55th
ALL INDIA
CO-ORDINATED PROGRAMME

AGRONOMY, SOIL SCIENCE & PLANT PHYSIOLOGY

TECHNICAL PROGRAMME (2019-20)

ICAR – INDIAN INSTITUTE OF RICE RESEARCH

RAJENDRANAGAR, HYDERABAD - 500030

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Note:

- ***All the weed parameters must be collected in trials in CMTs* at tillering and panicle initiation stages of the *crop.***
- ***Economics must be calculated and reported in all trials.***
- ***Water quantification is necessary for trial water management IN RICE .***
- ***Record pest and disease information in crop establishment, water management and cropping systems trials TO BE SUBMITTED IN COLLOBOTATION WITH ENTOMOLOGY AND PATHOLOGY .***

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INTRODUCTION

The Indian Institute of Rice Research – IIRR (formerly Directorate of Rice Research – DRR), through All India Coordinated Rice Improvement Project (AICRIP) coordinates multi-disciplinary and multi-location evaluation of improved cultures, crop management & protection technologies and their popularization through FLDs (Front Line Demonstrations) across diverse ecosystems for the past 54 years. As the nodal agency, IIRR has been facilitating joint planning and exchange of experimental material, conducting and monitoring of field trials, data compilation, analysis, preparation of reports and giving recommendations suitable to different states for enhancing rice productivity. Over 500 scientists from 45 funded centers along with about 60 voluntary centers representing various State Agricultural Universities, State Departments of Agriculture and ICAR Institutions and private organisations participate in this mega effort of co-ordinated rice research programme across the country. The 54th AICRIP meeting was held at NRRI, Cuttack during 30th may to 2nd June 2019.

The 55th Technical Programme of AICRIP combined both Agronomy and Soil science experiments to be conducted by Agronomists (55 Scientists of 37 funded and 18 voluntary) as well as Soil Scientists to study management practices for released varieties, cultural management practices to enhance the productivity of rice crop, weed management and resource conservation and climatic variations for developing efficient crop and resource management technologies that maximize the productivity and ensure higher profitability on sustainable basis. About 300 trials are proposed at 60 locations under various ecologies. The main studies are related to response of AVT-2 to graded levels of RFD application, cultural management practices for crop establishment, selective mechanization (with Engineering) and integrated weed management in different system, integrated pest & disease management (with Entomology & pathology), site specific nutrient management in collaboration with Soil Science (Nutrient Expert for rice – IPNI), studies on long term soil fertility management , amelioration of problem soils, identifying higher nutrient efficient cultivars and impact of conservation agriculture, climate resilient management practices in different rice based cropping systems (RBCS). All these trials were proposed to be conducted in collaborative mode for efficient resource utilization and for generating practicable recommendations which will go a long way in sustaining the rice productivity and enhancing the profitability of rice and RBCS.

AGRONOMY

I. NUTRIENT MANAGEMENT TRIALS – AVT-2 (Collaborative trials with Plant Breeding)

Trial No. : 1 (NMT 1(a) to 1(m))

Name of the trial	**:**	**Nutrient response trials on selected AVT-2 rice cultures under high and low input management**
Introduction	**:**	**There is need to evaluate the Advanced Variety Trial material (AVT-2)**
Objectives		❖ To study the grain yield potential, nutrient response and nutrient use efficiency of promising AVT-2 cultures under high and low input management in rice. ❖ To identify promising, efficient and stable genotypes based on the Grain Yield Efficiency Index (GYEI) and yield reduction in reduced Nutrient application ❖ To support breeders with agronomy data for release of varieties in CVRC

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AVT-2 Culture	*Days to 50% flowering*	Checks	Locations
(a) AVT 2-E(H)			
IET 26565	100	Shalimar Rice 3, Vivekdhan 86/VL Dhan 86 and Local Check	Almora, Khudwani, Malan, Upper Shillong
(b) AVT 2-MH (Irrigated)			
IET 26579 IET 26594 IET 25838	105	RC Maniphace 1(NE), Vivekdhan 62, V L Dhan 65(N) and LC	Almora, Khudwani, Malan, Umiam, Upper Shillong, Wangbal
(c) AVT 2-E(TP)			
IET 26767 IET 26803 IET 26477 IET 24914 IET 25713	80	NC- Sahbhagidhan, Vandana; ZC-Govind (NW), Narendra 97 (E), Varalu and CR Dhan 201 (W&S); and LC	Faizabad, Ghaghraghat, Hazaribagh, Jagdalpur, Mandya, Maruteru, Nagina, Puducherry, Ranchi, Rewa, Sabour, Vadgoan Varanasi
d)AVT 2 – IME			
IET 24950 IET 25745		NC- IR 64; ZC- PR 113 (N), Lalat (E & NE), Karjat 7 (W), MTU 1010 (C & S);	Aduthurai, Chinsurah, Dhangain, Faizabad, Gangavathi,

		HC- US 312; and LC	Karjat, Kota, Nagina, Navasari, Pattambi, Puducherry, Kanpur, Mandya, Nawagam, Varanasi
e) AVT 2 – IM			
IET 27263 IET 26418 IET 26420	100	NC- NDR 359; ZC- Pant Dhan-19 (N), NDR 8002 (E&C), Jaya (NE & S), Akshayadhan (W); HC- HRI 174;and LC	Chinsurah, Coimbatore, Dhangain, Faizabad,Jagdalpur , Karjat, Kaul, Kota, Maruteru, Nagina, Pantnagar, Titabar,
(f) AVT 2-L			
IET 26927 IET 26974 IET 25948 IET 26948	110	NDR 8002, Salivahana, Samba Masuri, Swarna, Ranjeet, Pushyamiand Local check	Aduthurai, Chinsurah, Dhangain, Karjat, Mandya, Maruteru,Pusa, Nagina
(g) AVT 2-MS			
IET 26549 IET 27136 IET 25802 IET 25798 IET 24990	100	DRRH 3/ KRH 4, WGL 14	Andman (CIARI), Chakdah, Dhangain Karjat, Kaul, Maruteru, Mandya, Nagina, Raipur

(h) AVT 2-Boro			
IET 26463 IET 26451	100	Gowtham, IR 64	Chinsurah(R), Gerua, Titabar
(i) AVT 2-AL&ISTVT			
IET 27077	100	CSR-10, CSR-23, CSR-36, Jaya and Local Check	ARI- Rajendranagar, Kanpur, Navsari, Lucknow
(j) AVT 2-RSL			
IET 26692	125	Dhanrasi, Pooja, Savithri and Local Check	Chinsurah, Dhangain, Faizabad, Ghaghraghat, Pusa,
(k) AVT 1-BT			
IET 26995 IET 26999	100		Chata, Dhangain, Faizabad, Kaul, Kanpur, Ludhiana, Nagina, Navsari, Pantnagar Raipur, Rewa

(l) AVT 2-Biofortified			
IET 27179		BPT 5204, Chittimuthyalu, IR 64 and Kalanamak	Andaman & Nicobar, Chinsurah, Coimbattore, Cuttack, Hyderabad (IIRR), Kaul, Mandya, Nagina, Nawagam, Pantnagar, Rajendranagar (ARI), Raipur, Rewa, Varanasi
(m) AVT 2-NIL			
i. Bl, BLB: IET 27285 IET 27294 IET 27280 IET 27286 IET 28014		BPT 5204, Swarna, RP Bio 226	Hyderabad (IIRR), Jagdalpur, Nellore, Pantnagar, Nagina
ii) Herbicide resistant Mutants *(Trial constitution in page) : 10			
G1 - 4901 G2 - 4902 G3 - 4903 G4 - 4904 G5 - 4905 G6 - 4906			Kaul Ludhiana Nagina Pantnagar IARI – Delhi IIRR - Hyderabad
(iii) Nitrogen use efficiency *(Trial constitution in page) : 14			
4401 to 4425			ICAR- IIRR, ICAR-NRRI, Ludhiana, Maruteru, Ranchi,Umiam

(iv) Phosphorus use efficiency *(Trial constitution in page) : 17			
4301 to 4336			ICAR- IIRR, ICAR-NRRI, Ludhiana, Maruteru, Ranchi, Umiam

*** NC- National Check, ZC- Zonal Check, E-Eastern, W- Western, N-Northern, S-Southern, NE- North Eastern, HC- Hybrid Check, LC-Local Check**

Note:

- ***Please include most recently released variety as local check***
- ***Keep the seeds of standard checks for next season.***

Observations:

1. Number of panicles/m^2 at harvest
2. Panicle weight (g)
3. Days to 50% flowering (compulsory)
4. Duration (Seed to Seed) (in days)
5. Grain yield (kg/ha)
6. Water quantification* (for AEROBIC TRIALS)
7. Incidence of disease and pests, if any
8. Soil nutrient status (available NPK)

(a) General instructions for transplanted

Layout **:** Split Plot Design
Replications **:** 3
Plot Size **:** 15 m^2
Spacing **:** 20 cm x 10 cm (Location specific spacing)
Treatments :
Season **:** *Kharif*

Main plots **:** Nutrient for short duration cultivars (1(a), 1(b), 1(c) and 1(d))
Nutrient 1 - 50% NPK/ha of recommended dose
Nutrient 2 - 100% NPK /ha of recommended dose.

For all other trials:
Nutrient 1 - 100% NPK/ha of recommended dose
Nutrient 2 - 150% NPK /ha of recommended dose

Sub-plots **:** Cultures/Varieties

Use urea as a source of nitrogen, apply N in 3 splits (50% at basal + 25% at tillering + 25% at Panicle initiation) and **indicate Nutrient rate applied (kg/ha)** under Nutrient -1and Nutrient 2 treatments for computing Nutrient response.
N Should be applied in three splits, K in two splits and P as basal
Use one Neam coated Urea
Mention the dose of Nutrients applied for each treatment

(b) General instructions for aerobic rice (AVT-2 E/ME direct seeded):

Layout **:** Split Plot Design
Replications **:** 3
Plot Size **:** 15 m^2
Spacing **:** Dibble 1 or 2 seeds / hill at spacing of 20 x 10 cm

- Apply Pendimethalin herbicide @ 1 kg a.i. /ha at near saturated condition within 3– 4 days of sowing.
- Inter-cultivation at regular intervals is recommended to control weeds
- Maintain aerobic condition and provide need based frequent irrigation so that plants will not experience moisture stress at critical stages of crop growth
- Rainfall data and quantity of irrigation water and Number of irrigations given during crop growth need to be recorded

P, K & Zn levels :

Apply P, K and Zn on soil test basis through Single Super Phosphate, Muriate of Potash and Zinc Sulphate. Indicate the levels of P, K and Zn applied.

Water Management: Recommended practices of irrigation **(Transplanted/direct seeded rice/ Aerobic rice)** and follow other operations as per package of practices uniformly.

- **Conduct the trials with same of cultivars mentioned in the Technical program**
- **Please retain the seed of check varieties for next season sowing**
- **Furnish the duration of cultures (seed to seed) under different fertilizer levels.**
- Indicate recommended dose of fertilizer (RDF)
- Supply the data of cultivars as per the sequence given in the technical programme.
- Mention the reasons for very high or low yields of the trials
- Mention the incidence of pests and diseases in different levels of N

c). General instructions for evaluation of AVT 2-Biofortified lines :

General instructions:

Sow the seedbed as thin as possible

Transplant 25-day old seedlings

Transplant seedlings very shallow

Gap fill within a week of planting

Incorporate fertilizer uniformly , equal quantity and evenly

Soil samples before planting and after harvesting to be collected and sent to IIRR for analysis for estimating Fe & Zn content

Data to be collected: Grain yield kg/plot based on net plot size to be reported
Panicles per sq.m (no)
Days to 50% flowering (no)
Plant height (cm)
Spikelets per panicle (no)
Grain quality characteristics to be provided wherever facilities exist.
50gms of grains per entry in 3 replications after harvesting to be sent to IIRR for Fe & Zn analysis

Imposition of Drought

- Trial should be conducted in transplanted condition for yield evaluation
- Drought can be imposed (or stop irrigation) for a period of 25-30 days starting from 50 DAT
- Fertilizer application: all fertilizer doses should be applied before imposing drought. 30% N, full P&K at basal; 40% N at 25 DAT; 30% N at 40 DAT
- Mention if there is any rainfall and quantity of rain during the period

Note: The state wise fertility maps are available and all the fertilizer 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 RFD need to as per the recommendation.

**AVT 2- NIL (BL & BLB) 1.m (i)

- Trial should be conducted in transplanted condition for yield evaluation
- Report any infestation of blast in IET entries in comparison to BPT 5204 (Check)

General instructions:	Sow the seedbed as thin as possible Transplant 25-day old seedlings Transplant seedlings very shallow Gap fill within a week of planting Incorporate fertilizer uniformly , equal quantity and evenly Soil samples before planting and after harvesting to be collected and sent to IIRR for analysis for estimating Fe & Zn content
Data to be collected:	Grain yield kg/plot based on net plot size to be reported Panicles per sq.m (no) Days to 50% flowering (no) Plant height (cm) Spikelets per panicle (no) Grain quality characteristics to be provided wherever facilities exist. 50gms of grains per entry in 3 replications after harvesting to be sent to IIRR for Fe & Zn analysis

Trial No : I m(ii)
Trial Code : AVT- Nils (HT cultivars)
Name of the trial : Evaluation of Imazethapyr herbicide tolerant Aromatic genotypes under dry direct seeded condition

Introduction	**:**	Rice crop suffers more from weed competition unlike other cereal crops. Efficient cultivars will reduce the weed competition and enhance the productivity with reduced input. So, present investigation to study the herbicide tolerance in elite Genotypes for their efficiency in Basmati growing areas of the country
Objective	**:**	1. To identify the promising herbicide resistant cultivars for enhancing the productivity 2. To assess the weed control efficiency and herbicide tolerance of the cultivars

Locations: 6

Kaul,	Ludhiana	Pantnagar
Nagina	IARI Delhi	IIRR-Hyderabad

- ***Materials will be supplied by IARI to above centers . Please intimate after receiving the material***

Kharif – 2019

Experimental Design: Split plot design, **Replications**: 3

Main plot treatments:

T1 – Imazethapyr

T2 – Pendimethalin fb bispyribacsodium

T3 – Weed free check

Sub plot treatments:

G1 - G2 - G3 - G4 - G5 - G6

Lay out of the Experiment :

	T1	T2	T3
Replication 1	G1	G5	G3
	G5	G2	G4
	G2	G6	G1
	G4	G4	G6
	G3	G3	G2
	G6	G1	G5
Replication 2	G4	G1	G5
	G5	G5	G2
	G6	G4	G6
	G2	G2	G1
	G3	G6	G4
	G1	G3	G3
Replication 3	G3	G5	G3
	G2	G4	G6
	G4	G1	G2
	G5	G3	G4
	G1	G6	G5
	G6	G2	G1

*Package of practices to be followed as per their state recommendation.

A) Imazethapyr 10% SL (Foliar Spray)
Concentration: 0.25%

- Imazethapyr – 2.5 ml/L

- Cyboost (Ammonium sulphate) -2g/L
- Cyspread (Agriculture spreader, activator)- 1.5ml/L
    - Note: All three (1+2+3) are to be mixed and sprayed.
- Time of application: Post Emergence,15-20 days after sowing, weeds should be at 2-3 leaf stage at the time of spray.
- Moisture should be sufficient earlier and no irrigation upto 48 hrs.
- No. of Sprays: 1.

B) Bispyribac Sodium- 10% SC –Foliar Spray

- Concentration: 80-120 ml per acre.
- Time of application: Post Emergence, 15-25days after sowing, 2-5 leaf stages of weeds. Moisture should be sufficient earlier and no irrigation upto 48 hrs. Maximum 2 times spray can be done.
- No of sprays:1

C) Pendimethalin Herbicide-30%EC

- Conc. -1kg a i /ha (440g/L).
- Time of application – Pre emergence + Early Post Emergence, 4 weeks prior to sowing. Good soil moisture is essential for the activation of pre-emergence herbicides. Pendimethalin should be applied after rice seed has imbibed germination water, that is, 2–3 days after sowing to avoid crop injury.
- No. of sprays:1

Note :

- Avoid spray if rain is expected within 6 hrs.
- Seeds of all the entries need to be sent back to ICAR-IARI, New Delhi for further detailed analysis

OBSERVATIONS TO BE RECORDED:

- Crop phyto-toxicity in 1-10 scale
- Phyto toxicity shall be recorded at 7, 14, 21, 28 and 35 days after herbicide application. Observations for the specific parameters like chlorosis, necrosis, wilting, scorching, hyponasty and epinasty should be noted by suing following scale.
    - Phyto toxicity Rating Scale (PRS)

CROP RESPONCE/CROP INJURY	Rating
0	0
1-10 %	1
11-20 %	2
21-30 %	3
31-40 %	4
41-50 %	5
51-60 %	6
61-70 %	7
71-80 %	8
81-90 %	9
91-100 %	10

1. Weed population/m2 group-wise and species-wise for 1 Day Before Herbicide Application, 15 Days After Herbicide Application (DAHA), 30DAHA, 45 DAHA & 60 DAHA
2. Weed biomass/m2 group-wise and species-wise for 1 Day Before Herbicide Application, 15 DAHA, 30DAHA, 45 DAHA & 60 DAHA
3. Plant height (cm) at max. vegetative stage and panicle initiation stage
4. No. of tillers/m2 at max. vegetative stage and panicle initiation stage
5. At harvest stage – No. of panicles/m2, panicle weight, test weight, filled grain %, Grain yield, Straw yield.

Trial No : I m(iii)
Trial Code : AVT- 2 (Nutrient efficient cultivars- Nitrogen)

Trial Name: a) Evaluation of identified cultures and cultivars for enhancing Nitrogen use efficiency in irrigated rice

Introduction:

The productivity of rice is very low due to imbalanced and excessive use of nitrogen fertilizers by the farmers. It has been reported that the apparent recovery efficiency of applied nitrogen is approximately about 30-33%. The remaining amount of N is either lost through surface runoff, leaching, volatilization or denitrification and further adds to increased cost of production and environmental degradation. The use of efficient and economical rates of nitrogen fertilizer is important for enhancing crop productivity and maintaining environmental sustainability. To achieve this, it is imperative to identify high nitrogen utilizing cultivars which can minimize the losses. Large numbers of rice cultivars have been released in India so far, but the question is that whether these cultivars are capable to utilizing the nitrogen efficiently. Inter varietal differences for nitrogen use efficiency has been reported by many researchers. Therefore, there is a need to identify the cultivars which can efficiently utilize the nitrogen and to develop a sustainable nitrogen rate recommendation for these cultivars which can further give enhanced yield and resource use efficiency.

Objectives :

To study the comparative performance of elite lines and cultivars under different levels of nitrogen

Locations:6

ICAR- IIRR Ludhiana	ICAR-NRRI Ranchi	Barapani,

Design: Split Plot Design
Replications :3

Treatments: Main = 2 N doses

N_1- No nitrogen (Control)

N_2-50 %of recommended N dose (P and K is constant)

N_3- 100 % of recommended dose of N (P and K constant)

Sub plots: Entries: 19+ Checks(6); Total: 25

Entries: 4401 to 4425

Plot size: 10 m^2

Replications: 3

***Fixed plot need to be maintained for this trial which is deficient in Nitrogen. Soil nitrogen estimation is essential before start of the experiment**

Observations :

- Soil nitrogen content before transplanting, and at harvesting
- Days to 50% flowering
- Plant height (cm)
- Total Tiller Number per plant or /m^2
- Productive tiller per plant (No.) or /m^2
- Panicle length (cm)
- No. of filled grains per panicle
- Spikelet Sterility percentage
- Grain yield per plot or t/ha
- Straw yield per 5 plant, grain yield per square meter and grain yield per plot
- % nitrogen in grain and straw
- Nitrogen uptake kg/ha

- Notes on pests, diseases and lodging
- Rainfall during the crop growth (Number of rainy days)

Maximum and minimum temperature.

General Instructions:

- Genotypes should be evaluated at Two levels of nitrogen 50kg/ha and 100 kg/ha
- Sow the seed in bed as thin as possible in nursery
- Transplant 25-day old seedlings, one seedling / hill.
- Gap fill within a week of planting
- Incorporate fertilizer evenly as per the trial

50% of nitrogen at transplanting as basal dose and remaining 50% in two top dressing

- Spacing : 20 x 15 cm

Trial No : I m(iv)
Trial Code : AVT- 2 (Nutrient efficient cultivars- Phosphorus)

Trial Name : a) Evaluation of identified cultures and cultivars for enhancing Phosphorus use efficiency in irrigated rice

Introduction:

Rice is a major cereal crop of India. Phosphorus is an important nutrient for rice production but the use efficiency of this nutrient is very low (20-30%) and phosphorus deficiency has been identified as one of the major constraint limiting crop production. Enhancing phosphorus use efficiency in rice would offer an affordable option for improving yields and economic returns with reduced inputs. Further, research studies have revealed that genotypic differences for PUE exist. There is a need to identify the cultivars which are adapted to low P situations and have higher P use efficiency.

Objectives :

- To study the comparative performance of elite lines and cultivars in different levels of Phosphorus
- To identify the elite lines for tolerance to low P soil conditions

Locations : 6

ICAR- IIRR Ludhiana	ICAR-NRRI Ranchi	Dhangaian Maruteru

Design : Split Plot Design

Treatments: Main = 2 P doses

P_1- No Phosphorus (Control) (N and K Constant)

P_2- 50 %of recommended P dose – 30 kg /ha (N and K is constant)

P_3- 100 % of recommended dose of P- 60 kg/ ha (N and K constant)

Sub plots : Entries : 32+ Checks(4) ; Total : 36

Entries : 4301 to 4336

Replications: 3

Plot size: 10 m^2

Note:

- Maintain fixed plot for conducting the trial.
- Initial analysis of soil in each level is must.

Observations:

- Soil phosphorus content should be estimated before transplanting, 45 DAT and at harvesting stage (3 times minimum)
- Days to 50% flowering
- Plant height (cm)
- Productive tiller Number per plant (No.) or m^2
- Panicle length (cm)
- No. of filled grains per panicle
- Spikelet Sterility percentage
- Grain yield per plot (kg) or kg/ha
- Phosphorus content in grain in each plot after harvest
- Notes on pests, diseases and lodging
- Rainfall during the crop growth (Number of rainy days)
- Maximum and minimum temperature.
- General instructions :
- Genotypes should be evaluated at 50% Phosphorus (30kg/ha), and 100% Phosphorus (60kg/ha)
- Sow the seed in bed as thin as possible like regular trial
- Transplant 25-day old seedlings, one seedling / hill.
- Gap fill within a week of planting
- Incorporate fertilizer evenly of recommended dose
- 50% of nitrogen at transplanting as basal dose and remaining 50% in two top dressings
- Spacing : 20 x 15 cm

II.CULTURAL MANAGEMENT TRIALS

Trial No. : 2
Trial Code : CMT-1
CMT-1 : Development of package of practices for Mechanized Transplanting

Introduction : Mechanical transplanting of rice is the process of transplanting young rice seedlings, which have been grown in a mat nursery, using a paddy transplanter. In conventional manual transplanting practice, 8-12 laborers are required to transplant one acre. The process is also very time consuming and difficult. However, if self-propelled paddy transplanters are used, three people can transplant up to three to four acres in one day. This has great advantages in areas where farm labor is scarce and expensive.

Hence the present trial is constituted to enhance the productivity of the mechanized transplanted rice.

Objectives: **i)** To enhance the productivity of mechanized transplanted rice
ii) To identify the suitable agronomic management practices to enhance the efficiency of mechanized transplanting

Locations :

Adhuturai	**Gangavathi**	**NRRI, Cuttack**
ARI, RajendraNagar	**IIRR, Hyderabad**	**Chplima (R)**
Puduchery	**Ranchi**	**ARS -Warangal**
Maruteru		

Any center, if interested can also take up the trial with intimation to PI

Design : Split plot design, Replications: 3
Treatments – Main

1. Normal Planting time Mechanical Transplanting (15 days seedlings and recommended spacing)
2. Normal Planting time Mechanical Transplanting (21 days seedling and recommended spacing)
3. Delayed Planting time (15 days late) Mechanical Transplanting (15 days seedlings and recommended spacing)
4. Manual transplanting – Normal time (25 days old seedlings)
5. Manual transplanting – Delayed sowing time (25 days old seedlings)

Sub: Varieties:
2-3 varieties of local choice and latest released cultivars

Fertilisers : As per the location specific based on the Soil test based

Data to be collected:

- No of hills per m^2 (15 days after planting)
- Plant height (cm)
- Dry matter /m^2 30 days interval
- Flag leaf length and width (cm)
- Tiller Number/m^2
- Productive tiller number/m^2
- Panicles per sq m (No.)
- Days to 50% flowering (No.)
- Flag leaf orientation (Leaf angle)
- Grain Number/Panicle
- Panicle weight (g)/m^2
- Sterility percentage
- Test Weight (g)
- Biomass (g)/m^2
- Notes on pests, diseases and lodging
- Grain yield (kg/plot or t/ha) based on net plot size to be reported
- Rainfall during the crop growth (Number of rainy days)
- Maximum and minimum temperature.

General Instructions

Initial soil analysis report for Ec, pH, N, P, K and Zn traits from locations has to be submitted to IIRR; accordingly fertilizer recommendation will be intimated

a. To begin with, seeds are sown in nursery and seedlings are prepared. After 4-5 weeks (better make it 3-4 weeks, younger seedlings are necessary for high yields) the seedlings are uprooted and planted in the field which has already been prepared for the purpose. The entire process is done by hand. It is, therefore, a **very** difficult method and requires heavy inputs. But at the same time it gives some of the highest yields.
b. **Land preparation**: Plow, harrow, puddle, and level the land; construct channels at regular intervals to facilitate easy drainage
c. **Optimum sowing time**: For TPR, complete the nursery sowing before the onset of heavy rains; early to mid June for IGP
d. **Seed preparation & sowing**: pre-germinate the seeds by soaking for 24 h in water or 1% KCl solution and incubating for 24-36 h and then broadcast or drum-seed
e. **Water management**: Keep a water level of 2-3 cm for the first 10 days after transplanting (DAT) so as to make the transplanted seedlings recover fast from the transplanting shock and establish well. Then, follow **AWD irrigation during vegetative ph**ase (10-45 DAT); maintain **3-5 cm water level during reproductive phase** (45-75 DAT); drain the field after physiological maturity (75-90 DAT); 30-40% water saving from reduced deep drainage, seepage & runoff in transplanted rice.
f. **Integrated Weed mgt**: cultural, mechanical & herbicides; water level in the field determines the level of weed infestation.
g. **Fertilizer mgt**: Incorporate all organic matter or manures into soil during plowing; Apply the fertiliser as per the treatment and N in 3 splits P as Basal and K as 2 splits.

h. **Pest and disease control**: Follow IPM

Details of the Mechanised Transplanting :

Manual transplating is a labour-intensive operation comprising nursery raising, uprooting of the seedlings, transporting and transplanting the uprooted seedlings in the main field, with a total labour requirement of about 280-350 man-hrs/ha. High labor demand during the peak periods adversely affects the timeliness of operation, thereby reducing the crop yield. The steady drift of agricultural labour to industrial sector is adding more to the woes of the rice farmer. Because of drudgery and notion that the farm operations are below the dignity, labour availability, in general, has decreased considerably in farm operations.

Chinese design of Paddy Transplanter

To offset these problems, mechanical transplanting is the solution. Many transplanters were developed in the past involving the use of traditionally grown paddy nursery for mechanical transplanting. However, several on-farm attempts made with different models of transplanters using the traditional root washed nursery were not successful because of the machine-related problems to use the nursery. This called for the necessity of raising the nursery in a special way, called mat nursery technique. Among the existing commercially available designs suiting mat nursery, Chinese model of paddy transplanter is found to have great promise.

Features of the Machine

- Available with its own source of power of 3-4 hp diesel engine.
- Covers eight rows at a time with a row to row spacing of 23 cm.
- Provision to vary the plant to plant spacing by 10 and 12cm.
- Provision for cage wheel for field use and rubber wheel for transport.

Features of the Mat Nursery

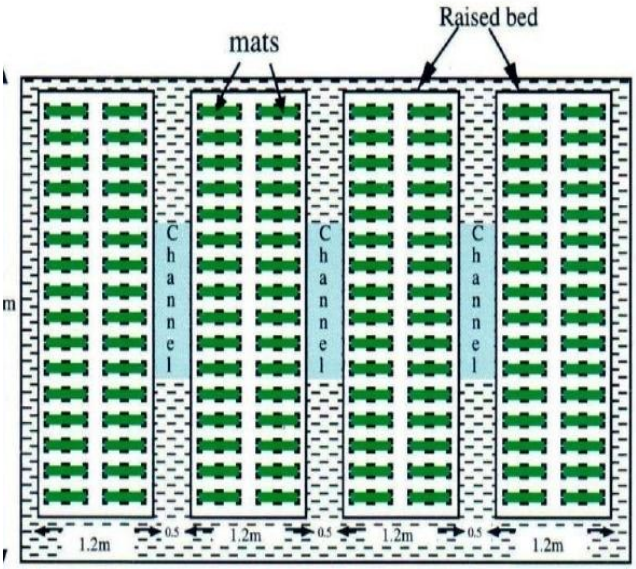
Seed preparation

- Soak the seeds for one day
- Incubate the seeds for one day
- Apply a seed rate of 50 kg/ha

Mat preparation

- Choose the suitable site for mat nursery raising (preferably within or nearer to the main field) and puddle the selected site.
- Raise the puddled soil bed to a level of about 5 cm and level it properly. To lay more than two rows of mats, select each bed width as 1.2 m. To cover one hectare of land, selected plot should be of size of about 20 x 7.5 m with provision of channels of width of 0.5 m (See the figure of mat layout).

- Spread the plastic sheet evenly on the levelled and raised beds.
- Mix the soil with FYM and water to prepare slurry.
- Keep the DRR designed mat frame (having dimansions of 19 x 50 x 2 cm of each block) on the plastic sheet and spread the slurry mixture in each block of the frame.
- After proper settling, lift the frame to leave the mats behind.
- Take 100-110 g of sprouted seed and spread it evenly on the prepared mats and press them gently. One hectare of main field needs 500-600 mats.



Layout of Mat Nursery (for 1 ha)

- The procedure is repeated to prepare all the mats. Spread either grass or plastic sheet on the mats overnight and take it out in the morning. Do not uncover if there is rain during the first week of mat raising.
- Sprinkle with rose can on all the mats everyday to keep the mats moist.
- After a week when the nursery looks green, provide water through channels to the level just below the mats.
- Apply fertilizer@30 g of DAP / litre of water and sprinkle on the mats with hand sprayer after 7-10 days of the nursery.
- The nursery will be suitable for transplanting after 15-20 days when the plant reaches a height of 12-15 cm.

Mat Nursery

Paddy Transplanter Operation

For efficient operation of transplanter the land preparation and knowledge of the mechanical provisions incorporated with the transplanter are essential to be known.

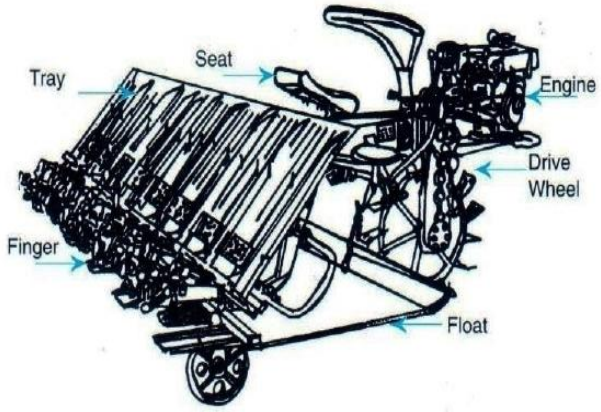
Land preparation

- Puddle the land, level it and remove the water after 24 hours (for clay soil) or 12 hours (for sandy/loamy soil) before the transplanting. In black or clayey soils the settlement is critical as the loosened soil can bury the seedlings planted.

- Just before the operation of transplanter, a thin film of water is necessary to ensure the free movement of transplanter and avoid adhering of soil to the moving parts of the transplanter.

Operation of the transplanter

- Check oil level in gear box, fuel tank and grease the specified parts.



Line diagram of transplanter

- While operating observe for any missing hills in any particular row and diagnose the problem immediately. The missing hills can be due to presence of stones/ foreign matter that would have obstructed the fingers that pick the seedlings from the tray.
- Choose the right speed of operation for a plant hill to hill distance of 10 or 12 cm.
- Observe the number of plants per hill and adjust to the requirement using the lever operating the finger movement.
- Observe the depth of planting with the lever and adjust accordingly.

Plant stand with transplanter

Performance

There will be a net saving of about 45 per cent over the manual transplanting. It can transplant about one hectare in a day of 8 hours. The transplanter performs with missing hills of 2-3 per cent. The machine costs about Rs.1,25,000 and is marketed by VST Agro Inputs, Mahadevpura, Whitefield Road, Bangalore-560 048

Courtesy: Dr. Vidhan singh ,Principal Scientist , Agriculture Engineering , IIRR

Trial No : 3

Trial Code : CMT-2 (Dry DSR)

Name of the trial : Developing suitable package of practices for dry DSR.

Introduction : Imminent water crisis, labour scarcity and climate change threaten the sustainability and profitability of traditional transplanted rice. Direct-seeded rice (DSR) technology has been proposed to reduce water requirement, save labour demand, mitigate greenhouse gas emission and improve environmental sustainability. It involves three principal methods viz., dry seeding, wet seeding, and water seeding, among which dry DSR is gaining momentum due to relatively high grain yield, less water consumption, reduced labour intensity, facilitating to mechanization during crop establishment, and less greenhouse gases emission. The major challenges confronting the development of dry DSR in India are poor crop establishment, weed infestation, lodging susceptibility, yield decline under continuous cropping, and variety breeding; and the strategies which may help in mitigating the constraints to dry DSR.

Objective :

3. To identify suitable and cost effective agronomic management practices to enhance the productivity of dry DSR
4. To maximize the resource use efficiency

Locations:

Arundhatinagar(K+R)	**Chatha**	**Chinsurah**	**Gangavati**
Hazaribagh	**Jagdalpur**	**Jagityala**	**Kota**
Mandya	**Nagina**	**Pantnagar**	**Pusa**
Ludhiana	**Ragolu**	**Raipur**	**Ranchi**
Sabour			

Kharif - 2019

Main plot treatments – 2: Time of sowing suitable to that location

Main : M1-Normal sowing time
M2-Delayed sowing by 30 days

Sub: 4
S1-Broadcasting of seeds
S2-Manual line sowing of seeds (20-25 cm row spacing sown in solid row)
S-3Mechanized line sowing of seeds (Dribbler, Happy seeder or any Drum seeder : Spacing as per the equipment specifications)
S4- Any improved system in that particular location

Seed rate for S1 = 50 kg /ha ; S2 & S3 = 25 kg /ha. S4: as per the system followed)

Design : SPLIT PLOT design
Replication : 4-5
Plot size : 30 m^2
Variety : Any HYV (Medium duration) of the location.

Note; Take up one sowing date if not possible due to availability of seeds and time

Observations:

- Plant population at 10 days and 20 days from fixed area.
- 2. Soil moisture content at 10, 15 and 20 days after sowing from 0-5 and 5-10 cm depth.
- Plant height
- Dry matter accumulation and partitioning of the dry matter (stem, leaves and grains at different stages)
- Tiller production (effective and ineffective)
- Days to 50% flowering
- **Weed parameters in all the treatments (Weed photos,Weed species, weed density no/m2, weed dry weight g/m^2 at active tillering and panicle initiation stages of rice crop)**
- Pest and disease incidence/dynamics

- Root activity and root parameters
- If possible microbial activities
- Uptake of major and minor nutrients
- Availability of nutrients in the soil (initial and after harvest)
- Yield attributes (Grain number, panicle number, panicle length, panicle weight and test weight)
- Grain and straw yield
- Economic evaluation of different methods of crop establishments
- Initial and final available soil nutrient status of each treatment.

Experimental details:

1. Identify a suitable plot with least interference of water seepage from adjoining rice fields as irrigation water input needs to be quantified.
2. Soil from the experimental area must be analyzed initially for texture, bulk density, soil fractions, pH, OC, EC, CEC, available nutrients N, P, K, Zn, S and soil moisture characteristics at saturation, field capacity and wilting point.
3. After dry ploughing the field making the soil into a fine tilth, proper levelling, main blocks are laid with provision for double irrigation channels, and leaving buffer zone of 2 m all round the blocks to minimize water interference from the adjoining plots. Sub plots are laid as per the layout. At the entry point of the plot for irrigation provision should be made to install digital water meter for quantifying water input or water meter. **Total quantity of irrigation water applied during crop season and effective rainfall must be provided.**
4. For dry direct seeded rice, dibble 2 – 3 seeds per hill in a well-prepared and levelled field maintaining spacing of 20 x 10 cm and irrigated and ensure proper crop stand.
5. Apply fertilizer as per the treatments.
6. In case of occurrence of Fe deficiency, the problem may be corrected by suitable spray schedule (0.50% $(NH_4)_2$ Fe $(SO_4)_2$ in water at pH 5.0) after recording observations on the intensity of deficiency.

Trial No : 4
Trial Code : CMT-3 (Wet DSR)
Name of the trial : Developing suitable package of practices for wet DSR.

Introduction : Direct wet seeding offers the advantage of faster and easier planting, reduced labour and less drudgery, 7-10 days earlier crop maturity, more efficient water use and higher tolerance to water deficit, less methane emission, and often higher profit in areas with assured water supply. This method of seeding in the past has received relatively less attention than transplanting. Sowing of sprouted rice seed or wet-seeded rice in puddled soil though becoming increasingly important as a method of crop establishment under lowland rice is beset with weed problems, particularly grassy weeds besides other management practices. Weeds emerge at about the same time that the rice seeds germinate, and therefore the yield losses caused by weeds will become greater with the trend towards wet seeding. Effective weed control is one of the key issue and major requirements to ensure a successful wet-seeded rice crop. Furthermore, varieties must be improved for early seeding vigour, weed competitiveness, submergence tolerance to survive untimely rainfall during stand establishment and drought tolerance to survive dry conditions during germination and later growth stages, and for lodging resistance at maturity.

Objective :

1. To identify suitable and cost effective agronomic management practices to enhance the productivity of wet DSR
2. To maximize the resource use efficiency

Locations:

Aduthurai(K+R)	**Arundhatinagar(K+R)**	**ARI-Rajendernagar**	**ARS-Warangal**
Coimbatore	**Chatha**	**Chiplima**	**Karjat**
Kota	**Maruteru(R)**	**Mandya**	**Moncompu**
Navsari	**Puduchery**	**Pusa**	**Raipur**
Ranchi	**Rewa**	**Titabar**	**Tuljapur**

Treatments under puddle conditions:

Main plot: M_1-Normal sowing time

M_2-Delayed sowing by 30 days

Sub-plot:

S_1-Broadcasting of seeds

S_2-Manual line sowing of seeds

S_3-Mechanized line sowing of seeds (Drum seeder, Any seeder used in wet condition)

S_4- Any improved system in that particular location

S_5- Normal Transplanting

Seed rate for S1 = 50 kg /ha ; S2 & S3 = 25 kg /ha. S4: as per the system followed)

Design : Split-plot
Replication : 4
Plot size : 30 m^2
Variety : Any HYV (Medium duration) of the location.
Replication : 4
Plot size : 30 m^2
Variety : Any HYV (Medium duration) of the location.

Observations:

- Plant height
- Dry matter accumulation and partitioning of the dry matter (stem, leaves and grains at different stages)

- Tiller production (effective and ineffective)
- Days to 50% flowering
- **Weed parameters in all the treatments (Weed photos, Weed species, weed density no/m^2, weed dry weight g/m^2 at active tillering and panicle initiation stages of rice crop)**
- Pest and disease incidence/dynamics
- Root activity and root parameters
- If possible microbial activities
- Uptake of major and minor nutrients
- Availability of nutrients in the soil (initial and after harvest)
- Yield attributes (Grain number, panicle number, panicle length, panicle weight and test weight)
- Grain and straw yield
- Economic evaluation of different methods of crop establishments
- Initial and final available soil nutrient status of each treatment.

Experimental details:

- Identify a suitable plot with least interference of water seepage from adjoining rice fields as irrigation water input needs to be quantified.
- Soil from the experimental area must be analyzed initially for texture, bulk density, soil fractions, pH, OC, EC, CEC, available nutrients N, P, K, Zn, S and soil moisture characteristics at saturation, field capacity and wilting point.
- After dry ploughing the field making the soil into a fine tilth, proper levelling, main blocks are laid with provision for double irrigation channels, and leaving buffer zone of 2 m all round the blocks to minimize water interference from the adjoining plots. Sub plots are laid as per the layout. At the entry point of the plot for irrigation provision should be made to install digital water meter for quantifying water input or water meter. **Total quantity of irrigation water applied during crop season and effective rainfall must be provided.**

- For dry direct seeded rice, dibble 2 – 3 seeds per hill in a well-prepared and levelled field maintaining spacing of 20 x 10 cm and irrigated and ensure proper crop stand.
- Apply fertilizer as per the treatments.
- In case of occurrence of Fe deficiency, the problem may be corrected by suitable spray schedule (0.50% $(NH_4)_2$ Fe $(SO_4)_2$ in water at pH 5.0) after recording observations on the intensity of deficiency.

Trial No : **5**

Trial Code : **CMT-4**

Name of the trial : **Enhancing the productivity of Direct seeded rice with Iron coating under different rice ecologies (Collaborative trial with Entomologists) (IIRR & JFE)**

Introduction : Seed treatment of soaking, incubation, and drying increases the germination rate of rice even at low temperatures or under anoxia and that the treatment is effective not only in Japonica but also in Indica cultivars (Yamauchi, 2002; Mori et al., 2012). Andoh and Kobata (2002) reported that seeds that had been soaked and then dried have increased a-amylase activity and a high germination rate. Thus, the treatment of soaking, incubation, and drying is a useful priming method. Primed rice seeds could be utilized in direct seeding in lieu of pre-germinated seeds. The high density Fe-coated seeds are resistant to birds and seedborne diseases. Iron-coated seeds exhibit improved anchorage in water seeding in puddled fields. Hence, the field trial was initiated to study effect of Fe-coating on growth and yield parameters of rice.

(Collaborative trial with Entomologists) (IIRR & JFE)

Objectives : To enhance the productivity of the DSR rice through seed priming

To assess the impact of the seed coating on crop establishment and productivity of the DSR system

Locations :

Chiplima, Coimbatore, IIRR, Karjat, Maruteru (K+R), Raipur

Plot size : 25 m^2
Design : Split-plot
Replication : 3

Main plot : Four sowings with **one week interval**
1st sowing
2nd sowing
3rd sowing
4th sowing

Sub plots

- **T_1** – Iron coated seed, Seed rate 25 kg/ha, broadcasting in 1-2mm water level condition (Direct sowing)
- **T_2** – Iron coated seed, Seed rate 25 kg/ha, broadcasting in wet condition (Direct sowing)
- **T_3** – Un-coated seed, seed rate 25 kg/ha, broadcasting in 1-2mm water level condition (Direct sowing)
- **T_4** – Un-coated seed, seed rate 25 kg/ha, broadcasting in wet condition (Direct sowing)
- **T_5** – Normal transplanting 21-25 days after sowing

Mention the variety: Swarna

Observation to be taken:

1. Germination rate (%) (on wet paper in petri dish)
2. Seed problem (Bird attack, Snail attack, Rotting etc.) Snail should be removed if you find out
3. Rain fall and irrigation flow rate
   Seed floating and run out from the field when introducing water
4. Crop establishment (plant/m^2) and distribution

5. Rice growth characteristics (flowering time, final plant height, leaf area index or number of leaves (m^2), etc.)
6. Grain yield (kg/ha) and 1000 grain weight (g)
7. Fe content in grain and plant
8. Taste(eating quality)
9. Chemical check of soil
   N, P, K & Fe status (Initial/Final)
10. Soil condition before and after the test
    (pH, Eh(v), Fe total and soluble content, fumos etc.)
11. Fertilizers (kinds, weight (g/m^2), number of applied times) @120, 60
12. Insects and diseases infestation - if any, control
13. Weather data (Max and Min temperature, Sunshine duration, Rain fall heights and event times, etc.)

Protocol for Fe coated DSR

Experimental design

No.	Seed treatment or Seedling	Seed rate* (kg/ha)	Water management at sowing	Sowing (surface)	Sowing week	Remarks
1st Sowing						
T1	Fe coated	25	Flooded (1-2mm water level)	Broadcast	1st	
T2	Fe coated	25	Dry (0 mm water level)	Broadcast	1st	
T3	Hydroprimed	25	Flooded (1-2mm water level)	Broadcast	1st	
T4	Hydroprimed	25	Dry (0 mm water level)	Broadcast	1st	
T5	Non coated	25	Standing water	Transplanting	1st	
2nd Sowing						
T6	Fe coated	25	Flooded (1-2mm water level)	Broadcast	2nd	
T7	Fe coated	25	Dry (0 mm water level)	Broadcast	2nd	
T8	Hydroprimed	25	Flooded (1-2mm water level)	Broadcast	2nd	
T9	Hydroprimed	25	Dry (0 mm water level)	Broadcast	2nd	
T10	Non coated	25	Standing water	Transplanting	2nd	
3rd Sowing						
T11	Fe coated	25	Flooded (1-2mm water level)	Broadcast	3rd	
T12	Fe coated	25	Dry (0 mm water level)	Broadcast	3 rd	
T13	Hydroprimed	25	Flooded (1-2mm water level)	Broadcast	3 rd	
T14	Hydroprimed	25	Dry (0 mm water level)	Broadcast	3 rd	
T15	Non coated	25	Standing water	Transplanting	3 rd	
4th Sowing						
T16	Fe coated	25	Flooded (1-2mm water level)	Broadcast	4th	
T17	Fe coated	25	Dry (0 mm water level)	Broadcast	4 th	
T18	Hydroprimed	25	Flooded (1-2mm water level)	Broadcast	4 th	
T19	Hydroprimed	25	Dry (0 mm water level)	Broadcast	4 th	
T20	Non coated	25	Standing water	Transplanting	4 th	

Lay out

ONLY FOR REFERENCE PURPOSE

1st sowing	T5	T1	T2	T3	T4	R1
	T1	T5	T3	T4	T2	R2
	T5	T3	T1	T2	T4	R3
2nd sowing	8	9	7	6	10	R1
	6	7	9	8	10	R2
	10	9	7	8	6	R3
3rd sowing	15	13	11	12	14	R1
	11	12	13	14	15	R2
	13	14	15	11	12	R3
4th sowing	17	19	16	18	20	R1
	20	17	19	16	18	R2
	16	19	18	17	20	R3

plot

T1	T6	T11	T16	Fe coated flooded
T2	T7	T12	T17	Fe coated dry
T3	T8	T13	T18	Hydro primed flooded
T4	T9	T14	T19	Hydro primed dry
T5	T10	T15	T20	NTP

Name of the trial : Effect of seed coating on insect pest incidence (ESCP)

Collaborative trial with Agronomy (CMT- 4: Enhancing the productivity of direct seeded rice with iron coating under different rice ecologies)

Objective: To assess the impact of Iron seed coating on insect pest incidence

Locations (6): Chiplima, Coimbatore, IIRR, Karjat, Maruteru, Raipur

Treatments, design, plot size, variety and layout are as per the Agronomy technical program. Please consult the Agronomist of your centre.

Entomologists will only record observations.

Observations to be taken by Entomologist

In three replications of all the treatments in two sowings (first sowing and fourth sowing), record three observations at 15, 30 and 45 DAS.

Also record pre-harvest/harvest count of panicle bearing tillers and white ears

At each observation, in each replication, select 5 plants at random and record the following:

Total number of tillers / plant

Total number of leaves/ plant

Number of dead hearts/ plant

Number of galls/ plant

Number of damaged leaves (indicate the pest- hispa, leaf folder, whorl maggot, thrips, case worm etc./ plant)

Panicle bearing tillers / plant

White ears/ plant

Number of BPH/WBPH/GLH per plant

Any other pest observed

Natural enemy count

Note; Entomologists of above mentioned centers will take observations in Agronomy lad out trial and report (Collaborative trial).

Contact Dr. Ch. Padmavathi for any clarifications

Trial No	**:**	**6**
Trial Code	**:**	**CMT-5**
Name of the trial	**:**	Yield maximization of rice through site specific nutrient management in farmers' fields- 10 farmers in each location (**special collaborative trial – Agronomy, Soil Science & IPNI**)

Objectives:

1. To assess indigenous nutrient supplying capacity of soils in various rice growing ecologies and geographies.
2. To compare yield and economic performance of field specific fertilizer recommendation with the existing blanket recommendation for rice in farmers' fields

Locations:

Chiplima	**Chinsurah (K+R)**	**Faizabad**	**Ghaghraghat**
Karaikal	**Karjat**	**Khudwani**	**Moncompu (K+R)**
Titabar			

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

Note : Intimate the Details of the farmers feilds where the trial will conducted and get the fertiliser recommendation from Dr. Satyanarayana Director IPNI:

A IPNI CD was supplied to all co-operators for determining the dosage based on the soil parameters

Treatment:

T_1 – Recommended fertilizer recommendation of that region
T_2 – SSNM based on Nutrient Expert (Varies for each location)
T_3 - Farmers' Fertilizer Practice
T4- Absolute control (No NPK)

The trial need to be conducted at least with 10 Farmers of the location. Initial soil details and soil nutrient status need to be assessed and furnish the details

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

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. Initial and Final Soil nutrient status
11. Plant uptake NPK at Harvest (Straw + Grain) if soil scientist are 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*
- *Send the samples a month advance to Department of soil Science with proper labeling for analysis*

- *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)*
- *For generating T2 – SSNM based on NUTRIENT EXPERT recommendation, Dr. Satyanarayana from IPNI (Ph No. 08790742660) will be contacted by each of the scientist cooperating centers and will generate the nutrient application rates.*
- *A training programme will be organized during 2017-18 on Nutrient Expert and assessment of Nutrient expert will facilitate in developing Nutrient expert for rice in the lines of of Maize and Wheat crops Nutrient Expert.*

Trial No : 7
Trial Code : CMT-6
Name of the trial : Water management for enhancing water use efficiency in different rice establishments methods (transplanted rice, mechanized transplanting, wet direct seeded rice using Drum seeders (puddled soil), aerobic rice and semi-dry rice (un-puddled soil)

Intoduction : Increasing water scarcity is becoming real threat to rice cultivation. Hence water-saving technology needs to be developed which not only economically beneficial but also maintains soil health. Any approach that would lessen the amount of water use without compromising the rice yield would certainly be a welcome strategy. Introduction of SRI is an alternative practice to solve water crisis, and as a methodology for increasing the productivity of irrigated rice. AWD is also called 'intermittent irrigation' or 'controlled irrigation'which can reduce the water requirement by 30 % in irrigated rice system

Hence, the field trial was initiated to study effect of different establishment methods, irrigation water levels and weed-management practices on growth and yield parameters of rice.

Objective :

1. To evaluate the suitable and promising irrigation management practices in different crop establishment methods
2. To assess the agronomic efficiency, plant water potential and water use efficiency under irrigation management practices in different crop establishment methods

Locations :

Arundhatinagar	**Chatha**	**Faizabad**	**Gangavati**
IIRR	**Karaikal**	**Mandya**	**Nawagam**
Puducherry (R)	**Pusa**	**Varanasi**	

Experimental details:

Design : Split plot design, **Replications:** 3 or4
Row spacing : 20 x 15 cm- for T.P and varies for each method
Plot size : 25 m^2
Variety : Any High Yielding Variety (Medium duration)

The irrigation management methods as main plots (to make water management precise and easier) and crop establishment methods as sub plots

Main plots : 3 irrigation management practices

Main plot treatments:

I_1 – Flooding throught crop growth (3 + / - 2 cm)
I_2 - Saturation maintenance upto PI and (3 + / - 2 cm) after PI
I_3 – Alternate wetting and drying (**AWD—flooding to a water depth of 5 cm when water level drops to 5 cm Below ground level from 15 DAT to PI-** with the help of Boumans Water tube)

Sub plot treatments – any 4 - 5: Methods of crop establishment suitable to that area

Wet system:

1. Mechanical Transplanting method on puddled soil (crop management methods same as for puddled transplanted rice)
2. Direct wet seeding on puddled soil (Use of Drum seeder/ dibbling of sprouted seed at 25 x 25 cm) fb crop management practices as per direct wet seeded rice
3. Normal manual Transplanting (20 x15 cm with flooding water management, 3-4 seedlings transplanted at 25-30 days old seedlings)

Dry system:

4. Aerobic rice
5. Direct broadcast dry seeding on well prepared unpuddled soil fb crop management practices for direct dry drill seeded rice (semi dry rice)
6. Optional- Location specific

(*Select 4-5 methods of crop establishment as per the choice of the Location and feasibility)

Note: The state wise fertility maps are available and all the fertilizer 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 provide RFD as per the recommendation

1. Identify a suitable plot with least interference of water seepage from adjoining rice fields as irrigation water input needs to be quantified.
2. The selected plot should be made weed free following Stale Seed Bed Method i.e., spraying Glyphosate weedicide @ 0.75-1.00 kg a.i./ha 10 – 12 days prior to opening the fields, followed by ploughing once, allow germination of left over weed seed, and then prepare the field for sowing rice by shallow ploughing to fine tilth and levelling of the field.
3. Soil from the experimental area must be analyzed initially for texture, bulk density, soil fractions, pH, OC, EC, CEC, available nutrients N, P, K, Zn, S and soil moisture characteristics at saturation, field capacity and wilting point.
4. For direct seeded rice, dibble 2-3 seeds per hill in a well-prepared and levelled field maintaining spacing of 20 x 10 cm and irrigated and ensure proper crop stand.
5. **Chemical Weed control with recommended herbicides one pre emergence application and one post emergence application. If required, another spray of post emergence herbicide for 3rd flush of weeds only for other than SRI method. Use cono weeder at three times i.e 10, 20 and 30 days of transplanting for SRI method**
6. Apply fertilizer uniformly for all the treatments.

7. In case of occurrence of Fe deficiency, the problem may be corrected by suitable spray schedule (0.50% $(NH_4)_2$ Fe $(SO_4)_2$ in water at pH 5.0) after recording observations on the intensity of deficiency.
8. All weed management practices are to be followed to keep the plots weed free in all the plots.
9. Send 1 kg processed soil from 0 – 15 cm depth collected from the experimental area before applying fertilizers to IIRR, Hyderabad.

Details of the plastic water tube- I3 (Bouman tube):

- AWD is also called 'intermittent irrigation' or 'controlled irrigation'
- Alternate flooding
- Compared with the traditional continuous flooding system, AWD using lowland rice cultivars can reduce water input by 15-30% without yield loss

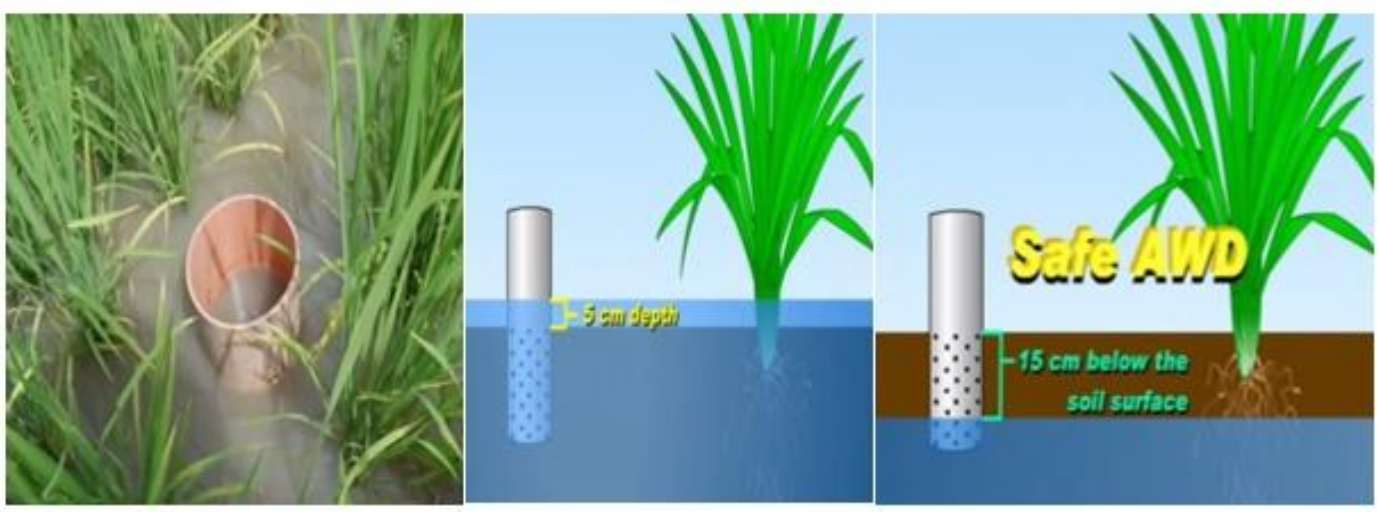


Fig. Safe AWD method

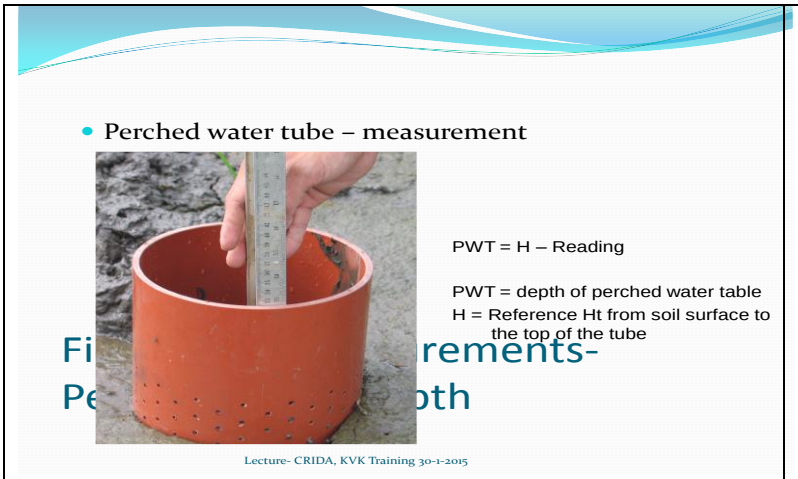


Fig. How to measure the depth of water

Water at 5 cm depth:Time to irrigate and flood the field again

Fig.Can be adopted in the present experiment

Observations:

- Plant height
- Dry matter accumulation and partitioning of the dry matter (stem, leaves and grains at different stages)
- Tiller production (effective and ineffective)
- Weed parameters in all the treatments(weed photos, weed species, weed population no/m2 ,weed dry weight g/m2, at active tillering stage and panicle initiation stages of rice crop)
- Pest and disease incidence/dynamics
- Days to 50% flowering
- Oxidability of the soil
- Root activity and root parameters
- If possible microbial activities
- Uptake of major and minor nutrients
- Treatment wise water input data
- Availability of nutrients in the soil (initial and after harvest)
- Yield attributes (Grain number, panicle number, panicle length, panicle weight and test weight)
- Grain and straw yield
- Economic evaluation of different methods of crop establishments

- Initial and final available soil nutrient status of each treatment.
- After dry ploughing the field making into a fine tilth, proper levelling, main blocks are laid with provision for double irrigation channels, and leaving buffer zone of 2 m all round the blocks to minimize water interference from the adjoining plots. At the entry point of the plot for irrigation provision should be made to install Digital water meter for quantifying water input or water meter. **Total quantity of irrigation water applied during crop season and effective rainfall must be provided.** Sub plots are laid as per the layout.
- Water input has to be quantified in each treatment (based on no of irrigations and quantity of irrigation for each irrigation)
- Provide total rainfall data

Details of the methods of crop establishment

I. Puddled rice situation:

M-1: Manual Transplanting Method:

1. This method is practiced in areas of fertile soil, abundant rainfall and plentiful supply of labour. To begin with, seeds are sown in nursery and seedlings are prepared. After 4-5 weeks (better make it 3-4 weeks, younger seedlings are necessary for high yields) the seedlings are uprooted and planted in the field which has already been prepared for the purpose. The entire process is done by hand. It is, therefore, a **very** difficult method and requires heavy inputs. But at the same time it gives some of the highest yields.
2. **Land preparation**: Plow, harrow, puddle, and level the land; construct channels at regular intervals to facilitate easy drainage
3. **Optimum sowing time**: For TPR, complete the nursery sowing before the onset of heavy rains; early to mid June for IGP
4. **Seed preparation & sowing**: pre-germinate the seeds by soaking for 24 h in water or 1% KCl solution and incubating for 24-36 h and then broadcast or drum-seed
5. **Water management**: Keep a water level of 2-3 cm for the first 10 days after transplanting (DAT) so as to make the transplanted seedlings recover fast from the transplanting shock and establish well. Then, follow **AWD irrigation during vegetative ph**ase (10-45 DAT); maintain **3-5 cm water level during reproductive phase** (45-75 DAT); drain the field after physiological maturity (75-90 DAT); 30-40% water saving from reduced deep drainage, seepage & runoff in transplanted rice.
6. **Integrated Weed mgt**: cultural, mechanical & herbicides; water level in the field determines the level of weed infestation.
7. **Fertilizer mgt**: Incorporate all organic matter or manures into soil during plowing; apply 14-18 kg/ha P and first dose of 20 kg/ha K before last harrowing & leveling; apply 90-120 kg/ha N in 3 splits –

33% basal just before transplanting, 33% at tillering, and 33% at Panicle Initiation (PI).

8. **Pest and disease control**: Follow IPM

M-2: Mechanised transplanting

Methodology : Raising seedling for Tansplanter

Trays (60cm x 28 cm) are filled with sieved soil (2.5 cm soil depth). Seeds are uniformly placed (100 g/tray) on soil, covered with thin soil layer and water through rose cans. Use 15 day old seedlings. Foliar spray of 2% nitrofoska (19:19:19) may be given.

{OR}

Prepare 10 cm raised bed. Level it. Place a thick polythene sheet on the bed. Make small holes on the sheet. Spread 2.5 cm soil on the polythene sheet. Place or sow seeds uniformly on the soil without overlapping. Cover the seeds with a thin soil layer. Cover the soil with straw mulch. Water the beds with rose can for 3 days. Remove the straw mulch after 3days. Open a channel around the beds and let in water into channel to keep seedbed moistened. Use 15 day old seedlings.

SM SRI – Transplanting with a transplanter and follow the other practices of SRI (water management, weed management by conoweeder).

Follow the principles same as above: b-h

a) **Weed control:** Use a cono weeder in both directions to uproot and incorporate the weeds into soil and most importantly, aerate the soil.
b) **Water management:** No standing water during growth period. Intermittent wetting and drying until panicle initiation (saturation field condition). After panicle initiation. 1-2 cm of water is kept for about three weeks.
c) **Nutrient management:** Use straw, green manure and animal manure to enrich populations of earthworms, micro organisms and to facilitate nutrient availability. Use reduced amounts (less than 50%) of chemical fertilizer assessing the requirement. Mention the dosage of

nutrients applied for the trial (75% RDF through organic form and 25% through inorganic form or chemical fertilizers)

M3- Wet direct seeded rice using Drum seeders

- **Rice varieties**: with early seedling vigor, rapid growth, weed suppressive ability –
- **Seed quality & seed rate**: **High yielding fine grain variety 30-40 kg/ha & coarse grain 45-60 kg/ha** of clean, quality seed to ensure uniform germination & good crop stand (150-200 plants m^{-2}); high seed rates reduced weeds by 41-48%
- **Land preparation**: Plow, harrow, puddle, and level the land; construct canals at regular intervals to facilitate easy drainage
- **Optimum sowing time**: sowing on the same day as nursery sowing for TPR; complete the sowing before the onset of heavy rains; early to mid June for IGP
- **Seed preparation & sowing**: pre-germinate the seeds by soaking for 24 h in water or 1% KCl solution and incubating for 24-36 h and then broadcast or drum-seed
- **Use drum seeder for line seeding or planting**
- **Water management**: For the first 10-15 DAS, **flush irrigate the field** to keep the soil saturated but not flooded to enhance seedling emergence, root development & anchorage; follow **AWD irrigation during vegetative phase** (15-60 DAS); maintain **3-5 cm water level during reproductive phase** (60-90 DAS); drain the field after physiological maturity (90-105 DAS); 30-40% water saving from reduced deep drainage, seepage & runoff in DSR
- **Integrated Weed mgt**: cultural, mechanical & herbicides; high seed rates reduced weeds by 41-48%
- **Fertilizer mgt**: Incorporate all organic matter or manures into soil during plowing; apply 14-18 kg/ha P and first dose of 20 kg/ha K before last harrowing & leveling; apply 90-120 kg/ha N in 3 equal splits 1/3rd at 10-15, 1/3rd at 25-30, & 1/3rd at 45-50 DAS
- **Pest and disease control**: Follow IPM

M4- Wet direct seeded rice by Broadcasting

- ❖ Same as above except Broadcasting of the seeds uniformly as per the seed rate
- ❖ Seed quality & seed rate: High yielding fine grain variety 30-40 kg/ha & coarse grain 45-60 kg/ha of clean, quality seed to ensure uniform germination & good crop stand (150-200 plants m^{-2}); high seed rates reduced weeds by 41-48%

M5- Optional Treatment

Give details of the method

Note : Quantity of nutrients and other inputs are same for all the methods

II. Unpuddled system (Dry system) :

Protocol of the crop establishment methods:

M1- Dry direct seeded rice on unpuddled soil ⁄ line sowing by hand in furrows, drill seeding by Happy seeder / Line sowing behind the plough)

Sowing of dry (primed) seeds is done in dry soil conditions with sowing behind the plough ⁄ or drill seeding by Happy seeder/ Line sowing by hand

Land preparation: Plough, harrow, & level the land to prepare a smooth seedbed; no tilling to strip tilling for zero-till or reduced till fields, with or without residues on surface

- ❖ **Optimum sowing time**: sowing on the same day as nursery sowing for TPR; complete the sowing **before the onset of heavy rains**; **early to mid June** for IGP
- ❖ **Seed preparation & sowing**: Treat the seeds with water or 1% KCl solution (priming) to induce drought tolerance, dry the seeds in shade, sow by broadcasting or line sowing by hand in furrows, or drilling in rows by machine; use zero-till seeder or planter to drill the seeds at optimum depth (3-5 cm) in zero-till or reduced till fields

- **Water management**: For the first 10-15 DAS, flush irrigate the field to keep the soil saturated but not flooded to enhance seedling emergence, root development & anchorage; follow AWD irrigation during vegetative phase (15-60 DAS); maintain 4-5 cm water level during reproductive phase (60-90 DAS); drain the field after physiological maturity (90-105 DAS); 30-40% water saving from reduced deep drainage, seepage & runoff in dry DSR
- **Integrated Weed mgt**: cultural, mechanical & herbicides; high seed rates → 41-48% less weeds
- **Fertilizer mgt**: Incorporate all organic matter or manures into soil during plowing; apply 14-18 kg/ha P and first dose of 20 kg/ha K before last harrowing & leveling; apply 90-100 kg/ha N in 3 equal splits, 1/3rd at 10-15, 1/3rd at 25-30, & 1/3rd at 45-50 DAS or LCC-based N management
- **Pest and disease control**: Follow IPM

M2- Dry direct seeded rice on unpuddled soil (Broadcasting)

Broadcasting dry (primed) seeds under dry soil conditions.

- **Land preparation**: Plow, harrow, & level the land to prepare a smooth seedbed; strip tilling for reduced till fields, with or without residues on surface
- **Optimum sowing time**: sowing on the same day as nursery sowing for TPR; complete the sowing **before the onset of heavy rains**; **early to mid June** for IGP
- **Seed preparation & sowing**: Treat the seeds with water or 1% KCl solution (priming) to induce drought tolerance, dry the seeds in shade, sow by broadcasting on fully tilled field and strip-tilled field
- **Water management**: For the first 10-15 DAS, flush irrigate the field to keep the soil saturated but not flooded to enhance seedling emergence, root development & anchorage; follow AWD irrigation during vegetative phase (15-60 DAS); maintain 4-5 cm water level during reproductive phase (60-90 DAS); drain the field after physiological maturity (90-105 DAS); 30-40% water saving from reduced deep drainage, seepage & runoff in dry DSR

- **Integrated Weed mgt**: cultural, mechanical & herbicides; high seed rates → 41-48% less weeds
- **Fertilizer mgt**: Incorporate all organic matter or manures into soil during plowing; apply 14-18 kg/ha P and first dose of 20 kg/ha K before last harrowing & leveling; apply 90-100 kg/ha N in 3 equal splits, 1/3rd at 10-15, 1/3rd at 25-30, & 1/3rd at 45-50 DAS or LCC-based N management
- **Pest and disease control**: Follow IPM

M3- Aerobic Rice on unpuddled soil

1. **Land preparation:** Initially plough the field in dry condition 2 – 3 times and pulverize. After that, plough the field and level it to bring the soil to a fine tilth so as to facilitate proper sowing of seeds and to provide favourable conditions for germination.
2. **Seed & sowing:** Use high yielding medium duration rice variety (115 – 120 days). Seed rate is as per the recommended package of the location (30-35 kg /ha). Treat the seeds with carbendazim (2 g/seed) and soak in water for 10 hours followed by incubation for 12 hours. Before sowing, treat the seeds with Azetobacter @ 10 g/kg seeds. Sow the seed by drill seeder or **by hand** in lines 20 cm **apart**. Follow the uniform seed rate. Location specific hybrids may be utilized for the trials.
3. **Thinning and gap filling:** These operations should be done 15 days after sowing. Maintain optimum population in all plots (150 to 200 plants per square meter).
4. **Irrigation:** Irrigate the plot immediately after sowing and provide protective irrigation 3 days after sowing. Irrigate the field as and when required preferably at IW/CPE ratio of 1.0. Maintain the plot near saturation without stagnation of water. Consider the effective rainfall also. **Number of irrigations must be mentioned in the data sheet.**
5. **Fertilization:** Use recommended doses of phosphorus, potash and zinc. Apply half dose of nitrogen, full dose of phosphorus, 75% of potash and full dose of zinc as basal and remaining dose of

N in two splits (25% N at active tillering and 25% N along with 25% potash at panicle initiation).

6. **Weed management:** Apply Pendimethalin (PE) @ 1.0 kg a.i./ha at 3 days after sowing and hand weeding at 40 days after sowing or mechanical weeding at 20 and 40 days after sowing.

Experimental details:

Identify a suitable plot with least interference of water seepage from adjoining rice fields as **irrigation water input needs to be quantified**.

1. The selected plot should be made weed free following Stale Seed Bed Method i.e., spraying Glyphosate weedicide @ 0.75-1.00 kg a.i./ha 10 – 12 days prior to opening the fields, followed by ploughing once, allow germination of left over weed seed, and then prepare the field for sowing rice by shallow ploughing to fine tilth and levelling of the field.
2. Soil from the experimental area must be analyzed initially for texture, bulk density, soil fractions, pH, OC, EC, CEC, available nutrients N, P, K, Zn, S and soil moisture characteristics at saturation, field capacity and wilting point.
3. After dry ploughing making the soil into a fine tilth, proper levelling, main blocks are laid with provision for double irrigation channels, and leaving buffer zone of 2 m all round the blocks to minimize water interference from the adjoining plots. Sub plots are laid as per the layout. At the entry point of the plot for irrigation provision should be made to install Digital water meter for quantifying water input or water meter. **Total quantity of irrigation water applied during crop season and effective rainfall must be provided.**
4. For aerobic rice, dibble 2 – 3 seeds per hill in a well-prepared and levelled field maintaining spacing of 20 x 10 cm and irrigated and ensure proper crop stand.
5. Weed control (recommended weedicide – pendimethalin @ 0.75 to 1.0 kg a.i./ha, 2 to 3 days after sowing, followed by application

of 2, 4 D Na salt 80 WP @ 0.80 kg a.i. / ha at 20-25 days after sowing or Nominee gold @ 30-35 g a. i./ha at 4-6 leaf stage of weeds and one manual weeding , if required.

6. Since water input has to be quantified in each treatment
7. Apply fertilizer as per the treatments.
8. In case of occurrence of Fe deficiency, the problem may be corrected by suitable spray schedule (0.50% $(NH_4)_2$ Fe $(SO_4)_2$ in water at pH 5.0) after recording observations on the intensity of deficiency.
9. All weed management practices are to be followed to keep the plots weed free in all the plots.

M-4- Semi-dry rice (unpuddled)

- Semi Dry rice cultivation is followed in uplands or rainfed lowlands where there is less possibility for water stagnation in early stages of crop growth.
- Uplands or rainfed lowlands are characterized by aerobic soil in which attempt is made to impound water.
- Upland rice is grown on both leveled and sloppy fields those are not bunded and are prepared well for dry seeding.
- The rice crop solely depends upon rainfall for its water requirement.
- This system of cultivation is followed in many parts of the world, however, mainly confined to tracts that don't have adequate irrigation facilities.

M-5: Optional Method of crop establishment: Give the details of the method followed

- Identify the farmers producing consistently highest yields in your area, document the farmers' best management practices of rice and record the differences in the rice yields of the best farmers and other farmers. (Indicate the methodology followed)

III.WEED MANAGEMENT TRIALS

Trial No.	**:**	**8**
Trial code	**:**	**WMT – 1**
Name of the trial	**:**	**Testing of Thiobencarb 80 Ec against weeds of puddle DSR rice**

Introduction:

Direct seeding is becoming the popular method of cultivation which will be threatened by the predominance of weeds. Hence, there is a need to identify suitable and cost effective herbicides especially post-emergence ones. In this context, among the low dose post-emergence Herbicides,Thiobencarb , a thiocarbamate herbicide is being evaluated at different locations in the current season for its bioefficacy and efficiency in weed management of direct sown rice. The site of activity for thiocarbamate herbicides is in the aboveground meristematic tissue. It thus kills weeds by inhibiting cell division and enlargement in the roots and shoots of the seedling plants. It controls many annual grasses and some selected broadleaves, with good selectivity between rice and weeds.

Objectives

- To evaluate the bio efficacy of the Thiobencarb under different doses in puddle DSR rice
- To assess the impact of Thiobencarb on growth and weed compilations

Locations:

ICAR-IIRR, Hyderabad	**KVK, Puducherry**
IGKVV, Raipur	**RRS, Malan**

Test Crop: Rice Wet Direct Sown Rice

Variety:120-125 days duration High Yielding Variety (Local choice)

No. of treatments:7

Design: RBD

Replications: 3

TREATMENTS:

1. Thiobencarb @ 4.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
2. Thiobencarb @ 4.50 L/hawith 500 L water/ha post-emergence application at 20 DAS
3. Thiobencarb @ 5.00 L/hawith 500 L water/ha post-emergence application at 20 DAS
4. Standard check (Recommended herbicide) Pyrazosulfuron ethyl 10% @200g/ha. pre-emergence application
5. Standard Check (Recommended herbicide) Bispyribacsodium 10% @300 ml/ha. post-emergence application
6. Control (weedy)
7. Hand weeding twice

OBSERVATIONS TO BE RECORDED on Weeds:

1. Location Specific and common rice weeds information
2. Weed population species wise before herbicide application (for treatments post emergence application only)and before 1sthandweeding
3. Weed population species wise 10-15 DAHA (days after herbicide application)
4. Weed population species wise 45-50 DAS
5. Weed biomass species wise before herbicide application (for treatments post emergence application only)and before 1sthandweeding
6. Weed biomass species wise 10-15 DAHA (days after herbicide application)
7. Weed biomass species wise 45-50 DAS
8. Weed control efficiency

OBSERVATIONS TO BE RECORDED in Crop:

1. Plant height (cm),
2. No. of tillers m^2
3. Filled grains percentage per panicle
4. No. of Panicles m^2
5. 1000 grain weight (gm)
6. Grain &straw yield)

- Soil nutrient analysis is not taken up for herbicide trials.
- ***Soil samples must be sent to <u>Sponsorer for Soil microbial analysis (India Pesticides Limited Lucknow)</u>***

Trial No. : 9

Trial Code. : WMT - 2

Name of the Trial : Long term trial on weed dynamics in mono or double cropped rice system under different establishment methods

Activity 1:-

Objectives : To assess the weed dynamics in different crop establishment methods

Duration: 5 years. * The layout has to be kept permanent for five years and continue with same set of treatments in each season

Layout : Split plot,

Replications: 3

Plot size: 20 sq.m.

Locations:

Aduthurai	**Chinsurah**	**Chiplima**	**Cuttack**
Gangavathi	**Ghaghraghat**	**Jagdalpur**	**Karaikal**
Kota	**Ludhiana**	**Malan**	**Moncompu**
Nagina	**Nawagam**	**Pantnagar**	**Parbhani**
Pattambi	**Pusa**	**Puducherry**	**Ranchi**
Rewa	**Titabar**	**Tuljapur**	**Varanasi**

Cultivars: Location specific high yielding cultivar

Treatments:

Main plot:

M1 – Mechanized transplanting/Transplanting (if transplanters not availble)

M2 – Puddled direct seeding (preferably machine)

M3 – Un-puddled dry direct seeding (Line sowing)

Sub plot treatments:

T_1 - Weed free

T_2 – Weedy check

T_3 – Mechanical weeding using weeder

T_4–Chemical weed control* (pre & post emergance herbicide application)

***The same chemicals have to be repeated every year to find out the changes in resistance or diversity in weed flora.**

Fertilizer Schedule: Location specific recommendation

Observations:

1. Tillers/m^2 at MT and PI stage
2. Panicles/m^2 at harvesting
3. Total dry matter /m^2
4. 1000 grain weight g
5. Panicle weight (g)
4. Grain yield (kg/plot)
5. Straw yield (kg/plot)

<u>Weeds</u>

1. Specific and major weed information of the location
2. Weed flora composition
3. Population (Total) - Number of individual weed species/ m^2. (Specify major weeds - Grasses, sedges & broad leaved weeds in each treatment should be recorded **thrice** at active vegetative stage, panicle initiation and heading stages*
4. Dry weed biomass (total, group wise) recorded **thrice** at active vegetative stage, panicle initiation and heading stages*
5. Weed indices

Activity 2:- Entomology and Pathology - Influence of Establishment Methods on Pest and Disease incidence (IEMP)

Collaborative trial with Agronomy (New trial on Long term trial on weed dynamics in mono/double cropped rice systems)

Objective: To assess the influence of different rice establishment methods and weed management practices on insect pest and disease incidence

Treatments: Main plot treatments include 3 establishment methods out of 6 at each location and 4 weed management practices as sub-plots

Locations (8): **Aduthurai, Gangavathi, Ludhiana, Pantnagar, Pattambi, Rajendranagar, IIRR**

Treatments, replications, design, plot size, variety and layout are as per the Agronomy technical program.

Please consult Agronomist of your centre. Entomologists will record observations in all the plots

Observations will be taken in 3 establishment methods in all the sub-plots.In three replications of all the establishment methods, record observations at 15 day interval starting from 15 days of planting/sowing.

At each observation, in each replication, select 5 plants at random and record the following:

- Total number of tillers / plant ; 2) Total number of leaves/ plant
- Number of dead hearts/ plant; 4) Number of galls/ plant
- Number of damaged leaves (indicate the pest- hispa, leaf folder, whorl maggot, thrips, case worm etc./plant)
- Panicle bearing tillers / plant; White ears/ plant
- Number of BPH/WBPH/GLH per plant
- Ocuurence of Disease in each Treatment
- Any other pest observed; Natural enemy count

Trial No. : 10

Trial Code. : WMT - 3

Name of the Trial : Evaluation of cultivars for weed competitiveness under direct seeded rice systems (puddled /**unpuddled)**

Objectives : To evaluate the performance of popular cultivars for weed competitive ability and yield.

Layout : Split plot, **Replications:** 3 **Plot size:** 20 sq.m.

Locations:

Chinsurah	**Cuttack**	**Ghaghraghat**	**Malan**
Monocompu	**Nellore**	**Pantnagar**	**Pattambi**
Pusa			

Note: Suitable system of the puddled /unpuddled or both may be opted.

Main plot treatments:

T_1 - Weed free

T_2 – Weedy check

T_3 – Mechanical weeding using weeder

T_4 - Chemical weed control* (pre & post emergance herbicide application)

Sub plot treatments:

V_1 - DRRDhan 50 (Mid Early)

V_2 – DRRDhan 52 (Mid Early)

V_3 – Latest released state variety (Early to mid Early)

Fertilizer Schedule: Location specific recommendation

Weed management: Pre emergence herbicide application fb post emergence herbicide application for weed management

Observations:

1. Tillers/m^2 at MT and PI stage
2. Panicles/m^2 at harvesting
3. Total dry matter /m^2
4. 1000 grain weight g
5. Panicle weight (g)
4. Grain yield (kg/plot)
5. Straw yield (kg/plot)

Weeds

1. Specific and major weed information of the location
2. Weed flora composition
3. Population (Total) - Number of individual weed species/ m^2. (Specify major weeds - Grasses, sedges & broad leaved weeds in each treatment should be recorded **thrice** at active vegetative stage, panicle initiation and heading stages*
4. Dry weed biomass (total, group wise) recorded **thrice** at active vegetative stage, panicle initiation and heading stages*
5. Weed indices

Note: ***Any one (a) or b)) or both the experiments can be taken based on the experiment are.***

INTEGRATED PEST MANGEMENT (IPM)

Trial No.	**:**	**11**
Trial code	**:**	**WMT – 4**
Name of the Trial	**:**	**Integrated Pest Management – On farm management of insects, diseases and weeds IPMs (Entomology, Pathology and Agronomy) - Special collaborative trial**

Introduction :

Biotic stresses are the major constraints in rice production resulting in significant yield losses. In the present context, IPM is considered as one of the major approaches to achieve the goal of sustainable rice production on a profitable basis. Farmers consider IPM as an advantageous option in protecting crop from ravages of pests. However, its implementation at farmers' level is inadequate, mainly due to the unawareness of the options available, limited resources and economic feasibility. Some of these IPM options need to be refined at farm level, working with farmers in their fields and selecting technologies suitable for their situation. Thus, IPMs trial was formulated with an objective to manage pests' viz., insects, diseases and weeds in a holistic and participatory way in farmers' fields.

Objectives :

1. To validate IPM practices from a basket of options available and demonstrate to farmers the management of pests in a holistic way (including insects, diseases and weeds).

Locations:

Chatha	**Chinsurah (K+R)**	**Faizabad**	**Gangavathi**
Ghaghraghat	**Jagdalpur,**	**Karjat**	**Karaikal(R)**
Kaul	**Malan**	**Mandya**	**Varanasi**

Nagina	**Navsari**	**Nellore**	**Pattambi (K+R)**
Puducherry	**Raipur,**	**Vadgaon**	**Titabar,**

Interact with AICRIP – Entomologist and Pathologist for pest and disease management

Variety Local popular high yielding variety

Plot size Two blocks of not less than 1 hectare for each block.

Replications 5 replications. Divide each block into 5 equal sized units (each unit = one replication)

Treatments Two treatments/ blocks

i) IPM

ii) farmers practices (FP)

The package of practices to be followed in each block are given below:

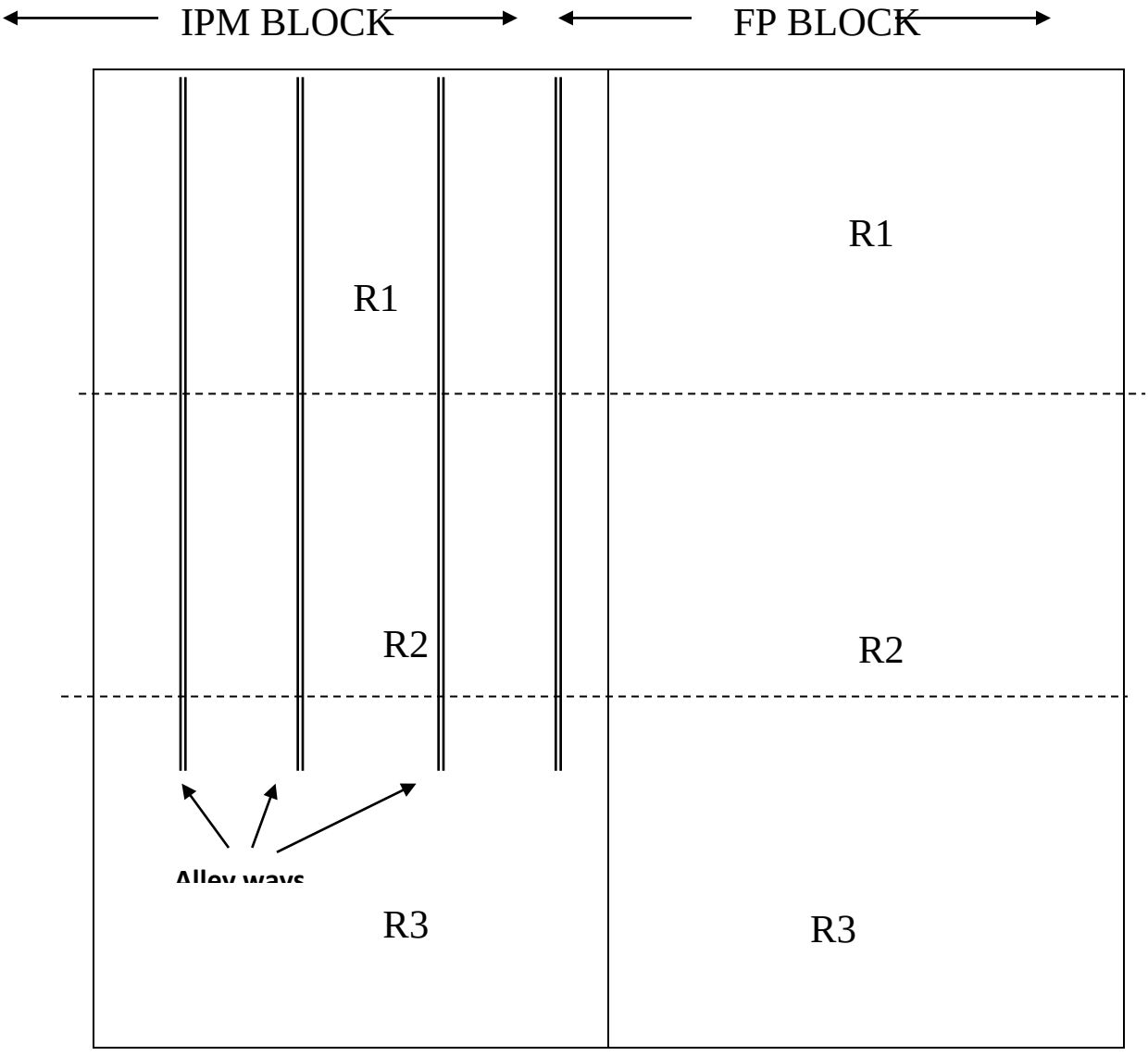
Treatment	IPM block	FP block
Nursery	❖ Apply butachlor or pretilachlor + safener @ 5 ml/lt water at 8-10 days after sowing. ❖ If weed intensity is more apply bispyribacsodium @ 8 ml/lt water at 2-3 leaf stage of weeds	❖ As per the local farmers practice. ❖ Please record the practices followed by farmers whenever you gofor observation / visit
Main field	❖ Transplant seedlings at a spacing of 20 x 15 cm. ❖ Leave alleyways of 30 cm after every 2 m or 10 rows. ❖ Fertilizers should be applied as per local recommended fertilizer dose. ❖ Apply herbicide within one week after transplanting the crop.	❖ As per the local farmers practice ❖ Please record the practices followed by farmers whenever you go for observation / visit
30 – 59DAT	❖ Depending on weed intensity spray post emergence herbicide as given N top dressing to be taken up as given in protocol using Leaf Color Chart ❖ Mid season drainage	❖ As per the local farmers practice (mention the quantities) ❖ Please record the practices followed by farmers whenever you go for observation / visit
> 90 DAT up to harvest	❖ Mark 5 x 5 m^2 area and take yield, at 5 places (5 repl.) in this block ❖ Also record the cost involved for each practice/ operation taken in IPM starting from nursery to harvest to estimate cost of cultivation as given in data sheet	❖ Mark 5 x 5 m^2 and take yield, at 5 places (5 repl.) in this block ❖ Also record the cost involved for each practice/ operation taken up by farmers starting from nursery to harvest to estimate cost of cultivation as given in data sheet

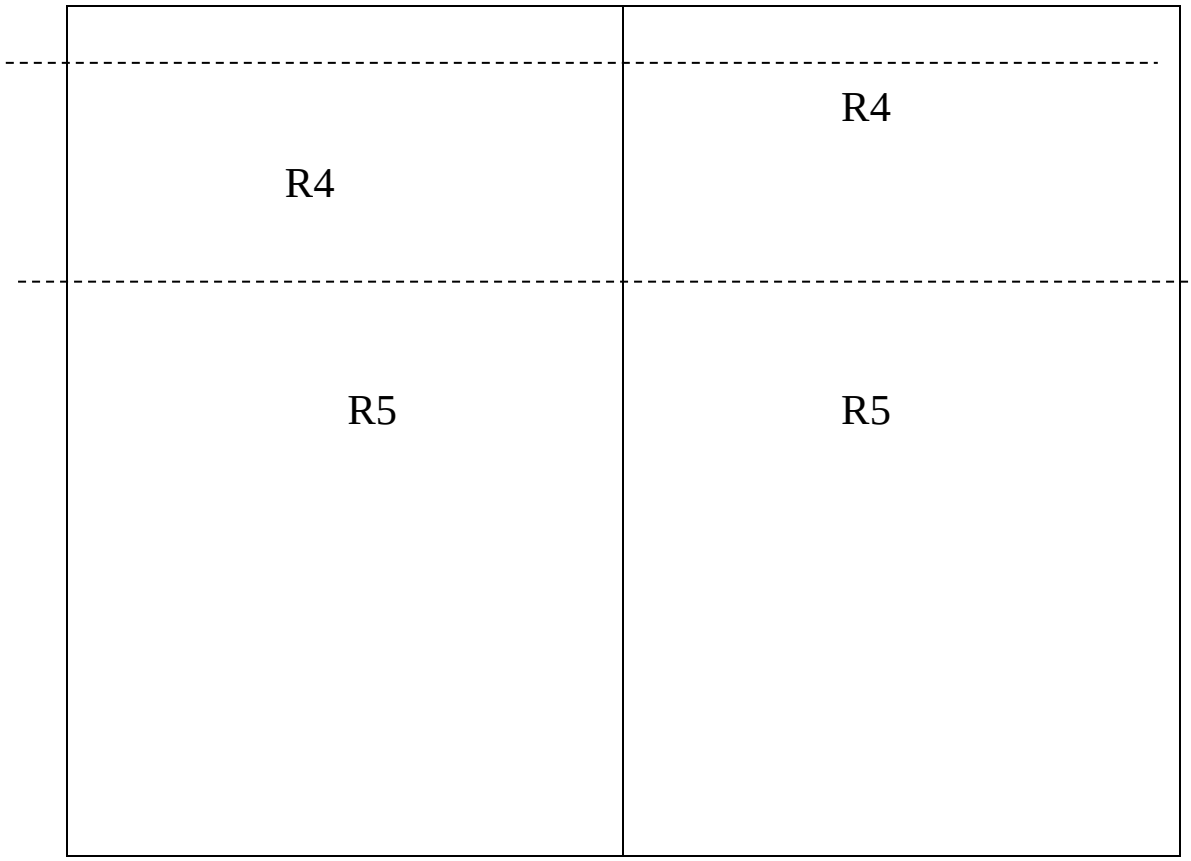
Observations to be recorded:

- Weed population (number/m^2) 30, 60 DAT
- Dry weight (gm/ m^2)of weeds at 30, 60 DAT
- Grain yield : Record the yield from 5 places of 1 x 1m area from each replication.

Note: In case of insect/ disease infestation, Inform/consult concerned PI/scientist in case of severe infestation or when in doubt about action to be taken.

LAYOUT PLAN FOR INTEGRATED PEST MANAGEMENT (SPECIAL) KHARIF 2016





A. Protocol for effective weed management in IPM Special trial (in IPM treatment)

Since the trial is being laid out in irrigated ecology, weed management both in nursery and main field are equally important.

1) <u>Nursery</u>

i. Maintain water level to avoid weeds
ii. In weed intense areas, apply Butachlor @25ml/250 m2 nursery area or Pretilachlor+ safener @ 60ml/250 m2 nursery area application at 8-10 days after sowing seed in nursery beds
iii. Raising nursery in strips of 1 m wide and leaving water canal of 0.25 m in between will help in intercultural operations

2) **<u>Main field:</u>**

Immediately after transplanting within a week

* Liquid formulation of new herbicides can be applied by mixing with sand or by foliar spray, respectively, within first week after transplanting by following the procedure outlined hereunder.

* Required quantity of herbicide (Butachlor @3literss/ha or Pretilachlor @1250-1500 ml/ha or Aniophos 1250-1500 ml/ha or Metsulfuronmethyl+chlorimuronethyl (Almix)@20g/ha) mixed with fine sand (50kg/ha) and broad casted. Or mixed in 500 liters water/ha and spray by flat Z type nozzle uniformly within 3 to 7 days after transplanting. It is necessary to maintain standing water (2-3 cm water) in the field.

Do not remove water at least 48 hours after application of herbicide.

* **Note that** under thorough land preparation and proper water management conditions this step may not be required. Take a decision on 2nd day after transplanting based on land leveling and water supply status.

Post-emergence application:

*Broad spectrum weed control – Bispyribasodium @ 250ml/ha at 2-3 leaf stage of weeds- spot application or Chlorimuron + Metsulfuron-methyl (Grasses, Sedges and Annual BLW) at 20-25 DAT @ 20 gm/ha

* If Broad leaf weeds predominate, apply 2, 4-D Na salt @ 1250-1500 g/ha at 20-25 DAT

* If grasses predominate, apply Cyhalofbutyl @1000 m/ha at 15-20 DAT or Fenoxaprop p ethyl @ 800-100ml/ ha at 25-30 DAT.

Fertilizer management: Apply top dressing nitrogen based on Leaf Color Chart (modified IIRR -LCC) supplied by IIRR. The instructions to use LCC are given on backside of LCC.

Observation to be recorded under IPM plot as well as in Farmers Practice plots:

Monitor at regular interval weed growth (Group wise no. of weeds i.e., grasses, sedges and broad leaves weeds) in 1 m2 area in each replication with the help of a quadrate. Collect all the weeds, dry them in oven at 600 C for constant dry wet and record dry weight at 20, 40, 60 DAT.

- Weed population (number/m2) 20, 40 DAT
- Dry weight (gm/ m2)of weeds at 20, 40 DAT
- Observe the changes in weed flora

It is also important to timely record and report farmer's practice being followed in FP plots. This information may also be forwarded to IIRR unit.

III. RESOURCE CONSERVATION TECHNOLOGIEs in RBCS (RCT)

Trial No. : 11

Trial code : RCT -1

Name of the trial : Conservation Agriculture / system based management practices in rice and rice based cropping systems (crop diversification) to utilise the resources and enhancing the profitability and productivity

Introduction

Conservation agriculture (CA) systems are yet to be developed for the intensive rice-based cropping systems (comprising rice plus additional cereal, legume and/or oilseed crops) that are common across India. Implementing CA in the rice-based crop system is feasible using a novel approach to establish rice (transplanting, direct wet seeding and aerobic). Further, in rabi season rice straw left out after harvesting can be used as mulch instead of adding outside mulch. The objective of the present study was to study the possibility of CA practices on rice base cropping systems to enhance the productivity of the system. Key questions were: how critical is it for increased residue retention to enable the CA system to be productive and; how long is the transition phase before the main benefits of CA for crop yield become apparent?

Objectives

- To study the effect of establishment methods on productivity of rice and on succeeding crop
- To find out the effect of kharif rice residue straw mulch on productivity of succeeding rabi crop
- To analyse nutrient uptake pattern in different rice based systems
- To calculate the profitability of the systems

Locations:

ARI-Rajendranagar	**Ghaghraghat**	**Jagdalpur(K+R)**	**Karjat (K+R)**
Patambi(K+R)	**Rewa**	**Titabar (K+R)**	**Tuljapur**
Vadgaon	**Varanasi**		

Design : Split plot design
Replications : 3
Plot size : *Kharif*: 150 m^2 for each main plot

Treatment
Main plots (Crop establishment methods)
M_1: Transplanting
M_2: Wet seeding (line sowing under puddle condition)
M3- Aerobic rice – Dry rice cultivation

Sub plots (Cropping sequences)- 9
Residue management in each main plot treatments
S_1: No residue
S_2: 15cm height of rice straw from ground
S_3: 30 cm height of rice straw from ground

Plot size of each sub plot: 50 m^2

S_1- M1S1	**S_4 –M2S1**	**S_7 -M3S1**
S_2- M1S2	**S_5–M2S3**	**S_8–M3S2**
S_3- M1S3	**S_6–M2S3**	**S_9–M3S3**

***Rabi crop may as per the location specific based on the prevailing cropping system**

- For *kharif* rice, *rabi* crops (wheat,/ rice/ maize / oilseeds/ pulse) nutrient will be applied as per the recommended package of the location

Note: Please mention recommended dose of fertilizer for all crops at the respective test location

During summer season all pulse crops will be sown under zero tillage condition

Observations:

1. Germination (%)
2. Plant density/m^2 (at 21 DAS and at maturity)
3. Tillers/m^2 (at maximum tillering)
4. Dry matter production /m^2
5. No. of panicles/m^2
6. Test weight of grains (g)
7. Weed population (number / m^2 at critical stages -30 and 60 DAS)
8. Weed dry matter (g/ m^2 at critical stages -30 and 60 DAS)
9. Cost of cultivation for each treatment
10. Grain yield (kg/plot)
11. Straw yield (kg/plot)
12. Soil fertility status (initial and after harvest of each crop)
13. Nutrient uptake by crops and soil available nutrient status
14. System productivity
15. Cost of cultivation (Rs./ha)

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.

Associated the Soil scientist of the location to collect data on nutrient uptake

*** The trial need to be conducted in both the seasons.**

Lay out of the Experiment -*Kharif* 2019

150 m^2		
Canal-		

***Rabi* 2019-20**

50 m ^{2}		
50 m ^{2}		
50 m ^{2}		

Colloboration : Entomology and Pathology

Name of the trial: Cropping Systems influence on pest incidence (CSIP)

Collaborative trial with Agronomy (CA/SM 1 – Conservation Agriculture/ System based management practices in rice and rice based cropping systems (Crop diversification) to utilise resources and enhance the productivity and profitability).

Objectives: i) To study the effect of cropping systems on carryover of insect pests in rice

ii) To assess the effect of Kharif rice residue straw mulch on insect pest incidence

Locations (7): Aduthurai, Maruteru, Karjat, Pantnagar, Rajendranagar, Jagdalpur, Pattambi

Treatments, design, plot size, variety and layout are as per the Agronomy technical program. Entomologists will be taking only observations.

Observations will be taken in all the establishment methods & cropping sequences & residue management plots

In three replications of all the establishment methods with residue management and cropping sequences, record observations at 10 day interval starting from 15 days of planting/sowing.

At each observation, in each replication, select 5 plants at random and record the following:

- Total number of tillers / plant
- Total number of leaves/ plant
- Number of dead hearts/ plant
- Number of galls/ plant
- Number of damaged leaves (indicate the pest- hispa, leaf folder, whorl maggot, thrips, case worm etc./ plant)
- Panicle bearing tillers / plant
- White ears/ plant
- Number of BPH/WBPH/GLH per plant
- Any other pest observed
- Natural enemy count and Record yield
- Occurrence of the diseases in each treatment

Trial No.	**:**	**12**
Trial code	**:**	**RCT 2**
Name of the trial	**:**	**Evaluation of promising cultivars for late planting and management for higher productivity and mitigate the effect climate change (Collaborative : Breeding and Agronomy)**

Introduction:

Late planting may be due to a number of reasons such as weather, machinery breakdown, water availability, etc. Regardless, our research has shown that delayed planting reduces yield potential of most of the varieties Furthermore, late planting pushes harvest later into fall where rains delay harvest, reduce quality and drive up drying costs. Hence it is very much essential to find out superior cultivars adopted to late planting and minimize the productivity of rice under late planting with better management practices.

Objectives:

- To evaluate the suitability of varieties for late sown conditions in comparison to early sown conditions.
- To develop suitable Agronomic management practice for enhancing productivity of late planting.

Locations (14):

Adhuthurai	**Chatha**	**Chiplima**	**Gangavathi**
IIRR, HYD	**Jagdalpur**	**Mandya**	**Nellore**
Sakoli	**Varanasi**		

This trial can be taken by others location if interested by showing their interest and with available latest release early to medium duration cultivars

Design : Split plot
Main Plots : Sowing dates: 2
M_1- Normal sowing
M_2- Late (30days after Normal)

Sub plot treatments: 4
S_1: Optimum fertiliser dose with normal spacing (20X15)
S_2: Optimum fertiliser dose with closed spacing (15X10)
S_3: Higher fertiliser dose (125 % of Recommended) with normal spacing (20X15)
S_4: Higher fertiliser dose (125 % of Recommended) with closed spacing (15X10)

If area is problem, please consider to take 2 Sub Treatments (S_1 and S_3**)**
Sowing method: Direct seeding in puddle or Direct seeding (based on the suitability of location)
Sub plots:
Entries: 10 -20
Replications: 3
Plot size : 10 m^2

Observations :

- Days to 50% flowering
- Plant height (cm)
- Total tiller number per /m^2
- Productive tiller per /m^2
- Panicle length (cm)
- No. of filled grains per panicle
- Spikelet sterility percentage
- Grain yield per plot converted to t/ha
- Straw yield per 5 plant, grain yield per square meter and grain yield per plot
- Notes on pests, diseases and lodging
- Rainfall during the crop growth (Number of rainy days)
- Maximum and minimum temperature.

***General Instructions:**

- Genotypes should be evaluated at Two levels of nitrogen 50kg/ha and 100 kg/ha
- Sow the seed in bed as thin as possible
- Transplant 25-day old seedlings, one seedling / hill.
- Gap fill within a week of planting
- Incorporate fertilizer evenly as per the trial. 50% of nitrogen after a week of DS dose and remaining 50% in two top dressing

These varieties are pooled from different parts of the country. Evaluation is done through direct seeding/transplanting based on the location.

Note: If entries have not received in time, conduct the trial under one sowing situation i.e. Late planted situation (M2 only) with four treatment.

****If the seed is available with co-operator the same can be used in the experiment***

Trial No.	**:**	**13**
Trial code	:	**RCT 3**
Name of the trial	:	**Assessing the performance and yielding ability of *kharif* sorghum hybrids in Rice–Sorghum sequence cropping system** (Collaborative : ICAR-IIRR and ICAR-IIMR)

Introduction:

In rice-fallows, sorghum cultivation was found to be high yield potential with labour and inputs intensive crop system. It is found that use of high inputs viz., pesticides, weedicides, fertilizers, labourers, and skillful management of all the innovative practices including irrigations, were resulted into the high yield. It is implied that the farmers were highly profit oriented and obtained high returns from the sorghum cultivation. Their profit margin could be further increased by mechanization and introducing standard package of practices. Keeping the yield benefits in view, the farmers innovative knowledge should be validated on their fields to develop standardize location-specific production technologies so that the productivity and soil health will sustain in long run. These innovative farmers would be able to educate and transfer the viable technologies more effectively among the other sorghum growers in rice-fallows as change agent. Further very efficient genotypes had been developed which are very much suitable for rice fallows. There is need to test in them in rice fallows of different locations to gain the benefit of the Rice sorghum cropping system.

Objectives:

- Quantifying production potential of grain sorghum in zero –tilled rice fallows.
- To develop suitable agronomic management practice for rice fallow grain sorghum

Locations:

Arundhathi Nagar	**Chinsurah**	**Cuttack**	**IIRR**
Jagdalpur	**Mandya**	**Nellore**	**Ranchi**
Ragolu			

Locations: Nandyal, Maruteru, Cuttack, Gerua, Bapatla
(Suggested by ICAR-IIMR)

Kharif -2019

Rice planting – 3 methods

T_1 - Transplanting
T_2 - Wet DSR
T_3 - Dry DSR

Replication- 5

Design: RBD

Plot size: 150 m^2

Observations :

- Days to 50% flowering
- Plant height (cm)
- Total tiller number per /m^2
- Productive tiller per /m^2
- Panicle length (cm)
- No. of filled grains per panicle
- Spikelet Sterility percentage
- Grain yield per plot converted to t/ha
- Straw yield per 5 plant, grain yield per square meter and grain yield per plot
- Notes on pests, diseases and lodging
- Rainfall during the crop growth (Number of rainy days)
- Maximum and minimum temperature.

During Rabi in Rice fallows:

Super impose the Varieties: 6-7 supplied by ICAR-IIMR for their yield potential

Season & year : Summer season, 2019-20
Time of sowing : December, 2019 (2nd fortnight)

Sorghum cultivars: 6-7; New *Kharif* Hybrids
Checks: V14 = CSH 25; V15: CSH 30;
(Supplied by the ICAR-IIMR collaborators)
Design: Split-Plot
Replications: 3

Plot size:

Gross: 4.50 x 5.00 m =22.5m2 (No. of rows: 10; Row length: 5m)
Net: 3.60 x 4.40 m=15.84 m2 (No .of rows: 8; Row length: 4.4 m)

Spacing: 45 x 10 cm; [row to row: 45cm and plant to plant 10cm].

Soil & Crop Management:

Paddy field: Sorghum crop should be sown as relay cropping before or immediately after harvest of paddy. The sorghum crop needs to be raised under Zero Tillage with two to three irrigations.
Nutrient/Fertilizer management: RDF (80:40:40 NPK kg/ha).
(Half of N, P, K should be applied as basal, and remaining half of N is to be side dressed at about 35 - 40 days after sowing coinciding panicle initiation stage).

Data to be collected:

Physico-chemical characteristics of soil :

(soil texture, pH, EC, OC, and available N, P & K) before application of treatments (at least 2-3 samples from each replication).

Soil moisture content at sowing and at harvest

- Plant stand after final thinning and at harvest (plants per net plot and /m^2).
- Days to 50% flowering and physiological maturity
- Plant height at harvest (cm)
- Number of panicles/m^2
- Grains (Number/panicle)
- 100-seed weight (g)
- Grain yield (kg/net plot),
- Dry fodder (Stover) yield (kg/net plot) at physiological maturity
- Harvest index (%)
- Nutrient (NPK) uptake by grain and stover (kg/ha)
- Economics
- Cost of cultivation (Rs./ha)
- Gross monetary returns (Rs./ha)
- Net monetary returns (Rs./ha)
- Benefit: cost ratio

Note: [Dr Aruna PI, Breeding to provide genotypes and other details)

Trial No.	**:**	**14**
Trial Code	**:**	**CRA (Climate Resilient Agriculture)**
Name of the trial	**:**	**Analysis of long term meteorological data (temperature and rainfall) for identifying the reasons for yield reduction in different rice based cropping systems**
Objective	**:**	**To determine the relative sensitivity of rice yield to changes in rainfall, Tmin and Tmax**

Rationale:

The impacts of temperature and solar radiation on rice yield remain imperfectly understood, despite decades of agronomic research. Current knowledge is based primarily on field trials and greenhouse experiments. These experimental studies indicate that increased temperature and decreased radiation can reduce yield, with the impacts varying across the plant's three growth phases (vegetative, establishment to panicle initiation; reproductive, panicle initiation to flowering; ripening, flowering to mature grain). Rice, alike other crops, also exhibits nonlinear relationships with various weather parameters, particularly temperature. Existing studies confirm that significant changes have occurred in the climate of this region during the 20th Century and that in some regions in the tropics, weather is already approaching critical levels during the susceptible stages of rice growth. Thus, the observed climatic changes (and attributed weather fluctuations) in the past may have had significant influences on rice productivity in the region.

Methodology:

Our general approach was to regress yield on weather variables (rainfall, Maximum and minimum temperature) and in some specifications, exogenously determined economic variables, whose inclusion improved the precision of the estimated weather impacts. ICAR-IIRR and its cooperating centres will collect the data on crop establishment and harvest dates, production inputs, and yields for each location in each season of each year.

The mean weekly weather data will be from a single monitoring station at each site, which was within 15–20 km from a site. This detail will enable us to construct location-specific measures of weather variables defined according to the rice plant's three growth phases (for each phase, weekly means of rainfall, Tmin and Tmax). The fact that the dataset include observations over multiple growing seasons enable us to use fixed effects to control for unobserved factors that varied across space (i.e., were unique to each location, such as soil) or time (were common to all observational locations at a given site in a given season and year, such as ambient CO_2 concentration).

Locations: All the locations (Data of all locations to be submitted in the prescribed format)

Funded and Voluntary centres

Data to be collected: Grain yield (t/ha)
Weather parameters (**rainfall, T max and T min**)

Mean weekly rainfall (1990-2018)

Year	**Standard meteorological week**											
2005	1	2	3	.	.	.	.	.	50	51	52	53
2006												
2007												
.												
.												
2015												
2016												
2017												
2018												

Mean weekly maximum temperature (2005-2018)

Year	**Standard meteorological week**											
2005	1	2	3	.	.	.	.	.	50	51	52	53
2006												
2007												
.												
.												
2015												
2016												
2017												
2018												

Mean weekly minimum temperature (2005-2018)

Year	**Standard meteorological week**											
2005	1	2	3	.	.	.	.	.	50	51	52	53
2006												
2007												
.												
.												
2018												

Rice grain yield (1990-2018)

Year	*Kharif*	*Rabi*
2005		
2006		
2007		
.		
.		
2018		

Standard meteorological week

Week No.	Dates	Week No.	Dates
1	01 Jan – 07 Jan	27	02 Jul –08 Jul
2	08 Jan – 14 Jan	28	09 Jul – 15 Jul
3	15 Jan – 21 Jan	29	16 Jul – 22 Jul
4	22 Jan – 28 Jan	30	23 Jul – 29 Jul
5	29 Jan – 04 Feb	31	30 Jul – 05 Aug
6	05 Feb – 11 Feb	32	06 Aug – 12 Aug
7	12 Feb – 18 Feb	33	13 Aug – 19 Aug
8	19 Feb – 25 Feb	34	20 Aug – 26 Aug
9	26 Feb – 04 Mar	35	27 Aug – 02 Sep
10	05 Mar – 11 Mar	36	03 Sep – 09 Sep
11	12 Mar – 18 Mar	37	10 Sep – 16 Sep
12	19 Mar – 25 Mar	38	17 Sep – 23 Sep
13	26 Mar – 01 Apr	39	24 Sep – 30 Sep
14	02 Apr – 08 Apr	40	01 Oct – 07 Oct
15	09 Apr – 15 Apr	41	08 Oct – 14 Oct
16	16 Apr – 22 Apr	42	15 Oct – 21 Oct
17	23 Apr – 29 Apr	43	22 Oct – 28 Oct
18	30 Apr – 06 May	44	29 Oct – 04 Nov
19	07 May – 13 May	45	05 Nov – 11 Nov
20	14 May – 20 May	46	12 Nov – 18 Nov
21	21 May – 27 May	47	19 Nov – 25 Nov
22	28 May – 03 Jun	48	26 Nov – 02 Dec
23	04 Jun – 10 Jun	49	03 Dec – 09 Dec
24	11 Jun – 17 Jun	50	10 Dec – 16 Dec
25	18 Jun – 24 Jun	51	17 Dec – 23 Dec
26	25 Jun – 01 Jul	52	24 Dec – 31 Dec

Supplementary information:

Particulars	
Date of sowing (*kharif)*	
Date of harvesting (*rabi*)	
Variety	
Any major disease, pest attack or reason for yield loss	
Nutrient dose applied	
Irrigated/rainfed	
Succeeding/previous crop	

Data sheet for the Parameters to be collected

Location	2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018	
Rainfall	Week no.	RF (mm)	Week no.	RF (mm)	Week no.	RF (mm)	Week no.	RF (mm)	Week no.	RF (mm)	Week no.	RF (mm)	Week no.	RF (mm)	Week no.	RF (mm)	Week no.	RF (mm)	Week no.	RF (mm)	Week no.	RF (mm)
	1		1		1		1		1		1		1		1		1		1		1	
	2		2		2		2		2		2		2		2		2		2		2	
	3		3		3		3		3		3		3		3		3		3		3	
	4		4		4		4		4		4		4		4		4		4		4	
	5		5		5		5		5		5		5		5		5		5		5	
	6		6		6		6		6		6		6		6		6		6		6	
	7		7		7		7		7		7		7		7		7		7		7	
	8		8		8		8		8		8		8		8		8		8		8	
	9		9		9		9		9		9		9		9		9		9		9	
	10		10		10		10		10		10		10		10		10		10		10	
	11		11		11		11		11		11		11		11		11		11		11	
	12		12		12		12		12		12		12		12		12		12		12	
	13		13		13		13		13		13		13		13		13		13		13	
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	27		27		27		27		27		27		27		27		27		27		27	
	28		28		28		28		28		28		28		28		28		28		28	
	29		29		29		29		29		29		29		29		29		29		29	
	30		30		30		30		30		30		30		30		30		30		30	
	31		31		31		31		31		31		31		31		31		31		31	
	32		32		32		32		32		32		32		32		32		32		32	
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	34		34		34		34		34		34		34		34		34		34	
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	36		36		36		36		36		36		36		36		36		36	
	37		37		37		37		37		37		37		37		37		37	
	38		38		38		38		38		38		38		38		38		38	
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	40		40		40		40		40		40		40		40		40		40	
	41		41		41		41		41		41		41		41		41		41	
	42		42		42		42		42		42		42		42		42		42	
	43		43		43		43		43		43		43		43		43		43	
	44		44		44		44		44		44		44		44		44		44	
	45		45		45		45		45		45		45		45		45		45	
	46		46		46		46		46		46		46		46		46		46	
	47		47		47		47		47		47		47		47		47		47	
	48		48		48		48		48		48		48		48		48		48	
	49		49		49		49		49		49		49		49		49		49	
	50		50		50		50		50		50		50		50		50		50	
	51		51		51		51		51		51		51		51		51		51	
	52		52		52		52		52		52		52		52		52		52	
	53		53		53		53		53		53		53		53		53		53	
	54		54		54		54		54		54		54		54		54		54	

Agronomy co-operators list

Funded centers:

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Note:

- *As per the Work shop proceedings the Agronomy and soil Science trials need to be conducted in collaboration and there should not be any repetition of the trials at these locations*
- *Agronomist and Soil Scientist should work together in generating the data*

Field Noting:

Sl.No	Date	Activity/ observations

Sl.No	Date	Activity/ observations

Note to Co-operators:

- No duplication of trials at each station.
- Collaborative trials need to be conducted by one section and other associated scientists will also collect data, compile and send to one of the PI of the programme.
- Consult PI on phone or e-mail for any clarification.
- Timely conduct and sending data is pre requisite for judging the best AICRIP centre.
- Conduct trials as per technical programme.
- Follow the guide lines strictly..
- Mention the required information while sending data. (for example – Variety taken, Recommended fertilizerdose, Initial soil states detail of the optional treatment etc.)
- Send the data by MIS (contact Dr. Sailaja, IIRR) also.
- Send very good pictures of experiment.

SOIL SCIENCE

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 (In both *kharif* and *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°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°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°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 150^0C. 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 37^0C. 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 metre 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.
- 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:

To identify the soil related and management constraints limiting the productivity in farmers

Fields

1. To give site specific recommendations to the farmers for higher productivity.
   The fertilizer recommendations given will be tested in the low yielding farm sites in *kharif* 2019.

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

Methodology: A Survey will be conducted in nearby villages during *kharif* 2019 involving data collection from around 40-50 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

Locations- Soil Science (7): Ghaghraghat, Jagtial, Karaikal, Pantnagar, Pusa, Raipur and Titabar.

Note: Interested cooperators **from Agronomy** discipline can take up this trial.

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: *Screening of germplasm for sodicity (kharif and rabi)*

Objective: 1) To evaluate the germplasm in sodic soils for their tolerance to sodicity.

2) To identify the efficient genotypes that tolerate soil sodicity with high productivity

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

Treatments:

kharif **-** Génotypes (20-25) – Include the recently released cultures which have been reported promising for sodic soils and advanced breeding lines.

Rabi – Same genotypes of *kharif* season can be used in *rabi*

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**:** 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, exch. Ca and Mg, SAR, available N, P, K, S, Zn, Fe, Mn
- 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, Zn, 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.

Observations:

- Damage due to pest/disease incidence and nutritional disorders. The crop has to be raised under protected conditions.
- 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, Soluble Na, Ca, Mg, K, exchangeable Ca, Mg, Available N, P, K, Zn, Fe, Mn and S before amendments are applied.
- Analyse plant samples (grain and straw) for N, P, K, Zn, Fe, and Mn drawn from each plot. Report all data replicate wise.
- 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.

Note 1**:** The evaluation of varieties will be done for sodic and saline soils with a minimum of 6 – 10 centres. Management aspects also can be included. Wherever sodic and saline soils exist and that centre does not have Soil Scientist, Agronomists can take up this trial.

Note : Same set of genotypes should be tested for two years

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

Locations (4) : Pusa, Kanpur, Mandya and Faizabad

Trial No-4: ***Screening of rice genotypes for tolerance to soil acidity (kharif)***

Objectives: 1)To evaluate the germplasm/genotypes for tolerance to soil acidity related nutrient constraints in typical locations and identify better genotypes with high productivity.

2) To study the response of genotypes to lime addition

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

Treatments: Main plots (2) – Nutrient and lime application; Sub plots (15-20): Varieties (Include all the cultures which have been reported promising in the previous years

Treatment Number	Treatment details
Main plots	Nutrient and lime application
1	Recommended NPK
2	Recommended NPK + liming material
Sub plots	Varieties (15-20). Please also include cultures found promising in the previous years and some important local cultures which have not been evaluated earlier for the test environment.

Note : Shift the experimental site to a new plot every year.

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

Observations:

1. Soil available N, P, K, OC, Texture, CEC, soil pH, Exch. Al, Fe, Reducible Fe
2. Recording of visual symptoms of Fe toxicity during crop growth. Follow standard procedures for scoring
3. Mortality % during crop growth
4. Days to 50% flowering
5. Chaffiness in grains
6. Grain and straw yield and N, P, K, Al, Fe uptake in grain and straw.
7. Important soil properties after harvest

Note: Plant Physiologist can be associated and observations to be taken by him/her

Locations (5) : Dumka (Ranchi), Hazaribagh, Moncompu, Raipur, Titabar

Trial No 5: *Yield maximization in farmers' fields using Nutrient Expert software (kharif)*

Objectives:

1. To assess indigenous nutrient supplying capacity of soils in various rice growing ecologies in various farmers' fields.
2. To compare yield and economic performance of field specific fertilizer recommendation using nutrient expert with the existing blanket recommendation for rice and farmers' practice

Design : Randomized Block Design

Replications : 3

Season : *Kharif*

Variety (Rice) **:** High yielding variety

Treatments : Nutrient management practices:

T1: Farmers' practice

T2: RDF

T3: Nutrient expert

Sources of Nutrients: Nitrogen - Urea; Phosphorus - SSP (Single Super Phosphate); Potassium- Muriate of potash; Zinc - $ZnSO_4$ (Zinc Sulphate)

Methodology: At each location, 5-10 farmers' sites are to be identified and experiment will be conducted in their fields with 3 treatments.

Observations:

1. Total tillers/$m^{2;}$ 2. Total panicles/$m^{2;}$ 3. Filled grains/panicle; 4. 1000 grain weight; 6. Grain yield/15 $m^{2;}$ 7. Straw yield/15 $m^{2;}$ 8. Initial/Final Soil nutrient status; 9. Plant nutrient (NPK) uptake at Harvest (Straw + Grain)

2. Report grain and straw yields after harvest in **kg/ha** or **tonnes/ha.**

Note: All the cooperators are requested to do the analysis of soil and plant samples for NPK and send the uptake data for report preparation.

Locations (11): Chinsurah, Faizabad, Jagtial, Karaikal, Khudwani, Mandya, Maruteru, Moncompu, Pantnagar, Puducherry and Purulia.

Trial No 6*: Bio-intensive pest management (BIPM) in rice Under Organically managed system (kharif and rabi)* (Collaborative trial of Soil Science and Entomology of IIRR) Experiment will be conducted by Entomologists

Objectives:

- To study the influence of organic farming on productivity, soil health and pest dynamics in rice.
- To develop a package of Bio-intensive pest management (BIPM) practices in organic farming.

Details of treatments	**Bio-intensive pest management (BIPM) block**	**Farmers' practice (FP) block**
Seed	Seed treatment with *Psuedomonas flourescnes* Dry seed treatment - Dress the seeds with the talc based formulation of *P. fluorescens* (@ 10 g/kg seed at the time of sowing or Wet seed treatment – Soak the seeds for 12 to 16 hours in a solution of *P. fluorescens* prepared @ 10 g/L of water or per kg seed. Seed treatment with *Azospirillum* and/or phosphorus solubilizing bacteria (PSB) or phosphorus solubilizing microorganisms (PSM) @10 g/kg seed (or) seedling root dipping in *Azospirillum* and/or PSB PSM suspension @ 600g culture for one ha land.	General POP with RFD and need based application of insecticides

Nursery	Apply vermicompost @ 500g/m^2 and rice husk ash @ 100 g/m^2 of the nursery bed and mix well with the soil at the time of preparation of the field. If vermicompost is not available, apply FYM @ 1 kg/m^2 and 100g of rice husk ash/m^2 of the nursery bed and mix well with the soil at the time of preparation of the field	
Preparation of land	Plough the field thoroughly to incorporate the weeds and straw into the soil. Ensure a smooth, level field for transplanting the seedlings. It would be better to transplant 10-15 days after incorporating organic manure.	
Fertilization	Apply 5 tonnes of FYM/ compost/ green leaf manure or 2.5 tonnes of vermicompost as basal + 300-500 kg oil cakes (ground nut cake, neem cake etc.)/ha (half as basal and half as top dressing at active tillering stage)	
Pest Management	1. Clipping of rice seedlings before transplating to remove stem borer egg mass. Avoid clipping of leaf tips at the time of transplanting in bacterial blight endemic areas 2. Mass trapping of stem borer by installing pheromone traps @ 20 numbers/ha can effectively reduce the stem borer damage. The pheromone trap is retained throughout the crop stage by replacing 3-4 times the 5 mg lure at 20 day intervals. Pheromone traps can be installed in the nursery also. 3. Growing flower borders to conserve natural	

	enemies 4. *Trichogramma japonicum* 5 cc egg cards/ha, six times weekly from first week after transplanting 5. *T. chilonis* for leaf folder management at weekly intervals from 20 days after transplanting or when the moths of these pests are observed in large numbers in the field 6. Need based application of neem formulations/ biopesticides for other defoliating pests 7. Foliar spray of *P. fluorescens* on the foliage @ 20 g/L of water. Spraying can be repeated depending on the disease severity. The application of *P. fluorescens* for a minimum of three times like seed treatment, seedling root dip and one foliar spray for protection from disease incidence.	

Average nutrient composition (%) of major nutrients of some organic manures

Source	N	P	K_2O
FYM	**0.5-0.8**	**0.4-0.8**	**0.5-0.9**
Compost	**0.5-1.5**	**0.5-1.4**	**1.4-1.6**
Vermicompost	**1.00-2.05**	**0.70-1.90**	**1.5-2.5**
Poultry litter, fresh	**1.0-1.8**	**1.4-1.8**	**0.8-0.9**
Poultry litter, very dry	**3.0-4.5**	**4.0-5.0**	**2.0-2.5**
Groundnut cake	**7.3**	**1.5**	**1.3**
Castor cake	**4.3**	**1.8**	**1.3**

Neem cake	**5.2**	**1.0**	**1.4**
Green manure (on dry weight basis) **Moisture % will be 80-85**	**2.0-2.5**	**0.4-0.8**	**0.5-1.0**

Note: Based on the average nutrient composition of the organic source used, the Soil Scientists can calculate the quantity of organic manures based on the N equivalent basis.

Observations to be recorded:

- Divide each Treatment block into 6 smaller blocks for observation purpose. Observations on pest incidence should be recorded on 10 randomly selected hills in each replication (60 hills/each treatment) at fortnightly interval.
- At each observation, record total tillers, dead hearts, silver shoots, total leaves, damaged leaves, number of plant hoppers/hill.
- At harvest record yield/m^2 randomly at 20 points in each treatment

Observations to be recorded by Soil Scientists:

Soil analysis:

- Initial soil analysis of two blocks separately for all Soil Characteristics like pH, EC, OC, available NPK status, micronutrient status and important physical properties.
- Final analysis of soils after harvest for all important properties in smaller blocks of each block.

Plant analysis:

- Grain and straw yields at harvest. Report grain and straw yields after harvest in kg/ha or tonnes/ha.

- Grain analysis for quality parameters (in brown rice and polished rice) along with hulling, milling and head rice recovery.
- **Cooperators should analyse grain and straw samples for nutrient concentration of major nutrients** and submit the data for report preparation.
- **If possible, grain quality parameters such as, N, P, K, Zn and Fe in brown rice/polished rice can be reported**

Note: If quality analysis is not available at the centres, send grain samples to the PI, (Soil Science), IIRR immediately after harvesting.

Number of samples: 2 samples in each small block of 6 in two big blocks (2x6=12)

Total number of samples= 24 (12+12-soil and plant samples).

Locations (4): Chinsurah, IIRR, Puducherry and Titabar

Trail 7: *Residue management in rice based cropping systems (kharif and rabi)*

Recycling of residues especially rice and wheat straw addition in agricultural field with respect to increase in crop productivity and enhance the soil quality has played a crucial role in ecological protection and sustainable agricultural production. And also, burning of straw/residues, mainly caused by the need of a short turnover period between *kharif* rice and *rabi* rice/non-rice crops and this has become one of the main sources to greenhouse gas emission and air pollution.. There are various options for incorporating the straw into the field as alternatives for burning viz., incorporation, mulching, composting etc. Keeping in view the growing importance of organic farming and to avoid burning this trial is being proposed.

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	Absolute Control
T2	Recommended Dose of Fertiliser (100%)
T3	Rice/Wheat residue (50% N) +50% chemical fertilizers (NPK)
T4	Rice/Wheat residue 50% N + GM/GLM 50%N
T5	Rice/Wheat residue 50% N + Vermicompost (VC) 50%N
T6	Rice/Wheat residue (50% N)+50% chemical fertilizers (NPK)+ZnSO4 (soil application)+Borax (soil application)

*Based on availability of microbial culture, two optional treatments can be taken up as below.

T7: Residue 100% N + Efficient microbial culture

T8: Residue 100% N + Trichoderma culture

**** The organics (residue/GM/GLM/VC) 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)

Observations to be recorded:

Soil analysis:

- Initial soil analysis of fields separately for all Soil Characteristics like pH, EC, OC, available NPK status, micronutrient status and important physical properties.
- Final analysis of soils after harvest for all important properties
- Analysis of straw for its NPK content
- Microbial properties such as microbial count, microbial biomass carbon, enzyme activities (dehydrogenase, FDA, urease, phosphatase etc).

  (**Note**: If facilities are not available, collected fresh samples may be sent to IIRR well in advance)

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, Zn, Fe, Mn and Cu.
- 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 grams grain samples to IIRR immediately after harvesting.

Locations (9): Ghagharaghat, IIRR, Karaikal, Khudwani, Maruteru, Pantnagar, Puducherry, Pusa, Raipur.

Trial 8: *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 identified as promising 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.
- Days to 50% flowering
- 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.

Locations (8) :) Karaikal, Khudwani, Mandya, Maruteru, Pantnagar, Purulia (Hathwara), Pusa, Raipur

List of cooperating centres of Soil Science and allotment of trials: 2019-20

S. No	Locations	Funded/Voluntary	Trial 1		Trial 2	Trial 3		Trial 4	Trial 5	Trial 6		Trial 7		Trial 8		Total	
			K	R	K	K	R	K	K	K	R	K	R	K	R	K	R
1	Kanpur	Funded				x	x					x	x	x		3	2
2	Karaikal	Funded			x				x			x	x	x		4	1
3	Mandya	Funded	x	x		x			x					x		4	1
4	Maruteru	Funded	x	x					x			x	x	x		4	2
5	Moncompu	Funded						x	x							2	-
6	Pantnagar	Funded			x				x			x	x	x		4	1
7	Pusa	Funded			x	x						x		x		4	-
8	Titabar	Funded	x	x	x			x		x				x		5	1
9	Chinsurah	Voluntary			x				x	x	x					3	1
10	Dumka (Ranchi)	Voluntary						x								1	
11	Faizabad	Voluntary			x	x			x	x						4	-

12	Ghaghraghat	Voluntary			x							x	x			2	1
13	Hazaribagh	Voluntary						x								1	
14	Jagtial	Voluntary			x				x							2	
15	Khudwani	Voluntary							x			x				2	
16	Puducherry	Voluntary							x			x				2	
17	Raipur	Voluntary						x				x		x		3	
18	Purulia (Kolkata)	Voluntary							x					x		2	
Total trials allotted			**3**	**3**	**8**	**4**	**1**	**5**	**11**	**3**	**1**	**9**	**5**	**9**		**50**	**10**

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

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

Locations(3): Mandya, Maruteru, Titabar

Trial No.2: **Soil quality and productivity assessment for bridging the yield gaps in farmers' fields**

Locations (7): Ghaghraghat, Jagital, Karaikal, Pantnagar, pusa, Raipur and Titabar

Trial No.3: **Screening of germplasm for sodicity**

Locations (4) : Faizabad, Kanpur, Mandya and Pusa

Trial No.4: **Screening of rice genotypes for tolerance to soil acidity**

Locations (5): Dumka (Ranchi), Hazaribagh, Moncompu, Raipur and Titabar

Trial No.5: **Yield maximization in farmers' fields using Nutrient Expert software**

Locations (11): Chinsurah, Faizabad, Jagtial, Karaikal, Khudwani, Mandya, Maruteru, Moncompu, Pantnagar, Puducherry and Purulia

Trial No.6: **Bio-intensive pest management (BIPM) in rice Under Organically managed system**

Locations (3): Chinsurah, Faizabad and Titabar

Trial No.7 : **Residue management in rice based cropping systems**

Locations (9): Ghagharaghat, Kanpur, Karaikal, Khudwani, Maruteru, Pantnagar, Pusa, Puducherry and Raipur

Trial No.8: **Screening of rice germplasm for Nitrogen Use Efficiency (NUE)**

Locations (7): Kanpur, Karaikal, Mandya, Maruteru, Pantnagar, Pusa, Purulia (Kolkata), Raipur and Titabar

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PLANT PHYSIOLOGY

Experimental details of Plant Physiology Programme for Kharif - 2019

IMPORTANT:

1. **Strictly adhere to the technical program to the possible extent**
2. **Grain yield and TDM must be reported as g/ m^2 FOR ALL THE TRIALS.**
3. **No. of replications minimum three.**
4. **Check the data before uploading on MIS**
5. **No alphabets or zeros in the data sheet**
6. **Silicon experiment has to be done in 500 m2 area.**
7. **Photographs are to be taken during the life cycle for each of the experiments.**

Trail 1: Influence of silicon on improving abiotic stress tolerance in rice genotypes

Objective (a) To study the effect of applied silicon on rice yield.

(b) Uptake of silicon in the tissues at different growth stages.

(estimation of ash content in different plant parts as a surrogate parameter for tissue silicon content)

Total Silicon content to be determined in the leaves and stem at harvest

Locations: CHN, CBT, NRRI, IIRR, KJT, KRK, MTU, PNR, PTB, REWA, TTB, Ranchi,

No. of Varieties: 8+1 varieties

1. IIRRH-122
2. IIRRH-131
3. IIRRH-132
4. HRI-174
5. KRH-4
6. JKRH-3333
7. US-314
8. 27P63
9. SAHABHAGIDHAN

Design : RBD/Split-plot with 3 reps & 10*20 cm spacing of 500/m2 plot size.

Fertilizer dose : 100N- 45P_2O_5- 60K_2O kg/ha. (P & K as basal dose)

N-Splits : 1st 50% of scheduled N at 10-15 days after planting
2nd 25% of scheduled N at active tillering
3rd 25% of scheduled N at panicle initiation (PI)

Silicon Treatments : 4

T-1 Control (do not apply any chemical and follows the same package of practices)

T-2 Spray at 0.6% silicon at tillering, PI, 50% flowering and milky grain stages.

***Most Important Treatment applications: silicon (ortho Silicilic acid) @ 400 ml in 200 litres/acre water (complete 200 litre water has to be given)**

T-3 silicon + water stress (Water stress to be imposed by withholding irrigation 12 days before flowering and again 10 days after anthesis (Total duration of stress will be 22 days)

T4 Water Stress only.

Leaf water potential or Relative water content (RWC) of leaves must be measured during stress imposition (every 2 days) and after relief from the stress.

Amount of raifall received throughout the crop growth period should be recorded.

Date of Sowing :

Date of Planting :

<u>Observations</u>:

Soil analysis: at initial stage and also at harvest stage:

- **Soil pH**
- **EC**
- **Organic contents**
- **Available NPK contents**

Agronomic Data:

- **Tiller population (number of tillers/m2), Plant height (cm) at flowering**
- Phenological: date of sowing & planting, days to 50% flowering and maturity.
- Leaf area**,** leaf wt., culm wt., panicle wt. TDM g/m2 at maximum tillering, PI, flowering & maturity-must
- **Yield attributes at maturity: shoot wt, panicle wt, total dry matter. g/m2 , pan no/m2, grain no/m2, spk no/m2, grain no/panicle, spk no/panicle, 1000 grain wt (g), grain yield g/m2, HI (%)**
- **Silicilic acid in leaves at three stages**

Sample to be collected at tillering, PI and flowering stages for silicon estimation and to be sent to Head Quarters.

Procedure for silicon estimation provided PDF separately.
If facility not available please collect the sap in eppendorf tubes, properly label and hand over to the ATCRIP team visiting your location. The procedure for collection of cell sap is Small pieces of leaf tissue, poured in a plastic syringe (Please remove the needle) and extract by pressurizing the piston. The sap coming out from the syringe 2=5 drops is sufficient and stored at cool temperature (Before handing over a drop of sodium hypo chlorite may be added preferable to avoid pathogenicity).
Estimation of silicilic acid (Not silica) : (SEE Kimio saito et al soil Sci and Pl. Nutrition 2005 29-36) from dry samples also can be done
USE ONLY PLASTICWARE WHILE PREPARING SOLUTIONS AND FOR STORAGE.
STOCK SOLUTIONS CAN BE STORED IN REFRIGERATOR

1. Extraction solution (Called HF solution)
(1.5 M Hydro Fluoric acid-0.6M Hcl)
Combine 1 Vol of conc HCl (36%) + 1 vol of HF (49%) + 18 mi DD water
To prepare 200 ml of HF add 10 ml of HCl +10 mi of HF + 180 ml of water

2. Reagents for assay

a. 0.5 M boric acid soln (stock)
b. 0.1 M boric acid working soln (0.5M dilute)
c. 0.5 M Sodium Molybdate solution
d. 0.8 M Sulfuric acid (stock soln)
e. 0.25 M working Molybdate soln; 1 Vol of Na molybdate + 1 vol of 0.8 M sulfuric . (Always prepare fresh before assaying)
Extraction: 0.5 g dry tissue or 10 micro litre sap (prefer sap- low vol) immerse in 10 ml HF soln and add 40 ml water (plastic only) stir and keep overnight or more than 6 hrs . Supernatant for assay as follows
Reaction mixture (10 ml total volume)
0.1 M boric acid 2.0 ml: Molybdenum (working soln) 2.0 ml: supernatant extracted 0.1 ml: 0.1 M citric acid 4.0 ml: water (Double distilled 1.9 ml
Mix well for 3-5 mins so that the solution turns yellow. Read OD 400 nm .Use plastic cuvettes only
Na silicate as standard solution (details separate mail PDF arranged)
Do not use Glass or Quartz cuvettes

Trial 2: Phenotyping of elite rice genotypes for Drought Tolerance

Objective: To screen the elites for their drought tolerance under field condition.

Locations: CBT, NRRI, PTB, REWA, TTB (Rabi Season), Raipur, Ranchi

Entries: Listed below (Varieties)

1	RFU 301	9	RFU 309	17	RFU 317	25	RFU 325
2	RFU 302	10	RFU 310	18	RFU 318	26	RFU 326
3	RFU 303	11	RFU 311	19	RFU 319	27	RFU 327
4	RFU 304	12	RFU 312	20	RFU 320	28	RFU 328
5	RFU 305	13	RFU 313	21	RFU 321	29	RFU 329
6	RFU 306	14	RFU 314	22	RFU 322	30	RFU 330 (LC)
7	RFU 307	15	RFU 315	23	RFU 323		
8	RFU 308	16	RFU 316	24	RFU 324		

Design : RBD with 3 replications and a suitable plot-size

Treatments : 2 (Rainfed and Irrigated). (as decided in the workshop, one irrigated control should be maintained besides normal rainfed condition. This will facilitate to compute required drought indices:

Fertilizer dose: 100N- 45P_2O_5- 60K_2O kg/ha.(P & K as basal dose)

N-Splits: 1st 50% at or just before sowing
2nd 25% at active tillering
3rd 25% at panicle initiation (PI)

Date of Sowing :
Date of Planting:

Observations:

1) Daily Weather data on Rainfall, Temperature, Relative Humidity, Wind speed, Solar Radiation and Sunshine Hours from Jan-Dec, 2016
2) Phenological date of sowing, days to 50% flowering and maturity.-must (preferably for individual genotypes)
3) Date of actual harvest (genotype –wise)
4) **MUST**: Soil moisture status at field capacity and wilting point. Please ensure to give soil characteristics and fertility levels wherever possible.
5) **MUST**: Soil moisture status at 20 cm depth during drought spell (Please specify actual dates during each dry spell period with no rain continuously for more than 7-days)-must
6) Plant height (Soil level to the uniform canopy top level) at flowering
7) **MUST**: TDM at flowering and at maturity
8) ***MUST : Collect 3 plants/hills from each treatment count the tiller number, record the dry weight of leaves, stem and panicle separately (individually for all the 3 plants) at flowering stage and at maturity (very important). Stem weight should be collected after removing the leaves and leaf sheath at both the stages.***
9) ***MUST : Collect 3 panicles at early grain filling stage (milk stage) and at maturity from each*** **treatment and record the panicle weight and grain weight individually for each of the 3 samples (very important).**
10) ***Collect 3 fully grown leaves from each treatment genotype wise at flowering stage and measure the length and width with a scale and record the dry weight of indiviaul leaves after drying (Very important)***
11) Grain yield data at harvest (panicle no/m2, grain no/pan, Spikelet no/pan, grain no/m2, spikelet no/m2, 1000 grain weight, grain yield/(g/m2), total dry matter/ (g/m2) and HI (%)
12) Yield components and grain yield at harvest on sq.m land area basis. Also please convert to Kg/tonnes per hectare as suggested. **Check for any discrepancies before dispatching the data.**

Note: the observations 9, 10, 11 are very important and must be recorded as they will be used as input to drought susceptibility indexes.

Trial 3: Evaluation of rice genotypes for heat tolerance suitable for future climate

Objective: To investigate the differences in the terminal heat stress tolerance in elite rice genotypes.

Locations: CHN, NRRI, IIRR, MTU, PNR, PTB, REWA, TTB

Provide the uniform size and style of the heat tunnel proposed (minimum height of the tunnel should be two meters across the locations)

Genotypes *30*

1	HT-901	7	HT-907	13	HT-913	19	HT-919	25	HT-925
2	HT-902	8	HT-908	14	HT-914	20	HT-920	26	HT-926
3	HT-903	9	HT-909	15	HT-915	21	HT-921	27	HT-927
4	HT-904	10	HT-910	16	HT-916	22	HT-922	28	HT-928
5	HT-905	11	HT-911	17	HT-917	23	HT-923	29	HT-929
6	HT-906	12	HT-912	18	HT-918	24	HT-924	30	HT-930

Design : Split-Plot
Treatments : Two (Treated and Control)
Fertilizer dose : 100N- 45P_2O_5- 60K_2O kg/ha.(P & K as basal dose)
N-Splits : 1st 50% at 10-15 DAP
2nd 25% at active tillering
3rd 25% at panicle initiation (PI)

Date of Sowing :

Date of Planting :

Methodology: The genotypes needs to be transplanted in two blocks/strips, one for control and another block/strip for imposing terminal heat stress by covering the block/strip with polythene sheet supported by a metal frame or bamboo sticks like a "tunnel" IMMEDIATELY AFTER PI STAGE (BEFORE ONSET OF

FLOWERING) stage until maturity. Control block/strip should be kept uncovered. Leave at least 10 cm space between polythene sheet for sufficient ventilation. Each entry should be sown in 3 rows of 1.5 meter length maintaining 20 cm spacing between rows and recommended plant to plant distance. Leave one blank row between the entries. Each row will be treated as a replication and all the observations needs to be recorded for each row separately. A minimum-maximum thermometer needs to be installed inside the tunnel and both minimum and maximum temperatures needs to be recorded everyday inside the tunnel.

Observations :

1. Daily Weather data on Rainfall, Temperature, Relative Humidity, Wind speed, Solar Radiation and Sunshine Hours during the crop growth period
2. Phenological: date of sowing & planting, days to 50% flowering and maturity.
3. Date of actual harvest (genotype –wise)
4. Plant height, leaf wt., stem wt., panicle wt. and total dry matter (g/m2), at flowering
5. Total dry matter produced at harvest
6. Grain yield data at harvest (panicle no/m2, grain no/pan, Spikelet no/pan, grain no/m2, spikelet no/m2, 1000 grain weight, grain yield/(g/m2), total dry matter/ (g/m2) and HI (%)
7. **Chlorophyll content at flowering and at early seed filling and late seed filling stages.**
8. **Stem wt. to be recorded at flowering stage and at harvest (select 3 plants (hills) at flowering and harvest resume leaves and determine column wt.). PLEASE ENSURE THT ONLY STEM WEIGHT IS RECORDED (WITH OUT LEAF SHEATH AND LEAVES) AT BOTH THE STAGES.**

Where facilities exists, Chlorophyll fluorescence parameters, leaf photosynthetic characteristics and chlorophyll a & b t content through solvent extraction method may be recorded at early and late seed filling stages in both control and heat stress plots.

Trial 4: Physiological characterization of selected genotypes for multiple abiotic stress

Tolerance

Locations : CBT, NRRI, FZB, KJT, KRK, MTU, PNR, PTB, REWA, TTB, Ranchi

(Only germination and vigour in the laboratory situations)

1. **Anaerobic germination,**
2. **Salinity**
3. **Drought**
4. **Low temperature**

Genotypes: 21 varieties.

1	MAS-501	7	MAS-507	13	MAS-513	19	MAS-519
2	MAS-502	8	MAS-508	14	MAS-514	20	MAS-520
3	MAS-503	9	MAS-509	15	MAS-515	21	MAS-521
4	MAS-504	10	MAS-510	16	MAS-516	22	MAS-522
5	MAS-505	11	MAS-511	17	MAS-517	23	MAS-523
6	MAS-506	12	MAS-512	18	MAS-518		

Please grow seedlings in Hoagland solution (which is control) if available

Water stress: 1% Mannitol and 2% Mannitol
NaCl stress: 200 mM (Water Potential: -1.26 MPa: pF 4.11)
Low temperature: 8-10 In refrigerator.

Change solutions once in every two days. Drain completely rinse three –four times with fresh solutions if possible so as to avoid increased stress level due to Mannitol and NaCl.
Experiment may be continued for one month and seedling vigour, germination and other related parameters may be taken against control. Maintain uniform temperature and replications (August-September ideal for this).

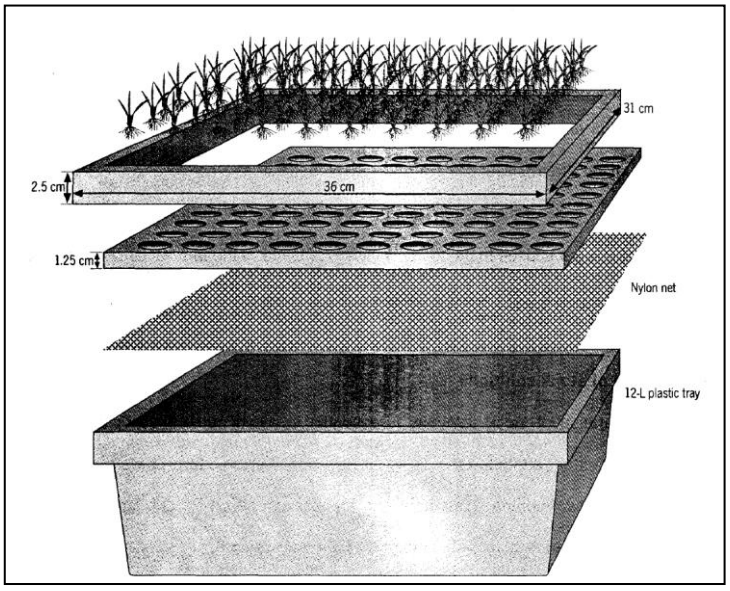
After germination, collect at least 5 seedlings per replication and record dry weight of leaf, root and stem separately at regular time intervals (2, 6, 10 and 15 days after germination) for each seedling. Please keep the number of seedlings same for each replication.

SCREENING FOR ANAEROBIC GERMINATION POTENTIAL:

1. At first, the seeds of different rice genotypes should be preheated at 50℃ for 2-3 days.
2. The soil to be used for this experiment should be dried and dusted properly so that there are no clots.
3. Then the plastic tub (15 cm in height) should be filled up with 3 cm of dried soil and the seeds should be directly sown on the soil at a depth of 1 cm. Immediately after sowing, the tubs should be filled with water without disturbing the upper soil, so that there is 10 cm of standing water inside the tub.
4. Inside tubs, there will be a single row for each genotype, where at least 20 seeds should be sown in a row. This way, each genotype should be replicated at least 3 times.
5. The control set should also be sown in similar way, but except standing water, there should be keeping adequate moisture in the soil.
6. The experiment should be continued for 21 days from the date of sowing.

SCREENING FOR SALINITY TOLERANCE:

1. Screening for salinity tolerance need to be carried out hydroponically at early vegetative stage of the plants i.e. when the plants reaches 3-4 leaf stage.
2. For this floating Styrofoam panel as shown in the figure need to be prepared (as per the size of the tray using thermocol sheet, mosquito nets and adhesive). The Styrofoam panel should have 10-12 × 8-10 holes.



3. Individual accession need to be grown as single line along with standard check lines and will be replicated at least thrice.
4. The tray need to be filled with a nutrient solution comprising of both macro and micro nutrients (as shown in the table) and should have a pH of 5.5

Table:1 Preparation of stock solution

Element (Macronutrient)	**Reagent (AR grade)**	**Preparation (g / L solution)**
N	Ammonium nitrate (NH_4NO_3)	91.4

P	Sodium phosphate, monobasic monohydrate ($NaH_2PO_4.H_2O$)	35.6
K	Potassium sulphate (K_2SO_4)	71.4
Ca	Calcium Chloride, Di-hydrate ($CaCl_2.2H_2O$)	117.35
Mg	Magnesium sulphate, 7- hydrate ($MgSO_4.7H_2O$)	324.00
Micronutrient Dissolve each reagent separately and mix in 500 mL of distilled water, then add 50 mL of conc. H_2SO_4 and make up volume to 1 L		
Element (Micronutrient)	**Reagent (AR grade)**	**Preparation (g / L solution)**
Mn	Manganous Chloride, 4- hydrate ($MnCl_3.4H_2O$)	1.5
Mo	Ammonium Molybdate, 4-hydrate [$(NH_4)_6Mo_7O_{24}.4H_2O$]	0.074
Zn	Zinc Sulphate, 7-hydrate ($ZnSO_4.7H_2O$)	0.035
B	Boric acid (H_3BO_3)	0.934
Cu	Cupric sulphate, 5-hydrate ($CuSO_4.5H_2O$)	0.031
Fe	Ferric chloride, 6-hydrate ($FeCl_3.6H_2O$)	7.7
	Citric acid, monohydrate ($C_6H_8O_7.H_2O$)	11.9

Table 2. Preparation of working nutrient solution

Element	**Reagent**	**mL of stock required solution /1 L of working nutrient solution**	**Concentration of element in ppm**
(Macronutrient)			
N	NH_4NO_3	1.25	40
P	$NaH_2PO_4.H_2O$	1.25	10
K	K_2SO_4	1.25	40
Ca	$CaCl_2.2H_2O$	1.25	40
Mg	$MgSO_4.7H_2O$	1.25	40
(Micronutrient)			
Mn	$MnCl_3.4H_2O$	1.25	0.50
Mo	$(NH_4)_6Mo_7O_{24}.4H_2O$	1.25	0.05
Zn	$ZnSO_4.7H_2O$	1.25	0.01
B	H_3BO_3	1.25	0.20
Cu	$CuSO_4.5H_2O$	1.25	0.01
Fe	$FeCl_3.6H_2O$	1.25	2.00

Preparation of working solution:-

Take 1.25 ml/L of each nutrient solution (Micro& Macro) and make up the volume as per need.

5. During the experiment, the solution need to be checked every day for maintaining the pH of the solution. If the pH shifts too far, then it is better to replace the solution.
6. Before starting the experiment, the seeds of each genotype needs to be pre-heated in hot air oven for 3-5 days at 50°C to break seed dormancy (if any).
7. The surface sterilized seeds need to be placed in petridishes with moistened filter papers and incubated at 30°C (or at Room Temperature) for 48 hours to germinate.
8. These pre-germinated seeds should be placed in the individual holes of the Styrofoam panel. Two seedlings per hole.
9. Initially, these seedlings should be kept in normal water for 2-3 days.
10. After that it need to be kept in nutrient solution (as described earlier).
11. After 5 days of growth in nutrient solution, salinity stress need to be imposed in one set of trays, whereas the other set would be kept as such for control.
12. Salt stress need to be imposed as 6 dS m^{-1} NaCl solution (approximately 60 mM NaCl i.e. ~3.0 g NaCl/L solution would give required level of E.C.) for initial two days. After two days it should be increased to 12 dS m^{-1} NaCl solution (approximately 120 mM NaCl i.e. ~6.0 g NaCl/L solution).
13. Visual scoring of the genotypes should be started (as mentioned below) as soon as appearance of the salt specific symptoms. Scoring should be continued until 60% of the plants of most susceptible genotype reaches the score of '9'. Genotypes should be ranked based on the final scoring at this stage.

Table 1: Modified standard evaluation score (SES) of visual salt injury at seedling stage.

Score	Observation	Tolerance
1	Normal growth, no leaf symptoms	Highly tolerant
3	Nearly normal growth, but leaf tips or few leaves whitish and rolled	Tolerant
5	Growth severely retarded; most leaves rolled; only a few are elongating	Moderately tolerant
7	Complete cessation of growth; most leaves dry; some plants dying	Susceptible
9	Almost all plants dead or dying	Highly Susceptible

Observations to be recorded:

1. Visual scoring
2. Root length, shoot length and root & shoot dry weight at the end of the experiment
3. Total chlorophyll content of the leaf at the end of the experiment
4. Na^+ & K^+ content of the root and shoot at the end of the experiment if Flame Photometer is available. Otherwise, dry samples of root and shoot may be sent at ICAR-NRRI, Cuttack for analysis.

Method for estimation of Total Chlorophyll Content:

1. At the end of the experiment, 50 mg of leaf tissue 50 mg should be collected and chopped before suspending it in 10 mL of 80% acetone and mixed well.
2. The test tubes then should be kept inside normal freezer (at 4 ^oC) for 48 hours.

3. Concentration of chlorophyll a, b and total chlorophyll should be quantified in samples by reading the optical density of the solution at 663 and 645 nm using a spectrophotometer.
4. The samples need to be analysed in triplicates.
5. The amount of chlorophyll content should be calculated as per the following formula -

Chlorophyll a (mg/g) = 12.21 (OD_{663}) – 2.81(OD_{645}) × V/W x 1000

Chlorophyll b (mg/g) = 20.93 (OD_{645}) – 5.03(OD_{663}) × V/W x 1000

Total chlorophyll content (mg/g) = Chlorophyll a + Chlorophyll b

Method for estimation of tissue Na^+ & K^+ Content:

1. Both root and shoot tissue samples should be washed thoroughly and carefully with distilled water to remove all contaminants before drying.
2. After washing the samples should be oven dried at 65 °C until constant dry weight of the samples is achieved.
3. The dried plant material need to be powdered by grinding and 50 mg dried sample should be placed in a 25-mL test tube.
4. Tissue extraction for Na^+ and K^+ should be done with 1.0 N HCl at 30 °C for 48 h.
5. Thus, obtained tissue extracts need to be diluted and filtered using Whatman #1 filter paper and again the volume should be made up to 25 mL using distilled water.
6. The Na^+ and K^+ contents in the tissue extracts need to be determined using Flame Photometer having Na^+ and K^+ filters.

Trial 5: SCREENING FOR SUBMERGENCE TOLERANCE:

Locations: CBT, NRRI, FZB, PTB, TTB,

***Genotypes**: 17*

1	SUB 101	6	SUB 106	11	SUB 111	16	SUB 116
2	SUB 102	7	SUB 107	12	SUB 112	17	SUB 117
3	SUB 103	8	SUB 108	13	SUB 113		
4	SUB 104	9	SUB 109	14	SUB 114		
5	SUB 105	10	SUB 110	15	SUB 115		

Screening using field tanks (wherever available) or in pots

1. Before sowing the seeds should be pre-heated at 50 °C for 2-3 days for breaking the seed dormancy (if any).
2. The seeds need to be directly sown inside the tanks using wet-bed direct sowing method.
3. Each genotype should be sown in 2 rows (min.) with 3 replications with a row to row spacing of 20 cm and plant to plant spacing of 15 cm.
4. Germinated seedlings should be grown normally till 20–25 days without submergence stress.
5. Plant height (average of 5 plants/genotype per replication) and number of hills per genotype per replication (total numbers) should be recorded before the imposition of submergence stress.
6. Then the plants should be subjected to the submergence stress in the form of standing water, where tanks should be filled with 80-

100 cm of water and the level of water must be 20-25 cm above the top of the plant canopy.

7. The level of water should be maintained for 14 days after imposition of submergence stress inside the tanks.
8. After 14 days of submergence stress, water should be drained out from the tanks (de-submergence), and initially plant height, the number of hills will be counted from the plants.
9. Finally, the de-submerged plants should be allowed to grow 5 days in normal condition and the number of survived hills should be calculated for each genotype.
10. Same experiment may be conducted in pots of 10 cm size and small cemented tanks. In case of pot experiment, it is better to put 2-day old germinated seedlings in the pot (3 seedlings per pot) with minimum 5 replications, where 1 pot serves as 1 replication. Rest of the protocol is same.

Observations to be recorded:

1. Plant height, Number of hills/plants per genotype should be recorded before and after imposition of stress.
2. Survival percentage should be calculated by the following formula:

   Survival Percentage (%) = (No. of hills present after submergence / No. of hills present before submergence) × 100
3. Total starch content of the leaf should be estimated before and after imposition of stress.

Method for estimation of Starch Content:

i. Dry leaf samples (~200 mg) should be crushed thoroughly, mixed with 10 ml of 1(N) HCl, and kept in a glycerine bath at 112 ℃ for 30 minutes.
ii. Then filter the sample for 2-3 times.
iii. The extract should be collected and final volume should be made up to 25 mL with the help of distilled water.
iv. An aliquot should be prepared (0.5 mL-1.0 mL) of above extract and volume make up to 2.5 mL with the help of distilled water.

v. Then the samples should be mixed with 10 mL of freshly prepared anthrone reagent. (100 mg of anthrone will be mixed with 100 ml of chilled concentrated sulphuric acid).
vi. Then the mixture should be boiled for 15 minutes in water bath.
vii. Finally, cooled sample should be measured at the wavelength of 620 nm.
viii. A blank (without the aliquot) and appropriate Glucose standard should be run at the same time.
ix. Final value of starch content should be calculated as the Glucose value (obtained from the std. curve of glucose) × 0.9 taking into consideration of appropriate dilution factor used for the estimation.

Trial 6: Screening of rice varieties for tolerance to low-light stress

Objective: To screen the elites for their low light tolerance under field condition.

Locations: NRRI, IIRR, KJT, MTU, PNR, TTB, and RAIPUR

Entries: Listed below (Varieties)

1	LLS 101	7	LLS 107	13	LLS 113
2	LLS 102	8	LLS 108	14	LLS 114
3	LLS 103	9	LLS 109	15	LLS 115
4	LLS 104	10	LLS 110	16	LLS 116
5	LLS 105	11	LLS 111	17	LLS 117
6	LLS 106	12	LLS 112	18	LLS 118

Design : Split-Plot
Treatments : Two (Treated and Control)
Fertilizer dose : 100N- 45P_2O_5- 60K_2O kg/ha.(P & K as basal dose)
N-Splits : 1st 50% at 10-15 DAP
2nd 25% at active tillering
3rd 25% at panicle initiation (PI)

Date of Sowing :
Date of Planting:

Methodology: The genotypes needs to be transplanted in two blocks/strips, one for control and another block/strip for imposing low light stress by covering the **shade net preferably white** with supported by a metal frame or bamboo sticks like a "tunnel" after a week of transplanting. Please ensure that two feet gap (open) on all sides so that

temperature is not built until maturity. Control block/strip should be kept uncovered. Each entry should be sown in 3 rows of 1.5 meter length maintaining 20 cm spacing between rows and recommended plant to plant distance. Leave one blank row between the entries. Each row will be treated as a replication and all the observations needs to be recorded for each row separately.

Observations :

1. **Daily Weather data on Rainfall, Temperature, Relative Humidity, Wind speed, Solar Radiation and Sunshine Hours during the crop growth period.**
2. **Measure light intensity (at least 3 to 4 times) in a cropping season.**
3. Phenological: date of sowing & planting, days to 50% flowering and maturity.
4. Date of actual harvest (genotype –wise)
5. Plant height, leaf wt., stem wt., panicle wt. and total dry matter (g/m2), at flowering
6. Total dry matter produced at harvest
7. Grain yield data at harvest (panicle no/m2, grain no/pan, Spikelet no/pan, grain no/m2, spikelet no/m2, 1000 grain weight, grain yield/(g/m2), total dry matter/ (g/m2) and HI (%)
8. **Chlorophyll content at PI and flowering stages (chl a, chl b, total chl). Very imp. observation**
9. **Stem wt. to be recorded at flowering stage and at harvest (select 3 plants (hills) at flowering and harvest resume leaves and determine column wt.). PLEASE ENSURE THAT ONLY STEM WEIGHT IS RECORDED (WITHOUT LEAF SHEATH AND LEAVES) AT BOTH THE STAGES.**

Where facilities exists, Chlorophyll fluorescence parameters, leaf photosynthetic characteristics and chlorophyll a & b t content through solvent extraction method must be recorded at early and late seed filling stages in both control and low light stress plots. Please indicate the equations for estimating chlorophyll content.

Star Chart of Plant Physiology Coordinated Studies for the Year 2019

Sno	Kharif 2018	CHN	CBT	NRRI	IIRR	FZB	KJT	KRK	MTU	PNR	PTB	REWA	TTB	RPUR	Ranchi	Total
1	Silicon	√	√	√	√		√	√	√	√	√	√	√		√	12
2	RFU		√	√							√	√	√ Rabi	√	√	7
3	Heat Tolerance	√		√	√				√	√	√	√	√			8
4	Multi Abiotic Stress		√	√		√	√	√	√	√	√	√	√		√	11
5	SUBMERGENCE		√	√		√					√		√			5
6	Low Light Stress			√	√		√		√	√			√	√		7
	Grand Total	2	4	6	3	2	3	2	4	4	5	4	6	2	3	50

Field Noting:

Sl.No	Date	Activity/ observations

Sl.No	Date	Activity/ observations

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