

**PROFESSOR JAYASHANKAR TELANGANA STATE
AGRICULTURAL UNIVERSITY**



DA-102

CROP PRODUCTION-1

Narendar Jannu

**Asst. Professor (Agronomy)
APT, Jammikunta**

Dr.A.Madhavi Lata

Principal, APT Malthummeda

G. Swathi

**Asst. Professor (Hort.)
APT, Kampasagar**

Index

Lc. No. 1	Importance of the cereal crops- paddy – area of cultivation, production and productivity- economic importance- climate conditions.
Lc. No. 2	Paddy- soils, sowing time, nursery preparation, types of nursery- wet nursery, dry nursery, SRI method, method of transplanting with transplanter- precautions for healthy nursery raising.
Lc. No. 3	Paddy- time of sowing- methods of sowing- spacing- precautions for aged nursery transplanting. Main field preparation.
Lc. No. 4	Paddy- important varieties- it's characters- seed rate, seed treatment, breaking seed dormancy.
Lc. No. 5	Paddy- nutrient management (integrated nutrient management, iron, zinc deficiency, symptoms and its correction), weed management, water management.
Lc. No. 6	Paddy- cropping systems, maturity, harvesting- storage – yield attributes- yield- export quality parameters.
Lc. No. 7	Paddy- SRI method of cultivation- direct seeding method- aerobic rice (Dry cultivation)
Lc. No. 8	Maize- area of cultivation, production and productivity- economic importance- climate conditions. Maize varieties, sweet corn, baby corn, pop corn- soils, sowing time, method of sowing- spacing- field preparation, important varieties- characters , seed rate- seed treatment.
Lc. No. 9	Maize- nutrient management, weed management, water management
Lc. No. 10	Maize – cropping systems, maturity, harvesting- storage – yield attributes- yield- value addition by products.
Lc. No. 11	Maize - Zero tillage cultivation
Lc. No. 12	Sorghum -area of cultivation, production and productivity- economic importance- climate conditions. Sorghum cultivated zones- soils, sowing time, method of sowing- spacing- field preparation, important varieties- characters , seed rate- seed treatment
Lc. No. 13	Sorghum - nutrient management, weed management, water management, maturity, harvesting- storage – yield attributes- yield- forage sorghum

	varieties.
Lc. No. 14	Bajra- area of cultivation, production and productivity- economic importance- climate conditions. soils, sowing time, method of sowing- spacing-
Lc. No. 15	Bajra- nursery raising techniques, field preparation, important varieties, seed rate, seed treatment.
Lc. No. 16	Bajra- nutrient management, weed management, water management, maturity, harvesting- storage – yield attributes- yield.
Lc. No. 17	Ragi / Finger millet- area of cultivation, production and productivity- economic importance- climate conditions, sowing time, method of sowing- spacing- field preparation, important varieties, seed rate, seed treatment. nutrient management, weed management, water management, maturity, harvesting- storage – yield attributes- yield
Lc. No. 18	Importance of the pulses, reasons for reduction of yield losses in pulses, methods to improve the yields. Redgram- area of cultivation, production and productivity- economic importance- climate conditions. - soils, sowing time, method of sowing- spacing- field preparation, important varieties, seed rate, seed treatment.
Lc. No. 19	Redgram- differences between <i>kharif</i> and <i>rabi</i> cultivation, nutrient management, weed management, water management, cropping system, maturity, harvesting (post harvest technologies) storage – yield attributes- yield
Lc. No. 20	Bengal gram- area of cultivation, production and productivity- economic importance- climate conditions. - soils, sowing time, method of sowing- spacing- field preparation, important varieties, seed rate, seed treatment.
Lc. No. 21	Bengal gram- differences between kabuli variety and local variety, nutrient management, weed management, water management, cropping system, maturity, harvesting (post harvest technologies) storage – yield attributes- yield
Lc. No. 22	Soybean - area of cultivation, production and productivity- economic importance- climate conditions. - soils, sowing time, method of sowing- spacing- field preparation, important varieties, seed rate, seed treatment. nutrient management, weed management, water management,

	cropping system, maturity, harvesting, storage – yield attributes- yield
Lc. No. 23	Blackgram - area of cultivation, production and productivity- economic importance- climate conditions - soils, sowing time, method of sowing- spacing- field preparation, important varieties, seed rate, seed treatment. nutrient management, weed management, water management, cropping system, maturity, harvesting, storage – yield attributes- yield, problems in rice followed by black gram cultivation, control measures.
Lc. No. 24	Greengram - area of cultivation, production and productivity- economic importance- climate conditions. - soils, sowing time, method of sowing- spacing- field preparation, important varieties, seed rate, seed treatment. nutrient management, weed management, water management, cropping system, maturity, harvesting, storage – yield attributes- yield, problems in greengram cultivation, control measures.
Lc. No. 25	Horsegram- area of cultivation, production and productivity- economic importance- climate conditions. - soils, sowing time, method of sowing- spacing- field preparation, important varieties, seed rate, seed treatment. nutrient management, weed management, water management, cropping system, maturity, harvesting, storage – yield attributes- yield.
Lc. No. 26	Cowpea- area of cultivation, production and productivity- economic importance- climate conditions. - soils, sowing time, method of sowing- spacing- field preparation, important varieties, seed rate, seed treatment. nutrient management, weed management, water management, cropping system, maturity, harvesting , storage – yield attributes- yield.
Lc. No. 27	Forage crops – Napier grass- area of cultivation, production and productivity- economic importance- climate conditions. - soils, sowing time, method of sowing- spacing- field preparation, important varieties, seed rate, seed treatment. nutrient management, weed management, water management, cropping system, maturity, harvesting , storage – yield attributes- yield.
Lc. No. 28	Paragrass - area of cultivation, production and productivity- economic importance- climate conditions. - soils, sowing time, method of sowing- spacing- field preparation, important varieties, seed rate, seed treatment. nutrient management, weed management, water management, cropping

	system, maturity, harvesting, storage – yield attributes- yield.
Lc. No. 29	Guinea grass- area of cultivation, production and productivity- economic importance- climate conditions. - soils, sowing time, method of sowing- spacing- field preparation, important varieties, seed rate, seed treatment. nutrient management, weed management, water management, cropping system, maturity, harvesting, storage – yield attributes- yield.
Lc. No. 30	Lucerne- area of cultivation, production and productivity- economic importance- climate conditions. - soils, sowing time, method of sowing- spacing- field preparation, important varieties, seed rate, seed treatment. nutrient management, weed management, water management, cropping system, maturity, harvesting, storage – yield attributes- yield.
Lc. No. 31	Berseem - area of cultivation, production and productivity- economic importance- climate conditions. - soils, sowing time, method of sowing- spacing- field preparation, important varieties, seed rate, seed treatment. nutrient management, weed management, water management, cropping system, maturity, harvesting, storage – yield attributes- yield.
Lc. No. 32	Stylosanthus- area of cultivation, production and productivity- economic importance- climate conditions. - soils, sowing time, method of sowing- spacing- field preparation, important varieties, seed rate, seed treatment. nutrient management, weed management, water management, cropping system, maturity, harvesting, storage – yield attributes- yield

Lecture No. 1

Importance of Food crops

1. Cereals *i.e* rice and wheat, millets like maize, sorghum, finger millet and other minor millets are major staple food for world human population.
2. Rice is the major food crop grown in world after wheat. Rice is most important food crop for Asian Countries, whereas wheat consumption is high in the Western world.
3. In India, rice is major food crop in Southern states where as in Northern states wheat is the major food crop.
4. Wheat is staple food for 10 billion people in world. In India, wheat occupies second place after rice. .
5. Maize is one of the most important grain crops in the world and it has highest productivity among all the grain crops. It is mainly used as feed for poultry and livestock. It is also consumed as sweet corn, pop corn and baby corn.
6. Maize is gaining more importance as it is the basic raw material for many industries.
7. Sorghum is the basic food in Asia and Africa. Sorghum stalks are mainly used as fodder for livestock.
8. In maize and Jowar, special fodder varieties were developed and at milky stage stalks were cut into small pieces with chopping machine and used as feed in many places. If higher fodder yield is obtained it is converted into silage and used as feed to cattle to increase the milk yield.
9. Barley and oats are majorly used as fodder and barley malt is the basic raw material for beer making.
10. In South India, Ragi is the major food crop and it is considered as healthy food. Both rich and poor people consume Ragi as it is healthy and affordable food. It is one of the important foods for diabetic patients to control diabetes.
11. Other minor millets are majorly grown in drought and hilly areas and it is the major staple food for tribal people. Minor millets are drought tolerant crops.
12. In storage, minor millets are safely stored for 2-3 years without any pest and disease infestation. In drought years, minor millets are the major meal for human population.
13. High fibre content in minor millets enhances the human health. For labour, this food is considered as energy food due to hunger reduction. In world, various people consume all grain types in different forms prepared by different methods.

RICE

Scientific Name: *Oryza sativa*

Family: Poaceae

Economic importance:

- Rice is an important staple food crop for more than 60 per cent of the world population.
- Rice bran is used in cattle and poultry feed, defatted bran, which is rich in protein, can be used in the preparation of biscuits and as cattle feed.
- Oil is extracted from rice bran.
- Rice husk is used as fuel source. It is also used as organic matter, which improves the soil structure.
- Paddy straw is used in card board making industry as insulating and cementing agent. It is used as cattle feed, live stock bedding, used for thatching roof and in cottage industry for preparation of hats, mats, ropes, sound absorbing.
- Rice husk is used in poultry industry as “litter”, this litter can be used as bulky organic manure after decomposition.
- Rice bran oil is used in soap industry. Refined oil can be used for cooking.
- 90% of the rice is mainly cultivated in Asian countries like China, India, Indonesia, Pakistan and Japan.

Area, Production, Productivity details of rice.

	Area (M. Ha)	Production (Mt)	Productivity (kg/ ha)
India	43.79	116.42	2659
Telangana (Irrigated)	31.79	207.44	6525

Climate requirement

- In India, rice is grown under widely varying conditions of altitude and climate.
- Rice cultivation in India extends from 8 to 35°N latitude and from sea level to as high as 3000 metres.
- Rice crop needs a hot and humid climate. It is best suited to regions which have high humidity, prolonged sunshine and an assured supply of water.

- The optimum temperature required for crop growth is 25-30 °C. But night temperatures can affect the starch deposition due to high respiration. Hence for better yields 25-33 °C day temperatures and 15-20 °C night temperatures are required.
- An average temperature of 25-30 °C can reduce the crop duration and encourages the flowering. As well as average temperature less than 15°C can hinder the crop growth and flowering ceases.
- Temperature requirement for blooming is in the range of 26.5 to 29.5°C.
- At the time of ripening, the temperature should be between 20-25°C.
- The areas where the sunlight is high is good for paddy cultivation, bright sunlight hours increase the photosynthesis rate.
- High wind velocity may cause the crop lodging, grain fall in reproductive stage. Paddy is cultivated in different climatic conditions, hence it is difficult to fix the suitable climatic conditions.
- Photo-periodically, rice is a short-day plant. However, there are varieties which are non-sensitive to photoperiodic conditions.

Lecture No. 2

Soils

- Soils having good water retention capacity with good amount of clay and organic matter are ideal for rice cultivation.
- The semi aquatic nature of the crop necessitates a heavy soil through which the irrigation or rain water will not be easily drained away because the demands of rice are more precise for water than soil conditions.
- Sandy soils to heavy soils are most preferable to rice crop cultivation.
- The crop has preference to 5.5 to 6.5 PH. Redsoils, black soils and laterite soils are also suitable.

Sowing Time:

- Suitable time for sowings in different areas:

Area	Kharif (Salva)	Rabi (Dalva)
Krishna, Godavari, Telangana	July	December
North kosta	August	November
Southern divisions	September	November
Less rainfall divisions	July – August	December

Nursery sowing time:

Nursery beds are prepared and sown on receipt of showers during the month of June. 20-25 days old seedlings are transplanted in main field.

Land preparation for transplanting:

Puddling should be done before 15 days of transplanting. Puddling to be done 2-3 times, green manures to be puddled 20-25 days prior to transplanting, to facilitate good decomposition, Single super phosphate (SSP) should be applied for better decomposition. Land should be levelled with levelling plank before transplantation. Equal water level to be maintained in entire field. It is better to complete puddling 2 days before transplanting in black cotton soils

Nursery preparation

Seedlings can be raised by different methods in rice. Dry nursery and wet nursery methods are mainly used to raise the nursery.

Dry Nursery

- The nursery is prepared in dry soil conditions
- The field is dry ploughed 5-6 times to acquire the fine tilth.
- Nursery area with sand and loamy soil status is more suitable for this type of nursery.
- Plots of 1 to 1.5 m bed width and channels may be formed. Length may be according to the slope and soil.
- Sowing may be dry seeding. Seeds may be covered with sand and finely powdered farm yard manure.
- This type of nursery is handy in times of delayed receipt of canal water

Wet Nursery

- The wet-bed nursery is mainly used in areas where there is enough water.
- Soil should be dry ploughed twice and apply 1tonne of FYM or compost to 20cents nursery.
- Later, it should be irrigated and allowed to be wet for another two days.
- Afterwards it should be puddled twice and the puddling may be repeated after a gap of one week.
- After levelling and final puddling, beds of convenient length (8-10 m) with width of 2.5 m are to be made, leaving 30 - 50 cm channels in between two beds.
- Sow the sprouted seeds uniformly on the seedbed.
- If the seeds are required for sowing immediately, keep the soaked seed in gunny bag in dark room for 24hrs for sprouting.

System of Rice Intensification (SRI) Nursery

- Prepare 100 m² nursery to plant 1 ha area.
- Select a levelled area near the water source.
- Spread a plastic sheet or used polythene gunny bags on the shallow raised bed to prevent roots growing deep into soil.
- 4m³ of soil mix is needed for each 100 m² of nursery. Mix 70% soil + 20% well-decomposed pressmud / bio-gas slurry / FYM + 10% rice hull.
- Incorporate in the soil mixture 1.5 kg of powdered di-ammonium phosphate or 2 kg 17-17-17 NPK fertilizer.

- Place a wooden frame of 0.5 m long, 1 m wide and 4 cm deep divided into 4 equal segments on the plastic sheet or banana leaves. Fill the frame almost to the top with the soil mixture.
- Soak the seeds for 24 hr, drain and incubate the soaked seeds for 24 hr, sow when the seeds sprout and radical (seed root) grows to 2-3 mm long.
- Sow the pre-germinated seeds weighing 90-100 g/m² (100g dry seed may weigh 130g after sprouting) uniformly and cover them with dry soil to a thickness of 5mm.
- Sprinkle water immediately using rose can to soak the bed and remove the wooden frame and continue the process until the required area is completed.
- Water the nursery with rose-can as and when needed (twice or thrice a day) to keep the soil moist. Protect the nursery from heavy rains for the first 5 DAS.
- At 6 DAS, maintain thin film of water all around the seedling mats.
- Drain the water 2 days before removing the seedling mats for transplanting.
- If seedling growth is slow, sprinkle 0.5% urea + 0.5% zinc sulphate solution at 8-10 DAS.
- Seedlings reach sufficient height for planting at 15 days. Lift the seedling mats and transport them to main field.

Nursery raising for machine transplanting

- Raise seedlings in special mat nurseries or in seedling trays.
- Use 18–25 kg of good seed per 100 m² of nursery for each ha.
- Seedlings will be ready for transplanting in 15–20 days after seeding (DAS).
- Load the seedling mats into the machine and transplant the seedlings at the selected machine setting.
- 15–20 days aged seedlings can be transplanted in 6-8 rows at a time with the help of transplanters.

Precautions to be taken for healthy nursery raising:

- Nursery to be puddled 3-4 times with an interval of 10-12 days. Canals to be prepared to irrigate and drain.
- 2kg Nitrogen (1 kg before sowing and remaining kg 15 days after sowing), 1 kg Phosphrous, 1 kg potash fertilizers to be added in primary tillage, phosphrous fertilizers to be added double in chill areas.
- Sprouted 5kg seeds to be broadcasted evenly per cent land.

- Regular irrigation is required till full bloom of single leaf and water level to be maintained.
- 2grams zinc sulphate in litre water solution to be sprayed where the Zn deficiency is observed.

Lecture No. 3

Transplanting methods

Generally line sowing is beneficial in paddy cultivation, but it is expensive

Transplanting

- Seedlings with 4-6 leaves should be used for transplanting. Yield will be reduced with aged seedlings.
- Shallow planting (3 cm) ensures quick establishment and more tillers
- Thin layer of water should be maintained during transplanting
- After transplanting path with 20 cm (alley ways) at every 2 metres will increase aeration, ventilation and will reduce pests and disease incidence.
- These paths also help in fertilizers, pesticides and herbicides application and for better observation of the crop.
- Based on rice varieties crop duration ,tillers number should be decided.

Tiller number based on rice varieties crop duration

Crop duration	Transplanting distance (cm)	Tillers per square meter
Long duration varieties (more than 150 days)	20 x 15	33
Medium duration varieties (125-135 days)	15 x 15	44
Short duration varieties (110-120 days)	15 x 10	66

Spacing

Kharif: 15 x 15 cm or 15 x 20 cm

Rabi: 15 x 10 cm

- With late tillering varieties or overaged seedlings, spacing may be even upto 15 x 10 cm or 20 x 10 cm.

However, avoid close planting in endemic areas of BPH incidence.

Management of aged seedlings

- Number of hills per unit area and number of seedlings per hill to be increased when aged seedlings are planted.
- Top 3-4 inches leaf sheath should be removed.
- Nursery / seedlings beyond 60 days should not be planted.
- Avoid cluster planting of aged seedlings which are hindering the formation of new tillers.
- New tillers alone are capable of producing normal harvestable panicle. Weak panicle may appear in the mother culm within three weeks after transplanting and vanishes well before harvest.
- To encourage the tiller production, enhance the basal N application by 50% from the recommended and thereafter follow the normal schedule recommended for other stages

Land preparation

- Puddling should be done 15 days prior to transplanting
- Flood the field 1 or 2 days before ploughing and allow water to soak in. Keep the surface of the field covered with water.
- Keep water to a depth of 2.5cm at the time of puddling.

Lecture No. 4

Seed treatment:

3grams of Carbendazim should be mixed to 1 kg paddy seeds and seeding can be done after 24 hours in nursery. 1 gram carbendazim should thoroughly be mixed in 1 litre of water, seed to be soaked for 24 hours, and to be sown after 24 hours in dry paddy. 1 litre of water is enough for soaking of 1 kg of seeds.

Breaking of seed Dormmancy:

To get germination after harvesting of the crop to break the seed dormancy 6.3ml for less dormant seeds and high dormant seeds like “Vijetha” 10 ml of concentrated nitric acid per litre water to be used and seeds should be soaked for 24 hours and seeds should be sown after 24 hours.

Seed rate : (per acre)

For Dry paddy – 20-25kgs
Broadcasting- 24-30 kgs
Seed drill (rainfed)- 30-36 kgs
SRI method- 2kgs

Recommended varieties for different Zones of Telangana:

1. Northern Telangana zone:

Sambamashuri, JagityalMashuri, Pranahita, Polasaprabha, JagityalSannalu, Telangana Sona, Anjana, Bathukamma, KunaramSannalu, MTU-1010, Manerusona, Jagityal Samba and Prathyumna

2. Central Telangana Zone:

Sidhi, Sambamashuri, Somnath,Badrakali,WarangalSannalu, Warangalsambha, Sheethal, Ramappa, Telangana sona, Bathukamma, Kunaramsannalu, Erramallelu, Prathyumna, varalu, MTU-1010 and MTU1001

3. Southern Telangana Zone:

Samba mashuri, Krishna, jagityalmashuri, Vijetha, Bathukamma, Kunaramsannalu, Telangana sona, Tellahamsa, MTU-1010 and Anjana

Newly released varieties:

1. Telangana Sona (R.N.R 15048):
 - Late sowing variety, hence green manure crops like Sun hemp, crotalaria etc can grow in June for Kharif
 - Resistant to rice blast, high yielding (2.6-2.8 tons/acre)
 - Less broken grains with good cooking quality.
 - Seed dormancy for 15 days.

2. Kunaramsannalu (K.N.M 118):
 - Alternative variety for MTU 1010
 - Suitable for kharif and rabi with 125 days crop duration.
 - Average yield is 2.8-3.2 tons/ acre.
 - It is having 3-4 weeks of seed dormancy.

3. Bathukamma (J.G.L. 18047):
 - Alternative variety for MTU 1010, as MTU-1010 has grain shedding character at harvesting time in Rabi
 - Suitable for kharif and rabi with 120 days crop duration.
 - Average yield is 2.8-3.2 tons/ acre.
 - It is having 3weeks of seed dormancy.

4. Somnath (W.G.L.347)
 - Medium quality seed, can tolerate the Rice gall midge, with medium duration (130-135 days).
 - Resistant to Rice blast
 - Yield is 2.6-3.0 tons/ acre.

5. Siddi (W.G.L-44)
 - Suitable for kharif only
 - Medium sized grain with 150 days crop duration.
 - Yield 2.4-3.0 tons/ acre.

Seed treatment

- Treat the seeds with Carbendazim @ 3 g/l of water for 1 kg of seeds and then sow in nursery after 24 hours.

- If the seeds are required for sowing immediately, keep the soaked seed in gunny in dark and cover with extra gunnies and leave for 24hrs for sprouting.

Breaking dormancy in Rice

Soak 1 kg of seed for 24 hours in 1litre nitric acid solution prepared by pouring 6.3 ml concentrated nitric acid in to litre of water. After soaking, sun dry seeds for about 3-7 days.

Seed rate

Broad casting: 24-30 kg (acre)

Sowing with Gorru (*Rainfed* condition): 30-36 kg

SRI method rice cultivation: 2 kg

Lecture No. 5

Nutrient management (Integrated Nutrient Management)

- Apply 12.5 t of FYM or compost; or green leaf manure @ 6.25 t/ha.
- If green manure is raised @ 20 kg /ha, *in-situ*, incorporate it to a depth of 15 cm using a green manure trampler or tractor.
- In the place of green manure, press-mud / composted coir-pith can also be used.
- Apply 22 kg urea/ha at the time of first puddling while incorporating the stubbles of previous crop to compensate immobilization of N by the stubbles.
- This may be done at least 10 days prior to planting of subsequent crop. This recommendation is more suitable for double crop wetlands, wherein, the second crop is transplanted in succession with short turn-around period.
- Broadcast 10 kg of soil based powdered Blue Green Algae (BGA) flakes at 10 DAT for the dry season crop. Maintain a thin film of water for multiplication.
- Raise *Azolla* as a dual crop by inoculating 250 kg/ha 3 to 5 DAT and then incorporate during weeding for the wet season crop.
- Mix 10 packets (2000 g)/ha of *Azospirillum* and 10 packets (2000g/ha) of Phosphobacteria or 20 packets (4000g/ha) of *Azophosinoculants* with 25 kg FYM and 25 kg of soil and broadcast the mixture uniformly in the main field before transplanting and *Pseudomonas fluorescens* (Pf 1) at 2.5 kg/ha mixed with 50 kg FYM and 25 kg of soil and broadcast the mixture uniformly before transplanting.
- Apply N and K in four equal splits *viz.*, basal, tillering, panicle initiation and heading stages.
- P may be applied as basal and incorporated.
- When the green manure is applied, rock phosphate can be used as a cheap source of P fertilizer. If rock phosphate is applied, the succeeding rice crop need not be supplied with P.

Zn deficiency Symptoms

1. The mid ribs of younger leaves especially base become chlorotic.
2. Appearance of brown blotches and streaks on lower leaves followed by stunted growth
3. The size of leaf blade is reduced but not leaf sheath

4. Uneven growth and delayed maturity in the field

Correction of Zn deficiency

1. Soil application @ 40-50 kg Zn SO₄/ha. (For normal soils once in 3 years and for saline soils once in every year.)
2. By dipping the seedlings in 2% suspension of ZnO is both cheap and convenient.
3. Seed coating is a new development and is at present being used in limited scale in drilled or direct seeded rice production.

Iron: If iron deficiency is noticed spray 1.5% ferrous ammonium sulphate + 75 g citric acid/1lit of water at 4 to 5 days interval till the leaves turn to normal growth

Weed management

- Manual weeding is also essential to remove the weeds closer to rice root zone.
- Cultural practices like dual cropping of rice-*Azolla*, reduces the weed infestation to a greater extent.
- Summer ploughing and cultivation of irrigated dry crops during post-rainy periods reduces the weed infestation.
- To control the nutsedges in nursery, Butachlor 50%, 1.5 lit mix in 200 lit water 7-8 days DAT to be sprayed after draining the water in the field or spray the *Cyhalofop-butyl* 10% 400 ml mix in 200 lit of water 14-15 DAT.
- To control the sedges and annual grasses, in low land paddy fields Use Butachlor 50% 1-1.5 liter or Anilophos 30% 500 ml or Pretilachlore 50% 500 ml. Any herbicide has to be mixed with 20kg of dry sand on the day of application (3-5 DAT) and applied uniformly to the field with thin film water on the 3 DAT. Water should not be drained for next 2 days from the field (or) fresh irrigation should not be given.
- If the sedges, grasses and broad leaf weeds are equally present in the field 4 kg butachlor granules and 1 kg 2,4-D ethyl ester 45 granules, to be mixed in 20 kg dry sand per acre to be broadcasted uniformly 3-5 DAT.
- To control the weeds Pyrazosulfuron 5% WP, 80gr/ acre 8-10DAT or Ethoxy sulphuron 15% WDG 50gr/acre to be mixed in 200 lit of water to be sprayed 15DAT.

- Alternatively, pre-emergence application of herbicide mixture viz., Butachlor 0.6kg + 2,4 DEE 0.75kg/ha, or Anilophos + 2, 4 DEE 'ready-mix' at 0.4kg/ha followed by one hand weeding on 30-35 DAT will have a broad spectrum of weed control.
- If pre-emergence herbicide application is not done, hand weeding has to be done on 15th DAT.
- If the field is infested with broad leafed weed (BLW) 2,4-D sodium salt (80% WP) 400gr/acre dissolved in 200 litres water to be sprayed on the foliage, by removing the water level 25-30 DAT.

Water management

- Puddling and levelling minimizes the water requirement
- Maintain 2.5cm of water over the puddle and allow the green manure to decompose for a minimum of 7 days in the case of less fibrous plants like sunnhemp and 15 days for more fibrous green manure plants like Kolinchi (*Tephrosia purpurea*).
- At the time of transplanting, a shallow depth of 2cm of water is adequate since high depth of water will lead to deep planting resulting in reduction of tillering.
- Maintain 2 cm of water up to seven days of transplanting.
- About 5cm submergence has to be continued throughout the crop period.
- Moisture stress due to inadequate water at rooting and tillering stage causes poor root growth leading to reduction in tillering, poor stand and low yield.
- Critical stages of water requirement in rice are, a) panicle initiation, b) booting, c) heading and d) flowering. During these stages, the irrigation interval should not exceed the stipulated time so as to cause the depletion of moisture below the saturation level.
- During booting and maturity stages, continuous inundation of 5cm and above leads to advancement in root decay and leaf senescence, delay in heading and reduction in the number of filled grains/panicle and poor harvest index.
- Provide adequate drainage facilities to drain excess water or strictly follow irrigation schedule of one day after disappearance of ponded water. Last irrigation may be 15 days ahead of harvest.
- Water requirement for the paddy crop is 1250 mm

Lecture No. 6

Harvesting index

- Green grains not more than four to nine per cent
- Percentage of milky grains less than one per cent
- Moisture content of grains less than 20 per cent
- 80 per cent panicles straw coloured and grains in lower portion of panicle in hard dough stage. At least five hills are to be studied at maturity.

Harvesting

- Taking the average duration of the crop as an indication, drain the water from the field 7 to 10 days before the expected harvest date as draining hastens maturity and improves harvesting conditions.
- When 80% of the panicles turn straw colour, the crop is ready for harvest. Even at this stage, the leaves of some of the varieties may remain green.
- 20-22% moisture present in grains at the harvesting.
- Confirm maturity by selecting the most mature tiller and dehusk a few grains. If the rice is clear and firm, it is in hard dough stage.
- When most of the grains at the base of the panicle in the selected tiller are in a hard dough stage, the crop is ready for harvest. At this stage harvest the crop, thresh and winnow the grains.
- Dry the grains to 12% moisture level for storage. Grain yield in rice is estimated only at 14% moisture for any comparison.
- Maturity may be hastened by 3-4 days by spraying 20% NaCl a week before harvest to escape monsoon rains.

Yield:

- Grain yield varies between 4000 and 6000 kg/ha depending on the management and climatic conditions. Straw yield of 8000-10000 kg/ha can normally be obtained.

Yield attributes;

Number of tillers per unit area (1 Sq. mt.), number of grains per tiller and 1000 grain weight.

= no. of tillers per sq.mt.X no. of grains per tiller X mature grain percent X Test weight

Ex: Sq.mt. 400 tillers

120 grains per tiller

Mature grain percent 85%

Test weight (1000 weight) - 24gr

yield per ace?

Per sq.mt.= $400 \times 120 \times 85 / 100 \times 24 / 1000 = 979.2$ kgs

Per Acre (4000 sq.mt) = $979.2 \times 4000 = 3916.8$ kg = 39.2 quintals

One bag (75 kgs)= $3916.8 / 75 = 52$ bags

Required parameters for export:

For export we consider 6 parameters those are..

1. High quality rice
2. Long grain with medium quality
3. Short grain
4. Parboiled rice
5. Aroma
6. Glutinous rice

Physical qualities for export

1. Long grain
2. Milling percent
3. Light transmit character
4. Fragments percent (broken percent)
5. Colored or white grains
6. Grain moisture percent and etc..

90% of rice without aroma, high or medium quality, long grain and short grain belong to japonica variety are exported. This type of rice exporting countries are mainly Australia, Thailand, North America

Remain 10% export are Scented/ aromatic Basmathi rice exports from India and Pakistan to International market.

Threshing

- **Hand threshing of sheaves:** against some hard surface like stone, wooden plank, a bench etc. This is practical when the quantity is small and also for when it is for seed purpose.
- **Cattle threshing:** It is adopted when large quantity is to be handled. First, a threshing floor is prepared well by removing stubbles, compacting etc., in a circular fashion and the sheaves are spread and trampling under the feet of cattle is made to go round and round.
- **Tractor threshing:** Now a days, it is widely adopted practice. The sheaves are heaped on the threshing floor in a circular fashion and the tractor goes round and round.

Winnowing:

Winnowing is done to the threshed grains to separate the dust and paddy straw, against the wind flow. Nowadays manual or tractor operated fans are used for winnowing.

Grain drying:

- Grains to be dried before storage, but moisture percent should not decline rapidly, hence grains should not be dried in the sun light.
- Storage to be done when grain moisture should be less than 14%
- For drying the grains machines are used i.e called dryers, grain moisture 12-14% can reduce the losses from insect or fungi.

Rice based cropping systems

- Rice-Rice
- Rice-Pulses
- Rice-Sugarcane
- Rice-groundnut
- Rice-Ragi

- Rice-Sesamum

Lecture No. 7

System of Rice Intensification (SRI) Method of Rice Cultivation

The System of Rice Intensification is a new and promising resource-saving method of growing rice under irrigated or rain-fed conditions. This method was first time practiced in “Madagascar” in 1980, this method is popularising in recent days. Higher yields can be got with less cost in this method.

SRI method cultivation paddy field need not to maintain the water level as practiced in conventional method of paddy cultivation. Water required is 1/3 to ½ in SRI method compared to conventional method.

Steps in SRI method.

1. **Early Transplanting:** Transplant 8-12 day old seedlings, with only two small leaves, (More tillering potential and root growth potential)
2. **Careful Transplanting:** Minimise trauma in transplanting. Remove plant from nursery with the seed, soil and roots carefully and place it in the field without pushing too deep into soil (More tillering potential)
3. **Wide Spacing:** plant single seedlings, not in clumps, and in a square pattern 25cm x 25cm apart or wider. Do not plant in rows. (More root growth potential)
4. **Weeding and Aeration:** use simple mechanical "rotating hoe" that churns up soil; 2 weedings required, (More root growth, due to reduced weed competition, and aeration of soil, giving roots more Oxygen and Nitrogen due to increased microbial activity) Each additional weeding after two rounds results in increased productivity up to 2 t/ha / weeding.
5. **Water Management:**Regular water application to keep soil moist but not saturated, with intermittent dryings, alternating aerobic and anaerobic soil conditions (More root growth because it avoids root degeneration, enables better absorption of nutrients from the soil).
6. **Compost / FYM** applied instead of addition of chemical fertilizer; 10 tons/ha (More plant growth because of better soil health and structure, and more balanced nutrient supply)
7. **A comparison of SRI and conventional method of rice cultivation is as follows**

Particulars	Conventional Method	SRI
Seed requirement per acre	30 kg	2 kg
Age of the seedlings (days)	21-30	8-12
No. of seedlings per hill	2-3	1
Spacing	15x10 cm	25x25 cm
No of plants per sq.m.	66	16
Fertilizers used	Chemical fertilizers	Organic fertilizers

Aerobic Rice

- In view of declining ground water table and without puddling, 3-4 times of tillage to obtain the fine tilth, the usual establishment method is dry direct seeding.
- In this method sufficient moisture should be available for germination.
- Seed rate 25-30kgs for 1 acre, to avoid the soil born and seed born disease, seed treatment with 60g carbendazim 50% WP should be done for 30kg seed.
- Aerobic rice can be rainfed or irrigated. Irrigation can be applied through flash-flooding, furrow irrigation (or raised beds) or sprinklers.
- Unlike flooded rice, irrigation—when applied—is not used to flood the soil but to just bring the soil water content in the root zone up to field capacity.
- Site-specific nutrient management can be used to determine the optimal management of fertilizers. In the absence of knowledge on SSNM, 70–90 kg N/ha could be a useful starting point to obtain a yield of 4–6 t/ha.
- The first split can best be given 10–12 days after emergence, the second at active tillering, and the third at panicle initiation.
- The application of Phosphorus fertilizer can be more critical to aerobic rice than to flooded rice.
- Early pre-emergence herbicide Pendimethalin 1lit for 1 acre is to be sprayed in the soil to control the weed problem, which is very high in aerobic rice.
- 2,4-D 800 gr per one acre to be used for control of the broad leaf weeds.

- Rice fields that are not permanently flooded tend to experience high growth and more species of weed. Appropriate herbicide use and additional manual or mechanical weeding in the early phase of crop growth, are therefore needed to control weeds.
- Soil-borne pests and diseases such as nematodes, root aphids, and fungi are known to occur more in aerobic rice than in flooded rice, especially in the tropics. It is recommended to grow aerobic rice in rotation with upland crops suitable in the area.

Lecture No. 8

MAIZE

Scientific name: *Zea mays*

Family: Poaceae

Origin

Maize crop is found at Peru, Bolivia, mountains of Ecuador. The Centre of origin of maize is considered to be the Central America and Mexico. America holds first in area of cultivation among entire world with 57% of production. Other major countries are China, Brazil, Russia and India

In India maize cultivation is in Gujrat, Rajasthan, Punjab, Haryana, MP, AP, Telangana, HP, Jammu, Kashmir and Bihar. In India highest cultivated area is in M.P. followed by Karnataka, and production is higher in Karnataka followed by M.P.

	Area (M. Ha)	Production (Mt)	Productivity (kg/ ha)
India (irrigated)	9.38	28.75	3065
Telangana	0.635	3.64	5730

Byproducts and economic importance

- Cobs harvested slightly ahead of maturation are grilled and consumed. Tasty soups and pancakes are cooked out of corn flour. Fermented corn is also common.
- Corn is used in industries in several ways. Grains ground into flour are employed to prepare corn flakes. Corn germ oil is a good cooking medium. Corn starch is raw material in many brews and jams.
- It is used in production of alcohol, Ethanol.
- Glucose, sucrose, dextrose, cellulose, gums are prepared from the grain starch.
- Edible oil is prepared from the maize in some countries, this oil is best suitable for the cardiac patients, due to presence of linolic, oleic acids and less cholesterols.
- Some of the other uses of corn are in preparing starch based adhesive. Proteins are of use in pharmaceuticals textiles, in addition corn germ is used in the soap making industry.
- Wet milling produces industrial starch like sweeteners, also produces various modified maize starch for paper lamination, textile wrap, sizing and laundry finishing.
- Dry milled products are animal feed, brewing, breakfast cereals and other food.

Classification of maize types:

Maize is classified in to 7 types as per the endosperm.

1. Dent corn (*Zea mays var indentata*)

This is the most common type grown in South America. Dent formation on the top of the kernel having yellow or white colour. The depression or dent in the corn of the seed is the result of rapid drying and shrinkage of the soft starch.

2. Flint corn (*Zea mays var indurata*)

It is widely grown and cultivated in India. Endosperm of kernel is soft and starchy in the centre and completely enclosed by a very hard outer layer. The kernel is rounded on the top. The colour may be white or yellow. Carbohydrates are high in this type of corn. Grown in Europe, Asia, Central America and South America.

3. Popcorn (*Zea mays var everta*)

It possesses exceptional qualities. Size of kernels is small but the endosperm is hard. This is suitable for popcorn.

4. Flour corn (*Zea mays var amylacea*)

It possesses a soft endosperm. Kernels are soft and though all coloured corns are grown but white & blue are the most common. Grown in USA & S. Africa.

5. Sweet corn (*Zea mays var saccharata*)

The sugar and starch makes the major component of the endosperm that results in sweetish taste of the kernels before they attain the maturity and after maturity, the kernels become wrinkled. The cobs are picked up green for canning and table purpose.

6. Pod corn (*Zea mays var tunicata*)

Each kernel is enclosed in pod. It is best suitable for forage (cattle feed). Economically it is growing in large area.

7. Waxy corn (*Zea mays var ceratina*)

The endosperm of the kernel when cut or broken gives a waxy appearance. It is used in gums and textiles and paper making industries.

Maize varieties:

Varieties	Crop duration (days)	Yield (Q/acre)	Characters
Hybrids			
DHM-103	105-120	22-25	Resistant to stem necrosis.
DHM-105	105-120	25-30	Resistant to stem necrosis, sustainable higher yields.
DHM-1	85-90	18-20	Short duration hybrid, resistant to leaf blight.
Trishulatha	105-120	25-30	Resistant to stem necrosis
DHM-107	88-95	22-25	Medium duration hybrid, cross breed
DHM-109	85-90	22-25	Short duration hybrid
Composite / synthetic			
Ashwini/ Harsha/ Varun	90-100	10-20	Withstand dry conditions, high quality and high yield
Amber pop corn	95-100	18-20	Pop corn variety
Madhuri sweet corn	65-70	30,000-35,000 cobs	Sweet variety, 30-35% sugar content
Priya sweet corn	70-75	30,000-35,000 cobs	Sweet variety, 30-35% sugar content, bigger in size than Madhuri variety

Climate conditions:

Maize requires warm conditions, 85% of maize is cultivated in *kharif* season. If the night temperatures are less than 15.6°C, growth of the crop ceases. Maize crop will not tolerate the snow at any stage of the crop growth. Maize is sensitive to water logged condition. It requires the annual rainfall of 600 mm.

Soils

- Maize can be grown on a variety of soils, but it grows best on well drained soils which are rendered fertile by adequate supply of manures.
- Loamy or silty loam or silty clay loam soil having fairly permeable sub soil is an ideal soil type. Optimum PH is 6.5-7.5

Sowing time

- *Kharif* season: with onset of monsoon *i.e* 15-June to 15-July and harvested in late September or October.
- *Rabi* season: Crop sown from 15-October to 15-November in Telangana and Rayalaseema. 15-October to 15- January in Coastal areas. During dry spell period, sowing should be before August.
- Sowing maize at about 5 days before onset of monsoon [i.e last week of May to the second week of June) and providing irrigation, results in good plant stand and highest grain yields.

Land preparation

At least 2-3 shallow tillage operations during summer season are essential in all maize growing areas. Deep ploughing is also helpful to control weeds and for efficient moisture conservation similarly bed and furrow or ridge and furrow systems are suitable in semi arid and sub humid regions.

Plough the soil with the help of ridge plough at a distance of 60-75 cm row to row and 20-25cm plant to plant. Sow the seeds at a height of 1/3 at right side to the ridge.

	Seed rate (kg/Acre)	Spacing	Plant density/ acre
General cross breeds	8	60x20	33,333
Sweet corn	4	60x20	33,333
Pop corn	5	60x20	33,333
Baby corn	10	45x20	44,444
Fodder maize	16	45x10	88,888

Seed treatment

- Seed treatment with 3gr of Mancozeb or Imidacloprid per kg seed.

Sowing

- Dibble the seeds at a depth of 4 cm along the furrow in which fertilizers are placed and cover with soil.
- Put one seed per hole if the germination is assured otherwise put two seeds per hole.

Lecture No. 9

Manures and Fertilizers

	Fertilizer dose (kg/acre)					
	<i>Kharif</i>			<i>Rabi</i>		
	N	P	K	N	P	K
General cross breeds	72-80	24	20	80-96	32	32
Sweet corn	60-72	24	20	72-80	24	20
Pop corn	32	24	20	40	24	20
Baby corn	48	20	16	60-72	24	20

- Apply 1/3 of nitrogen at final tillage, 1/3 at crop knee high stage and 1/3 at flowering stage.
- Total Phosphorus at final tillage.
- Potash ½ at final tillage and ½ at flowering.
- Zinc sulphate 20kgs at final tillage once in 2-3 seasons.
- Zinc deficiency leads to leaves turning to yellow colour and white bud formation. For correction, 2 g Zinc sulphate per litre of water should be sprayed on the foliage.

Weed control

- Apply the pre-emergence herbicide, Atrazine 50 WP @ 1-1.5kg /acre (200 lit of water) at 3 days after sowing as spray on the soil surface followed by one hand weeding at 40-45 DAS.
- Apply herbicide when there is sufficient moisture in the soil.
- Do not disturb the soil after herbicide application.
- Hoe and hand weeding on the 17th or 18th day of sowing, if herbicide is not applied.

NOTE: If pulse crop is to be raised as intercrop, do not use Atrazine.

Water Management

- The most critical period for moisture stress is flowering stage (*i.e.* tasselling, silking and milking stage).
- Upto 40 DAS, the crop is more sensitive to excess moisture and from pre-flowering to maturity, it is more sensitive to drought.
- Maize plant utilizes about half of its seasonal intake of water during the 5 weeks following attainment of its maximum leaf area which is before the tasselling stage.

Lecture No. 10

Inter Cropping

- Intercropping system of maize + redgram or with other pulses in 2:1 ratio is recommended for higher net returns
- Maize+Green Gram – 1:2
- Maize+Black Gram – 1:2
- Maize+Soyabean – 1:2
- Maize can be grown as an intercrop in orchards in first 3-5 years

Harvesting

Stage of harvest: Observe the following symptoms, taking into consideration the average duration of the crop.

- The sheath covering the cob will turn yellow and dry at maturity.
- The seeds become fairly hard and dry. At this stage the crop is ready for harvest.
- Harvest the cobs at moisture level of 25-30%.

Harvesting: Tear-off the cob sheath by using the gunny needle and remove the cobs from the plant. Carry out harvest operations at a single stage for easy transportation.

Threshing cobs: Dry the cobs under the sun till the grains are dry. Use mechanical threshers or by running the tractor over dried cobs to separate the grains from the shank. Clean the seeds by winnowing. Collect and store the dry grains in gunnies.

Straw for cattle feed: Maize straw can also be used as good cattle feed when it is green. Harvest the crop and cut the green straw into bits with a chaff cutter or chopping knife and feed the cattle.

Yield

- 5 tonnes of grain yield and 10 tonnes/ha of straw yield can be obtained.
- In case of Baby corn, about 6 tonnes/ha of cob yield with 25 tonnes/ha of green fodder yield is possible.

Lecture No. 11

ZERO TILLAGE- MAIZE:

Zero tillage is the process where the crop seed will be sown through drillers without prior land preparation and disturbing the soil where previous crop stubbles are present. Zero tillage not only reduce the cost of cultivation it also reduces the soil erosion, crop duration and irrigation requirement and weed control better than normal tillage. Zero Tillage (ZT) is also called as No Tillage or Nil Tillage.

Zero tillage for maize has several advantages such as

- Prevent delay in sowing, reduction in the cost of inputs for land preparation and therefore a saving of around 80% compared to normal tillage.
- Reduction in the crop duration and thereby early cropping can be obtained to get higher yields
- Most suitable for coarse soils, improves soil health and quality, reduce erosion.
- Sometimes temporary water logged conditions affects the growth of maize crop. In ZT there is more infiltration rate due natural soil aggregation which helpful in avoiding anaerobic conditions due to water logging.
- Residual moisture can be effectively utilized and number of irrigations can be reduced.
- Dry matter and organic matter gets added to the soil.
- Environmentally safe - Greenhouse effect will get reduced due to carbon sequestration.
- Zero tillage has better availability of water for maize especially in residue retained conditions.
- As the soil is intact and no disturbance is done, No Till lands have more useful flora and fauna.

Lecture No. 12

SORGHUM

Scientific name: *Sorghum bicolor*

Family: Poaceae

Sorghum is the most important cereal crop in India. It stands second in area (next to rice), but third in production after rice and wheat. It is cultivated primarily as a crop both during *kharif* and *rabi* which is one of the main reasons for low average yields (864 kg/ha). It is mostly grown in marginal lands which do not suit for wheat and maize. It is one of the major food crops of the world (wheat, rice, maize and sorghum). Millions of people in Africa and Asia depend on sorghum as their staple food.

In India, sorghum crop (irrigated) is cultivated in an area of 5.02 M.ha, production is 4.80 M. tonnes and productivity is 956 kg/hectare.

In Telangana, sorghum crop is cultivated in an area of 0.087 M.ha, production is 0.134 M. tonnes and productivity is 1535 kg/hectare.

Origin: Africa

Major Jowar growing zones:

1. **Low rainfall *kharif* zone:** The red soil area in the districts of Mahbubnagar, Nalgonda and Ananthpur. 500-750 mm rainfall with 75-175 days duration.
2. **High rainfall *kharif* zone:** 800-1000mm rainfall. It consists of the districts of Adilabad, Karimnagar, Medak and parts of Rangareddy, Warangal, Guntur and Prakasam where sowings are done during 2nd week of July. Growing period is 190-230 days.
3. **Early *rabi* or *maghi* zone:** 800-900 mm rainfall. 70:30 red and black soils. Contiguous areas of Khammam, Warangal, Nalgonda and Krishna.
4. **Nandyal valley:** 500mm rainfall. This zone includes the districts of Kurnool and Cuddapah where sowings are done during 2nd fortnight of September. Black cotton soils.
5. **Normal *rabi* zone:** Light to heavy black cotton soils. Parts of Adilabad, Rangareddy, Karimnagar, Medak, Mahbubnagar, Nizamabad and Guntur districts. Normal sowing period is 1st fortnight of October.
6. **Late *rabi* zone:** The districts of Nellore and adjoining areas of Prakasam constitute this zone which comes under the influence of NE monsoon.

Adaptation

It is a sturdy crop and can withstand varied climatic hazards more than any other crop. It is successfully grown in arid areas of UP, Rajasthan and also in humid regions of West Bengal and Bihar. It is primarily a tropical warm weather crop. It can withstand wide range of temperatures varying from 15°C to 40°C with rainfall variations of 400-1000 mm per annum. Although it is a crop of plains, it grows within plateau region of South India upto an elevation of 1000m. Sorghum is a short day plant. Flowering and grain formation starts when day length shortens during winter.

Soils: Sorghum can be grown in heavy black soils to red soils, but comes up well in heavy black soils. Sorghum does not grow well under gravelly and marshy soils. This crop can resist slight acidic and alkali soils, pH ranging from 5.5 to 8.

Sowing season:

There are 5 seasons in an year viz.,

Kharif - June

Maghi - September

Rabi - October

Late Rabi- November

Summer - January

Seed rate: 3-4 kg per acre

Spacing: 45x12-15cm

Seed treatment: For control of shoot fly - treat one kg seed with 3 g. Thiamethoxam or 12 ml of Imidacloprid 5g/kg seed.

or seed treatment with 3 g. of Thiram or Captan per kg of seed

Lecture No. 13

Manures and Fertilizers:

Both N & P are essential for stepping up grain yields of sorghum. The effect of P in increasing grain yield is more pronounced when it is applied in combination with N.

Application of N consistently increases uptake of P at all stages of growth. N uptake is also significantly increased at high levels of P application even at 60 days growth stage. Response to N is better in hybrids than in local improved varieties.. K need not to be applied to sorghum except in areas known to be deficient regarding potash.

	Irrigated crop(kg)	Rainfed crop(kg)
Nitrogen	32-40	24-32
Phosphorus	24	16
Potassium	16	12

Water management

Though sorghum is drought resistant, it responds well to irrigation. It is primarily a *rainfed* crop. It has an extensive and deep fibrous root system. It is observed that on an average, about 6-9 irrigations, each of 5-6 cm depth are necessary depending on climate. Total water requirement is about 500-600mm.

Moisture sensitive stages are flowering stage and grain filling stage.

Inter Cropping

Sorghum + red gram – 2:1

Weed control

- Apply the pre-emergence herbicide Atrazine 50 WP @ 800 g, mix in 250 lit/ ac of water, within 2-3 days after sowing as spray on the soil surface.
- If pulse crop is to be raised as an inter-crop in sorghum do not use Atrazine.
- Hoe and hand weed on the 10th day of transplanting if herbicides are not used. Hoe and weed between 30-35 days after transplanting and between 35-40 days for a direct sown crop, if necessary.
- Striga emerges 35-40 days after sorghum seed germination. 50g ammonium sulphate is mixed in one litre water or 200 g urea spraying will control the striga.
- Spray 2 g of 2,4-D sodium salt mix in one litre water to control the striga.

Harvesting and threshing

- Consider the average duration of the crop and observe the crop. When the crop matures, the leaves turn yellow and present a dried up appearance.
- The grains are hard and firm. At this stage, harvest the crop by cutting the earheads separately. Cut the straw after a week, allow it to dry and then stack. In the case of tall varieties, cut the stem at 10 to 15 cm above ground level and afterwards separate the

earheads and stack the straw. Dry the earheads. Thresh using a mechanical thresher or by drawing a stone roller over the earheads or by using cattle and dry the produce and store.

Yield:

Rainfed: 20-25 q/ha

Irrigated:50-60q/ha

Lecture No. 14

BAJRA

Scientific Name: *Pennisetum glaucum*

Family: Poaceae

It is also called as Pearl millet, Cat tail millet, Candle millet, Spiked millet and Bulrush millet.

Origin: Africa and India

Bajra is one of the major coarse grain crops and is considered as poorman's food. It is drought tolerant crop. Pearl millet is endowed with greater ability to withstand harsh climatic factors, and still yield substantially.

In India, bajra crop is cultivated in an area of 7.44 M.ha, production is 9.09M. tonnes and productivity is 1222 kg/hectare.

In Telangana, bajra crop is cultivated in an area of 0.02 M.ha, production is 0.01M. tonnes and productivity is 1172 kg/hectare.

Adaptation:

The crop has wide adaptability as it may grow under different day lengths, temperatures and moisture stress. It has a high degree of resistance for drought. Most of the varieties developed in India are photo-insensitive which permits in growing the crop during *Kharif*, *rabi* and summer seasons. The crop requires low annual rainfall ranging between 400 to 500 mm and dry weather. The crop needs wet weather, light showers and bright sunshine

at its grand growth stage. There should be no rain at flowering as the pollens are washed off and fertilization is poor, while at maturity it needs fairly dry weather associated with bright sunny days. The crop may tolerate drought but cannot withstand high rainfall of 900mm or above. The best temperature for the growth and development of bajra is between 30°C and 35°C.

Soils

Bajra can be grown on a wide variety of soils, but being sensitive to water logging, it does best on well drained sandy loams and clay loams. Bajra is sensitive to acidic soils. It is grown successfully on black cotton soils, alluvial soils and red soils of India.

Sowing time:

Kharif :June -July

Rabi:Sept-Oct

Summer: First fortnight of January

Avoid late planting beyond July 15th (In case, sowing is delayed there is a drastic reduction in yield due to more incidence of diseases like downy mildew or ergot, restricted vegetative growth of the crop, high rate of mortality and poor grain setting).

Spacing:

45 cm between rows and 12 to 15 cm between plants. 58000 to 72000 plants will accommodate in one acre.

Lecture No. 15

Seed Rate:

4.0-5.0 kg/ ha (If sown by drilling)

2.5-3.0 kg/ha (If sown by dibbling method)

Seed treatment:

Seed should be treated with Thiram or captan @ 3g/kg of seed.

Method of Sowing: Broadcasting, Drilling, Dibbling and Transplanting. Of these, Drilling is most popular. Thinning and gap filling should be done at 10-15 DAS.

Important varieties:

Variety	Seasons	Crop duration (days)	Yield (Q/ac)	Characters
WCC-75 composite	<i>Kharif, Summer</i>	85-90	8-10	Grows upto 180cm, 2-3 tillers/hill. Panicle length is 25-30cm, grains are in gray colour. Suitable to cultivate in all Districts.
ICMH-451	<i>Kharif, Summer</i>	85-90	10-12	2-3 tillers/hill. Medium sized grains with gray colour. Suitable to cultivate in all Districts.
Mallikarjuna	<i>Kharif, Rabi</i>	85-90	8-10	Drought tolerant variety. Suitable to cultivate in all areas.
ICTP 8203	<i>Kharif, Rabi</i>	85-90	8-10	Grain size is bold with white colour. Drought tolerant variety.
ICMV 221	<i>Kharif, Rabi</i>	85-90	8-10	Composite type, Suitable to cultivate in all areas. It is better than WCC-75
APS 1 Ananta	<i>Kharif</i>	80-85	8-10	Gives better yields in less rainfall areas also.

Lecture No. 16**Manures and Fertilizers:**

FYM @ 4t/ac should be applied and mixed well in to the soil about 20 days before sowing. Fertilizer schedule is as follows:

Rainfed crop :

N : 24 kg /acre

P₂O₅: 12 kg /acre

K₂O: 8 kg /acre

Irrigated :

N : 32 kg /acre

P₂O₅: 16 kg /acre

K₂O: 12 kg /acre

Half dose of nitrogen, full doses of phosphorus and potassium should be applied at the time of sowing. The remaining N is applied in 2 splits. Once at the time of thinning (3-4 weeks after sowing) and the rest at ear formation stage.

Water Management:

As Bajra is a rainfed crop, there is hardly any need for irrigation. Irrigate the crop if there are no rains. Generally, two irrigations during the growing period of the crop are enough. Moisture sensitive stages for this crop is tillering, panicle initiation stage, flowering and milky stage.

Covering of ground nut husk over the field at 30 days crop age, will conserve the soil moisture against the evaporation.

Bajra does not tolerate water logging. So do not allow rain water to stand in the field for more than few hours. Proper arrangement for draining the excess water must be made.

Weed Control:

The damage due to weeds is severe during 3-5 weeks after sowing. Intercultivation by hand hoe or wheel hoe should be done at 3-5 weeks after sowing. However, sometimes due to unavailability of labour or soil being too wet to permit manual weeding, timely weeding becomes difficult. Under such conditions the only effective way to control weeds is the use of herbicides. Pre-emergence application of Atrazine 50% WP @0.5 kg per/ha in 600 litres of water controls most of the monocot and dicot weeds.

Inter cropping: Bajra + Redgram – 2:1

Harvesting and Threshing:

Harvest the crop when grains become hard and contain about 20% moisture. Harvesting is done by cutting the entire plant or removing the ear heads first and cutting down the plants later on. The ear heads after harvesting, should be sun dried. The grains are separated either by beating the ear heads by sticks or trampling by bullocks. The threshed grain should be cleaned and dried in sun to bring the moisture content down to 12% for safe storage.

Yield:

Rainfed: Grain : 12-15 q/ha

Dry matter : 70-75 q/ha

Irrigated: Grain : 30-35 q/ha

Dry matter: 100 q/ha

Lecture No. 17**FINGER MILLET**

S. N: *Eleusine coracana*

Family: Poaceae

Common names are Ragulu, Birds foot millet, Taidalu *and* African millet.

Finger millet is commonly known as Ragi. It is an important minor millet grown in India. It is a staple food crop in many hilly regions of the country. It is predominantly grown as a dry land crop in Karnataka, Andhra Pradesh, and Tamil Nadu. Finger millet contributes nearly 40% of total small millet produce of India, It is cultivated for grain and forage.

Area &Production:

Total area in India is 2.50 M ha with a production of 2.20 Mt. Karnataka is the major state for finger millet production in India, accounts for 55.6% of the area and 60.7% of production in the country.

In our Telangana Ragi is cultivated in an area of 1724 ha , with a production of 2777 tonnes and the productivity is 1607 kg/ha.

Economic importance

- Germinating grains are malted and fed to infants also.
- It is also good for pregnant woman
- Special pops are prepared from the grains.
- It is a nutritive food for adults of different ages.
- It is good for persons suffering from diabetes

- The green straw is suitable for making silage, which gives sweet smell and consumed by cattle without wastage.
- Besides vitamin A&B, phosphorus is also present in smaller quantities.
- The grain is nutritionally rich and the richest in 'calcium', hence malts are prepared for the children.
- Tribal's of Bihar agency prepare the liquor from this finger millet.
- Country wide used to control the hepatitis
- In northern hills, grains are eaten mostly in the form of 'Chapattis' and halwa.
- In South India, grains are used in many preparations like cakes, puddings, sweets *etc.*

Adaptation:

It is a crop of tropical and subtropical climate and can be grown successfully from sea level to an altitude of 2100 meters on hill slopes as well as in plains. It is a hardy crop. It is grown in areas having annual average rainfall between 500 to 1000mm. In regions of higher rainfall it can be raised on well drained soils as a transplanted crop. It can be grown under rainfed as well as irrigated conditions.

Soils:

It can be grown on a wide variety of soils ranging from very poor to very fertile soils. It thrives best on well- drained loam or clay loam soils. Clayey soils, heavy black cotton soils, gravelly and stony soils with poor fertility and drainage are not suitable. It can tolerate salinity better than other cereals.

Land preparation:

The first ploughing with mould board plough should be done immediately after the harvest of the previous crop. With the onset of monsoon, field should be ploughed with local plough 2-3 times and finally leveled.

Season:

Finger millet is not a season bound crop. So, it can be grown throughout the year, if water is available. The main seasons are

1. Punasa Ragi (or) Burada Chodi:

Finger millet is grown in wetlands, prior to planting of rice in slushy conditions by taking advantage of monsoon rains in Srikakulam and Visakhapatnam Dist. Short duration

varieties (AKP -2) are preferred for this season. Twenty five percent Ragi in above districts is under this season (May-Aug).

2. Main Season (or) Pedda Panta:

The main area under Ragi crop during this season (Aug-Nov) accounts for 50% area of Srikakulam and Visakhapatnam. Suitable varieties are AKP -7 and Kalyani (WR – 652)

3. Pyru season:

Remaining 25% of area is under pyru season. (Nov/Dec – Feb/ March). As the crop is grown under assured irrigated conditions, the yields are high. VZM-2 is recommended.

Seed rate: 4-6 kg/ha. for nursery

7.5-10 kg/ha for broadcasting.

Spacing:

Adopt the 30x15cm spacing for transplanting the 21 days aged seedlings for short duration (85-90days) varieties, and 30 days aged seedlings for long duration (105-120 days).

Varieties:

Varieties	Season	Crop duration (Days)	Yield (Q/ac)	Characters
Bharathi	All seasons	105-110	10-12	Compact panicle, tolerant to blast
Srichaitanya	<i>Kharif</i>	110-120	10-12	Crop grows tall, and produces many tillers.
Hima	<i>Rabi</i>	105-110	10-12	White grained variety, tolerant to blast.
Vakhula	<i>Kharif</i>	105-110	10-12	Tolerant to blast.
Maruthi	<i>Kharif, summer</i>	85-90	9-10	Tolerant to blast and drought.

Manures & Fertilizers:

For Nursery: FYM: 10t/ha Incorporation before sowing

40-40-40 kg N, P₂O₅ and K₂O/ha

For main field: FYM: 10t/ha – Before sowing

60-30-30 kg N, P₂O₅ and K₂O/ha

N is applied in 2 Splits

1. At the time of transplanting – ½ dose of N along with full dose of P and K.
2. Remaining dose of N at 30 DAS.

Irrigation:

Ragi sown during *Kharif*, generally does not need any irrigation. Adequate moisture should be provided at the time of flowering and grain setting stages. It cannot tolerate waterlogged conditions. Hence, drainage facilities should be provided. After establishment of seedlings for a week or 10 days, irrigation should be cut off. This helps in hardening of seedlings and for vigorous and healthy growth.

Weed management:

It is essential to control weeds in the initial stage of plant growth and development. Weeding should be done with hand hoe after 25 days of sowing. 2-3hoeings would be sufficient to control the weeds in problems areas. Hand weeding gives satisfactory control of weeds. Pre emergence herbicides like metoxuran 0.75 kga.i./ha + one hand weeding gives excellent control of weeds.

Harvesting and Threshing:

The crop matures in about 4-4 ½ months depending on the tract and the variety. Irrigated or transplanted crop produces more tillers than that grown in dry lands. Ear heads on main shoots matures earlier than tillers. As & when ear heads are matured harvesting is done generally 2 or 3 times. Harvested ear heads are kept on floor and covered by gunny bags or tarpaulins which brings change in colour to all the grain in ear heads. It is dried & threshed by stone roller or cattle.

Yield

Rainfed:7- 8 q/ha - grain

11-18 q/ha – fodder

Irrigated:30-35 q/ha - grain

35-50 q/ha – fodder

Lecture No. 18

PULSES

India pulse production (under irrigation) is 25.42 M. tones in total pulse cultivated area of 29.81 M.ha. and the productivity is 853kg/ha. India has lion share in area (42.6%) and production (28.34%) of pulses globally.

Major pulse producing states are Madhya Pradesh, Maharashtra, Orissa, Rajasthan and Uttar Pradesh. Highest production of pulses is from Madhya Pradesh followed by Rajasthan and Uttar Pradesh. Madhya Pradesh has the highest productivity (1084 kg/ha). National average productivity is 5853 kg/ha. In our Telangana state, pulse cultivated area is 5.19 lakh ha., with 3.51 lakh tones production

Importance of Pulses:

- They are rich source of proteins
- The average protein available in pulses is 20-30%. Pulses are rich in 'Ca' & Phosphorous. They are also good sources of Vitamins.
- Pulses provide a superior quality of fodder & feed to the cattle, as they are good forage crops with proteins and mineral content.
- They are considered as good green manure crops because of rich canopy development.
- They improve the soil fertility by biological nitrogen fixation
- The nitrogen requirement of pulses is low & minimizes the N requirement of succeeding crop by around $\frac{1}{4}$ of its total requirement.
- Pulses help in the Soil and Water conservation.
- They improve the physical condition of the soil like soil aeration, water holding capacity by improving microbial population, breaking of hard pans and moisture retention.
- Pulses are important in crop mixtures / rotation. They act as catch crops.
- Some crops act as smothering crops which control weeds & protects soil from erosion. e.g. Cowpea and Horse gram. Pulses can also be used as better intercrops.

S. No.	Pulse crop	Protein %	Cereal crops	Protein %

1	Chickpea/ Bengal gram	21	Paddy	8.5
2	Red gram	22.3	Wheat	12.8
3	Green gram	24	Rice	6.9
4	Black gram	24	Maize	11.1
5			Barley	11.5

Constraints in pulses Production:

Weather conditions:

1. Mostly around 92% of pulses are cultivated under rainfed.
2. Crop critical stages encounters with dry spells, high temperatures, uneven distribution of rainfall, crop lodging conditions.
3. Cultivating in less fertile soils due to soil erosion, resulting in less yields.
4. Pulses are more sensitive to acidity, alkalinity and lodging.
5. Non availability of high yielding varieties (HYV).
6. Lack of knowledge to the farmers in pulse cultivating technologies.
7. Weed infestation
8. Losses due to Pest and disease attack.
9. High losses from storage pests.
10. Lack of post harvest technologies.

The main emphasis for increasing pulses production

1. Bringing an additional area under short duration high yielding varieties to fit in multiple cropping programmes as catch crop.
2. Developing new cropping systems like companion cropping, mixed cropping (or) intercropping for growing pulses between widely spaced crops such as sugarcane, maize, potato, cotton, arhar, groundnut, bajra and jowar etc. both under irrigated and rainfed conditions.
3. Developing the high yielding varieties or local suitable varieties.
4. Adoption of efficient plant protection measures (IPM).
5. Basal placement of phosphatise fertilizers and treating the seeds with Rhizobium culture.
6. Growing pulses on relatively fertile lands rather than growing them on marginal and sub marginal lands.

7. Adoption of improved package of practices like line sowing, control of weeds, harvesting at right time or at physiological maturity to avoid splitting of pods and thereby minimising shattering losses.
8. Granting subsidy on Government loans to the growers and providing improved seeds, fertilizers and plant protection materials on concessional price to the farmers.
9. Evolution of better plant-types of pulses for boosting pulse production.

Lecture No. 19

REDGRAM

Scientific name: *Cajanus Cajan*

Family: Fabaceae

Common Names - Arhar, tur, redgram, congo pea, Gungopea, no eye pea.

Pigeonpea is the second most important pulse crop of India after chickpea.

Origin: Africa

Area & Production:

- India's cultivated area is 4.44 M. ha, production is 4.29 M. tonnes with productivity of 967kg/ ha .(under irrigation), Maharashtra stood top in area of cultivation (1.24 M.ha) Production (1.13 M. tonnes) and productivity (909 kg/ha.)
- Telangana's cultivated area is 0.33 M. ha, production is 0.26 M. tonnes with productivity of 798 kg/ ha.

Distribution:

The important Pigeonpea growing states are Maharashtra, Uttar Pradesh., Madhya Pradesh, Andhra Pradesh & Karnataka. In India, Maharashtra, U.P & M.P together occupy 62% of the area & contribute 73% of total production.

Season:

Southern telangana zone, Northern telangana zones and less rainfall zones in *Kharif*- June

In *Rabi*- september

Krishna Godavari, northern kostha zone in *Kharif*: June– July

in *Rabi* September-October.

The sowing time depends upon the duration of variety and rainfall pattern of the region, early sowings are always better. Sowings should be planned in such a way that flowering and pod formation should not coincide with peak rainy period.

Climate:

It is a quantitative short day flowering plant i.e. the onset of flowering is hastened as day length shortens. It is grown throughout the tropical, sub-tropical & warmer regions of the world between 30°N & 35°S latitude. It tolerates heat and drought. It prefers moist and warm climate during vegetative period and cool and dry period during reproductive stage. It is susceptible to frost. The cloudy weather and excessive rainfall during flowering damage the crop to a great extent.

Temperature requirements:

Crop vegetative growth period: 20-25°C

Flowering and pod formation stage: 15-18 °C

Ripening stage: 35-40 °C

Soils: It can be grown on a wide range from Sandy loams to clay loams. The crop performs well on fertile well drained loamy soils. Saline, Alkaline and waterlogged are not suitable.

Land preparation

- Fine seed bed with friable soil with optimum moisture – for germination & growth
- Deep rooted crop – one deep plough fallowed with harrowing
- Raised bed (2.7m wide), Ridges & furrow, Flat sowing & making furrows at 2.7m

Varieties for *kharif*: Duration 170-180 days

ICPL 332 (Abhaya)

ICPL 87119 (Asha)

LRG-41

Early maturing varieties for *Rabi*: ICPL-87

ICRISAT varieties – ICPL 870, ICPH-8 (Hybrid variety)

Varieties	Crop duration (days)	Yield (Q/ac.)	Characters
Palnadu (LRG30)	<i>Kharif</i> 170-180	8.8-10	Bushy type, bends to side, yellow

			colour flowers, grain medium sized brown in colour, resistant to wilt
Maruthi ICPL 8863	<i>Kharif</i> 155-160	8	Erect growing, resistant to wilt medium sized grain. Suitable to grow on the bunds of paddy fields
Abhaya ICPL 332	<i>Kharif</i> 160-165	8-8.5	Erect and pod will be in clusters, medium sized brown in colour grain, resistant to pod borer
Laxmi ICPL 85063	<i>Kharif</i> 160-180	7.2-8	Bushy type with many branches, partial resistant to wilt disease. Bold sized grain with dark brown colour
Asha ICPL 87119	<i>Kharif</i> 170-180	7.2-8	Erect and bushy growing type, resistant to wilt, seeds are bold and dark green in colour
HY3C	<i>Kharif</i> 190-200	6.4-7.2	Red colour flowering, green colour pods used for vegetable, white colour seeds, wilt resistant and suitable to grow in Telangana region.
MRG 66	<i>Kharif</i> 180	8.8-9.6	Suitable to grow in black soils, resistant to macrophomina disease.
LRG 38	<i>Kharif</i> 170-180 <i>Rabi</i> 120-130	8-8.8	Suitable for early <i>rabi</i>
WRG 27	<i>Kharif</i> 180 <i>Rabi</i> 120-130	8-8.8	Red colour flowering, pods are in green colour with brown lines. brown colour seeds. Tolerant to <i>Helicoverpa armigera</i>
Durga ICPL 84031	<i>Kharif</i> 170-180	4.8-6	High yielding short duration variety, resistant to pod borer, suitable for Northen Telangana zone for <i>kharif</i> cultivation.
PRG 100	<i>Kharif</i> 145-150	8	Show resistance to wilt to some extent, suitable to grow in Telangana and Rayalaseema in light and chalka

			soils
--	--	--	-------

Differences between *kharif* and *rabi* Redgram

S. No.	Parameter	<i>Kharif</i> redgram	<i>Rabi</i> redgram
1	Season	June to July	Sep – Oct
2	Seed rate	5-7 kg/ha	15-20 kg/ha
3	Spacing	60x10cm-sole crop 1.2 to 1.5 m for Intercrop	45x10cm for sole crop.
4	Duration	160-180 days	120-125 days
5	Plant height	>2m	1-2m
6	Seed size	Big	Small
7	No.of pods/ plant	More	Less
8	Pest & Diseases	More	Less
9	Yield level	10-15 q/ha	8-12 q/ha

Spacing:

Short duration: 60x10cm

Medium and Long duration: 75x20 cm.

Seed treatment:

Seed treatment with fungicides like Bavistin 1g/ kg seed. Captan or Thiram @ 2.5 g/ kg before sowing effectively controls fungi and reduces incidence of both seed and soil borne fungi. Seed treatment with *Rhizobium* culture can increase the yield upto 20-30%.

Method of sowing: Seeds are sown behind the plough or with the use of seed drills.

Manures & Fertilizers:

Manures: 5 tons/ ha of FYM in *Kharif*.

Nitrogen: 20kg/ ha – long & Medium duration varieties

Phosphorous: 50 kg P₂O₅/ha for phosphorous deficient soils at sowing.

Potassium: 20kg K₂O/ha for potassium deficient soils by placement at sowing.

In A.P, 20N & 50 P₂O₅ in addition to 5t/ ha FYM for *Kharif* crop. For *rabi* crop, Nitrogen dose is doubled (40N kg/ha).

Water Management:

The critical periods for Irrigation are flower-initiation and pod-filling stages. Intensive cropping of pigeon pea can also be achieved under tube well irrigation, with highest production of 4 tons/ha. Redgram grown in *Kharif* does not require any irrigation

Weed management

Fluchloralin (Basalin) 45% @ 1.5kg *a.i*/ha. Mix in 200 lit of water spray as pre- sowing herbicide.

Pendimethalin 30% @ 1.3 to 1.6 lit/ ac. Mix in 200 lit of water spray 1 or 2 days after sowing.

Inter-cultivation at 30 and 60 DAS with gorru or danthi.

Inter Cropping

1. Short duration crops i.e. black gram, green gram, cereals, groundnut can be grown as inter crop.
2. Red gram + Sorghum/ Maize/ Bajra – 1:2
Red gram + Green gram/ Black gram/ Soya bean/ Ground nut- 1:7

Harvesting, Threshing & Processing:

- The Red gram is said to be indeterminate in growth habit where the flowering goes on continuously over the months on the same plant. Flowering, un-matured pods & already developed pods are seen at the same time. Hence, the crop is harvested in 2-3 pickings.
- The whole plants are cut when most of the pods are dried.
- Then the plants are bundled and staked for one week for the purpose of post harvest ripening of un-matured pods. The dried pods are beaten with sticks and then the seed is separated.
- Since seeds are consumed in the form of split cotyledons and dal it is better to go for processing before storing.
- Power operated hullers or processors are available for splitting of seeds into dal.
- The de-hulled operation is usually performed in 2 steps: the first involves loosening the husk from Cotyledons and the second involves removing the Husk from Cotyledons and splitting them using a roller machine

Yield: For irrigated – 15-18 q/ha

Rainfed – 10-15 q/ha

Inter/ Mixed cropping- 5 - 6 q/ha

Lecture No. 20

BENGALGRAM/CHICK PEA

Scientific Name: *Cicer arietinum*

Family: Leguminaceae

It is also known as Gram (or Chana).

Origin: Western Asia (Turkey)

Area & Production:

- India's cultivated area is 10.56 M. ha, production is 11.38 M. tonnes with productivity of 1078 kg/ ha .(under irrigation), Madhya Pradesh stood top in area of cultivation (3.59 M.ha) Production (4.60 M. tonnes) and productivity (1280 kg/ha.) followed by Maharastra with area of cultivation (2.0 M.ha) Production (1.69 M. tonnes) and productivity (1074 kg/ha.)
- Telangana's gram cultivated area is 0.29 M. ha, production is 0.27 M. tonnes with productivity of 912 kg/ ha.

Climate:

- It is a *rabi* pulse crop and requires cool humid weather and mainly suitable to North India.
- It is suited for less rainfall areas of 600-1000 mm.
- Water-logging results into wilt diseases (when grown with Red gram)
- Optimum temperature regime for chick pea is 24-30°C.
- Chick pea is a long day plant and requires sufficient bright sunshine.
- The period of cool temperature decides the duration of the crop, because of which in North India, it comes to harvest in 160-170 days.
- Whereas the winter is warm in South India then the duration is shorter of about 90-110 days

Soils:

- It can grow on wide range of soils from medium to heavy black soils. It does well on Black cotton soils and sandy loams.
- Optimum pH required for crop growth is 6.0 to 7.5 (>8.5 pH not suitable).
- It does not withstand water -logging, saline and alkaline conditions.

Land preparation: One deep ploughing followed by two harrowings. Crop needs clod free and fine seed bed for aeration in root zone.

Time of sowing: Middle October to first fortnight of November.

- If delayed, sowing of chick pea results in possibility of effecting wilt diseases.
- Early sowing results in excessive, vegetative growth and poor setting of pods.

Seed rate: Desi Type 20-26 kg/ac, 20% seed rate should be increased if late sowings.

Sowing: Seeds are sown behind the plough or with the use of seed drills

Spacing: Desi type 30x10cm.

Kabuli type :45x10cm.

Lecture No. 21**Types and Varieties in Chickpea:**

There are 2 important varietal types available in India. They are:

- 1) Kabuli type
- 2) Desi type.

Mostly cultivated type of chick pea is Desi type.

Differences between Desi type and Kabuli type:

Characters	Desi type	Kabuli type
Area under cultivation	More area	Less Area
Colour of the seed	Yellow to dark brown	White (or) Pale cream

Size of the seed	Small	Large ,bold and attractive
Shape of the seed	Irregular and wrinkled	Smooth
Plant structure	Small and bushy	Taller and erect
Percentage of production	85%	15%
Yield potential	High yielders	Low yielders
Adaptation	Mostly to winter climates	Mostly to spring
Test weight	17-26 gm /100seeds	>26 gm /100 seeds
Varieties	Jyothi (ANGRAU), Annegiri (Karnataka)	Kranthi, Swetha

Varieties:

Varieties	Crop duration (days)	Yield (Q/ac)	Characters
Kranthi ICC37	100-110	7.2-10	Bushy growing, medium sized seed. Resistant to wilt, local variety
Swetha ICCV 2	80-85	6-6.4	Kabuli type suitable for late sowings.
Annegiri	100-110	7.2-10	Bushy growing with many branches, seeds are slender ,medium sized brown in colour
Jyothi	100-110	6.4-7.2	many branches, bushy from the base of the plant, seeds are rough, medium sized brown in colour.
ICCV 10	100-120	7.2-10	Resistant to wilt, shows slight resistant to damping off. suitable to sow in October.
KAK-2	100-105	7.2-8	Kabuli type, erect growing type, white variety
Pule G 95311	105-110	7.2-8	Kabuli type , seed is big sized

Fertilizers:

The crop comes up well with residual fertility. But the recommended fertilizers are:

Fertilizer	Rainfed chickpea	Irrigated
N (kg/ha)	10	20
P (Kg/ha)	40	60

K (Kg/ha)	20	40
-----------	----	----

Zinc deficiency can be corrected by 0.5% ZnSO₄ spray or soil application of 25kg /ha of Zinc Sulphate which is effective in increasing the yields.

Bio-fertilisers: Seed treatment with the Rhizobium strain namely *Cicer rhizobium* will increase the Nitrogen fixing ability of the plant and thereby yield will be enhanced by 20-30%.

Irrigation:

- 55% area of chickpea is under *Rainfed* condition.
- Where under drought conditions, the crop requires 2 irrigations at critical stages.
 - 1) At branching (45 DAS) and
 - 2) At pod formation (75 DAS)
- If water is adequate then four irrigations are recommended at:
 - 1) Sowing
 - 2) Branching
 - 3) Flowering
 - 4) Pod filling
- Evaporative demand is high in South India, Irrigation at critical time can double the yield.
- Evaporative demand is low in North India, Irrigation can cause excessive growth leading to lodging.

Weed control:

Weeds become problematic in chickpea due to its short growing nature.

Pre emergence herbicides are Bentazon (1.0-1.5 kg/ha)

Pendimethalin (0.5-1.0 a.i kg/ha)

Pendimethalin (0.5%) + Imazethpyr (50g)

Pre-plant incorporation of Fluchloralin (0.5 – 1.0 a.i kg/ha)

Trifluralin (0.5-0.7%)

Harvesting:

- In North India, chickpea duration is 160-170 days. In South India crop comes to harvesting within 90-110 days.
- Crop is harvested when leaf turns to reddish brown and starts leaf shedding.
- Harvesting is done during morning to avoid shattering of pods.

- Plants are pulled out or cut with a sickle and carried to threshing floor.

Threshing:

- The harvested plants are dried in sun for about a week and then it is threshed under the feet of cattle (or) by beating with sticks.
- Then the grain is collected and it can be used directly (or) crushed.

Yield: 20-25 q/ha.

Nipping

Plucking the apical buds of the crop at about 30 to 40 DAS is done to stop the apical growth. It promotes the lateral branching, plants to become more vigorous and produce more flowers and pods and yield per plant is increased.

Lecture No. 22

SOYBEAN

Scientific Name: *Glycine max*

Family: Fabaceae

Origin: China

Area & Production:

- India's cultivated area is 10.33 M. ha, production is 10.93 M. tonnes with productivity of 1058 kg/ ha.(under irrigation), Madhya Pradesh stood top in area of cultivation (5.01 M.ha), Production (5.32 M. tonnes) and productivity (1062 kg/ha.) followed by Maharashtra with area of cultivation (3.69 M.ha), Production (3.80 M. tonnes) and productivity (1032 kg/ha.)
- Telangana's gram cultivated area is 0.15 M. ha, production is 0.25 M. tonnes with productivity of 1624 kg/ ha.

Economic Importance:

- Soybeans are an important global crop, providing oil and protein
- It contains about 20 % oil and 43 % high quality protein
- It contains a good amount of minerals, salts and vitamins (thiamine and riboflavin) and its sprouting grains contain a considerable amount of Vitamin C
- It can be used as fodder, forage can be made into hay, silage etc. Its forage and cake are excellent nutritive foods for livestock and poultry.
- Soybean being the richest, cheapest and easiest source of best quality proteins and fats and having a vast multiplicity of uses as food and industrial products is sometimes called as wonder crop.

Climate

- Basically it is a tropical crop but extends to subtropics and temperate climates.
- Soybean is short day plant, but response to day length varies with variety and temperature.
- A temperature of 26.5 to 30°C appears to be optimum for most of the varieties.
- Optimum day temperature is 15-32°C for higher germination.
- Maximum flowering occurs at 30°C.
- Temperature of 18°C or less – there is no pod setting.
- Temperature below 24°C – delays flowering by 2-3 days.
- A lower temperature tends to delay the flowering.
- Average rainfall is 600-650 mm

Soils

- Sensitive to water logging especially during early stages .
- Optimum soil PH range is 6.5-7.5
- Cannot withstand acidity
- Prefers sandy soil with more carbon content

Land Preparation

One or two deep ploughings followed by two harrowings. later land should be levelled and seed should be sown.

Varieties:

Varieties	Crop duration (days)	Yield (Q/ac)	Characters
JS 335	90	10-12	Puff (hairs) are absent on pods, seed germination capacity is high, pod shedding is low, resistant to damping off
PK 1029	100	10-12	Erect and medium height, fruiting is bunchy type, white flowering, resistant to rust disease.
MACS 450	100	10	Erect and medium height, Puff (hairs) are brown in colour on pods
MACS 58	90-100	8-10	Erect growing up to 65 cm height, pods are in brown in colour, pod shedding is low, seeds are attractive pale yellow in colour.
PK 472	100	8-10	Erect and medium height, bunchy type, fruiting pods are long erect and pods are brown in colour. Puff is present on the pod.
MACS 124	110-200	8-10	Short duration ,short variety, bunchy type fruiting.
LSB 1	65	2-7	Suitable for intercropping in cotton and redgram

Seed rate: 25-30 kg/ acre

Seed treatment: Seed is to be treated with Thiram (2g) + Carbendazim (1 g) or Thiram (3 g) + Imidacloprid (5 g) or Carbosulfan (30 g / 8-10 kg of seed)

Seed treatment with *Rhizobium japonicum* will increase the root nodules for nitrogen fixation

Sowing Season

Kharif: A rainfed crop is sown from June 15 to July in light soils

Rabi: Irrigated crop is sown from October

Summer: Sown in January, and extends upto February

Spacing : Heavy soils: 45 x 5 cm, Light soils: 30 x 7.5 cm.

Fertilizer and Nutrient Management

- For obtaining good yields, should apply 15-20 tonnes of FYM or Compost per ha.
- But soybean being a legume crop has ability to supply their own N needs provided they have been inoculated .
- Apply 12 kg Nitrogen, 24 kg phosphorus and 16 kg potassium per acre.

Weed management

- First 6-7 weeks after seeding is critical period, hence clean cultivation is essential.
- Since crop is sown in lines/rows, inter-cultivation can be done 2 times, first at 20-30 DAS, followed by second at 45 DAS along with manual weeding.
- For wide range of weeds in soybean, foliage herbicides provide excellent weed control

Pre emergence herbicides: Alachlor (1.5-2.0 lit/ac), Acetachlor (1-1.5lit/ac) Metachlor (1-1.5lit/ac) oxyflourfen (0.5-1.0 lt/ac)

Post emergence herbicides: Quizol fop ethyl (Turgasuper) @400 ml/ac Imazythepyr (250 mg / ac) (Pursuit) for broad leaved weeds.

Water Management

The soybean crop generally does not require any irrigation during *Kharif* season. However, if there were a long spell of drought at the time of pod filling, one irrigation would be desirable. During excessive rains, proper drainage is also equally important. Basically it is a rainfed crop, in deep black soils for *Kharif* and *rabi*, the crop responds to irrigation in intensive cropping system. Flowering and pod development stages are sensitive stages for moisture stress. Irrigation in Light soils can be given once in 10-12 days, in heavy soil at an interval of 18-20 days. Irrigated by check basin or border method, but furrow method is ideal.

Intercropping

Soybean + pigeon pea - 7:1 or 5:1

Soybean + cotton - 2:1 or 3:1

Harvesting

When plants mature, leaves turn yellow, start dropping, pods dry out quickly. There is a rapid loss of moisture from the seed. Harvesting can be done by hand, plants are uprooted or cut with sickle above ground level. After cutting, plants are heaped and sun dried for one or two days. Threshing is usually done by beating with sticks or using mechanical threshers. Threshed produce is winnowed to separate seeds from chaff. Cleaned seed is dried for 1- 2 days. Seed is stored in moisture proof bags / seed bins. Seed moisture should be 11% for storage. Germination capacity of the seeds for one season only, hence proper care to be taken for storage for the purpose of seed sowing. Seeds should be sun dried .

Lecture No. 23

BLACKGRAM/ URDBEAN

Scientific Name: *Vigna mungo*

Family: Fabaceae

Origin: India is considered as primary centre of origin and Central Asia as the secondary centre of origin of black gram.

Area & Production:

- India's cultivated area is 47.26 lakh ha, production is 27.51 lakh tonnes with productivity of 632 kg/ ha.
- In our Telangana, black gram cultivated area is 21278 ha, production is 26074 tonnes with productivity of 1225 kg/ ha.

Distribution

Distribution is comparatively restricted to tropical regions *i.e.* India, Pakistan, Bangladesh, Myanmar, Srilanka. States cultivating Black gram in India are Maharashtra, Andhra Pradesh, Tamil Nadu, Uttar Pradesh and Orissa.

Climate requirement:

- It is a Tropical crop
- Tolerates high temp, required annual rainfall is 600-1000 mm to grow this crop.
- Also cultivated in summer season.
- Short day plant to day neutral cultivars are available

- Optimum temperature between 25 & 35°C
- It can tolerate 42°C temperature.

Sowing time

Kharif: June-July

Rabi: October

Summer: February-March

November- December in immediate harvested paddy fields.

Soils: Ideal soils with well drained loam or sandy loam.

Seed rate:

Kharif – 15-18 kg/ha.

Rabi - 18-20 kg/ha

Spacing: Dibbling – 30x10cm. On wet land, dibble at 30cm spacing.

Seed Treatment: Treat 1 kg seed with 30 grams Carbosulfan, 25 grams Thiram

Fertilizer application:

Rainfed: 12.5 kg N + 25 kg P₂O₅/ha

Irrigated: 25 kg N + 50 kg P₂O₅/ha.

Foliar spray of DAP and NAA (rice follows)

- Spray 2% DAP at the time of first appearance of flower and 15 days later.
- Spray 40ppm NAA-at the time of first flowering and 15 days later.

Irrigation:

1. Irrigate immediately after sowing followed by life saving irrigation on third day.
2. Irrigate at interval of 10-15 day depending on soil moisture.
3. Flowering and pod formation are critical period for irrigation.
4. Avoid water stagnation at all stages.
5. Apply KCl as 0.5% foliar spray during vegetative stage if there is moisture stress.

Weed management: Spray Fluchloralin (Basalin) 45% EC @ 1.5 lit/ha mix in 200 lit of water and incorporated in the soil as Pre plant incorporation

Pendimethalin (Stomp) 2 lit/ha as pre-emergence 3 DAS followed by one hand weeding 30 DAS.

Harvesting & threshing:

Crop comes to maturity at 80-95 DAS. Upon ripening, black gram pods turn from green to yellow and then to black. In case of irrigated crop, ripened pods can be collected in one or two pickings. If plants come to harvest evenly, then plants are cut and spread on threshing floor to dry. The plants will dry and become black and pods start splitting. The plants are then beaten using sticks and separate seeds from pods followed by winnowing to remove debris.

Yield:

Rainfed: 600 -700 kg/ha

Irrigated: 1000-1300 kg/ha.

Rice follows: 500 kg/ha.

Varieties:

Varieties	Crop duration (days)	Yield (Q/acre)	Characters
LBG 20 Teja	70-75	5.6-6.4	Polish type, Puff (hairs) are absent on pods, resistant to yellow mosaic virus
T -9	70-75	4-4.8	Puff (hairs) are absent on pods, resistant to yellow mosaic virus.
LBG-623	75-80	6-6.8	Polish type, seed size is bold, resistant to sooty mould.
WRG-26	70-75	4-4.8	Puff (hairs) are absent on pods, bushy type, fruiting at the base of the crop and it will be covered with leafs, resistant to yellow mosaic virus.
PBG-1	70-75	4-4.8	General type, Puff (hairs) are absent on pods, resistant to yellow mosaic virus

Lecture No. 24

GREENGRAM

Scientific Name: *Vigna radiata*

Family: Leguminosae

Common Indian Name: Mung, Mung bean, Golden gram

Green gram is the third most important pulse crop of India after chick pea and pigeon pea.

The protein content in Green gram is 24 percent.

- India's cultivated area is 38.32 lakh. ha, production is 17.84 lakh. tonnes with productivity of 488 kg/ ha.
- Telangana cultivation of green gram is 0.16 M. ha, production is 0.53 lakh tones with 812 kg/ ha.

Economic importance:

- Pods are used as vegetables.
- It is highly digestible pulse crop than any other pulse crop having 25% proteins.
- The husk and haulms are used as good fodder for cattle.
- The left over seed coat *i.e* testa is also used for milch cattle.
- Due to its shorter duration, it can be fit well in several multiple cropping systems.
- It is also grown as a green manure crop.
- Inclusion of green gram in cropping systems improves soil health and fertility.
- Being a close growing crop, it helps in reducing soil erosion and also checks weed growth.
- Being a legume crop, it fixes biological nitrogen.
- Sprouted seeds contain Ascorbic acid, Riboflavin acid and Thiamine, which are good for health

Origin and distribution:

- The origin of greengram is India
- Greengram is widely cultivated throughout Southern Asia. Myanmar, Pakistan, Thailand, Srilanka. Indonesia and China are the principal countries of greengram cultivation.

Climate:

Green gram is a tropical pulse crop largely grown under semi arid and subtropical environment. It is well suited for all rainfed areas with Annual rainfall of 600-1000mm. It can tolerate high temperatures up to 40°C. It is hardiest among all the pulses

Soils:

- Green gram is cultivated on a wide range of soils from sandy loams to black cotton soils.
- In North India, the crop is cultivated on well drained loamy soils where as in South India, it is cultivated on red soils.
- The crop doesn't withstand water logging.
- Optimum soil pH: 6.5-7.5.
- Fairly tolerant to soil salinity.

Preparation of land:

There is no need for a fine seed bed preparation. 1 or 2 ploughings followed by harrowing is adequate for a *kharif* crop. Green gram is cultivated on deep soils during *Rabi* on *Kharif* fallow soils. There is no tillage for rice fallow (Relay Crop) as the seed is broadcasted in standing crop of Rice about a week before its harvest.

Sowing time

Kharif: 15-June to 15 July

Rabi: 15- September to 15 October

Seed Rate:

Sole Crop: *Kharif* 6-6.4 Kg/ac

Green manure: 25-30 Kg/ha

Summer Crop: 6.4-7.2 Kg/ac

Rice fallow pulse crop: 12-14 Kg/ac

Seed treatment: Seed should be treated with 30 grams Carbosulfan per kg seed

Method of sowing:

For Relay Crop: Broad casting

For direct sown crop: Drilling in rows (or) furrows behind a plough.

Spacing: 30X10 cm

Fertilizers

Rhizobium inoculations considerably minimize the need for nitrogen fertilizer application.

Rainfed Crop: 10 kgN/ha (Starter dose (or) booster dose) & 30 P₂O₅ Kg/ha (Basal)

Irrigated Crop: 20 kg N (Starter dose) & 40 P₂O₅ Kg/ha (Basal).

Water management:

- For *Kharif* crop, irrigation is not required but winter & summer crop require 2-3 irrigations.
- Rice fallow green gram crop is not irrigated
- Critical stages: Flower initiation (35 DAS) and Pod filling (55 DAS)
- Total water requirement: 300 – 400mm
- Water logging at flowering & pod filling reduce the yield up to 75% and more.

Weed Management:

- Critical Period for weed competition is up to 35 DAS
- Herbicide recommended is Fluchloralin (Basalin) @ 1.5 Kg *a.i*/ha
- Spray Pendimethalin 30% (stomp) 1.6 lit mix in 200 lit of water immediately or 1 DAS can control the weeds.
- Intercultural operation with gorru at 20-25 DAS.

Intercropping

- Green gram can be grown as inter crop in cotton and red gram.
- Green Gram+Cotton/ Rabi Red Gram- 3:1, Green Gram + Redgram - 7:1
- Suitable green gram varieties for intercropping are LGG-460, LGG-450, MGG-295, WGG-2, WGG-37 and ML-267

Harvesting: For *kharif* crop, the harvesting is done by picking the pods. For *Rabi* & Summer crops, harvesting is done by cutting the whole plant to the base.

Threshing and processing:

The produce is cleaned and sun dried to about 12 percent moisture content and then stored. Green gram is primary consumed in the form of Dal. Green pods are also used as vegetables. Sprouted seed is consumed as salads. Dry seed is boiled and used in soups, made into porridge with rice and wheat. Starch is used in making noodles.

Varieties:

AICRP Centre: RARS, Lam

Non-Plan Centre: ARS, Madhira

Varieties released from A.P:

Varieties	Crop duration (days)	Yield (Q/ac)	Characters
LGG 407	70-75	5.6-6.4	Resistant to yellow mosaic virus and leaf spot, somewhat drought resistant. Erect growing and fruiting on the top.
LGG 410	70-75	5.6-6.4	Erect growing and bushy type. Resistant to yellow mosaic virus resistant. Entire crop matures at a time.
LGG 450 Pushkara	65-70	5.2-6	Plant will grow to medium height with bushy appearance. Pods and grains will not damaged to sudden rains at harvesting stage.
MGG 295	60-65	5.2-6	Resistant to yellow mosaic virus and leaf spot, somewhat drought resistant. Erect growing and fruiting on the top, seed is medium sized.
WGG 37	60-65	4.8-5.6	Seeds are attractive green in colour, resistant to yellow mosaic virus. Suitable for all seasons.
WGG 2	65-70	4.8-5.6	Erect and bunchy type, seeds are attractive and bushy type, resistant to leaf spot.
LGG 460	60-65	4.8-6	Resistant to yellow mosaic virus and shoot rot, somewhat drought resistant. Erect growing and fruiting on the top.
ML-2056	75	4.5	Suitable for Kharif season. Plants are of medium height. Each pod contains 11-12 seeds. It is tolerant to yellow mosaic and cercospora as well as bacterial leaf spots. Also it is tolerant to sucking pest like jassid and white fly.
PS 16	60	3.2-4	Entire crop matures at a time, Suitable to all areas in the state
Pusa 150	65-70	4.8-6	Suitable for all regions in the state Bushy type, occupies larger area, long pods and bunchy fruiting, seeds are medium sized. Entire crop matures at a

			time, susceptible to yellow mosaic virus, leaf spot
K 851	60	4-4.8	Bushy type, long pods and bunchy fruiting, seeds are medium sized attractive. Entire crop matures at a time, susceptible to yellow mosaic virus, leaf spot and powdery mildew
MGG 348	65	4-5	Short plant type, suitable for intercropping.

Kharif: LGG450, LGG 407,LGG 460,WGG 37, MGG 295,M2 267,Pusa 105, MGG 347, MGG 348,PDM 54.

Rabi: Lam M2,LGG 460, LGG 410, Pusa 105,LGG 407, MGG 295, WGG 37, TM96-2

Summer & Spring Season: Pusa Baisakhi and Co-4

Rice fallows: LGG 410

Tolerant to high temperature: Padma, Sunaina & Co-4

Early maturing (60-65 day): Pusa Baisakhi, K851,PS16,Padma, Sunaina & Co-4, Pusa Bold (Vishal), COGG 912

First mung variety released in Orissa during 1980: Dhuli

First Mung been variety released in India during 1948: T1.

Resistant Varieties:

Yellow Mosaic virus: LGG 407,LGG 460,WGG 2,WGG37,PDM 54,ML 267,

Leaf Curl: LGG 460, MGG 295

Angular Black Leaf Spot: LGG 407, WGG 2

Powdery Mildew: TM 96-2, TARM 1

Lecture No. 25

HORSEGRAM

Scientific Name:*Dolichos biflorus* (or) *Macrotyloma uniflorum*

Family: Fabaceae

Origin: India

Other names: Rabi pulse crop, poorman's pulse crop, test crop for drought, crop of virgin soils.

Area, Production and Productivity:

Horse gram is cultivated over an area of 1.7 million hectares with an estimated production of 0.58 million tonnes of grain in India. The largest area under this crop (0.56m.ha) is in Karnataka. It is extensively grown in Karnataka, Andhra Pradesh, Tamilnadu, Madhya Pradesh , parts of Maharashtra.

In our Telangana black gram cultivated area is 1030 ha, production is 910 tonnes with productivity of 882 kg/ ha.

Economic importance: It is consumed as a whole seed, as sprouts, or as whole meal in India, popular in many parts of India and also used as concentrated feed for cattle

Climate: It can be invariably grown as rainfed crop in areas of low rainfall.

Soils: It can be grown in wide range of soils, mostly on poor lateritic soils and also grown in red and black soils.

Season: It is grown mainly in August-November

In summer- February

Spacing: Short duration: 30x10cm, Long duration: 45x10cm.

Seed rate:

15-16 kg/ ha for *kharif* crop

30-35 kg/ha in rice fallow horsegram

16-18 kg/ha as summer crop.

Fertilizers: The crop normally receives no fertilizers. A basal dose of 10kg N, 25kgP₂O₅, 20kg K₂O/ ha are recommended.

Irrigation: This crop does not require much irrigation as it is grown as *rainfed* crop irrigation is essential at flowering and pod formation stage.

Weed control: Weeding should be done 25-30 days after sowing. Application of pendimethalin @0.75kg/ha as pre emergence herbicide.

Cropping systems:

Crop rotation: Groundnut – Horsegram

Sesame – Horsegram

Mesta – Horsegram

Upland paddy – Horsegram

Inter cropping: Ragi + Horsegram

Maize + Horsegram

Niger + Horsegram

Harvesting and storage

Harvesting is done by pickings in the indeterminate types and cut the entire plant in determinate type. Threshing done with the help of sticks to separate seed. Then the seeds are stored in gunny bags. Protect the seed from stored grain pests by treating with edible oil.

Lecture No. 26

COWPEA

Scientific Name: *Vigna unguiculata*

Family: Fabaceae

Origin: Central Africa (or) India

Other names: Black eyed pea, southern pea, china pea, Marble pea.

It is also called as weed smothering crop.

Area and production:

Major area lies in Africa and few countries of Asia, America, Australia and Europe. Highest cowpea production nations are Nigeria, India, Brazil. In India. Cowpea is grown in about 0.5 million ha with an average productivity of 600-750kg /ha. Major states growing cowpea are Maharashtra, Karnataka, Tamil Nadu, Madhya Pradesh, Rajasthan, Andhra Pradesh.

Economic Importance:

- It can be used as pulse, fodder, green manure crop
- Feeding and forage value of cowpea is very high compared to other legumes.
- Crop gives heavy vegetative growth and covers ground very quickly thus it checks weed growth.
- It is a erosion resistant crop
- It is an important alternate pulse crop on dryland areas.

- Cowpea seeds are highly nutritious with high protein (23-24%), carbohydrates, minerals and vitamins.
- Nutritive value :Protein - 22-24% ,Carbohydrate - 55-66 % , Iron - 0.005% ,Calcium - 0.08 – 0.11 % .Essential amino acids -lysine, leucine and phenylalanine

Climate Condition:

- Cowpea is warm weather and semi arid crop, where temperature is ranging from 20^o C to 30^o C.
- Minimum temperature for seed establishment is 20^o C and above 32^o C temperature development of root ceases. For maximum production, day temperature of 27^o C and night temperature of 22^o C is required.
- It is sensitive to cold and below 15^o C temperature the yield is adversely affected. It can grow under shade of tree but cannot tolerate cold or frost.
- It can tolerate heat and dry weather and grown at low rainfall of 300-400mm (drought resistant)

Soil Type & Field Preparation

Well drained loam or slightly heavy soil are best suited. In colder climate, somewhat sandy soil is preferred as crop matures earlier in them. It can grow successfully in acidic soil but not in saline/ alkaline soil. In hard soil, one deep ploughing followed by two or three harrowing and planking are sufficient. In normal soil, only two harrowing & planking is enough. For summer season crop give a irrigation immediately after harvesting of Rabi crop.

Varieties: Pusa 152, Pusa Sawani, Amba(V-16), PTB1 (Kanakamani), PTB 2 (Krishnamani)
 Latest varieties – Anaswara, Varun, Pusa Phalguni,P-118, Paiyur 1, Pusa Dofasali, Pusa Barsathi, Russian Gaint, Pusa Barsati (Cowpea fodder), Pusa Baisakhi.

Sowing Time

Kharif- With onset of monsoon from early June to end of July, *Rabi*- October- November (southern India), *Summer* - 2nd to 4th week of March (grain), February (Fodder), Hills: April-May, Green manure- Mid June to 1st week of July

Seed Rate

For pure crop: 20-25 Kg/ ha (grain), for fodder and Green Manure-30-35 kg./ha. During summer 30 kg/ha for grain and 4kg/ha for fodder and green manure.

Seed Treatment

Treat the seed with Thiram (2gm.) +Carbendazim (1gm.). It is also desirable to treat the seed with Rhizobium culture @10g/kg seed.

Spacing: Row to row—30(Bushy) to 45 cm (spreading), Plant to Plant-10 (Bushy) to 15 cm (spreading)

Manure & Fertilizer

Apply FYM/compost- 5-10 t/ha as basal in last ploughing. 15-20 kg N/ ha as starter dose in poor soils (organic carbon<0.5%), 50-60 kg/ha P₂O₅ and 50-60 kgK₂O/ha. Phosphorus and Potassic fertilizer should be given according to soil test value.

Micro Nutrients

1. Zinc- Quantity of Zinc requirement is determined according to the soil type & it's availability or status in the soil. Therefore, the doses of zinc should be applied based on the soil type as follows:

Red sandy and loamy soils -2.5 kg Zn ha⁻¹(12.5 kg zinc sulphate heptahydrate/ 7.5 kg zinc sulphate monohydrate) per hectare.

Black soils -1.5 to 2.0 kg Zn ha⁻¹(7.5 to 10 kg zinc sulphate heptahydrate/ 4.5 to 6.0 kg zinc sulphate monohydrate) per hectare.

Laterite, medium and alluvial soils -2.5 kg Zn ha⁻¹(12.5 kg zinc sulphate heptahydrate/ 7.5 kg zinc sulphate monohydrate) as basal along with 200 kg of farm yard manure.

Low organic carbon content and hilly sandy loam soil -2.5 kg Zn ha⁻¹(12.5 kg zinc sulphate heptahydrate/ 7.5 kg zinc sulphate monohydrate) as basal in every alternate year.

2. Molybdenum - In clay loam soils, apply 0.25 kg Ammonium Molybdate ha⁻¹as basal.

Water Management

For summer crop, irrigation is most critical among all inputs followed by weeding and fertilizer. Generally, crop requires 5-6 irrigations depending on soil, prevailing weather conditions etc, at an interval of 10-15 days. The response to irrigation is in order of flowering> pod filling>vegetative.

Crop can tolerate flooding up to 2 days at flowering and pod setting thereafter, a marked decrease in yield and its attributes is noticed.

Weed management:

Unrestricted weed competition reduces cowpea yield to extent of 70-90%

- Presence of weeds throughout season causes 75% yield loss.
- For higher yield, crop should be free from weeds up to 25 to 30 day crop stage. Application of Pendimethalin @ 0.75 - 1 kg.a.i./ha combined with one hand weeding at 35 days after sowing is beneficial.

Cropping systems:

Inter-cropping: Sorghum + cowpea

Maize + cowpea

Pearlmillet + cowpea

Pigeonpea + cowpea

Cropping sequence:

Rice-wheat – cowpea

Pigeonpea-wheat – cowpea

Sorghum + Pigeonpea – cowpea

Cowpea-wheat – Greengram

Cowpea-cotton – wheat

Harvesting and post harvest care

Varieties exhibiting synchronous maturity, harvesting is done by uprooting or cutting entire plant at ground level when plant shows 90% maturity. Harvested produce is sundried on threshing yard and threshed by trampling either by animals or tractor and winnowed. If the varieties does not have synchronous maturity, pods have to be harvested manually.

Yield: Fodder yield – 14t/ha.

Grain yield – 3-4q/ha.

Lecture No. 27

FORAGE CROPS

Importance of Forage crops

- Live stock production is an integral part of Indian agriculture.
- India ranks first in live stock production and accounts for 15% of cattle production in the world.
- States with largest acreage under cultivated fodders are Rajasthan, Gujarat, Haryana, Punjab, U.P., M.P., Maharashtra and Tamil Nadu.
- Total area under forage crops in India is 8.3 m.ha which is 4.2 to 4.9% of total cropped area.
- There is a need to improve the fodder acreage up to 8 to 10% of total cropped area to meet the deficit of green fodder for sustained live stock production in India which is considered as an important avocation of rural areas in India .

Characteristic Features of Forage/ fodder Crops or ideal characters of forage /fodder crops

1. It should be succulent and juicy and easy palatable.
2. It should have more number of leaves i.e., high leaf-stem ratio, less shattering of leaves.
3. It should contain high amount of carbohydrates or proteins.
4. Resistance to pests and diseases.
5. It should have regeneration (ratooning) capacity.
6. It should have quick growth and smother weeds.
7. More number of tillers and fine stem.
8. Should be photo insensitive and give more number of cuts.
9. Should have shorter life cycle so that it can fit in cropping systems.
10. It should tolerate shade, drought resistant so best suited for agri-silvi pastoral conditions.

11. Should be suited to different soil classes from III to VII.
12. It should be free from hairs and thorns.

HYBRID BAJRA NAPIER

Scientific Name: *Pennisetum purpureum*

Common Name: Giant Napier /Pusa giant napier / Gajraj / Giant Elephant grass

Climate:

- It is cultivated in areas receiving more than >1000 mm rainfall.
- It can withstand drought and recover the growth quickly with the onset of monsoons.
- Optimum temperature is around 24-28°C. It can tolerate low air temperatures but less than 10°C makes the crop remain dormant.
- It is sensitive to frost. Even a light frost kills the crop but the underground rhizomes will sprout again when the temperature rises.
- It performs better under long day than short day photoperiods.

Soil: Sandy loam or clay loams are the best suitable. pH range is 6.5 – 8.0. In sandy soils, its vigour is low and yield is reduced. It cannot withstand flooded or water stagnated condition. It should be grown in well-drained soils with good moisture retention capacity. It comes up well in saline sodic soils better than guinea grass.

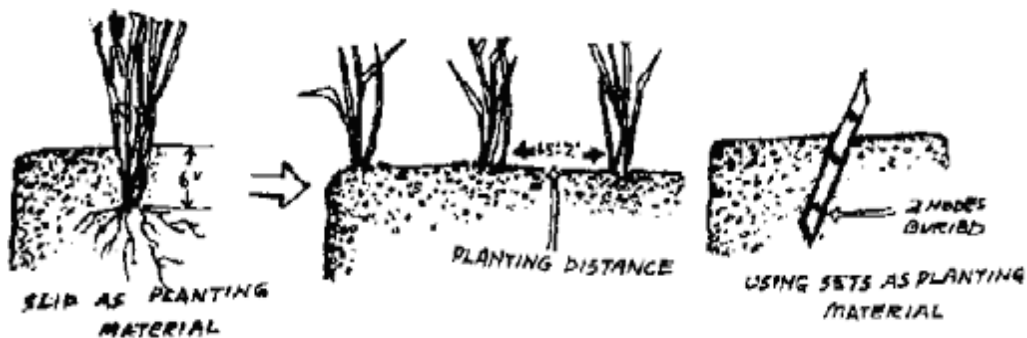
Season: It can be grown during any part of the year provided sufficient water is provided. Optimum time of planting during *Kharif* and summer is June-July and January-February respectively. Winter sowing is not recommended due to low temperatures.

Method of sowing: The seed of hybrid Napier is sterile. Therefore hybrid bajra Napieris multiplied only through stem cuttings or rooted slips. The stem cuttings are obtained from clumps grown upto 2.5 to 2 m ht. Top ¼ is removed and remaining ¾ is used. Rooted slips are obtained from clumps, which are 1 m width.

Stem cuttings: Stem cuttings can be stored for about 20 days for planting by covering with moist gunny bag but in sub tropics, with cold weather, they can be stored during the entire winter season.

45° angle method: Stem cuttings are obtained from basal ¾ portion of the plant. Each stem cutting with 2 nodes measures about 30-40 cm inserted in the soil in a slanting position at 45°

angle. One bud should be inside the soil and one bud should be exposed over the soil surface. Buds inside the soil develop roots and, the bud over the soil produce shoots.



End to End Method: 2 budded or 3 budded sets are placed in the furrow such that eyes on the node are exposed to the sides of the furrows and then cover with soil. Then irrigation is given.

Rooted slips: Break up the old clumps and separate the tillers along with their roots. Each slip should consist of 1-2 tillers measuring 10-12 cm height. Dig a small hole in the furrow and insert the roots into these holes. Propagation by this method is best in Summer Season. The stem cuttings are likely to dry up due to desiccating winds and hot summer.

Land preparation: It needs thorough land preparation. plough the field 4-6 times followed by harrowing. Then made into ridges and furrows.

Varieties:

In India, first hybrid developed is NB-21.

CO 1: It is profusely tillering, highly leafy, tall growing and non-lodging, yields 300 t/ha.

CO 3: It is tall growing, highly tillering and non-lodging with low oxalic acid and crude fiber content. Yield 300-350 t/ha.

APBN 1: Released during 1998 by AICRP on Forage Crops, L.R.S., ANGRAU. It is tall growing highly tillering, more leafiness (high L:S ratio) with low oxalic acid content. It is found to be drought resistant and adopted for cultivation.

IGFRI No.3: It is a profusely tillering type with erect growth habit. It is good for intercropping and has the capacity to yield 100-150 t/ha green fodder per year. It is suitable for NE hills, U.P., M.P. hills of N. India.

IGFRI No.7: Suitable for temperate zone of the country. It is an erect growing and leafy variety with high regenerative capacity. 120-150 t/ha. It may be grown under acidic conditions.

IGFRI No.10:It can be grown throughout the country. It is also erect growing, leafy and multi-cut variety. It produces 100-160 t/ha green fodder per year. The variety is also suitable for acidic soils and sub-temperate situations

Seed rate: 80,000 rooted slips or stem cuttings/ha. Spacing is 60 x60cm.

Spacing 90x90cm in inter cropping with cowpea in *kharif* and lucerne in *Rabi*.

Irrigate the field through furrows and plant the one rooted slip or stem cutting per hole at a depth of 3-5cm on one side of the ridge

Fertilizers:

Being a heavy feeder this hybrid should be applied 25t/ha FYM orcompost.50kg/ha of nitrogen,50kg/ha of phosphorus and 40kg/ha of potassium. Band application of the fertilizer mixture prior to the planting is preferred. For this open furrows 5cm deep on the one side of the ridge, apply fertilizer mixture and cover with soil. Repeat the basal application once in year for the sustained higher yields. Top dress with 100 kgN/ha after each cut.

Weeding and intercultural operations

Hand weeding or hoeing and weeding should be followed on the 30th day. Gap fill to maintain population. Subsequent weeding may be carried out preferably after each harvest. Earth up once after three cuts and removal of dried tillers is recommended.

Irrigation

Irrigate immediately after sowing and give light irrigation on the 3rd day after sowing and thereafter can be irrigated at 10-15 days interval depending upon the requirements of crop.

Harvesting

When cutting the crop for forage, a fairly long stubble of 13-15cm has to be left to avoid damaging the growing point near the base of the plant. First cut at 70-90 days after planting and subsequent cuts once in 45 days. In case of sewage or high N containing effluents irrigation, the harvest interval may be increased to 55-60 days to minimize the nitrate/oxalate problem.

Yield: Green fodder yield is about 250-300 t/ha in 6-8 cuttings in one year.

Lecture No. 28

PARAGRASS

Scientific Name: *Brachiaria mutica*

Family: Poaceae

Common name: Water grass, Buffalo grass, Mauritius grass, Angola grass, California grass

Origin and Distribution:

Though it is a native of tropical Africa and tropical south America (Brazil), it is widely distributed as a fodder grass in tropical and subtropical areas of the world. It grows well on moist soils (a water loving grass) and withstands prolonged flooding or water logging, but makes little growth during dry weather. More suited for water inundated condition and sewage farms. It can be used for green soiling, hay and should be grazed rotationally as it will not withstand heavy grazing.

Climate and soil:

Grows well in areas with Rainfall 1000-1500 mm. with optimum temperature around 15-38°C. Can tolerate water logging and most suitable for marshy areas. Comes up well in sewage water. But sensitive to cold and frost. Semi-aquatic grass grows well in rice growing areas of world. Highly tolerant to saline and sodic soil and used for reclamation of saline soils than any other grass.

Season:

In irrigated condition, throughout the year it can be sown and suitable time for *kharif* is June - July or the onset of spring. In *rabi* conditions growth is very poor. Summer: February- March, as it is water loving crop. summer crop cultivation is rare phenomenon.

Seeds & sowing:

Propagated by seed, rooted slips and runners/ stem cuttings. Seed setting is poor and has dormancy. So mostly propagated by rooted slips and runners. In summer, rooted slips are safer than runners.

Seed rate: 2.5-3.0 kg/ha. Transplanting method- 40,000-50,000 rooted slips/ha or 2-4 q/ha planting material is required.

Spacing is 35cm × 35cm. Planting should be done at a depth of 3cm on the side of the ridge.

Land preparation: It needs thorough land preparation. plough the field 4-6 times followed by harrowing. Then made into ridges and furrows.

Manures & Fertilizers:

Apply 25 t/ha of FYM or compost after the second ploughing. There commended nitrogen (50kg/ha), phosphorus (50kg/ha) and potassium (30kg/ha) should be applied in band prior to the sowing. Top dressing of nitrogen 20kg/ha after each harvest.

Weeding:

Hand weeding or hoeing and weeding on the 30th day should be practiced. Gap fill to maintain population. Subsequent weeding may be carried out preferably after each harvest. Earth up once after three cuts and removal of dried tillers simultaneously.

Irrigation:

Irrigate immediately after sowing and give light irrigation on the 3rd day and thereafter can be irrigated as and when depending upon the requirement of crop.

Harvesting and yield:

The crop is ready for the first cut in the three months after the planting and subsequent cutting can be taken at an interval of 30-35days. Para grass is reported to have yielded 150-200 t/ha in 10-12 cuttings/year.

Lecture No. 29

GUINEA GRASS

Scientific Name: *Panicum maximum*

Family: Poaceae

Origin and Distribution :

This grass is native of tropical Africa. Introduced in our country in 1798. It is one of the oldest introduced grass in our country.

Climate and soils:

The grass thrives best in warm moist climates with annual rainfall of 600-1000 mm. Tolerates drought fairly but susceptible to frost. Frost burns the plant tips and leaves rapidly lose their succulence and stems become hard and dry. Optimum temperature is 15-38°C. Best grass which suits under orchards or forestry trees because of shade tolerance ability. Adapted to wide range of soils except water logging and acidity, can tolerate medium salinity. Fertile or well drained medium loamy soils are most suitable. Can be grown along the field bunds and sides of irrigation channels to prevent erosion.

Season:

In South India, under irrigation all months are suitable except in Dec-Jan. Under rainfed condition it is sown during June-August. In North India, Mid Feb-August is favourable under irrigated conditions.

Seeds & sowing:

Propagated by seed, rooted slips and stem cuttings. In summer, Root stocks are safer than stem cuttings. 5-6.25 kg/ha seeds may be broadcasted in the nursery bed and 40000 seedlings transplanted in the field with the onset of the monsoon. Plant the rooted slips to a depth of 3cm on the side of the ridge or sow the seeds on the marked lines or raise seed in nursery and transplant 20-25 days after germination.

Land preparation:

The land is prepared by giving 1-2 ploughings, followed by 3 to 4 harrowings.

Varieties:

The following are some of the commercial varieties of large or medium types.

- 1) **Queensland common:** East African Origin. It is a well-tillered bunchy type grows to 150 cm height. Stem nodes are hairy and finer leaf sheath and blades.
- 2) **Riverdale:** is a selection from 9 C made by South Johnstone Research Station at Riverdale.
- 3) **Makueni:** Drought resistant one. Grows to a height of 1 m in height and light green in colour.
- 4) **Gatton panic:** is a medium type variety. Easily distinguished from Queensland guinea, as the stem nodes are smooth. Resistant to grazing and creates less management problems.
- 5) **Hamil:** very tall variety of guinea grass. Robust, smooth, erect that grows from 3 to 3.5 m height. Foliage is dark green than Riverdale and Makueni and stem nodes are free of exposed hairs. Well accepted by animals.

6) **Colonial guinea:** Very palatable type but less productive than other guinea grass varieties. Very tall variety growing up to 3 m. Practically hairless and thick fleshy stems. Well accepted by cattle. The foliage is blue green and flowers later, than other varieties due to long growing season. Very drought resistant.

Small types: Green panic or slender guinea var. (trichoglume). This is a French grass has an ascending habit crown expanding by short horizontal stems. It shows drought resistance and survives well in situations where Rhodes grass dries out completely. Leaves are fine and soft and stems are slender. Has a good (unique) regenerative capacity and most responsive to improved fertility.

Spacing: 50 x 50 cm.

Fertilizers:

The grass responds well to manuring. To ensure high yields, a basal dose of FYM 10-15 t /ha or compost after the second ploughing should be incorporated. There commended doses of nitrogen 50kg/ha, phosphorus 50kg/ha and potassium 40kg/ha should be applied in band prior to the sowing. Repeat the basal application once in a year for sustained higher yields. Top dressing of nitrogen @ 25kg/ha after each cut.

Irrigation:

Irrigate immediately after sowing and give light irrigation on the 3rd day and thereafter can be irrigated at 10-15 days interval.

Harvesting & Yield:

The first cut can be taken in 50days after planting. After first cut each cutting with 40 days interval. The average production is about 200-250t/ha/yr in 7-8 cuttings. The yield however, declines with age and it is advisable to replant the field with fresh slips every fifth year. Planting can be done in the standing field of guinea grass in between the rows and the old plants removed after the new plants get established. The fodder supply can be maintained at an uniform level.

Lecture No. 30

LUCERNE

Scientific Name: *Medicago sativa*

Family: Fabaceae

Common name: Alfalfa/ snail clover/Chilean clover

It is regarded as QUEEN OF FORAGE crops.

Also called as GREEN GOLD of forage crops.

Alfalfa is an Arabic word means 'the best'

This crop contains 18-20% proteins, high content of amino acids, Ca and vitamins.

Climate:

Comes up well in tropics, sub tropics and temperate regions up to 2400m above MSL. Temperature in the range of 15-25°C- day time, 10-20°C -night time, 20-30°C is required for seed set and 15-20°C is optimum for vegetative growth.

Soils:

Well drained deep loamy soils rich in lime, N, P, K with pH 5.5-8.5 are optimum. Do not perform well on sandy soils. Can tolerate drought but not water stagnation and high humidity. Remains dormant under conditions of drought and resume the growth with the availability of water in the soil. Acidic soils are not suitable. Root growth is stunted due to less concentration of Ca, S and Mg, can thrive on alkaline soils too.

Season:

It is a *rabi* season crop. Sowings are taken up during the months of October & November depending upon the prevailing temperatures.

Seeds & sowing:

Seed rate: for forage 15 kg/ha, for seed purpose 7.5kg/ha in line sowing would be sufficient.

Spacing: crop is sown 25-30 cm apart in solid rows.

Seed treatment: Seed should be treated with 10% brine (salt) solution to remove the seeds and inert material. Scarified against hard surfaces to soften the seed coat for better germination. Seed is soaked in water for 10-12 hrs or soak in diluted H₂SO₄ for 2-3 minutes and then rinse with water 4-5 times and cooling to the room temperature. Then mix with 1.25 kg *Rhizobium*. Seed should be treated with recommended *rhizobium* culture for nitrogen fixation if it is sown for first time in the field.

Land preparation:

One MB ploughing followed by 4-5 harrowing to make a fine tilth. Field is made in to rectangular sized plots for proper irrigation and better drainage.

Varieties:

Annual varieties: Anand-1,2, LLC-3, RCL-87-1 & LLC -5.

Perennial: CO-1, T-9 or Sirsa-9, Sirsa-8, RL-88, Sri ganga sagar, IGFRI-S-244(chetak), alamdar-1 & IGFRI –S-54, Anand-3.

Manures and Fertilizers:

Lucerne responds well to manuring which needs about 25 t FYM /ha, 20-25 kg N,120 kg P₂O₅, 40 kg K₂O /ha. P is applied as SSP and K as MOP.½ N, entire P and K as basal and ½ N at 30 DAS.

Weeding:

Requires thorough weeding in the initial stages. Cuscuta is a complete stem parasite. Remedy is to uproot the plants along with host plants and burning. Do not allow the weed to set seed. The seed will live in the soil for a long time. Cultivation of Lucerne should be avoided in fields once infested with cuscuta at least for 3 years.

Chemical treatment: 5 ml/ lit water of Pendimethalin as pre emergence herbicide orimazethpyr 2 ml/ lit. of water as early post emergence (10-12 days).

Irrigation: Water requirement is quite high. Initially at weekly interval, then at 10-12days interval. Crop requires 10-15 irrigations in a year.

Harvesting & Yield:

The first cut at 55-60 DAS or at 50% flowering stage. Subsequent cuts at 25-30 days interval. Yielding about 75-88 t/ha in 8-10 cuttings per year.

Lecture No. 31

BERSEEM

Scientific Name: *Trifolium alexandrinum*

Family: Fabaceae

Common name: Egyptian clover

Origin and distribution

Berseem is believed to be indigenous to Egypt. It is introduced in India from Egypt in 1904 and tried at various centres for its performance, by 1916 it was recognized as a widely adaptable and valuable addition to the forage crops of India. Now it is the prominent fodder legume in irrigated areas of Punjab, Delhi, Rajasthan and Uttar Pradesh.

Climate

Grows in tropics, subtropics and temperate regions. Temperature range is 25-35°C optimum for seedling growth. 15-20°C optimum for vegetative growth and branching. 35-37°C optimum for flowering and seed setting. It cannot tolerate frost and temperature below 4-5 °C.

Soils: Well drained deep loamy soils rich in lime, P, K with pH 5.5-8.5 are recommended. Do not perform well on sandy soils, water logging and acidic soils. Can tolerate salinity, alkalinity and is thus useful for reclaiming brackish and alkaline lands.

Season:

It is a *rabi* season crop. October to November sowings are adopted depending on prevailing temperatures and previous *kharif* crop.

Methods of sowing: Can be sown dry or wet. The land is divided into small plots of convenient size, irrigate the plots to a depth of 5 cm. soak the seed in water over night and broadcast it in the standing water.

Spacing: Inter row spacing of 25-30 cm is adopted in solid rows. If seed production is taken intra rows spacing of 10 cm is maintained.

Land preparation: One MB ploughing followed by 4-5 harrowing are required to make a fine tilth. Fine seed bed is prepared since the seed is small.

Cultivar groups:

1. Mescavi: varieties under this group develop short side branches at the base of the stem in advanced stage of its growth. When the plant is cut or harvested, these branches elongate and produce new growth. Therefore it is possible to take 5-6 cuts per year from this group.

Varieties: Wardan, JB-1, JB-2, JB-3, UPB-103.

2.Fahl: develop small side branches in the upper portion of the stem very freely. They do not produce branches at the base. Therefore there is no regeneration of these varieties after harvest. They give only one cut.

3.Saidi: They develop shoots for a short time. Develops branches at the upper portion less freely than in Fahl. They give 2-3 cuts per year. Ex: Khandwari, Pusa giant, IGFRI-99-1, IGFRI-54, Jawahar.

Seed rate: 10- 15 kg/ha in line sowing, 20-30kg/ha in broadcasting would be sufficient. Bright yellow, plump seeds should be used discarding all the brown and immature seeds.

Seed treatment: Seed should be treated with 10% brine (salt) solution to remove the seeds of chicory. Scarified against hard surfaces to soften the seed coat for better germination. Seed is soaked in water for 10-12 hrs or in diluted H₂SO₄ for 2-3minutes and then rinsed with water 4-5 times. 10% jaggery solution 1.25 kg with 1.25litres of water is prepared by boiling and cooling to the room temperature. Then mix with 1.25 kg *Rhizobium trifolii* bacterial culture. Sprinkle the culture on the seed uniformly and dry under shade. Mix the seed with 10 kg of soil and broadcasted or drilled in the field.

Manures & Fertilizer:

Berseem responds well to manuring and need about 10 t FYM /ha, 25 – 30 kg N, 80-100 kg P₂O₅, 30-40 kg K₂O kg /ha P is applied as SSP and K as MOP. ½ N, total P and K as basal and remaining ½ N should be applied 30 DAS. Micronutrient deficiencies are common with regard to B, Mo, Fe and Zn and has to be corrected. Boron deficiency is very common in coarse textured and soils with more leaching. Its deficiency causes several pale yellow spots on the leaves which resemble the leaf hopper damage. Corrected by foliar application of 0.1% borax or soil application of borax @ 10 kg/ha as basal and Mo as Ammonium molybdate @ 1- 1.5 kg/ha.

Weeding :

Requires thorough weeding in initial stages. *Cichorium intybusis* associated weed of berseem. Remedy is soaking in the 10% brine solution for 10-15 minutes, seeds floating on the water are removed. hand weeding at 30 DAS is effective. Do not allow the weed to set seed. The seed live in the soil for a long time.

Chemical treatment : 0.75 -1.0 kg a.i. /ha pendimethalin as pre emergence herbicide is recommended. Incidence of *Cuscuta* is also noticed.

Irrigation

Water requirement is quite high. Initially irrigation is given at weekly interval later at 10-12 days interval. Crop requires 140cm of water in a year. In places where irrigation water is not sufficient for berseem, oats can be grown as an alternate crop.

Harvesting:

The first cut can be taken at 55-60 DAS or at 50% flowering stage. Subsequent cuts are obtained at 25-30 days interval. Mescavi types are good for fodder purpose as it gives 5-6 cuttings.

Lecture No. 32

STYLOSANTHES

Scientific Name: *Stylosanthes* sps.

Family: Fabaceae

This is also known as Caribbean stylo and Verano stylo.

Being nutritive and palatable, it is used as feed for all types of animals in the form of hay, silage.

It is herbaceous and dichotomously branched perennial. It attains a height of 1.2 meters, leaves are trifoliate, leaflets lanceolate, acute and glabrous with 4-6 pairs of veins. Rachis is 4-6

mm long and bidentate, stipules adnate to the base of the petiole with hairs on the sheath and teeth. The inflorescence is an oblong spike with 8-14 yellow flowers on a long stem. The pods or so-called seeds are medium to dark brown in colour, 2-2.5 mm long asymmetrical by reniform, radical ends fairly prominent and beak is slightly coiled. Actual seed comes after removing the brown covering and is light yellow in colour.

Origin:

It is a native of the islands of West Indies and found generally adjacent the coastal regions of North and South America, and introduced in many tropical regions of Australia, Burma and India.

Species in Stylo:

Stylosanthes scabra: It is an upright small woody shrub. Its compound leaves consist of three leaflets, which are loosely covered in hairs on both surfaces, some of which are sticky. It can be grown as inter crop.

Stylosanthes hamata (Verano stylo): This species has creeping growth habit. leaves are thick green and trifoliate. it can withstand drought condition.

Stylosanthe humilis (Townsville stylo): It is a low growing annual. The stems are narrow, hairy, many-branched, erect. The leaves are trifoliate and the leaflets are narrow and pointed.

Climate:

It thrives well in the areas receiving annual rainfall from 500 to 1270 mm with a pronounced dry season.

Soils: It is adapted to a wide range of soil types and is drought resistant.

Sowing season: Rainfed crop: June-July, Irrigated crop: September-October

Seed rate: 12.5-15 kg/ ha for broadcasting, 5-7 kg/ ha for sowing in rows.

Spacing: 15x20 cm

Seed treatment: Before sowing, the seeds should be scarified or treated with hot water for 1-1.5 minutes.

Weeding and inter cultural operations:

For better establishment, 1-2 hand weedings and inter cultivation with gorru is required for better growth.

Fertilizers: At the time of field preparation and before sowing 5-8 tonnes/ha FYM + 30 kg N and 60 kg P₂O₅/ha and 30 kg K₂O/ha are applied. From second year onwards, 30 kg P₂O₅ and 15 kg N/ha are sufficient.

Harvesting: During establishment year (first year), it should not be allowed to be grazed at all but should be harvested at the height of 10 cm from ground level after four months of sowing. From second year onwards, it may be grazed or harvested 2-3 times. Rotational grazing is preferred for higher production.

Yield: The green forage yield ranges from 20 - 30 t/ha in rainfed condition and 75 t/ha in irrigated condition. It generally produces 350 - 400 kg seeds/ha but from well-managed pasture, seed production reaches up to 1000 kg/ha.