TECHNICAL PROGRAMME

ALL INDIA COORDINATED SOIL SCIENCE TRIALS

2021 – 22

ICAR - Indian Institute of Rice Research (IIRR)
Rajendranagar, Hyderabad - 500 030, Telangana.

Trial No-1: ***Long term soil fertility management in rice based cropping systems (RBCS) (kharif and rabi)***

Additional objectives:

1. To study potential of carbon sequestration in the soils in all the treatments, besides analysing soil for biological parameters like soil respiration, microbial biomass carbon, important enzyme activities and available sulphur and zinc status and contribution of irrigation water / silt to S nutrition. The methodology for C sequestration and enzyme studies will be provided later.
2. To evaluate the influence of liming (in acids soils only) on rice productivity and nutrient dynamics (treatment no. 7) and additional dose of vermicompost and oil cakes (treatment no. 13)

Trt. No.	Treatment details
1	Control –1, No fertilizer or manure
2	100% PK (-N)
3A	100% NK in place of 100% N (-P)
3B	STCR recommended dose for target yield
4	100% NP (-K)
5A	100 % NPK + Zn + S
5B	100% NPK+ Zn + S + FYM / PM @ 5 t/ha (to be applied in *kharif* and *rabi* seasons)
6	100% NPK –Zn
7A	100% NPK – S
7B	100% NPK – S + liming @1.0 t/ha (only in acid soils - Titabar)
8	100% N + 50% P + 50%K
9A	50% NPK
9B	50% NPK+ *Azospirillum* + PSB (both seasons in rice-rice and in *kharif* in rice-CP system)
10	50% NPK + 50% GM – N (GM – N to be applied in both seasons)
11	50% NPK + 50% FYM – N (FYM – N to be applied in both seasons)
12	50% NPK + 25% GM-N + 25% FYM–N (GM and FYM–N applied in both seasons)
13A	FYM @ 10 t/ha (*kharif*) ; FYM @ 15 t/ha (*rabi* season)
13B	FYM@10t/ha + 3.0 t/ha Vermicompost + 200 kg/ha oil cakes as top dressing (In both *kharif* and *rabi* season)

At all locations, in treatment 9B, PSB is included additionally along with Azospirillum

Design: RBD; Replications: 4; Gross plot size: 100 m^2 surrounded by 1-2 m wide buffer zone. Spacing: 20 x 10 cm (for rice) and for other crops as per recommendation.
Water management: Continuous submergence up to 5-8 cm depth for rice, and for other crops irrigation to be provided as per recommendations.

Experimental details:

1. NPK levels: The recommended levels of NPK for the respective zone, crop and season have to be applied. The levels of NPK applied should be reported for each crop/season.

2. Apply $ZnSO_4$ @ 40 kg/ha once either in *kharif or rabi* season depending on the local recommendations, uniformly to all the plots except in treatments 6 and 7.
3. In treatment No.6 Zn should not be applied while in treatment No.7, Zn is applied by dipping seedlings in 2.0% ZnO_2 suspension before transplanting rice.
4. In treatment No.7 phosphorus is applied through triple super phosphate (TSP) or Diammonium Phosphate (DAP) instead of Single Super Phosphate (SSP) to avoid application of S. In all other treatments P is supplied through SSP. This has to be followed for both the seasons continuously. In acid soils (Titabar only), liming treatment may be imposed in 50% of the plot area by applying lime @ 1 t/ha in *kharif* season to assess the impact of lime on soil nutrient dynamics and rice productivity.
5. Treatment No. 3: One half of treatment 3 should be imposed with 100%NK treatment in place of 100% N treatment, and in the second half impose soil test based fertilizer recommendation for a yield target of *kharif* and *rabi* crops obtained at each location. Analyse the soil in treatment No. 3 for available N, P, and K and apply STCR fertilizer recommendation as per the equation developed for the district by STCR scheme. The yield target yield should be the one that is realisable at the location recorded in the STCR experiments or in progressive farmers' fields. Report the STCR recommended dose and the target yield fixed.
6. Treatment No.5: One half of the plot should be continued as per the old treatment. In the second half impose additionally FYM/poultry manure @ 5 t/ha. The nutrient composition (NPK) of the FYM/poultry manure applied should be furnished.
7. Treatment No 9: One half of the treatment area should be continued as per the old treatment i.e., 50% NPK. In the second half impose bio fertilizer treatment of applying *Azospirillum* mixed in suitable quantity of cow dung /FYM slurry at the rate recommended for the location for both *kharif* and *rabi* crops in rice – rice system, and for *kharif* crop in rice –cowpea system. The quantity and the rate of bio fertilizer application and the procedure followed should be reported.
8. N and K, wherever necessary are applied through urea and muriate of potash (MOP). However, in treatment No.7, where DAP is the source of P, the N applied through DAP should be accounted for the total N dose.
9. For treatments 10 and 12, 8 week old Dhaincha (*Sesbania aculeata*) or leaves of *Glyricidia* sp. plants or any other green manure crop suitable to the location should be used in both the seasons (*kharif and rabi*) to supply the required amount of N. The quantity of green manure (fresh) incorporated and N content on ODB per hectare basis should be reported.
10. For the treatments 5, 11, 12 and 13, locally available, well-decomposed farmyard manure (FYM) should be applied. Analyse for C, N, P, K contents in the manure used and report the data on moisture and nutrient contents. Further, in treatment no. 13 as suggested during the annual workshop additional treatment of 3.0 t/ha of vermicompost plus 200kg/ha of oil cakes over and above 10 t/ha of FYM should be applied as top dressing in 50% of the plot area (50 sq. m) in both the seasons to study its effect on the overall soil and crop productivity in view of reduced crop yields recorded in the treatment.
11. Before applying GM or FYM in both seasons (*kharif and rabi*), calculate quantity to be applied based on the N content and moisture percentage of the manures. Report the quantity of FYM applied. Raise the green manure *in situ* wherever possible.
12. All plant protection measures and other management practices must be followed as per recommendations.

13. Promising treatments should be validated in about five (5) farmers' fields of 0.5-1.0 acre (2000-4000 sq. meters) under FLDs around the location in comparison with current nutrient practices to demonstrate and transfer the technology. The results of the demonstration on yield, nutrient accumulation and basic soil data have to be reported.

Soil and Plant Sampling and Analysis:

- At the end of each cropping season (at the harvest) about 1 kg of composite soil sample (0 – 15 and 15 – 30 cm depth) should be drawn from each replicate and treatment, processed and preserved for analysis.
- Report grain and straw yields after harvest in **kg/ha** or **tonnes/ha.**
- Grain and straw samples at maturity should be collected, oven dried and processed for analysis to estimate crop removal of nutrients.

Observations (after each crop):

1. Moisture and nutrient (N, P, and K) content of organic manures on ODB.
2. Grain and straw yields for *Kharif* and *Rabi* crops.
3. Replicate-wise content of nutrients in grain and straw at harvest *viz*., N, P, K, S and Zn.
4. Replicate-wise soil analysis for available N, P, K, S, Zn and org. C.
5. Bulk density of the soil to be measured for evaluating changes in soil physical conditions.
6. S content in irrigation water and silt in water.
7. Microbial biomass carbon and dehydrogenase enzyme activity after harvest of *kharif* rice (Procedure enclosed)*
8. Incidence of pest/disease and other observations on crop performance treatment wise.

Estimation of microbial biomass:

i) Fumigation and extraction method for measuring soil microbial biomass: Chloroform is used as fumigant for measuring biomass as it is an effective biocide, and does not solubilising or predispose non-microbial soil organic matter. The increase in extractable organic C following soil fumigation is used to estimate C held in the soil microbial biomass.

Procedure:

- Weigh 20 g (dry weight) of moist sieved soil in duplicate into glass beakers.
- Fumigate one set with ethanol free $CHCl_3$* leaving the other set non-fumigated by placing the beakers in a large vacuum desiccator that is lined with moist filter paper.
- A beaker containing 50 ml of alcohol-free $CHCl_3$, and anti-bumping granules is placed in the desiccator.
- The desiccator is then evacuated with the help of vacuum pump till the $CHCl_3$ starts boiling. Allow the $CHCl_3$ to boil for 1 – 2 min, seal the desiccators and incubate the samples under $CHCl_3$ vapour for 18 to 24 h at 25^{o}C.
- Then break the vacuum in the desiccators slowly, open it, and remove the moist paper and $CHCl_3$ vapors by repeated evacuations.
- Non-fumigated control soil samples are also kept in a desiccators lined with moist paper for 18 to 24 h at 25^{o}C.
- After fumigation, extract the soil with 0.5*M* K_2SO_4 (1:4 soil : solution ratio) for 1 h.

- Filter the extracts through Whatman no. 1 filter paper and store the extracts at 4 -5^{o}C till further assay.
- An aliquot of the K_2SO_4 soil extract is used for measuring organic C in the extracts.

Microbial biomass C (mg C/kg dew of soil) = (C content in extracts of fumigated soil - C content in extracts of non fumigated soil) / 0.411 (K_c)

ii) Spectrophotometric method:

Pipette out 5 ml portions of the extract into digestion tubes, add 5 ml of 0.07 N $K_2Cr_2O_7$, add 10 ml of 98% K_2SO_4, add 5 ml of 88% H_3PO_4 and mix well. Use 0.5 M K_2SO_4 as blank. Boil samples in a digestion block for 30 minutes at 150^{0}C. Cool samples before reading absorbance at 440 nm. **Standard:** 1000 mg/l carbon in sucrose (0.2377g sucrose in 100 ml of 0.5 M K_2SO_4. **Working standards:** 0, 20, 40 60, 80, 100 and 150 mg/l carbon (dilute 0, 2, 4, 6, 8 10 and 15 ml of stock to 100 ml with 0.5 M K_2SO_4) Purify by shaking (3x) 5 ml chloroform with 5 ml of 5% H_2SO_4 and then wash 3x with distilled water and dry over K_2CO_3.

II. Estimation of dehydrogenase enzyme activity in soil (Casida *et al.,* 1964**)**

Reagents:
1) Calcium carbonate ($CaCo_3$), reagents grade.
2) 2, 3, 5-Triphenyl-tetrazolium chlorides (TTC), 3%: Dissolve 3g of TTC in about 80 ml of water and adjust the volume to 100 ml with water.
3) Methanol, analytical reagent grade.
4) Triphenyl formazan (TPF) standard solution: Dissolve 100 mg of TPF in about 80 ml of Methanol, and adjust the volume to 100 ml with methanol. Mix thoroughly.

Procedure:

Thoroughly mix 20 g of air-dried soil (<2mm) and 0.2 g of $CaCO_3$, and place 6 g of this mixture in each of this mixture in each of three test tubes. To each tube add 1 ml of 3% aqueous solution of TTC and 2.5 ml of distilled water. This amount of liquid should be sufficient that a small amount of free liquid appears at the surface of the soil after mixing. Mix the contents of each tube with a glass rod, and stopper the tube and incubate it a 37^{0}C. After 24 h, remove the stopper, add 10 ml of methanol, and stopper the tube and shake it for 1 min. Un-stopper the tube, and filter the suspension through a glass funnel plugged with absorbent cotton, into a 100 ml volumetric flask. Wash the tube with methanol and quantitatively transfer the soil to the funnel, then add additional, methanol (in 10-ml portions) to the funnel, until the reddish colour has disappeared from the cotton plug. Dilute the filtrate to a 100 ml volume with methanol. Measure the intensity of the reddish colour by using a spectrophotometer at a wavelength of 485 nm and a 1-cm cuvette with methanol as a blank. Calculate the amount of TPF produced by reference to a calibration graph prepared from TPF standards. To prepare this graph, dilute 10 ml of TPF standard solution to 100 ml with methanol (100 mg of TPF ml^{-1}), make up the volumes with methanol, and mix thoroughly. Measure the intensity of the red colour of TPF as described for the samples. Plot the absorbance readings against the amount of TPF in the 100 ml standard solutions.

Important decisions in the group meeting: (All centres are requested to follow the below instructions)

- It was decided to select the most popular and high yielding variety for this trial.
- It was decided to leave a buffer zone of at least 1 meter on all sides.
- Any additional observations Viz., Pest and disease occurrence may be collected.
- It was decided to study the microbial properties in selected important treatments at NRRI by microbiologist.
- It was decided to study the temporal and spatial yield stability.
- Water related parameters like water holding capacity of the soil to be analysed
- Any other important soil parameters can be studied in detail in the following treatments

Trt. No.	Treatment details
1	Control –1, No fertilizer or manure
5A	100 % NPK + Zn + S
5B	100% NPK+ Zn + S + FYM / PM @ 5 t/ha (to be applied in *kharif* and *rabi* seasons)
9A	50% NPK
12	50% NPK + 25% GM-N + 25% FYM–N (GM and FYM–N applied in both seasons)
13A	FYM @ 10 t/ha (In both *kharif* and *rabi* seasons)

Locations (3): Mandya, Maruteru, Titabar

Trial No 2: ***Soil quality and productivity assessment for bridging the yield gaps in farmers' Fields (kharif)***

Rice production must increase to meet future food requirements amid strong competition for limited resources. Large variations in yield are a major impending problem for rice sustainability in India. Yield gap analysis is an useful method to examine how large the ranges are between potential, desirable rice yields and those actually realized in farmers' fields. Balanced nutrient application is must to meet the growth requirements of a genotype for realizing the yield potential of several contemporary genotypes. Current fertilizer management practices, in general, are not tailored to site specific soil nutrient supply capacities and crop demand. Blanket fertilizer recommendations are still being followed in large domains with less importance being given to management induced site variations of soil nutrient supply capacities, and crop demand more so when new high yielding cultures with increasing yield potential are being regularly introduced. In view of this, an existing old trial is modified and reported here.

Objectives:

1. To identify the soil related and management constraints limiting the productivity in farmers Fields
2. To give site specific recommendations to the farmers for higher productivity.

Note: The fertilizer recommendations given below in the table will be tested in the low yielding farm sites in *kharif* 2020.

Type of data collection : By Survey in the new farm sites

Methodology: A Survey will be conducted in nearby villages during *kharif* 2020 involving data collection from around 20-30 farmers regarding Variety, sowing time, manures and fertilizer application, management practices, Yield, weather parameters, soil conditions as per their knowledge and other details. The farmers will be grouped into Low and high categories based on their yields. Soil and plant samples will be collected from field after harvest and analyzed for their nutrient contents. The data will be analyzed critically and the reasons for low yield will be identified in comparison with high yielders. For next season crop, site specific recommendations to the farmers will be given for higher productivity and soil health improvement.

Observations: 1. Soil type. 2. Variety and seed rate 3. sowing time 4. Manures and fertilizer application 5. Management practices followed 6. Harvesting time 7. Yield 8. Rainfall 9. Insect Pests 10. Diseases 11. Initial/post harvest soil analysis data 12. Nutrient uptake at harvest

Note: Interested cooperators **FROM AGRONOMY** discipline can take up this trial.

Important decisions in the group meeting :

- Variety, season and ecology-wise yield gaps to be assessed
- Econometric analysis for yield gap estimation to be done with the help of Economist

Locations (8): Moncompu, Pantnagar, Pusa, Titabar, Ludhiana, Faizabad, Karaikal, Kaul, Raipur

Soil Science coordinated trial No. 2 (Questionnaire)

Soil quality and productivity assessment for bridging the yield gaps in farmers'Fields

Details of crop management practices followed by the farmers (Season- *kharif* ----------):

Name of the farmer :

Village **:** **Mandal / Tehsil** **:**

District **:** **State** **:**

Land holding / cultivated area (ha):

GPS coordinates (Longitude/ latitude) of the site:

Soil type : Soil fertility status (kg/ha) : N: _____ P_2O_5:_____ K_2O :_____

Zn: _____

Rice ecosystem: Irrigated / Rain fed low land

Variety: _____ Duration (days):_____

Date of sowing: _____ Date of Planting: _____

Water source: Canal / Tank / Bore well / Water quality: _____

Crop management:

Organic manures applied (t/ha) _____ (FYM / Compost / Poultry manure / Green manure / crop residue)

Fertilizer recommendations for the site (kg ha); N____, P_2O_5_____K_2O ____ Any other nutrients: _____

Farmer's fertilizer practice: N: _____, P_2O_5: _____, K_2O _____ Any other nutrients: _____

Fertilizer sources used: _____

Top dressing (Qty. kg / ha) and source including stage of crop (days after planting) :

1._____ at stage (DAT); 2 _____ at stage (DAT); 3, _____at stage (DAT)

Pest management: Major pests : _____

Control strategies : _____

Soil related problems: Salinity / alkalinity / acidity _____

Any other problems: _____

Observations:
Crop data at harvest:

Yield (3 replication): Gross plot (m^2) _____ Net plot (m^2):_____ **of each farm**

Soil data (pre sowing or post harvesting)

Soil Texture : _____

pH (1:2 ratio; soil/water) : _____

EC (1:2 ratio; soil/water) : _____ (dSm^{-1})

OC (%) : _____ (Walkley and Black method)

Available N (kg/ha) :_____ (Subbiah and Asija method - Alkaline permanganate method)

Available P_2O_5 (kg/ha) : _____ (Olsen's 0.5 N $NaHCO_3$ method)

Available K_2O (kg/ha) :_____ (Hanway–Hiedel: Neutral Normal Ammonium acetate method)

Available Zn: _____ (DTPA method)

<u>Note</u>: Please identify any specific soil related/management related constraints that are limiting the yields and mention in the excel sheet

Trial No.3: Management of sodic soils using nano Zn formulation *(kharif and rabi)*

Objectives: 1) To study the ameliorative role of nano Zn on rice growth and yield under sodic soils
2) To study the effect of nano Zn on plant physiological activities
3) To study the effect of nano Zn formulations on grain nutrient contents and their effective translocation.

Lay out: Fixed plot (undisturbed) layout; Varieties: Rice – varieties will be sent by IIRR (IIRR) and wheat – recommended variety for sodic soils; Design**:** Split plot (for sodic soils)

Design : Split plot design

Main plots: Treatments

1) Control (NPK alone)
2) NPK + $ZnSO_4$ @ 0.5 % foliar spray – 2 times. One at tillering and other at PI stages
3) NPK + Nano Zn (20 ppm) foliar spray – 2 times. One at tillering and other at PI stages
4) NPK + Nano Zn (50 ppm) foliar spray – 2 times. One at tillering and other at PI stages

Subplots : Four Génotypes - Génotypes (4) will be sent by IIRR.

Cropping system: Rice in *kharif* followed by rice in *rabi* season to be grown with standard package of practices and recommended fertilizer dose.

Plot size: At least 25 m^2 (Undisturbed layout); Replications**:** 3 or 4

Spacing: Rice – 20 cm x 10 cm.

Water management: Frequent irrigation to shallow submergence for wetland rice. Drainage facility should be provided for the experimental plots

Experimental details:

- Select experimental field with high pH soil. Bulk soil sample (0-15 cm depth) representing the experimental area should be collected before the imposition of treatments and analysed for pH, OC, EC, ESP, available N, P, K, and Zn.
- Plough the land dry, puddle the soil block wise and layout the plots.
- Apply recommended dose of fertilisers for the location and crop. N through urea in 3 split doses (1/3: 1/3: 1/3). Report the fertilizer dose.

- All Basal application of N, P, K and S should be incorporated into the soil up to 15 cm depth before transplanting rice.
- *Rabi* crop also has to be grown following standard package of practices. Report the nutrient doses applied, yield of grain, straw/shoot weight.
- Spray ZN SO4 and nano Zn as per the recommendation at recommended stages.

Observations:

- Grain and straw yield, yield parameters of *kharif* rice and *rabi* crops. Report grain and straw yields after harvest in kg/ha or tonnes/ha.
- Initial soil analysis for soil pH, OC, texture, CEC, ESP, EC, SAR, available N, P, K, Zn before amendments are applied.
- Analyse plant samples (grain and straw) for N, P, K and Zn drawn from each plot. Report all data replicate wise. Report Zn values separately for grain and straw to calculate translocation of Zn. If Zn analysis is not possible at your centres, send 50 g grain and 20 g powdered straw samples well in advance immediately after harvest to IIRR (in December preferably)
- post harvest soil properties to be reported for ESP and available N, P, K, Zn
- Care should be taken to avoid contamination of grain/straw samples from dust/metals, etc. Before analysing the grain samples, the material should be washed with tap water followed by 2% HCl, tap water, distilled water (in sequence) for few minutes, dried with filter paper immediately and oven dried in containers at 50-60^{o}C to uniform weight.

- **<u>Note:</u> Same set of genotypes should be tested for two/three years and preserve your seed after harvest so that the same seed can be used in the next year.**

- **Plant Physiologist can be associated and observations to be taken by him/her**

Locations (4): Mandya, Ludhiana , Faizabad and IIRR.

Trial No-4: ***Management of acid soils (kharif)***

Objectives: 1) To evaluate the selected germplasm/genotypes for tolerance to soil acidity under different management practices
2) To identify better genotypes with high productivity under soil acidity.

Ecosystems: The experiment can be laid out either in **Rain fed/irrigated conditions** in a soil of pH less than 5.5 (Soil: water 1: 2).

Design : Split plot design

Main plots: Treatments

1) Control (NPK alone)

2) NPK + Silixol spray3 times 1. Vegetative stage – 500 ml per acre

2. 500 ml/acre at booting stage
3. 500 ml/acre at grain filling stage

3) NPK + Rice husk ash 250 kg/ha during land preparation followed by Dolomite 250 kg/ha 30 days after transplanting.

Subplots : Génotypes **;** Génotypes (5) will be sent by IIRR.

Plot size: At least 25 m^2 (Undisturbed layout); Replications**:** 3 or 4 ; Design: Split plot

Spacing: Rice – 20 cm x 10 cm.

Water management: Frequent irrigation to shallow submergence for wetland rice. Drainage facility should be provided for the experimental plots

Observations:

- Grain and straw yield, yield parameters of *kharif* rice and *rabi* crops. Report grain and straw yields after harvest in kg/ha or tonnes/ha.
- Initial soil analysis for soil pH, OC, texture, CEC, EC, available N, P, K, (Zn, Fe if possible) before amendments are applied.
- Analyse plant samples (grain and straw) for N, P, K (Zn, Fe if possible) from each plot. Report all data replicate wise.
- post harvest soil properties to be reported fpr pH, EC, av. NPK (Zn, Fe)
- Care should be taken to avoid contamination of grain/straw samples from dust/metals, etc. Before analysing the grain samples, the material should be washed with tap water followed

by 2% HCl, tap water, distilled water (in sequence) for few minutes, dried with filter paper immediately and oven dried in containers at 50-60^{o}C to uniform weight.

- **<u>Note:</u> Same set of genotypes should be tested for two/three years and preserve your seed after harvest so that the same seed can be used in the next year.**

- **Plant Physiologist can be associated and observations to be taken by him/her**

Locations (3): Dumka (Ranchi), Moncompu and Titabar

Trail 5: ***Residue management in rice based cropping systems (kharif and rabi)***

Recycling of residues, especially rice and wheat straw, by returning them directly to fields, plays a significant role in ecological protection and sustainable agricultural production as it helps to enhance soil quality and increasing crop productivity. Straw incorporation is effective in situ residue management strategy that solves the problem of excess residue while simultaneously improving soil fertility, promoting crop growth and yield, and enhancing soil quality. It also can lead to a reduction in the burning of straw/residues, which is practiced to clear the field for the next crop due to the short turnover period between *kharif* rice and rabi rice/non-rice crops and has become a major source of greenhouse gas emissions and air pollution. Keeping these aspects in view, this trial proposes to study the effect of straw incorporation along with microbial decomposers (Pusa Decomposer) and green manure/green leaf manure on straw decomposition, and crop productivity and soil quality.

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Objective:

1. To study the influence of rice/wheat residue on rice crop productivity, soil health and grain quality in rice based cropping systems

2. To develop efficient residue management practices with a view to avoid adverse environmental effects of residue burning

Treatments:

T1	100% RDF (Recommended Dose Fertilizer)
T2	50% Residue + 50% RDF
T3	50% Residue + 50% RDF + Pusa decomposer
T4	50% Residue + 50% GM/GLM
T5	50% Residue + 50% GM/GLM + Pusa decomposer
T6	Residue @ 2.5 tons per acre + Pusa Decomposer
T7	Residue @ 2.5 tons per acre + No Pusa Decomposer
T8	Absolute control

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**** The organics (residue/Green Manure/Green Leaf Manure) should be analysed for their N content and then quantity of organics to be applied should be decided based on N equivalent basis.**

Note: The experiment should be conducted in the same field every year in an undisturbed field layout

Design : Randomized Block Design

Replications : 3

Plot size : 30 – 50 m^2 plot/treatment
Variety : Local popular variety (Zone specific)

Preparation of Pusa Decomposer (PD) inoculum

1. Take 150 g jaggery/gud and add in 5 litres of water
2. Boil jaggery vigorously and remove all the dirt with sieve
3. Cool the solution in a deep square tray/tub till it is slightly warm
4. Add 50 g of chickpea flour/besan and mix
5. Break four capsules of PD inoculum and mix thoroughly
6. Cover with thin cloth and keep in warm place
7. Growth will start in two days. A mat of different colours will start to grow
8. After 10 days, mix well again and use for inoculation as described below

(If upscaling is necessary for more inoculum production, after full growth another 5 liters of jaggery/gud solution can be added, mixed and allowed to grow for 7 days and then used)

•10L of the liquid PD inoculum has to be diluted into 200 L water and then sprayed on the straw/GM/GLM lying in one acre (approx 2.5 tons). Calculate as per your plot size and amount of straw

Method of treatment of residue with PD inoculum (*kharif* and *rabi*)

- After puddling/ leveling/land preparation and laying out the experiment, spread the required quantity of straw (rice/wheat)/GM/GLM in plots (T2—T7)
- Spray PD inoculum on the straw/GM/GLM as per treatment (T3, T5, T6, T7)
- After spraying immediately incorporate the residues into the field. Ensure sufficient moisture in the field before incorporation during rabi
- Wait for 2-4 days before transplanting seedlings/sowing

Observations to be recorded:

Soil analysis:

- Initial analysis of field soil for **pH, EC, OC, available NPK status, micronutrient status** and important physical properties**,** soil enzymes (**soil dehydrogenase and alkaline phosphatase**) and microbial counts (**bacteria and fungi**)
- Record and report the **NPK** content of **straw, green manure, green leaf manure and the quantity** (kg) of **straw, green manure, green leaf manure applied in plots**
- Soil (all plots) to be sampled 25 days after the spraying of Pusa Decomposer (0-15cm depth soil) and analysed for Organic C, available N and soil enzymes (soil dehydrogenase, alkaline phosphatase) and microbial counts (bacteria and fungi)
- Final analysis of soils after harvest for all important properties

  (**Note**: If facilities are not available, freshly collected samples may be sent to IIRR for analysis. Soil in labeled zip lock covers can be packed along with plastic covered cool/ice packs in a thermocol box and sent to ICAR-IIRR for analysis of microbiological properties).

Plant analysis:

- Grain and straw yields at harvest. Report grain and straw yields after harvest in tonnes/ha.
- Grain and straw analysis for its nutrient content especially N, P, K,
- Grain analysis for quality parameters (in brown rice and polished rice) along with hulling, milling and head rice recovery.

  Note: If quality analysis is not available at the centres, send 200 g of grain samples to IIRR immediately after harvesting.

Locations (10): Karaikal, Maruteru, Pantnagar, Pusa, Hazaribagh, Puducherry, Khudwani, Faizabad, Ludhiana and IIRR.

Trial 6: ***Screening of rice germplasm for nitrogen use efficiency (kharif)***

Nitrogen is the key nutrient element required in large quantities for crop productivity and is subjected to various losses in wetland rice soils. All Indian soils are in general, low in available nitrogen and N consumption is increasing every year leading to air and water pollution. Therefore, reducing N fertiliser consumption and increasing nitrogen use efficiency is the need of the hour. Genotypes differ in their nutrient use efficiency and genotypic variation in nitrogen use efficiency is also reported. Hence, the present study is being proposed with the following objectives.

Objectives:

1. To study the genotypic variation for nitrogen use efficiency across different soils
2. To evaluate rice genotypes for their response at different nitrogen levels.

Treatments: Main (3) – N levels- 0, 50 and 100% RDN; Sub (10) - Varieties

Treatment Number	Treatment details
Main plots	Nitrogen levels
1	Control – N0 (no nitrogen but only P and K)
2	50% Recommended N (with 100% P and K)
3	100% Recommended N (with 100% P and K)
Sub plots	Varieties (10). The varieties harvested in the previous *kharif* season should be used and only hybrid seed will be sent by IIRR

Replications: 3; Design: Split plot; Plot size: 15-20 sq. m.

Methodology: At each location, the field will be divided into 3 nitrogen blocks (N0, N50 and N100% of RDN) and the varieties will be transplanted in main blocks randomly without bunding by leaving a small gap between the varieties.

Observations to be recorded:

Soil analysis:

- Initial soil analysis for all Soil Characteristics like pH, EC, OC, available NPK status.
- Final analysis of soils after harvest for available N only in 3 blocks from 5 places in each block

Plant parameters and plant analysis:

- Recording of visual symptoms of N deficiency if any, during crop growth.
- Tiller number and panicle number/m^2 at harvest
- Panicle length/weight
- Grain number/panicle
- 100 grain weight
- Grain and straw yield in kg/ha or tonnes/ha
- N% and uptake in grain and straw.

Important decisions in the group meeting:

- ✓ Agronomic, physiological and soil-related traits that impart high NUE to be studied
- ✓ Various use efficiency indices to be calculated

Locations (7): Karaikal, Maruteru, Titabar, Pantnagar, Pusa, Faizabad, Purulia

Trial 7: ***Yield maximization of rice in different Zones (New trial)***
(collaborative trial – Agronomy, Soil Science)

Rice (Oryza sativa L.) is grown in India over a gross area of 44 million hectares (ha). The total production in 2019 was about 107 million tonnes. However, India would need to produce at least 200 million tonnes of paddy to meet its ever-growing population requirements, and this figure would have to increase by almost 75 percent by 2020. Rice occupies a pivotal position concerning food security in India. The future of food security in this region will depend on its ability to improve rice productivity continuously on an ecologically sustainable basis.

One of the main reasons for low rice productivity in India is the variation in fertilizer usage between the country's different agroclimatic zones and between states in each region. Low input use in general is a further factor accounting for the plateau or declining trend of grain yields.

Objectives:

1. To maximize the yield in different zones
2. To compare yield and economics of the best management practices **Locations: (Agronomy and Soil Science)**

Agronomy		**Soil Science**	
CHIPLIMA,	**CHINSURAH**	**Karaikal**	**Raipur**
MARUTERU (K+R)	**RAIPUR**	**Mandya**	
FAIZABAD	**GANGAVATHI**	**Maruteru**	
MONCOMPU (K+R)	**PATTAMBI (K+R)**	**Moncompu**	
TITABAR	**PANTHNAGAR**	**Titabar**	
IIRR,	**KARJAT,**	**Chinsurah**	
KARAIKAL (R)	**CHINSURAH**	**Puducherry**	
GHAGHRAGHAT	**MANDYA**	**Purulia**	
PUDUCHERRY	**RANCHI**	**Khudwani**	
RAIPUR	**KUDWANI**	**Kaul**	

Agronomy and Soil science collaborators are requested to conduct in collaborative mode and supply data together as decided in the workshop meeting

Design **:** Randomized Block Design
Replications **:** 4
Season : *Kharif and rabi*
Variety (Rice) **:** High yielding variety
Seed rate : 20-25 kg/ha (20 x15 cm)

Treatments:

T1: Fertilizer as per the site specific nutrient managemet (RDF)
T2: T1 +FYM@10t/ha
T3: 125 % of T1
T4:150% of T1
T5: T1+ Sampoorna (KAU) @ 10 g /L (250 L/ha) micronutrient spray (55-60 DAT)
T6: T1 + Eco Agra spray 3 times @ 1lt in 300 lt of water (25,40 and 55 DAP)
T7: Farmers application dose
T8: Optional – Location specific and mention the doses while sending data
In rabi: Rice or any other rotation crops with same nutrient combinations

Maintain the plot and take big plot size (50 m^2 per treatment)

Note :The state-wise fertility maps are available and all the fertiliser recommendations in the AICRP trials should be based on the fertility level suggested by these maps in different states. This is for strict compliance and provides RFD as per the recommendation

***Avoid manual labour involvement as much as possible to minimize cost of cultivation**
***The goal of this trial should be reducing the cost of cultivation as much possible along with maximization of yield o rice**

Observations:

1. Total tillers/m^2
2. Total panicles/m^2
3. Filled grains/panicle
4. Unfilled grains/panicle
5. 1000 grain weight
6. Pests and disease infestation
7. Grain yield/20 m^2 (mention yield in kg/ha or tons/ha)
8. Straw yield/20 m^2 (mention yield in kg/ha or tons/ha)
9. Initial and Final Soil nutrient status
10. Plant uptake NPK at Harvest (Straw + Grain) if soil scientist is associated

Note:

- *Wherever facilities are available and involve soil scientists for analysis of soil and plant samples and send the analysed the data for report preparation*
- *Contact PI of Agronomy for LCC charts (R.Mahender Kumar, PI Agronomy kumarrm21364@gmail.com – 94404 76493)if needed*
- *Contact Dr. K.Surekha regarding chemical analysis (surekhakuchi@gmail.com–Mobile-9440963382)*

Trial 8: ***Enhancing productivity of Organic Rice cultivation (New trial) –***
permanent trial for 5 years and in permanent plot and system-based approach Zones
(collaborative trial – Agronomy, Soil Science and Crop protection)

Organic farming is rapidly gaining recognition worldwide as a promising means to offer healthier food and to ensure environmental sustainability. Currently, organic produce including organic rice is in huge demand owing to its potential to fetch premium prices in the global market. Even though rice performs well under organic production system, a set of constraints including nitrogen stress at critical growth stages, unavailability of rapidly mineralizable organic amendments, lack of appropriate varieties and intense crop–weed competition pose major challenges to realize the potential yield. Use of diverse organic nutrient sources including the split application of fast mineralizable nutrient-rich manures (vermicompost, poultry manure), green manures and bio-fertilizers can supply optimum nutrients in organic rice system. In parallel, development and deployment of rice varieties having a response to organic nutrient inputs, resistance to diseases/insects and the ability to compete with weeds can help minimize the risk of crop failure.

Further, higher emission of greenhouse gases (GHGs) in the organic rice field deserves greater attention because of environmental sustainability. Strategic water management and selection of appropriate organic amendments could help address this issue. However, a substantial research gap still exists demanding a deeper understanding of the organic rice system to register higher yield gains. There is an urgency for the alignment of modern agricultural techniques with organic rice production to improve both the system productivity and the product quality along with effectively avoiding the risks associated with indiscriminate use of chemicals in agriculture.

Objectives:

1. To maximize the yield in organic rice through management practices
2. To compare yield and economics of the different organic management practices
3. To assess the soil health, Pest dynamics and seed quality parameters in organic rice

Locations:

Agronomy		Soil Science	
CHIPLIMA	**CHINSURAH**	**Mandya**	
KARAIKAL	**KARJAT(K+R)**	**Moncompu**	
TITABAR	**GANGAVATI**	**Khudwani**	
FAIZABAD	**GHAGHRAGHAT**	**Karaikal**	
KHUDWANI	**MONCOMPU (K+R)**	**Chinsurah (k+r)**	
PATTAMBI (K+R)	**PUDUCHERRY (K+R)**	**Kaul**	
PARBHANI	**RAIPUR**	**Raipur**	
PUSA			

Note: Agronomy and Soil science collaborators are requested to conduct in collaborative mode and supply data together as decided in the workshop meeting

Design	:	Randomized Block Design
Replications	:	5
Season	:	*Kharif and rabi*
Variety (Rice)	:	High yielding variety
Seed rate	:	20-25 kg/ha (20 x15 cm)

Treatments:

T1- Absolute Control (No: NPK)
T2 - 100% RDN
T3: 100 % N (FYM)
T4: 150 % N (FYM)
T5: 50 % N (FYM)+ 50 % N (Green manure/ green Leaf Manure)
T6: 50 % N (FYM)+ 50 % N (Vermicompost)
T7: 50 % N (FYM)+ 50 % N (Neem / Castor/ any cake)

Optional Treatments

T8: Optional 1- 75% RDN 50% each through FYM + Vermicompost ; FYM as basal and VC 20 days after transplanting + Panchgavya + Jeevamrit + Ghanjeevamrit.
T9: Optional 2 – Best State Organic practice (mention the treatment)

Note:

- Vermi compost to be used as top dressing
- Rice-legume based system should be practiced at all locations on permanent basis

Note: The state-wise fertility maps are available and all the fertiliser recommendations in the AICRP trials should be based on the fertility level suggested by these maps in different states. This is for strict compliance and provides RFD as per the recommendation

- Maintain permanent plot for 5 years
- Minimum plot size per treatment is 100 m^2 with thorough bunding
- Rice – rice or any rice based system can be tested with similar treatments for rabi crop

Observations:

1. Total tillers/m^2
2. Total panicles/m^2
3. Filled grains/panicle
4. Unfilled grains/panicle
5. 1000 grain weight

6. Pests and disease infestation
7. Lodging resistance
8. Grain yield/20 m^2
9. Straw yield/20 m^2
10. Quality parameters of the seed
11. Initial and Final Soil nutrient status
12. Pests and Disease infeatation (Colloboration with Entomoly and Pathologists)
13. Plant uptake NPK at Harvest (Straw + Grain) by associating soil scientist of the center

Note:

- *Wherever facilities are available and involve soil scientists for analysis of soil and plant samples and send the analysed the data for report preparation*
- *Contact PI of Agronomy for LCC charts (R. Mahender Kumar, PI Agronomy kumarrm21364@gmail.com – 94404 76493)if needed*
- *Contact Dr. K.Surekha regarding chemical analysis (surekhakuchi@gmail.com–Mobile-9440963382)*
- *Dr. Ch. Padmavathi: chintalapatipadmavathi68@gmail.com*
- *Dr. M.S.Prasad : data.msprasad@gmail.com*
- *For Quality analysis Please send 500 g of harvested seed (14% moisture) to Dr. Aravind Kumar I/C Quality lab by 15th January 2022.*
  Dr. Aravind Kumar
  Principal Scientist and I/C Quality lab
  IIRR , Rajnedra nagar
  aravindjukanti@gmail.com

- ***Material should reach by January 15th of 2022 for analysis***

List of cooperating centres of Soil Science and allotment of trials: 2021-22

Sl. No	Locations	Trial 1		Trial 2		Trial 3		Trial 4	Trial 5		Trial 6		Trial 7		Trial 8		Intended
		K	R	K	R	K	R	K	K	R	K	R	K	R	K	R	
1	Kanpur (F)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Karaikal (F)				X				X	X	X		X		X		06
3	Kaul (F)			X									X		X		03
4	Mandya (F)	X	X			X							X		X		05
5	Maruteru (F)	X	X						X	X	X	X	X	X			08
6	Moncompu (F)			X				X					X		X		04
7	Pantnagar (F)			X					X	X	X	X					05
8	Pusa (F)			X					X		X						03
9	Titabar (F)	X	X	X				X			X		X				06
10	Ludhiana (F)			X		X			X								03
11	Chinsurah (V)												X	X	X	X	04
12	Dumka (V)							X									01
13	Faizabad (V)			X		X			X		X						04
14	Hazaribagh (V)								X	X							02
15	Khudwani (V)								X				X		X		03
16	Puducherry (V)								X				X				02
17	Raipur (V)			X									X		X		03
18	Purulia (V)										X		X				02
19	IIRR					X			X								02
Total trials allotted		**03**	**03**	**08**	**01**	**04**	**-**	**03**	**10**	**04**	**07**	**02**	**11**	**02**	**07**	**01**	**66**

K – Kharif; R- Rabi; X - indented by Soil Scientists

Trial No.1: **Long-term soil fertility management in rice based cropping systems (RBCS) (**Mandya, Maruteru, Titabar)
Trial No.2: **Soil quality and productivity assessment for bridging the yield gaps in farmers' fields** (Moncompu, Pantnagar, Pusa, Titabar, Ludhiana, Faizabad, Karaikal, Kaul, Raipur)
Trial No.3: **Management of sodic soils using nano Zn formulation** (Mandya, Ludhiana, Faizabad and IIRR)
Trial No.4: **Management of acid soils** (Moncompu, Titabar, Dumka)
Trial No.5: **Residue management in rice based cropping systems** (Karaikal, Maruteru, Pantnagar, Pusa, Ludhiana Hazaribagh, Puducherry, Khudwani,Faizabad,IIRR)
Trial No.6: **Screening of rice germplasm for Nitrogen Use Efficiency (NUE)** (Karaikal, Maruteru, Pantnagar, Pusa, Titabar, Faizabad, purulia)
Trial No.7: **Yield maximization of rice in different Zones** (Karaikal, Mandya, Maruteru, Moncompu, Titabar, Chinsurah, Puducherry, Khudwani, purulia,Kaul,Raipur)
Trial No.8: **Enhancing productivity of Organic Rice cultivation** (Mandya, Karaikal, Moncompu, Chinsurah, Khudwani, Kaul, Raipur)

List of Soil Science Cooperators – 2021-22

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