

TECHNOLOGY FOR DRYLAND AGRICULTURE

Growing of crops in rainfed situation is known as dryland agriculture. In Andhra Pradesh, out of 148 lakh hectares of cultivable land, nearly 105 lakh hectares is under rainfed agriculture, with 65% area under red soils and 25% area under black soils. 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 m² 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 m² 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.
- 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.
- 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 m³ with dimensions of 10 m length x 10 m breadth x 2.5 m depth to store 250000 lts of water. Supplemental irrigation of 10 mm through sprinkler at moisture stress during critical stages, increases groundnut pod yield by 25-30%. In black soils farm ponds will also serve as both rain water storage and also drainage water storage during excess rains. These water can be reused for supplemental irrigation during dryspells.

SUITABLE CROPS

Red soils

- Groundnut, sorghum, pearl millet, fox tail millet, redgram, greengram, cowpea, castor and horsegram are suitable crops. Groundnut + Redgram (11:1), groundnut + castor (11:1), sorghum + Redgram (2:1) 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 intercrop of groundnut + redgram is profitable. If rainfall is received after August, the suitable contingent crops are fodder pearl millet, fodder sorghum, greengram, 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.

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 P₂O₅ and 40 kg K₂O/ha are necessary for groundnut and groundnut + redgram. For horsegram, apply 10 kg N and 30kg P₂O₅/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 ₂ O ₅) (kg/ha)		Potassium (K ₂ 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 33⁰C 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*. Erection of pheromone traps @ 8 per acre suppresses the population of leaf miner by pheromone mass trapping technique.
- b) **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.

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 gorry 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 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.