seed from MS plants only for further multiplication of GMS line as well as for the production of hybrid seed.

- The identification of MS and MF plants in GMS lines of safflower is only possible at flowering from the pinched brush like capitulum opening in MS plants and normal capitulum opening in case of fertile plants. Besides, no pollen production is observed in sterile plants whereas, abundant
pollen is produced in the fertile plants. Yellow colour pollen grains studded along the style can be seen with naked eye. For final confirmation of male fertility or sterility of the plant, gently pull out the style from the first one or two florets which have just protruded out of the closed bracts of the flower head, then look for presence or absence of pollen on the style. Florets of fertile plants are big and fully opened whereas those of sterile plants are small and not wide opened. Style of fertile flower is longer than that of sterile flower.

☐ The difference between MS and MF heads will not be very much distinct as the crop attains maturity. Hence, the marking of MS plants is necessary and is done by tagging all MS plants at the time of bloom with a small tag or piece of a waste cloth. Marking of MS plants should not be delayed and to be done when the crop is in bloom. Delay may cause confusion in differentiating MS and MF plants. Harvest seed only from male sterile (tagged) plants. While tagging male sterile plant, confirm the sterility as described above. Conformity of male sterile plants is very essential to maintain sterility percent in female line. Any bagging of fertile plants would affect not only the purity of the seed but would adversely affect the segregation ratio of sterile to fertile plants in subsequent generations.

☐ Make three field visits: before flowering, during flowering and at the time of flower drying to rogue out off-type plants.
☐ Carry out harvesting of MS plants first in order to avoid any physical mixing of this seed with seed from fertile plants. While threshing the MS plants, check for tag on the plant to avoid mechanical mixing of fertile plants. The seed from sterile plant should be screened for the seed characters described in the following table. The seed deviating from the description should be discarded. Do threshing of fertile plants only after packing of seed from sterile plants is over to avoid physical mixing at the threshing floor.

☐ Sow the nucleus seed at 45 x 20 cm spacing. Sow two seeds per hill and leave only one plant per hill after 15 days of germination to ensure good plant stand and growth. Recommended doses of fertilizers and agronomic practices as used in commercial safflower production are followed to raise a good crop.

☐ Care should be taken while selecting a field for seed production. The field should be well leveled with good drainage facility. Avoid seed production in low lying areas as safflower is highly susceptible to waterlogged condition.

☐ Take up plant protection measures in the evening hours when the bee activity is not seen in the field so as to avoid any harm to honey bee, which is the major pollinator in safflower seed production blocks.
### Morphological characteristics of parental lines of DSH-129

<table>
<thead>
<tr>
<th>Description</th>
<th>MS 9 (O)</th>
<th>A1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spines</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>Plant height (cm)</td>
<td>65-70</td>
<td>80-90</td>
</tr>
<tr>
<td>Days to 50% flowering</td>
<td>88</td>
<td>90-91</td>
</tr>
<tr>
<td>Days to full maturity</td>
<td>120</td>
<td>130</td>
</tr>
<tr>
<td>100-seed weight (g)</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Stem colour</td>
<td>White</td>
<td>White</td>
</tr>
<tr>
<td>Flower colour at bloom</td>
<td>Orange-yellow</td>
<td>Orange-yellow</td>
</tr>
<tr>
<td>Flower colour at drying</td>
<td>Orange-red</td>
<td>Orange</td>
</tr>
<tr>
<td>Bracts enclosing head</td>
<td>Complete</td>
<td>Complete</td>
</tr>
<tr>
<td>Location of branching on main stem</td>
<td>Upper 2/3 of stem</td>
<td>Upper 2/3 of stem</td>
</tr>
<tr>
<td>Length of branches</td>
<td>Short</td>
<td>Medium</td>
</tr>
<tr>
<td>Pollen production</td>
<td>Absent in the male sterile</td>
<td>Present</td>
</tr>
<tr>
<td>Pollen colour</td>
<td></td>
<td>Yellow</td>
</tr>
<tr>
<td>Hull colour</td>
<td>Dirty-white or light brown</td>
<td>White</td>
</tr>
<tr>
<td>Hull thickness</td>
<td>Partially thick</td>
<td>Very thick</td>
</tr>
<tr>
<td>Stripes on hull</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Tapering of seed</td>
<td>Tapers at one end</td>
<td>Non-tapering</td>
</tr>
<tr>
<td>Seed shape</td>
<td>Obpyramidal and long</td>
<td>Obpyramidal</td>
</tr>
<tr>
<td>Seed size</td>
<td>Very bold</td>
<td>Bold</td>
</tr>
</tbody>
</table>