## (ii) CUMBU (*Pennisetum glaucum* (L) R. Br. )

### CLIMATE REQUIREMENT

| T_Max°C | T_Min°C | Optimum °C | Rainfall mm | Altitude m MSL |
|---|---|---|---|---|
| 40 | 8 - 10 | 27 - 35 | 250 - 350 | up to 1800 |

Tropical warm weather crop. Grow in a wide range of ecological conditions and can still yield well even under unfavourable conditions of drought stress and high temperatures. Best suited temperature for crop growth is between 27 - 30°C. Short day plant.

### CROP IMPROVEMENT

### I SEASON AND VARIETIES

| Sl.No. | Agro ecological zones | Districts | Season | Varieties/ Hybrids |
|---|---|---|---|---|
| 1 | North Eastern Zone | Vellore, Thiruvannamalai, Cuddalore, Villupuram, Thiruvallur, Kancheepuram | Jan-Feb (Thaipattam)<br>April - May (Chithiraipattam)<br>June-July (Adipattam)<br>Sep-Oct Puratassipattam) | CO 10 and Hybrid CO 9 |
| 2 | North Western Zone | Salem, Namakkal, Dharmapuri, Krishnagiri | | |
| 3 | Western Zone | Coimbatore, Erode, Karur, Tiruppur, Theni and Dindigul | | |
| 4 | Cauvery Delta Zone | Trichy, Thanjavur, Thiruvarur, Nagapattinam, Pudukkottai Perambalur and Ariyalur | Jan-Feb (Thaipattam)<br>April - May (Chithiraipattam)<br>June-July (Adipattam) | |
| 5 | Southern Zone | Madurai, Sivagangai, Virudhunagar, Ramanathapuram Tirunelveli and Thoothukudi | Jan-Feb (Thaipattam)<br>April - May (Chithiraipattam)<br>Sep-Oct (Puratassipattam) | |

## II. PARTICULARS OF CUMBU HYBRID AND COMPOSITE

| PARTICULARS | Hybrid CO 9 | CO 10 |
|---|---|---|
| Year of Release | 2011 | 2016 |
| Year of Notification | SO.1708(E)/26.07.2012 | SO. 2238 (E) /29.06.2016 |
| Parentage | ICMA 93111A x PT 6029-30 | Composite of five elite inbred lines |
| Season-irrigated/ rainfed | Both | Both |
| Duration (Days) | 75-80 | 85-90 |
| Grain yield (kg/ha) | | |
| Rainfed | 2707 | 2923 |
| Irrigated | 3728 | 3526 |
| Plant height (cm) | 160-180 | 160-180 |
| Tillers (No.) | 4-6 | 4-6 |
| Pigmentation | - | - |
| Hairiness | Absent | Absent |
| Days to 50% bloom | 45-50 | 47-50 |
| Shape of ear head | Candle to Cylindrical | Spindle |
| Bristles | Absent | Absent |
| Length of ear head (cm) | 25-35 | 25-30 |
| Ear head girth diameter (cm) | 3.1-3.6 | 3.1-3.6 |
| Grain Colour | Grey yellow | Grey brown |
| 1000 grains weight (gm) | 13-14 | 12-13 |
| Special features | Short duration, High Fe content (8mg/100g) Resistant to downy Mildew | High protein Content (12.07%) and Resistant to downy mildew |

## CROP MANAGEMENT

### II NURSERY

**1. PREPARATION OF LAND**

i. For raising seedlings to plant one ha select 7.5 cents near a water source. Water should not stagnate.

ii. Plough the land and bring it to the fine tilth.

**2. APPLICATION OF FYM**

Apply 750 kg of FYM or compost and incorporate by ploughing. Cover the seeds with 500 kg of FYM.

**3. FORMING RAISED BED**

i. In each cent mark 6 plots of the size 3 m x 1.5 m with 30 cm channel in between the plots and all around.

ii. Form the channel to a depth of 15 cm.

iii. Spread the earth excavated from the channel on the beds and level.

NOTE: The Unit of 6 plots in one cent will form one unit for irrigation.

**4. REMOVAL OF ERGOT AND SCLEROTIA AFFECTED SEEDS TO PREVENT PRIMARY INFECTION**

i. Dissolve one kg of common salt in 10 litres of water.

ii. Drop the seeds into the salt solution

iii. Remove the ergot and sclerotia affected seeds which will float.

iv. Wash seeds in fresh water 2 or 3 times to remove the salt on the seeds.

v. Dry the seeds in shade.

vi. Treat the seeds with three packets (600g) of the Azospirillum inoculant and 3 packets (600g) of Phosphobacteria or 6 packets (1200g) of Azophos.

**5. TREATMENT OF THE NURSERY BED WITH INSECTICIDES**

Apply Phorate 10 G 180 g or Carbofuran 3 G 600 g mixed with 2 kg of moist sand, spread on the beds and work into the top 2 cm of soil to protect the seedlings from shoot fly infestation.

## 6. SOWING AND COVERING THE SEEDS

i. Open small rills not deeper than 1 cm on the bed by passing the fingers over it.

ii. Sow 3.75 kg of seeds in 7.5 cents (0.5 kg / cent) and use increased seed rate upto 12.5 kg per ha in shoot fly endemic area and transplant only healthy seedlings.

iii. Cover the seeds by smoothening out the rills with hand. Sprinkle 500 kg of FYM or compost evenly and cover the seeds completely with hands.

NOTE: Do not sow the seeds deep as germination will be affected.

## 7. IRRIGATION TO THE SEED BED

i. Provide one inlet to each unit so as to allow water in the channels.

ii. Allow water to enter the channel and turn off the water when the raised bed is completely wet.

iii. Irrigate as per the following schedule.

| | Light Soil | Heavy Soil |
|---|---|---|
| 1st | immediately after sowing | Immediately after sowing |
| 2nd | on 3rd day after sowing | On 3rd day after sowing |
| 3rd | on 7th day after sowing | On 9th day after sowing |
| 4th | on 12th day after sowing | On 16th day after sowing |
| 5th | on 17th day after sowing | |

## 8. PROTECTION OF SEEDLINGS IN THE NURSERY FROM PEST ATTACK

If seed bed is not treated before sowing, protect the nursery by applying any one of the insecticides given below on the 7th and 14th day of sowing by mixing in 6 litres of water. Endosulfan 35% EC 12ml ; Methyl demeton 25% EC 12 ml, Dimethoat 30% EC 12 ml.

Note:

1. The seedlings should not be kept in nursery for more than 18 days. Otherwise the establishment and yield will be affected adversely.

2. Ensure that cracks should not develop in the nursery. This can be avoided by properly adjusting the quantity of irrigation water.

## I. PREPARATION OF MAIN FIELD

### 1. FIELD PREPARATION

i. Plough with an iron plough twice and with country plough twice. Bring the soil into fine tilth.

ii. CHISELING FOR SOILS WITH HARD PAN: Chisel the soils having hard pan formation at shallow depths with chisel plough at 0.5m interval, first in one direction then in the direction perpendicular to the previous one, once in three years.

### 2. APPLICATION OF FYM OR COMPOST

Spread 12.5 t/ha of FYM or compost or composted coir pith uniformly on unploughed soil. Incorporate the manure by working the country plough and apply Azospirillum to the soil @ 10 packets per ha (2000 g) and 10 packets (2000g) of Phosphobacteria (or) 20 packets (4000 g) of Azophos with 25kg of soil and 25 kg of FYM.

### 3. FORMING RIDGES AND FURROWS/BEDS

i. Form ridges and furrows (using 3 ridges) 6 m long and 45 cm apart. If pulses is intercropped, form ridges and furrows 6 m long and 30 cm apart.

ii. If ridge planting is not followed, form beds of the size 10 $m^2$ or 30 $m^2$ depending upon water availability.

iii. Form irrigation channels.

iv. To conserve soil moisture under rainfed condition, sow the seeds in flat and form furrows between crop rows during inter-cultivation on third week after sowing

### 4. APPLICATION OF FERTILIZERS

Apply NPK fertilizers as per soil test recommendations as far as possible. If soil test recommendation is not available follow the blanket recommendation of 70:35:35 kg N, $P_2O_5$, $K_2O$/ha for all varieties. For hybrids, apply 80 kg N, 40 kg $P_2O_5$ and 40 kg $K_2O$ per ha. Apply the recommended N in three splits as 25:50:25 per cent at 0.15 and 30 DAS and full dose of phosphorus and potassium basally. Combined application of Azospirillum and Phosphobacteria or Azophos along with 75 per cent of the recommended level of N and P is recommended for rainfed conditions. Apply 30 kg S basally for S deficient soils.

**Method of application:** For transplanted crop, open a furrow more than 5 cm deep on the side of the ridge (1/3 distance from the bottom), place the fertilizer and cover. For the direct sown crop, mark the lines more than 5 cm deep 45 cm apart in the beds. Place the fertilizer below 5 cm depth and cover upto 2 cm from the top before sowing. In the case of intercropping with pulses, mark lines more than 5 cm deep 30 cm apart in the beds. Apply fertilizer only in the rows in which Cumbu is to be sown and cover upto 2 cm. When Azospirillum inoculant is used for seeds, seedlings use only 50 kg N/ha for variety, 60 kg N/ha for hybrid, as soil application in other words, reduce 25% N of soil test recommendations.

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

**Pearl millet- Hybrid**

Soil : Mixed black calcareous (Perianaickenpalayam series)

Target : 3.0 – 4.0 t $ha^{-1}$

FN = 6.04 T - 0.49 SN - 0.80 ON

$FP_2O_5$ = 2.78 T - 1.65 SP - 0.97 OP

$FK_2O$ = 3.29 T - 0.17 SK - 0.58 OK

| Initial soil test value (kg $ha^{-1}$) | | | Yield target – 3 t $ha^{-1}$ | | | Yield target – 4 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** | **$FP_2O_5$** | **$FK_2O$** |
| 180 | 15 | 300 | 40* | 25 | 20* | 98 | 52 | 53 |
| 200 | 20 | 325 | 40* | 20* | 20* | 89 | 44 | 48 |
| 220 | 25 | 350 | 40* | 20* | 20* | 79 | 36 | 44 |
| 240 | 30 | 375 | 40* | 20* | 20* | 69 | 28 | 40 |
| 260 | 35 | 400 | 40* | 20* | 20* | 59 | 19 | 36 |

* Maintenance 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 $ha^{-1}$.

## 5. APPLICATION OF MICRONUTRIENT MIXTURE

Apply 12.5 kg/ha of micronutrient mixture formulated by the Department of Agriculture. Mix the mixture with enough sand to make 50 kg and apply on the surface just before planting/after sowing and cover the seeds. Broadcast the mixture on the surface of seed line (or) Apply TNAU MN mixture @ 12.5kg/ha for irrigated and 7.5 kg/ha for rainfed crops as enriched FYM (prepare enriched FYM at 1:10 ratio of MN mixture and FYM at friable moisture and incubate for one month in shade). If micronutrient mixture is not available apply 25 kg of zinc sulphate per ha. Mix the chemical with enough sand to make 50 kg and apply as above. For Mn deficiency apply 12.5 kg $MnSO_4ha^{-1}$ basally or foliar spraying of 0.2% $MnSO_4$ thrice can be followed.

## II. MANAGEMENT OF MAIN FIELD

### 1. TRANSPLANTING SEEDLINGS OR SOWING PRE-TREATED SEEDS

**Transplanted Crop**

i. Pull out the seedlings when they are 15 to 18 days old.

ii. Adopt the spacing 45 x 15 cm for all the varieties / hybrids.

iii. Plant seedlings on the side of ridge, half way from the bottom. Depth of planting should be 3 to 5 cm.

iv. Root dipping with bio-fertilizers: Prepare the slurry with 5 packets (1000 g)/ha of Azospirillum inoculant and 5 packets (1000g/ha) of Phosphobacteria or 10 packets of Azophos (2000g/ha) in 40 lit. of water and dip the roots of the seedlings 15 - 30 minutes before planting.

**Direct sown crop**

Soaking of Cumbu seeds either in 2% Potassium chloride (KCl) or 3% Sodium Chloride (NaCl) for 16 hours followed by 5 hours shade drying improves germination and stand.

i. Adopt the spacing of 45 x 15 cm for all varieties / hybrids. If pulse is intercropped, adopt a spacing of 30 x 15 cm for Cumbu and 30 x 10 cm for pulses. One pair row of Cumbu is alternated with a single row of pulse crop.

ii. In the furrows in which fertilizers have been applied, place 5 kg of seed, allowing them to fall 4 - 5 cm apart (Use higher seed rate of 5 kg to offset mortality). The optimum population should be 1,45,000 per ha. Use increased seed rate upto 12.5 kg per hectare in shoot fly endemic area and remove the shoot fly damaged seedlings at the time of thinning.

iii. Where pulse seeds are to be sown, drop pulse seeds to fall 5 cm apart and cover.

## 2. WEED MANAGEMENT Transplanted crop

Spray pre-emergence herbicide Atrazine 0.25 kg/ha on 3 DAT followed by one hand weeding on 30 - 35 DAT. If herbicide is not used hand weeding twice on 15 DAT and 30 - 35 DAT.

### Direct Sown crop

i. Apply the pre-emergence herbicide Atrazine 0.25 kg/ha on 3 DAS as spray on the soil surface using Back- pack/Knapsack/Rocker sprayer fitted with flat type nozzle using 500 litres of water/ha.

ii. Apply herbicide when there is sufficient moisture in the soil.

iii. Hand weeding 30 - 35 DAT if pre-emergence herbicide is applied.

iv. If pre-emergence herbicide is not applied hand weeding twice on 15 and 30 DAT.

## 3. THINNING AND GAP FILLING

In direct sown crop after 1st weeding at the time of irrigation, gap fill and thin the crop to a spacing of 15 cm between plants; cowpea crop to 20 cm between plants and other pulses crops to 10 cm between plants.

## 4. TOP DRESSING OF FERTILIZERS

i. Top dress the nitrogen at 15 and 30 days after transplanting or direct sowing.

ii. In transplanted crop, open a furrow 5 cm deep with a stick or hoe at the bottom of the furrow, place the fertilizer and cover.

iii. In the case of direct sown crop apply the fertilizer in band. If inter-cropped with pulses apply the fertilizer to Cumbu crop only.

iv. After the application of fertilizer, irrigate the crop.

## III. WATER MANAGEMENT

| | Days after transplantation/sowing | |
|---|---|---|
| **STAGES** | **Transplanted Crop** | **Direct Sown Crop** |
| **Light Soils** | | |
| i. Germination | 1st day after transplanting | 1st day after sowing |
| | 4th day | 4th day |
| ii. Vegetative phase | 15th Day | 17th day |
| | 28th day | 30th day |
| iii. Flowering phase | 40th day | 42nd day |
| | 52nd day | 55th day |
| | 65th day | 68th day |
| iv. Maturity phase | 77th day | 79th day |
| Total | 8 irrigations | 8 irrigations |
| **Heavy Soils** | | |
| i. Germination | 1st day after planting | 1st day after sowing |
| | 4th day | 5th day |
| ii. Vegetative phase | 15th day | 15th day |
| | 28th day | 30th day |
| iii. Flowering phase | 42nd day | 45th day |
| | 54th day | 57th day |
| iv. Maturity Phase | 66th day | 70th day |
| Total | 7 irrigations | 7 irrigations |

NOTE: This is only a guideline and the irrigation schedule is to be adjusted depending upon the prevailing weather conditions.

## IV. HARVESTING THE CROP

### 1. SYMPTOMS OF MATURITY

i. Leaves will turn yellow and present a dried appearance.

ii. Grains will be hardened.

### 2. HARVESTING

i. Cut the ear heads separately.

ii. Cut the straw after a week, allowing it to dry and stack it in the field till it can be transported.

### 3. THRESHING, CLEANING, DRYING AND STORING

i. Dry the ear heads

ii. Thresh in a mechanical thresher or

iii. Spread it and drag a stone roller over it or

iv. Cattle thresh.

v. Dry the seeds below 10 per cent and mix 100 kg of grains with 1kg of activated Kaolin to reduce the rice weevil and rice moth incidence.

vi. Spray Malathion 50% EC 10 ml/ lit @ 3 lit of spray fluid/100 $m^2$ over the bags during storage godowns,

vii. For grain purpose the grain should be dried well below 10% moisture and stored in gunny bags.

### CROP PROTECTION

**Protection of seedlings in the nursery from pest attack**

If seed bed is not treated before sowing, protect the nursery by applying any one of the insecticides given below on the $7^{th}$ and $14^{th}$ day of sowing by mixing in 6 litres of water; Methyl demeton 25% EC 12 ml, Dimethoate 30% EC 12 ml.

Note:

1. The seedlings should not be kept in nursery for more than 18 days. Otherwise the establishment and yield will be affected adversely.
2. Ensure that cracks should not develop in the nursery. This can be avoided by properly adjusting the quantity of irrigation water.

## A. PEST MANAGEMENT

### Pest management strategies

| Pest | Management strategies |
|---|---|
| **Shoot fly**<br>*Atherigona approximata* | ▪ Use seeds pelleted with insecticides (see sorghum)<br>▪ Seed treatment with Imidacloprid 70 WS 10 g/kg of seeds<br>▪ Plough soon after harvest, remove and destroy the stubbles.<br>▪ Set up the TNAU low cost fish meal trap 12/ha till the crop is 30 days old.<br>▪ **Spray any one of the following :** Methyl demeton 25 EC 500 ml/ha Dimethoate 30 EC 500 ml/ha Neem seed kernel extract 5% |
| **Ear midge**<br>*Geromyia pennisetti* | ▪ **Apply any one of the following at 50 % flowering :**<br>Carbaryl 10 D 25 kg/ha<br>Malathion 5 D 25 kg/ha<br>Carbaryl 50 WP 750 g/ha or Dimethoate 30 EC 600 ml/ha (500 l of spray fluid/ ha). |

### B. Disease Management

**Seed treatment:**

- **For removal of ergot / sclerotia to prevent primary infection:**

  Dissolve 1 kg of common salt in 10 litres of water and add the seeds into the salt solution. Remove the floating ergot and sclerotia affected seeds. Wash the seeds in fresh water for 2 to 3 times to remove the salt, shade dry the seeds and treat the seeds with Thiram @ 2 g /kg of seed.
- Treat the seeds with Metalaxyl @ 6 g/kg for the management of downy mildew in endemic areas

| Name of the Disease | Recommendations |
|---|---|
| **Sugary or Ergot disease:** *Claviceps fusiformis* | • Spray Carbendazim @ 500 g or Mancozeb @1000 g /ha during 5 - 10% flowering and repeat at 50% flowering stage |
| **Rust:** *Puccinia substriata* | • Sow during December – May to reduce the level of incidence<br>• Spray wettable Sulphur@ 2500 g / ha or Mancozeb @ 1000 g/ha during initiation of disease symptom and repeat after 10 days, if necessary |

| | |
|---|---|
| **Downy Mildew:** *Sclerospora graminicola* | • Grow downy mildew resistant varieties CO (Cu) 9 and TNAU-Cumbu Hybrid-CO 9 and CO 10<br>• Transplant the seedlings to reduce the disease incidence<br>• Remove the infected seedlings in both transplanted and direct sown crop up to 45days<br>• Spray Metalaxyl + Mancozeb @ 500 g or Mancozeb @ 1000 g/ha |

**Integrated management strategies for major pest and diseases of pearl millet**

Treat the seeds with Metalaxyl @ 6 g/kg of seed + Imidacloprid @ 5 g/kg of seeds + remove the downy mildew infected plants up to 45 days of sowing + spray Mancozeb @ 1000 g/ha + spray NSKE 5% at 50% flowering to manage downy mildew, rust and shoot fly.

## CUMBU (PEARL MILLET) - 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 of pearl millet.

**Season**

- October - December and June - September.

**Pre-sowing seed treatment**

- Soak the seeds in 2 % KCl for 16 h at 1:1 ratio and dry back the seeds to original seed moisture content (8 - 9 %) under shade. This can be adapted both for the garden and dry land ecosystem.

**Fertilizer requirement**

- Apply NPK @ 100 : 50 : 50 kg / ha.
- Apply NPK @ 50 :50:50 kg / ha as basal and 50 kg N on 30 days after sowing as top dressing.

**Spacing**

- 45 x 20 cm.

**Foliar spray**

- Spray 1 % DAP at peak tillering stage to increase seed filling.

**Harvesting**

- Seeds attain physiological maturity at 27 - 30 days after 50 % flowering.
- Harvest the ear heads when the seed attained the characteristic pale green colour, as once over harvest at 20 - 25 % moisture content.
- Harvest the crop two times when the tillers number is more.
- Ear heads from late-formed tillers (after 7 ear heads from first formed tillers) should not be selected for seed purpose.

**Threshing**

- Thresh the ear heads either manually or mechanically at moisture content of 15 - 20%.

**Drying**

- Dry the seeds either under sun or using mechanical hot air driers to reduce the moisture content to 10%.

**Seed grading**

- Grade the seeds with 4 / 64" (or) 5 / 64" round perforated metal sieve for grading.

**Pre-storage seed treatment**

- Treat the seeds with Carbendazim @ 2 g / kg of seed (or)
- Treat the seeds with Halogen mixture @ 3 g / kg ($CaOCl_2$ + $CaCO_3$ + *arappu* (*Albizzia amara*) leaf powder mixed in the ratio of 5:4:1) 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 10 - 12 %.

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

## CUMBU (PEARL MILLET) - HYBRID SEED PRODUCTION

**Land requirement**

- Select fertile land with good drainage and irrigation facilities.
- Field should not have volunteer plants. Hence, the previous crop should not be the same or different variety / hybrid of pearl millet.

**Isolation**

- All around the field, leave 200 m distance from same and other varieties / hybrids of pearl millet.

**Season**

- October - November and June - July.

**Spacing**

- 45 x 20 cm.

**Planting ratio**

- Sow the female and male lines in the ratio of 8 : 2 to 12 : 2 depending upon the hybrids.

**Fertilizer requirement**

- Apply NPK @ 120:60:60 kg / ha as basal application.

**Foliar spray**

- Spray 2 % DAP at peak tillering stage for enhanced seed set.

**Synchronization techniques**

- Stagger the sowing of male and female parents depending upon the hybrid and location.

**Harvesting**

- Harvest the male parent (R line) first and remove from the field.
- Harvest the hybrid crop when 90 % seeds on the ear head have attained the characteristic pale green colour.