(iv) SUNFLOWER (*Helianthus annuus*)

CLIMATE REQUIREMENT

T_Max°C	T_Min°C	Optimum °C	Rainfall mm	Altitude m MSL
38 - 40	10 - 15	20 - 30	350 - 600	up to2500

Tropical and subtropical climate. During vegetative phase, crop requires cold temperature. Higher temperature (> 38°C) during reproductive stage reduces the oil content. Day neutral plant. Crop gives highest yield of oil per hectare when grown below 1,500m MSL.Cannot tolerate drought and water logging.

CROP IMPROVEMENT

I. SEASON AND VARIETIES

DISTRICT / SEASON	VARIETIES
A. Rainfed	
1. Adipattam (Jun-July)	
Coimbatore, Erode, Salem, Namakkal, Tirunelveli, Dindigul, Dharmapuri, Tiruchirapalli, Perambalur, Karur	Variety : COSFV 5 Hybrid : COH 3.
2. Karthigaipattam (Oct- Nov)	
Cuddalore, Villupuram, Virudhunagar, Sivagangai , Ramanathapuram, Madurai, Dindigul, Theni, Tiruchirapalli, Perambalur, Karur, Tirunelveli	Variety : COSFV 5 Hybrid : COH 3
B. Irrigated	
1. Adipattam (July-August)	
Coimbatore, Erode, Salem, Namakkal,Tirunelveli, Dindigul, Dharmapuri, Tiruchirapalli, Perambalur, Karur	Variety : COSFV 5 Hybrid : COH 3
2. Karthigaipattam (Nov-Dec)	
Cuddalore, Villupuram, Virudhunagar, Sivagangai , Ramanathapuram, Madurai, Dindigul,Theni, Tiruchirapalli, Perambalur, Karur, Tirunelveli	Variety : COSFV 5 Hybrid : COH 3

3. Margazhipattam (Dec-Jan)

Salem, Namakkal, Dharmapuri, Erode, Coimbatore, Madurai, Dindigul, Theni, Tirunelveli, Thoothukudi	Variety	: COSFV 5
	Hybrid	: COH 3

4. Chithiraipattam (April - May)

Coimbatore, Erode, Dharmapuri, Salem, Namakkal, Tiruchirapalli, Perambalur, Karur	Variety	: COSFV 5
	Hybrid	: COH 3

I. DESCRIPTION OF SUNFLOWER VARIETIES

Particulars	COSFV 5	COH 3
Year of Release	2006	2017
Year of Notification	SO.1178(E)/20.07.2007	S.O. 6318(E) / 26.12.2018
Parentage	Cross derivative of *Helianthus annus X H. preacox*	COSF 6A X IR 6
Duration (days)	85-90	90-95
Yield (kg/ha)		
Rainfed	1500	2150
Irrigated	1700	2410
Oil content (%)	40-42	40- 42
Ray floret	Yellow	Yellow
Plant height (cm)	145-165	160-170
Seed size & colour	Dark brown	Black
1000 seed weight (g)	48-50	52
Volume weight (g/100ml)	45-48	47

CROP MANAGEMENT

1. FIELD PREPARATION

Plough once with tractor or twice with iron-plough or three to four times with country-plough till all the clods are broken and a fine tilth is obtained.

2. APPLICATION OF FERTILIZERS

i) Spread 12.5 t / ha of FYM or compost or composted coir pith evenly on the field before the last ploughing and incorporate in the soil by working a country plough.

If soil test recommendations are not available, follow the blanket NPK/ha for both irrigated and rainfed crops.

	Season	Blanket recommendation of Nutrients (kg/ha)		
		N	P_2O_5	K_2O
Hybrids	**IRRI**	60	90	60
	RF	*40*	*50*	*40*
Varieties	**IRRI**	60	30	30
	RF	*40*	*50*	*40*

Soil test crop response based integrated plant nutrition system (STCR- IPNS recommendation may be adopted for prescribing fertilizer doses for specified yield targets. (read reckoners are furnished for irrigated sunflower)

Sunflower – Hybrid

Soil : Mixed black calcareous (Perianaickenpalayam series)
Target : 2.0- 2.5 t ha^{-1}

FN =9.60T- 0.49SN-0.68 ON
FP_2O_5=4.20T -1.87SP-0.80 OP
FK_2O=9.24T-0.45SK-0.64 OK

Initial soil test values (kg ha^{-1})			Yield target – 2.0 t ha^{-1}			Yield target – 2.5 t ha^{-1}		
			NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}			NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
160	12	300	59	45*	30*	90**	53	56
180	14	325	49	45*	30*	90**	49	45
200	16	350	39	45*	30*	87	45*	34
220	18	375	30*	45*	30*	77	45*	30*
240	20	400	30*	45*	30*	67	45*	30*

* Maintenance dose;** Maximum dose

Note: FN, FP_2O_5 and K_2O are fertilizer N, P_2O_5 and K_2O in kg ha^{-1}, respectively; T is the yield target in q ha^{-1}; SN, SP and SK respectively are available N,P and K in kg

ha^{-1} and ON, OP and OK are the quantities of N, P and K supplied through organic manure in kg ha^{-1}.

iii) Biofertilizer : Soil application - Mix 10 packets (2000 g/ha) of Azospirillum and 10 packets (2000 g/ha) of Phosphobacteria or 20 packets of Azophos (4000 g / ha) with 25 kg FYM and 25 kg soil and apply before sowing.

3. APPLICATION OF MICRONUTRIENTS

a) Mix 12.5 kg / ha of micronutrient mixture formulated by the Department of Agriculture, Tamil Nadu with enough sand to make total quantity of 50 kg/ha. For **rainfed sunflower** apply TNAU MN mixture @ 7.5 kg ha^{-1} as enriched FYM

b) variety and 10 kg ha^{-1} as enriched FYM for hybrid and for ***Irrigated sunflower*** apply TNAU MN mixture @ 12.5 kg ha^{-1} as enriched FYM for variety and 15 kg ha^{-1} as enriched FYM for hybrid (Prepare enriched FYM at 1:10 ratio of MN mixture & FYM ; mix at friable moisture &incubate for one month in shade).

c) Apply the mixture over the furrows and top two thirds of the ridges before sowing.

d) Do not incorporate the mixture in the soil.

(i) To overcome Manganese deficiency foliar spray of 0.5% $MnSO_4$ on 30,40 & 50^{th} day after sowing and

(ii) For Zinc deficiency apply 25 kg $ZnSO_4$ / ha as basal or 0.5% $ZnSO_4$. Spray on 30,40 & 50^{th} day after sowing.

(iii) For B and S deficient soils, apply 10 kg Borax or 0.2% Boric acid twic and 40 kg S as Gypsum / ha.

4. FORMING RIDGES AND FURROWS

i. Form ridges and furrows with 60 cm spacing.

ii. Use bund-former or ridge plough to economise and

iii. Form irrigation channels across and ridges according to the topography of the field.

5. SEED RATE

	Rainfed	Irrigated
Varieties	7 kg/ha	6 kg/ha
Hybrids	5 kg/ha	5 kg/ha

6. SEED TREATMENT

Soaking seeds in 2% for 12 hrs and shade drying is recommended for rainfed $ZnSO_4$ sowing.

7. SEED TREATMENT

i) Treat the seed with *Trichoderma* @4g/kg. This can be done just before sowing. It is compatible with biofertilizers. Such seeds should not be treated with fungicides.

ii) Treat the seeds with Carbendazim or Thiram at 2 g/kg of seed.

iii) Treat the seeds 24 hours prior to sowing.

iv) Treat the seeds required for sowing 1 ha with 600 g of *Azospirillum* and 600 g of Phosphobacteria (or) 600 g of Azophos using rice gruel as binder, shade dry the treated seeds for 30 min and sow immediately.

Liquid formulation Treat one hectare of seeds with 125 ml of *Azospirillum* and 125 ml of Phosphobacteria, shade dry it for 30 minutes before sowing

v) Moist hydration for 24 hours in moist gunny bags followed by drying and seed dressing with Thiram @ 2g / kg to enhance field emergence.

vi) Seeds dried to 8 - 9% moisture content, treated with Thiram @ 2g / kg and packed in polylined (300 guage) cloth bag can store upto 9 months with 70% germination.

8. SOWING

Spacing : Hybrids: 60 cm x 30 cm

Varieties : 45 cm x 30 cm

i) Place the seeds at a depth of 3 cm along the furrows in which the fertilizer mixture is placed. Put two seeds per hole

9. THINNING

Thin out seedlings leaving only one healthy and vigorous seedling in each hole on the 10th day of sowing.

10. WEED MANAGEMENT

i) Apply Fluchloralin @ 1.0 lit / ha before sowing and incorporate or apply as pre-emergence spray on 3rd day after sowing followed by irrigation or apply Pendimethalin @ 1.0 litre / ha as pre- emergence spray 3 days after sowing. The spray of these herbicides has to be accomplished with Knapsack sprayer fitted with flat fan nozzle using 500 lit water/ha as spray fluid.

All the herbicide application is to be followed by one late hand weeding 30 - 35 days after sowing.

After application of pre emergence herbicide, instead of hand weeding, power weeder can be used if sowing was done with the spacing of 75 x 25 cm.

ii) If pre emergence herbicide was not applied, hand weeding to be done on on 15th and 30th day after sowing and remove the weeds.

11.WATER MANAGEMENT

Irrigate immediately after sowing followed by an irrigation on 4 – 5th day and later at interval of 7 to 8 days according to soil and climatic conditions at seeding, flowering and seed development stage.

12.FOLIAR SPRAY OF NAPHTHALENE ACETIC ACID (NAA)

i) Foliar spray of Napthalene Acetic Acid (NAA) at 20 ppm concentration (280 g NAA in 625 litres of water per ha) on the 30th and 60th day of sowing.

ii) Use a high volume sprayer and give a thorough coverage of the entire plant.

iii) Do not use brackish water.

13.SULPHUR FERTILIZATION

Apply Sulphur @ 20 kg / ha Through Ammonium Sulphate or Single Super Phosphate. Or apply gypsum@ 200kg / ha as basal

14.BORIC ACID

Foliar spray of Boric acid @ 0.2 % (2g / l of water) to capitulum at ray floret opening stage to improve seed set and seed filling.

15.IMPROVING SEED SET BY MECHANICAL MEANS

a. During the mid flowering phase, improve pollination by :
   i. Mild rubbing of the capitulum with the hand covered with soft cloth or
   ii. Rubbing two flowers face to face gently.
   iii. The mid-flowering phase are: 58 to 60 days of planting for long duration varieties, 45 to 48 days of planting for short duration varieties
   iv. Do this operation in the morning hours between 9.0 and 11.00 am when pollen shedding is high.
b. Keeping bee hives at the rate of 5 / ha improves seed setting.

16.JUDGE WHEN TO HARVEST

Observe the bracts on the backside of the capitula. When they turn lemon yellow, the heads harden and the crop is ready for harvest.

Bird damage: Use of reflective ribbons scares the birds effectively and thus prevents loss of grain.

17.HARVESTING

i. Cut the capitula (flower heads) only

ii. Thresh and clean

a. Immediately after harvest, dry the heads in the sun for 3 days.

b. Spread the heads in thin layer and give turning once in 3 hours.

NOTE: Do not heap or store the heads before drying properly as mould fungi will develop and spoil the grain quality.

c. Thresh using a mechanical thresher, or beat with a stick and separate the grains.

d. Winnow and clean the seeds

e. Dry the seeds again in the sun for another two days

f. Store in gunny bags

CROP PROTECTION

A. Pest management

Weevil *Myllocerus* spp.	▪ Hand pick the *Helicoverpa* larvae and destroy. ▪ Spray Azadirachtin 5% W/W 0.5 ml/lit
Tobacco cutworm *Spodoptera litura*	
Gram podborer *Helicoverpa armigera*	
Leafhopper *Amrasca devastans*	▪ Treat seed with Imidacloprid 70 WS at 7 g/kg protection upto 7 weeks. ▪ Spray Imidacloprid 70 WS 490 ml/ha (or) Imidacloprid 17.8 SL 100 ml/ha
Whitefly, *B.tabaci, A.dispersus*	▪ Spray Imidacloprid 70 WS 490 ml/ha (or) Imidacloprid 17.8 SL 100 ml/ha
Thrips	▪ Spray Imidacloprid 17.8 SL 100 ml/ha

B. Disease management

Alternaria leaf spot: *Alternaria helianthi*	• Spray Mancozeb @ 1000 g/ha or • Treat the seeds with Carbendazim + Mancozeb @ 3g/kg + Propiconazole 0.1 % sprays at 30 and 45 days after sowing or • Treat the seeds with *Pseudomonas fluorescens* @ 10 g/kg seeds along with foliar spray of Hexaconazole or Propiconazole @ 0.1% at 45 days after sowing and foliar spray of *P. fluorescens* at 60 days after sowing
Rust: *Puccinia helianthi*	Spray Mancozeb @ 1000 g/ha

Charcoal rot: *Macrophomina phaseolina* *(Rhizoctonia bataticola)*	• Soil application of *P. fluorescens* or *T. asperellum* @ 2.5 kg / ha with 50 kg of well decomposed FYM or sand at 30 days after sowing. • Spot drenching with Carbendazim @ 1 g/ l
Powdery mildew: *Golovinomyces cichoracearum*	Two sprays of Difenoconazole @ 0.05% at 40 and 60 DAS
Head rot: *Rhizopus* sp	Spray Mancozeb @ 1000 g/ha in case of intermittent rainfall at the head stage, directing the spray to cover the capitulum. Repeat fungicidal application after 10 days, if humid weather continues
Necrosis virus disease: *Tobacco streak virus* (Ilarvirus) (Vector: Thrips)	• Raise Sorghum as border crop (one month prior to Sunflower sowing). • Seed treatment with Imidacloprid @ 2 g/kg of seeds • Spray Imidacloprid 17.8 SL @ 100 ml/ha

SUNFLOWER - VARIETAL SEED PRODUCTION

Land requirement

- Land should be free of volunteer plants. The previous crop should not be the same variety or other varieties of the same crop. It can be the same variety if it is certified as per the procedures of certification agency.

Isolation

- For certified / quality seed production, leave a distance of 200 m all around the field from the same and other varieties / hybrids of sunflower.

Spacing

- 45 x 30 cm.

Pre-sowing seed treatment

- Seed soaking in 2 % KNO_3 for 6 hrs to release dormancy.
- Seed hardening with 2 % KH_2PO_4 for 16 h and dry back to original moisture content.
- Seed coating with polymer @ 3 g / kg + Imidachloprid @ 2 ml / kg + Carbendazim @ 2 g / kg + *Pseudomonas fluorescens* @ 10 g / kg.

Fertilizer

- Apply NPK @ 60:45:45 kg / ha as basal application.

Foliar application

- At the stage of capitulum opening, spray 0.2 % boric acid for increased seed set.

Supplementary pollination

- During flowering, rub the heads with muslin cloth or palm during 8 - 11 am on alternate days till the completion of flowering (7 - 10 days).
- Keep bee hives @ 5 nos. / ha to increase insect activity.

Harvesting

- Harvest the heads when the thalamus drooped and turned to lemon yellow in colour with black coloured seeds.
- Harvest the heads and dry immediately until the seed moisture content reduced to 15 - 16 %.
- Separate the seeds either with mechanical thresher or manually.

Seed grading

- Grade the seeds using 9 / 64” round perforated sieve.
- Upgrade the size graded seed using specific gravity separator.
- Remove the broken and dehulled seeds from the lot.

Pre-storage seed treatment

- Treat the seeds with Carbendazim @ 2 g / kg of seed along with Carbaryl @ 200 mg / kg of seed.
- Treat the seeds with Halogen mixture ($CaOCl_2$ + $CaCO_3$ + *arappu* leaf powder mixed in the ratio of 5:4:1 @ 3 g / kg as eco-friendly treatment.

Storage

- Store the seeds in gunny or cloth bags for short term storage (8 - 9 months) with a seed moisture content of 8 - 9 %.
- Store the seeds in polylined gunny bag for medium term storage (12 - 15 months) with a seed moisture content of 7 - 8 %.
- Store the seeds in 700 gauge polythene bag for long term storage (more than 15 months) with a seed moisture content less than 7 %.

SUNFLOWER - HYBRID SEED PRODUCTION

Land requirement

- Land should be free of volunteer plants. The previous crop should not be the same variety or other varieties of the same crop. It can be the same variety if it is certified as per the procedures of certification agency.

Isolation

- For certified quality seed production, leave a distance of 400 m all around the field from the same and other varieties / hybrids of sunflower.

Border rows

- Sow four rows of male parent around the field for the availability of adequate pollen.

Planting Ratio

- Sow female and male plants in a ratio of 4:1 or 6:1

Foliar spray

- Spray 0.2 % boric acid at button opening stage to increase seed set.

Supplementary pollination

- During flowering, collect pollens from male flowers and smear the pollen over the female heads with muslin cloth or palm at the time between 8 - 11 am on alternate days till the completion of flowering.
- Keep bee hives @ 5 nos. / hectare.

Harvesting

- Harvest 'R' lines first and remove from the field before harvesting the hybrid.
- Harvest the earheads of female plants as once over harvest.