# Technologies Released from UAS, Raichur (2009-10 to 2018-19)

## Crop Production Technologies

### Soil and moisture conservation in pigeonpea


Soil moisture can be conserved by opening furrow between two rows of pigeonpea at 30 days after sowing. Moisture conservation furrow opened plots were compared with unopened furrows. Significant improvement was observed in soil moisture and its availability during later part of the season. Instead of leaving space between two rows of pigeonpea open furrow it act as conservation as well as drainage channel.

### Transplanting technique of pigeonpea

Pigeonpea is generally broadcasted or line sowing. Transplanting of pigeonpea seedlings is one of the alternate agronomic practices to overcome late sowing and related lower yields of pigeonpea. This technique involves rising of seedlings in polythene bags in the nursery for one month and transplanting the seedlings with the onset of monsoon after the soil profile is uniformly wet. Yield potential is 15-16 q/ ha as rainfed intercrop and 30-35 q/ha as irrigated monocrop can be obtained. Very early and early varieties yield 20-30 % less.

Advantages of the transplant technology

- Sowing will be in May-15 even if it does not rain at right time
- Due to early sowing, pod borer insect damage can be avoided
- Drought resistance develops due to deep rooting
- Easy to spray insecticides as plants are at definite intervals
- Saving in seeds, only 2.0 kg/ha is required for transplanting as against10-12 kg/ha under normal practice
- Tailor made technology for small and marginal farmers
- Increase in yield at wider spacing allows enough sunlight to reach the leaves of each pigeonpea plant thus reducing competition for water, space and nutrients.

**Transplanting of pigeonpea to main field**

After deep ploughing and tilling, opening furrows/ pits of 0.5 sq. ft size should be dug at 5 x 3 ft in deep-medium soils (with a plant density of 7260 seedlings/ha) for sole crop under irrigated condition or 6 x 3 ft in deep soils (6050 seedlings/ha) for inter crop under irrigated condition. For taking up pigeonpea as the sole crop, saplings should be planted at distances of 5 x 3 ft in deep soil (7260 seedlings/ha) under *rainfed* condition. Fill the pits with soil and compost in equal proportion before 15 days of transplanting. Transplant one seedling per spot. In intercropping, pigeonpea should be planted after the first crop is planted. For example, crops like blackgram/greengram/soybean should be sowed first and then pigeonpea plants have to be transplanted into opened furrows/ pits (as said above) . In both sole and inter cropping, ridges and furrows to be opened at 5 and 6 ft intervals. Separate the bag before transplanting. Light irrigation is must after transplanting.

**Nipping in pigeonpea**

Nipping of 5-6 cm top growth in pigeonpea has to be done at 20-25 days after transplanting (DAT). Between 50 and 55 days of germination, the main shoot tip (called as "mother" shoot locally) and the secondary branch tips (secondary shoots, called "daughters") are pruned. This promotes development of large number of tertiary shoots (called "grand children" locally), which bear more number of pods, thus increasing the yield by 30-50%. Grand children grow only at the expense of mothers and grand mothers, goes local saying.

**Transplanting technique of Bt-Cotton**

Transplanting of 25-30 days old seedlings of Bt cotton at 90x90 cm or 90x60 cm spacing helps for further growth and development. The main purpose of transplanting is to catch hold season with right time of planting. It has the advantage of maintaining the optimum plant population and quick establishment. The cost towards plastic covers is additional and it will be compensated with the lower seed rate. It is better than dibbling and ensures optimum plant population with uniform crop stand.

**Revised recommendation of fertilizers for sunflower**

It has been revalidated. The existing recommendation of chemical fertilizers of 24:30:24 kg NPK/acre to 36:36:24: kg NPK/acre. Application of graded levels of fertilizer has resulted in 8.9 % increase in seed yield (1317 kg/ha) and higher net returns (Rs. 24032/ha) and B: C ratio. The potential yield of sunflower was achievable at the graded levels of nutrients. Higher dose of N and P gave higher yield and oil content.

**Spraying of potassium nitrate in cotton**

Successive two sprays of 1% (10 g/l of water) potassium nitrate at bud formation and flowering stage controls flower drop and enhances fruit formation and development. The results indicated that potassium nitrate spray reduced flower drops & increased fruit setting in cotton.

**Agronomic practices for raising of paddy seedlings in trays for mechanized paddy transplanting**

The technology is developed for mechanized transplanting of paddy. Instead of plastic trays, mixture of red soil / black soil/ black soil + vermi-compost / black soil + FYM spread on plastic sheets for raising paddy seedlings. It minimizes cost towards plastic trays. However; there was no difference in establishment. The modified form of paddy seedlings rising on mat was found to be easy and cost effective. The maximum no. of labours is required for transplanting and harvesting. The mechanized transplanting needs proper mat and healthy seedlings. The advanced methodology of seedlings rising helps in achieving uniform plant population in a short time.

**Medicinal and aromatic plants in saline *Vertisols***

Medicinal and Aromatic plants

1. In salt affected black soil EC: 6.0 dS/m vetiver grass can be grown.
2. Not suggested to cultivate *Andrographis paniculata* in salt affected black soil.
3. *Ocimum bassilicum* can *be* grown in salt affected black soil EC : 4.8 dS/m *Ocimum sanctum can be grown* in salt affected black soil EC : 5.1 dS/m

**Integrated farming system for irrigated and rainfed areas**

Different IFS component viz., crops, vegetables, flower crops, goats, dairy animals, poultry, vermi-culture and fodder species and bunds was more profitable over existing conventional farming system components. The above mentioned components were compared with existing conventional IFS components in rainfed areas. The system income was much higher than conventional system in addition to unaccountable benefits. The benefits from IFS system was realized in terms of employment generation, monetary benefit, improvement in soil fertility in addition to fulfillment of domestic requirement.


**Components for irrigated area (1 ha model)** **Components for rainfed areas (1ha model)**

## Direct seeded rice in command areas

Rice is an important crop of our country as well as in Karnataka state. It is grown in different areas under different methods; in high rainfall areas of Western Ghat and transition zone of Karnataka, it is raised by direct seeding/sowing; in command areas, rice is being grown under transplanted conditions and in other parts of the country *viz*., Tamil Nadu and Bihar, under Madagaskar or SRI method is popular with the farmers. In West Godavari district of Andhra Pradesh rice is also grown by wet seeding method. The tail end farmers of the ThungaBhadra (TBP) and Upper Krishna (UKP) command areas are getting good yields under dry direct seeding with minimum cost of production. Direct seeded rice (DSR) is a new technology for the farmers of irrigated area, the knowledge on the agronomic practices of DSR is most important for farmers who are willing to adopt this technology in command areas.

### Cultivation practices of dry direct seeded rice

**Land preparation:** Ploughing for 2-3 times under optimum moisture condition followed by harrowing etc are necessary before sowing.Some times farmers of TBP and UKP run a reverse blade (of land leveling implement) for smoothening/compacting the soil.

**Sowing:** During *kharif* season, sowing should be done 30-35 days before the release of canal water in command area either after the receipt of sufficient rainfall or in dry condition. Those who are having water facility can irrigate immediately after sowing. Sowing can be done by either improved seed-cum-fertilizer drill or zero till multi crop planter with a spacing of 22.5 cm between rows. The seeding depth should not be more than 2-3 cm.

**Seed rate:** Depending on the size of the seeds, a seed rate of 8-10 kg per acre (for varieties like BPT-5204, Cauvery sona, Shreeram gold etc.) or 12-14 kg/acre (for varieties like IR-64, MTU-1001, 1010) is sufficient for sowing.

**Varieties:** The varieties which are already recommended for particular region can be used for sowing.

**Weed management**

1. If sowing is done after the receipt of soaking rains, application of pre emergent weedicide (Pendimethalin 30% EC or Pendimethalin 38.7% CS @ 1000 ml or 700 ml, respectively in 200 liters of water for one acre) immediately after sowing, will take care of weeds for 15-20 days.
2. In case where, dry sowing is done, farmers can use the above mentioned pre-emergent herbicide one or two days after the receipt of rainfall.
3. Farmers having irrigation facilities can adopt dry sowing followed by irrigation and application of the above herbicide and doses, 24-48 hours after irrigation.
4. The weeds, which appear after 20- 35 days after sowing can be managed by a post emergent herbicide application (Bispyribac sodium 10% SC @ 100 ml in 200 liters of water). There should be sufficient moisture during the application of weedicide.
5. The weeds can also be managed by inter cultivation or by passing cycle weeder in between the rows if the spacing between rows is about 10 inch.
6. If the paddy filed is dominated by broad leaved weeds, application of 2,4-D sodium salt 80% WP (@ 2.5 g/l of water) or 2,4 D ethyl easter (@ 2.5 ml/l of water) will effectively suppress broad leaved weeds. However, this weedicide molecule should not be used in those paddy lands, which are surrounded by cotton fields. Cotton is very sensitive to 2,4-D.

**Water management**

In *Kharif*, if direct seeding is done after the receipt of soaking rains, the crop is dependent on the monsoon rains till the canal water is released. The rainfall received in between before the release of canal water may or may not suffice the water requirement of the crop. However, DSR tolerates moisture stress up to 20-25 days in black soils. In irrigated areas, maintaining moist condition is essential till the germination of all the seeds. However, stagnation of water in the fields can kill the germinating seeds. It is recommended to maintain sufficient moisture in the field during critical stages (tillering, flowering and grain filling) of the crop, otherwise it will lead to lesser yields. The farmers residing in the upper reaches of canal can irrigate the crop when hair line cracks are seen after the previous irrigation, during the growth of the crop. This practice not only saves water but also improves health of the soil.

**Nutrient management**

Application of 50 kg/acre DAP along with seeding is recommended in irrigated condition and in cases where seeding is done after the receipt of profile wetting rains. Basal application of DAP is not required for dry seeding. After 15 days of germination, if rains are received/ after irrigating the crop, 10 kg Zinc Sulphate is applied per acre. Zinc Sulphate can also be applied along with FYM before sowing. The farmers of Tunga Bhadra and Upper Krishna project commands are reaping more paddy or equal yields as under transplanted conditions by applying 80:40:40 kg NPK/acre to direct seeded rice. Use of micronutrients especially, Zinc ($ZnSO_4$ @ 10 kg/acre) and Iron ($FeSO_4$ @10 kg/acre) is essential for direct seeded rice. Whenever, the deficiency symptoms of these nutrients are seen in the crop, the availability of these micronutrients can be increased by maintaining moist conditions for few days.

**Pest and disease management**

The practices followed for the management of pest and diseases in DSR are similar to those of transplanted rice. However, the following points helps in reducing the incidence of pest and diseases in DSR.

1. Using a seed rate of 8-10 kg/acre or 12-14 kg/acre as per the seed size of the variety
2. Balanced use of fertilizers
3. Direct seeded crop looks good only after 45-60 days depending upon the variety and there is no need to apply excess nitrogenous fertilizer to make it lush green.

**Yield:** The yield under DSR is either more (100-200 kg/acre) or equal to the yield obtained under transplanted conditions.

**The average grain yield of different varieties under DSR and transplanted (TPR) rice**

| Sl. No. | Variety | Grain yield (kg/acre) | |
|---|---|---|---|
| | | DSR | TPR |
| 1 | BPT-5204 | 2880 | 2640 |
| 2 | Gangavati Sona | 2440 | 2840 |
| 3 | MTU-1010 | 2640 | - |
| 4 | JGL-11470 | 3200 | 3000 |
| 5 | Kaveri Sona | 2700 | - |
| 6 | Shreeram Gold | 2720 | 2640 |

**Quality of grain**

DSR facilitates the farmers to take up sowing on time or earlier than the normal sowing. Therefore, the quality of grain will be good with less number of chaffy grains per panicle (especially in BPT-5204) and hence, the test weight is better than the transplanted paddy.

**Benefits of DSR**

1. Direct seeded rice uses 17-35 % less water than the transplanted rice *i.e.* it saves 17-35 % water
2. It helps in timely sowing of the crop
3. By direct seeding the resources, time, energy required to raise and protect the nursery are saved besides avoiding land preparation of main field.
4. Less seed rate per unit area (8-12 kg/acre)
5. Saving in energy (diesel 8-10 l/acre) and consequently, it is less polluting technology
6. Farmers are saving 25-30% fertilizers in DSR
7. Less cost of cultivation (Rs. 7,000-8,000/acre)
8. Judicious use of water leading to increased water productivity besides avoiding problems associated with excess use of water like salinity in command areas.

## Production technologies for linseed

Linseed is an important minor oilseed crop of north Karnataka, which is rich in omega-3-fatty acid so that it can be used as one of the nutritional food ingredient in daily human diet. The oil extracted from linseed is used for manufacturing of paints, varnishes and printing ink. This crop is grown in the districts of north Karnataka *viz*., Raichur, Vijaypura, Bagalkot, Kaluburgi, Bidar, Koppal, Yadgir and Ballari as sole and intercrop with an area of 11,000 ha.

**Varieties**

| Sl. No | Varieties | Zones and situation | Sowing time | Maturity days | Special features |
|---|---|---|---|---|---|
| 1 | NL-115 | 1,2 and 3 both under rainfed and irrigated conditions | October 15 to November 15 | 110 | 1. Resistance to powdery mildew disease<br>2. Bold seeds and high oil content |
| 2 | S-36 | 1,2 and 3 under rainfed conditions | October 15 to November 15 | 120 | 1. Medium sized seeds<br>2. Moderately resistant to powdery mildew disease |

**Inputs (per acre)**

| Inputs | Quantity |
|---|---|
| Seeds | 10 kg |
| FYM | 1.2 tonnes |
| Nitrogen | 16 kg |
| Phosphorous | 8 kg |
| Potash | 8 kg |

**Sowing:**

Incorporate 1.2 tonnes of FYM to the soil 2-3 weeks before sowing. Seeds are sown with a spacing of 30 cm from row to row and 5 cm from plant to pant. In order to ensure the good germination, seeds should be placed not more than 5 cm depth of soil. In rainfed condition all recommended dose of fertilizers should be applied at the time of sowing whereas under irrigated conditions, half a dose of recommended dose of nitrogen and full dose of phosphorus and potassium is applied as a basal dose. The remaining nitrogen is applied with first irrigation *i.e* about 35 days after sowing.

**Intercultivation:**

Intercultivation operation should be done at 30 and 60 days after sowing. It is necessary to keep the crop free from the weed for the first 35 days after sowing to get good yield.

**Plant protection:**

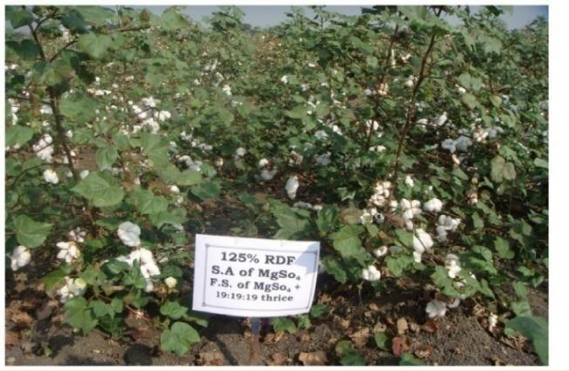
| Sl. No. | Pests / Diseases | Symptoms and damage | Management |
|---|---|---|---|
| 1 | Bud fly | Insects feeds on buds results in the formation of chaffy seeds | Spray with Imidacloprid 17.8 SL @ 0.3 ml/litre of water at the time of bud stage |
| 2 | Leaf eating caterpillar | Feeds on leaves and cut the plants | Spray with Lamdacyalothrin 5 EC @ 0.5 ml/l at 25-30 days after sowing. |
| 3 | Powdery mildew | Initially formation of green yellow patches on leaves, later on presence of powdery growth on leaves, stem and buds | Spray with Carbendazim @ g/l of water |
| 4 | Root rot | Initially wilting and drooping of leaves in the infected plants leads to drying of leaves. Roots of the infected plants will rot and peeling of outer layer | Seed treatment with Carbendazim @ 2 g/kg or seed treatment with Captan @ 3 g/kg of seeds |

**Intercropping:** Linseed is grown as inter crop with safflower, wheat, and chickpea (4:2) with a row ratio of 2:1.

**Harvest and yield:**

The crop should be harvested when the leaves are dry, the capsules have turned brown and the seeds have become shiny. Irrigated: 4-5 q/acre Rainfed: 2.5-3.5 q/acre

## Management of leaf reddening in cotton




Leaf reddening menace can be kept under check by spraying 1.0 % $MgSO_4$ solution or 2.0 % DAP or urea when the crop is at 90 and 110 days after sowing. Leaf reddening incidence is relatively more in Bt cotton. The incidence can be controlled satisfactorily with 25 % additional RDF dose, along with soil application of 25 kg $MgSO_4$ /ha at the time of sowing and three foliar sprays of 1.0 % $MgSO_4$ (10 g $MgSO_4$ per 1 litre of water) + 1.0 % 19:19:19 (10 g 19:19:19 in 1 litre of water) NPK at flowering, boll formation and boll development stages.

**Revised spacing for long duration pigeonpea varieties** For long duration pigeonpea varieties (BSMR- 736), sowing pigeonpea in 150 cm x 20 cm spacing was effective over 90 x 30 normal spacing.

### Revised split application of N & K for Bt cotton

For Agro-climatic zone 3 irrigated cotton application of 12.5 % recommended N and K at basal, 12.5 % at 25 DAS, 50 % at 50 DAS and remaining 12.5 % at 75 and 100 DAS was found effective and enhanced seed cotton yield.

### Alternate cropping system for Paddy-Paddy in UKP command area

In UKP command area paddy-paddy is most common cropping system. An alternative cropping system such as maize-chickpea and Bt cotton – sesame are more profitable over paddy- paddy.

### Maize + Pigeonpea (4:2) intercropping in irrigated condition

For Agro-climatic zones 2 and 3, maize + pigeonpea (4:2) intercropping was more profitable than respective sole crops.

## Chickpea + Linseed (4:2) intercropping system

For Agro-climatic zone 1, 2 and 3, chickpea + linseed (4:2) intercropping was more profitable than respective sole crops.

**Management of pigeonpea podborer, *Helicoverpa armigera* through intercropping**


Destroying eggs and pupae of *helicoverpa* by summer ploughing. By growing redgram + sunflower / mesta in 6:1 proportion reduced the *helicoverpa* incidence.

## Profitable paddy based integrated farming system

1. **Cropping system**
   - Paddy-Paddy
   - Paddy-Sunflower
   - Paddy-Sesame
   - Maize-Chickpea
   - Bt cotton-fallow

2. **Horticulture**
   Guava+ Curry leaf + Drumstick + Bhendi + Aster + Cluster bean+ Lablab
3. **Kitchen garden:**Pundi, Palak, Methi,
4. **Animal husbandry**: Buffalo (2) + cows (2)
5. **Goat farming** : 4+1(Female + Male)
6. **Farm pond**-5% area
7. **Fodder crops-** 3% area
8. **Others**- Earth worm: 6 vermicomposting units ( 4x 3x2 ft ) + Azolla
9. **On bunds**-Sagwani, coconut, glyricidia and fodder crops

**Organic Irrigated Paddy Production:**

Paddy is an important food crop of this region; soil, water and environment is being polluted due to excessive use of chemical fertilizers. Seeds contained high concentration of pesticides residues which may cause detrimental effects on human being. In this context there is a need to produce residue free rice through organic approach.

**Varieties are similar to non organic production practices**

**Inputs required for sowing (per acre)**

| | | |
|---|---|---|
| 1 | Seeds (transplanted paddy) | 25 kg |
| 2 | Organic manures | |
| | FYM / compost | 2.5 t |
| | Poultry manure or | 0.75 t |
| | Vermicompost | 1.0 t |
| | Neem cake | 200 kg |
| 3 | Bio-fertilizers | |
| | *Azosprillum* | 200 g |
| | Phosphate solubilisers | 200 g |

***Cultural operations:***

- **Seed bed preparation**: About 300 $m^2$ nursery bed is required to raise seedlings required for 1 acre area.
- Puddle and level the nursery land
- Provide irrigation facility and adequate drainage to remove excess water from the nursery.
- Incorporate FYM @ 0.25 tonnes/ 100 $m^2$ area.
- Germinate the paddy seeds before sowing by drenching the seeds in water for 24 hours followed by keeping the seeds in warm conditions for 48 hours.
- Sow the seeds @ 50-70 $g/m^2$
- Ensure that seedling not to be dried during initial stage of the crop.
- Provide a light irrigation when the crop is about one foot height
- For control of sucking pest, two weeks after sowing, spray NSKE @ 5% or Neem oil @ 0.2 % or cow urine @ 10% and spray Panchagavya @ 3% at 15 to 20 days crop growth.

**Preparation of main land and organic manure incorporation:** Apply 2.5 tonnes of FYM per acre before two weeks ahead of transplanting and broadcast 0.8 tonnes of poultry manure and incorporate into the soil with the help of tractor driven tiller. Keep it as such and puddle

the land after two weeks and level. Care should be taken not to allow the water to go from one plot to another and a thin layer of water is allowed to stand over soil surface.

**Transplanting:** Seedlings will be ready for transplanting within 25 days. The roots of the seedlings are dipped in the slurry of *Azosplirillum* (500 g), PSB (500 g) and *Trichoderma* (100 g) and plant the seedlings at 20 cm rows and 10 cm apart. After 30 to 35 and 55 to 60 DAT, apply 250 kg of neem cake.

**Green manure crop and *Azolla* for higher yield:** Grow Daincha or Sunhemp green manure crop @ 10 kg per acre and incorporate into soil after 6-7 weeks and then transplant paddy. After 10 days of transplanting, a thin layer of water is allowed to stand over the soil and spread *Azolla* @ 500 gram. At 20-25 days, *Azolla* grows well and spread to entire paddy land. Drain water completely and incorporate *Azolla* into paddy field.

**Weed management:** Intercultivate the land by rotary weeder between two rows at 2,7 and 9 weeks after transplanting, followed by two hand weeding at 20 and 40 DAT.

**Water management:** After transplanting, during initial period of 10 days, maintain a height of 2.5 cm water and then 5 cm. After complete percolation of water and retain water to a height of 5 cm. This cycle has to be continued till harvest. Before 10 days of harvest, drain the water from the paddy land completely. Ensure that water should not be shortage from tillering to grain filling stage.

**Growth promoter:** Spray Panchagavya @ 3% solution at flowering and fruit development stage. Besides, spray cow urine @ 20% solution.

**Plant Protection measures:** For control of BPH, drain out the water completely from paddy fields. Spray the crop with ***Metarrhizium*** bio-fungicides @ 2 g/l or neem oil @ 2 ml/l.

- Install Pheromone traps: 5 number per hectare to monitor the population of stem borer.
- After 30 days of transplanting release predator *Trichogramma* @ 20,000 per acre at an internal of a week for 4 to 5 times.
- Control the stem borer and leaf roller with *Beauverriya bassiana* bio-fungicide @ 2 g/l at 30 and 50 days after planting or spray neem oil @ 2 ml/l at base of the plant.
- Spray neem oil @ 0.2% for sucking pests.
- For control of leaf blight, dip the seeds for 30 minutes with *Pseudomonas fluorescence* @ 10 g/l.

- Before transplanting drench the roots of seedling for 20 minutes in a solution containing *Pseudomonas fluorescence* (4 g/l). After 20 to 25 days, spray with *pseudomonas* @ 4 g/l
- Spray the crop with 20 % cow urine solution to control bacterial blight

**Note:** Undertake plant protection measures only after incidence of pest & disease

**Yield:** Seed yield will be 1.6 to 2.0 tons and straw yield 2 to 2.5 tons per acre after 4 years. by following above mentioned organic package .

**Note:** Paddy yield obtained under organic system will be on par with that under inorganic system

after addition of organic manure for 3 years.

- Incorporating organic manure continuously for 6 years, addition of organic manure can be reduced by 25 % from 7$^{th}$ year onwards.

**Organic *Rabi* Jowar Production:**

It is an important crop of Northern Karnataka suitable for growing in different soils and climatic condition. It is not only a major food crop but also provides fodder to livestock. This crop is being grown as *Rabi* crop on residual soil moisture in zone 1, 2 and 3 of Karnataka State. It can be grown successfully by organic approach.

**Varieties are similar to non organic production practices**

**Inputs required for sowing (per acre)**

| Sl. No. | Inputs | Quantity |
|---|---|---|
| 1 | Seeds | 3.0 kg |
| 2 | Organic manures | |
| | Compost FYM or Compost/ FYM | 3.0 t |
| | | 1.25 t |
| | Vermicompost or Compost/ FYM | 0.72 t |
| | | 1.0 t |
| | Vermicompost | 0.5 t |
| | Green manure | 0.75 t |

| | | |
|---|---|---|
| 3 | Jeevamrutha | 200 L |
| 4 | Neem cake | 1.0 q |
| 5 | Bio-fertilizers | |
| | *Trichoderma* | 10 g |
| | *Azospirillium* | 200 g |
| | Phosphate Solubilisers | 200 g |

**Organic manure:** Use different sources of organic manure as mentioned here for better utilization of nutrients by the crop. After preparation of the land, 10-15 days before sowing of crops, incorporate compost (FYM) green manure. However, in case of vermicompost, apply at the time of sowing along with neem cake. By using different source of organic manures,

**Seed treatment:** Shade dry the seeds which are dipped previously in 25% cow urine solution for 8 hours and then treat seeds(per hectare) with 500 grams of *Azospirillium* and 500 grams of P.S.B. and 30 grams *Trichoderma.*

**Sowing:** It is better to sow the seeds during 1st week of October to avoid incidence of pest and disease. The treated seeds are sown at 45 cm rows and 15 cm apart in 5 to 7 cm depth.

**Weed management:** Intercultivate the land 2 to 3 times at an interval of 8 to10 days after 30 days of sowing. Mulch the soil with available crop residues to avoid loss of soil moisture.

**Plant growth promoter:** Spray the crop 2 to 3 times with 3% Panchagavya solution when the crop is at 30 days old.

**Plant protection measures:**

- Grow shoot borer resistant variety M 35-1.
- For the control of mites and shoot borer, spray the crop with 5 % NSKE or V*erticilium leucani* @ 2 g/l.
- Spray with 5% NSKE solution to control stem borer.

**Yield:** Grain yield 5 to 6 quintal and straw yield 16 quintal per acre after 2 to 3 years of organic management.

**Note:** At the times of sowing drench the land with 500 liters of Jeevamrutha

- Grow green manure crop in the off season.

- Follow crop rotation with Redgram and Greengram

**Organic Pigeonpea Production:**

Pigeonpea is an important pulse crop of Northern Karnataka. It is grown as sole crop in Kalaburagi District and in other districts (Yadgir, Bidar, Raichur, Koppel, Bellary and Vijaypur), it is being grown as inter crop with Green gram, Groundnut, Black gram, Sesamum, Jowar, Maize and Sunflower. Being nitrogen fixer, it assumes importance in organic system as a inter crop or relay crop. Recent GI tag for tur dal.

**Varieties are similar to non organic production practices**

Use below mentioned organic manures in different proportions. After complete preparation of land, before 10 to15 days before sowing, incorporate compost/FYM/green manure into the soil. If vermicompost and rock phosphates are to be used, apply gypsum and neem cake together at the time of sowing.

**Seed Treatment:** Before sowing of seeds the seeds required per hectare are use to be treated with 500 g *Rhizobium*, 500 g PSB and 60 g of *Trichoderma.*

**Sowing:** It is better to take up sowing in June to prevent incidence of pests. Treat the seeds with *Trichoderma* and bio-fertilisers and sow those seeds in 90 cm rows and 20 cm apart. When Pigeonpea is grown as a sole crop, mix the seeds with 100 g of Sorghum/ Styloxanthus. These plants act as shelter plants for birds which can eat on insects. Besides, all around the fields of Redgram, one or two lines of Marigold or planting of 100 plants of Marigold per acre can reduce the insect menace.

**Inputs required for sowing: organic manure: (per acre)**

| Sl. No. | Inputs | Quantity |
|---|---|---|
| 1 | Seed | 4-5 kg |
| 2 | Organic manure | |
| | Compost/FYM | 3.0 t |
| | **Or** Compost/FYM | 1.25 t |
| | Vermicompost **Or** Compost/FYM | 1.0 t |
| | | 0.75 t |
| | Vermicompost | 3.0 t |
| | Green manure | 0.4 t |
| | Rock phosphate | 80 kg |

| | | |
|---|---|---|
| 3 | Jeevamrutha | 200 L |
| 4 | Bio-fertilizers | |
| | *Rhizobium* | 200 g |
| | Phosphate solubilisers | 200 g |
| 5 | Bio-pesticide | |
| | *Trichoderma* | 25 g |
| 6 | Neem cake | 100 kg |
| 7 | Gypsum | 40 kg |

**Intercultivation:** Intercultivate the land at an interval of 15 to 20 days.

**Growth promoter:** Spray with 3% panchagavya solution when the crop is at flowering, fruit setting and fruit maturing stage.

**Plant protection measures:**

- Do summer ploughing to kill the eggs of pest & grow disease resistant variety.
- While sowing of Pigeonpea, mix the seeds with jowar seeds and grow marigold all along the border.
- Install pheromone traps of 2 per acre at a height of 1 or 1.5 feet above the crop canopy to monitor the population and activity of fruit borer. Replace sex attractant chemicals at 15 days internal. Start spraying and insecticides when 5 or more number of months are noticed in trap or two insect eggs on flower buds/ flower or one insect on flower.
- When the crop is at initial stage of flowering, for the control of fruit borer, spray with 5% NSKE solution along with this, use 100 gram of soap powder as a dispersing agent. In case neem seeds are not available, spray with neem oil @ 3 ml/l.
- In the later stage, spray N.P.V-250 LE/ha or along with 5% NSKE solution, use 10% cow urine or 2 ml *Bt* solution per litre or chilli powder (0.5%) and garlic powder extract (0.25%). Ensure that same chemicals not to be used continuously and it is to be changed periodically.
- For management of wilt disease use *Trichoderma* (4-5 g/kg) the treated seeds and separately mix *Trichoderma* powder (2 kg); keep the moisture content of above mixture at 50% and cover with a plastic cover for 7 days. Then apply the above mixture to the soil of one hectare along with FYM.
- Remove the plants affected with sterility mosaic virus. As a prevention measure, spray with 5% cow urine solution.

**Yield:** **3.5** to 4.5 q/acre after 3 years of adoption of above mentioned organic package.

**Note:** Pour 500 L Jeevamrutha solution per hectare at the time of sowing & it is better to rotate the pigeon pea with either Green gram or Rabi Jowar

**Organic Chickpea Production:**

It is an important *Rabi* season pulse crop of Northern Karnataka. It is being grown mainly in deep black soils under rained condition in zone 1,2, and 3. Being a pulse crop, this can be grown as a major rotational crop with Sunflower and Blackgram in Bidar, Raichur Kalaburgi, Yadgir and Ballari districts. The yield of chickpea mainly depends on soil fertility, amount soil moisture and pest control.

**Varieties are similar to non organic production practices**

**Inputs required for sowing: (quantity per acre)**

| | | |
|---|---|---|
| 1 | Seeds | 20 kg |
| 2 | Organic manure | |
| 3 | FYM/Compost | 1 t |
| | Vermicompost | 14 t |
| 4 | Bio-fertilizer | |
| | *Rhizobium* | 500 g |
| | P.S.B. | 500 g |
| 5 | Bio-pesticide | |
| | *Trichoderma* | 75 g |

**Seed treatment:** To increase the drought resistance, drench the seeds before sowing with 25% cow urine solution for 8 hours or 2% $CaCl_2$ solution for 30 minutes and dry the drenched seeds in the shade for 7 hours. After this, treat the seeds with *Trichoderma* @ 4 g/ kg seeds and bio-fertilizers ( *Rhizobium* and P.S.B).

**Sowing:** Plough the land completely and incorporate the FYM/Compost into field about 3 weeks before sowing. At the time of sowing, apply vermicompost in the rows. Application of organic manures of different sources will be useful in releasing nutrients more efficiently. Sow the seeds in 30 cm rows and 8 to 10 cm apart and apply neem cake at the time of sowing.

**Weed management:** Intercultivate field two times after 15 DAS and 35 to 40 DAS with a blade harrow. If need be one hand weeding can be made.

**Growth promoter:** Spray with panchagavya @ 3% solution or cow urine @ 10% solution, twice at the time of flowering at 15 days internal.

**Plant protection measures:**

- Install pheromone traps @ 2-3 traps per acre to monitor fruit borer population.
- While sowing mix chickpea seeds (per hectare) with 50 grams of Sunflower / Rabi Jowar seeds to attract natural predator.
- To control fruit borer, spray the crop with 5% NSKE solution or N.P.V. 250 L.E. per hectare or neem oil (0.03%) or spray with garlic & chilli extract @ 20 ml/l or *Bt* solution @ 2 ml/l, at 25 to 30 DAS and 40 to 45 DAS.
- For control of wilt and root rot disease, previously treat the seeds with *Trichoderma* bio-fungicide @ 4 g /kg. Apply *Trichoderma* enriched compost at the time of sowing (2.5 kg *Trichoderma* in 100 kgs of FYM; moisture maintained at 50-60%; keep the mixture for 7 days). Destroy the wilt or root rot affected plants.

**Yield:** 5-6 quintals per acre after 3 years of adoption of organic package.

**Note:** Pour Jeevamrutha solution to the land @ 200 l per acre

- Follow crop rotation.

**Organic Greengram Production:**

It is an important pulse crop of Northern Karnataka, which can be grown in different soils and climatic conditions. Being a pulse crop, it improves the soil fertility by fixing atmospheric nitrogen in plant roots. This crop is popular in zone 1 and 2 as a relay crop and inter crop with Pigeonpea and Groundnut under rainfed situation.

**Varieties are similar to non organic production practices**

**Inputs required (per acre)**

| Sl. No. | Inputs | Quantity |
|---|---|---|
| 1 | Seed | 5-6 kg |
| 2 | Organic manure | |
| | Compost/FYM | 3.0 t |

| | | |
|---|---|---|
| | **or**<br>Compost/FYM | 1.25 t |
| | Vermicompost<br>**or**<br>Compost/FYM | 1.0 t<br>0.5 t |
| | Vermicompost | 3.0 t |
| | Green manure | 0.4 t |
| | Rock phosphate | 75 kg |
| 3 | Jeevamrutha | 200 lit. |
| 4 | Bio-fertilizers | |
| | *Rhizobium* | 200 g |
| | Phosphate solubilisers | 500 g |
| 5 | Bio-pesticide | |
| | *Trichoderma* | 25 g |
| 6 | Neem cake | 100 kg |

**Use of organic manure:**

After preparation of land, 10 to 15 days before sowing, incorporate FYM/compost/green manure into the soil as per the different sources & proportions. In case vermicompost and rock phosphate are to be used, apply them in rows at the time of sowing.

**Sowing:** Sow the seeds during 1st week of June to protect the crop from insect and disease. Before sowing, treat the seeds with *Trichoderma* and bio-fertilisers and sow them in 30 cm rows.

**Weed management:** Intercultivate two times before 40 days of sowing. Go for hand weeding after 20 DAS.

**Growth promoter:** When the crop is at flowing and initial stage seed setting, spray with Panchagavya @ 3% solution.


**Plant protection measures:**

- Do summer ploughing
- After 25 to 30 DAS, spray with 5% NSKE or neem oil (0.03%) or plant based bio-pesticides @ 10% solution to control at leaf eating caterpillar.

- Install pheromone traps: 5 number per hectare to monitor population of stem borer. Along with 5% NSKE, spray with cow urine @ 5% solution.
- To control powdery mildew, spray with 5% bio-fungicide (*Pseudomonas fluorescence)*

**Yield:** 2 to 2.5 quintals per acre after 3 years of adoption of organic package.

**Note:** At the time of sowing apply Jeevamrutha to the soil @ 200 l per acre & incorporate residues after harvest of Greengram.

**Nutrient management in greengram**

By spraying 1% 19:19:19 (19:19:19@ 10 g/litre of water) during flowering in groundnut will enhance the yield.

**Potassium management in groundnut in red soils**

By applying 12.5 kg potash to red soils and 1% potash spray (10 g potash in 1 litre of water) during flowering time will manage the reddening in leaf tip and also enhances the yield.

**Phosphorus management in transplanted pigeonpea through VAM**

During 2nd week of May in Zone-1 and 2nd week of June in Zone-2, adding 1 kg mycorrhiza (VAM) to 100 kg vermicompost and 15 g mixture to polythene bags and sowing the pigeonpea seeds and 25-30 days old seedlings can be transplanted in late rain conditions.

**Performance of linseed varieties in adoption to different dates of sowing**

Sowing of linseed during 3rd and 4th week of October in zone 1, 2 and 3 is ideal.

**Integrated nutrient management in greengram-linseed system**

In greengram-linseed cropping system, by treating seeds of greengram with *Rhizobium* and PSB along with 5 t FYM and *Azatobacter* and PSB to linseed, 25% of recommended nitrogen and phosphorus to greengram and 25 % recommended nitrogen, phosphorus and potash to linseed can be saved.

**Conservation practices in pigeonpea**

By applying the previous crop residues as mulches helps in increasing the moisture availability and enhance the 29.5 % pigeonpea yield (440 kg/acre).

**New Chapter on mulberry cultivation practices**

Since there is no information on mulberry cultivation practices, the information mulberry varieties, transplanting techniques bio fertilizers, nutrient management, weed management, water management, and yield information included.

**Method of planting on seed yield in chickpea Cv.JG-11 under irrigated condition**

By manual dibbing of chickpea seeds in 45 cm raised beds and 10 cm between plant to plant the higher yields can be achieved

**Efficient use of water through drip irrigation in onion**

From transplanting to 30 days, 31-60 days, 61-90 days and 91-100 days, applying water 1 lit, 2 lit, 3 lit and 1 lit for every sq meter respectively will save the water and enhance the onion yield.

**Response of groundnut to different dates of sowing**

Groundnut sowing can be taken up during 2$^{nd}$ week of September to 2$^{nd}$ week of October instead of December sowing to avoid canal water shortage.

**Perennial forage grasses for salt tolerance in TBP command area**

Perennial forage grasses like rhodes, paragrass & grazing guinea are suitable for growing in salinity of 4-8 dS/m.


**Boron application in Pigeonpea**

Spraying 0.1% Boron (1 g/l of water) during early flowering in Pigeonpea increases the yield.

**Nutrient management in Bt cotton**

In Tungabhadra command area, the recommended dose of fertilizers for *Bt*-cotton is 72:36:36 kg NPK/acre.

**Response of Chickpea to different seed rates**


In irrigated chickpea the seed rate required for one hectare is 75 kg. It is recommended for zone II and III.

**Nutrient management in maize – bengalgram cropping system**

Maize – Bengalgram cropping system, for maize application of 76:30:15 kg NPK/acre and for bengalgram as per the existing recommended dose of fertilizers.

**Land preparation in mechanical transplanted Paddy (in transplanted condition)**

Prepare puddling with rotovator followed by leveling with spike tooth harrow will enhance for transplanting.

**Production of elite seedlings through organic techniques in paddy**

Spray 3% panchagavya during seedling, flowering, panicle initiation and grain filling stages will enhance the paddy seedlings establishment and yield.

**Management of paddy seed crop through organic techniques**

Apply 80 kg FYM in 100 $m^2$ 15 days before sowing and 27 kg vermicompost and spraying 3% Panchagavya during $12^{th}$ day & $18^{th}$ day after sowing, leads to good healthy seedlings.

**Management of paddy seed crop through organic techniques**

Treating the paddy seeds with 12.5% coconut water and 3% leaf extracts of seethaphal and keep them for 16 hours (1.5 l/kg paddy seed) and drying for overnight.

**Seed Polymerization and Foliar spray of micronutrients in Bt cotton**

Treat cotton seeds with seed polymer at 8 ml/kg seed with ferrous sulphate, manganese sulphate and magnesium sulphate (4 g/kg seed). Then spray the crop with 0.5% zinc sulphate (EDTA Form), 0.5% iron sulphate, 0.5% manganese sulphate and 1% magnesium sulphate mixture 2 times during flowering (10 days intervals) will get higher yields.

**Seed Polymerization and foliar spray of micronutrients in pigeonpea**

Seed hardening with 2% $CaCl_2$ for one hour and drying under shade for 7 hours. The hardened seeds are treated with seed polymer (6 ml/ kg seeds) which contains micronutrients like $ZnSO_4$, potassium molybdate and borax (@20 g/kg seed). Then treat the seeds with Rhizobium, PSB and PGPR biofertilizers for Zone 1 and 2, GB-2 and for zone-3 CC-1 Rhizobium strains are used to reduce 50 % of nitrogen. Apart from this spray EDTA form 0.5 % $ZnSO_4$, 0.1% potassium molybdate and 0.2 % Borax two times during flowering (10 days interval) will enhance the pigeonpea yields.

**Seed polymerization and foliar spray of micronutrients in chickpea**

Seed hardening with 2 % $CaCl_2$ solution for 30 minutes or with 25% cow urine for 8 hours and drying under shade for 8 hours. The hardened seeds are treated with seed polymer @ 6ml/kg seed with $ZnSO_4$, $FeSO_4$, Borax and Ammonium molybdate at two grams for kg seed. Then treat the seeds with *Rhizobium* and PSB. Then spray the mixture containing 0.5 % EDTA ZnSO4, 0.5% FeSO4, 0.2% borax and 0.1% Ammonium molybdate 2 times during flowering (10 days interval) will enhance the bengalgram yield.

**Seed Polymerization and Foliar spray of micronutrients in Groundnut**

Treat the seeds with seed polymer (@ 4 ml/kg seed) with $ZnSO_4$, FeSO4, Borax and Ammonium molybdate and $CaSO_4$ at 2 g/kg seed. Then treat the seeds with 3 g Captan 80% WP or Thiram 75WP or Carbaxin 75 WP or 4 g *Trichoderma*. Then treat with *Rhizobium* and PSB. Then the spray 2 times the mixture containing 0.5% EDTA $ZnSO_4$, 0.5 % $FeSO_4$, 0.2 % borax and 0.1% ammonium molybdate during flowering (10 days interval) will enhance the groundnut yield.

**Use of new PSB strains in pigeonpea**

Treating the redgram seeds with phosphorus solublizing bacteria (PSB-1) will increase the nodulation in redgram and their by increasing the yield.

**Use of growth regulator (pulse magic) in pigeonpea**

To increase the yield in redgram, spraying the crop with pulse magic @ 10 g/l of water during 50 % flowering and 15 days after $1^{st}$ spray.

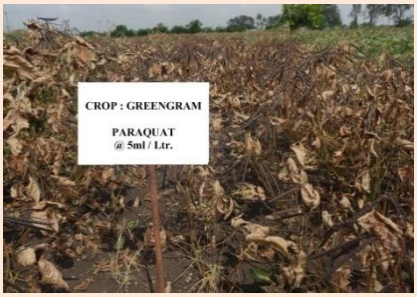
**Medicinal and aromatic plants for saline *Vertisol:*** Citronella can be grown in EC 7.20 dS/m salinity in the TBP command area


**Use of seed hardening and PGR spray for Chickpea**

To increase the yield in bengalgram, treat the seeds with @ 2 % $CaCl_2$ and spray 100 ppm CCC during flowering time.

**Seed treatment for drought tolerance in greengram**

Keeping seeds in @ 2% $CaCl_2$ solution for 7-8 hours and then dried in shade will increase drought resistance in green gram. When green gram is at maturity stage, spraying 5 ml paraquat per litre of water will defoliates the leaves facilitating easy harvesting.




**Use of defoliator in blackgram**


When blackgram is at maturity stage, spraying 5 ml paraquat per litre of water will defoliates the leaves facilitating easy harvesting.

**Weed Management in Blackgram**

Spraying of 800ml Propaquizafop 2.5% + Imazethapyr 3.75% v/v in 400 litres of water will control both monocot and dicot weeds. 1ml of Intatron or Dhanuvit (surfactant) per litre of solution should be added to the herbicide solution.


**Weed management in blackgram**

Spray 30g Imazethapyr 35% + Imazamex 35% WG combiproduct for 1 acre at 20 days after sowing or when the weeds are at 2-5 leaf stage. Add 2 ml of adjuvant to the spaying solution. For one acre, 300 litres of spraying solution is required. This technology is recommended for zone 2 and 3.

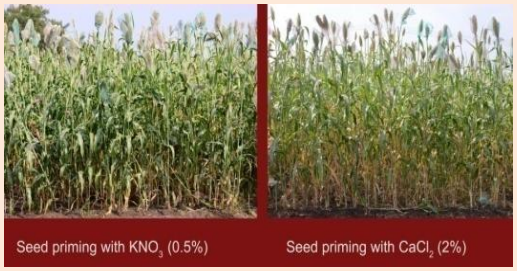
**Response of growth regulator (Paclobutrazol 23% SC) on growth & yield of Bt Cotton**

Two sprays of pactobutrazole 23% SC @ 0.35 ml/litre of water during 50-55 DAS and 80-85 DAS will decrease the flower and boll drop in cotton. 200 litres of spray mixture is required for one acre. This technology is recommended for zone 2 and 3.

***Rabi* sorghum + linseed Intercropping system**

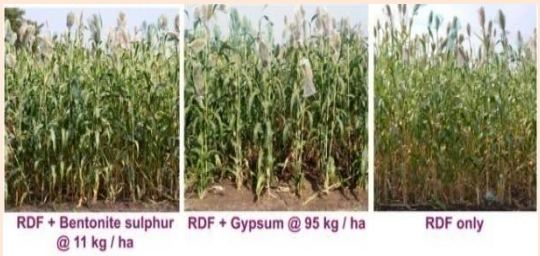
Growing two rows of linseed and one row of sorghum (2:1) in an intercropping system during *rabi* enhances yield and income. It is recommended for zone 2 and 3.

**Effect of seed priming on the yield of rabi sorghum**




Seed priming with KNO3 (0.5%) increases the yield of rabi Sorghum. This technology is recommended for zone 2 and 3.

**Management of sulphur in rabi Sorghum**




Apply 8 kg sulphur for enhancing rabi jowar yields. This technology is recommended for zone 2 and 3.

**Application of liquid biofertilizers in rabi Sorghum**

Application of liquid biofertilizers as seed treatment *viz*. Azospirillum (4 ml/ kg of seed) and liquid PSB (4 ml / kg of seed) is advocated. This technology is recommended for zone 2 and 3.

**Weed Management in linseed**


Spray 1.25 kg Pendimethalin 30 EC + Imazethapyr 2EC in 300 litres of water immediately after sowing or next day will control both dicot and monocot weeds.

**Weed management in dry DSR**

Evaluation of pre-emergent butachlor followed by post-emergent bispyribac sodium herbicides for control of weeds in dry DSR. Spraying of 600 ml Butachlor 50EC in 200 litres of water at two days after sowing and post emergent application of Bis-pyricbac sodium 10 EC @ 140 ml in 200 litres of water when the weeds are at 2-4 leaf stage. This technology is recommended for zone 2 and 3.

**Foliar spray of nutrients in sunflower**

Two sprays of cow urine @ 50 ml per litre of water during 30 and 45 DAS will enhance yield in sunflower. This technology is recommended for zone 2 and 3.

**Modified method of sowing in sunflower**

Dibbling of sunflower seeds in 60 cm raised ridges with 30 cm plant to plant spacing will enhance t he yield. This technology is recommended for zone 2 and 3.

**Evaluation of clusterbean against grassy and broad leaf weeds**

Spraying Imazethapyr 10% SL @ 0.625 ml per litre of water at 20 days after sowing of cluster bean or when the weeds are at 2-3 leaf stage will control weeds.

**Note:** Succeeding crop of sorghum or maize should not be grown in the same field.

**Performance of pigeonpea under organic production system**

Since there is no information on Organic redgram cultivation in the package of practices, the information on varities, organic manures, sowing methods, plant protection growth promoters and yield is included. This technology is recommended for zone 2 and 3.

**Drip fertigation in pigeonpea**

Application of recomme nded fertilizers in five equal split doses @ 16.4 kg mono ammonium phosphate and 6.6 kg urea per split at 30, 45, 60, 75 & 90 DAT though drip fertigation. This technology is recommended for zone 2 and 3.

**Weed management in Direct seeded rice**

Spray of pyrazosulfuron ethyl 10% WP at 3 days after sowing followed by spraying of

byspiribac sodim 10% SC at 20-22 days after sowing or when the weeds are at 1-2 leaf stage will control both dicots and monocot weeds. This technology is recommended for zone 2 and 3.

**Weed management in transplanted Paddy**

Spray pyrazosulfuron ethyl 10%WP g a.i./ha at 3DAT followed by chlorimuron ethyl + metsulfuron methyl 20WP 4 g.ai/ha at 20-25 DAT control both monocot & dicot weeds in transplanted paddy. This technology is recommended for zone 2 and 3.

**Water management in transplanted rice by alternate wetting and drying**

Plastic PVC pipe of 30 cm long and 20 cm diameter, make small holes upto 15 cm on the pipe. Place the holed pipe portion inside the soil. During irrigation process, the water will enter into the pipe and maintain the same water level both in the pipe and in the field. There should be 5 cm water level in the field. When the water level in the pipe goes below 15 cm, again maintain 5 cm water in the field. Maintain this level up to panicle initition stage. By adopting this technology, one can save 25% of water. After Panicle Initiation stage, again maintain water level up to 3 cm till harvesting. This technology is recommended for zone 2 and 3.

**Use of biofertilizers in paddy**

Application of 1.4 kg Azospirillum and 1.4 kg PSB with 20 kg FYM before transplanting along with 75% recommended fertilizers provide yield on par with 100% RDF yield thus saving 25% of fertilizers. This technology is recommended for zone 2 and 3.

**Weed management in direct seeded rice**

Spray pretilachlor 6% + pyrazosulfuron methyl 0.5% GR (Combiproduct) @ 4 kg to DSR at 3 days helps to control both mono cots and dicot weeds. This technology is recommended for zone 1, 2 and 3.

**Effect of foliar nutrition on productivity of groundnut**

Two sprays of water soluble 19:19:19 @ 10 g/l of water at the time of flowering and

15days after spraying of first spray will enhance the yield of groundnut. This technology is recommended for zone 2 and 3.

**Weed management in Groundnut**

Spray 30g imazethapyr 35% + imazamex 35% WG combiproduct for 1 acre at 20 days after sowing or when the weeds are at 2-5 leaf stage. Add two ml of adjuvant to the spaying solution. For one acre 300 litres of spraying solution is required. This technology is recommended for zone 1, 2 and 3.

**Nutrient management in groundnut**

Foliar spray of the nutrient mixture of 8 kg MgSO4 and one kg Boron for one acre @ 3 ml per litre of w  ater at 45 DAS to groundnut crop improves the yield. This technology is recommended for zone 1, 2 and 3.

**Control of *Cynotis cucullata* by herbicides**

Spray of 5g paraquat or 10g 2 : 4-D sodium salt 80% per litre of water will control *cynotis* 2 days after the spraying of paraquat and 8-10 days after the spraying of 2, 4-D Sodium salt. This technology is recommended for zone 2 and 3.

**Note :** While spraying 2,4-D Sodium salt there should not be any broad leaved crops around the field.

**Evaluation of fingermillet in saline vertisols of TBP irrigation command**

Finger millet can be grown in saline vertisols of TBP command area where the EC is 5.4 dS/m. This technology is recommended for zone 3.

**Effect of sulphur and boron nutrition in soybean**

Application of 80 kg Gypsum and 4.2 kg borax per acre will enhance yield in soybean. This technology is recommended for zone 2 and 3.

**Irrigation management for chickpea based cropping system under different land configuration**

Sowing chickpea in broad bed furrow with the help of seed drill in three rows of chickpea and one row of safflower and irrigating the during 45 & 75 DAS will in BBF will enhace the yield. This technology is recommended for zone 2 and 3.


**Conservation agricultural practices for enhancing productivity of chickpea based cropping systems in rainfed area**

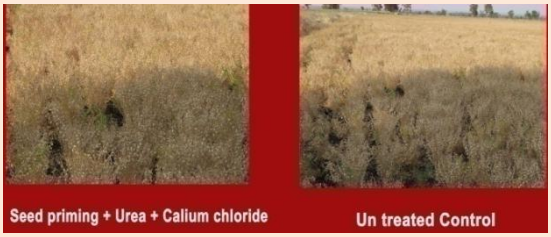
In conservation agriculture system chickpea can be directly sown with retaining previous crop residues as mulch material for conserving higher soil moisture and enhance the chickpea yield. This technology is recommended for zone 2 and 3.


**Drought mitigation in chickpea**

Seed hardening with $CaCl_2$- 2%+ foliar spray of 2 % urea at 1st flower + foliar spray of 100 ppm salicylic acid at 50 % flowering will increase the chickpea yield. This technology is recommended for zone 2 and 3.


**Heat mitigation in chickpea**

Seed hardening with $CaCl_2$-2%+ foliar spray of 2 % urea at 1$^{st}$ flower + foliar spray of 2% CaCl2 at 50% flowering will enhance the yield. This technology is recommended for zone 2 and 3.




**Biofortication of zinc in chickpea**

Spraying of 0.5% Zinc Sulphate + 1% FeSO4 in 0.25% clear lime water two times at flowering (10 days interval) in chickpea enhances the yield. This technology is recommended for zone 1, 2 and 3.


**Weed management in maize**

For higher weed control efficiency, follow pre- emergent application of 200g atrazine 50% WP followed by Tembutrione 34% WSC @ 48 g per acre as post emergent spray when weeds are at 3-5 leaf stage at 25-30 DAS. Mix 5 ml of surfactant per litre solution. When sedges are more in the field spraying of Halosulfurom Methyl 75% WG @ 27 g per acre + 500g Atrazine 50%WP combiproduct at 15-20 days after sowing or when the weeds are at 3-5 leaf stage is advised. This technology is recommended for zone 1, 2 and 3.


**Weed management in soybean**

Spraying Pendimethalin 30% + Imazethapyr 2% @ 400g in 300 litres of water foe one acre will control weeds in soybean. This technology is recommended for zone 1, 2 and 3.

**Fertigation and foliar spray in water melon**

Application of 100 % RDF through drip irrigation + 0.3% foliar spray of humic acid at 30, 60 & 90 DAS will increases the yield and size of the fruit. This technology is recommended for zone 2 and 3.

**Effect of spacing and planting geometry on Pole type Frenchbean under shade net**

Sowing of pole type French bean with the spacing of 45 c m x 45 cm will enhance the yield. This technology is recommended for zone 2 and 3.

## Weed management technologies

**Weed Management in paddy**

Application of bispyribac sodium 10% SC @ 100 ml/acre at 15- 20 days after transplanting of paddy or 3-4 leaf stage of weeds was effective against sedges and grasses.

Application of Bispyribac sodium 10% SC @ 100 ml/acre at 3-4 weeks after transplanting of paddy or 3-4 leaf stage of weeds was effective against annual and dicot weeds. Further, spraying of Pyrozosulfuron Ethyl 10WP (80 g in 200 l of water) during 3-7 days after transplanting controls both dicots and monocot weeds in Paddy.

**Weed management in maize**

Spray 1.25 kg atrazine 50WP + 2.5 lit Pendimethalin 30 EC in a tank mixture of 1000 litre of water on the day of sowing or during the next day. Ensure sufficient soil moisture at the time of herbicide application. For severe broad leaved weeds spray 2, 4.D sodium salt 80% WG at 20-25 days after sowing as post-emergent herbicide.

## Weed management in irrigated wheat

Spray 16 g in 200 litres of water for one acre metsulfuron methyl 20% WDG herbicide at 20-25 days after sowing. It is recommended for agroclimatic zone-2 of Karnataka.


**Weed management in Chickpea:**

In addition to existing weed management practices of chickpea use of pendimethalin 38.7 CS @ 2 ml/l at sowing or one day after sowing was found to be effective.

**Chemical method of weed control in pigeonpea**

Control of weeds in standing crop of pigeonpea is a challenge and no post emergent herbicides are available in the market. The pre-emergent herbicides are not effective due to long crop period. Spraying of Imazethapyr 10% SL @ 1ml/l 21-25 days after sowing and spraying of paraquat @ 2 ml/l after 42-45 days after sowing significantly controlled weeds throughout the crop period. Spraying of post-emergent herbicide Imazethapyr 10% SL @ 1 ml/l was effective in controlling weeds. The technology was compared with pre-emergent herbicide pendimethalin @ 0.75 kg a.i./ha spray followed by one hand weeding @ 50 DAS.

Application of Imazethapyr 10% SL @ 1.0 ml/l at 3 weeks or 3-5 leaf stage of weeds followed by spraying of Paraquat @ 2 ml/l using spray hood on either side of crop rows was found effective in control of weeds.

### Weed management in *Bt* cotton

In *Bt*-cotton weeds can be managed by application of Pendimethalin 38.7 CS @ 1.75 ml/l of water on the day of sowing or one day after sowing. Further, spraying of Pyrithiobac Sodium 10 % EC @ 1.25 ml per litre of water at 20-25 days after sowing controls both monocot and broad leaved weeds.

### Weed management in groundnut by Imazethapyr 10% SL

By spraying Imazethapyr 10% SL @ 2 ml/l of water at 15-20 days after groundnut sowing was effective to control all types of weeds. Total spray volume required per acre is 200 liters. Care must be taken optimum soil moisture at the time of herbicide spray.

### Weed management in Sunflower by using Propaquizafop

Application of propaquizafop 1.6 ml/l of water at 15-20 days after sunflower sowing was effective in control of monocot weeds. Total spray volume required per acre is 200 litres water and 320 ml of spraying chemical.

### Weed management in transplanted onion by using Propaquizafop 5% EC and Oxyflurofen 12% EC

For one acre spray 150 ml of Propaquizafop 5 EC + Oxyflurofen 12% EC (in 400 litres of water) during 28 days after sowing in onion the weeds can be controlled.

### Management of broad leaf weeds in sweet orange


Spraying of 2, 4-D @ 400 g/acre as post emergent herbicide will control the weeds in sweet orange. Care must be taken for optimum soil moisture at the time of herbicide spray.

### Management of Bellary Jali (*Prosopis juliflora*) through chemicals

Spary of 30g glyphosate (Meera 71), 5g sodium salt and 10ml paraquat at early stages (less than 1cm stem thickness). Even after 1$^{st}$ spray regrowth occurs spraying of above

mentioned chemicals should be continued. As the number of stems and stem thickness increases number of chemical sprayings also increases.



# I. Plant Protection Technologies

## Paddy

### Management of paddy blast disease by Isopropathacoine 5% EC

Seed treatment of carbendezim 50% WP @ 2 g/kg of seeds and spray carbendezim 50 WP @ 1g/l or spraying of isopropathacoine 5 EC @ 1.5 ml/l was found to be effective in control of paddy blast. It is highly effective over existing practice of Zineb 75%WP @ 2.5g/l or Hexaconazole 5%EC @1ml/l. Significantly high degree of disease control, higher grain yield and economic returns was recorded with spray of isopropathacoine 5% EC @ 1.5 ml/l.

### Management of sheath blight of paddy by Hexaconazole 5% EC

The disease is noticed with the symptoms of circulars white patches surrounded by brown circulars rings. When it is severe all the leaves will dry up. When crop suffer from sheath blight disease, spraying of velidamycin @ 1.5 g/l. or hexaconazole 5% EC @ 1 ml/l was found to be effective. It resulted in 50% reduction in sheath blight and velidamycin spray has reduced 40 % of sheath blight damage.

### Management of sheath blight

To control sheath blight in paddy, spraying of 2 g mixture of Zineb 68% WP + Hexaconazol (4 %) per liter water is recommended.

### Management of root rot by seed treatment

To control wilt in paddy, seed treatment with 3.5 g mixture of carbendazim + mancozeb is recommended.

**Management of sunflower powdery mildew disease**

By spraying mycobutanil 10% WP (0.5 g/l) 2 times (immediately after noticing powdery mildew and 15 days after 1st spray), powdery mildew in sunflower can be controlled.

**Management of early blight of tomato**

During early crop growth in tomato if early blight is noticed, spraying of azoxystrobin 23% SC@ 1 ml/l immediately after disease is noticed and 15 days after 1st spray, the disease can be controlled.

**Management of linseed powdery mildew**

Spraying of 4 g soluble sulphur in 1.0 l of water at 45 and 60 DAS will control powder mildew disease in linseed.

**Management of anthracnose and powdery mildew of greengram**

By treating 1 kg greengram seeds with 2 g of carbendazim and by spraying hexaconozole 5% EC @ l ml/l anthracnose and powdery mildew of greengram was found effective in controlling the disease.

## Maize

**Management of Maize stem borer**

Spraying of chlorantraniliprole @ 0.2 ml/l of water at 20-25 days after sowing was found effective in five management of stem borer in maize.

**Integrated management of major foliar diseases of maize**

Treating of maize seeds with 25 g *azospirillum* (ACD-15 or ACD-20 strains) and 6 g of t*richoderma harzianum* for every 1 kg of seed. Treating the seeds with captan 50 WP @ 2 g or mancozeb 75 WP @ 2.5 g or spraying of hexaconazole 5% EC 1 ml/l of water. If required repeat the spray 15 days after first spray.

## Sorghum

**Management of stem borer in sorghum**

Spraying of chlorantraniliprole 18.5 SC @ 0.2 ml/l of water at 20-25 days after sowing was found effective in control of stem borer in sorghum.

## Cotton

### Management of Mealy bug in cotton

Spraying of Bufrofazin 25% SC @ 1 ml/l of water was found effective in controlling nearly bug.

### Management of mirid bug in cotton

Spraying of Fipronil 5 SC @ 1ml/l was found effective against mirid bug in cotton.

### Management of thrips in cotton

In addition to existing management practices, spraying of Fipronil 80 WG @ 0.1g/l was found effective in controlling thrips in cotton.

### Management of leaf sucking pests in cotton

Leaf sucking pests of cotton can be controlled effectively by spraying of Dinotefuron 20% SG @ 0.15 g at economic threshold level.

### Integrated management of major foliar diseases of cotton

Spraying of chlorathalanil 75 WP @ 2 g/l of water as first spray. Then spray *Pseudomonas fluorescens* @ 5 g/l of water at 15 days after spray and then spray Chlorathalanil 75 WP @ 2 g/l of water as third spray to control leaf spot and rust diseases in cotton.

## Pigeonpea

### Management of pod borer through intercropping

Pigeonpea pod borer can be controlled below economic threshold level through intercropping. Pigeonpea intercropped with sunflower or pundi in 6:1 row proportion was found effective in reducing the pod borer.

### Management of spotted pod borer in pigeonpea

Spraying of Profenophos 50% EC @ 2 ml/l and DDVP 76 EC @ 0.5 ml/l during flower bud initiation and blooming stage was found effective in management of spotted pod borer.

**Management of pigeonpea pod borer**

Spraying of Rynxypyr 20 SC @ 0.15 ml/l and Flubendiamide 20 WG @ 0.075 ml/l was found effective in management of pigeonpea pod borer.

**Management of pigeonpea pod fly**

Pod fly will be severe when delayed sowing of early duration varieties like WRP-1, TS3-R, Gulyal, Jamadar local, Rudrawadi, Bennur local, in medium duration varieties like Maruthi and in late duration varieties like Asha (ICPL 87119), BSMR-736. It is commonly found in second flush of flowering. Spraying of methomyl 40 SP @ 0.6 g + jaggery 10g/l at the time of fruit development stage followed by Thiomethaxum 25 SG @ 0.2 g/l + Jaggery 10g/l after 15 days of 1$^{st}$ spray.

**Management of cercospora leaf spot**

Spraying of Napthalene Acitic Acid 4.5% SL plant stimulant (0.5 ml/l) and Carbendazim fungicide (1.0 g/l) controls cercospora leaf spot along with pigeonpea pod borer.

**Management of flower drop in pigeonpea**

For control of flower drop in pigeonpea integrated pest management schedule along with spraying of Napthol Acetic Acid @ 0.5 ml/l and spraying of Carbendazim @ 0.1 g/l at flowering.

**Management of wilt and rot in Pigeonpea**


Seed treatment with *Trichoderma* @ 4 g /kg of seed and 2 kg *trichoderma* mixed in 100 kg FYM + 50 kg neem seed cake maintaining 50% moisture by covering with plastic sheet keep it for 7 days and then mixed with recommended FYM per ha and then to soil.

### Management of Fusarium Wilt of pigeonpea

Treating of one kg redgram seeds with 2 g captan 80 WP or Thiram 75 WP or 25 g Carboxyl 75 WP or 1.5 g Captan 70% + Hexaconazole 5% fungicide or 4 g *Trichoderma* was effective in control of fusarium wilt.

## Greengram

### Management of anthracnose and powdery mildew in greengram

Treating of seeds with carbendezim @ 2g/kg seeds and by spraying of Hexaconazole 5 EC@ 1 ml/l was effective in control of anthracnose and powdery mildew of greengram.

## Chickpea

### Management of chickpea wilt

Seed treatment with trichoderma bio-fungicides @ 4 g/kg of seeds and also powder form of trichoderma @ 2 kg, FYM @ 250 kg were mixed with neem extract @ 50 kg and maintained at 50 % of moisture stored for 7 days and applied at the time of sowing was found effective in control of wilt.

### Management of gram pod borer in chickpea by Flubendamide 20% WG

Spraying of 0.2g Flubendamide 20 WG or 0.075 ml os Flubendamide 48 SC (2 Sprays at 50% flowering and pod development stage) was effective in control of pod borer in chickpea.

### Harvesting and threshing techniques in safflower

Harvesting and threshing of safflower is difficult due to presence of thorns in plants. Mechanical harvesting and threshing did not damage the seeds, seed viability and germination. It also resulted in reducing cost of production.

**Management of fruit borer in okra**

In addition to existing management practices spraying of Rynaxypyr 20 SC @ 0.25 ml/l at five weeks after sowing was effective in controlling fruit borer in Okra.

**Management of sucking pests in grapes**

For vines developed after April month spraying of acetamiprid, 20 SP @ 0.30 g/l. or Thiomethoxam 25 WDG @ 0.2 g/l was found effective in control of thrips, mites and other sucking pests.

**Adoptable integrated plant protection management module for Tomato**

1. Dip the seedlings in Imidacloprid 17.8 SL @ 0.3 ml/l, followed by need based spraying of Imidacloprid @ 0.3 ml/l or Thiomethoxam 25 WG @ 0.30 g/l at 15 DAP and physical removal of TOSPO & TLCV-affected plants.
2. *Pseudomonas fluorescence* spray @ 5 g/l at 30-35 DAP
3. Use of the african marigold as trap crop in the ratio of 1:16 plants.
4. Soil application of neem cake after 20 DAP @ 100 kg/acre to reduce fruit borer, leaf miner and nematode.
5. Bird perches @ 10/acre should be erected for facilitating field visits of predatory birds.
6. Spraying of Mancozeb 75 WP @ 2 g/l or Azoxystrobin 250 SC @ 1 ml/l at 45-60 DAP
7. Use of botanicals, like Spraying of 5% NSKE at 15 DAP against leaf-miner.
8. Foliar spray of Triazophos 40EC @ 1.5 ml/l for the control of whiteflies
9. Regular collection and destruction of damaged fruits i.e. clean cultivation. Rouge out and destroy leaf-curl and wilt affected plants.
10. Pheromone traps @ 5 l/ ha be installed for monitoring fruit borer activity.
11. Spray of Calcium Ammonium Nitrate @ 16 g/l against fruit rot and blossom end rot
12. If the borer incidence crosses ETL (5% damage), apply Novoluran or Spinosad or Rynaxypyr or Flubendamide or Emamectin benzoate

**Management of stored grain pests**

*Acorus calamus* powder @ 2 % and Neem seed extract @ 1-2% reduced the incidence of pests of stored grains


## Sesame

**Management of *Alternaria* disease in sesame**

When plants show the symptom of brown rings on leaves and later spread to all the parts of the plant. Finally whole plant looks like burning of plants. Spraying of mancozeb 75 EC @ 2 g/l at 35 days after sowing followed by *Pseudomonas fluorescence* 5 g/l.

## Groundnut

**Integrated Management of pests in groundnut**

Seed treatment of groundnut with trichoderma 600 g, 375 g of *Rhizobium* for one ha seeds, mixing of castor seeds @ 500 g/ha and pearl millet 3 to 4 rows around bunds, pheromone trap @ 5 /ha at a distance of 30 ft, for leaf eating caterpillars with spraying of 5% neem extract spodoptera NPV 250 LE/ha for leaf folding caterpillars by spraying of profenophos 50 EC @ 2 ml/l was found effective in controlling different pests of groundnut.

**Management of stem rot in groundnut**

To control stem rot in Groundnut seed treatment with 3.0 g Sprint (Carbendazim + Mancozeb) was found effective in control of stem rot.

**Management of leaf spot in groundnut**

Application of Avtar (Zineb 68%+ Hexaconozole 4% WP) @ 2.5 g/l effectively controls leaf spot in groundnut.

**Management of rust in groundnut**


Spraying of Zineb 68% + Hexaconazole 4% (0.25%) at 35-50 days after sowing. Repeating the spray 15 days after first spray was found effective in control of rust.

**Bio-intensive management of major foliar diseases and stem rot in groundnut**

Spraying of *adsali mixture* at 30-45 days after sowing & at 60 days after sowing. To control leaf spot, rust and stem rot diseases treat 1kg groundnut of seeds with 5 g *Trichoderma* and 5 g *Pseudomonas*, mix 4 kg of *Trichoderma* and 4 kg of *Pseudomonsas* in 250 kg FYM and apply in seed lines. Spraying of 5 g *Trichoderma* + 5g of *Pseudomonas* in 1 lit of water during 30 and 45 days after sowing was found effective in control of leaf spot.

## Sunflower

**Management of sucking pests in sunflower**

Seed treatment of Thiamethoxam 30 % FS @ 10 ml/kg of seeds was found to be effective in controlling sunflower sucking pests.

**Management of sunflower defoliators**

There were no chemical or management practices to control defoliators and each of these chemicals are found to be effective in controlling defoliators. Spraying of quinolophos 25 % EC @ 2 ml/l or indoxcarb 14.5 SC @ 0.3 ml/l or spinosad 45 SC @ 0.1 ml/l was effective in sunflower defoliators.

**Management of sunflower powdery mildew disease by application of myclobutanial 10% WP**

Spraying myclobutanial 10% WP (0.5 g / l of water) 2 times (immediately after noticing powdery mildew and 15 days after 1st spray), powdery mildew in sunflower can be controlled.

**Management of lepidopteron insects in sunflower**

Seed treatment with Thiamethaxam 30% FS @ 10 ml/kg of sunflower seed.

## Chilli

**Management chilli defoliator and fruit borer**

Defoliator and fruit borer in chilli are major problem. Spraying of Lufenuron 5 % EC @1.0 ml/l recorded lowest number of larval population per plant, less foliage damage, lower fruit damage. It also recorded higher green chilli yield and economic returns.

For management of chilli fruit borer by spraying of 5% neem extract @ 7 weeks followed by Rynaxypyr 20 SC @ 0.25 ml/l was found to be effective in control of fruit borer. It is found to be effective over existing practice of spraying 5% neem extract @ 7 & 11 weeks after planting. Conventional practice of spraying neem extract alone was not found effective but the successive spray of Rynaxypyr minimizes fruit damage**.**

**Management powdery mildew and rust in chilli**

Spraying of tebuconazole 25.9 EC @ 1.5 ml/l for management of powdery mildew in chilli.

**Management of wilt by Trichoderma viridae**

Seed treatment with *Trichoderma viridae* @ 4.0 g/kg of seed and 2.5kg *Trichoderma viridae* + 2.5 kg *Pseudomonas flourascense* mixed with 25 q FYM and then to the soil before sowing.

**Management of thrips and mites in chilli**

For management of thrips and mites in chilli by application of Acephate 95 SG @ 750 g.a.i/ha (1.2 g/l).

**Management of thrips in chilli**

To control thrips in chilli, spraying of 1.3 ml Tolphenpyroid 15% EC per liter of water at 40, 70 and 70 days after transplanting.

**Eco-friendly management of Aflatoxin contamination in chilli for quality production.**

Spray *Pseudomonas fluorescens* @ 5 g/l of water to the chilli crop at fruit ripening stage will reduce the Aflatoxin contamination in fruits.

# Onion

**Management of thrips in onion**

Treating of one kg onion seeds with 15 ml Imidachloprid 60FS and spray Fipronil 5 SC @ one ml per litre of water at 20-25 days after transplanting.

**Management of purple blotch of onion**

Treating of one kg onion seeds with 5 g *Pseudomonas fleuroscens*. Spray Mancozeb 75WP @ 2 g/l of water or Difenconozole 25% EC @ one ml/l of water when purple blotch in onion is noticed. Then spray Pseudomonas fluorescens @ 5g/l of water after 15 days of first spray. If the disease symptoms are still existing spray Difenconozole 25 % EC @ 1 g/l of water.

**Plant protection measure in onion**

Spraying 0.5ml Chloroniprol 18.5 SC or 0.12 ml Spinosad 45 SC or 2 ml Quinolphos in 1 litre of water controlled the leaf defoliator in onion



# Banana

**Management of soft rot of banana in tissue culture seedlings**

Spray copper oxychlroide @ 3.0 g and streptomycin sulphate @ 0.5 g/l of water to the banana seedlings or suckers to control banana soft rot. Repeat the spray schedule for every 15 days up to 4 months. Applying 25 g bleaching powder 2 inches away from the stem for each plant will control banana soft rot.

**Management of shootfly and sucking pests of rabi sorghum**

Treating of 1 kg seeds of sorghum with 5ml of Thiomethoxam 30 FS controls shoot fly and sucking pests incidence in *rabi* sorghum. This technology is recommended for zone 2 and 3.

**Sugarcane trash decomposition through *in-situ* vermiculturing**

The residues left out field of sugarcane can be irrigated with sprinkler /drip/flood irrigation. 10kg of earthworms (*Eudrillus euginaia*) are allowed for 1 acre. The earth worms will feed on the residues and turns into vermicompost after 7 months. This technology is recommended for zone 1 and 3.

**Management of plant hoppers through Dinotefuron 20 SG in paddy**

Spraying 0.4g Dinotefuron 20 SG in 1 litre of water controls plant hoppers in paddy. This technology is recommended for zone 2 and 3

**Management of blast & sheath blight disease of rice**

Spraying of Trifloxystrobin 25% WP + Tebuconazole 50% WP @ 0.4 g/l in management of blast and sheath blight disease of rice is most effective. This technology is recommended for zone 2 and 3.

**Management of stem rot disease of paddy**


Seed treatment with Carbandezirm 50 WP @ 2.0 g per kg of head), seedling dipping with Carbendezirm (0.2%) soluition for 20 minutes and spraying Diplozamide 24SC @ 0.75 g in 1 liter of water will control the stem root disease in paddy. This technology is recommended for zone 2 and 3.

**Management of false smut in paddy**

Spraying 0.4 g Triploxistrobin + Tebuconozode in 1 liter of water two times i.e., 40 and 60 DAS will control false smut in paddy. This technology is recommended for zone 2 and 3.

**Management of paddy planthoppers using triflumezopyrim 10.6 SC followed by pymetrozine 50 WDG**

By spraying 0.5 ml Triflumezopyrim 10.6 SC or 0.8 g. Pymetrozine WDG in one liter of water will control paddy plant hoppers. This technology is recommended for zone 2 and 3.

**Management of rice brown planthopper with Buprofezin 70 DF**


Spraying 0.5 ml Buprofezin 70 DF in 1 liter of water to the rice stem will control brown plant hoppers in paddy. This technology is recommended for zone 2 and 3.

**Management of sucking pests in Bt-cotton**

Spraying Bufrofezin 70 DF @ 0.7gms in 1 litre of water will control sucking pests in Bt-cotton (Based on ETL). This technology is recommended for zone 2 and 3.

**Management of Powdery mildew in clusterbean**

Spraying of Difenoconozole @ 1 ml in l litre of water controls podery mildew in cluster bean. This technology is recommended for zone 2 and 3.

**Integrated management of stalk rot of maize caused by *Fusarium moniliforme***

Treating 1 kg of seed of maize with 5 gm *Trichoderma* and 5 gm *pseudomonas flourascense*. Application of 1 kg *Trichoderma* + *Pseudomonas flourascens* mixing with FYM and then applied to the field will control of stalk rot in maize. This technology is recommended for zone 2 and 3.

**Evaluation of new formulation of seed treatment chemical against sucking insect pests of chilli**

For sucking pest management seed treatment with Imidachloprid 48 FS @ 20ml for 1 kg of seed will control the sucking pests up to 35 DAS. This technology is recommended for zone 2 and 3.

**Evaluation of new formulation of seed treatment chemical against sucking insect pests of okra**

For sucking pest management seed treatment with Imidachloprid 48 FS @ 20ml for 1 kg of seed will control the sucking pests up to 35 DAS. This technology is recommended for zone 2 and 3.

**Bioefficacy of Flupyridifurone 20 SL against leafhopper of okra**

Spraying Flupyridifurone 20 SL @ 1 ml in 1 litre of water will control leaf hoppers in Okra. This technology is recommended for zone 2 and 3.

**Bioefficacy of Cynatriniliprole 10 SC against major insect pests of chilli**

Spraying Cynatriniliprole 10 SC @ 1 ml in 1 litre of water will control sucking pests (Thrips & Aphids) in chilli. This technology is recommended for zone 2 and 3.

**Bioefficacy of Cynatriniliprole 10 SC against major insect pests of chilli**

Spraying Cynatriniliprole 10 SC @ 1 ml in 1 litre of water will control sucking pests (Thrips & Aphids) in chilli. This technology is recommended for zone 2 and 3.

**Bioefficacy of Cynatriniliprole 10 SC against major insect pests of tomato**

Spraying Cynatriniliprole 10 SC @ 1 ml in 1 litre of water will control sucking pests (Thrips & Aphids) in Tomato. This technology is recommended for zone 2 and 3.

**Bio-efficacy of Azoxystrobin 11% + Tebuconazole 18.3% SC against purple blotch in onion**

Three sprays of Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1.5 ml/l litre of water soon after the disease appearance with 15 days interval will control purple blotch in onion. This technology is recommended for zone 2 and 3.

**Integrated disease management of dry root rot of blackgram**

Seed treatment with Trichoderma @ 5 grams per kg of seed followed by spraying of Carbendizim 50WP @ 1 g/l of water will control dry root rot of black gram. This technology is recommended for zone 2 and 3.

**Integrated management of phoma leaf spot of pigeonpea**

Two sprays of hexaconazole 5% EC (0.1%) interspersed with Pseudomonas fluorescens (0.5%) with 15 days interval at the onset of disease will control the Phoma leaf spot in pigeonpea. This technology is recommended for zone 2 and 3.

**Management of phytophthora blight in pigeonpea**

Seed treatment with Metalaxyl MZ 68 WG @4gm/kg and spray with Metalaxyl MZ 6 8WG @ 2 g/l (2sprays) reduces phytophthora blight in pigeonpea. This technology is recommended for zone 2 and 3.

**Management of Helicoverpa armigera by Ha NPV in chickpea ecosystem**

For control Helicoverpa in chickpea, spray Helicoverpa NPV (SBIR)@ 7.0 and per liter of water is recommended. This technology is recommended for zone 2 and 3.

**Management of wilt and dry root rot in chickpea**

4 ml of Thioforet methyl seed treatment with pyroclostrbin in 10 liter of water will control dry root soil in chickpea. This technology is recommended for zone 2 and 3.

**Integrated management of stem and pod rot of groundnut**

Deep ploughing + seed treatment with Trichoderma sp. @ 4 kg of seed + furrow application of Trichoderma sp. (4kg enriched with 250kg of FYM) will reduce the incidence of pod rot. This technology is recommended for zone 2 and 3.

**Management of powdery mildew and Alternaria blight of linseed**

Spraying of Pseudomonas floresecence at 0.5% at onset of disease followed by hexaconzole 0.1% will control the Alternaria blight of linseed. This technology is recommended for zone 2 and 3.

**Management of thrips and leaf miner watermelon by using protection cover**

Spreading protection cover to Watermelon soon after transplanting will helps for controlling thrips and leaf miner up to 40 days and also good yield can be enhanced. This technology is recommended for zone 1, 2 and 3.

**Management of powdery mildew in mango**

Spraying 1 ml Azoxystrobin 23% SC in 1 lit of water before flowering and at the time of fruit development will control Powdery mildew in Mango. Repeat the same spray if powdery mildew incidence occurs. This technology is recommended for zone 2 and 3.

**Management of turmeric leaf blight**

Spraying 1 ml of Hexaconogole in 1 liter of water thrice at 15 days interval wil control leaf blight in turmeric. Repeat the same spray if powdery mildew incidence occurs. This technology is recommended for zone 1 and 2.

## II. Horticulture Sciences

**Keeping quality improvement in sweet orange**

After harvest of sweet orange dip in 2 % calcium chloride for 15 min. The treated fruits can be stored for 30-36 days without any damage. This technology will be helpful for export purpose and long distance transport.

**Production technology for bell pepper under shade house**

In shade houses prepare raised beds of 10 cm height with 60 cm width and 50 cm between beds. Improved cultivation practices of bell pepper with respect to spacing, fertilizer and manure application along with plant protection measures gave significantly higher fruit yield and economic returns. Apply of 50 % recommended N and full dose of P and K to the beds. Seedlings can be transplanted at a distance of 30 cm x 30 cm spacing. The technology of bell pepper cultivation gave higher fruit yield (79 t/ha), net return (Rs. 9.18 lakh/ha) and B: C ratio (3.85).

**Post harvest technology for increasing shelflife in fig**

After harvesting of fig fruits, dipping them in 15% *Aloe vera* solution and 8 % $CaCl_2$ solution for 10 seconds one can increase the shelf life of fruits.

**Water management in ridge gourd through drip irrigation**

| Drip irrigation stage (Days) | Quantity of water per plant/day (litres) | Irrigation time (minutes) |
|---|---|---|
| 0-30 | 0.5 | 15 |
| 30-60 | 2.25 | 75 |
| 61-90 | 3.25 | 105 |
| 91-120 | 0.5 | 15 |

**Efficient use of water through drip irrigation in onion**

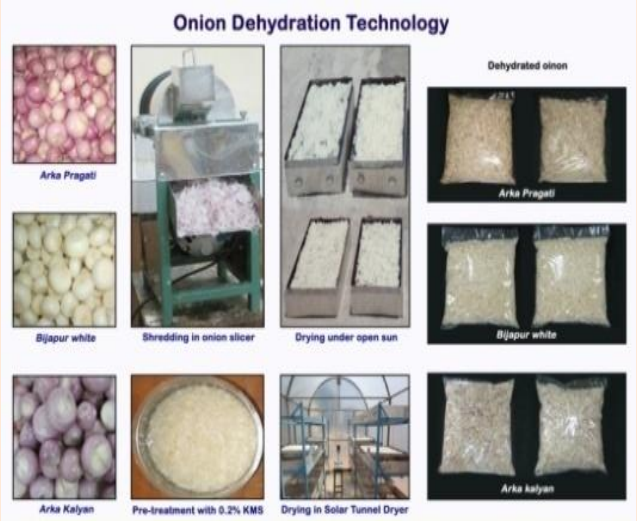
From transplanting to 30 days, 31-60 days, 61-90 days and 91-100 days, applying water 1, 2, 3 and 1 litre for every sq.mt respectively, will save the water and enhances the onion yield. The cost of drip irrigation is Rs. 6000/- per acre.

## III. Agricultural Engineering technologies

### Chilli powder making machine


Generally, chilli powdering machine or chilli pulverisers are used to make chilli powder. The improved chilli powder making machine has water jacket for cooling purpose that helps to prevent the rise in temperature during milling operation. By this premium quality chilli powder with maximum retention of colour and nutrients can be obtained. Cost of the machine Rs. 60,000 with a capacity of 50-60 kg/hr.

### Drying of chaffed onion

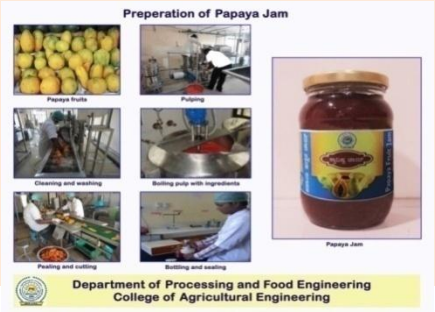



The peel and the roots of the onion bulbs are removed and cut in to 3-5 mm slices using onion slicer. The slices are dipped in 2 g potassium metabisulphate ($K_2S_2O_5$) for 15 minutes. The treated slices are dried in Solar Tunnel Dryer for 15 to 16 hours or in de-humidified air dryer for 8-10 hours to the final moisture content of 5-6 %. The dried onion slices are packed in food grade poly propylene (PP) bags and can be used up to 6-9 months or can be sold in domestic and international markets to earn higher profits.

### Improved dhal making machine

Improved mini dhal mill consists of cleaning, grading, oil treatment, dehusking and splitting units. The machine operates on 3 HP electric motor and has the output capacity of 100-125 kg/h with 70-74% dhal recovery. Cost of machine is Rs. 75,000/-.

### Papaya jam preparation




Matured and ripened papaya fruits are washed, peeled and cut in to pieces. The papaya pulp is extracted using fruit pulper. The ingredients *viz*., sugar (1/2 kg), pectin (10 g) and

citric acid (3 g) per kg of fruit pulp are added. The pulp and ingredients mixture is boiled till it reaches 68.5 °Brix and hot filled in glass or pet jars. The filled jars are kept 24 hours for setting. The prepared papaya jam can be used up to 6 months. One tonne papaya can give 500 kg of papaya jam.

**Solar Tunnel Drier (One and two tonne capacity)**

- The solar tunnel drier is a poly-house dryer suitable for drying of most of the food crops/commodities and medicinal & aromatic plants.
- It consists of a tunnel type semi-cylindrical drying chamber provided with windows to allow the ambient air to enter the dryer.
- Trolleys and trays are provided to hold one tonne / two tonnes of food products/ commodities or medicinal & aromatic plants
- The rise in the temperature of the air inside the dryer is about 22 - 25°C above the ambient temperature.
- Reduction in drying time compared to (60 %) compared to open sun drying
- Need not depend on electricity and other fuel sources for drying
- More consistent quality products in terms of colour, texture and appearance
- Useful for small and marginal farmers slices, fish, medical and aromatic plants

Initial investment- Rs. 1.5 lakhs for one tonnes capacity and Rs. 2.0 lakhs for two tonne capacity and operating cost Rs. 223.5 per quintal for drying chilli. The efficiency was up to 98 per cent with a capacity of one to two tonnes per batch.

**The major advantages are**

- Reduced post harvest losses
- Saving in drying time and labour
- Free from contamination.
- Protect from wind, dust, rain, birds and animals
- Quality products through colour retention may results in higher market value, more profit and environment friendly.

**Pedal cum power operated ice crusher**

✓ The ice crusher consists of a crushing cylinder with spikes, casing, feeding chute, outlet slots, discharge chute, flywheel, chain and sprocket power transmission system with pedal and seat arrangement and also an electric motor of 0.745 KW

- ✓ The speed of crushing cylinder is about 485–500 rpm for an average pedaling and 720 rpm with 0.745 KW motor
- ✓ The average crushing capacity of the machine is one tonne/h by manual pedal operation and three tonne/hr with one hp electric motor
- ✓ Two labours are required for manual crushing and one labour is sufficient with electric motor
- ✓ The technology helps the fishermen to save about 40-60% of ice requirement when it is used on board

Efficiency ⟶ 95-97 per cent

- ➢ Capacity – 1000 kg/h (manual) and 3000 kg/hr (one hp electric motor)
- ➢ Cost of machine- Rs. 30,000/- with one HP electric motor
- ➢ Operating cost- Rs.53.45 per hour and Rs.0.88 per ice block

- ➢ Increase in the production of crushed ice helps in the preservation of fish on board or in the fish landing center
- ➢ The cost of operation is Rs. 1.0/- for crushing one block of ice which is comparatively very less
- ➢ Reduction in the human drudgery as traditionally ice blocks are crushed manually
- ➢ Reduction in the crushing time
- ➢ Hygienically produced crushed ice used for fish preservation
  Fisherman can crush the ice on rental basis and generate more income for his family

**Mechanized fish de-boner**

- ➢ Fish meat bone separator works on belt and drum mechanism of meat bone separation
- ➢ It consists of food grade stainless steel cylinder of 6 mm thickness, food grade rubber belts, rectangular feeding tray, one HP single phase motor as power source and chain and sprocket arrangement of transmitting drive
- ➢ The mechanism involves feeding of dressed fish between counter rotating belt and perforated drum. The meat gets squeezed through holes into the cylinder under pressure applied by the conveyor belt partially encircling the cylinder while bones and skin retain on the outside of the drum and eject through a discharge chute
- ➢ Suitable for small and marginal fishermen and small scale fish processors

- The developed meat bone separator is economically feasible with indigenous technology
- Developed fish meat bone separator would help in utilization of low value and under-utilized fish species which are now used for making fish meal and fish oil
- This would also help in recovery of meat from fillet trimming
- This would provide dual opportunity of diversification of fish processing industry and utilization of low value fish for human consumption
- Technology would give rise to the development of variety of new value added surimi based fish products such as Kamaboko, fish sausage, fish cakes, fish sticks, etc.

This would generate additional income to the people involved in fisheries and employment opportunities among the rural fisher folk.

- Cost of the unit is Rs. 65,000/-

The operating cost of the machine is Rs.50/- per hour and Rs. 1.5-2.0 per kg of fish

The capacity is 50-75 kg/h varies with the meat content of the fish with an efficiency of 90-95%.

**Laser Guided Land Leveling or Laser leveling**


It is an automatic and precise land levelling with the laser (Transmitter) technology. Levelling index around 1 cm (Better and precise levelling), field capacity was in the range of 0.08 ha/hr, uniformity coefficient of moisture distribution was 95%, saving in irrigation time and saving in water around 15-20%. Which will lead to additional irrigated area and ultimately increase in productivity and production. Equipment cost is Rs.4, 25, 000, operational cost Rs.8000/ha and Rs. 600/hr. Better and precise levelling will lead to uniform distribution of resources (water, nutrients and fertilizers and uniform yield), Better conservation of rainwater and fertile soil. It will conserve water and top fertile soil and it may result in increased irrigation efficiency and reduction tail drainage water and better environment.

**Raised bed planter**

Overall dimensions of the planter are 1800 mm x 2100mm x 1400 mm (L x W x H). Box section of 40 x 40 x 5 mm size was made by welding 40 x 40 x 5 mm size angle iron. The power source requirement was 45 -50 hp tractor. It is suitable for planting of small and bold size, seeds like groundnut, bhendi, maize, gram. The effective field capacity was found to be 0.3ha/hr with a field efficiency of 63.45 per cent. Cost of the planter is Rs. 50,000/-. Cost of operation is Rs. 1388 per ha for bhendi. It can save 65 to 70 % in labour and 30% of irrigation water by adopting alternate row irrigation method.

**Self propelled reaper binder**

The dimensions of the planter are 3140 mm x 1900 mm x1160 mm (L x W x H). Prime mower is 8 kW single cylinder, four stroke vertical air cooled diesel engine. The average field capacity for paddy was 0.33 ha/hr with the output of the material 2 t/hr. Cost of the reaper binder is Rs. 1,80,000/-. Cost of operation is Rs. 250/ha. The saving in cost of operation and labour was 41% and 51% respectively over manual harvesting of paddy.

**Self propelled power weeder**

This weeder is having 5 HP diesel engine and weeding can be done upto 0.5m width in between two rows of the crops. The efficiency of the weeder is 0.19 ha/hr. This can be recommended for widely spaced crops.

**Double bullock drawn improved steel cart**

The steel cart is eco-friendly, it does not use wood (except in the yoke) and as a result it helps in reducing cutting of trees in the farms or from the forest for this purpose. Dimensions of double bullock drawn improved steel cart are 4480X1740X1520 mm (L x W x H). The weight of the steel cart is 245 kg which is 175 kg less than a wooden cart of equivalent size. Hence, so a steel cart helps in increasing the carrying capacity of the animal. Double bullock drawn improved steel cart is capable to carry a pay load of 10-12 quintals per trip. The operator on custom hiring is capable to generate Rs. 250-300 per day after meeting the cost of feed materials of bullocks. The double bullock drawn improved steel cart is cheaper (Rs. 17,000/-) as compared to that of Rs. 20,000/- for wooden cart. The cost of cart is Rs. 17,000/-.

**Bullock drawn engine operated sprayer**

Dimensions of the sprayer are 3900 x 1240 x 2120 mm (L x W x H). The weight of the steel cart is 305 kg. It is fitted with HONDA, 2.28 kW/3600 rpm engine, a spray boom of 5200 mm in length with 7 nozzles. The average field capacity of bullock drawn engine operated sprayer for spraying on cotton and pigeonpea crop was found to be 1.20 and 1.18 ha/hr. The cost of the system is Rs. 53,000/-. The cost of operation for spraying on cotton and pigeonpea crop were Rs. 108.80/- and 114.90/- per ha. The bullock drawn engine operated sprayer required labour requirement of 12.83 man-h/ha as compared to that of 25.52 man-hr/ha for traditional method spraying. A saving in cost of 49.90% can be achieved over traditional method.

**Modified rice husk cook stove**

Dimensions of the cook stove are outer diameter – 0.35m, inner diameter of fire port – 0.10 m and height – 0.45 m. The weight of the cook stove is 3.5 kg. Central fire port is made of stainless steel perforated mesh of 18 gauge. The average thermal efficiency of the cook stove was 23.20 per cent as against 12.7 per cent for traditional stove. The time required for cooking of rice and dhal were 23 and 34 minutes respectively. Time can be saved (30 to 40 per cent) as compared to that of traditional chulhas. The cost of the cook stove is Rs. 1,000/-.

**Spreri model IDGB improved cook stove**

This cook stove is working on the principle of gasification. The required quantity of air is used for burning and efficiency is 50% more compared to ordinary stove. The cooking time is less and 30% of the fuel can be saved.

**Hand operated single acting maize sheller**

The output capacity of hand operated single acting maize sheller was 15-18 kg/hr. The cost of operation was Rs. 52/- per quintal as compared to that of Rs. 115/- per quintal for traditional method of hand shelling. The cost saving was up to Rs. 63/- per quintal of maize shelling over traditional method of hand shelling.

**Solar powered knapsack sprayer**

This sprayer does not require any fuel as it utilizes freely available solar energy for spraying operation. The field capacity of the sprayer is found to be 0.15 ha/hr. It not only saves about 20 per cent in spraying cost as compared to traditional knapsack sprayer, but also reduces the drudgery of the labour. Cost of each unit is Rs. 6,000/-.

**Aloe vera inner gel powder**

Select the homogeneous leaves according to size, ripeness, colour and freshness. Wash the leaves to remove mud, dirt and bitter exudates, carryout the leaf trimming process to remove the side, base and tip. Perform the manual filleting of gel to obtain Aloe vera gel fillets. Cut the Aloe vera gel cubes manually to obtain uniform gel cubes of about 10×10 mm size. Dry the Aloe vera gel cubes in dehumidified air dryer at 45 °C and 15% RH for 10 hours to obtain dried Aloe vera gel cubes having moisture content below 5% (d.b.). Grind the dried Aloe vera gel cubes in hammer mill to get superior quality Aloe vera inner gel powder which can be used as an important ingredient in manufacture of food, pharmaceutical, nutraceutical and cosmetic products.

**Aloe vera whole leaf powder**

Select the homogeneous leaves according to size, ripeness, colour and freshness. Wash the leaves to remove mud, dirt and bitter exudates, perform the leaf trimming process manually to remove the side, base and tip. Slice the trimmed leaves manually to get leaf slices of about 10-15 mm thickness and dry in dehumidified air dryer at 45 °C and 15% RH for 11 hours to reduce the moisture content of slices below 5% (d.b.). Grind the dried Aloe vera whole leaf slices in low temperature grinder with liquid nitrogen to obtain the superior quality Aloe vera whole leaf powder which can be used as an important ingredient in manufacture of pharmaceutical, cosmetic and cosmeceutical products. One tone of Aloevera can produce 600-700 kg Aloevera powder by using whole leaf whereas 20 kg power by using only inner gel.

**Improved mini-Dhal mill**

Improved mini dhal mill is operated with 3 HP motors and it makes 100-150 kg dal/hr and its work efficiency is 70-74%.

**Instant goat milk powder production technology**

The fresh goat milk is filtered through muslin cloth and pasteurized in $72^0$C for 15 sec. till getting 39% solids. Then the milk is subjected to $175^0$C for drying through spray method. Then the 0.32% lesithin is mixed to milk powder and dried under $60^0$C through iodized bed method. One litre of goat milk can give 100 g powder.

**Tractor operated Rotary model weed removing machine**

Tractor operated rotary model weed machine is attached to 45 HP tractor, can remove the weeds in between 3 rows at a time. The machine can remove weeds in 0.52 ha in 1 hour. This can be used in pigeonpea, cotton and other widely spaces crops.

**Tractor operated air pressure spraying machine**

Tractor operated air pressure spraying machine having 10.8 m length boom having 20 spraying nozzles. This machine can spray in 2.20 ha in 1 hour. This machine is used in redgram and widely spaced crops.

**Tractor operated raised bed seed drill**

Tractor operated raised bed seed drill is attached to 35HP tractor and can from 23 raised beds and easy sowing. This seed drill can sow in 0.48 ha in 1 hour.

**Foxtail millet dehusker**

This machine is of roller model and with high speed and in opposite direction rotating two equal sized rubber rollers are there. By the friction of these two rubber rollers the foxtail millet grains gets dehusked and the pure foxtail millet can be sized in suitable sizes. This machine has 2HP motor and can dehusk 150 kg foxtail millet and having 78 to 81% efficiency. The capacity of the dehusker is 100 kg per hour.

**Enhancing the shelf life of dehusked foxtail millet**

The foxtail millet can be stored in plastic bags of gauge PET-400 of small quantities up to 1-2 kg for 6 months and in large quantities of 25-50 kg can be stored in plastic bags of 200 gauge up to 4 months without any stored insect pest attack and without deteriorating the nutritional quality of foxtail millet.

**Dried fig production technology**

Fine ripened fig fruits are washed in clean water and can be dipped in hot water of $90^0$C for 1 min. The fruits are dipped in 25 ounce brix sugar solution (1:2) for 24 hours. Then the fruits are taken from sugar solution and cleaned in clean water and treated with 2% Potassium meta-bisulphate solution for 5 minutes.

**Improved drainage methodology in command areas**

In command areas, the existing and the newly constructing drainage channels can be fitted with internal drainage controller up to the root depth. By this 13-26% of water demand can be reduced.

**Tractor operated square baler**


Tractor operated square baler having the efficiency of about 1.0 ha for one hour and can prepare bales from 58 to 61 (35 x 45 x 60 $cm^3$). Each bale having the average weight of 10 kg having the density of 71.8 $kg/m^3$. The machine can save 88% time and 64% of the cost when compared to traditional methods.

**Use of biodiesel for tractor**

Biodiesel and diesel can be mixed in the proportion of 20:80 and can be used in tractors for agricultural operations.

**Bullock drawn solar powered high clearance sprayer**

This machine is working by using solar energy and without any fuel requirement. This machine is suited for tall growing crops. The capacity of the machine is 0.90 to 0.95 ha/hr. By using this machine, 55 to 60% spraying cost and labour cost can be minimized.

**Tractor drawn groundnut digger cum elevator**

This machine is fixed to 35 HP tractor having ‘V’ shaped blade which helps in digging out groundnut plants. Then the dugout plants are separated out from soil with the help of rotating chain. The efficiency of the machine is 96.33 % and 0.38 ha area can be covered in 1 hour.

**Tractor operated wheel rake**

The efficiency of the machine is 1.29 ha/hr. After using this machine, the fodder baler machine can be used to increase the number of bales production and increases 2.5 times more in combination.

**Modified atmospheric packaging ($CO_2$ flushing) unit for food grains**

The machine is fabricated by using grain filled polythene cover in a box, $CO_2$ cylinder, air pressure regulator, solenoid type time regulator and seal making facilities. By using this machine, the different capacities of plasting bags can be packed (1 kg, 2 kg and 5kg capacities bags can be filled with grains). The plastic bags should be of 100 microns or 400 gauge. The plastic bags can be filled with $CO_2$ and the grains (both cereals and pulses) can be stored for 20 months and oilseed crops can be stored for 12 months without any insect damage.

**Development of pedal cum power operated groundnut decorticator**

It is fabricated with hopper, rubber lining having drum, half moon shaped sieve, Blower, Peddle running with 0.75 HP motor. This machine having the groundnut shelling percentage of 90-95 %, 90-120 kg/h (peddle operated) and 170-200 kg (motor operated) this machine is shelling the groundnut seeds based on their size.

**Standardization of process technology for muffins fortified with wheat grass powder**

To prepare wheat fodder fortified muffin, the following ingredients are required:

Wheat flour: wheat fodder powder = 95: 5 g (100 g)

Sugar-50 g, Butter-50 g, Milk-50ml, Vanilla perfume-1ml, Baking powder-4 g, Salt-0.4 g.

The above ingredients are mixed and the mixture is filled in muffin blocks and keeping them in baking oven in $170^0$C for 25 minutes. The prepared muffin is having higher nutritional value.

**Development and performance evaluation of portable MAP ($CO_2$ flushing) unit for grain disinfestation**


This machine is having Teraffil Candel and iron oxide nano atoms prepared cartridge uses to separate Arsenic and heavy metals without any electricity. This machine is having the efficiency of 3-4 l/hr.

**Response of cotton to drip irrigation in saline soils under conservation agricultural practices**


Under saline soils, the paired row cotton cultivation can be taken up in drip irrigation system (with 400 mm net water demand) and by giving extra 20% of more water (80 mm) leads to pushing more salts towards the periphery. Mulching the crop with 1.25 cm thickness (0.69 kg/m$^2$) paddy straw can increase the soil moisture upto 3%. By adopting this technology, the salts near the root zone can be drained out easily, weeds can be control and higher cotton yield can be achieved.

**Laser land leveling technology for enhancing water productivity of paddy production under puddled transplanting method**

Before puddling, land levelling can be done by using laser leveller instead of traditional land levelling, 11% of the water can be saved.


T1: Puddled Transplanted Rice in Laser Leveled Land


T2: Puddled Transplanted Rice in Normal Leveled Land

**Laser land leveling technology for enhancing water productivity of paddy production under DSR method**

In direct seeded rice cultivation, while land levelling instead of tractor operated bucket harrow, laser leveller can be used to level the land thereby 6% of the water can be saved.

T1: Direct Seeded rice in Laser Leveled Land

T2: Direct Seeded rice in Normal Leveled Land

**Use of humic acid on mulberry and subsequent effect on silkworm hybrid, PM × CSR 2**

Spraying one ml humic acid in per litre of water to mulberry leaves can enhance the yield.

**Inclusion of new chapter on mulberry cultivation practices**

Since there is no information on mulberry cultivation practices, the information mulberry varieties, transplanting techniques bio fertilizers, nutrient management, weed management, water management, and yield information included.

**Stress management of working bullocks by feeding pro-biotics as a supplement**

Feeding bullocks with 10 – 15 g of “pro-biotic” along with regular diet, increases the nutrients use to 11-12 % and 15 % of tiredness of the animal can be reduced. The capacity of bullocks can be achieved by 8 – 10 % and can perform better.

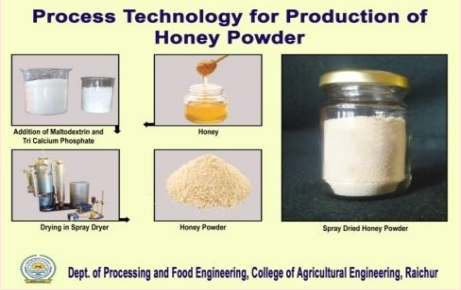
**Development of packaging technology for fresh figs to enhance their shelf life**

Normally figs are packed in cotton boxes which are prone to more physical damage. To avoid this damage use craft paper (90-100 gsm) in honey comb model which avoids physical damage and increase the shelf life of fig fruits upto 6 days.

**Honey comb packaging material production machine for fig fruit**

This type of packing machine requires layers of papers which are to be pasted on a roller by putting gum in between each paper. This machine is having self started tray. The capacity of the machine is 180 cartoon trays per hours of 20 kg capacity. To pack 1 kg fig fruits, the additional cost incurred is Rs. 1.60.

**Production of honey powder**

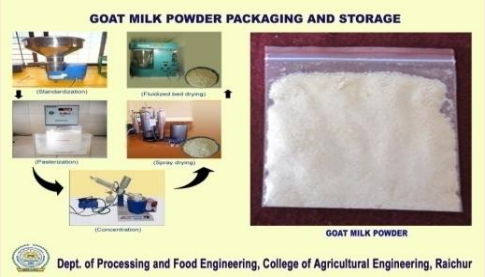



Mixing honey, malto dextrin and water in the ratio of 1:1:3 and mix 1.75% tricalcium phosphate (Anticaking agent). Subject the mixture for drying in spray dryer upto 200$^0$C, we can get good quality honey powder.

**Aloe vera leaf slicing machine**

Normally Aloe vera leaves are cut manually thereby more man power is required for processing. To avoid this, a machine is used to cut the leaves. The machine is fitted with 0.5 HP motor and can cut 600-650 kg leaves per hour.

**Sorption isotherms and storage life of spray dried goat milk powder**




The fresh goat milk is sieved in muslin cloth and is pasteurized at 72$^0$C for 15 seconds to get 39% solidification. The milk is subjected for spray drying under 171$^0$C and then mix 0.32% Lecithin powder & then dry under 60$^0$C in fluidized bed. By this we can get good quality goat milk and can be packed in Aluminium foil packing and can be stored upto 6 months.

**Nanoencapsulation of probiotic bitter gourd juice powder**


The bittergourd juice is added with 1% *Lactobacillus* and 30% Gum Arabica and subjected for spray drying having ultrasonic spray nozzle upto $140^0$C. By this we can get good quality probiotic bitter gourd juice and can be kept for 4 months in polythene packing.

**Development of value added products from fig fruits**


Fresh fig fruits are cleaned with water and separated out pulp and then keep it for boiling add 70% sugar and 0.5% pectin to the boiling pulp. Stir the pulp until it get $60^0$ Brix solidified product. Then add 0.4% citric acid and 0.02% Sodium Benzoate and then boil it until it get $68.5^0$ Brix solidified product. The solidified jam can be stored PET (Polyethelene Terephthabte) or in glass bottles and keep it for 24 hours. The product can be kept for 3 months.

**Bullock drawn air must canopy sprayer**

This air pressure spraying machine is having 5 HP diesel engine. By blowing air pressure, the spraying can be taken up in height growing crops like cotton, redgram etc. the sprayer can spray 3 rows at a time. The efficiency of the sprayer is 0.6 to 0.7 ha/hr. Suitable precautionery measures should be taken for bullocks and spray man.

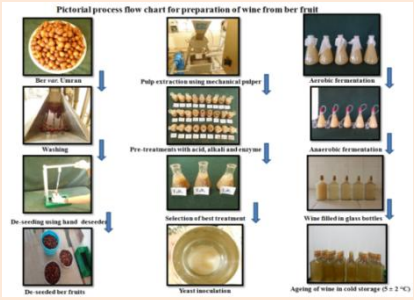
**Small tractor operated weeder for wide row crops**

This interculture machine is having an efficiency of 0.4 ha/hr and 75% weed control efficiency can be achieved. By this we can save 62% expenditure, 61% labours and 80% time. The weeder can be used in height growing crops upto 1.5ft and 3ft wider row spacing.

**Mechanized chopping of biomass**

The fodder and crop residues can be cut mechanically. The chopped fodder and residues can be easily manageable, transportable, storable and usable characters. By this, we can save 80% savings.

**Vine preparation technology from Ber.**




The juice of ber fruits is treated with 1% penctinose enzyme for 12 hours. Then treat the same with 5% Cecchromyces cervaceae yeast for 16 days for fermentation. This has to be left for 90 days for ageing. Then vine with 12% alcohol will be ready.

**Evaluation of subsurface drip irrigation on soil physico - chemical properties, growth and yield of salt tolerant sugarcane in saline vertisols of Tunga-Bhadra command area**

The salt tolerant sugarcane is recommended to plant in paired rows in saline soils (ECe of 4.6 dS $m^{-1}$) under sub-surface drip irrigation in 20 cm depth. This will drain the excess salts from root zone and increases the yeild of sugarcane.

**Assessment and mapping of salt affected soils of Raichur district in Tungabhadra Command area of Karnataka**

Table: Soil summary of Raichur District under TBP [Soil Salinity (>4) and soil alkalinity(SAR>13)]

| Taluka | Saline | Alkaline |
|---|---|---|
| Sindhanur | 22.0 | 14.6 |
| Manvi | 8.00 | 18.0 |
| Raichur and Deodurga | 8.25 | 12.5 |

**Status and improvement of Zinc and Iron in selected watershed areas of Raichur, Yadgir and Kalaburagi districts.**


Mix 4 kg (for rainfed areas) and 10 kg (for irrigated areas) of $FeSO_4$ in 1:1 proportion with vermicompost or well decoposed FYM and allow for fortification for 15 days. Apply this mixture along with recommecnded dose of fertilizers at the time of sowing.

**Technology for separation of Phycocyanin liquid from Spirulina algae by using super critical $CO_2$.**

Instead of using artificial blue coloured agent, one can use natural blue dye Phycocyanin which is extraeted from Spirulina algae by using super critical $CO_2$ Phycocynin increases the disease resistance and also kills the food poisoning micro organisms like E. coli, Streptococcus, Solmonella etc. The extracted phycocyanin can be dried to make powder and then mixed with peppermints, scented milk and other milk products.

**Use of pulse magic in greengram**


Spraying pulse magic @ 10g/l of water during flowering stage will enhance the yield of greengram.

**Use of pulse magic in blackgram**

Spraying pulse magic @ 10 g per litre during flowering stage in blackgram will enchance the yield.

**Cultivation of muskmelon (Cucumis melo L.) under shade net condition**

Make l m long and 0.3 m raised beds (50 cm apart), Spread 30 micron thin plastic sheet on the raised beds. Plant seedings 50 cm apart in each beds. Provide stage to each plant. Allow to grow only two branches and one furit in each branch. At fruit development stage, spray 0.5% 0:0:50 water soluble fertrlizer 4 times at one week interval. There will be enhancement of quality and yield of muskmelon.

**Pre treatment of bulbs with GA3 in tube rose**

Treat tuberose bulbs in water overnight. Then treat the bulbs in 100 ppm GA3 solution for 1 hour. By planting treated bulbs, the germination percentage will be enhanced and inturn flower yield.

**Weed management studies in tuberose**

Spray oxyflurofen 23.5 EC @ 2.12 liters in 1000 liters of water before 3 days of sowing. Then spray the same herbicide 2 times at 30 and 60 DAS thereby weeds can be controlled.

**Small tractor operated weeder-cum-fertilizer applicator**

By using small tractor operated weeder cum fertilizer applicator one can apply fertilizer and also can carry out weeding operation simultaneously. The work efficiency of the machine is that it covers 0.32 ha in 1 hour with 78% weed control efficiency. This machine can be used in widely spaced crops having 90cm row distance.

**Drone mounted sprayer**

Drone mounted sprayer is having 20 liters capacity tank which can be used in paddy and groundnut crops. The efficiency of this sprayer is about 2.0 to 2.5 ha per hour. The government rules while using this sprayer needs to be taken vcare off. As per the government rules while using the sprayer care must be taken.

**Solar powered remote controlled sprayer**

Solar powered remote controlled sprayer with 100 liters capacity of hoding spray mixture, can be used in chili, groundnut and other crops. The work efficiency of this sprayer is around 1.15 to 1.26 ha per hour.

**Hand operated paddy straw baler**

This machine can be operated by hands to make paddy straw balers. The square type paddy straw balers of size 60 x 32x 40 cm can be prepared. With the help of this machine 120 paddy straw balers can be prepared per day. The work efficiency is more and cost of unit is less when compared to tractor baler. This baler is most useful for small farmers.

**Production of micro encapsulated Asthma plant**

The uprooted asthma plants are separated from roots are to be cleaned, with clean water and dry them under sun. The dried leaves and stem are to be powdered and the liquid has to be separated by super critical technology. The liquid is mixed with fatty substance in suitable proportion and can be filled in capsules through spray drier. Then the capsules can be filled with brown glass bottes and should be stored in cold and dry place. These capsules are used to treat the asthma and other respiratory problems as per Ayurveda Medical Science.

**Process technology for extraction of sweet flag rhizome oil**

The sweet flag rhizomes are to be subjected to 200 bars pressure and 45-55$^0$C by super critical $CO_2$. By this 90% of the rhizomes oil can be extracted. The oil contain 26% of B-Acerone. The 100 micro liters of oil for every 1 litre of water can be effectively used against Staaphilococcus aurius, mucor and Aspergillus pathogens. The oil can be treated to fig fruits to increase the life for 7 days.

**Biodegradable chitosan nanosilver composite packaging film**

The 2% polyvenyl alcohol can be boiled at 80$^0$C for 2 hours and can be mixed with Kytocene liquid in 1:1 propertion (which is having 2% Kytocene and 1% silver nano particles). The mixture is boiled at 94$^0$C for 30 minutes and can be poured in Tefflon plate of suitable size and dry if for 48 hours.The Biodegrabdoble chitosan nano sliver composite packging film is ready and can be used for packing bread and fig fruits by this self life can be increased to 7 and 10 days, respectively.

# IV. Animal Science technologies

**Chaffed feeding: intake and utilization of nutrients in animals**

The chaffed fodder mixed with 1% salt along with concentrate mixture (1kg) which helps in digestion and utilization of nutrients by the animal. This technology can reduce the wastage of fodder to an extent of 50-60 per cent. Increase intake of dry matter and utilization of nutrients. Increase milk yield in lactating animals. The 40-50% of cost of production can be minimized by avoiding loss of feed and fodders. The cost of manual chaff cutter is Rs. 5,000/- to 6,000/- and power operated is Rs. 50,000/- to 60,000/-.

**Improved goat breeds for IFS (Both rainfed and Irrigated ecosystem)**


In Integrated Farming System (IFS) under both rainfed and irrigated ecosystems improved goat breeds like Sirohi, Barbari & Jamunapri performed better.

**Ram lambs fattening under stall fed rearing system**

Stall fed rearing system to Ram lambs can yield healthy and better fattening in Ram lambs.

**Use of pelleted calcium supplements in dairy**

For milking dairy animals use of pelleted calcium supplements gives good quality and higher milk yield.

## Improved low cost cattle shed

Improved low cost cattle shed can be constructed by leaving 2.45m height in the centre, 1.75m on both sides. The top-roof can be covered with dried leaf litter and on that, cool fibre should be covered. This will reduce the temperature, improvement in animal health and can save 41% of the cost. The cost of cattleshed for 4 animals is Rs. 30,000/-.

# V. Other technologies

**Use of spiral separator machine for grading of pulses**

By spiral separator machine the seeds of pulses like soybean, redgram, bengalgram, greengram, blackgram can be easily separated.

**Use of protective hand gloves in agriculture**

Hand gloves made up of plastic and cotton helps in harvesting of bengalgram, safflower, sunflower, bhendi and fruit crops like papaya, sapota which helps in protection of hands.

**Harvest tool for lime**

Lime can be easily harvested from tall plants and even in dense plants.

**Various crop residues for vermi-composting**

For vermi-composting use of banana trash, sorghum stalk or sunflower stalk was found effective in improving quality of manure. These residues also enhance secondary and micronutrient content of vermi-compost. Mixture of sorghum stalk, sunflower stalk, banana, chilli and pigeonpea stalks gave higher nutrient composition after vermi-compost as compared to initial major and micro nutrient content.

**Reuse of plastic bottles for irrigation in dryland horticulture and forestry species**

Instead of pitcher irrigation, use plastic water bottles (1 litre capacity) in dry land horticulture and forestry for watering the saplings for first 1 to 2 years, thereby saving precious water and protecting the environment.

Based on this principle, in drip installed gardens, used plastic water bottle (1 litre capacity) filled with sand is buried into the soil, one feet away from the plant and to a depth of 10-12”, before burying the bottle, bottom of the bottle should be cut open and buried facing upwards. Then watering is done through the drippers fitted into the bottle opening.

Through this method, 50 per cent of water is saved and fertilizer use efficiency will also be enhanced if fertigation is practiced through this method.

**Standardization of germination testing method of Kabuli Chickpea (2016-17)**

To test the germination of Kabuli Chickpea, placing 25 or 50 seeds in suitable spacing on a germination paper (2 papers in the bottom & one paper on the top) is ideal.

**Seed treatment in chickpea (2016-17)**

Drying the chickpea seeds < 8% moisture and treat 1 kg seed with 5 ml castor oil and then dry under shade. By this we can avoid stored pests incidence and the germination can be improved till 18 months.

**Optimum sieve size for grading of Bengalgram /GBM 2 (2018-19)**

While grading chickpea (GBM-2) 5mm round shaped sieve should be used for better quality seeds.

ಜರಡಿ ಗಾತ್ರ : 5.00mm (R)
ಚೇತರಿಕೆ ಪ್ರಮಾಣ % : 94.49

ಜರಡಿ ಗಾತ್ರ : 5.50mm(R)
ಚೇತರಿಕೆ ಪ್ರಮಾಣ %: 88.78

**Optimum sieve size for grading of redgram (TS-3R) (2016-17)**

While grading the redgram using 3.75mm round sieve is ideal in order to get good quality seeds and good germination percentage.