Annexure – 6

PACKAGE OF PRACTICES FOR ORGANIC CROPS

1. RICE

Varieties: Improved White Ponni, Bhavani, Mappillai Samba, Kichedi Samba, IR 20, CO 43, CO (R) 48, KDML 105, Red Kavuni and Seeraga Samba

Season: Kuruvai, Thaladi and Samba seasons

Seed rate: 7- 8 kg for single seedling per hill

Spacing: 25 cm x 25 cm (SRI)

Seed treatment: Seed treatment with Panchagavya @ 1 % (overnight soaking and shade dry) followed by treatment with *Pseudomonas* fluorescens @ 10 g/kg, *Azospirillum* @ 30 g/kg and *Phosphobacteria* @ 30 g/kg.

Manures for nursery : Basal application (per m^2) of well decomposed FYM @ 1.25 kg, neem cake @ 50 g, Trichoderma *viride* @ 4 g and gypsum @ 100 g at 10 DAS

Green manuring: Prior to rice cultivation sowing of daincha (*Sesbania aculeata*) seeds @ 40 kg/ha as green manure and *in situ* incorporation at 50% flowering

Main field preparation

- Puddle the land thrice with country plough or power tiller
- Level the field for proper water and weed management

Manures for main field

- Basal application of enriched farm yard manure (EFYM) @ 750 kg/ha (FYM enriched with rock phosphate @ 10 kg, Azospirillum @ 10 kg and Phosphobacteria @ 10 kg)
- Top dressing of vermicompost @ 1 ton / ha in two equal splits at 25 and 45 DAT
- Foliar spraying of Panchagavya @ 3% twice at active tillering stage (25 DAT) and panicle initiation stage (45 DAT)

Water management

- Irrigation only to moist the soil in the early period of 10 days
- Restoring irrigation to a maximum depth of 2.5cm after development of hairline cracks in the soil until panicle initiation
- Increasing irrigation depth to 5.0cm after PI one day after disappearance of ponded water

Weed management

- Dominant weeds in the transplanted paddy field are *Monochoria vaginalis, Echinochloa crus-galli*, *Cyprus difformis, Cyprus iria* etc
- The first 6 week after transplanting is the critical time of weed competition two or three timely weeding will provide adequate weed control
- Use rotary weeder or cono weeder thrice at 7-10 days interval from 10-15 days after planting on either direction of the rows and column.
- Flood the field for 2-3 day after transplanting and a 5 cm water depth should be maintained throughout the growing season if weeds are problem in that area.
- Manual weeding is also essential to remove the weeds closer to rice root zone.

Pest management
Nursery

Thrips: *Stenchaetothrips biformis*

- Sufficiently thin film of water should be maintained in the nursery

Green leafhopper: *Nephotettix virescens*

- Set up light traps to collect insects

Rice case worm: *Nymphula depunctalis*

- Flooding the field followed by dragging a rope across the field and draining out the water from the field.

Swarming caterpillar: *Spodoptera mauritia*

- Kerosenate the water while irrigation - suffocation
- Allow ducks into the field
- Drain the water

Main Field

Rice stem borer: *Scirpophaga incertulas*

- Avoid close planting and continuous water stagnation
- Pull out and destroy the affected tillers
- Set up light traps to attract and kill the adult moths
- Harvest the crop up to the ground level and disturb the stubbles

- Use resistant varieties
- Inundative release of *Trichogramma japonicum* five to six times @ 1,00,000/ha from 15 DAT
- Apply *Bacillus thuringiensis* var *kurstaki @ 1.0 kg/ha* and NSKE @ 5%

Gall midge: *Orseolia oryzae*

- Ploughing under the ratoon of previous crops can reduce infestation
- Removal of alternate hosts like grassy weeds and wild rice
- Avoiding staggered planting and complete planting in an area within 3 weeks
- Grow resistant varieties like MDU 3
- Foliar spraying of NSKE @ 5% or neem oil @3%

Swarming caterpillar: *Spodoptera mauritia*

- Kerosenate the water while doing irrigation
- Allow ducks into the field to picking the caterpillars
- Deep plough the fields in summer to kill pupae
- Remove excess nurseries and weeds from the field and bunds
- Ensure alternate wetting and drying of the fields
- Set up light traps to monitor and control population

Leaf folder (or) leaf roller: *Cnaphalocrocis mainsails*

- Early planting helps to avoid greater degrees of leaf damage
- Wider spacing decreases leaf damage
- Grow resistant varieties like TKM 6
- Release of *Trichogramma chilonis* @ 1,00,000/ha five times from 15 days after transplanting
- Spray NSKE @5%, neem oil 3%, *Beauveria bassiana* @ 0.2%

Green leafhopper: *Nephotettix virescens*

- Use of resistant varieties
- Set up light traps to collect insects
- Spray neem oil @ 3% or NSKE @ 5%

Brown plant leafhopper: *Nilaparvata lugens*

- Draining the water from the field to reduce the initial infestation
- Provide alley ways in the main field
- Grow resistant varieties
- Spray neem oil @ 3% /*Mahua* oil @ 3% / NSKE @ 5%

Mealybug: *Brevennia rehi*

- Remove the grasses from the bunds and trim the bunds
- Remove and destroy the affected plants
- Conserve the natural enemies like *Anatrichus pygmaeus and Mepachymerus ensifer*

Rice Ear-head bug: *Leptocorisa acuta*

- Synchronous planting of early-maturing varieties
- Weed sanitation and eradication of alternate hosts from rice field
- Smoking the field, hand-picking of adults and Nymphs have also been advocated
- Spray NSKE @ 5% @, Notchi leaf extract @ 10%, *Prosopis* leaf extract @10%
- Apply *Acorus calamus* dust @ 10% during morning hours

Thrips: *Stenchaetothrips biformis*

- Flooding field for 2 days as a cultural control practice
- Conserve the biological control like coccinellids, anthocorid bugs and staphylinid beetles
- Sufficient thin film of water should be maintained in the nursery
- Application of neem oil @ 3% / NSKE @ 5%

Disease management

Blast*: Pyricularia oryzae*

- Plant a resistant variety
- Removes weed hosts from bunds
- Burning of straw and stubbles after harvest
- Plant early to avoid the likelihood of heavy blast pressure late in the season.
- Dry seed treatment with *Pseudomonas fluorescens* talc formulation @10g/kg of seed
- Spray *Pseudomonas fluorescens* talc formulation @ 0.5% at 45, 55 and 65 DAT

Brown Spot: *Bipolaris oryzae*

- Plant varieties that are resistant to brown spot
- Use clean, fungicide-treated seed

Sheath Blight: *Rhizoctonia solani*

- Apply FYM 12.5 t/ha or green manure@ 6.25 t/ha to promote antagonistic microflora
- Soil application of *P. fluorescens* @ 2.5 kg/ha mixed with 50 kg FYM on 30 DAT
- Foliar spraying of *P. fluorescens* @0.2% at boot leaf stage and 10 days later
- Avoid flow of irrigation water from infected to healthy field.

False Smut: *Ustilaginoidea virens*

- Destruction of straw and stubble from infected plants
- Use disease free seeds
- Plant less susceptible varieties if possible
- Select season in order to greater incidence of false smut

Bakanae disease - *Fusarium moniliforme* (*Gibberella fujikuroi)*

- Use salt water to separate lightweight, infected seeds

Bacterial Leaf Blight: *Xanthomonas oryzae pv. oryzae*

- Use disease free seed
- Maintaining shallow water in nurseries and providing good drainage during severe flooding
- Grow nurseries preferably in isolated upland conditions
- Careful handling of seedlings during transplanting.
- Avoid clipping of seedlings during transplanting.
- Grow tolerant varieties like IR 20, TKM 6
- Spray neem oil @ 3% / NSKE @ 5%
- Spray fresh cow dung extract 20% twice at 15 days intervals starting from initial appearance

Harvesting: Harvest the rice when the grains are fully matured and filled so as to get maximum quality and quantity. Harvesting can be done when the crop looks dried appearance due to drying of all most all the leaves.

Yield: 2.6 - 4.9 t/ha

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2. COTTON

Season: *Kharif* (first fortnight of August to second fortnight of September

Varieties: Suraj, Surabhi, MCU12

Spacing: 60 cm x 30 cm

Seed rate: Delinted seeds @ 7.5 kg/ha

Field preparation

- Prepare the field to get a fine tilth
- Chisel the soils having hard pan formation at shallow depths with chisel plough once in three years
- Form ridges and furrows 10 m long with 60 cm spacing by using ridge plough or bund former

Seed treatment

- Azospirillum @ 600 g/ha)
- Phosphobacteria @ 600 g/ha
- *Pseudomonas fluorescens* @ 10 g/kg of seeds

Organic manures

- Basal application of FYM @ 7. 5 t/ha or Vermicompost 4.0t/ha, Azospirillum @ 2.5 kg, Phosphobacteria 2.5 kg, *Pseudomonas fluorescens* @ 2.5 kg and *Trichoderma viride* @ 2.5 kg
- Top dressing of vermicompost @ 1t/ha at 45 DAS and foliar spraying of *Panchagavya* @ 3% thrice at 30, 60 and 90 DAS

Irrigation

- About 15-18 irrigations depending up on the weather and soil type. Most critical stages for irrigation are germination phase (1-15 days), vegetative phase (16-44 days) and flowering phase (85-90 days)

Weed management

- *Acalypha indica, Cyanodon dactylon, Cyperus rotundus, Digera arvensis, Chloris barbata, Trianthema portulacastrum and Parthenium hysterophorus* are the major weed species.
- Critical stages are vegetative and flowering phases.
- Manual weeding and stubble mulching with organic materials

Plant protection

Fruit borer (*Helicoverpa armigera*)

- Summer ploughing to destroy the resting stages of insects in the soil
- Optimum spacing and proper density management
- Crop rotation with cereals like maize/sorghum to reduce the incidence
- Hand picking of grown up larvae during morning and in the evening hours.

- Installation of pheromone traps @ 12/ha to attract and kill the adult moths
- Application of NPV @ 3 x 10^{12} POB/ha in evening hours at 7th and 12th week after sowing
- Application of *Beauveria bassiana* 1.15%WP @ 400 g/ha
- Release of *Thichogramma chilonis* @ 6.25 cc/ha at 15 days intervals thrice from 45 DAS
- Release of *Chrysoperla carnea* predator @ 1 lakh / ha
- Foliar spraying of NSKE @ 5% or neem oil @3%
- Sow marigold as trap crop along the borders
- Removal of terminals shoot during 80-90 days to reduce *Helicoverpa* oviposition
- Erection of bird perches @ 10/ha encourages the predatory birds.
- Spraying of commercial Bt formulations @ 1.5 lit. / ha during morning and evening hours

Tobacco caterpillar (*Spodoptera litura*)

- Crop rotation with cereals like maize/sorghum to reduce the incidence
- Summer ploughing to destroy the resting stages of insects in the soil
- Castor as trap crop along the borders to attract the adults for egg laying
- Collection and destruction of egg masses
- Hand picking up of grown up caterpillars
- Pheromone traps @ 12/ha to attract the male moths and to kill the adults
- Releases of egg parasitoid *Trichogramma chilonis* @1.5 lakh / ha thrice
- Erection of bird perches @ 10/ha encourages the predatory birds.
- Foliar spray of neem oil @ 3% of Neem Seed Kernel Extract @ 5% to deter the adult moths
- Spraying of commercial Bt formulations @ 1.5 lit. /ha during morning and evening hours
- Spraying of SlNPV @ 500 LE /ha to target the young larvae

Pink boll worm (*Pempherulus affinis*)

- Synchronized sowing to reduce the pink bollworm incidence
- Optimum spacing and proper density management
- Basal application of neem cake @ 250 kg / ha
- Stem drenching of neem oil 1-3% thrice at 10 days intervals from 30 DAS
- Installation of pink boll worm pheromone traps @ 12/ha
- Collection and destruction of cotton stubbles immediately after harvest
- Three weekly releases of egg parasitoid *Trichogramma chilonis* @100000/ha
- Foliar spray of neem oil @ 3% of NSKE @ 5%

Leaf hoppers / Jassids (*Amrasca biguttula biguttula*)

- Grow resistant varieties like LRA 5166, Surabhi and Sumangala

- Cowpea as bund crop to encourages predators such as coccinellids, syrphids etc.
- Grow maize as border crop which act as barrier crop for jassids
- Release of *Chrysoperla cornea* @ 500-1000/ha according to the intensity of jassid damage between 20-25 days of crop growth
- Spraying of neem oil @ 3%, neem seed kernel extract @ 5%, fish oil rosin soap @ 2.5%, notchi leaf extract @ 5% and *Beauveria bassiana* 1.15%WP @ 400 g/ha

Foliar diseases

Alternaria leaf spot (*Alternaria macrospora*): Neem oil @3% as foliar spray, spraying of *Bacillus subtilis* @ 0.04% on 60, 90 and 120 DAS

Wilt (*Fusarium oxysporum f. sp. vasinfectum*) : Seed treatment with *Trichoderma viride* @ 4g/kg, Destruction of the infected plant debris and soil application of *Trichoderma viride* @2.5kg/ha

Root Rot (*Rhizoctonia bataticola*) : Seed treatment @ 4 g/kg with *T. viride* @ 10g/kg seed, destruction of infested plant debris, soil application of *Pseudomonas fluorescens* @ 2.5 kg/ ha at time of sowing

Duration: 160 - 165 days

Average yield (irrigated): 18-20 q/ha

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3. MAIZE

Varieties: CO 1 and COH(M)6

Seed rate: 20 kg / ha

Spacing: 60 cm x 30 cm

Green manuring

- Prior to maize cultivation sowing of daincha (*Sesbania aculeata*) seeds @ 40 kg/ha as green manure and *in situ* incorporation at 50% flowering.

Seed treatment

- Seed treatment with *Azospirillum* @ 30 g*/kg, Phosphobacteria* @ 30 g/kg and *Pseudomonas fluorescens @* 10 g/kg

Field preparation

- Plough the field with disc plough once followed by cultivator ploughing twice, after that spread FYM or vermicompost and till to obtain fine tilth
- Form ridges and furrows providing sufficient irrigation channels. The ridges should be 6 m long and 60 cm apart using a bund former or ridge plough.

Manures

- Basal application of FYM @ 12.5t/ha or vermicompost @ 4t/ha or biogas slurry @ 10t/ha, *Azospirillum* @ 2.5 kg/ha and *Phosphobacteria @ 2.5* kg/ha
- Top dressing with vermicompost @ 1 ton at 30 DAS
- Foliar spray of Panchagavya @ 3% thrice at 30, 45 and 60 DAS

Irrigation

- Based on weather and soil type 9-11 irrigations.
- Most critical stages for irrigation are germination and establishment phase (1-14 days), vegetative phase (15-39 days), flowering phase (40-65 days) and maturity phase (66-95 days).

Weed management

- Major weed species present in maize field maintained organically includes *Acalypha indica, Cyanodon dactylon, Cyperus rotundus, Digera arvensis,Chloris barbata, Trianthema portulacastrum* and *Parthenium hysterophorus.*
- Manual hand weeding duringr vegetative phase and stubble mulching during flowering phase is highly effective.

Pest management

Stem borer (*Chilo partellus*)

- Release of egg parasitoid *Trichogramma chilonis* @ 2,50,000/ha (three release at weekly intervals) is desirable.
- Third release is accompanied with larval partasitoid *Cotesis flavipes* @ 5000/ha.

Corn worm / earworm (*Helicoverpa armigera*) :

- Set up sex pheromone traps @ 12 nos./ha
- Application of NPV @ 3 x 10^{12} POB/ha along with country jaggery @ 2.5 kg + cotton seed kernel powder @ 250 g in the evening hours.
- Field release of *Trichogramma chilonis* @ 5cc/ha (three releases at weekly intervals)

- Foliar spray of NSKE @ 5% or neen oil @ 3%
- Grow marigold as trap crop for *Helicoverpa* adults for egg laying

Sucking pests
- Foliar spraying of neem oil @ 3%
- Spraying of neem seed kernel extract @ 5%
- Fish oil rosin soap @ 25g/lit
- *Beauveria bassiana* @ 2ml/lit.

Foliar Diseases
- Neem oil @ 3%
- *Pseudomonas fluorescens* @ 0.2%

Duration: 100 - 110 days

Harvesting
- Harvesting can be done once the sheath covering the cob will turn yellow and dry when the seeds become fairly hard and dry.

Yield: 3750 - 4200kg/ha

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4. SUNFLOWER

Varieties: TNAU Sunflower Hybrid CO 2 and COSFV 5

Seed rate: 6 kg/ha

Spacing: 45 cm x 30 cm

Green manuring

- Prior to maize cultivation sowing of daincha (*Sesbania aculeata*) seeds @ 40 kg/ha as green manure and *in situ* incorporation at 50% flowering

Field preparation

- Plough once with tractor or twice with iron-plough or three to four times with country-plough till all the clods are broken and a fine tilth is obtained
- Spread 12.5 t/ha of FYM evenly on the field before the last ploughing and incorporate in the soil by working with a country plough
- Form ridges and furrows 6 m long. Use bund-former or ridge plough to economise and form irrigation channels across and ridges according to the topography of the field

Seed treatment

- Treat the seeds with with *Azospirillum* @ 30 g*/kg, Phosphobacteria* @ 30 g/kg and *Trichoderma viride @* 4 g/kg

Manures

- Basal application of FYM @ 12.5 tonnes / ha or Vermicompost @ 4t/ha or biogas slurry @ 3t/ha, *Azospirillum* @ 2.5 kg/ha and *Phosphobacteria @ 2.5* kg/ha
- Top dressing of vermicompost @ 500 kg on 30 DAS followed by foliar spraying of Panchagavya @ 3% on 45 and 60 DAS

Irrigation

- Depending up on the weather and soil type 10-12 irrigations. Irrigation is most important during critical stages of the crop like seedling, flowering and seed developmental stages.

Weed management

- Major weed species present in maize field maintained organically includes *Acalypha indica, Cyanodon dactylon, Cyperus rotundus, Digera arvensis, Chloris barbata, Trianthema portulacastrum* and *Parthenium hysterophorus.*
- Manual hand weeding duringr vegetative phase and stubble mulching during flowering phase is recommended.

Pest management

Capitulum borer / Head borer (*Helicoverpa armigera*)

- Summer ploughing to destroy the resting stages of insects in the soil
- Optimum spacing and proper density management
- Crop rotation with cereals like maize/sorghum to reduce the incidence
- Hand picking of grown up larvae during morning and in the evening hours.
- Sow marigold as trap crop along the borders

- Use pheromone traps @ 12 nos./ha to attract the male moths and to kill the adults
- Two to three releases of egg parasitoid *Trichogramma chilonis* @1.5 lakh / ha
- Foliar spray of neem oil @ 3% / NSKE @ 5% to deter the adult moths
- Removal of terminals shoot during 80-90 days to reduce *Helicoverpa* oviposition
- Erection of bird perches @ 10 nos./ha encourages the predatory birds.
- Spraying of NPV @ 500 LE /ha to target the young larvae
- Spraying of commercial Bt formulations @ 1.5 lit. /ha during morning and evening hours

Tobacco caterpillar (*Spodoptera litura*)

- Crop rotation with cereals like maize/sorghum to reduce the incidence
- Summer ploughing to destroy the resting stages of insects in the soil
- Grow castor as trap crop along the border
- Use pheromone traps @ 12 nos. /ha to attract the male moths and to kill the adults
- Two to three releases *Trichogramma chilonis* @1.5 lakhs/ha
- Foliar spray of neem oil @ 3% / NSKE @ 5% to deter the adult moths
- Erection of bird perches @ 10/ha encourages the predatory birds.
- Spraying of commercial Bt formulations @ 1.5 lit. / ha during morning and evening hours
- Spraying of NPV @ 500 LE /ha to target the young larvae

Foliar diseases: Neem oil @ 3% or liquid *Pseudomonas fluorescens* @ 0.2%

Charcoal rot (*Macrophomina phaseolina*): Soil application of *Pseudomonas fluorescens* @ 2.5 kg/ha or *Trichoderma viride* @ 2.5kg/ha along with 50 kg of composed FYM at 30 DAS

Harvest: Observe the bracts on the backside of the capitula. When they turn lemon yellow, the heads harden and the crop is ready for harvest.

Yield: 1200 - 1600 kg/ha

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