LECTURE 13
SAFFLOWER

Economic Importance

- Rich in PUFA (78%) – to reduce blood cholesterol
- Used for preparation of:
  - Margarine, and salad dressing
  - Varnishes, paints and surface coating materials
- Oil (28-32%) is also used in:
  - Infant food and liquid nutrition formulations
  - Effective non-allergenic dispersant for injectable medicines
  - Charred oil is used to heal sores and rheumatism
- Flowers
  - For dye extraction – red dye
  - Cosmetics preparations
  - Petals reported to have effects on circulatory systems
- Cake (30%)
  - Un decorticated cake as manure
  - Decorticated fed to ruminants and mono-gastric animals
  - Can be as human food, if bitter principles and phenolics are removed
- Hulls (40%) can be used for manufacture of
  - Cellulose, insulations, abrasions, hard boards and as fuel
- Thinned young plants are used as vegetables
  - Since contains carotene, riboflavin and vitamins
- It is crop as border against animals

Origin and distribution

- Vavilow (1926): India, Afghanistan or Ethiopia
- De Candole (1886): Arabia
- Modern assessment:
  - Area encompassing S. USSR, W. Iran, Iraq, Syria, S. Turkey, Jordan and Israel
- Distributed now:
  - Between 14° & 45° N and 15° & 35° S
World scenario – safflower (million ah & million t)

<table>
<thead>
<tr>
<th>Country</th>
<th>Area</th>
<th>Production</th>
<th>Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>0.42</td>
<td>0.23</td>
<td>0.55</td>
</tr>
<tr>
<td>Canada</td>
<td>0.002</td>
<td>0.002</td>
<td>1.00</td>
</tr>
<tr>
<td>USA</td>
<td>0.086</td>
<td>0.087</td>
<td>1.02</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>0.009</td>
<td>0.006</td>
<td>0.67</td>
</tr>
<tr>
<td>China</td>
<td>0.012</td>
<td>0.03</td>
<td>2.50</td>
</tr>
<tr>
<td>Australia</td>
<td>0.033</td>
<td>0.036</td>
<td>1.09</td>
</tr>
<tr>
<td>World</td>
<td>0.822</td>
<td>0.58</td>
<td>0.71</td>
</tr>
</tbody>
</table>

(FAOSTAT, 2006)

India Scenario – safflower

<table>
<thead>
<tr>
<th>State</th>
<th>Area ('000 ha)</th>
<th>Production ('000 t)</th>
<th>Productivity (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maharastra</td>
<td>263</td>
<td>159</td>
<td>605</td>
</tr>
<tr>
<td>Karnataka</td>
<td>81</td>
<td>60</td>
<td>741</td>
</tr>
<tr>
<td>AP</td>
<td>17</td>
<td>80</td>
<td>471</td>
</tr>
<tr>
<td>Orissa</td>
<td>1.3</td>
<td>0.8</td>
<td>615</td>
</tr>
<tr>
<td>MP</td>
<td>1.0</td>
<td>0.3</td>
<td>300</td>
</tr>
<tr>
<td>India</td>
<td>364.6</td>
<td>228.6</td>
<td>627</td>
</tr>
</tbody>
</table>

(Ministry of Agriculture, Govt. of India, 2005-06)

Climate

- A day neutral plant
- But short day can prolong rosette stage
- Temp is more important than day length
  - Thermo-sensitive
    - Extremes of cold and heat not suitable
  - Tolerance to low temp at vegetative
  - But susceptible to high temp during flowering
  - For germination 15°C
  - Vegetative: 20-21°C
  - Flowering: 24 to 32°C
- Rainfall at flowering affects pollination
Excessive humidity at any stage affects
More suitable for rabi season in India

The Plant
Highly branched, herbaceous
Annual height varying from 30-150cm
Well defined fleshy tap root system
Stem is stiff cylindrical fairly thick at base and thin at top
Central stem branches at 15-20cm to secondary
Each branch terminates in a flower head
The angle of branching is varietals but can be by environment also
The leaf deeply serrated on lower stem, short, stiff, ovate at the inflorescence
The inflorescence – numerous florets
Flower color may vary from whitish yellow to red-orange
The capitula, head size may vary from 1.25 to 4.0 cm
The fruit achene, resembles small slightly rectangular sunflower seeds
Seed weighs 250 – 800mg/grain

Soils
Fertile, fairly deep and well-drained
pH range of 5-8
Shallow soils irrespective of fertility seldom produces high yield
In traditional belts it is black cotton soil
On heavy soils
- This crop follows early Kharif crops
- Or may often single crop in Rabi
It is considered as salt tolerant next to cotton
Tolerant to Na salts but < to Ca & Mg
Salinity reduces seed size and oil content
Seeds and sowing

Varieties
- K1 120 days, CO 1 125 days
- Bhima (33% oil) - Maharastra
- JSF 1 (30%) – Rajasthan & MP
- Manjira - AP
- Nira – (30%) Maharastra & TN
- HUS 305 (35%) for Peninsular India

Seed rate
- 7-20 kg depending upon spacing and variety

Spacing
- 45 x 15 cm  in TN
- 45 x 20 cm
- 60 x 30 cm etc

Seed treatment
- Pre-sowing seed hardening
- Use fresh seeds every year

Sowing
- From last week of Sep to end of Oct
- Early sowing has advantage
- Line sowing using improved seed drill
- Ferti cum seed drill is more desirable
- Seeds can be sown behind the plough also
- Small furrow may be opened and seeds dropped and half covered
- Depth of sowing may be 5-7.5cm
- Light planking for the soils which looses moisture

Nutrient management

Rainfed crops
- N ranges from 25 kg N to 50 kg
- P₂O₅ – 20 to 50 kg
- K₂O – Mostly not recommended
- General: 40:20:0
Irrigated
  - 60:30:20 (Chatisgarh) to
  - 75:75:35 (Karnataka)

Time of fertilizer application
  - Rainfed – basal – deep placed by ferti-cum seed drill
  - Irrigated 50% N+ full P & K as basal
  - Remaining half N at 5th week during 1st irrigation

Water management
  - It is deep rooted xerophytic plant, can thrive under scarce soil moisture
  - One or two irrigations (25 & 75 DAS) is optimum
  - Sensitive to excess moisture at any stage
  - If the soil profile contains 250mm ASM
    - ET of the season is 250-300mm- no response to irrigation
  - Under irrigated condition the crop may be sown under Broad beds of 1.35 to 1.8m and furrow
    - To drain the excess water
  - Points to remember:
    - If one irrigation is possible, provide it at critical period
    - Avoid contact of above ground parts with irrigation water

Weed management
  - Being wider spaced
    - critical periods for weed management extends up to end of rosette (25-50DAS)
  - Hand weeding and hoeing
    - at 20 and 35 DAS is good
  - Herbicides
    - PPI – Fluchloralin 0.75 to 1.0 kg
    - PE – Oxadiazone – 0.75 -1.0 kg or
    - PE – Pentimethalin – 0.75 kg

Important intercultural operations
  - Thinning to single plant and filling the gap at the early stage (before 15DAS)
  - Nipping of central shoot to induce branching
  - Bird damage
By parrots at Isolated pockets
- Cultivate in contiguous block
- Bird scaring - morning and evening during
  - Seed filling to physiological maturity

**Harvesting**
- Duration of the crop varies due to regions
  - 115-140 days
  - 120-125 days in TN
  - Gujarat & Orissa – 140-150 days
  - In cooler regions 150-180 days

**Maturity**
- When the lower leaves and most of the bracteoles dry and brown
- Harvest in the early hours
  - Shattering minimum
  - Spines relatively soft
- Combine harvester is becoming popular now since
  - Manual harvesting, bundling, threshing are all becoming problematic

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**Yield**
- In improved agro-techniques are used
  - Under scanty moisture – 800-1200kg/ha
- Under favourable 1500-2000 kg
- Under irrigated – 1800-2800kg/ha

- Storage
  - 5% moisture, clean and dry

**Cropping system**

- It is potential crop to replace dry rabi crops
  - Wheat, coriander, linseed, chickpea, pulses
- In traditional areas it is raised as intercrops
  - Sorghum, wheat, linseed, chickpea, coriander etc.
- Sequence cropping
  - Farmers rarely raise more than one crop due to non availability of moisture
  - There is scope for double cropping either preceding with Kharif crop or after rabi by irrigation

**Multiple choice questions**

1. Scientific name of safflower is ______
   a. *Helianthus annuus*   b. *Carthamus tinctorious*   c. *Sesamum indicum*

2. Oil content of safflower is ______
   a. 24-28 %   b. 26-28 %   c. 28-32 %

3. Which of the following is used for dye extraction
   a. Sunflower   b. Safflower   c. Sesame

4. Total production of safflower in the world is ________ m tonnes
   a. 0.93   b. 0.98   c. 0.88

5. Total production of safflower in India is ________ m tonnes
   a. 0.70   b. 0.43   c. 0.67
6. Spacing followed for safflower in Tamil Nadu is______
   a. 40 x 20 cm   b. 60 x 30 cm   c. 45 x 15 cm

7. Seed rate for safflower varies from _______ to _______ kg/ha depending upon
   the variety and spacing
   a. 7 – 20       b. 5 – 10       c. 20 – 25

8. General fertilizer recommendation for rainfed safflower is ______ kg NPK /ha
   a. 60:30:20     b. 40:20:0     c. 75:75:35

9. Saturated fatty acid content in safflower is ________
   a. 12 %         b. 15 %        c. 10 %

10. Mono unsaturated fatty acid content in safflower is ________
    a. 12 %        b. 15 %       c. 14 %