

**SOUTHERN ZONE  
PRODUCTION  
RECOMMENDATIONS  
FOR  
KHARIF & RABI 2015**

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## APPENDIX - I

### PRODUCTION RECOMMENDATIONS OF MAJOR CROPS FOR KHARIF & RABI 2015 RICE

#### Varieties Recommended for *Kharif*

<b>Situation</b>	<b>Varieties for Southern Zone</b>
Early Kharif Plantings	Bharani (NLR 30491), Somasila (NLR 33358), Swetha (NLR 40024), MTU 1010
Kharif Normal Plantings	Simhapuri, Pinakini, Sriranga, NLR 9674, Pardhiva, NLR 3041(Nellore Sona)
Kharif Aged Nursery (Aged seedlings)	Simhapuri, Sriranga
Low land submerged areas	Badava Mahsuri, Savitri
Saline soils	Swarnamukhi, Somasila, Deepti, Nellore mahsuri
Late kharif plantings	Swarnamukhi
Rainfed areas	Sri satya, Varalu, JGL 17004 (Prathyumna)
Irrigated dry situation	Simhapuri
BPH prone areas	Deepti, Vijetha, Cottondora sannalu

#### Varieties Recommended for *Rabi*

<b>Situation</b>	<b>Varieties for Southern Zone</b>
Rabi Normal Plantings	Swarnamukhi, Cottondora sannalu (MTU 1010), Vijetha (MTU 1001), Nellore Mahsuri (NLR 34449), NDLR 8 (Nandyal sannalu), NLR 3041 (Nellore Sona)
Saline soils	Somasila (NLR 33358), Nellore Mahsuri (NLR 34449)
Late Rabi plantings	Satya, Somasila
BPH prone areas	Cottondora Sannalu (MTU 1010), Vijetha (MTU 1001)

**Brief Description of Varieties**  
**Southern Zone**

Variety	Duration (days)	Yield (T/ac)	Pest/ Disease Resistance	Special Features
Bharani	125	2.5	Tungro Virus	Fine grain
Somasila	105-110	2.5	Blast	Super fine grain
Simhapuri	160-170	3.0	Blast	-
Pinakini	160	2.5	Blast (T)	-
Savitri	150	2.5	-	Bold grain
Sri Ranga	170	2.5	Blast	Fine grain
NLR 9674	165-170	2.5	Blast (T)	-
Pardhiva	155	2.2	Blast	Fine grain
Swarnamukhi	135	3.2	Stem borer, Blast, Gallmidge	Super fine grain
MTU 4870	150	2.5	BPH, BLB (T)	Non lodging, fine grain
MTU 1001	140	2.5	BPH, Blast	Fine grain
Varalu	90-95	1.6	Gallmidge 1, 3, 5	Superfine grain
Sri satya	110	2.0	Gallmidge	Coarse grain, suitable for rainfed situation
MTU 1010	125	3.0	BPH, Blast (T)	Super fine grain
Nellore Mahsuri	125	3.0	Blast	Fine grain
Nandyal Sannalu	125	2.5	Tolerance to Blast	Fine grain
JGL 17004 (Prathyumna)	100	2.25	Blast	Fine grain and suitable for contingency situations

**Sowing Nurseries and Seed Rate**

- Early Kharif - April first fortnight
- Sowing up to August 15th during Kharif and from November first fortnight in Rabi
- For Nursery transplanting 20-25 Kg, for dry seed nurseries 25-30 Kg, For Direct seeding 10-12 Kg, for Direct Seeding with Gorru 16 Kg.

**Nursery Management (Wet)**

- Select an area of nursery, which has good irrigation and drainage facility.
- Prepare the nursery field one month before sowing
- Prepare nursery field by ploughing twice in the summer subsequently by puddling 3-4 times at an interval of 5-6 days.
- Level the field after final puddling and prepare raised beds of one-meter width and of convenient length duly forming channels for irrigation and proper drainage.
- Apply Well-decomposed FYM/ compost @ 200 kg/ 5cents nursery to improve soil condition.

- Soak the paddy seed for 16-24 hours and incubate for 24-36 hours before sowing of sprouted seed.
- Apply 2 kg Nitrogen (4.4 kg of Urea), 1 kg of 'P<sub>2</sub>O<sub>5</sub>' (6.25 kg of SSP) and 1kg of 'K<sub>2</sub>O' (1.6 kg of MOP) for a nursery bed of 5 cents (200 m<sup>2</sup>).
- Apply total 'P' & 'K' fertilizers and ½ 'N' as basal (before final leveling and thoroughly mixed in the soil).
- Apply the remaining ½ 'N' at 10-15 days after sowing depending up on seedling growth.
- Sow the sprouted seed @ 5 kg/cent (40 m<sup>2</sup>) of nursery bed and 20 kg seed is sufficient for one acre of main field.
- Broadcast sprouted seed uniformly in seedbeds by keeping thin film of water and drain the water next day morning for proper aeration.
- Maintain alternate wet and dry during first week, after that beds can be flooded 2-3 cm depth depending up on height of seedlings.
- Apply @ 75 ml Benthocarb or Pretilachlor with safener @ 40 ml or Butachlor @ 50 ml or Pyrazosulfuron ethyl @ 5 g in 10 litres of water as pre emergence application for five cents nursery to overcome weed problem
- Apply *Cyhalo fop P butyl* @ 20 ml/ 10 litres of water at 12-15 DAS to control *Echinochloa spp.* effectively.
- At the time of uprooting, the nursery should be flooded two days before to avoid root damage

#### **Main Field**

- Plough the soil once or twice in midsummer prior to main field preparation; it will help in checking the weed growth by exposing the root system of weeds. It also exposes egg masses and hibernated stages of different pests and disease to the hot Sun and helps soil to retain moisture received during summer.
- Under canal irrigation green manuring is very much suggested
- Initiate puddling at least 15 days before transplanting
- Tractor / power tiller puddling to a depth of 15 cm is enough.
- Level the field perfectly after final puddling and allow it to settle for 2-3 days before transplanting in heavy soils which helps in better water and weed control.
- Transplant 30 days old rice seedlings during Kharif and 20-25 days old seedlings for Rabi.
- Avoid usage of over aged seedlings for transplanting in rice as use of 60 or more days for long duration while more than 40 days for medium duration and more than 30 days for short duration varieties reduce the yield drastically.
- Transplant 33 hills/m<sup>2</sup> during Kharif and 44 hills/m<sup>2</sup> during Rabi at 2-3 cm depth @ 2-3 seedlings /hill
- In less fertile soils and in the case of over aged seedlings, transplant 44 hills / m<sup>2</sup> to reduce the yield loss to some extent.
- Make 20 cm alleyways at every 2 meters apart to facilitate free aeration and for uniform application of fertilizers, Weedicides and pest management practices.

#### **Water Management**

- Proper water management facilitates good tillering, increased nutrient use and reduce weed infestation.
- Maintain shallow depth of water (1-2 cm) at the time of transplanting.
- Increase the water level up to 5 cm depth after transplanting till crop establishment
- Maintain shallow depth of water ( 2-3 cm) during tillering phase of crop.

- Maintain 5 cm of water during panicle initiation to physiological maturity (10 Days before harvest) of the crop.
- Crop should not face water stress at panicle initiation, flowering and milk stages.

### Nutrient Management

#### Recommended Fertilizers for Different Agro-Climatic Zones of A.P

Zone	Kharif (kg/acre)			Rabi (kg/acre)		
	N	P	K	N	P	K
Southern Zone	32	24	16	48	24	16

- Soil fertility and productivity of rice can be improved and maintained through integrated use of organic, inorganic and bio fertilizers in a balanced manner.
- 25-50% of recommended N through Green manures/compost /FYM/ poultry manures results sustainable yields.
- Green manuring insitu with Sesbania / Crotalaria / Pillipesara or grain legume crop residues like black gram/ green gram can sustain the soil fertility and productivity.
- Bio fertilizers like blue green algae, Azolla, Azospirillum Phosphobacteria can save about 10 - 20 % 'N' & 'P' requirement of rice crop.
- Apply N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O @ 80: 60: 40 kg /ha during *kharif* and @ 120: 60:40 kg /ha during *rabi*. Apply entire 'P<sub>2</sub>O<sub>5</sub>' & 'K<sub>2</sub>O' as basal while 'N' in three equal splits (Basal + Active tillering + Panicle initiation stage). In light textured soils apply 'K<sub>2</sub>O' in two splits half at basal and half at panicle initiation along with 2<sup>nd</sup> top dressing of 'N'.
- Drain out the field before N topdressing and irrigate the field after 2 days only.
- Avoid top dressing of Phosphorus or Phosphorus containing complex fertilizers after 15 days of planting.
- Apply Zinc Sulphate @ 50 Kg / ha to avoid the Zn deficiency. Deficiency in the standing crop can be corrected by spraying zinc sulphate @ 0.2% (2 g /L of water). The spraying should be repeated at 5 days interval depending on the severity of the problem.
- If Iron deficiency noticed Spray of ferrous sulphate @ 20-25 g and citric acid @ 2-2.5 g/L is suggested. 2-3 sprays at 5-day interval are needed.

### Weed Management

- The crop should be maintained weed free especially till 45 DAT.
- Hand weeding at 20 and 40 days after transplanting in areas where sufficient manual labour is available
- To overcome weed problem apply any one of the following herbicides keeping thin film of water. Butachlor @ 1.25 litres /acre (or) Anilophos @ 500 ml/acre (or) Pretilachlor @ 600 ml /acre (or) Oxadiargyl @ 40 grams (mixed with one litre of water) with in 3 to 5 days of of transplanting or spray Pyrazosulfuran ethyl @ 80-100 g/ acre at 8-12 DAT or Bensulfuron methyl @ 35 g /acre as pre to post emergence (3-25 DAT). 2,4- D SS @400 g / acre at 20-25 DAT to control broadleaved weeds .

### Insect Pests and Diseases

#### Cultural Practices Recommended for Reducing the Build up of Insect Pests

- Summer ploughing
- Grow suitable resistant varieties
- Use recommended doses of fertilizers
- Clipping of the leaf tips of seedlings while planting
- Adopt normal spacing

- Formation of alleyways.
- Alternate wetting and drying
- Weed management

### Economic Threshold Levels of Insect Pests

S. No.	Insect Pest	Stage of the Crop	Economic threshold level
1	Stem borer	Nursery and Tillering	One adult or one egg mass per one sqm or 5% of dead hearts per sqm.
2	Gall midge	Nursery and Tillering	One silver shoot per hill or 5% galls per sqm.
3	BPH/WBPH	Tillering	10-15 insects per hill
		After Flowering	20-25 insects per hill
4	Leaf folder	All stages	One to two damaged leaves per hill
5	Hispa	Tillering stage	Two adults per hill or two damaged leaves per hill
6	Green leaf hopper	Nursery	One or two insects per sqm
		Tillering	10 insects per hill
		Flowering	20 insects per hill
7	Gundhi bug	Flowering	One to two adults per hill

### Chemical Control

#### Tillering Stage

##### *Stemborer, Thrips and Hispa*

- Spray monocrotophos @ 36 SL 1.6 ml or chlorpyrifos 20 EC @ 2.5 ml or phosphamidon 40 SL @ 2.0 ml/litre of water.

##### *Gallmidge*

- Apply phorate 10G @ 12.5 kg/ha or carbofuran 3 G @ 25 kg/ha at 15 DAT in 1- 2 inches of standing water.

##### *Leaf folder*

- Spray profenophos @ 2.0 ml or chlorpyrifos @ 2.5 ml or monocrotophos 36 SL @ 1.6 ml/litre of water.

##### *Hispa*

- Spray profenophos @ 2.0 ml or chlorpyrifos @ 2.5 ml or monocrotophos @ 1.6 ml/litre of water

##### *Leaf mite*

- Dicofol @ 5.0 ml or wettable sulphur @ 3 g /l of water.

### Panicle Initiation to Booting Stage

#### *BPH/WBPH*

- Spray acephate @ 1.5 g or monocrotophos @ 2.2 ml or ethofenprox @ 2.0 ml or fenobucarb @ 2.0 ml or imidacloprid @ 0.25 ml or thiamethoxam @ 0.2 g or Buprofuzin 1.6ml per litre of water.
- Spray fluid (200 litres/acre) should be directed towards the base of the plant.
- Avoid spraying of combination of insecticides and synthetic pyrethroids.
- If second spray is warranted alternate the previous chemical preferably belonging to another group.

#### *Stemborer*

- Cartap hydrochloride 50 WP 2.0 g  
or acephate 1.5 g or profenophos 2.0 ml  
Chlorantriniprole 0.4 ml/litre of water (or) apply cartaphydrochloride 4G @ 8 kg/acre  
when the adult moths/egg masses @ one/ sq.m are noticed in the field.

#### **Leaf folder**

- Spray cartaphydrochloride 2.0 g or acephate 1.5 g or profenophos 2.0 ml /litre of water.

#### **Panicle mite**

- Spray profenophos 2.0 ml or dicofol 5.0 ml/litre of water

#### **Post Flowering**

##### **BPH/WBPH**

- The insecticides as recommended at boot stage should be used.

##### **Cutworm**

Irrigate the field and spray in the evening hours with any of the following combinations of dichlorovos 1.0 ml + chlorpyrifos 2.5 ml/litre of water.

#### **Rice Diseases**

<b>Disease</b>	<b>Time of application</b>	<b>Fungicide</b>	<b>Dose</b>	<b>No. of applications &amp; time interval</b>
Sheath blight	At the initiation of the disease. Normally around 45 days after transplanting in <i>kharif</i> and 30 days after transplanting in <i>rabi</i>	Hexaconazole 5EC Validamycin 3L Propiconazole 25 EC	@ 2ml/l @2ml/l @ 1ml/l	2 sprays at 15-day interval
Blast a) Leaf blast	At the initiation of the disease under favourable weather conditions	Tricyclazole / Isoprothiolane	75 WP @ 0.6g/ml 40 EC @1.5 ml/l	2 to 3 sprays depending on the severity & spread of the disease at 15 days interval
b) Neck blast	i) Under disease favourable weather conditions just before panicle emergence stage	Tricyclazole / Isoprothiolane	75 WP @ 0.6g/ml 40 EC @1.5 ml/l	One spray
ii) On appearance of the disease	Tricyclazole 75WP/ Isoprothiolane 40 EC	@ 0.6g/ml @1.5 ml/l	One spray	
BLB	No chemical available. Management is mainly through rationalization of nitrogenous fertilizer application	---	---	---
Stem rot	At the appearance of the disease (Normally from maximum tillering to crop maturity stage)	Validamycin 3L / Hexaconazole 5EC / Propiconazole 25 EC / Carbendazim 50 WP/ Benomyl 50 WP	@ 2ml/l @ 1ml @2ml/l @ 1g/l @ 1 g/l	2 to 4 sprays at 10-15 days interval depending how much early the disease has been noticed
Red stripe	At the appearance of the disease from advanced boot leaf to crop maturity	Carbendazim 50 WP	@ 1g/l	One spray



	stage			
Sheath rot	At the appearance of the disease or at panicle emergence stage	Carbendazim 50WP	@ 1g/l	One spray
False smut	At flowering stage	Propiconazole 25 EC/ Copper oxychloride 50WP/ Carbendazim 50WP	1.0ml/l 2.0g/l 1.0g/l	One spray during evening hours

### **Rodent Control**

#### ***For Endemic Areas***

- Destruction of rodent harborage and observe rat moment.
- Reducing the number and size of field bunds
- Complete the sowing and planting uniformly in one area.
- From puddling to one month after planting, setup local traps @ 20 /acre.
- Installation of permanent bait stations from planting to flowering stage @ 5 /ha Four at corners of the field one meter inside the cropped area from the field bund and one at the centre, Bromadiolone bait @ 30 g per bait station should be replenished twice in a week.
- During crop period baiting with bromadiolone 0.005% in baits prior to primordial initiation stage of the crop.
- From primordial initiation to crop harvest smoking of burrows with “burrow fumigator“developed by APRRI & RARS, Maruteru.

#### **Management of Rodents with Bromadiolone 0.005%**

- Identify live burrows and simultaneously place 15 gm freshly prepared bromadiolone (2% poison) loose bait in packets inside the burrow when LBC is 50/ha.
- Repeat bromadiolone (2% poison) loose baiting in the active /live burrows as and when the incidence is above ETL.

**Note:** Control schedules should be executed on community basis to check cross infestation through migration.

#### **Harvesting and Storage**

- Harvesting should be done when at least 80 % of the grains are matured. If the crop is harvested without proper maturity it leads to loss of viability of grains and broken in milling.
- The harvested material should be dried in the field for 2-3 days.
- The grain should be free from inert material after threshing and winnowing.
- The winnowed grains should be sun dried until the moisture content reaches < 13%.
- Both over drying and under drying will lead to breakage of the grain during processing.

High moisture content during storage leads to loss of viability due to increased grain respiration and attack of storage insects and pests.

## GROUNDNUT

### 1. INTRODUCTION:

Groundnut is an important oilseed crop grown in India. Globally India ranks first in area and second in production. India, accounts for 31 % of the total groundnut area in the world (24.6 m. ha) and 22 % of the total production (35.7 mt.) . In Andhra Pradesh it is mainly cultivated in Rayalaseema districts viz., Anantapur, Cuddapah, Kurnool and Chittoor districts followed by coastal districts. In Andhra Pradesh it is cultivated in an area of around 11.80 lakh ha with a production of about 8.8 lakh tonnes and a productivity of 749 kg/ha ( 2013-14)

In *kharif*, groundnut is mainly grown as rainfed crop. This can be cultivated during *rabi* under irrigated conditions and in rice fallows after harvesting *kharif* rice. Well drained loose and friable sandy loams and red soils are preferable. Deep black and clay soils are not suitable for groundnut cultivation.

### 2. VARIETAL RECOMMENDATION:

Condition	Suitable Varieties	Duration (Days)	
		<i>Kharif</i>	<i>Rabi</i>
a) For Scarce Rainfall areas	Kadiri-9, Kadiri Harithandhra, Anantha, Greeshma, Kadiri-6, Tirupati-4, Narayani, Abhaya, ICGV-91114, Dharani	105- 110	110-120
b) For excess rainfall conditions	Kadiri-7Bold, Kadiri-8Bold, Kadiri-9, Kadiri Harithandra	125 - 130	125-140
	Abhaya, Kadiri-9	105 - 110	115-120
c) For assured rainfall areas with supplementary irrigations	Kadiri-7 Bold, Kadiri-8Bold	125 - 130	125-140
	Kadiri-6 Kadiri-9, Kadiri Harithandra, Greeshma Abhaya, Narayani, Rohini, ICGV-91114, Dharani	105 - 110	115-120
d) Varieties having tolerance to leaf spot	Kadiri-9, Kadiri Harithandra ,Greeshma, Anantha, Abhaya, Dharani	105 - 110	115-120
e) Nematode infected Areas	Kalahasti , Prasuna, Kadiri-9	110-115	115-120
		100 - 105	110-115
f) For delayed Monsoons	Greeshma, Dharani, Kadiri-9, Kadiri Harithandra	90-100	100-110
g) Varieties having drought tolerance	Kadiri-9, Anantha, Greeshma, Abhaya, ICGV-91114, Dharani	105 - 110	115-120
h) For rice fallow conditions	Kadiri-6, Greeshma, Kadiri Harithandra, TAG-24, Kadiri-9, Dharani	95-100	100-115
i) Coastal sands	Kadiri-6, Greeshma, TAG-24 & Narayani, Dharani	105 - 110	115-120

### 3. LAND PREPARATION:

Prepare the land till fine tilth is attained.

It facilitates root growth, peg penetration and pod development.

Weeds and clods are to be avoided.

### 4. SEED RATE: Depends on variety and season

<u>Varieties</u>	<u>Kharif</u>	<u>Rabi</u>
Narayani, Kadiri-6, ICGS 44, Kalahasti Kadiri-7Bold, Kadiri-8Bold, Kadiri-4, Kadiri-5, TAG-24, JCG-88, TMV-2, Abhaya , Kadiri-9	150kg.	180kg Kernel/ha
ICGV 91114, Kadiri Harithandra, Greeshma, Anantha	125 kg.	150kg. Kernel/ha

With traditional sowing two ha of area can be covered in a day while, with tractor an area of 5-6 ha, with small tractor 4-5 ha area can be covered

- 25 Kg of seed per hectare can be saved due to tractor drawn seed planters compared to traditional behind the plough or bullock drawn gorru sowing. Inter plant competitions reduced due to uniform spacing. Hence, sowing with tractor drawn seed drill will reduce the seed and sowing cost.

### 5. SPACING:

	<u>Kharif</u>	<u>Rabi</u>
<u>Spanish Bunch Varieties</u> Kadiri-6, Tirupati-4, Narayani, ICGV-91114, JL-24, TMV-2, Kadiri Harithandra, Greeshma, Kadiri-9, Rohini, Ananta	30 x 10 cm	22.5 x 10cm
<u>Virginia Bunch Varieties</u> ICGS-11, 44, Kadiri-7Bold, Kadiri-8Bold.	30 x 15 cm	22.5 x 15 cm

### 6. SEED TREATMENT:

Seed should be treated with Imidachlopid @ 2 ml / kg seed followed by Tebuconazole 2ds @ 1g or Mancozeb @ 3 gm / kg seed.

If the seed is dormant, soak it in 0.05 % Ethrel solution for 12 hours followed by shade drying. or spray 125ml ethophan/4lit water/100kg seed before 12 hours of sowing.

*Trichoderma viride* seed treatment @ 4 g/kg seed for rot prone areas

*Rhizobium* inoculation is necessary for groundnut in non-traditional areas and rice fallows.

## 7. SOWING TIME:

Area	Kharif	Rabi
Coastal Andhra	First fortnight of June to last week of June	First FN of November to first FN of December
Rayalaseema	First fortnight of July to 1 <sup>st</sup> FN of August	First FN of November to first FN of December

## 8. FERTILIZER RECOMMENDATIONS:

Application of farm yard manure/ compost @ 10 tonnes /ha once in 2 - 3 seasons

NPK recommendations should be on soil test basis

Apply 20kg Urea + 100kg SSP+ 35kg Murate of Potash kg/ac as basal for kharif crop. Phosphorus should be applied through single super phosphate.

For rabi apply 20kg Urea + 100kg SSP+ 35kg Murate of Potash kg/ac as basal and 10kg Urea per acre at flowering stage.

Apply Gypsum @ 500 kg /ha at flowering stage by placement.

Wherever Zinc deficiency is observed, apply Zinc sulphate 20 kg/ha. Once in 3 seasons.

Wherever Iron deficiency is noticed on crop, spray 0.5 % ferrous sulphate along with 0.1 % citric acid two times with one week interval.

Seed treatment with Rhizobium and soil application of Phosphorous Solubilising Bacteria will reduce the chemical fertilizers requirement.

## 9. WEED MANAGEMENT:

Crop must be weed free up to 45 days after sowing.

Intercultivation at 20 and 40 DAS followed by one hand weeding.

The crop should not be disturbed by weeding or intercultivation after 45 DAS.

Preplanting application of Fluchloralin @ 1.0 to 3.0 l. / ha.

Pre-emergence application of Butachlor /Metalachlore/ Pendimethalin @ 1.0 to 1.3 l/acre ha. or Oxyflourfen @ 1.5 to 2.0 l./ha followed by one intercultivation and one hand weeding will effectively control the weeds.

Wherever, pre-emergence herbicides could not apply, weeds can be controlled by post-emergence herbicides by spraying Imazethaphyr @ 300 ml/ac or Quizalofop ethyl @ 400 ml/ac at 20 DAS when the weeds are at 2 leaved stage.

## 10. IRRIGATION MANAGEMENT:

Groundnut crop requires on an average 400 to 450 mm depth of water.

Good crop of groundnut requires 8 to 9 irrigations at 10 day interval starting from 25 DAS.

After the crop is established, it is necessary to withhold irrigation for about 25 days/upto the 1<sup>st</sup> flowers initiation to create stress which helps in synchronization of flowering.

The last irrigation is to be at 90 days after sowing.

About 24-30 % irrigation water can be saved due to use of sprinklers.

**Soil moisture conservation practices should be followed in rainfed crop viz.,**

Apply 12.5 tonnes of groundnut shells per hectare at 15-20 DAS as mulch to reduce evaporation losses of soil moisture.

To reduce transpiration losses from crop canopy, spray calcium sulphate solution (50 g/l).

Spray urea solution (20 g/l) during dry spell period in order to make recover the crop from stress.

**Critical stages for water requirement:** Flowering, peg penetration and pod development,

**11. PEST MANAGEMENT:**

**A. Insect Pest management:**

**1. Red hairy caterpillar:**

**Identification:**

Young larvae feed gregariously on the undersurface of leaves.

Grown up larvae feed individually by devouring leaves, flowers and growing points.

When the pest is severe only the bare stem points remain resulting in heavy yield loss.

Early instar larvae are ash brown in color, but when fully grown assume reddish color with hairs on the body.

**Problem areas:** Srikakulam, Visakhapatnam, Kadapa, Kurnool, Anantapur and Chittoor districts.

**Remedies:**

Pre-monsoon deep ploughing (two/three times) will expose the hibernating pupae to sunlight and predatory birds.

Removal and destruction of alternate wild hosts which harbor the hairy caterpillars.

Use trap crops around main crop Eg. Cowpea.

Monitor the emergence of adult moths through light trap.

Organize bonfires on community basis from 7.30 PM to 11.00 PM to attract the newly emerging moths for 3 or 4 succeeding days when good showers are received.

Collect and destroy egg masses and early instars larvae.

Dust Quinalphos or Carbaryl @ 25 kg /ha to control early instars of the caterpillar.

To control grown up larvae, spray Dimethoate @ 2.0 ml or Monocrotophos 1.6 ml/l of water.

Trap and kill the migrating larvae in deep cut straight trenches by dusting Methyl parathion 2% in the trench around the field.

## 2. Root grub:

### *Identification:*

Young grubs feed on rootlets and nodules.

Old grubs devour the entire taproot.

Affected plants wither and die. Such plants when pulled from the soil, the devoured taproot can be clearly seen.

Damage usually occurs in patches.

Pest usually occurs in August and September months.

**Distribution:** In localized parts of A.P.

### **Remedies:**

Pre-monsoon deep ploughing (two/three times) will expose the hibernating pupae to sunlight and predatory birds

Apply 10 G Phorate granules @ 1.5 kg a.i. /ha at the time of sowing.

Seed treatment with chlorpyrifos @ 6 ml /kg in root grub problem fields or Imidachloprid 2ml/kg seed.

## 3. Leaf miner:

### **Identification:**

Small blister like mines appear initially on the upper surface of the leaf.

At severe stages entire leaflet becomes brown and it rolls, shrivels and dries up.

Severely infected crop may die and give burnt appearance in the field when we see from distance.

**Problem areas:** Presently it is a major pest in all parts of the state.

### **Remedies:**

Rotation of groundnut with non-leguminous crops should be followed to reduce the pest incidence.

Rotation of groundnut with soybean should be avoided.

Collection and destruction of moths by setting light traps early in the season.

Keeping pheromone traps in the field.

Spraying of Quinolphos 2.0 ml or Monocrotophos 1.6 ml/l of water should be followed.

## 4. Tobacco caterpillar (*Spodoptera litura*)

### **Identification**

Larvae long, Stout, pale green (or) brown with black spots on the body

During daytime it hides in cracks and crevices.

Eggs are small and in masses, covered with yellow anal hairs

In initial stages larvae congregate and scrapes and skeletonises on the leaves.

Leaves become white papery.

In severe cases it defoliates.  
Grown up larvae disburses and make irregular holes

### **Problem Areas**

All groundnut areas (Anantapur, Kadapa and Chittoor.

Severe in the months of September, October and November.

### **Remedies**

Monitor the pest from September last week onwards by Pheromone traps @ 10 per ha. Collection and destruction of eggs masses and damaged leaves along with gregarious larvae.

For early stages spray neem oil 5ml or Chlorpyrifos 2.5 ml or Monocrotophos 1.6 ml per liter of water.

Arrange bird perches @ 25 per ha.

Spray N.P.V 500 LE/ha. from third instar larvae

Make deep plough furrow around the field and dust with methyl parathion or Endosulfan dust to control migratory caterpillars

For late instar (3<sup>rd</sup> onwards) larvae spray Thiodicarb 1.0 g or Novaluron 1.0 ml or Chlorfenpyr 2.0 ml/l. of water

Use poison bait to attract and to control late instar larvae per hectare

Rice bran	-	12.5 kg
Jaggery	-	1.25 kg
Carbaryl	-	1.25 kg (or)
Monocrotophos	-	1.25 litres (or)
Methomyl	-	0.75 kg
Water	-	10-12 litres

Mix the above and make small pellets and apply them in one hectare, during evening hours near base of plants.

## **5. Sucking pests (Jassids, Aphids and Thrips):**

### **Identification:**

Jassid infestation results in yellowing of the leaves.

Thrips infestation results in curling of leaves and stunting of the crop.

Aphid infestation results in chlorotic plants and curling of leaves.

Aphids and thrips transmit Rosette and Bud necrosis diseases of groundnut.

**Distribution:** Present in all groundnut growing areas.

**Remedies:** Spraying of Monocrotophos 1.6 ml or dimethoate 2.0 ml or Imidacloprid

0.4 ml per liter of water

## 6. Storage Pests:

Groundnut bruchid which occurs in storage.

Spray 5% Malathion on pod and gunny bags.

Fumigation with aluminium phosphide tablets 3-5 tablets /tonne of groundnut pods.

Mixing neem oil 5 ml/kg of pods protect from bruchid.

## B. DISEASE MANAGEMENT:

### 1. Tikka leaf spot

#### Identification:

- In case of early leaf spot, the lesions are sub circular and 1-10 mm diameter and dark brown on the upper surface of the leaf
- In case of late leaf spot, the lesions on the leaf are small, more nearly circular and darker than those of early leaf spot.
- Both the lesions may also appear on the stem, petiole and pegs

**Problem areas:** Both the leaf spots are commonly present in all groundnut-growing areas, but, the incidence is relatively more in North coastal and heavy rainfall areas.

#### Remedies:

- Removal of infected plant debris
- Crop rotation should be followed
- Seed treatment with Tebuconazole 2ds @ 1g or mancozeb @ 3 g/kg of seed
- Growing tolerant varieties viz., Kadiri Harithandra, , Abhaya and Kadiri 7 bold and Kadiri-9
- Spraying of mancozeb @ 1000 g + Carbendazim @ 500 g /ha or Hexaconazole @ 1000 ml or Chlorothalonil @ 1000 g or Tebuconazole @ 500 ml/ha in 500 liter of water at fortnightly intervals from first disease appearance.

### 2. Rust:

#### Identification:

- Orange coloured pustules appear on the lower surface of the leaflets
- In severe cases, lesions also appear on other plant parts except flowers

**Problem areas:** Occurs in all groundnut-growing areas

#### Remedies:

- Removal of infected free areas
- Collect seed from disease free areas
- Seed treatment with Tebuconazole 2ds @ 1g or 3 g of mancozeb/kg of seed



- Spraying of mancozeb @1000 g or Chlorothalonil @1000 g or Tridemorph @1000 g /ha in 500 liter of water at 15 days interval starting from disease appearance.

### 3. Collar rot:

#### Identification:

- Rapid desiccation of the affected plant
- Affected tissue is covered with black mass of spores
- In mature plants, lesions develop on the stem just below the soil surface and then spread upward along the branches.
- In mature plants, symptoms generally do not appear until the wilting of the entire plant is apparent

**Problem areas:** More prevalent in light sandy soils

#### Remedies:

- Select healthy seed
- Seed treatment with Tebuconazole 2ds @ 1g or mancozeb 3 g/kg or Captan 2 g/kg of seed
- Deep sowing of seed should be avoided
- Deep ploughing of fields and destruction of plant debris
- Crop rotation with chickpea reduces the disease

### 4. Dry root rot: \*\*\*\*\*

#### 4. Stem rot:

#### Identification:

- Appears generally after 70 days of sowing
- Yellowing and wilting of branches just above the soil
- White mycelium of the fungus develops around the affected stem above the soil level
- Infection of pegs and pods occurs in severe cases and seeds turn to bluish colour\

**Problem areas:** Occurs in areas where the soils are heavy

#### Remedies:

- Deep ploughing in summer
- Selection of healthy seed
- Seed treatment with Tebuconazole 2ds @ 1g or mancozeb @ 3 g/kg of seed
- Soil application before sowing with *Trichoderma viride* developed by mixing 225 kg farm yard manure +25 kg neem cake + 5 kg *Trichoderma viride*/ha and allow to grow for 15 days under shade
- Gypsum application @ 500 kg/ ha
- Timely management of foliar diseases leads to reduction of incidence of stem rot

### 4. Peanut Stem Necrosis Disease (PSND)

#### Identification:

- Necrotic lesions on terminal leaflets, death of top growing bud on main stem followed by necrosis of all top buds on primaries. Complete stem necrosis and often-total necrosis of entire plant in early infection
- Infected plants become stunted and showed auxiliary shoot proliferation with small sized and chlorotic leaflets
- Necrotic spots on pods. Testa are not discolored or mottled

**Problem Areas:** Anantapur, , Kurnool and Chittoor districts of A.P.

**Remedies:**

- Seed treatment with Imidachloprid @ 2 ml/Kg of seed
- Weeds such as *Parthenium hysterophorus*, *Tridax procumbence*, *Ageratum conyzoides*, *Cleome viscosa*, *Commelina benghalensis*, *Vernonia cineraria*, *Achyranthus aspera*, *Acanthospermum hispidum*.. should be removed before flowering in and around the field
- Barrier crops namely bajra, maize and sorghum should be planted in 4-8 rows around the groundnut field. These will prevent thrips and wind borne weed pollen carrying virus
- Grow inter crop with bajra/ sorghum/ maize in the ratio of 7:1 or 11:1
- Spraying of monocrotophos @ 800 ml or Dimethoate @ 1000 ml or Imidachloprid @ 200 ml/ha in 500 liters of water at 25-30 days after sowing

**5. Peanut bud necrosis disease:**

**Identification:**

- Initial symptoms appear on young leaflets as chlorotic spots and develop in to chlorotic or necrotic ring spots
- Terminal bud necrosis on main stem followed by death of top buds on all primaries
- Stunting growth with reduced size of leaflets and petioles
- Leaflets produced on auxiliary shoot showed reduction in size, distortion of lamina and mosaic

**Remedies:**

- Use of tolerant varieties viz., R-8808, ICGS-11, 44
- Intercropping with bajra (7:1)
- Spraying of monocrotophos @ 800 ml or Dimethoate @ 1000 ml or Imidachloprid @ 200 ml/ha in 500 liters of water at 25-30 days after sowing
- Maintenance of recommended plant population

**12. HARVESTING:**

Should be done at right stage of maturity  
 At the time of 70-80% leaves and stems turn yellow  
 When the inner side of the shell turn black

When sufficient moisture is available in the root zone

### **13. STORAGE:**

Seed should not contain more than 9% moisture for storage

Prefer poly ethylene/gunny bags for storage

Spray Malathion 5 ml / liter of water once in 2-3 weeks on storage bags against storage pests.

### **14. TIPS FOR INCREASING PRODUCTION**

Deep summer ploughing

Adoption of quality seed of HYV

Use small seed with out shrivelling of improved varieties

Seed treatment

Adoption of recommended seed rate

Adoption of Ferti-cum- seed drill to ensure right placement of seed and fertilizer

Ensure optimum population

Adopt recommended fertilizer dose

Apply Gypsum and SSP to provide calcium and Sulphur

Avoid inter cultivation/weeding after 45 DAS.

Adopt IPM Package

Practice crop rotation and intercropping

Use mechanization for sowing, inter cultivation ,harvesting and stripping to reduce cost of cultivation

# SUGARCANE

## 1. Varieties

- a. Early maturing Co 6907, 85 A261, 84 A 125, Co 8014, 83 A 30, 87 A 298, 99 V 30, 86 V 96, 91 V 83, 2000 V 59, 2003 V 46, 93 A 145, 97 A 85, 2001 A 63, 2003T 121, 2005T 16 and 83 R 23.
- b. Mid-late maturing Co T 8201, Co A 7602, Co 7805, 83 V 15, 86 A 146, 88 A 162, 96 A 3, 97 R 129, 2000 V 48, 2000 A 225, 98 A 163 and 99 A 5
- c. Late maturing Co 8011, Co 7219, Co 7706, 87 A 380 and Co R 8001.
- d. Moisture stress Co T 8201, Co 6907, 87 A 298, 97 A 85, Co 7219, Co A 7602 and 83 R 23, 98A 163 and 2000A 56.
- e. Swamp water logged conditions 84 A 125, 87 A 298, 86 V 96, 97 V 118, Co 6907, Co T 8201, Co 7219, 85 A 261, 2000 V 59, 83 V 15, Co 7706, Co A 7602, 2003 V 46 and Co R 8001.
- f. Saline - Alkaline soils Co T 8201, 97 A 85, 93 A 145, 99 V 30 and Co 7219.

## 2. Soils / Areas

Alluvial and red delta soils. Well-drained loamy soils.

## 3. Land preparation

Soils are to be worked to fine filth to a depth of 20-25 cm. Form furrows of 30 cm width and 20 cm depth by manual drawn or tractor drawn iron plough or ridgemar.

## 4. Seed rate

40,000 three budded setts per hectare. Seed from short crop of 6-7 months age ensures good germination and improve cane yield by 2-3 tones/acre

## 5. Seed treatment

Dip the setts in Carbendazim (1g/litre) and Malathion (2 ml/litre) to eliminate pineapple disease and scale insect.

**6. Spacing** 80 cm between rows for early varieties and 90 cm for mid-late varieties.

**7. Time of planting**

Early varieties December - January

Mid varieties February

Late varieties March

**8. Fertilizer management**

- Farm yard manure @ 25 tonnes per hectare or press mud cake @ 12.5 tonnes per hectare in the last ploughing.
- Nitrogen @ 224 kg/ha (pocket application) has to be applied in two equal split doses at 45 and 90 days after planting.
- Phosphorus @ 100 kg and Potassium @ 120 kg per hectare are to be applied as basal at the time of planting. Spray Zinc sulphate (2 gm/lt) and Ferrous sulphate (10-20 gm/lt) at 45-60 days after planting where zinc and iron deficiencies are observed.
- Use of biofertilizers like azatobactor (4kg/acre) , azospirillum (4kg/acre) saves nitrogen to an extent of 25%
- Use of phospho bacteria (4kg /acre) and VAM (5kg /acre) saves phosphorus to an extent of 20 to 25%

**9. Weed management:**

**Pre emergence:**

Spray Atrazine @ 5 kg/ha or metribuzine @ 1.5 kg/ha in 1125 lts of water on the third or fourth day after planting, depending on soil moisture.

**Post emergence**

Spray 2,4-D (4 ½ kg) + Gramoxone (2.5 lts) in 1125 lts/ha at 20 & 60 DAP between cane rows with hood to protect the crop or spray metribuzine @ 1.0kg + 2,4-D Sodium salt @ 2.0kg /ha at 25-30 DAP as blanket application.

**Other cultural operations:**

1. Earthing up at about four months after planting, propping the crop by trash twist, twice or thrice, depending on crop growth.
2. Keep the crop erect by TT propping twice or thrice depending upon crop growth leaving 6-8 green leaves in the crown.
3. For control of creeper weeds spray almix @ 20g/ha at 75 DAP
4. Inter cultivation between 45-60 DAP control weeds besides improving aeration.

## **10. Irrigation**

Once in six days during summer and once in 15-21 days from November to harvest. During grand growth period, irrigation is to be provided when dry spell exceeds 15 days. If, only one irrigation is possible during formative phase, it has to be given at 30 days after planting and trash mulching has to be done three days after planting @ 3 t/ha.

## **11. Harvesting**

Crop has to be harvested at peak maturity depending upon variety, date of planting and juice quality.

## **12. Post harvest management**

Sugarcane harvested in a field should be free from root material, soil etc., The immature top portion should be cut to the first visible top internode. Such dressed cane should be crushed within 24 hours either in a sugar factory or jaggery crusher to avoid loss in the cane weight and sugar recovery.

### **Management for bud chip / single node seedling cultivation:**

In sugarcane, seed cost itself accounts for 25% of the total cost of cultivation. Generally, 10.0 tonnes of seed cane is being utilized for getting optimum cane and sugar yields. Hence, to reduce seed cost and increase the cane production per unit area growing of sugarcane through bud chip or single bud seedlings is found to be the new innovative technology and becoming popular among the farming community.

### **Advantages of growing bud chip / single bud seedlings**

1. Budchip / single bud seedlings can put forth more tillers at a time which will be more homogenous and gives higher number of millable canes with higher cane weight and sucrose content. The yield increase was up to 5 tonnes per acre over traditional method of sett planting in coastal areas.
2. Easy to adopt seed treatment with required pesticides because of less quantity of seed material.
3. Saving of one month period in main field similarly, water and critical inputs can be saved during that period.
4. After removal of budchip or single bud the remaining cane can be utilized for making jaggery or sugar.
5. More time will be available for preparation of main field after harvest of paddy which ensure deep ploughing and thorough land preparation.
6. Cane crop comes to maturity early by one month.
7. Mechanization can be adopted in seedling transplanted crop which will reduce cost of cultivation and increase net monetary returns.
8. Ratoon crop yields can also be improved due to maintenance of optimum population and uniform tillering .

## **Raising of Nursery:**

### **Selection of seed cane:**

For growing sugarcane seedlings high yielding varieties suitable for that particular region are to be selected. It is always better to use 6-7 months aged healthy short crop as seed material.

### **Preparation of budchips / single nodes from the seed cane:**

Budchip cutting machine and node cutting machines are available for removing budchips or single nodes from the cane with little or no damage to bud.

In traditional method of 3 bud sett planting 4-6 t/ac. of seed material is required. But in bud chip seedlings planting method, only 750-800 kgs of seed cane is sufficient for raising seedlings required / acre.

Trays of 98C.C. pit size and 5 cm along bud chip / cane node will give good germination and healthy seedlings.

Selection of healthy and undamaged budchips or single buds by grading method will not only improve germination percentage but also gives strong seedlings.

Treating the bud chips / single nodes with 0.5 g carbendazim + 1.0 ml malathion / lit of water for 15 minutes to reduce the incidence of pine apple disease and scale insect.

Protrays (Plastic trays) having 50 pits can be used for sowing of budchips. For sowing of single nodes trays with large size pits are to be used.

To get 90-95% germination, use healthy bud chips or single buds by following grading method.

Fill the pits (half) with coco peat or well decomposed FYM / vermi compost + sand mixed in equal proportion. Then put the treated budchips or single buds at 60-70° angle and eye should be towards upward direction. Then fill the trays completely with coco peat and press gently

Arrange trays in a shade net in such a way that each series contains 10 trays and cover and tie with black polythene sheet tightly so that heat will be produced and germination of buds will be initiated.

After 3-4 days, with the start of germination, arrange trays side by side in shade net and watering should be done in alternate days with rose can or sprinklers. Within one week all the buds will germinate. At 3-4 weeks after sowing every seedling will put forth 3-4 leaves with profuse root growth.

### **Preparation of main field and planting:**

For planting one acre field, 7,500-8,000 budchip seedlings are required. (150-175 plastic trays are sufficient). Growth and vigour of the seedlings also depends on type of rooting media used. Spray 19:19:19 @ 0.1% or vermi wash 1.0% to improve the seedling growth.

Seedlings raised from single bud setts are found to be more vigorous and stronger than budchip seedlings and giving relatively higher yield.

Main field is to be thoroughly prepared by ploughing with 2 M.B. plough or rotavator and perfect leveling should be done.

Furrows are to be formed at 60/120 cm spacing i.e. paired rows of 20 cm depth within the row and seedlings are to be planted at 45-60 cm distance. In the inter space between rows pulse crops like blackgram, greengram and Groundnut can be grown which will improve soil fertility besides suppressing weed growth to certain extent. Drip system can be installed in the pairs to improve water use efficiency. While planting, seedlings are to be planted without disturbing root mass along with coco peat which holds moisture also

Seedlings can also be planted with tractor drawn seedling transplanter.

Light irrigations are to be given at 3-4 days interval at initial stages for quick establishment of the seedlings.

Early planting in January - February is essential for good establishment of seedlings and synchronous tillering.

### **Nutrient Management:**

Application of fertilizers at frequent intervals up to earthing up (90-100 days) found to give higher cane yields as compared to traditional method of application.

1.5 t/ac FYM + 12.5 kg Diammonium phosphate (Urea + S.S.P can also be applied) to be applied at planting nearer to the seedling and covered with soil.

12.5 kg D.A.P along with FYM at 10-15 days after planting.

25 kg D.A.P. along with FYM at 30-35 days.

25 kg urea + 25 kg M.O.P /ac at 50-55 days.

50 kg urea + 25 kg M.O.P/ac. at 70-75 days.

Last dose of 100 kg urea + 100 kg M.O.P. per acre is to be applied at 90-100 days age and earthing up is to be done.

Application of fertilizers at regular intervals to seedlings improves tillering ability and reduces water shoots formation and finally increases number of millable canes at harvest which is a pre-requisite for improving cane yield.

### **Weed management:**

Spraying atrazine @ 2.0 kg or metribuzin @ 600 g/ac in 450 lit of water as preemergence spray within 3<sup>rd</sup> day after planting seedlings.

At 20-25 days after planting, spraying of metribuzin @ 400 g + 2,4-D @ 800 g /ac. mixed in 450 lit. of water will control the weeds effectively. Weeding and hoeing within the rows will reduce the weed growth and improves aeration.

Tractor drawn weeders or rotavators can also be used to reduce weed growth.

### **Water management:**

Light irrigations at frequent intervals (3-4 days) is very much essential during initial stage of the seedling growth. During formative phase irrigations are to be given at weekly interval.

Irrigation through drip system saves water and improves water use efficiency also. Nitrogen fertilizer can also be applied through fertigation in 20 splits starting from 15 days after planting.



### **Other cultural operations:**

Earthing up is to be done at 90-100 days age to prevent water shoots and protect the crop from lodging.

Trash twist propping is to be done at 180 days age depending on crop growth. At maturity crop is to be harvested at ground level and used for jaggery or sugar.

Intensive cultivation is very much essential for realizing higher yields under seedling cultivation.

### **Ratoon crop management**

**1. Varieties** The same varieties indicated for plant crop are suitable for ratoon crop

**2. Soils/Areas** Alluvial, red and well drained loamy soils

#### **3. Stubble shaving and interculture**

Plant crop has to be harvested to the ground level or just below ground level. Stubble shaving has to be done with spades without disturbing the stools. The interspaces have to be ploughed to 12 to 15 cm depth to break the crust and improve aeration for better ratooning.

#### **4. Trash mulching**

Trash mulching @ 3 t/ha at 3-5 days after ratooning ensures conservation of soil moisture and suppression of early shoot borer and weed growth.

#### **5. Manures and fertilizers**

336 kg N/ha has to be applied in two split doses at ratooning and 45 days later.  $P_2O_5$  @ 100 kg / ha and  $K_2O$  @ 120 kg / ha are to be applied at the time of ratooning. If deficiency of iron is noticed Ferrous sulphate (2%) is to be sprayed on foliage immediately.

#### **6. Gap filling:**

Gap filling has to be done with seedlings raised in polythene bags or in nursery from single budded setts within two weeks after ratooning.

## 7. Weed management:

Weeding and hoeing at 1<sup>st</sup>, 4<sup>th</sup> and 7<sup>th</sup> week after ratooning or spraying Atrazine @ 5.0 kg / ha immediately after ratooning followed by one hand weeding at 45 days after ratooning or metribuzin @ 1.5 kg/ha in 450 lit. of water within three days after ratooning followed by one hand weeding at 45 days after ratooning.

## 8. Harvesting:

Ratoon crop matures earlier than plant crop. Therefore crop has to be harvested earlier than plant crop at peak maturity.

### Management under saline / alkaline conditions

1. Varieties 93 A 145, 97 A 85, Co T 8201 and Co 7219.
2. Land preparation Deep ploughing is to be avoided with other aspects are similar to plant crop.
3. Seed rate 45,000 three budded setts per hectare. Seed material should be selected from matured crop.
4. Planting time  
Early planting December - January

#### 5. Manures and fertilizers

Gypsum has to be applied @ 2-5 t/ha depending upon P<sup>H</sup> ranging from 8.5 - 9.2. Farm yard manure @ 25 t/ha or press mud cake @ 12.5 t/ha and Zinc sulphate @ 50 kg / ha are to be applied in the last ploughing. P<sub>2</sub>O<sub>5</sub> @ 100 kg / ha and K<sub>2</sub>O @ 120 kg / ha for early planted crop and 50 kg K<sub>2</sub>O / ha for late planted crop at the time of formation of ridges and furrows. For early planting, Nitrogen @ 168 kg/ha in two splits at 60 and 120 days after planting should be applied.

#### 6. Inter cultivation and other management practices

- i. Provision of drainage and leaching with good quality water.
  - ii. Earthing up at 4 months after planting and trash twist propping 2-3 times depending upon the growth of the crop.
  - iii. Trash mulching @ 3 t/ha three days after planting.
- #### 7. Irrigation

For early planted crop - once in six days during summer and once in 15-21 days from November to harvest. During rainy season if dry spells prevails one to two irrigations may be provided. Late planted crop is usually rainfed. Yield can be improved with supplemental irrigation during post monsoon period

## 8. Harvesting

Crop has to be harvested at peak maturity depending upon variety, date of planting and juice quality.

### Management of pests and diseases

#### INSECT PESTS:

##### *Early shoot borer*

- Planting of setts in deep furrows.
- Application of phorate 10 G granules @ 15 kg/ha or carbofuran 3 G @ 33kg/ha or Fipronil 0.3 G @ 25 kg/ha at the time of planting.
- Trash mulching @ 3 t/ha at 3 days after planting in plant crop and immediately after stubble shaving in ratoon crop.
- Irrigate the crop at frequent intervals during summer.
- Spray chlorpyrifos (2.5 ml/lts) or acephate (1g/litre) at 4, 6 and 9 weeks after planting in 450, 675 and 900 lts of water, respectively.
- Early ratooning in the months of December - January coupled with closer irrigations in the formative phase of the crop.
- Use synthetic pheromones in water traps @ 3 /acre commencing from 35 days after planting or ratooning for monitoring of the pest.
- Release egg parasitoid, *Trichogramma chilonis* @ 50,000/ha at 30 days after planting or ratooning and subsequent releases should be made at 7-10 interval.

##### *Internode borer*

- Control early shoot borer in early stages of the crop growth.
- Detrash the crop to destroy the larvae and pupae attached with the leaf sheaths.
- Remove water shoots at eighth/ ninth month age.
- Avoid high dose of nitrogen
- Drain out excess of water in low-lying areas.
- Use synthetic pheromones in water traps @ 3 /acre commencing from the internode formation stage of the crop for monitoring of the pest.
- Release egg parasitoid, *Trichogramma chilonis* @ 50,000/ha at fortnightly intervals from 120 days after planting until a month before harvest.
- Spray chlorpyrifos (2.5 ml/lt) 0.05 % or monocrotophos (2.1 ml/lt) twice at 15 days interval during June-July months.

##### *Scale insect*

- Dip the three budded setts in malathion (2 ml/lt) or dimethoate (1.7 ml/lt) for 15 minutes before planting.
- Detrash the cane in the first weeks of July, August and September months followed by spraying with dimethoate 1.7 ml/lt or malathion 3 ml/litre.
- Dimethoate is preferred for spraying during heavy rains.
- Avoid ratooning of plant crop affected with heavy scale infestation .

##### **Mealy bug:**

- Avoid ratooning of the plant crop infested with mealy bugs .

- Destroy alternate host plants (certain grasses like *Cymbopogon*) near sugarcane fields.
- Avoid excess usage of nitrogenous fertilizers.
- Avoid multi ratooning in areas prone to mealy bug.
- Detrash the grown-up crop and spray dimethoate @ 1.7 ml/lt or malathion @ 2ml/lt. by using foot sprayer with long lance.

**White fly:**

- Provide adequate drainage facilities
- Heavy rainfall washes out the pest.
- Apply 'N' fertilisers at recommended dose at stipulated time.
- Avoid ratooning in low lying areas prone for water logging.
- Spray malathion 2ml/lt or chlorpyrifos 2.5 ml/lt or monocrotophos 1.6 ml/lt or imidacloprid 0.3 ml/lt using foot sprayer with long lance.

**Termites:**

- Systematic digging of termite mounds and destruction of queens. Apply methylparathion 2%D @ 200g/ mound followed by proper leveling.
- Apply methyl parathion 2%D in the furrows @ 25 kg/ha at planting.
- Spray chlorpyrifos 20 EC @ 5ml/lt wherever damage is noticed in standing crop

**Cane fly:**

- Detrash the lower leaves
- Use Nitrogenous fertilizers Judiciously.
- Prevent lodging by timely TT propping.
- Spray malathion @ 2 ml/lt or dimethoate 1.7 ml/lt or monocrotophos @ 1.6 ml/litre with foot sprayer
- Release *Epiricania melanoleuca* 4000-5000 cocoons/ha or 4-5 lakhs eggs per hectare.
- Avoid spraying of insecticides if Epricania is observed in the field

**9. Mites:**

- Removal and destruction of infested leaves
- Removal and destruction of grasses on the bunds.
- Spray wettable sulphur @ 3g/lt at 15 days interval starting from the appearance of the pest on crop as well as grassy weeds.
  - Adopt balanced nutrition.
  - Provide frequent irrigations during the pre-monsoon if possible.

**10. Woolly aphid:**

- Harvest affected matured crop on priority basis.
- Avoid transport of cane with infested leaves.
- Avoid ratooning, if the plant crop is heavily infested with woolly aphid.
- Adopt paired/wider row planting.
- Removal and burning of affected leaves.
- Wrapping and propping of canes to avoid spread of pest.
- Use Nitrogenous fertilizers and irrigation water judiciously.
- Provide proper drainage.

- Conserve the existing natural enemies like *Chrysoperla carnea*, Syrphid fly, Brown lace wing, *Micromus timidus* (Ord. Neuroptera) and *Dipha aphidivora* (Ord. Lepidoptera). Release the bioagents if infestation is severe.
- Monitor the pest incidence through yellow traps.
- Spray with malathion @ 2ml/lit or monocrotophos @ 1.6 ml/lit. or dimethoate @ 1.7ml/lit or chlorpyrifos @ 2.5 ml/lit. or methyl demeton @ 2ml/lit. or acephate @ 1g/lit.

### **11. Root grub**

- Root grub is more problematic in light soils.
- Apply phorate 10 G granules @ 15 kg/ha or fipronil @ 25 kg/ha at planting in endemic areas.
- In standing crop, flooding of fields for 2-3 days is effective in reducing the severity.
- Avoid ratooning of infected fields

## **DISEASES:**

### **1. Smut**

- i. Systematic eradication of smutted clumps.
- ii. Avoid second ratoon if incidence is severe.
- iii. Treat three budded setts in hot water at 52° C for 30 minutes or aerated steam at 51° C for two hours followed by dipping setts in carbendazim and raise special seed nurseries.
- iv. Select seed material from disease free areas atleast 40m away from affected fields.
- v. Treat the setts with propiconazole (1 ml/lit) or hexaconazole (2ml/liter) for 15 minutes before planting the susceptible varieties like 87A 298, Co 6907.
- vi. Spray propiconazole (1.05 ml/lit) immediately after ratooning and 30 days after 1<sup>st</sup> spray in ratoon crop.

### **2. Red rot**

- i. Select healthy seed material from disease free areas
- ii. Systematic eradication of affected clumps.
- iii. Uproot and destroy un-germinated setts of plant crop and un-sprouted clumps of ratoon crop.
- iv. Avoid ratooning of infected plant crop
- v. Provide good drainage and avoid stagnation.
- vi. All stubbles and debris should be burnt and further cane planting should not be done up to four months in the infected field.
- vii. Harvest the infected crop as early as possible and burn the crop residues.
- viii. Keep the crop erect without lodging by trash twist propping.
- ix. Grow resistant varieties like Co 7706, Co A 7602, Co 7219, CoT 8201, Co R 8001, 98A163, 85A 261, 83 A 30, 87 A 298, 86 V 96, 83 V 15, 83 R 23, 90 A 272, Co 7219, 97A 85 and 2001A 63.

### **3. Grassy shoot disease**

- Uproot and destroy affected clumps.

- Avoid ratooning of severely affected plots.
- Select seed material from disease free plots.
- Treat the setts in hot water at 52<sup>o</sup> C for 30 minutes or aerated steam at 50<sup>o</sup> C for one hour and raise special seed nursery.
- Spray Malathion (2 ml/ lt) or Dimethoate (2 ml/lt) to check vector population.

#### **4. Pineapple disease:**

- Treat the setts by dipping in carbendazim solution (150 g of Carbendazim in 300 litres of water for 40,000 three budded setts sufficient to plant in one hectare).

#### **5. Wilt:**

- Provide frequent irrigations during summer
- Avoid water logging
- Use disease free seed material
- Control the diseases and pests effectively to avoid primary infection
- Apply recommended dose of nitrogen within the stipulated time

#### **6. Leaf scald:**

- Grow healthy short crop seed material for planting
- Sterilize harvesting knives with 5 % formaldehyde or on direct flame
- Treat the setts in hot water at 52<sup>o</sup>c for 30 minutes ``dipping in carbendazim (0.05 %) for 15 minutes.

#### **7. Top rot:**

- Two sprays of mancozeb (3 g/lt) at 2-3 weeks interval during rainy season.

#### **8. Ring spot:**

- Spray either carbendazim (0.1 5) or mancozeb (0.3 %) or copper oxychloride (0.04 %) twice or thrice at three weeks interval starting from the first appearance of disease.

#### **9. Rust:**

- Spray tridemorph @ 1 ml / lt. or Mancozeb @ 3 g/ lt. at 15 days interval starting from the first appearance of disease.

#### **10. Viral diseases (YLD and Mosaic)**

- Uproot and destroy affected clumps
- Avoid ratooning of severely affected crop
- Use disease free seed material, preferably cane raised from tissue culture seedlings
- Spray Dimethoate 2ml/lt to control vector population

## PULSES

### VARIETIES:

#### GREENGRAM

**Kharif:** LGG 450, LGG 407, LGG 460, TM 96-2, Pusa 105 and PDM 54.

**Rabi-Uplands:** LGG 460, LGG 407, TM 96-2.

**Rice fallows :** LGG 460, TM 96-2, LGG 410

**Summer :** LGG 460, LGG 450, PDM 54, LGG 407, TM 96-2

#### BLACKGRAM:

**Kharif :** LBG 752, LBG 20, LBG 623, T 9, Pant U 31.

**Rabi-Uplands:** LBG 752, LBG 685, LBG 645, LBG 709, LBG 623, LBG 20, PBG 107

**Rice fallows:** LBG 648, LBG 645, LBG 685, LBG 709, LBG 752.

**Summer:** LBG 752, PU 31, LBG 20, T 9.

**Soils/Areas :** All types of soils with good drainage facilities. Saline soils are **not** suitable.

**Land Preparation :** Land should be prepared to fine tilth with 2 ploughings followed by harrowing.

#### Sowing time :

	Kharif	Rabi uplands	Rice fallows	Summer
<b>Greengram &amp; Blackgram</b>	June 15 - July 15	October	2nd fortnight of November to first fortnight of December	Mid February to mid of March (uplands)  March 15 <sup>th</sup> to March ending. (Rice fallows)

#### Seed rate :

	Kharif	Rabi uplands	Rice fallows	Summer
<b>Greengram</b>	15-16 kg/ha	15-16 kg/ha	30-32 kg/ha	16-18 kg/ha

<b>Blackgram</b>	18-20 kg/ha	18 -20 kg/ha	40-42 kg/ha	20 kg/ha
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**Seed treatment** : Captan/ Thiram / Mancozeb / Carbendazim @ 2.5 g per kg seed; Imidacloprid 600 FS @ 5 ml or Thiamethoxam @ 5g /kg seed to protect the crop from sucking pests and diseases up to 15-20 days after sowing. First treat the seed with fungicide and allow to dry for 30 - 60 min, then treat the seed with insecticide and dry them in shade. Later treat the seed with Rhizobium @ 2 g/kg seed before sowing.

**Spacing** : 30 x 10 cm

**Manures and fertilizers** : 20 N + 50 kg P<sub>2</sub>O<sub>5</sub> /ha as basal dose

**Intercultivation** : Twice at 20 and 30 DAS

**Weed Control** : Spray Pendimethalin at 2.5 to 3.5 lt/ha immediately after sowing or the next day to check the weed growth for the first 20-25 days.

**Irrigation** : Usually grown as rainfed. Irrigate twice if water is available at 30 to 50 DAS to get higher yields.

**Pest management:**

**Stemfly** : Seed treatment as above. Spray Acephate 1.0 g/lt or Monocrotophos 1.6 ml/lt or Dimethoate 2.0 ml/lt twice at weekly intervals from 10 days after sowing

**Flea beetles** : Seed treatment as above. Spray Monocrotophos 1.6 ml/lt or acephate 1.0 g/lt if the incidence is severe.

**Thrips** : Spray either Monocrotophos 1.6 ml/lt or acephate 1.0 g/lt or fipronil 1.0 ml/lt

**Whitefly** : Foliar application of 5 % NSKE at 20 DAS as prophylactic spray against whitefly that transmits YMV. Spray monocrotophos 1.6 ml/lt or Triazophos 1.5 ml/lt or acetamiprid @ 0.2 g/lt.

**Aphids:** Spray either acephate 1.0 g/lt or monocrotophos 1.6 ml/lt or imidacloprid 0.3 ml/lt.

**Maruca Pod borer** :

- Monitor the occurrence of adult moths at flower bud initiation stage of blackgram/greengram (i.e at 35-40 DAS).
- Application of 5% NSKE or neem oil @ 5 ml/lt should be taken up before flower bud initiation or at 35 DAS to avoid egg laying by Maruca adults.
- Spray Acephate 1.0 g or chloropyriphos 2.0 ml/lt or Quinalphos 2.5 ml or Thiodicarb 1.0 g at the time of flowering initiation. Add Dichlorovos 1.0 ml/lt to the above chemicals if more number of webbings were observed in the crop.
- In case of severe incidence spray either novaluron 1.0 ml or spinosad 0.3 g or emamectin benzoate 0.4 g or chloranthraniliprole 0.3 ml or flubendiamide @ 0.2 ml/lt



- First spray should be given one week before flowering initiation as and when the adult population is noticed in the crop.
- Use 500 liters of spray fluid per hectare with hand compression sprayer
- Use 150-170 liters of spray fluid per hectare and increase the insecticide dose three times while using power or Taiwan sprayer,
- Repeat the spray twice at 7 days interval by changing the insecticide depending on the intensity of the pest.
- Do not spray the crop during early morning hours until the dew on leaf surface dries off

### **Tobacco caterpillar:**

Adoption of IPM practices such as

- Erection of Pheromone traps @ 10/hectare
- Growing of castor as trap crop to monitor egg laying and hatching,
- Collection and destruction of skeletonised leaves along with first instar larvae,
- Spraying of SNPV @ 500 LE/ha.
- Spray either chlorpyrifos 2.5 ml/lit or acephate 1g/lit or quinolphos 2 ml/lit against early instars.
- Apply poison bait containing rice bran, jaggery and insecticide (Carbaryl /Chlorpyrifos / Monocrotophos) @ 10:1:1 ratio against grown up caterpillars at the evening hours.

### **IPM practices in blackgram and greengram:**

- Seed treatment with either Imidacloprid 600 FS @ 5 ml or Thiamethoxam 70 WS @ 5g /kg seed
- Intercropping with redgram (7:1)
- Erection of yellow sticky traps for monitoring of whiteflies
- Spraying of 5 % NSKE or neem oil @ 5 ml/lit (3000 ppm) as prophylactic spray at 20 and 35 DAS against both whiteflies and Maruca pod borer
- Need based application of recommended insecticides

### **Disease management:**

**Collar rot:** Seed treatment with Captan/ Thiram / Mancozeb / Carbendazim @ 2.5 g per kg

**Anthracnose, Cercospora leaf spot:** Seed treatment as above. Spray Carbendazim 0.1% or Mancozeb 0.25% twice at 10 days interval.

**Powdery mildew:** Spray Carbendazim 0.1% or Thiophanate methyl 0.1% twice at 10 days interval soon after noticing the disease.

**Angular black leaf spot:** Grow resistant varieties like LGG 407 and LGG 450. Spray Carbendazim 0.1% twice at 10 days interval.

### **Plant Protection Schedule in rice fallows:**

30-35 days : First spray with Copper oxychloride @ 3 g or Mancozeb @ 2.5 g/lit to control *Corynespora* leaf spot.

45-50 days : Second spray with Dinocap @ 1 ml + Mancozeb @ 2.5 g/lit to control powdery mildew and *Corynespora* leaf spot.

60-65 days : Third spray with Tridemorph @ 1 ml or Dinocap @ 1 ml + Mancozeb @ 2.5g/lit to control rust, *Corynespora* leaf spot and Powdery mildew.

#### **Yellow mosaic virus:**

1. Grow resistant varieties like LGG 407, LGG 460, ML 267, PDM 54 of greengram and LBG 752, PU 31 and T 9 of blackgram
2. Seed treatment with imidacloprid 600 FS @5 ml/kg or thiamethoxam 70 WS 5 g/kg seed
3. Spraying of 5% NSKE or Neem oil 5 ml/lit at 20 DAS as prophylactic measure
4. Roughing of YMV infected plants at initial stages of disease appearance
5. Spray Triazophos 1.5 ml/lit or acetameprid 0.2 g/lit for control of whitefly to check further spread of disease.

**Leaf curl virus:** Seed treatment with Imidacloprid 5.0 ml/ Thiomethoxam 5.0g per kg seed.

### **REDGRAM**

#### **Varieties :**

**Medium duration:** LRG 41, LRG 30, LRG 38, ICP 8863, ICPL 332 and ICPL 87119, ICPL 85063, TRG 22.

**Short duration :** ICPL 84031 (Durga), ICPL 85010 and CORG 9701

**Wilt resistant varieties:** ICP 8863 and ICPL 87119.

**SMD resistant varieties:** ICPL 87119, BSMR 736 and BSMR 853.

**Rabi varieties:** ICPL 85063, LRG30, LRG 38, LRG 41

**Soils/areas:** All types of soils with good drainage. Saline soils are not suitable.

**Land preparation :** Land should be prepared to fine tilth by ploughing 2 to 3 times followed by harrowing.

**Seed rate :** Medium duration varieties : 5-10 kg/ha

Short duration varieties : 15-18 kg/ha depending on type of soils.

Rabi : 12-15 kg/ha

**Spacing :** Medium duration varieties : 150 to 240 x 20 cm (depending on soil type)

Short duration varieties : 90 x 20 cm (black soils) or  
60 x 20 cm (light soils)

Rabi : 45-60 x 10 cm rainfed:  
conditions

90 x 10 cm under ID

**Sowing/planting :**

Kharif : 15th June - August.

Rabi : September 20th to October 20th

**Manures and fertilizers :**

Kharif: Apply 20 N + 50 P<sub>2</sub>O<sub>5</sub> kg/ha as basal dose.

Rabi: 20 kg N and 50 kg P<sub>2</sub>O<sub>5</sub>/ha as basal+ 20 kg N as top dressing at 25 DAS

**Intercultivation :** Twice at 20 and 30 DAS

**Weed Control :** Spray pendimethalin at 2.5 to 3.5 lt/ha immediately after sowing or the next day to check the weed growth for the first 20-25 days.

**INTERGRATED PEST MANAGEMENT OF *HELICOVERPA* ON REDGRAM**

**I. CULTURAL**

Summer ploughing

Avoid mono-cropping

Follow crop rotation

Adopt wider row spacing (more than 2 meters)

Use recommended dose of fertilizers

Cultivate tolerant/recouping varieties (LRG 41, ICPL 332, ICPL 84060, LRG 38 and LRG 30)

Grow intercrops

(Kharif : Maize, Sorghum, Soybean, Gingelly, Greengram, Blackgram, Dry paddy and Bajra)

Grow single variety on large scale.

Cultivate slightly early maturing varieties in light soils to escape from the terminal moisture stress.

**II. MECHANICAL**

Monitor with Pheromone traps 10/ha

Dislodge the larvae by shaking the plants

**III. BIOLOGICAL**

Release Trichogramma twice at weekly intervals 65,000/ha

Keep bird perches 50/ha up to flowering stage

Spray NPV and B.T. (NPV 500 LE/ha or B.T. 1 kg/ha)

#### **IV PLANT PRODUCTS**

Use Neem oil 5 ml/l or Repelin 10 ml/l or NSKE 50 g/l

#### **V. SYNTHETIC PESTICIDES**

Follow need based application

Avoid cocktail mixtures.

Aim the sprayings at early instars

Chlorpyrifos 2.5 ml/l or Quinolphos 2 ml/l or Acephate 1 g/l or spinosad 0.3 g/l, emamectin benzoate 0.4 g/l alternatively during the flowering & pod formation stage.

Ensure thorough coverage (400-500 l/ha)

Use Hydraulic/Pneumatic hand compression sprayers (900-1000 l/ha)

Discourage synthetic pyrethroids

Avoid sub-lethal dosage

Adopt community approach

**Maruca Pod borer:** Spray a combination of Chlorpyrifos 2.5 ml + Nuvan 1ml/lit at flowering stage, spinosad 0.3 g/l or emamectin benzoate 0.4 g/l or clorantraniliprole @ 0.3 ml/l or Flubendiamide 0.2 g/l in case of severe infestation.

**Pod fly :** Monocrotophos 1.6 ml/l or Acephate 1 g/l or profenophos 2.0 ml/l or dimethote 1.0 ml/l at the time of pod formation and development stages on need basis.

#### **Disease management :**

**Wilt :** Grow resistant varieties, ICPL 87119, ICP 8863, WRG 65, PRG 158.

**Sterility mosaic virus :** Grow resistant varieties, BSMR 853, BSMR 736 and ICPL 87119.

**Macrophomina blight :** Grow resistant variety, MRG 66 and MRG 1004.

#### **Post harvest technology:**

Properly dried produce can be stored in nylon bag, polythene lined gunny bag or compactly knitted gunny bag upto a period of 180 days.

## **BENGALGRAM**

Varieties:

Desi- JG 11, JAKI 9218, PG 81-1-1, JG 130,

Kabuli - KAK 2, Phule G 95311 and LBeG 7

<b>Sowing :</b>	October to	November
<b>Soils :</b>	Medium to deep black	soils
<b>Seed rate :</b>	85-90 kg/ha (Desi);	100-110 kg/ha (kabuli)
<b>Spacing :</b>	30 x 10 cm	
<b>Fertilizers:</b>	20 kg N, 50 Kg P <sub>2</sub> O <sub>5</sub> ,	40 kg S/ha-basal dose

**Intercultivation:** Twice at 20 and 30

**Weed Control :** spray Pendimethalin at 2.5 to 3.5 lt/ha immediately after sowing or the next day to check the weed growth for the first 20-25 days.

**Irrigation :** Rainfed, One light irrigation at pre flowering at 35-40 days will increase yields.

**Pest control:**

**Helicoverpa Pod borer:**

Adopt IPM practices against *Helicoverpa* in redgram

- a) Follow stripcropping of bengalgram with coriander (16:4)
- b) Sow 4 rows of sorghum all round the plot
- c) Transplant 50-100 marigold seedlings all round the plot
- d) Monitoring with pheromone traps @ 10/ha to target the pest at right stages.
- e) Use bird perches (50/ha)
- f) Use neem formulations for insect repelling (NSKE 5%) soon after the pest occurrence.
- g) Use biocides like Bt @ 1 kg/ha and NPV @ 500 LE/ha twice at an interval of 7-10 days in the evening hours.
- h) If necessary spray Endosulfan 2 ml/lt or Chlorpyrifos 2.5 ml/lt or Quinolphos 2 ml/1 or Acephate 1 g/l, 500 lts of spray fluid per ha.

***Spodoptera exigua:***

The incidence of *S.exigua* generally appears at early vegetative stage i.e upto 20-30 days after sowing. Larvae damage the lower leaves by scraping. In severe cases, foliage will drop down. Spray either monocrotophos 1.6 ml/lt or acephate 1.0 g/lt or quinalphos 2.0 ml/lt or thiodicarb 1.0 g/lt.

**Diseases:**

**Wilt** : Seed treatment with Captan or Thiram 2.5 g/kg seed or Trichoderma (4g/kg).  
Grow resistant varieties such as JG 11, JG 130, JAKI 9218.

**Dry root rot:** Seed treatment with Captan or Thiram 2.5g or Rhizocin 2.5 g/kg seed.  
Grow resistant variety, ICCV 10.

**Post Harvest Technology:**

**Storage** : Properly dried un-infested produce can be safely stored in Nylon bag, polythene lined gunny bag or compactly knitted gunny bag even upto a period of 180 days.

**SOYBEAN**

**Varieties** : JS 335, PK 1029, MACS 58, MACS 201, MACS 124, MACS 450, PK 471, PK 472, LSb-1 and JS 80-21, LSB 18 (Bheem), ADB 22 (Basara).

**Soils/Areas** : Medium clay soils, light soils under irrigation.

**Land preparation** : Plough the field twice followed by harrowing to achieve fine tilth.

**Seed rate** : 60-65 kg/ha

**Seed treatment** : Seed treatment with Captan or Thiram 3 g and Carbosulfan 30g/kg seed. Treat the seed with *Rhizobium japonicum* bacteria before sowing.

**Spacing** : 45 x 5.0 cm or 30 X 10 cm

**Sowing** : June - July for Telengana Region

End of July to 1<sup>st</sup> F.N. of August for coastal region

**Manures and fertilizers** : 30 N + 60 P<sub>2</sub>O<sub>5</sub> + 40 K<sub>2</sub>O kg/ha, if inoculated with Rhizobium.  
60 to 90 N + 60 P<sub>2</sub>O<sub>5</sub> + 40 K<sub>2</sub>O kg/ha, if not inoculated. Use of FYM and Sulphur containing fertilizers should be encouraged. Treat the seed with *Rhizobium japonicum*.

**Intercultivation and other management practices** : Keep the crop free from weeds upto 45 DAS. One to two hoeings. Use Pendimethalin @ 3.3 l/ha as pre-emergence to check weed growth.

**Irrigation** :Under I.D. conditions irrigate at critical stages i.e., at pre-flowering and pod filling stages.

**Pest Management:**

**Stemfly** : Spray Monocrotophos 1.6 ml/lit or Acephate 1 g/lit or quinalphos 2.0 ml/lit

**Leaf folder/Webber and *Spodoptera exigua*** : Quinalphos 2 ml/lit or Acephate 1 g/lit.

**Gram caterpillar** : Quinolphos 2 ml/lit or Chlorpyriphos 2.5 ml/lit.

**Pod borers including *Spodoptera*** : Collection and destruction of egg masses and skeletonized leaves. Need based spray with quinalphos 2 ml/lit or Chlorpyriphos 2.5 ml/lit.

**Whitefly** : Triazophos 1.5 ml/lit or Neem oil 5 ml/lit .

**Jassids** : Monocrotophos 1.6 ml/lit

**Thrips** : Acephate 1 g/lit.

**Disease Management:**

**Cercospora leaf spot** : Spray Carbendazim 0.1%.

**Alternaria blight** : Seed treatment with Cap tan or Thiram 3 g/kg of seed.

**Rust** : Mancozeb 1.5 kg/ha

**Bacterial leaf spot** : Chlormycitin 100 ppm

**Mosaic** : Acephate 1 g/lit to check vector

**YMV** : Triazophos 0.2 kg a.i/ha or Dimethoate 0.3 kg a.i/ha to check whitefly.

**Harvesting and Post Harvesting Technology:**

The crop is harvested when majority of leaves have become golden yellow and ready to fall and the lower pods are yellowish and dry. Seed is to be dried properly to a moisture level of 11-12% before storage.

## MILLETS

**Name of the crop: Jowar**

S. No	Operation	Details
1	Varieties along with recommended area	<p><b>KHARIF</b>  <b>Varieties:</b> PSV-1, Palem-2, CSV-10, CSV-11, CSV-13, CSV-15 and Srisaila (PSV 56)  <b>Low rainfall areas of Rayalaseema:</b> CSV-15, PSV-1, Srisaila (PSV 56)  <b>Hybrids:</b> CSH-10, CSH-11, CSH-14, CSH-16, CSH- 18, CSH-21  <b>Low rainfall areas of Rayalaseema:</b> CSH 6, CSH 14, CSH 23, Srisaila (PSV 56)</p> <p><b>RABI</b>  <b>Varieties :</b> NTJ-2, NTJ-4, CSV 216R, CSV 14R, M35-1, Kinnera  <b>Early rabi areas of Rayalaseema :</b> CSV 14 R, NTJ2, NTJ4, N14  <b>Hybrids:</b> CSH-15 R, CSH-16  <b>Early rabi areas (Maghi) of Rayalaseema:</b> CSH15 R, CSH-16</p>
2	Land preparation	One deep ploughing with mould board plough followed by ploughing with wooden plough twice in summer season. Before sowing, secondary tillage with cultivator to prepare smooth seed bed. Minor land smoothing before sowing helps in better insitu moisture conservation
3	Seed treatment	Treat the seed with Thiomethaxam @ 3 g/kg seed and Thiram or Captan @ 3 g/kg seed.
4	Sowing time	Kharif: 1 <sup>st</sup> week of June to 2 <sup>nd</sup> week of July Rabi: 2 <sup>nd</sup> fortnight of September to October end
5	Seed rate and Spacing	8-10 kg/ha 45 x 12-15 cm Remove excess plants at 15-20 days age of the crop.
6	Fertilizer doses and time of application	FYM : 10 t/ha <b>Light soils with low rainfall</b> Basal : 30N + 40P + 30K kg/ha Top : (30-40 days crop) : 30 N kg/ha <b>Fertile soils with assured rainfall</b> Basal : 40N + 60P + 40K kg/ha Top : (30-40 days crop) : 40 N kg/ha
7	Weed control (name of chemical and mechanical)	<ul style="list-style-type: none"> <li>• Two manual weedings along with two intercultural operations with danti are effective.</li> <li>• Pre emergence application of Atrazine @ 4 g/litre with in 48 hrs of sowing coupled with one manual weeding and one intercultural operation is also economical.</li> </ul> <p><b>Witch weed:</b></p>



		<ul style="list-style-type: none"> <li>• Pre emergence spray of Atrazine @ 4 g/L.</li> <li>• Spray Ammonium sulphate @ 50 g/l or Urea 200 g/l on striga plants.</li> <li>• Destroying the parasites before flowering.</li> </ul>
8	Major disease and pest control	<p><b>Pests:</b></p> <p><b>1. Shoot fly:</b></p> <ul style="list-style-type: none"> <li>• Deep ploughing to expose larval and pupal stages present in the stubbles.</li> <li>• Sowing with the onset of monsoon before 15<sup>th</sup> July.</li> <li>• In the late sown crop, use high seed rate of 10-12 kg/ha and thinning out the affected and extra plants at 4 weeks after sowing.</li> <li>• Seed treatment with Imidacloprid @ 4 ml/kg of seed Carbosulfan 50 sp @ 100 g/kg seed.</li> <li>• In heavy infested areas, soil application of carbofuran 3G at 20 kg/ha in seed furrows.</li> </ul> <p><b>2. Stem borer:</b></p> <ul style="list-style-type: none"> <li>• Deep ploughing to expose larval and pupal stages present in the stubbles.</li> <li>• Sowing with the onset of monsoon.</li> <li>• Removal and destruction of dead hearts</li> <li>• Intercropping with the non cereal crop.</li> <li>• Whorl application of Carbofuran 3G @ 10 kg/ha at 25 and 35 days after emergence.</li> </ul> <p><b>3. Corn leaf Aphid :</b></p> <ul style="list-style-type: none"> <li>• Lady bird beetles and horse flies devour Aphids</li> <li>• Spraying of Methyldemeton or Dimethoate @ 2 ml/litre.</li> </ul> <p><b>4. Ear head bug:</b></p> <ul style="list-style-type: none"> <li>• Early sowing minimizes bug damage.</li> <li>• Application of carabaryl 5% Malathion 5D @ 20 kg/ha at pre bloom and again at milk stages.</li> </ul> <p><b>5. Panicle worm :</b></p> <ul style="list-style-type: none"> <li>• Application of Malathion 5D @ 20 kg/ha</li> <li>• Spraying of Monocrotophos 1.6 ml/l.</li> </ul> <p><b>6. Mite:</b></p> <ul style="list-style-type: none"> <li>• Spray Dicofol @ 3 ml/l or Monocrotophos @ 1.6 ml/l.</li> </ul> <p><b>7. Sorghum midge :</b></p> <ul style="list-style-type: none"> <li>• Application of Malathion 5D @ 20 kg/ha at 90 % ear head emergence stage.</li> </ul> <p><b>Diseases:</b></p> <p><b>1. Grain molds:</b></p> <ul style="list-style-type: none"> <li>• Spray Propiconazole (Tilt) @ 0.5 ml/l twice at 50%</li> </ul>

		<p>flowering and 10-15 days later.</p> <p><b>2. Smuts:</b></p> <ul style="list-style-type: none"> <li>• Seed treatment with Thiram @ 3 g/kg seed.</li> </ul> <p><b>3. Ergot:</b></p> <ul style="list-style-type: none"> <li>• Mechanical removal of sclerotia from seeds by washing in 2% salt solution followed by rinsing with plain water before sowing.</li> <li>• Spraying with benlate @ 1 g/l or Propiconazole (Tilt) @ 0.5 ml/l or mancozeb @ 2 g/l at 10% flowering and another spray at 50 % flowering</li> </ul>
9	Irrigation schedule along with critical stages	In irrigated crop, irrigation should be given at sowing, 20-25 days after sowing, ear head emergence / flowering and grain filling stages.
10	Harvesting	In general the maturity duration is 110-115 days
11	Quality characteristics	--
12	Expected yield of the variety / Hybrid	In general the varieties give grain yield of 25 - 30 q/ha and hybrids will give a grain yield of 35-40 q/ha

**Name of the crop: Bajra**

S. No	Operation	Details
1	Varieties along with recommended area	<p><b>Open pollinated varieties (Composites &amp; synthetics):</b> ICMV 221, ICTP 8203, Raj 171</p> <p><b>Hybrids:</b> HHB 67, ICMH 356, RHB 121 and PHB - 3</p> <p>These varieties / hybrids are suitable in all Bajra growing areas of Andhra Pradesh</p>
2	Land preparation	One deep ploughing with mould board plough followed by ploughing with wooden plough twice in summer season. Before sowing, secondary tillage with cultivator to prepare smooth seed bed. Minor land smoothing before sowing helps in better insitu moisture conservation
3	Seed treatment	Treat the seed with Thiram or Captan @ 3 g/kg seed. Soak the seed in 2% (20 g /lit) salt solution for 10 minutes to remove ergot infected seed.
4	Sowing time	<p>Kharif : Complete sowings by 15th July</p> <p>Rabi : September- October</p> <p>Summer : January 15 - February end</p>

5	Seed rate and Spacing	4 kg/ha 45 x 12 - 15 cm Remove excess plants at 15-20 days age of the crop.
6	Fertilizer doses and time of application	<b>FYM: 2-3 t/ha</b> <b>Irrigated conditions:</b> Basal: 40 N + 40 P + 30 K kg/ha Top (30-35 days crop): 40 N kg/ha <b>Rain fed conditions</b> Basal: 30 N + 30 P + 20 K kg/ha Top (30-35 days crop): 30 N kg/ha
7	Weed control (name of chemical and mechanical)	<ul style="list-style-type: none"> <li>• Two manual weedings along with one or two intercultural operations with danti is effective.</li> <li>• Pre emergence application of weedicide Atrazine @ 4 g/lit with in 48 hrs of sowing coupled with one manual weeding and one intercultural operation is also economical.</li> </ul>
8	Major disease and pest control	<p><b>Pests:</b></p> <p><b>1. White grub:</b></p> <ul style="list-style-type: none"> <li>• Apply Phorate @ 12 kg/ha or Carbofuran granules @ 20 kg/ha in seed furrows at the time of sowing.</li> </ul> <p><b>2. Shoot fly:</b></p> <ul style="list-style-type: none"> <li>• Application of carbofuran 3G at 20 kg/ha in seed furrows</li> </ul> <p><b>3. Grey weevil and other leaf feeding and ear head pests:</b></p> <ul style="list-style-type: none"> <li>• Dust Methyl parathion 2% or Fenvalerate 0.4% or Quinolphos 1.5% @ 25 kg/ha</li> </ul> <p><b>Diseases:</b></p> <p><b>1. Downy mildew:</b></p> <ul style="list-style-type: none"> <li>• Treat the seed with Apron SD 35 @ 6 g / kg seed.</li> <li>• Foliar spray of Ridomil 25WP @ 1 g/lit at 21 days after sowing if infection exceeds 5%.</li> <li>• Uproot and burn the infected plants.</li> <li>• Avoid monoculture of particular cultivar.</li> </ul> <p><b>2. Ergot:</b></p> <ul style="list-style-type: none"> <li>• Dip the seeds in 2 % brine solution, stir and remove the floating seeds and sclerotia, dry the seeds lying at the bottom and sow.</li> <li>• Need based spray of Mancozeb (2.5 g/lit) or Carbandazem (1gm/lit) or Ziram @ 2 g/litre at boot leaf and flowering stage.</li> <li>• Plough the field soon after harvest to bury the ergot inoculum</li> </ul>
9	Irrigation schedule along with critical	In irrigated crop, irrigation should be given at sowing, tillering, ear head emergence / flowering and grain filling stages.

	stages	
10	Harvesting	In general the maturity duration is 80-85 days
11	Expected yield of the variety	In general the varieties give grain yield of 20 - 25 q/ha and hybrids will give a grain yield of 30-35 q/ha

**Name of the crop: Ragi**

S. No	Operation	Details
1	Varieties along with recommended area	<p><b>KHARIF:</b></p> <p><b>Short duration (80-90 days):</b> Maruthi and Champavathi</p> <p><b>Medium duration (100-115 days):</b> Saptagiri, Bharathi, Godavari, Srichaitanya and Vakula</p> <p><b>RABI:</b></p> <p><b>Short duration (80-90 days):</b> Maruthi and Champavathi</p> <p><b>Medium duration (100-115 days):</b> Saptagiri, Bharathi, Godavari, Vakula and Hima (White ragi variety suitable for growing in Rabi season)</p> <p>For coastal districts: Bharathi, Srichaitanya, Godavari For Telangana area: Maruthi, Srichaitanya, Godavari For Rayalseema area: Saptagiri, Vakula</p>
2	Land preparation	One deep ploughing with mould board plough followed by ploughing with wooden plough twice in summer season. Before sowing, secondary tillage with cultivator to prepare smooth seed bed. Minor land smoothening before sowing helps in better <i>in situ</i> moisture conservation.
3	Seed treatment	Treat the seed with Carbendazim @ 2 g or Mancozeb @ 3 g/kg seed.
4	Sowing time	<p>Kharif: July- August</p> <p>Rabi: November - December</p> <p>Summer: January - February</p> <p>Spacing:</p>
5	Seed rate and Spacing	5 kg/ha (Raise nursery in 400m <sup>2</sup> ) 22.5 cm X 10 cm
6	Fertilizer doses and time of application	<p>FYM : 2-3 t/ha</p> <p>Basal : 30N + 40P + 30K kg/ha</p> <p>Top (35-40 days crop): 30 N kg/ha</p>
7	Weed control (name of chemical and mechanical)	<ul style="list-style-type: none"> <li>• In line sown crop, 2-3 inter cultivations with one hand weeding.</li> <li>• In broad cast crop, two hand weedings.</li> <li>• In assured rainfall areas:</li> <li>• Spray pendimethalin 30 % (stomp) @ 3 ml/lit as pre emergence weedicide application.</li> </ul>

		<ul style="list-style-type: none"> <li>• 2, 4-D Sodium salt @ 2 g/lit as post emergence weedicide application around 20-25 days after planting.</li> </ul>
8	Major disease and pest control	<p><b>Pests:</b></p> <p><b>1. Army worms and Cut worms:</b></p> <ul style="list-style-type: none"> <li>• Dust Malathion 5% or Phosalone 5% or Quinolphos 1.5% @ 20-25 kg/ha.</li> <li>• Spray chloripyriphos @ 2.5 ml/lit or quinolphos 2 ml/l</li> </ul> <p><b>2. Leaf aphid:</b></p> <ul style="list-style-type: none"> <li>• Spray Dimethoate 2 ml/l</li> </ul> <p><b>3. Stem borers:</b></p> <ul style="list-style-type: none"> <li>• Spray Dimethoate 2 ml/l or Phosphamidon 2 ml/l or Monocrotophos 1.6 ml/l</li> </ul> <p><b>4. Ear head caterpillars:</b></p> <ul style="list-style-type: none"> <li>• Dust Malathion 5% or Phosalone 5% or Quinolphos 1.5% @ 20-25 kg/ha. Spray chloropyrophas @ 2ml/L</li> </ul> <p><b>Diseases:</b></p> <p><b>1. Blast:</b></p> <ul style="list-style-type: none"> <li>• Treat the seed with Carbendazim @ 2g / kg seed</li> <li>• If necessary spray the nursery with Carbendazim 1g/l, or Kitazin 2 ml/l or Saaf 2.5 g/l</li> <li>• Spray any of the above fungicides at 50% flowering and repeat 10 days later to control neck/ finger blast.</li> </ul> <p><b>2. Brown leaf spot :</b></p> <ul style="list-style-type: none"> <li>• Damage could be severe if the crop is subjected to drought or nutrition deficiency. The disease can be effectively managed by proper nutrition and water management.</li> <li>• Need based spray of Mancozeb or Saaf 2.5 g/l</li> </ul> <p><b>3. leaf blight:</b></p> <ul style="list-style-type: none"> <li>• Seed treatment with captan or thiram @ 3g/l</li> <li>• Spray mancozeb @ 2.5 g/l</li> </ul>
9	Irrigation schedule along with critical stages	In irrigated crop, irrigation should be given at 3 days after transplanting, tillering, ear head emergence / flowering and grain filling stages.
10	Harvesting	For short duration varieties : 80-90 days For medium duration varieties: 110 - 115 days For long duration varieties: 120-130 days
11	Quality characteristics	--
12	Expected yield of the variety	In general the varieties give grain yield of 25 - 35 q/ha

**Name of the crop: Korra**

S. No	Operation	Details
1	Varieties along with recommended area	<b>KHARIF AND RABI</b> Prasad, Krishnadevaraya, Narasimharaya, Srilakshmi, Suryanandi, SiA 3085 and SiA 3156 These varieties are recommended for Andhra Pradesh korra growing areas
2	Land preparation	One deep ploughing with mould board plough followed by ploughing with wooden plough twice in summer season. Before sowing, secondary tillage with cultivator to prepare smooth seed bed. Minor land smoothing before sowing helps in better insitu moisture conservation.
3	Seed treatment	Treat the seed with Carbendazim @ 2g / kg seed
4	Sowing time	Kharif: July- August Rabi: December - January Spacing:
5	Seed rate and Spacing	5 kg/ha for line sowing 10 kg/ha for broad casting Line sowing : 25 x 10cm
6	Fertilizer doses and time of application	FYM : 5 t/ha Basal : 20N + 30P + 0K kg/ha Top (30 days crop) : 20 N kg/ha
7	Weed control (name of chemical and mechanical)	In line sown crop, 2-3 inter cultivations with one hand weeding. In broad cast crop, two hand weedings.
8	Major disease and pest control	<b>PESTS:</b> <b>Army worms, Cut worms and Leaf scraping beetles:</b> Need based dust application of Malathion 5% @ 20 -25 kg/ha. Spray chloripyriphos 2.5 ml or quinolphos 2 ml/l <b>DISEASES:</b> <b>1. Blast, Brown spot and Rust:</b> If these diseases appear at the early stages of the crop, spray Mancozeb 2.5 g/l. <b>2. Grain smut:</b> Seed treatment with Carbendazim @ 2 g/ kg seed. <b>3. Downy mildew:</b> Seed treatment with Ridomil MZ @ 2 g/l or metalaxyl @ 3 g/Kg seed. Roguing out and destroying the affected plants. Spray 1g/l metalaxyl or 2.5 g/l mancozeb.
9	Irrigation schedule along with critical stages	In irrigated crop, irrigation should be given after sowing, tillering, ear head emergence / flowering and grain filling stages.
10	Harvesting	For early duration varieties: 70-75 days For medium duration varieties: 80-85 days
11	Quality characteristics	--
12	Expected yield of the variety	In general these varieties gives grain yield of 25 - 30 q/ha

## Name of the crop: Sama

S. No	Operation	Details
1	Varieties along with recommended area	<b>KHARIF</b> OLM 20, OLM 36, OLM 203 and Co 2 These varieties can be grown in Andhra Pradesh
2	Land preparation	One deep ploughing with mould board plough followed by ploughing with wooden plough twice in summer season. Before sowing, secondary tillage with cultivator to prepare smooth seed bed. Minor land smoothing before sowing helps in better <i>in situ</i> moisture conservation.
3	Seed treatment	Treat the seed with Carbendazim @ 2g / kg seed
4	Sowing time	Kharif: June - July
5	Seed rate and Spacing	8 kg/ha 25 cm X 10 cm
6	Fertilizer doses and time of application	FYM: 5 t/ha 20:20:20 NPK kg/ha - Basal
7	Weed control (name of chemical and mechanical)	In line sown crops- 2-3 inter cultivations with one hand weeding. In broad cast crop- Two hand weedings.
8	Major disease and pest control	<b>PESTS:</b> <b>Shoot fly:</b> Early sowing; Reduce Nitrogen by 50 % and replace FYM or bio fertilizers. <b>DISEASES:</b> <b>Grain smut:</b> Seed treatment with carbendazim @ 2 g/kg seed
9	Irrigation schedule along with critical stages	In irrigated crop, irrigation should be given at tillering, ear head emergence / flowering and grain filling stages.
10	Harvesting	In general the maturity duration is 100-105 days
11	Quality characteristics	--
12	Expected yield of the variety	In general these varieties gives grain yield of 10 - 15 q/ha

## Maize (*Zea mays L.*)

Maize is the most widely distributed cereal crop of India after rice and wheat. Of late, the economic importance of maize crop has been increasing because of its diversified agrobased industrial uses apart from its food, feed and fodder value. In Andhra Pradesh, maize is grown in an area of 2.36 lakh ha with a production of 15.64 lakh tons and productivity of 6629 kg/ha (2012-13). The following package of practices has to be adopted to achieve higher yields during *Kharif* and *Rabi*.

**Soils:** Red sandy loams to medium black soils with good drainage facilities are preferable. Maize does not come up well in saline, alkaline and waterlogged soils. The optimum pH range should be 6.5 to 7.5.

### ***Time of sowing:***

**Kharif:** June 15<sup>th</sup> to July 15<sup>th</sup>. In case of delayed monsoon, sowings may be extended up to first week of August using short duration hybrids under assured irrigation facilities.

**Rabi: Normal sowing:** October 15<sup>th</sup> to November 15<sup>th</sup>. **Rice-Fallows:** December-January 1<sup>st</sup> week

**Seed treatment:** Seed treatment with Captan or Thiram or Mancozeb @ 3 g/kg of seed. In case of downy mildew Metalaxyl 4 g/kg of seed.

**Seed rate:** 8 kg per acre for normal hybrids, 3-4 kg per acre for sweet corn, 5 kg per acre for popcorn and 10 kg per acre for baby corn.

**Spacing:** 60 cm between rows and 20 cm between plants which gives an optimum plant population of 33,333 plants per acre for all the hybrids and speciality corns except baby corn (45 x 20 cm).

**Method of sowing:** Sowing one side of ridge at a distance of 1/3<sup>rd</sup> from top facilitates irrigation as well as drainage. Excess seedlings should be thinned 10 days after emergence to have single seedling per hill.

### ***Fertilizers***

*For Kharif crop, a dose of 72-80 kg N, 24 kg P<sub>2</sub>O<sub>5</sub>, 20 kg K<sub>2</sub>O per acre is recommended. Nitrogen may be applied in three splits i.e., at sowing, knee high stage and at flowering stages.*

*For Rabi crop, 80-100 kg N, 32 kg P<sub>2</sub>O<sub>5</sub>, 32 kg K<sub>2</sub>O per acre is recommended. Nitrogen may be applied in four splits viz., at sowing, knee high stage (30-35 DAS), at flag leaf emergence (50-55 DAS) and at tasseling-silking stage (60-65 DAS).*

In both seasons, 20 kg of commercial zinc sulphate per acre may be applied if soils are known to be deficient in available zinc. If symptoms appear later, the crop can be sprayed with 2 g/l solution of zinc sulphate.



### **Weeding**

Pre-emergence spraying with Atrazine 50 W.P. @ 800 -1200 g/ac depending on soil type and at 30 days after sowing, spraying of 2,4-D Sodium salt 80 WP @ 500 g/ac in 200 litres of water will control most of the broad leaved weeds effectively. After 30-35 days, crop may be inter-cultivated and earthing up should be done. Atrazine is recommended when maize is grown as a pure crop only.

### **Irrigation**

Though the crop is grown under rainfed conditions, if drought occurs during flowering stage, irrigation helps to give good yields. When the crop is in initial stages, provide proper drainage facilities to drain out excess water in case of heavy down pour.

Four to six irrigations are needed during the *Rabi* season. If six irrigations are given, they should be applied at the following crop growth stages. Two irrigations up to flowering at an interval of 20-25 days, one at the time of flowering, two after flowering and one at the early grain filling stage. If five irrigations are given, one irrigation at the vegetative stage may be avoided and if only four irrigations are given, one irrigation after the dough stage may be avoided. The irrigation schedule may however be changed suitably based on the soil conditions

### **Plant protection**

**a) Pests:** The stem borer, *Chilo partellus* infests the crop during *Kharif* and pink borer *Sesamia inferens* infests during *rabi* season. The borers cause dead hearts in early stage of crop. The pest incidence is recognized by the presence of shot-holes in the leaf blades as well as exit-holes on the stem. To control the pest, prophylactic spraying of Monocrotophos 36 SC @ 1.6 ml/l or Coragen 0.3 ml/l when the crop is 10-12 days old and or application of Carbofuran 3 G in leaf whorls @ 3 kg/ac is recommended when the crop is 25-30 days old.

### **b) Diseases:**

The important diseases of maize are leaf blight (*Exserohilum turcicum*), late wilt (*Cephalosporium maydis*) and charcoal rot (*Macrophomina phaseolina*). One to two sprayings of Mancozeb @ 2.5 g/l at 7-10 days interval starting from knee high stage of the crop controls the leaf blight. Banded leaf and sheath blight is observed in some of the districts and when the symptoms are noticed, stripping of the affected bottom 2-3 leaves along with their sheath and spraying of Propiconazole @ 1 ml/l is recommended. For late wilt & charcoal rot - crop rotation, removing plant debris, summer ploughing, avoiding moisture stress after flowering and growing tolerant hybrids should be followed. For downy mildew disease spray Metalaxyl @ 2 g/l of water.

### **Recommended hybrids/variety**

#### **Hybrids:**

**Long duration** (100-120 days): DHM 113, 900 M Gold, Bio 9681, Pro-311, 30 B 07, NK30, NK 6240, SMH 3904, MCH 36, JKMH 2492 and Bisco 97 Gold.

**Medium duration** (90-100 days): DHM 111, DHM 117, DHM-119, KH 510, Bio 9637, KH 9541, MCH 2, Kohinoor, Prabhal, Bisco 855, KMH 25K60 and JKMH 175, Bio 9544, NMH 1242, NSCH 12, S 6217.

**Short duration** (<90 days): DHM 115, Prakash, KH 5991, JKMH 1701, DKC 7074 R, MMH 133, Pioneer 3342, Bio 605, Sun Vaman and Vivek Maize Hybrid 45.

### **Speciality corn**

#### **Hybrids**

Sweet corn: Sugar 75, Bright Gene

Popcorn: BPCH 6

Baby corn: HM 4, PEH-1, PEH-2, DHM 115

Quality protein: Amber Shakti, HQPM-1, HQPM-4, HQPM-5, HQPM-7, Vivek QPM 9

Varieties:

Sweet corn: Madhuri, Priya, Win Orange, Almora sweet corn.

Popcorn : Amber popcorn, Pearl popcorn, VL popcorn

Baby corn: VL 42, Him 123, Him 128, Him 129, Madhuri, Prakash, VL78,  
VL Baby corn 1

#### **Critical interventions:**

- Maintaining optimum plant population of 33,333 plants/acre
- Plant protection measures against stem borer within 10-12 days after germination
- Keeping the crop weed free up to 45 days
- Top dressing of urea coinciding with the rains in *Kharif*
- Irrigation at silking, milky and dough stages

#### **Zero tillage maize**

- ✚ No preparatory tillage
- ✚ Dibble the seed after harvesting *Kharif* rice at 2-3 cm depth, in optimum moisture, or else, give light irrigation before dibbling depending on the soil type.
- ✚ Practice Line-sowing by adopting a spacing of 60x20 cm
- ✚ Spray Gramoxone 1.0 l/acre (5 ml /l) to prevent the regrowth of rice stubbles
- ✚ Spray Atrazine 800g - 1.2 kg/acre (4 g/l) immediately after sowing or next day to prevent broad leaved weeds
- ✚ Combination of Gramoxone 1.0 l/ac and Atrazine 1.0 kg/ac can also be used for controlling regrowth of rice stubbles and broad-leaved weeds.
- ✚ Ensure proper moisture at the time of spraying herbicide
- ✚ A recommended dose of 100-32-32 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O per acre is applied. Entire Phosphorous as basal, nitrogen in four splits *viz.*, at sowing, knee high stage (30-35 DAS), at flag leaf emergence (50-55 DAS) and at tasseling-silking stage (60-65 DAS) and potassium in two splits *i.e.*, basal and flowering stage.
- ✚ The fertilizers should be applied through placement method for better utilization of nutrients.
- ✚ Provide 5-6 irrigations based on the soil type and climatic conditions
- ✚ Adopt need based plant protection measures like normal maize.

## OILSEED CROPS

### 1. SUNFLOWER

Sunflower by virtue of its photo insensitive nature is ideally suited for successful cultivation in different seasons. Although, sunflower has emerged as an important oilseed crop under contingency planning, choice of appropriate cultivars and crop management practices have to be scrupulously followed to achieve maximum productivity.

**1. Soils:** Sunflower can be grown on almost all soil types viz., red, black and alluvial soils. It grows best in deep, well drained and fertile soils. Low lying, coastal soils with water stagnation and acidic soils are not suitable for sunflower cultivation. The ideal pH is around 6.5-8.0. Sunflower can tolerate moderate levels of salinity.

#### 2. Recommended varieties/hybrids:

S. No.	Variety/ Hybrid	Duration (Days)	Yield (Kg/ac) under rainfed conditions	Oil Content (%)	Plant Height (Cm)	Special Characters
1	Morden	80-85	300-400	35-38	90-120	Suitable for intercropping
2	DRSF-108	90-95	400-500	38-42	150-160	
3	KBSH-1	90-95	500-600	42-44		
4	NDSH-1	80-85	500-600	40-42	120-130	Resistant to downy mildew, tolerant to rust and moisture stress
5	DRSH-1	90-95	500-600	42-44	150-160	Resistant to Downy mildew, tolerant to Alternaria.
6.	APSH-66	90-95	700-800	42-44	160	Tolerant to Alternaria

**3. Time of sowing:** In light soils sowing can be done from second fortnight of June to first fortnight of July, while in heavy soils second fortnight of August is recommended. For rabi, crop can sown from 2<sup>nd</sup> FN of October to 1<sup>st</sup> FN of November.

**4. Seed rate and spacing:** Rain fed crop requires more seed (3-4 kg /ac for varieties and 2-2.5 kg for hybrids) than irrigated (2.5-3.5 and 2 kg/ac, respectively, for varieties and hybrids). Seed should be soaked for 14 hrs and shade dried prior to seed treatment with 2-3 g Thiram/Captan/ Metalaxyl or 5g Imidacloprid. Spacing of 45 x 20 cm in light soil, 45 x 30 cm in medium soil & 60 x 30 cm in heavy soils is recommended.

**5. Nutritional Management:** Basal application of 3 t of FYM, 16-24-12 Kg N: P<sub>2</sub>O<sub>5</sub> K<sub>2</sub>O/ha and top-dress 6 kg N at 30 DAS and 50 DAS for rainfed crop. For hybrids in black soils with irrigation, 30N-36P<sub>2</sub>O<sub>5</sub>-12K<sub>2</sub>O dose is recommended.

**6. Water management:** The critical stages for irrigation in sunflower are bud initiation flower opening and seed filling. During *Kharif*, irrigations can be given based on soil type i.e. 1-2, 2-3 and 3-4 for heavy, medium and light soils, respectively.

**7. Intercultivation:** Thinning should be done at 10-15 DAS and harrowing at 20-25 DAS.

## **8. Plant protection:**

### **8.1. Insects:**

#### 8.1.1. Sucking pests:

Spray Dimethoate/ Methyl Dematon (2 ml) or Monocrotophos (1.6 ml)/l for the control of Jassids. For white fly control, spray Triazophos(2.5 ml)/ Monocrotophos (1.5 ml)/ Acephate (1 g)/l. To control mites which transmit necrosis, spray Imidacloprid (6 ml/ 15 l)/ Monocrotophos (1.6 ml/l).

#### 8.1.2. *Spodoptera*:

- \* Deep summer ploughing
- \* Collection and destruction of egg masses and larvae.
- \* In early stages spray Neem oil (5 ml/l) or Monocrotophos (2.0 ml/l) or Chlorpyrifos (2.5 ml/l) or Acephate 1.5 g/lit or Profenophos 2 ml/lit.
- \* Poison baits (5 kg rice bran + 500 g Jaggery + 500 ml Monocrotophos/500 g Carbaryl or 500 ml Chlorpyrifos).

#### 8.1.3. Bihar hairy caterpillar:

- \* Spray neem oil (5ml)/Chlorpyrifos (2 ml)/Dichlorvos/ Methyl parathion (1 ml) per l.

8.1.4. *Heliothis*: Spray HNPV (200 LE) or Chlorpyrifos/Quinolphos (2 ml) or Monocrotophos (1.6 ml) or Cypermethrin/Deltamethrin/Fenvalrate/Methyl parathion (1 ml)/l or Novaluron 1 ml/lit or Spinosad 0.3 ml/lit or Indoxacarb 1 ml/lit.

### **8.2. Diseases:**

#### 8.2.1. Alternaria/rust:

- \* Treat the seed with Thiram or Captan @ 3 g/kg.
- \* Spray Mancozeb or Zeneb 2 g/l.
- \* Removal and destruction of affected plants.

8.2.2. Head Rot: Spray Metalaxyl (1g) + 3g Wettable Sulphur/l twice with 10 days interval.

#### 8.2.3. Downy mildew:

- \* Remove infected spikes and destroy.
- \* Spray Metalaxyl MZ (2g) or Copper oxy chloride (3 g)/l.

8.3. Parrots: Bird scaring with reflecting ribbons.

## **9. Harvesting and storage:**

Harvest when back side of the head turns yellow. Thresh after drying for 2-3 days and store the seed with 9-10% moisture.

## 2. SESAME

1. **Soils:** Low lying soils with water stagnation, acidic and saline soils are not suitable.

2. **Recommended varieties/hybrids:**

S. No.	Variety	Duration (Days)	Yield (Kg/ac)	Oil Content (%)	Seed colour	Special Characters
1.	Gouri	90	200	50	Dark brown	Tolerant to gall fly
2.	Madhavi	70-75	200	50-51	„	Suitable for sequence cropping
3.	YLM-11	80-85	250	52	„	Matures at a time
4.	YLM-17	75-80	200	51	„	Tolerant to powdery mildew
5.	Chandana	85	200	50-51	Dark brown	Tolerant to phyllody
6.	YLM-66	80-85	300	50	Dark brown	High yielding and tolerant to leaf spot disease

3. **Sowing Season:** May- June (Kharif), 1<sup>st</sup> FN of January-1<sup>st</sup> FN February

4. **Seed Rate and Sowing:** Treat one-kilogram seed with 3 g Captan/ Thiram/ Mancozeb. Sow 2-4 kg/ac after 2-4 ploughings and leveling with 2 harrowings adopting 30x15 cm spacing.

5. **Nutritional Management:** Basal application of 4 t of FYM, 16-8-8 Kg N:P<sub>2</sub>O<sub>5</sub> K<sub>2</sub>O/ha and top dress 6 kg N 30-35 DAS and 60-65 DAS.

6. **Intercultivation:** Thinning should be done 15 DAS and harrowing at 20-25 DAS.

7. **Plant protection:**

7.1. Insects:

7.1.1. Sucking pests: Spray Dimethoate (2 ml) or Monocrotophos (1.6 ml)/l.

7.1.2. Semilooper and pod borer: Spray Monocrotophos (1.6 ml)/Chlorpyrifos (2.5 ml)/l.

7.1.3. Gallfly: Spray Monocrotophos (1.6 ml) or Dimethoate (2 ml)/l.

7.1.4. Bihar hairy caterpillar:

\* Spray Chlorpyrifos (2.5 ml)/Acephate (1.5 g) per l.

7.2. Diseases:

7.2.1. Root and stem rot:

\* Treat the seed with Thiram or Captan or Carbendazim @ 3 g/kg.

\* Spray Copper oxy chloride or Mancozeb 3 g/l.

\* Removal and destruction of affected plants.

7.2.2. Alternaria:

\* Remove infected parts and destroy.

\* Spray 1g Carbendazim/ Mancozeb 2.5 g/l 2-3 times with 15 days interval.

7.2.3. Phyllody:

\* Remove infected parts and destroy.

\* Spray 1ml Methyl Dematon or Dimethoate 3 ml/l.

7.2.4. Powdery Mildew: Spray Wettable Sulphur 3 g/l.

8. **Harvesting and storage:**

Harvest when 75% pods turn yellow in a spike. Thresh after drying for 5-6 days and store the seed with 8% moisture.

### 3. CASTOR

**1. Soils:** Castor can be grown on all types of soils having good drainage. Salinity and soils with water stagnation are not suitable.

**2. Recommended varieties/hybrids:**

S. No.	Variety / Hybrid	Duration (Days)	Yield (q/ac)	Special Characters
1.	Kranthi	90-150	5.50-6.50	Bold seed, early maturing and tolerant to drought
2.	Haritha	90-180	5.50-6.50	Resistant to wilt
3.	Kiran	90-150	5.00-6.00	Tolerant to drought and to grey rot due to non spiny capsules
4.	Jyothi	90-150	5.00-6.00	Drought tolerant
5.	Jwala	90-180	4.00-5.00	Tolerant to wilt and grey rot
6.	PCH-111	90-180	7.00-8.00	High yielding and wilt resistant hybrid
7.	GCH-4	90-180	5.50-7.00	Tolerant to wilt and root rot
8.	DCH-32	90-180	5.50-7.00	
9.	DCH-177	90-180	6.00-7.50	Resistant to wilt and tolerant to drought
10.	PCH-222	90-180	7.0-8.0	Resistant to wilt

**3. Sowing Season:** 15<sup>th</sup> June to end of July (Kharif), October 1<sup>st</sup> FN (Rabi)

**4. Seed Rate and Sowing:**

Situation	Seed rate (kg/ac)*	Spacing (cm)*
Heavy soils, high rain fall	2-2.5/1.5-2.0	90 x 60/ 90 x 90 or 75 x 75
Light soils, low rain fall	4/2-3	90 x 30 or 90 x 45/90 x 60
Late sowing	4-5/4-5	60 x 45/60 x 60

\* Varieties/hybrids

Treat one-kilogram seed with 3 g Captan/ Thiram or 1 g Carbendazim.

**5. Nutritional Management:** Basal application of 2 t of FYM, 12-16-12 Kg N:P<sub>2</sub>O<sub>5</sub> K<sub>2</sub>O/ha and top dress 6 kg N 30-35 DAS and 60-65 DAS. For hybrids additional dose of 6 kg N as at 90-95 DAS can be given.

**6. Intercultivation:** Thinning should be done 15-20 DAS and harrowing at 20 and 40 DAS.

**7. Plant protection:**

**7.1. Insects:**

7.1.2. Semilooper:

- \* In early stages spray neem oil (5 ml/l) or NSKE (5%) twice with an interval of 10-15 days.
- \* Collection and destruction of larvae.
- \* Release 50, 000 Trichogramma/ac.
- \* Arrange 10 bird perches /ac.
- \* Spray Monocrotophos (1.5 ml)/ Carbaryl (3 g)/l.

7.1.3. Spodoptera:

- \* Deep summer ploughing
- \* Collection and destruction of egg masses and larvae.
- \* In early stages spray Neem oil (5 ml/l) or Monocrotophos (2.0 ml/l) or Chlorpyriphos (2.5 ml/l) or Acephate 1.5 g/lit or Profenophos 2 ml/lit.
- \* Poison baits (5 kg rice bran + 500 g Jaggery + 500ml Monocrotophos/500 g Carbaryl or 500 ml Chlorpyriphos).

#### 7.1.4. Shoot and capsule borer:

- \* Spray Dimethoate/ Methyl-o-dematon/Monocrotophos (2 ml/l) or Acephate 1.5 g/lit or Indoxacarb 1 ml/lit at flowering stage and 20 days later.

#### 7.1.5. Bihar hairy caterpillar:

- \* Spray neem oil (5 ml)/Chlorpyriphos (2 ml)/Dichlorvos (1 ml) per l.

#### 7.1.6. Jassids:

- \* Spray Dimethoate (2 ml)/ Monocrotophos (1.5 ml/l) per l.

### **7.2. Diseases:**

#### 7.2.1. Fusarium Wilt:

- \* Use tolerant varieties like Haritha, 48-1, PCH-111, PCH 222, DCH 177, DCH 519
- \* Treat the seed with Thiram or Carbendazim @ 3 g/kg.
- \* Intercropping with Redgram and crop rotation with Bajra.
- \* Spray Carbendazim 1 g/l.
- \* Removal and destruction of affected plants.

#### 7.2.2. Botrytis Grey Rot:

- \* Soon after cyclone warning is given in Radio/T.V., spray Carbendazim (1.0 g/l).
- \* Remove infected spikes and destroy.
- \* Spray Carbendazim after the rains.
- \* Apply 20 kg urea and 10 kg potash/ac.

### **8. Harvesting and storage:**

Harvest when 80% capsules turn yellow in a spike. Thresh after drying and store the seed with 9-10% moisture.

## COTTON

Desi Cotton Varieties ( <i>G.arboreum.L</i> )	: Aravinda, Srinandi (NDLA-2463), Yaganti (NDLA-2933) and Veena (MDL-1875)
Americian Cotton Varieties ( <i>G. hirsutum L.</i> )	: Kanchana (LPS 141), LK-861, L-389, L- 603, L-604, Narasimha (NA-1325), Sivanandi (NDLH-1755), MCU5 VT, LRA-5166 and LRK-516.
Intra-specific Cotton Varieties / Hybrids 7, Krishna	: LAHH-1, LAHH-4, LAHH-5, Lam Cotton Hybrid- NDLHH-390, NDLHH-240 and Orugallu (WGHH-2), NHH-44, JKHy 1, Savitha, H-6, H-8 and H-10.
Egyption Cotton Varieties / Inter-specific Cotton Hybrids	: Suvin & Jayalakshmi (DCH-32)
Bt. Cotton Hybrids being	: Officially identified private Bt cotton hybrids cultivated and found suitable for the last 3-4 years.
Soils	: Deep black Cotton and Red fertile soils with irrigated or assured rainfall conditions.

### Land Preparation

For rainfed cotton, deep ploughing once in 3 years with mould board plough or disc harrow facilitates deep infiltration of water and charging of soil profile with large quantities of water. The land has to be ploughed 2 to 3 times and work with harrow to bring the soil to good tilth. Seeds can be dibbled by maintaining spacing in between plants after running a marker in one or two direction(s). For irrigated crop, ridges and furrows are to be formed at recommended spacings after deep ploughing.

### Seed Rate

Americian Cotton Varieties ( <i>G.hirsutum.L</i> )	:	2 kg / acre
Desi Cotton Varieties ( <i>G.arboreum.L</i> and <i>G.herbaceum.L</i> )	:	4-5 kg / acre
Intra-/Inter-specific Cotton Hybrids	:	0.75-1 kg / acre

### Seed Treatment :

For acid delinting, seed should be treated with 80-100 ml H<sub>2</sub> SO<sub>4</sub> per kg of seed for 2-3 minutes followed by lime solution and thorough washing with water 2-3 times to make the seed acid free. Seed treatment with appropriate insecticide(s); imidacloprid 70 WS @ 5 g / kg or thiomethoxam 70 WS @ 4 g / kg or imidacloprid 48 FS@ 9ml/kg or carbosulfan 25 DS @ 40 g/kg of seed. followed by, treatment with *Pseudomonas fluorescens* @ 10 g / kg or



*Trichoderma viride* or *T. harzianum* @ 10 g / kg or carbendazim 50 WP @ 2 g / kg or mancozeb 75 WP @ 3 g / kg or captan 50 WP 3 g / kg or thiram 75 WP @ 3 g / kg.

### **Spacing**

Desi Cotton Varieties (cm)	:	60 x 30
American Cotton Varieties (cm)	:	90 x 60 or 105 x 60
Conventional Hybrids (cm)	:	90 x 60 or 120 x 60
Bt. Cotton Hybrids (cm)	:	90 x 45 or 90 x 60 or 120 x 45 or 120 x 60

### **Sowing with Cut-off dates**

Red soils	:	June - July
Black soils	:	July - 1 <sup>st</sup> Fortnight of August

### **Inter Cropping:**

Inter cropping with mungbean / urdbean / soybean / cluster bean in 1:2 or 1:3 ratio, and pigeonpea 4:1 or 6:1 or 8:1 ratio.

### **Gap filling and Thinning:**

Gap filling should be done preferably within 10 DAS. Thinning should be done within three weeks after sowing retaining two plants per hill in case of varieties, one plant per hill in case of hybrids.

### **Manures and Fertilizers:**

Apply FYM @ 4 t / acre (10 cart loads) besides the recommended fertilizers.

### **For Desi Cotton Varieties:**

8 N + 8 P<sub>2</sub>O<sub>5</sub> kg/acre. Entire P as basal. N is in two splits at 30 DAS and 60 DAS by pocketing method.

### **For American Cotton Varieties:**

36 N + 18 P<sub>2</sub>O<sub>5</sub> + 18 K<sub>2</sub>O kg/acre. Entire P as basal, N and K in three splits 30, 60 and 90 DAS by pocketing method.

### **For Conventinol Cotton Hybrids:**

48 N + 24 P<sub>2</sub>O<sub>5</sub>, 24 K<sub>2</sub>O kg/acre. Entire P as basal, N and K in three splits 30, 60, 90 DAS by pocketing method.

### **For Bt Cotton Hybrids:**

25% excess N over recommended N should be applied. The recommended N and K should be given in 3-4 splits at 20 days interval starting from 20 DAS. Foliar application of 2% urea/ 2% DAP/ 2% KNO<sub>3</sub> at flowering and boll development stages.

For correcting magnesium, boron and zinc deficiencies, foliar application of MgSO<sub>4</sub> @ 1% twice at 45 and 75 DAS; Boron @ 0.15% twice at 60 and 90 DAS; and ZnSO<sub>4</sub> @ 0.2% twice at 4-5 days interval at 45 DAS is recommended. For correcting iron deficiency due to heavy moisture stress in early crop growth stage, foliar application of 0.5% FeSO<sub>4</sub> along with citric acid should be done twice at weekly interval.

## Weed Management:

Spray pendimethalin @ 1.5 to 2.0 l/acre immediately or within 48 hours of sowing. Inter cultivation with tined harrow and blade harrow 2-3 times upto 90 DAS. For control of grasses and broad leaved weeds post emergence spray of quizalofopethyl @ 400 ml/acre and pyriithiobac sodium @ 250 ml / acre is recommended at 25-30 DAS. Post emergence directed spray of parquat @ 5.0 ml/l of water or glyphosate 10.0 ml + 10.0 g of urea or ammonium sulphate/l of water is recommended for control of the weeds in the cotton crop, where inter-cultivation or manual weeding is not possible due to unfavourable weather conditions.

**Irrigation:** Generally cotton crop requires 2-4 irrigations depending upon the soil type.

## Pest Management in Cotton

### Management of Sucking Pests in cotton:

1. Grow sucking pest tolerant / resistant varieties / hybrids.
2. Seed treatment with imidacloprid 70 WS 5.0 g /kg or thiamethoxam 70 WS 4.0 g / kg or imidacloprid 48 FS @ 9.0 ml/kg or carbosulfan 25 DS @ 40.0 g/kg of seed, gives early protection against sucking pests.
3. Growing of intercrops like mungbean or urdbean or soybean or cluster bean in 1:2 or 1:3 ratio will facilitate the buildup of native natural enemy populations that in turn keep sucking pests under check
4. Growing of cowpea as bund crop is advantageous to encourage predacious insects like coccinellids, syrphids and chrysopids
5. Maize or sorghum or pearl millet grown as barrier crops in the border prevents spread from neighbouring fields.
6. Stem application at 30 & 45 DAS with monocrotophos (1:4) and at 60 DAS with imidacloprid (1:20) for protecting the crop from early season sucking pests is highly effective.
7. Setting up of yellow sticky traps @ 10 per acre for monitoring whitefly incidence.
8. Economic Threshold Level (ETL) for sucking pests on cotton is presented hereunder :

Name of the Pest	ETL
Jassids	Two adults or nymphs per leaf or appearance of second grade injury (yellowing in the margins of the leaves)
Thrips	10 adults per leaf
Aphids	15% affected plants
Whiteflies	6-8 adults per leaf
Mealy bugs	5% affected plants
Mites	10 per cm <sup>-1</sup>

## 9. ETL based application of insecticides

Leafhoppers / aphids / thrips	- Monocrotophos 36 SL @ 1.6 ml/l or Acephate 75 SP @ 1.5g/l or Imidacloprid 17.8 SL @ 0.4 ml/l or Acetamiprid 20 SP @ 0.2 g/l or Thiamethoxam 25 WG @ 0.2 g/l or Fipronil 5 SC @ 2.0 ml/l Diafenthiuran 50 WP @ 1.25 g/l Flonicamid 50 WG @ 0.3 g/l
Whitefly	- Triazophos 40 EC @ 2.0 ml/l or Profenophos 50 EC @ 2.0 ml/l or Diafenthiuron 50% WP @ 1.25 g/l or NSKE @ 5% (extract from 10.0 kg of Neem Powder/acre)
Red mite	- Wettable sulphur 80 WP @ 3.0 g/l or Dicofol 18.5 SC @ 5.0 ml/l

### Insecticide Resistance Management Strategies to manage cotton pests in Bt-cotton

#### Early Sucking Pest Window 1: 0-60 DAS: No foliar spray upto 60 DAS.

- Cultivation of sucking pest tolerant varieties / hybrids
- Use dual gene cotton hybrids such as Bollgard II (Cry I Ac + Cry 2 Ab)
- Raising densely planted border rows of maize / sorghum / pearl millet / pigeonpea
- Mechanical control of *Parthenium* and *Abutilon* weeds to avoid build up of initial mealy bug inoculum.
- Stem application of monocrotophos at 30 and 45, and imidachloprid at 60 DAS.
- Neem oil sprays @ 1.0 l/acre + detergent powder @ 1.0 g or sandovit @ 0.5 ml or Teepol 0.5 ml/lt. for the control of whitefly.

#### Window 2: 60-90 DAS : Initial boll worm infestation. Mostly eggs and young larvae: Biological and bio-pesticide window.

- Hand picking of *Helicoverpa* and *Spodoptera* larvae, and egg masses of *Spodoptera*.
- One spray of novaluron @ 1.0 ml/lt or lufenuron @ 1.25ml/lt for the control of *Spodoptera* on need basis only.
- Installation of yellow sticky traps @ 10.0 / acre for monitoring of the whitefly.
- Application of 5% NSKE for bollworm and whitefly infestation.
- No spray against minor lepidopteran pests.

- Follow Integrated Nutrient Management practices including foliar spray of nutrients to reduce leaf reddening.
- Neonicotinoids like imidacloprid or acetamiprid or thiomethaxam for the control of sucking pests.
- Spinosad or emamectin benzoate only on non-Bt cotton.

### **Window 3: 90-120 DAS: Peak Boll worm infestation.**

- One application of chlorpyrifos or quinalphos or thiodicarb or spinosad on conventional or Bt-cotton plants showing flared up squares.
- Poison bait (10 kg rice bran +2.0 kg jaggery + chlorpyrifos 500-700 ml or thiodicarb 250-300 g) for the control of grown up larvae of *spodoptera*.

### **Window 4: >120 DAS : Boll worms & Mealy bugs.**

- In case of minimum infestation of mealy bug, uprooting and destroying of infested plants.
- Surrounding weeds especially, *Parthenium* are sprayed with chlorpyrifos and destroyed subsequently.
- In severe mealy bug infestation drenching the affected stems with malathion @ 2.0 ml/l or buprofezin @ 2.0 ml/l or acephate @ 2.0 g/l along with sticky agents.
- Insecticides like chlorpyrifos, quinalphos, profenophos, carbaryl are used in case of severe economic damage due to mealy bug.
- Need based use of insecticides: Spraying of persistent insecticides like thiodicarb 75 WP @ 1.5 g/l or quinalphos 25 EC @ 2.5 ml/l or chlorpyrifos 20 EC @ 2.5 ml/l at 15 days interval.
- Hand picking of surviving bollworm larvae from Bt-cotton fields and destruction of residual pupae by deep ploughing immediately after harvest.

### **Integrated Pest Management in Cotton:**

1. Avoid monocropping of cotton.
2. Application of chemical fertilizer as supplement to organic or biological fertilizers as per the recommended doses.
3. Growing intercrops/strip crops/barrier crops with greengram, blackgram, soybean cowpea, clusterbean, groundnut, foxtail millet and coriander were found better intercrops in increasing the effectiveness of natural enemies like coccinellids, syrphids, chrysopids, spiders, *Trichogrammids*, *Apanteles* etc. Growing fodder sorghum or maize as barrier crops and castor as ovipositional trap crop with in the cotton was also found to be more advantageous to manage the pests of cotton.
4. Seed treatment with recommended insecticides and fungicides.
5. Stem application of Monocrotophos at 30 and 45, and imidacloprid at 60 DAS.

6. Monitoring pests by using light, sticky and pheromone traps. The adults monitoring should be supported by egg and larval monitoring following sequential sampling technique at frequent intervals in case of boll worms.
7. Bird perches should be arranged @ 10 per acre for encouraging bird predation on bollworm larvae.
8. The buildup of broad spectrum predators viz., spiders, coccinellids and chrysopids should be synchronised in other cultural operations. Release of *Trichogramma* egg parasite @ 50,000/ha and *Chrysopa* egg larval predator @ 10000/ha, should be done as soon as the first brood of bollworms are noticed.
9. Topping of cotton plants when maximum egg laying of *Helicoverpa armigera* is noticed (October-November months).
10. Application of HNPV @ 500 LE/ha or neem seed kernel extract (5%) in synchrony with early larvae of *Helicoverpa*. Neem oil formulation to manage initial whitefly.
11. ETLs for Bollworms

Name of the Pest	ETL
American bollworm ( <i>H. armigera</i> ) and Spotted Boll worm ( <i>E. vitella</i> )	Five per cent damaged fruiting bodies or one larva per plant or total three damaged square per plant taken from 20 plants selected at random for counting.
Pink bollworm ( <i>P. gossypiella</i> )	Eight moths per trap per day for three consecutive days or 10 % infested flowers or bolls with live larvae.
Tobacco caterpillar ( <i>S. litura</i> )	One egg mass or skeletimized leaf / ten plants

12. Poison bait (10.0 kg of rice bran + 2.0 kg jaggery + 500-750 ml of chlorpyrifos or 250-300 g of thiodicarb) for the control of grownup larvae of *Spodoptera*.
13. Resorting to chemical insecticides for the control of leafhoppers spray monocrotophos 36 SL @ 1.6 ml/l or acephate 75 SP @ 1.5 g/l or fipronil 5% SC @ 2.0 ml/l or imidacloprid 17.8 SL @ 0.4 ml/l or acetamiprid 20 SP @ 0.2 g/l or thiamethoxam 25 WG @ 0.2 g/l or flonicamid 50 WG @ 0.3 g/l. For the management of whitefly spray triazophos 40 EC @ 2.0 ml/l or profenophos 50 EC @ 2.0 ml/l or diafenthiuron 50 WP @ 1.25 g/l or neem seed kernel extract @ 5% or neem oil @ 5.0 ml/l; for the control of *Helicoverpa armigera* spray quinalphos 25 EC @ 2.5 ml/l or chlorpyrifos 20 EC @ 3.0 ml/l or acephate 75 SP @ 1.5 g/l or indoxacarb 14.5 SC @ 1.0 ml/l or thiodicarb 75 WP @ 1.5 g/l or spinosad 45 SC @ 0.3 ml/l or flubendiamide 48 SC @ 0.3 ml/l or chlorantraniliprole 18.5 SC @ 0.3 ml/l. For managing red spider mites, application of wettable sulphur 80 WP @ 3.0 g/l or dicofol 18.5 SC @ 5.0 ml/l. Similarly if mealy bugs spread in patches to alarming level spray acephate 75 SP @ 2.0 g/l or profenophos 50 EC @ 3.0 ml/l mixing with sandovit or teepol.

14. Removal of cotton stubbles after last picking without opting for ratoon crop or prolonging the crop growth with irrigations and fertilizer applications. This is essential to break the cycles of problem pests in the system as a whole

### **Mealy bug management in Cotton**

- Adopt crop rotation
- Removal and burning of alternate weed hosts like *Parthenium*, *Abutilon* etc. in the vicinity of cotton crop
- Control mealy bug population on the alternate crop hosts during on and off season
- Stem application of monocrotophos diluted with water in 1:4 ratio during vegetative and early reproductive stage of the cotton crop at 30, 45 and 60 DAS as a prophylactic measure.
- Monitoring the initial infestation of mealy bug, particularly on border plants and shaded areas for timing of control measures.
- Need based spraying of insecticides, triazophos 40 EC @ 3.0 ml/l or prophenophos 50 EC @ 3.0 ml/l or acephate 75 WP 2.0 g/l mixed with stickers like triton or sandovit or teapot etc @ 1ml/l of spray fluid
- Spot application of insecticides is desirable when the infestation is confined to isolated pockets in the field.
- Removal and destruction by burning of heavily infested dried / dead cotton plants may be taken up to arrest further spread of the pest incidence.
- Removal and burning of left over cotton stubbles after harvesting.

### **Management strategies for pink bollworm:**

1. Grow early maturing varieties so that the cotton bolls mature before the heavy population of pink bollworm builds up.
2. Avoid staggered sowing in an area and take up timely sowings.
3. Use of acid delinted seed.
4. Adopting efficient and timely agronomic practices such as use of organic manures and recommended doses of 'N' fertilizers only.
5. Keep the crop free from weeds.
6. Regular monitoring for pest build up with field scouting and pheromone traps.
7. Destroy pink bollworm larvae in rosette flowers and also through periodical removal of dropped squares, dried flowers and pre-matured bolls, to suppress pest population in the initial stage.
8. Avoid ratooning and summer cotton.
9. Allow cattle, sheep and goats to graze upon immature green bolls and attacked bolls after final picking to prevent carry-over of the pest to the next season.
10. Prompt removal and destruction of cotton stubbles to prevent carryover of pest to next season.

11. Restrict the movement of cotton seed from other areas/states
12. Need based use of insecticides: Spraying of persistent insecticides like thiodicarb 75 WP @ 1.5 g/l or quinalphos 25 EC @ 2.5 ml/l or chlorpyrifos 20 EC @ 2.5 ml/l at 15 days interval.

### **Management of Cotton Diseases:**

**Bacterial blight:** Angular leaf spots develop and spread through veins causing vein blight. Under severe conditions disease spreads to branches causing black arm. Dark green spots develop on bolls which turn black and bolls rot.

Control: Seed treatment with *Pseudomonas fluorescens* @ 10.0g/kg seed; spraying copper oxy chloride 3.0 g/l + streptomycin 100 mg/l starting from 50 days after sowing, 2-3 times, at fortnightly intervals.

**Alternaria leaf spot:** Brown spots with concentric rings develop on leaves, join together and dry; defoliation occurs. Lesions on stem extend and break.

**Helminthosporium leaf spot:** Light brown spots with ashy centres and red margins

**Cercospora leaf spot:** Dark brown circular spots with white centres and purple margins develop on leaves.

Control: For the control of leaf spots seed treatment with *P. fluorescens* @ 10.0 g or carbendazim 2.0g or thiram 3.0g or vitavax 2.0 g/kg of seed; spraying copper oxy chloride 3.0 g/l or mancozeb 3.0 g/l or propiconazole 1.0 ml/l or captan + hexaconazole 1.0 g/l starting from 50 DAS, 2-3 times, at fortnightly intervals.

**Grey mildew:** Angular, white, powdery spots develop on leaves, spread and defoliation occurs. Control: Spraying water soluble sulphur 3.0 g/l or carbendazim 1.0 g/l, 2-3 times, at 10-15 days interval.

**Rust:** Yellowish brown to reddish brown pustules develop on both sides of the leaves.

Control: Spraying water soluble sulphur 3.0 g/l or tridemorph 1.0 ml/l or propiconazole 1.0 ml/l, starting from 75 DAS, 2-3 times, at fortnightly intervals.

**Boll Rots:** Dark spots or lesions develop on bolls.

Control: Spray copper oxy chloride 3.0 g/l + streptomycin 100 mg/l or carbendazim 1.0 g/l or dithane M-45 2.5 g/l.

**Root rot:** Sudden death of young plants in patches, roots become sticky and bark shreds in grown up plants.

**Fusarium wilt:** Damping off symptoms at seedling stage, lower leaves wilt early and drop. Brown streaks are visible in split open branches or stems, sometimes with black spores.

**Verticillium wilt:** Interveinal chlorosis and dark lesions develop on leaves with appearance of tiger stripes, brown discoloration is visible in split open stems, branches and also inside the bark, plants die in the centre of infected patch.

Control: Seed treatment with *Trichoderma viride* @ 10.0 g or *P. fluorescens* @ 10.0 g or carbendazim 2.0 g or thiram 3.0 g or vitavax 2.0 g/kg of seed; soil application of *T. viride* or

*P. fluorescens* @ 1.0 kg/acre developed in 100.0 kg FYM or vermicompost along with 20.0 kg of neem cake. Balanced Nitrogen application and correcting micronutrient deficiencies. Soil drenching at the base of infected plants with copper oxy chloride 3.0 g/l or carbendazim 1.0 g/l or benomyl 1.0 g/l.

### **Harvesting :**

1. Kapas from fully opened bolls should be collected during cooler times of the day.
2. Kapas picked should be free from debris like dried leaves, dried bracts etc.
3. Kapas from the first and last pickings should not be mixed with middle pickings, which are of better quality.
4. Kapas damaged by bollworms should be picked separately.
5. The cleaned kapas is to be graded and stored in heaps or in gunny boras in dry and well ventilated godowns.

### **Post-harvest Technology:**

1. It is essential that proper care is taken at various stages of handling and processing to ensure that the inherent quality of cotton is not adversely affected so as to realize maximum price.
2. Watering the kapas before weighment should be avoided.
3. Admixtures of different varieties should be avoided. The admixture of the inferior type lowers the quality of the superior type, due to differences in the fiber quality traits.
4. Only one variety of cotton should be heaped and packed to maintain the purity and quality of the cotton.
5. For supply of high quality of cotton, proper packing should be done to protect from contamination and dampness.
6. Improper drying due to lack of proper yard at village will generally result in to the discoloration of the fibres.
7. Even at the market level, the conventional packing of kapas in bales gives rise to problems such as requirement of large space and possible fire hazards. Storing in open yards at the market should be avoided.
8. The seeds from insect attacked and immature bolls being more fragile get crushed during ginning resulting in staining of lint by the oil oozing out of the cut-seeds. This oil acts as a medium for growth of the micro-organisms which will destroy the lint. So, the insect infested kapas should be separated.
9. Difficulties in handling of kapas due to its bulky nature - adequate storage space is to be provided both at the farmer's level as well as at the market.



## WEED CONTROL

The following are the Weed Control recommendations in important *rabi* crops, based on the research work done at the IWM Unit, RARS, Lam.

### 1. Rice

#### i) Rice nursery:

##### a) Pre emergence:

i) In case of dry nurseries, spray pretilachlor at 1.0 L/ha immediately or within two days after sowing as pre-emergence spray will effectively control *Echinochloa* and other annual monocot and dicot weeds in rice nurseries

ii) In case of wet nurseries, mix oxadiargyl 80% WP 90 g/ha in 1.25 liters of water and apply as sand mix application (in 50 kg sand/ha) at 3 to 5 days after sowing in a thin film of water

##### b) Post emergence

Post emergence spray of cyhalofop butyl at 1.0 L/ha at 15 days after sowing will effectively control *Echinochloa spp.* without any phytotoxicity to rice.

(or)

Post emergence spray of bispyribac sodium at 200 ml/ha at 15 days after sowing will effectively control grasses and broad leaf weeds. without any phytotoxicity to rice.

##### ii) Transplanted rice:

##### a) Within 3 to 5 days after planting (As sand mix application in 50 kg sand /ha)

Apply 2,4-D ethyl ester granules 10 kg/ha + butachlor granules 10 kg/ha as sand mix application.

(or)

Apply butachlor at 3 to 5 L/ha as sand mix application

(or)

Apply anilophos at 1.33 to 1.67 L/ha as sand mix application

(or)

Apply 2, 4-D ethyl ester granules 10 kg ha<sup>-1</sup> + anilophos 0.70 L/ha as sand mix application

(or)

Apply 2, 4-D ethyl ester granules at 10 kg ha<sup>-1</sup> + butachlor 2.5 L/ha as sand mix application

(or)

Mix oxadiargyl 80% WP 125 g/ha in 1.25 liters of water and apply as sand mix application.

##### (b) 25-30 days after planting (when dicot weeds are problematic)

Spray 2,4-D sodium salt 80% WP at 0.75 to 1.0 kg/ha in 500 liters of water using hand compression sprayer at 25-30 days after planting

(or)

Spray ethoxysulfuron 125 g/ha in 500 liters of water after draining water from the field at 25-30 days after planting.

## 2. MAIZE

Spray atrazine at 2.5 to 3.5 kg/ha immediately or within three days after sowing  
(or)

Spray alachlor at 3.75 to 5.0 L/ha immediately or within three days after sowing

## 3. SORGHUM

Spray atrazine at 2.0 kg/ha immediately or within three days after sowing sorghum

## 4. RAGI

Spray pendimethalin at 2.5 L/ha one week after transplanting ragi seedlings  
(or)

Spray anilophos at 1.75 L/ha one week after transplanting ragi seedlings  
(or)

Spray 2,4-D ethyl ester at 1.5 to 2.0 L/ha one week after transplanting ragi seedlings

## 5. PULSES

### a) PULSES- UP LAND:

Spray pendimethalin at 2.50 to 3.75 L/ha immediately after sowing or the next day  
(or)

Spray alachlor at 3.75 L/ha immediately after sowing or the next day

### b) Rice fallow blackgram

For the control of *Echinochloa* spp, and broad leaf weeds apply at 2.5 to 5.0 L/ha immediately after removal of paddy sheaves as sand mix application followed by spraying of water up to 1000-L ha<sup>-1</sup> depending upon the soil moisture condition.  
(or)

For control of *Echinochloa* spp. spray fenoxaprop ethyl @ 625 ml/ha (or) propaquizafop ethyl @ 625 ml/ha (or) quizalofop ethyl at 1.0 L /ha as post emergence spray at 15-20 days after sowing.

(or)

For control of grasses and broad leaf weeds post emergence spray of imazethapyr @ 500 ml /ha at 15-20 days after sowing.

For the control of *Cuscuta* post emergence application of pendimethalin at 2.0 to 3.75 L/ha immediately after removal of paddy sheaves as sand mix application followed by spraying of water up to 1000 L/ha depending upon the available soil moisture on the soil surface

For the control of *Vicia sativa*, post-emergence application of butachlor at 4.0 L/ha or pendimethalin at 3.3 L/ha immediately after removal of paddy sheaves as sand mix application followed by spraying of water up to 1000 L. ha<sup>-1</sup> depending upon the available soil moisture

## 6. GROUNDNUT

Spray pendimethalin at 2.5 to 3.75 L/ha immediately or with in three days after sowing  
(or)

Spray alachlor at 3.75 to 5.0 L/ha immediately or with in three days after sowing

## 7. SESAMUM

Spray pendimethalin @ 2.5 L/ha immediately or with in three days after sowing  
(or)

For control of *grassy weeds* spray fenoxaprop ethyl @ 625 ml/ha (or) quizalofop ethyl at 1.0 L/ha as post emergence spray at 20 days after sowing.

## 8. PERENNIAL WEEDS IN ORCHARDS

Perennial weeds like *Cyperus rotundus*, *Cynodon dactylon* etc. in orchards can be controlled effectively by spraying glyphosate at 2.5 to 5.0 L/ha dissolved in 500 liters of water using hood. Falling of the spray fluid on young fruit plant foliage should be avoided .Second spray is required when there is regrowth of weeds

### Note

In case of glyphosate, the efficacy depends upon the stage of the weed (should be in active vegetative stage), age and duration of infestation (older and longer duration of infestations may required several repeated sprays on active vegetative growth), soil moisture and type of weed and nature of foliage (surface morphology/ herbicide retention and absorption). Application of glyphosate with 1% ammonium sulphate solution will enhance up take and translocation by weeds . In wide spread infestations, it is better to plough the area first, induce the regrowth of the weeds and then spray glyphosate on the active growth stage.

(or)

If annual grasses and dicot weeds are prevalent, the herbicide paraquat at 2.5 to 3.75 L/ha dissolved in 500 L/ha of water can be sprayed using hood. Falling of spray fluid on fruit trees should be avoided.

## ANNEXURE

Common name, trade name, active ingredient and approximate cost of the herbicides included in the recommendations.

S.No.	Herbicide		Percent active ingredient	Rate (Rs./Unit)
	Common Name	Trade Name		
1.	Alachlor	<b>Lasso, Alatop</b>	50%EC	390/- Lt.
2.	Anilofos	Aniloguard, Arozin, weedonil, Anildhan	30 %EC	250/- Lt.
3.	Atrazine	Atrataf, Solaro, Milzin, Surya,Atratop,Atrafil,Ultrakem	50 %WP	Upto 300/- Kg.
4.	Butachlor EC	Butachlor, Trapp, Teer, Machete.	50 %EC	Up to 200/- Lt.
5.	Butachlor	Butachlor (G)	5 % Granules	25/- Kg.
6.	Glyphosate (IPA salt)	Glycel, Weed off, Noweed, Glyphos,Brake, Round up, Clean up, Rulout	41%SL	250-300/- Lt.
7.	Glyphosate (Ammonium salt)	Excelmera, Glyfos dekor, Allkill	71%SG	Upto75/per 100g
8.	Paraquat	Gramoxone, Uniquat, Paralac	24% EC	Up to 300/- Lt.
9.	Pendimethalin	Stomp, Pendiguard, Pendiherb, Pendistar, Tatapanida, Bond	30%EC	350 to 450/- Lt.
10.	2,4-D EE	Agrodone conc. 48, Herbonil	<b>36% EC</b>	250/- Lt.
11.	2,4-D EE	Agrodex and Knock weed granules	4% Granules	25/- Kg.
12.	2,4-D Na salt	Fernoxone, Weed mar, Salix	80% WP	250/- Kg.
13.	Oxadiazyl	Topstar, Oximain	80 %WP	225/- per 35 g
14.	Oxyfluorfen	Goal, Oxygold, Galigan, Kroll	23.5%EC	1600/-Lt
15.	Pretilachlor	Rifit, Eraz, Preet, Pretiherb	50%EC	400/-Lt
16.	Fenoxaprop ethyl	Whip super, Fenixasil, Dell power	9%EC	1300/-Lt
17.	Cyhalofop butyl	Clincher, Wrap up	10%EC	1400/-Lt
18.	<b>Quizalofop ethyl</b>	Targa super	5%EC	1400/-Lt
19.	<b>Metribuzin</b>	Tatametri, Sencor, Tribute, Metriagon	70% WP	1000-1500/kg
20.	<b>Pyrazosulfuron ethyl</b>	Saathi	10% WP	200/80g
21.	<b>Butachlor + 2,4-D EE</b>	Anuchlor + knockweed Butachlor+2,4-D EE	5%+4%G	250/-8kg
22.	<b>Imazethapyr</b>	Pursuit, Lagam, Dinamaz, Perfect, Weedlock	10 % EC	1600/ Lt
23.	<b>Bispyribac sodium</b>	Nominee gold, Tarak, Edora	10%EC	600/100 ml
24.	<b>Pyrithiobac</b>	Theme, Hitweed, Rife	10%SL	2000/Lt
25.	<b>2,4-D amine salt</b>	Weedmar super, Dura	58%EC	400/Lt
26.	<b>Ethoxysulfuron</b>	Sunrice	15% WDG	250/50gm
27.	<b>Propaquizafop</b>	Society, Agil, Opal	10 % EC	1400/ Lt
28.	<b>Cyhalofopbutyl</b>	Clincher , Wrap up, Dentil	10% EC	1600/Lt

## DRYLAND AGRICULTURE

Growing of crops in rainfed situation is known as dryland agriculture. The total geographical area of Andhra Pradesh is 160.2 lakh ha. The net sown area is 67.19 lakh ha, Net Irrigated area is 28.08 lakh ha. Rainfed area is 39.11 lakh ha and it accounts for 58.21% of net sown area with 60% area under red soils and 25% area under black soils. Among the 13 districts of Andhra Pradesh, Ananthapuramu district is having highest area under rainfed agriculture (9.65 lakh ha) and top rainfed priority rank followed by YSR Kadapa, Kurnool, Chittoor and Prakasam districts. Variation in crop yields is more in dryland agriculture due to non receipt of timely rainfall, early cessation of rains, inadequate and uneven distribution of rainfall and prolonged dry spells during crop periods. Adoption of suitable conservation measures and improved management practices will increase higher yields.

## SOIL AND WATER CONSERVATION

### Red soils

These soils are shallow in depth with low water holding capacity. Rainwater is lost due to runoff causing erosion along with top layer of the fertile soil and nutrients. Research efforts were made to reduce these losses and soil conservation measures were found useful in reducing runoff and soil loss.

- When soil depth is 20 cm or more, deep tillage once in three years helps in better infiltration of rainwater and also reduces pest and weed problems.
- Cultivation across the slope reduces runoff.
- If slope is multiple and more than 2%, construction of contour bunds with a cross section of 0.63 m<sup>2</sup> at 50 m horizontal interval helps in conservation of soil and water. In areas where annual rainfall is more than 750 mm, graded bunds are recommended.
- In soils where surface crusting is a major problem, application of sand @ 40 t/ha before sowing helps in decreasing the crust strength and facilitate infiltration of water in to the soil and improves germination and crop stand.
- To avoid water stagnation on downstream side of contour bunds, formation of compartmental bunds with spacing of 15 m X 10 m before emergence of the crop or formation of conservation furrows with receipt of rainfall 20 days after sowing of the crop helps in reducing the water stagnation and facilitates infiltration of water in to the soil.
- *In situ* conservation measures like dead furrow in groundnut at an interval of 3.6 m enhances the availability of soil moisture to the crop.
- Intercropping groundnut with mixed pulses like horse gram, cowpea and red gram in 11:1 ratio control the runoff losses and increases net returns.

## **Black soils**

In black soils, water holding capacity is very high. Deep cracking, low permeability and poor drainage are the major soil constraints in *vertisols*. Soil conservation and improved management practices enhances the productivity of dryland crops.

- Formation of graded bunds with a cross section of 0.8 m<sup>2</sup> is recommended in these soils. Formation of a channel with a slope of 0.1 - 0.25% along the graded bunds and merging these channels in to a grassed waterway help in drainage of water without soil erosion.
- Formation of ridges and furrows is useful for deep black soils. Sowing should be done on the ridges. Furrows facilitate easy drainage of water (or) formation of raised bed with 3 m width at 20 cm height will increase yield of crops, as the furrows facilitate better drainage of water.
- Compartmental bunding with 5 X5 m before onset of monsoon will improves the soil moisture storage capacity and useful for post rainy season crops.
- Application of FYM @ 20 t/ha would increase infiltration rate.

## **RAINWATER MANAGEMENT**

### **Red soils**

- Runoff of rain water can be prevented by practicing soil conservation measures. Sub soil chiseling with sub soiler improves the water holding capacity of shallow soils and reduces runoff.
- Mulching with groundnut shells @ 5 t/ha, within 10 days after sowing of the crop reduces evaporation losses.
- **Rain water collection and storage for subsequent use is known as water harvesting.**

Runoff constitutes 25 % of rainfall in red soils. Water harvesting in farm ponds and subsequent use as supplemental irrigation helps in increasing the yields of rainfed crops. Water harvested from catchment area of 10 ha can be used to irrigate one hectare. Seepage losses were minimized when farm pond is lined with soil + cement at 6:1 ratio. The optimum size of farm pond is 250 m<sup>3</sup> with dimensions of 10 m length x 10 m breadth x 2.5 m depth. Supplemental irrigation of 10 mm through sprinkler at moisture stress during critical stages, increases groundnut pod yield by 25-30%.

## **SUITABLE CROPS**

### **Red soils**

- Groundnut, sorghum, pearl millet, fox tail millet, redgram, greengram, cowpea, castor , cluster bean and horsegram are suitable crops. Groundnut + redgram, groundnut +

castor, sorghum + redgram are the profitable intercrops and inter crop ensure some income though main crop fails during drought years.

- Choice of the crops has to be made depending on the time of receipt of rainfall. Castor or redgram can be sown if the rains are received during June. If rains are received during July intercropping of groundnut + redgram is profitable. If rainfall is received during August, the suitable contingent crops are fodder pearl millet, fodder sorghum, greengram, cluster bean cowpea and horsegram. If rainfall is received after 15 September, sorghum (fodder), pearl millet (fodder) and horsegram are suitable.

## **BLACK SOILS**

- Cotton, chillies, sunflower, bengalgram, sorghum, safflower and coriander are suitable crops. Sorghum and sunflower sown during first fortnight of September will give higher yield.
- Application of zinc sulphate @ 50 kg/ha once in three seasons is necessary, if zinc deficiency is observed.
- If iron deficiency is observed, spraying of ferrous sulphate @ 2 g/l of water is necessary.

## **ENERGY MANAGEMENT**

### **Tractor Drawn Ananta Groundnut Planter: 8 rows**

Tractor drawn Ananta planter (8 rows) developed to mechanize the groundnut sowing for timely operation with mechanical advantage and intercropping facility. A 5 cm width covering blade is also fitted behind the furrow openers to cover the furrows after seed placement. The inclined disc plate seed metering mechanism gives correct seed to seed distance and maintains the recommended seed rate of 90 to 100 kg/ha. The seed damage is negligible and placement of seed is at proper depth of 4-5 cm. The field capacity is 6 to 7 ha/day and can cover large area before the soil moisture is dried up. The germination and optimum plant population was possible. The intercropping of redgram or castor can also be sown using Ananta planter along with groundnut sowing. The spring type cultivator of this planter facilitates to sow in stony and pebble slopy soils. The cost of Ananta planter is about Rs.50, 000. Ananta planter can also be used with mechanical adjustments for sowing redgram and chickpea with distinct row to row and seed to seed spacing.

### **Ananta 4-Row Bullock Drawn Automatic Planter**

Ananta 4-row bullock drawn automatic planter developed to mechanize groundnut sowing for timely operation with keeping in view of the small and marginal farmers. Main advantage with this planter is low cost of Rs.4, 000 towards the seed metering mechanism attachment to local bullock drawn gorru for groundnut sowing. Total cost of planter is around Rs. 8000. The trough feed type seed metering mechanism gives correct seed to seed distance about 10 cm in a row and maintains the recommended seed rate of nearly 100 kg/ha by

adjusting the depth gauge in the hopper. It covers 4-rows at a time with 30 cm spacing. The seed damage is nil and placement of seed is at proper depth of 4-5 cm. The field capacity is 1.6 to 2.0 ha/day and can cover large area before the soil moisture is dried up compared to bullock drawn local gorru with precise sowing and required seed rate. The weight of planter is only 52 kg, so that two bullocks can easily pull the planter without much stress.

### **Tractor Drawn Ananta Interculture Implement**

Normally weeding in rainfed groundnut is done by *metla guntaka* and *danti guntaka* driven by a pair of bullocks in between rows at 20 and 40 days after sowing or by hand weeding with the help of hand hoe. The tractor drawn interculture implement was developed to mechanize the intercultivation in groundnut for timely and reduce the labour cost. The tractor drawn interculture implement can run in between the row spacing of 30 cm without any plant damage. Its field capacity is 4 to 5 ha/day. The pneumatic small tyres of 8.3" X 32" size were fitted to the rear wheels of the tractor. The tractor drawn Ananta interculture implement with small tyres can run in the groundnut field at a row spacing of 30cm. The interculture implement with 8 tynes was developed with T-shape and V-shape sweeps fitted to the tynes and field tested. The cost of pneumatic tyres and interculture implement with sweeps was about Rs. 30,000.

### **Tractor Drawn ANGRAU Blade Guntaka**

General practice of harvesting is by hand pulling of groundnut crop when the crop comes to maturity. If rain occurs during the crop maturity, hand pulling is easy due to sufficient moisture in soil. However, the soil becomes hard and compacts if there is no rainfall at the time of maturity. The farmers use bullock drawn *madaka* to open the furrow along the rows to loosen the soil and plants are removed from the loosen soil to minimize pod loss. Under these circumstances the harvesting losses are more even upto 20%. Its field capacity is only 1.0 to 1.5 ha per day. The tractor drawn blade guntaka was developed to perform the harvesting operation easy and more economical. It covers 4 rows at a time. The harvesting can be done at right time to avoid other field losses. The cost of blade guntaka is Rs.12, 000. The worn out blade can be replaced with a new one in the blade slot which is fixed to the 6" pipe frame. Its repairs can be attended easily by the local artisans.

### **Groundnut grader**

Farmers prefer to groundnut kernels instead of pods as they can realize remunerative price. Groundnut decorticators are available to separate the kernels, but the graders are not available to separate different size of kernels. Groundnut grader was developed with three size of sieves. to separate the kernels. In first sieve the seed size is 1.24 cm, second sieve the seed size is 1.06 cm and third sieve the seed size is less than 1cm. The capacity of the grader was 285 kg/h. The cost of the unit is Rs.17, 000.

## **USE OF SMALL KERNEL OF GROUNDNUT FOR SEED PURPOSE**

Generally, farmers prefer bold kernel to sow groundnut crop. The cost of cultivation can be reduced by sowing with small and medium size seed. Medium and small seeds germinated faster and seed requirement was low when compared to bold seed. Small



groundnut seed recommended for sowing under rainfed situation to reduce cost of cultivation as seed cost alone constitutes 30 % of the total cost of cultivation of groundnut.

## NUTRIENT MANAGEMENT

Basal application of 20 kg N, 40 kg P<sub>2</sub>O<sub>5</sub> and 40 kg K<sub>2</sub>O/ha are necessary for groundnut and groundnut + redgram. For horsegram, apply 10 kg N and 30kg P<sub>2</sub>O<sub>5</sub>/ha.

It is better to apply phosphorus and potassium based on soil test values. For groundnut crop grown in *alfisols*, the following schedule is recommended.

Phosphorous (P <sub>2</sub> O <sub>5</sub> ) (kg/ha)		Potassium (K <sub>2</sub> O) (Kg/ha)	
Available in the soil	To be applied	Available in the soil	To be applied
<20	40	<150	40
20-40	20	150 -250	20
>40	Nil	> 250	Nil

For correcting zinc deficiency in groundnut, spraying of 0.2% zinc sulphate is recommended at 35 and 45 days after sowing.

## WEED MANAGEMENT

Intercultivation should be practiced at 25 and 40 days after sowing. In areas where labour is a shortage broadcasting of fine soil mixed with pedimethalin @ 2.5 l/ha or spraying pedimethalin @ 5 ml/l is recommended, within two days after sowing of the crop.

## PEST AND DISEASE MANAGEMENT

Since the farmers are less resourceful, IPM is a suitable technology. To reduce the cost of pest and disease management, these aspects are to be considered.

1. Pest monitoring and prediction.
2. Monitoring of natural enemies.
3. Forewarning of pest outbreak.
4. Critical stage of chemical intervention.

Relationship between weather parameters and occurrence of pests and diseases has been established in many crops.

### Sorghum

- a) **Stem borer:** Infestation varies with time of sowing. More on late and less on early sown sorghum, rainfall determines the time of emergence of adults.
- b) **Shoot fly:** Extreme temperature and continuous heavy rains adversely affect the population. Rainfall influences peak emergence of adults. Maximum temperature (20° - 30°C) is conducive for egg laying and larval development. RH (above 60%) favours intensity of attack.
- c) **Midge:** Mean temperatures (25°-30°C). RH (above 60%). Adult midges emerge after accumulation of 43°C heat units (based on mean daily 10 cm soil temperature) above a threshold of 14.8°C whereas 679 and 973 heat units are required for 50 and 95% emergence.

### Groundnut

- a) **Leaf miner:** Maximum temperature of more than 33°C and afternoon relative humidity of less than 40 per cent followed by dry spell of more than one week results in incidence of the pest. If rain occurs, the incidence gets reduced during *Kharif*.
- b) **Red hairy caterpillar:** Rainfall received between last week of June and September causes the emergence of RHC moths. The emergence is noticed on 2<sup>nd</sup> day after the occurrence of rainfall of 10 mm and more. If heavy rainfall of 80 mm and above is received in one day during June/July, heavy emergence of RHC will take place at a time and subsequent emergence will be less. However, the moths emerged during September, though they lay eggs, mortality of eggs and larvae is observed due to the parasitisation and thereby the influence on the crop will be less.
- c) **Late leaf spot:** Morning relative humidity of 80% coupled with night temperature around 22°C causes the initiation of the late leaf spot disease on groundnut. If the weather conditions exist for a week, the disease spread will be more. Added to this the leaf wetness index of 2.3 coupled with 10% LLS incidence requires the control measures.

### FARMING SYSTEMS RESEARCH

Under farming system where groundnut is a predominant crop, rearing of 10 sheep/ha (ram lambs) for about four months with groundnut haulms alone or stall feeding of haulms + grazing has been found highly profitable than crop alone. Besides provide 65 man days of employment after harvest of groundnut. Backyard poultry with improves breeds like Rajasri/ Vana Raja/ Gramapriya (20 +5) improves livelihoods of small and marginal farmers.

## POST HARVEST TECHNOLOGY

\* \* \*

The farmer, in a remuneration point of view, must attend to certain primary processing operations like threshing, winnowing, cleaning, drying, grading, polishing, milling etc. There is a need to adopt appropriate post harvest technologies for cost, time and labour saving towards *enhancement* of quality and marketability to the produce by value addition and by-products utilization. Primary processing by farmers can potentially get more remunerative price and profits by increasing quality by value addition and efficient utilization of by products besides reducing post harvest losses.

### 1. Threshing of Paddy by power thresher:

Power threshers are recommended for threshing paddy crop due to its multiple advantages like low investment, high threshing efficiency, low operational cost compared to traditional tractor threshing. It has additional advantages of simultaneous winnowing and cleaning, besides threshing. Under-utilization of tractor of 35 hp power can be avoided, as the job of threshing to the same extent could be achieved by expending only 7-10 hp, in case of power thresher. About 5-6 litres of diesel could be saved, besides increased output of 1-2 bags of paddy which otherwise goes as threshing loss in case of tractor threshing. Under-utilisation of 35 hp tractor for a 10 hp, job of threshing, if avoided would go a long way in saving fuel energy and foreign exchange.

### 2. Threshing benches:

Threshing benches either with wire mesh top or with perforated M.S. Sheet may be used in place of wooden benches for threshing the paddy crop as they are more efficient and have more service life. Four men can thresh about 25 bags of paddy in a day. Each threshing bench costs about Rs. 1600/-. The process is particularly advisable when paddy is collected for seed purpose.

### 3. Winnowing machines for grain cleaning:

Hand and power operated (Power tiller, tractor or small engine operated) winnower can separate chaff, dust etc. from grain. About 500-800 kg of grain can be winnowed in one hour. These machinery are useful when sufficient winds (velocity) are not available and during unfavourable weather conditions.

### 4. Husk fired furnace dryer for drying of paddy:

A half ton capacity husk fired furnace type batch dryer developed at this centre can dry paddy from 25% moisture content to 13% moisture content in a matter of 4-5h. It is much useful when sun drying is not practicable in inclement weather during rainy season and under sudden cyclone threat conditions.

5. Agricultural waste fired chilli dryer and its utilisation as multipurpose dryer to dry other crops:

A two quintal capacity chilli dryer designed and developed at this centre can dry ripe chillies from 70% moisture content to 15% moisture content in 24 hours compared to 12-15 days in open yard sun drying. The chillies dried by this dryer retained colour for a longer time during storage compared to sun dried produce and are dust-free with high quality and appearance. Drying can be done from the crop residue or paddy husk. This dryer could be used as multipurpose dryer for drying other crops like turmeric, groundnut and coconut.

a) Drying of turmeric:

Drying of turmeric using Agricultural waste fired dryer is advantageous in time and cost saving. The results showed 65.47% of time saving and 7.8% of cost saving compared to traditional method of sun drying. It took 58 hours to dry turmeric of 79.24% moisture content to 12.5% level against 168 hours of time taken for the similar level of drying in open yard drying.

b) Drying of groundnut:

The Agricultural waste fired dryer was also evaluated for drying groundnut. When dried at 40-43° C it took 25 hours compared to 4 - 5 days required in open yard sun drying for bringing down the moisture content from 28% to 8%. There was no adverse effect on germination of the seed after drying by the dryer.

6.a) Mini Dhal Mill:

The mini dhal mill plant was developed with suitable accessories and attachments like drying cum storage bin with husk fired heat exchanger system, sieve set, mixer for pre-treatment with oil and water, thus mechanising all the processing operations involved in dhal making. It will separate dehusked wholes. It can run with a 3 h.p motor and can mill 150 to 160 kg of blackgram per hour with 65% to 70% wholes and 15% to 18% splits recovery, thus about 80%-82% dhal was recovered compared to only 70-75% in traditional method.

b) TNAU-Power operated mini dhal mill:

The mini-dhal mill was tested. It is capable of splitting 30 kg of blackgram per hour with a recovery of 83.5% split half grains with 12% of broken. In respect to greengram, it can mill 32 kg/h. with recovery of 80% splits and 17% broken.

7. Power operated turmeric polisher:

With suitable alterations and further attachments like 2 h.p motor, V-belt and chain drive mechanism and gear system, the hand operated turmeric polisher was converted into power operated turmeric polisher. It can run at 30-32 rpm. The power operated ANGRAU Turmeric polisher can polish about 600-700 kg of turmeric in an hour with 98% polishing efficiency.

8. ANGRAU Turmeric Grader:

The ANGRAU turmeric grader designed and developed by this centre can grade about 400 kg of turmeric in an hour into four fractions namely bulbs, fingers (3 cm length and above), Polishable Nali (2 to 3 cm length) and un-polishable Nali (less than 2 cm length) in a single pass, thus eliminates tedious and laborious manual grading. This also facilitates better quality and value addition to get higher remunerative price.

9. Batch type rice bran stabilizer suitable for stabilization of rice bran:

Stabilization of rice bran with rice bran stabilizer at 100° C for 10 minutes controls the increase in free fatty acid up to 28 days in storage, by inactivation of lipase enzyme. This facilitates extraction of edible grade oil, thus helps in better utilization of rice bran, the by-product of rice milling industry.

10. Chilli Seed extractor:

The TNAU chilli seed extractor was found to operate at 46-50 kg/hr capacity which is particularly suitable for extracting seed from smaller lots without intermittent cleaning. PKV chilli seed extractor was found to be effective to obtain clean seed i.e., free from broken pericarp and dust. The capacity of the extracting machine is around 100 kg/hr. The extraction efficiency for both the equipment is in the range of 96 to 99%. The high capacity extractor is useful for seed producers and large farmers.

11. Mango Harvester:

Experiments using IIHR mango harvester gave a harvesting capacity of 170-200 kg mangos/hr (500-550 fruits/hr). It was observed that farmers are using a dhoti which is made locally using bamboo stick and net made of jute thread. The net is connected to the curved frame. Local dhoti gave a capacity of about 300-350 fruits/hr. Percentage dropped fruits while harvesting were found to be lower 8-10% compared to 20-25% in local dhoti thereby reducing the damage to the fruits. However the IIHR mango harvester is somewhat heavy and difficult to handle for harvesting fruits by standing on the tree particularly for old and well branched trees. Two types of Mango harvesters which are useful to harvest fruits from ground (for small trees / young gardens) and on the tree (for old and well branched trees) as alternatives to local harvester have been

designed, fabricated and tested with Banginapalli variety. The light weight harvester when used on large, well branched tress gave a harvesting capacity of 625-650 fruits per hour. The heavy weight model useful to harvest fruits from ground gave a capacity of 600-615 fruits per hour. Local dhori gave a capacity of 300-350 fruits / h.

12. Survey of rice milling in Andhara Pradesh :

A survey of rice milling system was conducted in Andhra Pradesh and the data collected in the form of a questionnaire. The grain factors that affect the percentage of broken include moisture content, variety, type of soil and time of harvest. The machine factors that affect include the condition of the rubber rollers, speed and wear and tear in sheller and gap between cone and concave, life of rubber packing and wear of emery cone in the polisher. Out turn of rice from paddy after milling differs from sample to sample and type of milling system. Breakage of rice invariably originates from cracked, immature and other damaged grains. The corrective measures suggested to reduce broken percentage of rice are; harvest the paddy at optimum moisture content, thresh the paddy by mechanical thresher, dry the paddy uniformly in steps by maintaining tempering periods, modern rice mills with rubber roll shellers are recommended for minimum broken percentage of rice, to maintain the rice mill timely replacement of rubber rolls, and timely replacement of cone in the cone polisher. Maintaining proper gap between the cone and the rubber brake in the cone polisher is critical to reduce broken in rice milling.

13. Conversion of tobacco barns for chilli drying

Ten to twelve quintals of ripe chillies can be loaded in the existing tobacco barns to dry chillies. G.I. wire mesh trays of size 105 x 75 x 7.5 cm are suitable to hold chillies on the existing tiers. Each tray can be loaded with 7 to 8 kg of ripe pods. Drying time required to reduce moisture from 75 to 10% (w.b.) vary considerably depending upon whether the chilli is hybrid with thick pericarp (eg. Wonder hot) or varieties with medium to thin pericarp (eg. LCA 334). The former takes about 50 hours to dry whereas the latter type takes about 40 hours only. The temperatures ranging from 50°C to 55°C are appropriate for drying chillies. The open yard sun drying takes 12 to 15 days in comparison to barn drying method. The cost of barn drying is approximately Rs.1.50-2.00 per quintal of dry chilli. The percentage discoloured pods can be reduced to about 3.5 to 4% in barn dried produce in comparison to 9-10% in open yard sun drying. The barn drying method has the advantages such as; 1) quality product with good colour retention and free from external contamination 2) less number of discoloured pods (Talukaya) 3) Reduction in drying time 4) Drying can be accomplished even during inclement weather particularly early in the chilli season i.e., November to February to fetch remunerative price.

14. Drying of chillies in a poly house:

ANGRAU poly house solar dryer of size 12 x 7.8 x 2.1m has been developed to dry about 20 quintals of ripe pods. The dryer essentially consists of an arch type poly house to hold chillies on two different tiers made of wire mesh fixed to frame assembled by nuts and bolts. The whole frame structure is covered with a UV stabilized 150 gsm

cross laminated semi-transparent polyethylene sheet with ventilators at bottom and top to facilitate movement of air. The drying time is 5 to 8 days to reduce moisture from 75% to 10% (wb) in comparison to 15 to 20 days required to dry chilli in open yard sun drying. The dryer can be converted into nursery house by replacing poly sheet cover using 50% shade net. About 70,000 chilli seedlings can be raised in the house per batch. The poly house can also be used to raise green Coriander during off season i.e. in May and June when the chilli drying is completed. The poly house can be efficiently used for about 10 months in a year in chilli growing region i.e. Drying of chillies during December to April, Coriander leaf production in May to June, raising Chilli nursery during July to September.

15. Performance of Sonalika thresher for Bengal gram :

The performance evaluation of Sonalika thresher for Bengalgram was evaluated at Chandulur and Dronadula villages of Prakasam district. It was observed that it can thresh about one to one and half acres of Bengalgram crop in one hour. It was also found that the output of the thresher was 10 to 12 quintals of Bengalgram in one hour. The threshing capacity depends upon the crop variety and its yield. The average efficiency of the thresher was found to be 98.33%. Cost of operation was about Rs. 500/- per hour which includes labour and diesel.

16. Mobile Turmeric Steam Boiler

A study was undertaken to first develop as all scale turmeric steam boiler. The developed boiler was tested in comparison to different methods such as bana method, autoclave cooking and water bath boiling. Experiments were conducted to establish the most effective cooking method for turmeric (*Curcuma longa* linn) based on the drying time, curcumin content, colour and physical appearance of the product. The 1000 kg/hr capacity mobile turmeric boiler was fabricated with the help of local manufacturer. Preliminary trials were conducted. Manufacturing defects such as leakage of steam, improper functioning of steam valve were observed. The defects were rectified and the boiler was tested. Details of experimental results are furnished.

i.	Capacity of cooking	1 ton/h
ii.	Cooking time	10-12 min
iii.	Steam pressure	2 kgf/cm <sup>2</sup> (140°C)
iv.	Fuel consumption	6.3 lph
v.	Moisture initial	75% (w.b)
vi.	Moisture final	78% (w.b)
vii.	Drying time	12 days
viii.	Operation cost	Rs. 1.70/kg dry

17. On-Farm Paddy dryer for managing high moisture paddy

A 5 Ton capacity on-farm Paddy has been developed at Post Harvest Technology Centre, Bapatla in collaboration with M/s Kardi Dryers Pvt. Limited, Chennai for management of combine harvested high moisture paddy. Extensive tests were conducted and custom hiring

of the dryer was also given to the farmers on request. The farmers were expressed their satisfaction on the performance of the dryer and good seed germination was observed. The following are the salient features of the performance of the dryer.

#### Salient features of On-Farm Paddy Dryer

S.No.	Description	Salient Features
1	Type	Mobile - Flat bed - Non Mixomg type Paddy dryer (Mixing mechanism optional)
2	Capacity	5 ton (Optimized for mobile model)
3	Power source	Genset / 3 phase AC current
4	Loading and unloading	Loading: Manual (Elevator mechanism Optional) Unloading: Gravity discharge chutes
5	Drying time	29% (IMC) - 12% (FMC) - 13.5 - 15.0 h 24% (IMC) - 12% (FMC) - 6-8 h
6	Fuel consumption	Kharif: 45-60 lt (both for Genset and fuel burner) Rabi: 20-30 lt (both for Genset and fuel burner)
7	Milling tests	Milling Recovery: 62-63%, Head yield - 58-59%, Brokens - 3-4%
8	Economics (Diesel Run)	<b>Total operating costs:</b> <b>Kharif:</b> Rs. 3937/ batch or Rs. 59/ bag of 75 kg or Rs. 0.78/kg <b>Rabi:</b> Rs. 2287/batch or Rs.34/-bag of 75 kg or Rs. 0.46/kg <b>Total costs:</b> <b>Kharif:</b> Rs. 6019/batch or Rs. 90/bag or 75 kg or Rs. 1.20/kg <b>Rabi:</b> Rs. 4369/batch or Rs. 65/bag of 75 kg or Rs. 0.87/kg
9	Benefit Cost Ratio	<b>Kharif:</b> 1.47 <b>Rabi:</b> 2.02
10.	Payback period	<b>5 years</b>

#### 18. Fuel Briquetting machine:

Fuel Briquetting machine is tested for its performance evaluation. Locally available crop residues such as paddy husk, maize, chilly stacks, groundnut shells and Bengal gram stacks etc are being used as raw material for making the briquettes. The Engineering properties like Bulk density, calorific value, ash content, moisture content of these raw materials before and after briquetting were determined. Briquettes made with rice husk, groundnut shells, chilly stacks, maize stacks burned for long duration and can be used in agro dryers to reduce operating cost and to save conventional fuel. Economics of fuel briquetting machine is studies. Cost of production of briquettes Rs. 4.15 / kg.

#### 19. Safe Storage of groundnut:

##### a) Drying and storage structures:

Groundnut has to be dried to less than 9% moisture for safe storage which can be stored upto 6 months without aflatoxin contamination and loss of viability. The groundnut can be stored better in 1) loosely knitted gunny bags 2) compactly knitted gunny bags, 3) nylon bags and 4) polythene lined gunny bags.



b) Viability of groundnut in storage:

TMV-2 variety of groundnut maintained high viability (83%) with lesser fungal growth (16%) at 240 days of storage while the viability was least in K-150 (24%) followed by K-3 (21.6%) indicating their unsuitability for storage as seed. The viability was 79% in K-1186, 73% in K-153 and 67% in K-1143 at 180 days of storage. However the viability of these varieties drastically fell below 35% level by 240 days of storage.

20. Safe storage of pulses:

Pulses can be safely stored in nylon bags, polythene lined gunny bags for 6 months provided the grain is properly dried before storage. Mixing of 250g of edible oil per quintal of pulses is beneficial for safe storage.

21. Chilli storage:

Chillies stored in amber coloured polythene bags were found to retain colour for longer period of storage. Mechanically dried chillies showed higher colour value in chillies during storage than that of open yard sun dried produce.

22. Biochemical changes in paddy during storage:

Paddy stored upto 10-12 months was found to improve its quality without change in their milling and culinary properties. However, beyond 18 months of storage, there is deterioration in its milling and culinary properties.

23. Use of plant origin materials for safe storage of pulses:

Mixing of neem oil or vegetable oil at 0.25% to the pulse grain was found effective in protecting the pulses from the damage by pulse beetle, *Callosobruchus maculatus* upto 300 days of storage.

24. Curcumin content in stored turmeric varieties:

The Curcumin content in stored turmeric varieties progressively decreased with length of storage period. Among the varieties tested the decrease in Curcumin content in storage was higher with Mydukur followed by PCT-14 and TC-2.

25. Chemical treatment of copra to prevent fungal damage:

Mature coconut halves treated with solutions of 1% acetic acid, sodium bicarbonate or sodium chloride protected the copra from spoilage due to fungal infection.

26. Suitability of storage containers for storage of tamarind:

Tamarind gained moisture when stored in mud pots and gunny bags with reduced total acidity compared to the produce stored in polythene bag, tetrapack or glass bottle. The acidity of the samples stored in tetra pack was highest followed by polythene bags, whereas it was least in case of the samples stored in gunny bags followed by mud pots. None of the structures however could prevent discolouration of stored tamarind as it is temperature dependent.

27. Use of Maize stalks for oyster and milky Mushroom Cultivation

Maize stalks after harvest of the cobs can be utilized for the cultivation of oyster and milky mushrooms in place of paddy straw. Yield and bio-efficiency of the mushrooms cultivated by using maize stalks will be on par with mushroom yield cultivated with paddy straw.

Addresses and contact phone numbers of Post Harvest& Agricultural Equipment suppliers.

S.No	Address	Phone No.
1.	The Manager (Implements) AP Agro Industries Development Corporation Agro Bhavan, 10-2-3, A.C. Guards, Hyderabad-500 004	040 - 23396530, 23317225
2.	M/s Viswakarma Engineering Company Plot No.138, Road No.26 Industrial Estate, Kattedan, Hyderabad - 500 077	040-24361719
3.	M/s Karshak & Sons Shop No.42, Al Karim Trade Centre M.G. Road, Secunderabad - 500 003	040-27542315
4.	M/s Mekins Agro Products Pvt. Ltd. Plot No.30, IDA, Gandhinagar, Balangar, Hyderabad-500 037	040-23085959
5.	M/s Escorts Tractors 160/1, Sardar Patel Road Opp. Global Trust Bank Secunderabad	040-27907073

6.	M/s Farm Implements (India) Pvt. Ltd., 10, Kumarappa Street, Nungamakkam, Chennai - 600 034	044-28261676
7.	M/s Farm Steel Products PD 17 & 18, Industrial Estate Vijayawada - 520 007	0866-2472694 (R), 2553958 (O)
8.	M/s Jai Bharathi Engineering Works Plot No. C-25, Industrial Estate Machilipatnam Road, Gudivada - 521 301	08674 - 243392
9.	M/s Modern Arc Welding Works 16-256, Venkateswara Theatre Road Gudivada - 521 301	08674- 242029 (O), 246505 (R)
10.	M/s Riteset Industries Gudivada - 521 301	08674-243918 (O) 243997 (O), 243626 (R)
11.	M/s Siri Enterprises Plot No.38, Phase - III Indira Autonagar Guntur - 500 001	0863-2211444 (O) 2556678 (R) 2556319 (R) 9440471202
12.	M/s Sri Adhivishnu Machine Tool Stores Old Bus Stand, Morrispet, Tenali - 522 202	08644-223320 (O) 228711 (R)
13.	M/s Sri Srinivasa Auto Engineering Works Industrial Estate, Plot No.C2 & C3,Gudivada	08674 - 242862 242374
14.	M/s Navya Industries, Plot No.A-3 Auto Nagar,Gudivada - 521 301	08674 - 244597 245482 98666 31866
15.	M/s A.P Agros industries development corporation 504, Heritage complex, Hill ford road, Hyderabad-4 A.P. Agros industries development corporati workshop complex, Narasapur Road, Balanaga Hyderabad.	040-23391331, 23314246, 23317225.
16.	M/s Methasis Engineers Pvt. Ltd Plot No. B-35, B.H.E.L - A.I.E, Ramachandrapuram, Hyderabad -3	040- 23020628, 23022298, 23730134.
17	M/s Kardi Dryers (p) Ltd. Old No.86 (New No. 69) Survey No. 203/2, 2 <sup>nd</sup> Extension, Nageswara Rao Road, Athipet Chennai - 600 086. <a href="mailto:info@kardridryers.com">info@kardridryers.com</a> <a href="http://www.kardidryers.com">www.kardidryers.com</a>	Phone: 044-26880001 9791664050

