5. OILSEEDS

(i) GROUNDNUT (*Arachis hypogaea*)

CLIMATE REQUIREMENT

T_Max°C	T_Min°C	Optimum °C	Rainfall mm	Altitude m MSL
40	15	25 - 35	500 - 700	1160

Tropical crop, wide spectrum adoptable crop which grown in all 3 seasons. Flowering and seed setting affected by cloudy weather. Day neutral plant. Resists drought and tolerate flooding for one week once it establish.

CROP IMPROVEMENT
I. SEASON AND VARIETIES

Zone/ District/Season	Sowing Month	Varieties
I. Western Zone (Irrigated)		
Coimbatore, Tiruppur		
Chithiraipattam	April-May	TMVGn 13, VRIGn 6, VRI 8, CO 7, TMV 14, BSR 2
Erode,Theni,Dindigul		
Margazhipattam	Dec- Jan	TMVGn 13, VRIGn 6, VRI 8, CO 7, TMV 14, BSR 2
Western Zone (Rainfed)		
Coimbatore,Tiruppur, Erode, Theni, Dindigul		
Anippattam	June- July	TMVGn 13, VRIGn 7, CO 6, VRIGn 6, VRI 8, CO 7, TMV 14, BSR 2
II. Southern Zone (Irrigated)		
Ramanathapuram, Thirunelveli		
Thaippattam	Jan- Feb	TMVGn 13, VRIGn 6, VRI 8, CO 7, TMV 14, BSR 2
Karur, Pudukkottai, Madurai, Virudhunagar		
Margazhipattam	Dec- Jan	TMVGn 13, VRIGn 6, VRI 8, CO 7, TMV 14, BSR 2
Sivagangai		
Ayppasipattam	Oct- Nov	TMVGn 13, VRIGn 6, VRI 8, CO 7, TMV 14, BSR 2

Southern Zone (Rainfed)		
Karur, Pudukkottai, Madurai, Sivagangai		
Anippattam	June-July	TMVGn 13, VRIGn 6, VRI Gn 7, VRI 8, CO 6, CO 7, TMV 14, BSR 2
Virudhunagar		
Adippattam	July-Aug	TMVGn 13, VRI 8, CO 7, TMV 14, BSR 2
Ramanathapuram, Thirunelveli		
Purattasipattam	Sep- Oct	TMVGn 13, VRI Gn 7, VRI 8, CO 6, CO 7, TMV 14, BSR 2
Thoothukudi		
Karthigaipattam	Nov- Dec	TMVGn 13, VRIGn 6, VRI 8, CO 7, TMV 14, BSR 2
III. North Eastern Zone (Irrigated)		
Villupuram		
Chithiraipattam	April-May	TMVGn 13, VRIGn 6, VRI 8, CO 7, TMV 14, BSR 2
Thiruvallur, Kancheepuram		
Margazhipattam	Dec- Jan	TMVGn 13, VRIGn 6, VRI 8, CO 7, TMV 14, BSR 2
Cuddalore		
Ayppasipattam	Oct- Nov	TMVGn 13, VRIGn 6, VRI 8, CO 7, TMV 14, BSR 2
Vellore, Thiruvannamalai		
Karthigaipattam	Nov- Dec	TMVGn 13, VRIGn 6, VRI 8, CO 7, TMV 14, BSR 2
Thiruvallur, Cuddalore, Vellore		
Anippattam	June-July	TMVGn 13, VRI Gn 6, VRI 8, CO 7, TMV 14, BSR 2
Kancheepuram		
Adippattam	July-Aug	TMVGn 13, VRI Gn 6, VRI 8, CO 7, TMV 14, BSR 2
Thiruvannamalai		
Purattasipattam	Sep- Oct	TMVGn 13, VRI Gn 6, VRI 8, CO 7, TMV 14, BSR 2
Villupuram		
Karthigaipattam	Nov- Dec	TMVGn 13, VRI Gn 6, VRI 8, CO 7, TMV 14, BSR 2
IV. North Western Zone (Irrigated)		
Perambalur, Ariyalur		
Margazhipattam	Dec- Jan	TMVGn 13, VRI Gn 6, VRI 8, CO 7, TMV 14, BSR 2

Namakkal, Dharmapuri		
Vaigasipattam	May- June	CO 6, VRI GN 7
Salem, Krishnagiri		
Karthigaipattam	Nov- Dec	TMVGn 13, VRI Gn 6, VRI 8, CO 7, TMV 14, BSR 2
North Western Zone (Rainfed)		
Namakkal		
Vaigasipattam	May- June	CO 6, VRI Gn 7, BSR 2
Salem, Dharmapuri, Krishnagiri		
Anippattam	May- June	TMVGn 13, CO 6, VRI Gn 7, BSR 2
Perambalur, Ariyalur		
Adippattam	July-Aug	TMVGn 13, VRI Gn 6, VRI 8, CO 7, TMV 14, BSR 2
V. Delta Zone (Irrigated)		
Thiruchirapalli, Thanjavur, Thiruvarur, Nagapattinam		
Margazhipattam	Dec- Jan	TMVGn 13, VRI Gn 6, VRI 8, CO 7, TMV 14, BSR 2
Delta Zone (Rainfed)		
Thiruchirapalli		
Anippattam	June-July	TMVGn 13, VRI Gn 6, VRI 8, CO 7, TMV 14, BSR 2
Thanjavur, Nagapattinam		
Margazhipattam	Dec- Jan	TMVGn 13, VRI Gn 6, VRI 8, CO 7, TMV 14, BSR 2

Bunch varieties : TMV Gn13, TMV 14, VRI Gn 6, VRI 8, CO7, BSR2
Semi spreading varieties : VRI Gn 7, CO6
Suitable varieties for irrigated : VRI 8, BSR 2, CO 7
Suitable varieties for rainfed **:** TMV Gn13, TMV 14, BSR 2, CO 6, CO7 and VRI 7
Bold variety (Gujarat) : GG 7
TMV 14 and BSR 2 are alternate varieties for TMV 7

II. DESCRIPTION OF GROUNDNUT VARIETIES

Particulars	TMVGn 13	VRIGn 6
Year of Release	2006	2007
Year of Notification	SO.1178(E)/20.07.2007	SO.449(E)/11.02.2009
Parentage	Selection from Pollachi red	Derivative of ALR 2 X VG 9513
Duration (days)	100-105	120-125
Average Yield of Pods kg/ha		
Rainfed	1613	1916
Irrigated	2580	2403
Shelling %	71.4	75
100-seed weight (g)	44	36
Oil content %	50	50
Special features	Red kernel, high yield and tolerant to terminal drought	Small pods, moderately resistant to late leaf spot, rust and PBND diseases. Resistant to early season drought, high harvest index (34.6%)
Growth habit	Bunch	Bunch
Leaf colour	Green	Light green
Seed colour	Red	Light Rose

Particulars	VRIGn 7	BSR 2
Year of Release	2008	2019
Year of Notification	SO.2187(E)/27.08.2009	SO.3220(E)/05.09.2019
Parentage	Derivative of TMV 1 X JL 24	VR12 x TVG 0004
Duration (days)	120-125	105-110
Average Yield of Pods kg/ha		-
Rainfed	1865	2222
Irrigated	-	2360
Shelling %	72	70.2
100-seed weight (g)	46	40-43
Oil content %	48	45.01
Special features	Moderately resistant to late leaf spot and rust diseases. Moderately resistant to leaf miner	One or two seeded, usually two seeded, medium sized pods, Moderately resistant to late leaf spot and rust diseases
Growth habit	Semi-spreading	Bunch
Leaf colour	Dark green	Green
Seed colour	Rose	Tan

Particulars	VRI 8	TMV 14
Year of Release	2016	2018
Year of Notification	SO.2805(E)/25.08.2017	SO.1498(E)/01.04.2019
Parentage	ALR 3 x AK 303	VRI Gn 6 x R 20012
Duration (days)	105-110 days	95-100 days
Average Yield of Pods kg/ha		
Rainfed	2130	2124
Irrigated	2700	2286
Shelling %	70	70.6
100-seed weight (g)	45-50	38.0
Oil content %	49	48.0
Special features	Moderately resistant to sucking pest and defoliators. Moderately resistant to foliar fungal disease. Medium bold kernel suitable for confectionary/table purpose	Higher dry pod yield than VRI (Gn) 6 & TMV (Gn) 13; Higher shelling percentage than VRI Gn 6 Less incidence of *Spodoptera*, thrips and leaf miner compared to VRI (Gn) 6 and TMV (Gn) 13 under field conditions; Moderately resistant to late leaf spot and rust disease under field conditions
Growth habit	Bunch	Bunch
Leaf colour	Light green	Green
Seed colour	Rose	Rose

Particulars	TNAU CO 6	CO 7
Year of Release	2010	2013
Year of Notification	SO.1708(E)/26.07.2012	SO.2680(E)/01.10.2015
Parentage	Derivative of CS 9 X ICGS 5	Derivative of ICGV 87290 X ICGV 87846
Duration (days)	125-130	100 -105
Average Yield of Pods kg/ha		
Rainfed	1914	2300
Irrigated	-	2806
Shelling %	73.5	71
100-seed weight (g)	48.5	35 - 44
Oil content %	49.5	51
Special features	Dark green foliage, tolerant to foliar diseases	High oil, moderately tolerant to Rust and Late leaf spot , tolerant to Drought
Growth habit	Semi- spreading	Spanish Bunch
Leaf colour	Dark green	Green
Seed colour	Tan testa	Tan testa

CROP MANAGEMENT

I. Rainfed

1. FIELD PREPARATION

i) Plough with tractor using a disc followed by harrow, once or twice with iron plough or 3 - 4 times with country plough till all the clods are broken and a fine tilth is obtained.

ii) Chiselling for soils with hard pan: Chisel the soils having hard pan formation at shallow depth with chisel plough first at 0.5 m interval in one direction and then in the direction perpendicular to the previous one, once in three years. Apply 12.5 t/ha of FYM or composted coir pith besides chiselling.

iii) Amendments for soil surface crusting: a) To stide over the surface crusting, apply Lime @ 2 t/ha along with FYM or composted coir pith @ 12.5 t/ha. b) Coir pith at 12.5 t/ha converted to compost by inoculating with *Pleurotus* and applied serves as a good source of nutrients.

2. APPLICATION OF FERTILIZERS

Apply NPK fertilizers as per soil test recommendation. If soil test is not done, follow the blanket recommendation.

N	P	K	
10	10	45	Kg/ha

For rainfed groundnut –castor intercropping system, apply the recommended dose of 10:10: 45 kg NPK ha^{-1} to the main crop of groundnut and for castor apply the recommended dose of 40 kg N

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

Rainfed Groundnut

Soil : Red sandy clay loam (Somayanur

Target : 1.0-1.2 t ha^{-1}

FN = 7.50 T - 0.33 SN - 0.45 ON

FP_2O_5 =3.50 T - 1.67 SP - 0.55 OP

FK_2O = 6.78 T - 0.31 SK - 0.43OK

Initial soil test values (kg ha^{-1})			Yield target – 1.0 t ha^{-1} NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + PSB @ 2 kg ha^{-1}			Yield target – 1.2 t ha^{-1} NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
160	12	160	5*	5*	23*	15**	8	23*
180	14	180	5*	5*	23*	11	5*	23*

200	16	200	5*	5*	23*	5*	5*	23*
220	18	220	5*	5*	23*	5*	5*	23*
240	20	240	5*	5*	23*	5*	5*	23*

* Maintenance dose;** Maximum dose

Note: FN, FP_2O_5 and K_2O are fertilizer N, P_2O_5 and K_2O in kg ha^{-1}, respectively; T is the yield target in q ha^{-1}; SN, SP and SK respectively are available N,P and K in kg ha^{-1} and ON, OP and OK are the quantities of N, P and K supplied through organic manure in kg ha^{-1}.

3. FORMING BEDS

i) Form beds of size 10 m^2 to 20 m^2 depending upon the slope of the land and type of soil.

ii) Wherever tractor is engaged, bed former may be used.

Or Ridges and furrows may be laid at 60cm spacing between ridges and sowing taken on both sides of the ridge

Or Raised bed with a width of 60cm and with a furrow of 15cm on either side may be formed and sowing taken on the raised bed

4. APPLICATION OF MICRONUTRIENTS

Apply TNAU MN mixture @ 7.5 kg /ha as Enriched FYM (Prepare enriched FYM at 1:10 ratio of MN mixture & FYM ; mix at friable moisture &incubate for one month in shade). Broadcast evenly on the soil surface immediately after sowing. Do not incorporate micronutrient mixture in to the soil.

5. NUTRITIONAL DISORDER

Zinc deficiency: Apply 25 kg $ZnSO_4$/ha as basal.

If soil analysis shows less than 1.2 ppm of Zinc, soil application of 25 kg $ZnSO_4$ is recommended. Reduce $ZnSO_4$ application from 25.0 kg ha^{-1} to 12.5 kg ha^{-1} if FYM is applied @ 12.5 t ha^{-1}. For the standing crop, less than 39.4 ppm of Zinc in leaves, foliar spray of 0.5% $ZnSo_4$ is recommended.

Iron deficiency: Foliar of spray 1% $FeSO_4$ + 0.1% citric acid thrice on 30, 40 and 50 days after sowing.

Boron deficiency: Application of Borax 10 kg

Sulphur deficiency: Gypsum 400 kg/ha as soil application at 45th day after sowing.

6. SEED RATE

Use 120 kg/ha of kernels, 175 kg/ha of kernels for bold seeded varieties.

7. SPACING

Adopt a spacing of 30 cm between rows and 10 cm between plants. Wherever Groundnut Ring Mosaic (bud necrosis) is prevalent, adopt a spacing of 15cm x 15 cm.

8. SEED TREATMENT

i) Treat the seeds with talc formulation of *Trichoderma viride* @ 4 g/kg seed or *Pseudomonas fluorescens* @ 10 g/kg seed.

Biocontrol agents are compatible with biofertilizers.

Treat the seeds with biocontrol agents first and then with *Rhizobium*. Fungicides and biocontrol agents are incompatible.

ii) Treat the seeds with *Trichoderma* @ 4g/kg. This can be done just before sowing. It is compatible with biofertilizers. SUCH SEEDS SHOULD NOT BE TREATED WITH FUNGICIDES

(or)

iii) Treat the seeds with Thiram or Mancozeb @ 4 g/kg of seed or Carboxin or Carbendazim at 2 g/kg of seed.

iv) Treat one hectare of seeds with 125 ml of *Rhizobium* (TNAU 14) and 125 ml of Phosphobacteria, shade dry it for 30 minutes before sowing

9. SOWING

- Use Kovai seed drill/gorru to sow the seeds in lines.
- Put one seed in each hole. Protect the seeds from crows and squirrels.

10. INTERCROPPING

i) Raise one row of cowpea for every five rows of groundnut wherever red hairy caterpillar is endemic.

ii) Raise intercrops like redgram, blackgram, sunflower, gingelly or other pulses.

iii) Cumbu can be raised as intercrop.

iv) Groundnut + Gingelly or Groundnut + Blackgram in the ratio of 4:1 or Groundnut + Cowpea at 6:1 ratio and Groundnut + Sunflower at 6:2 ratio may be raised.

11. WEED MANAGEMENT

i) **Pre-emergence**: Pendimethalin @ 1.0 litre/ha applied through flat fan nozzle with 500 l of water/ha. After 35 - 40 days one hand weeding may be given.

ii) If no herbicide is applied two hand weeding may be given on 20^{th} and 40^{th} day after sowing.

12. EARTHING UP

Accomplish earthing up during second hand weeding/late hand weeding (in herbicide application).

NOTE: i) Earthing up provides medium for the peg development

ii) Use the improved hoe with long handle which can be worked more efficiently in a standing position.

iii) Do not disturb the soil after 45th day of sowing as it will affect pod formation adversely.

13. APPLICATION OF CALCIUM SULPHATE (GYPSUM)

i) Apply Gypsum @ 400 kg/ha by the side of the plants on 40th to 70th day depending upon soil moisture.

ii) Apply Gypsum, hoe and incorporate it in the soil and then earth up.

iii) Avoid Gypsum in calciferous soils.

iv) Gypsum is effective in soils deficient in calcium and sulphur.

NOTE: Application of Gypsum encourages pod formation and better filling up of the pods.

Application of Gypsum at the rate of 50 % basal both in rainfed and irrigated condition reduces Khadhasty malady and pod scab nematode

Combined nutrient spray

Pod filling is a major problem especially in the bold seeded varieties. To improve pod filling spraying of nutrient solution is to be given. This can be prepared by soaking DAP 2.5 kg, Ammonium sulphate 1 kg and Borax 0.5 kg in 37 lit of water overnight. The next day morning it can be filtered and about 32 litre of mixture can be obtained and it may be diluted with 468 lit of water so as to made up to 500 litre to spray for one ha. Planofix at the rate of 350 ml. can also be mixed while spraying. This can be sprayed on 25th and 35th day after sowing.

14. HARVESTING

i) Observe the crop, considering its average duration. Drying and falling of older leaves and yellowing of the top leaves indicate maturity.

ii) Pull out a few plants at random and shell the pods. If the inner shell is brownish black and not white, then the crop has matured.

iii) Irrigate prior to harvest, if the soil is dry, as this will facilitate easy harvesting. If there is enough moisture in the soil, there is no need for irrigation for harvesting.

iv) If water is not available for irrigating the field prior to harvest, work a mould board plough or work a country plough, so that the plants are uprooted. Engage labour to search pods left out in the soil, if necessary.

NOTE: Do not keep the pulled out plants in heaps when they are wet, especially the bunch varieties, as the pods will start sprouting.

v) Strip off the pods from the plants. Groundnut stripper developed by TNAU can be used.

vi) Dry the pods in the sun for 4 or 5 days. Repeat drying for 2 or 3 more days after an interval of 2 or 3 days to ensure complete drying. When temperature is very high, avoid direct sun drying. Collect the pods in gunnies and store on the ground over a layer of sand to avoid any moisture coming in contact with dry pods.

I. Irrigated

1. FIELD PREPARATION

i) Plough with tractor using a disc followed by harrow, once or twice with iron plough or 3 - 4 times with country plough till all the clods are broken and a fine tilth is obtained.

ii) Chiselling for soils with hard pan: Chisel the soils having hard pan formation at shallow depth with chisel plough first at 0.5 m interval in one direction and then in the direction perpendicular to the previous one, once in three years. Apply 12.5 t/ha FYM or composted coir pith besides chiselling.

iii) Amendments for soil surface crusting: a) To tide over the surface crusting, apply Lime @ 2 t/ha along with FYM or composted coir pith @ 12.5 t/ha. b) When coir pith at 12.5 t/ha is converted into compost by inoculating with *Pleurotus* and applied, it serves as a good source of nutrient

2. APPLICATION OF FERTILIZERS

If soil test is not done, follow the blanket recommendation.

N	P	K
25	50	75 kg/ha

80 kg S as gypsum on 45 DAS

For calcareous soil, application of 40 kg S elemental sulphur along with either 50 kg $FeSO_4$ + 12.5 t FYM or 5 kg Fe EDTA can be used. For Sulphur deficient Calcareous soil, application of 60 kg S/ha elemental Sulphur as basal application is recommended. Growing CO7, ALR3 and CO2 can be recommended in Calcareous soils tolerate lime induced iron chlorosis while CO4, TMV2 and ALG320 were highly sensitive to iron deficiency.

N and K in three splits *viz.,* 50 % N & K as basal + 25 % N and K at 20 DAS + 25 % N and K at 45 DAS is recommended.

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

Groundnut (1)

Soil : Red sandy loam (Irugur series)

Target : 2.0 - 2.5 t ha^{-1}

FN =6.54T-0.56 SN-0.69 ON

FP_2O_5=3.80T-3.32 SP-0.77 OP

FK_2O=8.35T-0.65SK-0.87 OK

Initial soil test values (kg ha^{-1})			Yield target – 2.0 t ha^{-1} NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + PSB @ 2 kg ha^{-1}			Yield target – 2.5 t ha^{-1} NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
160	12	160	13*	25*	38*	34	35	65
180	14	180	13*	25*	38*	23	29	52
200	16	200	13*	25*	38*	13*	25*	39
220	18	220	13*	25*	38*	13*	25*	38*
240	20	240	13*	25*	38*	13*	25*	38*

* Maintenance dose

Groundnut (2)

Soil : Red sandy clay loam (Somayanur series)

Target : 2.0- 2.5 t ha^{-1}

FN = 6.54T - 0.51SN - 1.10 ON

FP_2O_5 = 4.19 T - 2.95SP - 0.77 OP

FK_2O = 5.47 T - 0.33SK - 0.87 OK

Initial soil test values (kg ha^{-1})			Yield target – 2.0 t ha^{-1} NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}			Yield target – 2.5 t ha^{-1} NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
160	12	160	13*	28	38*	38**	49	44
180	14	180	13*	25*	38*	32	43	38*
200	16	200	13*	25*	38*	22	38	38*
220	18	220	13*	25*	38*	13*	32	38*
240	20	240	13*	25*	38*	13*	26	38*

* Maintenance dose;** Maximum dose

Groundnut (3)

Soil : Low level Laterite

Target : 2.0- 2.5 t ha^{-1}

FN = 5.97 T - 0.45 SN

FP_2O_5 = 3.80 T – 3.32 SP

FK_2O = 7.08 T - 0.58 SK

Initial soil test values (kg ha^{-1})			Yield target – 2.0 t ha^{-1} NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + PSB @ 2 kg ha^{-1}			Yield target – 2.5 t ha^{-1} NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
160	12	120	13*	25*	38*	37	35	67
180	14	140	13*	25*	38*	28	29	56
200	16	160	13*	25*	38*	19	25*	44
220	18	180	13*	25*	38*	13*	25*	38*
240	20	200	13*	25*	38*	13*	25*	38*

* Maintenance dose

Note: FN, FP_2O_5 and K_2O are fertilizer N, P_2O_5 and K_2O in kg ha^{-1}, respectively; T is the yield target in q ha^{-1}; SN, SP and SK respectively are available N,P and K in kg ha^{-1} and ON, OP and OK are the quantities of N, P and K supplied through organic manure inkg ha^{-1}.

3. Forming Beds

Form beds of size 10 m land and type of soil to 20 m depending upon the availability of water, slope of the

- Wherever tractor is engaged, bed former may be used. or
- Ridges and furrows may be laid at 60cm spacing between ridges and sowing taken on both sides of the ridge
- Raised bed with a width of 60cm and with a furrow of 15cm on either side may be formed and sowing taken on the raised bed

4. POLYTHENE FILM MULCHING

Broad beds and furrows method of groundnut cultivation is a proven technology from ICRISAT. Considering the favourable environment in the Broad beds and furrows system for the development of groundnut pods, with a little modification in the size, beds are to be formed for the polyethylene film mulched groundnut. Make the beds at a width of 60 cm, leaving 15 cm on the either side for the furrows. In a plot size of 4.5 m x 6.0 m, five beds can be made. After the formation of the bed and fertilizer application, spread black polythene sheet (90 cm width) over the soil surface. The edges of the polyethylene can be coveted with soil

Seven micron polythene film sheet @50 kg/ha is required. Holes can be made at required spacing of 30 x10 cm before spreading of the sheets. The seed requirement is similar to normal groundnut cultivation

5. APPLICATION OF MICRONUTRIENTS

- Apply TNAU MN mixture @ 12.5 kg /ha as Enriched FYM . (Prepare enriched FYM at 1:10 ratio of MN mixture & FYM ; mix at friable moisture and incubate for one month in shade).
- Broadcast evenly on the soil surface immediately after sowing. Do not incorporate the micronutrient mixture in the soil.
- To increase flower retention, pod filling and to induce drought tolerance apart from yield improvement, 2 sprays of TNAU groundnut rich @ 5.0 kg/ha (for each spray) at 35 DAS (50 per cent flowering) and 45 DAS (Pod developing stage) in 500 litres of water is recommended

6. NUTRITIONAL DISORDER

Zinc deficiency: Apply 25 kg $ZnSO_4$/ha as basal.

If soil analysis shows less than 1.2 ppm of Zinc, soil application of 25 kg $ZnSo_4$ is recommended. Reduce $ZnSO_4$ application from 25.0 kg ha^{-1} to 12.5 kg ha^{-1} if FYM is applied @ 12.5 t $ha^{-1.}$ For the standing crop, less than 39.4 ppm of zinc in leaves, foliar spray of 0.5% $ZnSo_4$ is 4 recommended.

Iron deficiency : Foliar spray of 1% $FeSO_4$ + 0.1% Citric acid on 30, 40 and 50 days after sowing. Apply 50 kg $FeSO_4$ + 12.5 t FYM basally.

Boron deficiency: Application of Borax 10 kg basally (or) 0.2% boric acid twice on 40, 50 DAS.

For multinutrient deficiency: Apply 25 kg $ZnSO_4$ + 10 kg borax + 20kg S as Gypsum.

Copper deficiency: Basal application of 10 kg $CuSO_4$ or 0.2% $CuSO_4$. Spray twice after observing plant nutrient deficiencies.

7. SEED RATE

Use 125 kg/ha of kernels. Increase the seed rate by 15% in the case of bold seeded varieties.

8. SPACING

Adopt a spacing of 30 cm between rows and 10 cm between plants. Wherever groundnut ring mosaic (bud necrosis) is prevalent, adopt a spacing of 15cm x 15 cm.

9. SEED TREATMENT

i) Treat the seeds with *Trichoderma viride* @ 4 g/kg seed or *Pseudomonas fluorescens* @ 10 g/kg seed.

Biocontrol agents are compatible with biofertilizers.

First treat the seeds with biocontrol agents and then with *Rhizobium*.
Fungicides and biocontrol agents are incompatible.

ii) Treatment with *Trichoderma* can be done just before sowing. such **seeds should not be treated with fungicides.**

iii) Treat the seeds with Thiram or Mancozeb @ 4 g/kg of seed or Carboxin or Carbendazim at 2 g/kg of seed.

iv) Treat the seeds with 3 packets (600 g)/ha of Rhizobial culture TNAU14 developed at TNAU using rice kanji as binder. If the seed treatment is not carried out, apply 10 packets/ha (2000 g) with 25 kg of FYM and 25 kg of soil before sowing.

Seed treatment will protect the young seedlings from root-rot and collar rot infection.

10. SOWING

a) Dibble the seeds at 4 cm depth along with fertilizer.

11. WEED MANAGEMENT

i. **Pre-emergence**: Pendimethalin @ 1.0 litre/ha applied on third day after sowing through flat fan nozzle with 500 litres of water/ha followed by irrigation. After 35 - 40 days one hand weeding may be given.

ii. Spray Early post emergence application of Imazethapyr @ 50 ml/ha at 20-30 days after sowing based on weed density as post emergence spray

iii. If no herbicide is applied two hand hoeing may be given on 20^{th} and 40^{th} day after sowing.

iv. Apply, PE Oxyfluorfen @ 200 g/ha on 3^{rd} DAS and followed by one hand weeding on 40-45 DAS

v. Apply, PE Oxadiazon @ 0.8 kg ha^{-1} followed by one earthing up using hoes (or) working star type weeder

12. EARTHING UP:

Accomplish earthing up during second hand weeding/late hand weeding (in herbicide application).

NOTE: i) Earthing up provides medium for the peg development. ii) Use the improved hoe with long handle which can be worked more efficiently in a standing position. iii) Do not disturb the soil after the 45th day of sowing as it will affect pod formation adversely.

13. APPLICATION OF GYPSUM

- Apply Gypsum @ 400 kg/ha by the side of the plants on the 40th to 45th day of sowing.
- Apply Gypsum, hoe and incorporate in the soil and then earth up.
- Avoid Gypsum in calciferous soils.
- Gypsum is effective in soils deficient in calcium and sulphur.

NOTE*: Application of Gypsum encourages pod formation and better filling up of the pods.*

Application of gypsum at the rate of 50 % basal both in rainfed and irrigated condition reduces Khadhasty malady and pod scab nematode

Combined nutrient spray

Pod filling is a major problem especially in the bold seed varieties. To improve pod filling spraying of nutrient solution is to be given. This can be prepared by soaking DAP 2.5 kg, Ammonium sulphate 1 kg and borax 0.5 kg in 37 lit of water overnight. The next day morning it can be filtered and about 32 litre of mixture can be obtained and it may be diluted with 468 lit of water so as to made up to 500 litre to spray for one ha. Planofix at the rate of 350 ml. can also be mixed while spraying. This can be sprayed on 25th and 35th day after sowing. or Spray TNAU Groundnut Rich @ 5.5 kg/ha for 2 sprays (50 per cent flowering and pod developing stage) to increase flower retention and pod filling.

14. WATER MANAGEMENT

Schedule the irrigation at 0.40 and 0.60 IW/CPE ratio during vegetative and reproductive phase respectively. Regulate irrigation as per the growth phase of the crop. Pre-flowering phase : 1 to 25 days Flowering phase : 26 to 60 days Maturity phase: 61 to 105 days Regulate irrigation based on physiological growth phases. Pegging, flowering and pod development phases are critical for irrigation during which period adequate soil moisture is essential. Irrigate as follows:

i) Sowing or pre-sowing

ii) Life irrigation, 4 - 5 days after sowing.

iii) 20 days after sowing

iv) At flowering give two irrigations
v) At pegging stage give one or two irrigations
vi) In pod development stage, 2 - 3 irrigations depending on the soil type

Note: Spraying 0.5% Potassium chloride during flowering and pod development stages will aid to mitigate the ill effects of water stress. Sprinkler irrigation will save water to the tune of about 30%. Borderstrip irrigation is recommended in command areas in light textured soils. Composted coir pith increases moisture availability and better drainage in heavy textured soil.

15.HARVESTING

i) Observe the crop, considering its average duration. Drying and falling of older leaves and yellowing of the top leaves indicate maturity.
ii) Pull out a few plants at random and shell the pods. If the inner shell is brownish black and not white, then the crop has matured.
iii) Irrigate prior to harvest, if the soil is dry, as this will facilitate easy harvesting. If there is enough moisture in the soil, there is no need for irrigation for harvesting.
iv) If water is not available for irrigating the field prior to harvest, work a mould board plough or work a country plough, so that the plants are uprooted. Engage labour to search pods left out in the soil, if necessary.

NOTE: Do not keep the pulled out plants in heaps when they are wet, especially the bunch varieties, as the pods will start sprouting.

v) Strip off the pods from the plants. Groundnut stripper developed by TNAU can be used.
vi) Dry the pods in the sun for 4 or 5 days. Repeat drying for 2 or 3 more days after an interval of

2 or 3 days to ensure complete drying. When temperature is very high, avoid direct sun drying. Collect the pods in gunnies and store on the ground over a layer of sand to avoid any moisture coming in contact with dry pods.

CROP PHYSIOLOGY

Foliar spray of TNAU Groundnut Rich @ 2 kg/acre in 200 litres of water at peak flowering and at pod development stages increases flower retention, pod filling and improves moisture stress tolerance and pod yield.

CROP PROTECTION

Economic threshold level for important pests

Pest	ETL
Leaf miner	Leaf miner 1 larva / m row
Tobacco caterpillar	8 egg masses/100 m row

Pests Management strategies

Red hairy caterpillar, *Amsacta albistriga*	• Dig out and destroy the pupae from field bunds and shady spots prior to summer rains. • In rain fed crop set up 3 to 4 light traps and bonfires immediately after rains to attract and kill the moths. • Collect and destroy gregarious, early instar larvae on lace-like leaves of intercrops such as redgram and cowpea. • Collect and destroy egg masses in the cropped area. • Dig a trench 30 cm deep and 25 cm wide with perpendicular sides around the infested fields to avoid larval migration. • Spray Aa NPV • Apply quinalphos 1.5 DP 25 kg/ha
Virus multiplication Collect medium sized larvae of *Amsacta albistriga* from the field and starve them over night. Make a pure suspension of virus with the nucleus culture in water. Dip *Calotropis* leaves in virus suspension, shade dry and feed them to starved larvae for 1 or 2 days. From third day, normal, untreated leaves can be fed to these larvae. From 5th day, the treated larvae will start dying. Virus infected larvae can be diagnosed by their pinkish ventral surface, their head hanging downwards with white body contents oozing out through ruptured body wall in the late stage. Collect the dying larvae, keep in fresh potable water for a few days, grind the larvae and filter through several layers of fine cloth and collect filtrate (Crude virus suspension). Use virus suspension obtained from 750 medium sized larvae for spraying one hectare along with a sticker 250 ml or Triton in 350 L of water. Use potable water for mixing and spray in the evening hours.	
Tobacco caterpillar**,** *Spodoptera litura*	• Grow castor as border or intercrop in groundnut fields to serve as indicator or trap crop. • Monitor the emergence of adult moths by setting up light trap and pheromone traps. • Collect egg masses and destroy. • Collect the gregarious larvae and destroy

	them as soon as the early symptoms of lace-like leaves appear on castor, cowpea and groundnut. • Spray Methomyl 40 SP 750ml / ha to control the early instar (1st to 3rd instar) larvae. • Spray NSKE 5% • Apply Nuclear Polyhedrosis Virus 1.5 x 10^{12} POBs/ha with crude sugar 2.5 kg/ha and Teepol 250 ml/ ha.
Leaf hopper, *Empoasca kerri*	Intercrop lab lab with groundnut 1:4 ratio **Spray any one of the following insecticides.** Imidacloprid 17.8 SL 100 ml Quinalphos 25 EC 1400 ml
Leafminer / Leaf webber, *Aproaerema modicella*	Set up light trap between 8 and 11 pm at ground level **Spray any one of the following insecticides** Methyl demeton 25 EC 1000 ml Quinalphos 25 EC 1400 ml
Podborer (Earwig) *Anisolabis stali*	Apply Carbofuran 3 CG 50 kg/ha to the soil prior to sowing in endemic areas. Repeat soil application of any formulations on the 40th day of sowing and incorporate in the soil during the earthing up.
White grubs *Holotrichia consanguinea, H. serrata*	Apply Carbofuran 3 CG 33.3 kg/ha
Aphid *Aphis craccivora*	**Apply anyone of the following insecticides** Imidacloprid 17.8 SL 100 ml Methyl demeton 25 EC 1000 ml
Thrips *Scirtothrips dorsalis*	Apply Quinalphos 1.5 DP 23.3kg/ha Spray Quinalphos 25 EC 1400 ml/ha
Termites	Apply Thiamethoxam 75 SG@125 g/ha

DISEASE MANAGEMENT

Seed treatment : Treat the seeds with Carbendazim @ 2 g/kg or *Trichoderma asperellum* @ 4 g /kg or *Pseudomonas fluorescens* @ 10 g/kg of seeds

Disease	Recommendations
Rust: *Puccinia arachidis*	Spray Mancozeb @ 1000 g /ha or Chlorothalonil @ 1000 g /ha or wettable Sulphur @ 2500 g /ha. If necessary, repeat the spray 15 days later.
Early leaf spot: *Cercopora arachidicola* (*Mycosphaerella arachidis*) **Late leaf spot:** *Phaeoisariopsis personata* (*Mycosphaerella berkeleyii*)	Spray Carbendazim @ 500 g/ha or Mancozeb @ 1000 g/ha or chlorothalonil @ 1000 g/ha. If necessary, repeat the spray 15 days later. **CIB Recommendation** • Spray Hexaconazole 5% EC @ 1500ml/ha or Metiram 70% WG 2 kg/ha or Propiconazole 25% EC @ 500 ml/ha or pyraclostrobin 20% WG @ 500g/ha or Sulphur 40% WP @ 5.65-7.50 kg/ha or sulphur 80% WP @ 2.5-5.0 kg/ha or sulphur 85% DP @ 15-20 kg/ha or Carbendazim 12% + Mancozeb 63% WP @ 500 g/ha or fluxapyroxad 167 g/l + Pyraclostrobin 333 g/l SC @ 300 ml/ha or Pyraclostrobin 133g/l + Epoxiconaxole 50g/l SE @ 500/ha **For combined infection of leaf spot and rust** • Spray Bitertanol 25% WP @ 1 kg/ha or Chlorothalonil 75% WP @ 1.5 g/l or Mancozeb75% WP @ 1.5 to 2 kg/ha or Tebuconazole 25.9% m/m EC @ 0.50-0.75 l/ha **For combined infection of leaf spot and stem rot** • Spray Carbendazim 25% +Flusilazole 12.5% SE @ 640-800 g/ha **For collar rot, seed rot, root rot and stem rot** • Treat the seeds with Carboxin37.5% + Thiram 37.5% DS @ 3g/kg of seeds **For the management of termites, thrips, jassids, root grubs, collar rot and stem rot** • Spray Imidacloprid 18.5% + Hexaconazole 1.5 % FS @ 200 ml/ha
Combined infection of rust and leaf spot	Spray 10% *Calotropis* leaf extract or spray Carbendazim @ 250 g + Mancozeb 1000 g/ha or Chlorothalonil @ 1000g/ha. If necessary, give the second spray 15 days later.

Root rot: *Macrophomina phaseolina* (*Rhizoctonia bataticola*)	• Soil application of *P. fluorescens* @ 2.5 kg /ha with 50 kg of well decomposed FYM / sand at 30 DAS. • Spot drench with Carbendazim @ 1 g / L
Groundnut bud necrosis: (*Groundnut bud nercrosis virus*) (Vector: *Thrips tabaci, Frankliniella schultzeii*)	• Antiviral principles (AVP) from Sorghum or Coconut leaves. AVPs are extracted as follows: Sorghum or Coconut leaves are collected, dried, cut into small bits and powdered. To one kg of leaf powder two litres of water is added and heated to 60°C for one hour. It is then filtered through muslin cloth and diluted to 10 litres and sprayed. To cover one hectare area 500 l of fluid will be required. Two sprays at 10 and 20 days after sowing will be needed. • For vector management, apply quinalphos 1.5 DP 23.3kg / ha or spray quinalphos 25 EC @ 1400 ml/ha

GROUNDNUT – VARIETAL SEED PRODUCTION

Land requirement

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

Isolation

- For certified / quality seed production, leave a distance of 3 m all around the field from the same and other varieties of the crop.

Season

- June - July and December - January.

Spacing

- 25 x 15 cm.

Pre-sowing seed hardening

- Harden the graded seeds by soaking in 0.5 % $CaCl_2$ (50 % seed volume) for 6 h. After 6 h soaking, incubate the seeds in between moist gunny bags for 12 -18 h. Observe the sprouting of radicle periodically at 2 h interval after 12 h of incubation.
- Separate the seeds with sprouted radicle (just visible expression of radicle) and dry under shade.

Fertilizer requirement

- Apply NPK @ 25:50:75 kg / ha as blanket.
- Apply Borax as basal application @ 10 kg / ha in Boron deficient soils.
- Apply Gypsum @ 400 kg / ha at peg formation stage and at earthing.

Foliar application

- NAA @ 200 ppm at 60 days after sowing to arrest late formed flowers and increase the seed yield in groundnut.

Pre-harvest spray to arrest *in situ* germination

- Spray 1250 ppm MH (Maleic Hydrazide) at 60 days after sowing.

Harvest

- Harvest the pods as and when the colour of the inner side of the shell turns black and dry to 10 - 12 per cent moisture.

Drying

- Stake the plants as the pods are exposed outside for easy drying of pods.
- Dry the pods to 15 - 20 % moisture content under sun.

Decortication

- Dry the pods to 16 per cent moisture content and decorticate either manually or using hand operated decorticator with proper adjustment.
- Dry the kernels to 7 to 8 per cent moisture.
- Practice pod verification based on varietal characteristic before grading to remove genetically impure seeds.
- Remove all discoloured pods.
- Reject mechanically injured pods for seed purpose.

Pre-storage seed treatment

- Treat the pods with Carbendazim @ 2 g / kg at 6 - 7 % moisture content.

Seed storage

- Store the pods in gunny bags with Calcium chloride @ 250 g / 30 kg of pods.
- Store the seeds in gunny for short term storage (8 - 9 months) with a seed moisture content of 8 - 9 %.
- Store the seeds in polylined gunny bag for medium term storage (12 - 15 months) with a seed moisture content of 6 - 8 %.
- Store the seeds in 700 gauge polythene bag for long term storage (more than 15 months) with a seed moisture content less than 5 %.