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RESEARCH ARTICLE

Progress of rice research in the west central table land zone of Odisha in India.

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Abstract

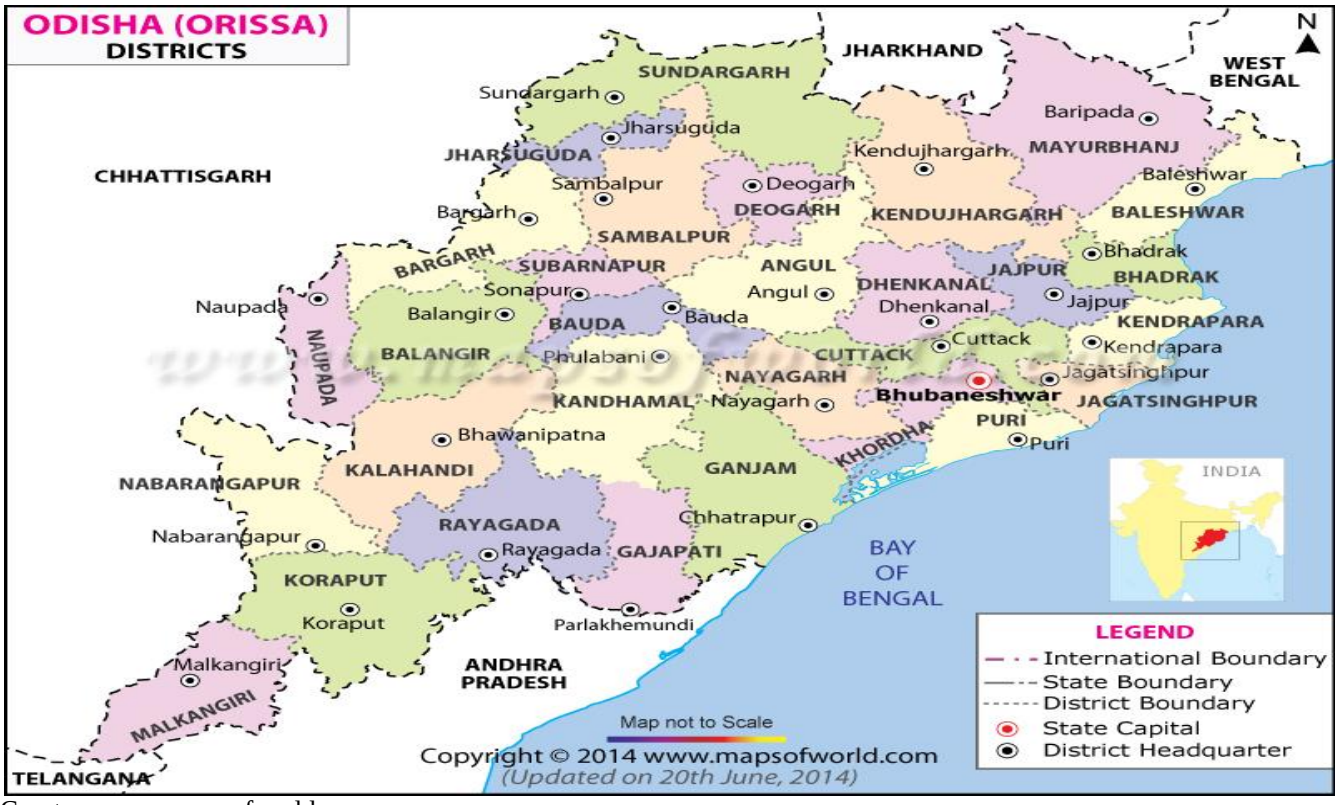
In this article we have summarized the rice research conducted during 1971-2015 in the West Central Table Land Zone of Odisha in India in the areas of plant breeding, agronomy, entomology and plant pathology, and presented the future research road map for next 10 years.

Introduction:-

The West Central Table Land Zone of Odisha consists of six districts, namely, Balangir, Subarnapur, Bargarh, Sambalpur, Jharsuguda and Deogarh (Fig.1).This zone has a total geographical area of 17.19 lakh hectares out of which 56.9% contribute towards net sown area. The cropping intensity of this zone is around 136%. The irrigation potential of this zone is around 30%. The predominant soil type is mixed red, black and lateritic. The climate of the area is warm sub-humid.

Rice is the principal crop of the zone (55.6%) followed by pulses like mungbean (greengram) and urdbean (blackgram); oilseeds like groundnut and sesame and vegetables like brinjal (egg plant), lady's finger (okra), pointed gourd, cole crops, chilli (pepper) and onion.

To meet the need of the rice farmers of this zone, a centre of All India Coordinated Rice Improvement Project was established at OUAT-Regional Research and Technology Transfer Station, Chiplima, Sambalpur, Odisha, India during 1971. The latitude, longitude and altitude of Chiplima are 20° 21′ N, 80° 55′ E and 178.8 m above mean sea level, respectively. The temperature varies from as low as 9.0^0 C to as high a 44.2^0 C. The mean maximum and mean minimum temperatures of 40.5^0 C and 13.0^0 C are recorded in the months of May and December, respectively coinciding with 227.6 mm (maximum) and 81.3 mm (minimum) evaporation. The station receives rain from south-west monsoon with mean annual rainfall of 1426.2 mm in 93 rainy days of which 86.5% is in monsoon months (June-September), 6.9% in post-monsoon (October- January) and 6.7% in pre-monsoon (February-May) period. The rice research work carried out during 1971-2015 in the West Central Table Land Zone of Odisha in India in the areas of plant breeding, agronomy, entomology and plant pathology is summarized below.



Courtesy: www.mapsofworld.com

Fig.1: The West Central Table Land Zone of Odisha: Balangir, Subarnapur, Bargarh, Sambalpur, Jharsuguda and Deogarh Districts.

Progress of Research:-

A. Plant Breeding:-

The details of the varieties developed and released from this centre are as follows:

Variety	Parentage	Year of Release (Notification)	Days to 50% Flowering	Duration (Days)	Average Yield (Q/Ha)	Grain Type	Resistance to Diseases & Pests	Ecosystem
Lalat (ORS 26-2014-4)	OBS 677/IR 2071-625// Vikram/W1263	1988 (1989)	95	125-130	42.00	LS	GLH, BPH, GM	Irrigated Mid -Early
Meher (ORS 26-2008-4)	OBS 677/ IR 2071-625// Vikram/W1263	1992 (1994)	105	135-140	40.00	LB	BL, BPH, WBPH, GM	Irrigated Medium
Pratikshya (ORS 201-5)	Swarna/IR-64	2005 (2006)	110	140-145	50.00	MS	BS, GM, LF	Irrigated Medium
Siddhanta (ORS 102-4)	Jajati/Annapurna	2005 (2006)	65	95-100	30.00	SB	BL, BS, GM, LF	Rainfed Upland

NB: BL= Blight, BPH = Brown Plant Hopper, BS = Brown Spot, GLH = Green Leaf Hopper, GM= Gall Midge, LF = Leaf Folder, WBPH= White Backed Plant Hopper

Suitable rice varieties identified for different ecosystems:-

The following high yielding varieties, released by O.U.A.T., after evaluation at AICRIP, Chiplima are identified for cultivation in different ecosystems in the West Central Table Land Zone of Odisha:

Upland	Khandagiri, Udayagiri.
Medium Land	Bhoi, Gajapati, Konark, Surendra, Kharavela and Sebati
Low land	Mahanadi, Indravati, Prachi and Ramchandi.

Hybrid Rice Evaluation:-

Hybrid rice varieties like BS 025 (6155 kg / ha), Ajaya (4778 kg / ha), PHB 71 (4917 kg / ha) and Rajlaxmi (5130 kg / ha) have been found suitable for West Central Table Land Zone based on their performance.

Local Land Races Evaluation:-
Forty seven local land races of rice collected from the districts of Bargarh and Sonepur have been characterized.

Germplasm Maintenance:-
Sixty six non-aromatic and forty six aromatic accessions of germplasm are being maintained.

Heat Tolerance Evaluation:-
IR-12-C- 144 (5227 kg/ ha), IR-12-C- 145 (4611 kg/ ha) and IR-12-C-147 (4507 kg/ha) from IR-12-C series and IR-13-C- 131 (5433 kg/ha), IR-13-C- 121 (5201 kg/ha) and IR-13-C- 120 (5121 kg/ha) from IR-13-C series were found promising under heat-stressed situations. They are being evaluated for the second year during current rabi/summer 2015-16 and the suitable entries will be nominated for all India co-ordinated varietal evaluation trial next year.

B. Agronomy:-

Effective herbicides for transplanted rice:-
Application of Butachlor 50 EC @ 1.0 kg (a.i.) / ha (800 ml / acre) or Butachlor 50 EC followed by 2, 4-D PE 32 EC @ (1.0 + 0.4) kg (a.i) / ha (800 ml + 500 ml / acre) or Butachlor followed by Almix (750 ml + 20 g / acre) are effective herbicides.

Effective herbicides for upland condition:-
Application of Pendimethalin 30 EC @ 1 kg (a.i.) / ha at 7 days after rice emergence (DARE) followed by 2, 4-D Na salt 80 WP @ 0.6 kg (a.i.) / ha at 25 DARE was found effective for controlling weeds in upland rice.

Effective herbicides for direct sown puddled rice:-
Mixture of Butachlor + Safener @ 1.5 kg (a.i.) / ha at 3 days after sowing (DAS) is the most effective in controlling the weeds with higher yield.

Intercropping in rice under rainfed upland condition:-
Out of three rice-groundnut combinations (2:1, 3:1 and 4:1), intercropping of rice with groundnut (Var. OG 52-1) in 2:1 ratio was maximum profitable than the sowing of sole rice (cv Parijat). Sole crop of groundnut (OG 52-1) followed by rice- groundnut (2:1) was superior in land equivalent ratio (LER) and net return.

Date of planting and effect of N level of grain yield of Basmati rice varieties:-
Basmati rice varieties like Pusa Basmati and Taraori Basmati produced higher yield when planted during first fortnight of July.

Scented rice varieties responded N application up to 90 kg / ha and produced higher grain yield (4.0 t / ha).

Use of 8 row drum seeder in direct seeded puddled condition:-
Sowing of sprouted seeds of rice by using 8-row drum seeder just one day after puddling is recommended.

Use of herbicide “Butachlor” at 4-6 days after sowing gave better WCE (weed control efficiency).

One hand weeding at maximum tillering stage is the best practice for direct seeded rice yielding 4.7 t/ha grains.

Cultural management practice for higher grain yield of rainfed upland rice:-
Application of NPK @ 40:20:20kg/ha (50% of the recommended dose) along with F.Y.M. @ 5 t/ha recorded maximum grain yield (2.6 t/ha).

Basal application of Sulphur Coated Urea (SCU) or root zone placement of Urea Super Granules (USG) @ 87 kg N / ha recorded superior grain yield and was found to be remunerative than split application of prilled urea.

Application of phosphorus significantly increased the grain yield. Regardless of the sources, the split application of P was significantly superior over basal application of 60 kg level in low land rice. The effect of delayed and split application of Ammonium polyphosphate and Diammonium Phosphate splitted during basal,15 and 30 DAT(days after transplanting) have given higher grain yield which can also be comparable with split application of single super phosphate. Application of NPK @ 40:20:20 kg / ha (50% of the recommended dose) along with F.Y.M. @ 5 t / ha recorded maximum grain yield (2.6 t / ha).

Package of practices for hybrid rice:-

The following package of practices is recommended for the zone to get higher yield from hybrid rice varieties DRRH -1, PA -6201, PHB-71 and PAC-831.
Seed density @ 10-20 g / m^2 of nursery.
Use of 2 seedlings / hill
Timely planting with 120:60:60 kg NPK / ha + 25 kg $ZnSO_4$ / ha
Application of 50% of N as basal, 25% N at tillering and 25% N at booting stage as prilled urea.

C. Entomology:-

Chiplima is a hot spot for major insect pests of rice like stem borer, gall midge, brown plant hopper and white backed plant hopper. Therefore, this place has been identified by ICAR-Indian Institute of Rice Research, Hyderabad to conduct host plant resistance field trials against such insect pests.

Over the years of study through light trap, it has been observed that yellow stem borer is the major stem borer species which constitutes more than 90 per cent of stem borer species. Stripped rice borer and white rice borer appear in trace proportions. During *kharif*, the stem borer appears in July but highest activity is generally noted during the month of September (3rd-4th week) while in summer, the peak activity is observed during April (1st-2nd week). It has been ascertained that stem borer damage in terms of white ear head at reproductive stage was the key factor for drastic reduction in grain yield than dead hearts produced during the vegetative stage.

From the trial Effect of Planting Dates on Pest Incidence (EPDP) it is found that early planting (last week of July to 1st week of August) is helpful to get rid of higher insect pest pressure. So, Farmers should go for early planting of rice to get higher yield.

Gall midge is referred to as the second important insect pest as it caused maximum damage in terms of silver shoot during vegetative stage, thereby reducing the number of panicle bearing tillers. This pest appears in this area during July in *kharif* season but attains its peak during second week of September.

The plant hoppers, *viz.*, brown plant hopper (BPH) and white backed plant hopper (WBPH) are also serious pests of paddy for both *kharif* and summer crop. The hoppers start infesting the crop from 60-75 days after transplanting in *kharif* and attain its peak during September-October while in summer crop highest activity is witnessed during April.

There has been evidence of plant damage by gall midge in highly resistant accessions (against Biotype 1) like Kavya, Phalguna, Jhitpiti, Aganni, W-1263, Abhaya in different years of testing. This clearly indicates the possibility of existence of another biotype in this region (biotype 2) which needs further confirmation.

Although leaf folder and case worm existed as minor pests in this region, but recently they appear as serious pests during the year 2012 and 2014.

Among the predator fauna, spiders dominate in rice eco-system followed by mirid bugs and lady bird beetles. Among the parasitoids, the egg parasitoid *Trichogramma sp* dominates while *Platygaster oryzae has* been found to parasitize gall midge. Stem borer egg mass is also parasitized by *Cotesia sp.* Hence, inundate release of these parasites can bring the insect numbers down.

Among the botanicals tested against rice pests, it has been proved that the neem products like Rakshak @ 0.05 % or Neemazol @ 0.3 % or Econeem @ 0.5 % effectively controlled plant hoppers.

Pheromone, a major component of biorational control of pests has been tested against stem borer at this centre. Pheromone traps @ 8/ acre (1 for 500 m^2) can be used to reduce stem borer attack in rice field.

The IPM module already developed for this zone is as follows:

a) Summer ploughing during May
b) Use of gall midge resistant variety like Lalat or Pratikshya
c) Transplanting within 15th July
d) Nursery application of Furadan 3G @1 kg (a.i.) / ha or Cartap 4 G @ 1 kg (a.i.) / ha 5 days before pulling the seedlings.
e) Use of pheromone trap @ 8/ acre
f) Application of conventional pesticides like chlorpyriphos or monocrotophos @ 1000 ml / ha or acephate @ 750 g/ ha against stem borer, gall midge, leaf folder once or twice during vegetative period depending up on the ETL values of any of these pests.
g) Need based application of ethofenprox (500 ml/ ha) or Imidacloprid (125 ml/ ha) or buprofezin 25 EC @ 750 ml / ha against plant hoppers at late vegetative/reproductive stage.

Application of fipronil 0.3 G @ 15 kg/ ha or isazophos 3 G @ 33.3 kg/ ha or carbofuran 3 G @ 33 kg / ha 5 days before pulling control early stage pests like stem borer, gall midge, whorl maggot in transplanted rice up to 1 month.

Among the new molecules tested over years, it has been experimentally proved that flubendiamide 20 WDG @ 175 g/ ha is effective against stem borer. The combination product (Flubendiamide + buprofezin) 20 SC @ 875 ml/ ha is effective against both plant hoppers and stem borer insects. Cartap hydrochloride 50 SP @ 1.25 g/ l, Rynaxypyr 20 SC @ 0.3 ml/ l of water is also very effective against stem borer, leaf folder and case worm insects.

Among the new molecules tested for hopper management it is found that Glamore (Imidachloprid + Ethiprole) @ 0.25 g/l and Pymetrozine 50 WG @ 0.6 g/ l of water are effective for their management.

In recent years, a new trial has been tested over years to study the compatibility of insecticide and fungicide against major insect pest and disease causing organisms in rice. The following treatment combinations have been found to be highly effective:

a) Spinosad 45 SC (1 ml/ l) + Carpopramid (0.25 g/ l) and Buprofezin 20 + Acephate 50 % WP in combination with Tricyclazole 75 WP were effective against stem borer, hoppers and blast without any phytotoxicity.
b) Rynaxypyr 20 SC @ 0.3 ml/l in combination with Carbendazim 12% plus mancozeb 63% WP (CM 75) @ 2.0 g/l of water or Validamycin 3 SL @ 2.5 ml/l of water are effective in controlling stem borer, leaf folder, sheath blight and blast incidence of rice. No phytotoxicity in any respect was noticed in rice.
c) Imidacloprid 200 SL (0.25 ml/ l) + Propiconazole 25 EC (1 ml/ l);
Imidacloprid 200 SL (0.25 ml/ l) + Validamycin 3L (2.5 ml/ l);
Thimethoxam 25 WG (0.2 g/ l) + Propiconazole 25 EC (1 ml/ l)
Thimethoxam 25 WG (0.2 g/ l) + Validamycin 3 L (2.5 ml/ l)
All were effective against brown plant hopper and sheath blight on rice without any phytotoxicity.

D. Plant Pathology:-

The most commonly observed diseases in the disease observation nursery with 3 sowings, *viz.* early, normal and late include leaf blast, neck blast, sheath blight, sheath rot, false smut and bacterial leaf blight. In general, these diseases were higher in normal sown crop whereas, early sown crop suffered more from sheath blight and late sown crop from blast disease.

The optimum sowing time for *kharif* and *rabi* crop is first fortnight of July and first fort night of January respectively to escape diseases like blast, BLB, sheath rot and sheath blight.

Seed treatment with Bavistin or Chlorothalonil followed by foliar spraying with Bavistin 50 WP @ 1 g / l during active tillering and panicle initiation stages of the crop were recommended against leaf and neck blast, brown spot, sheath rot and sheath blight diseases for better grain yield.

Use of Plantomycin, Carbendazim and Copper oxychloride mixture in proportion of 1:1:2.5 g / l of water was recommended against complex disease syndrome of blast, BLB & sheath rot.

In BLB endemic pockets, use of resistant or tolerant varieties like Daya, Pratap, Ananga, Bhuban & Lalat were recommended for getting minimum crop damage due to the disease.

Application of Tricyclazole (Beam 75 WP) @ 0.6 g / l of water thrice at maximum tillering, panicle initiation & milking stage was found effective against leaf and neck blast in rice.

Application of Propiconazole (Tilt 25 EC) @ 1ml / l or Chlorothalonil 40 SC @ 2 ml / l or ATEMI 50 SL @ 2 ml / l of water at boot leaf stage twice at 15 days interval controlled the initial disease infection of false smut.

Application of combination of granular formulations of Coratop 5 G or Kitazin 17 G @ 40 kg / ha at active tillering stage followed by one spraying with Bavistin @ 1 g / l at boot leaf stage minimized the leaf & neck blast intensity in the main field without any seed treatment or nursery treatment.

Seed dressing with Fongorene 50 WP @ 4 g / kg seed and foliar spraying of Fongorene on appearance of blast disease, at tillering and boot leaf stage was most effective in controlling leaf and neck blast.

Rovral 50 WP @ 1 g / l of water at initial sheath blight appearance or nursery application of Validacin 3 L @ 2 ml / l three days prior to uprooting or application of Chlorothalonil 75 WP @ 1 g / l of water proved to be effective in controlling sheath blight disease.

Four sprayings of SWING 250 EC (Epoxiconazole + Carbendazim) @ 2 ml 'or' Folicure 250 EW (Tebuconazole) @ 1.5 ml' or Fongorene 50 Wp (Pyroquelon) @ 0.4 g or SAFF-75 WPC (Carbendazim + Mancozeb) @ 1.5 g 'or' Win-300 SC (Carpopamid) @ 1 ml per liter of water (1st spraying at the appearance of the disease, 2nd spraying 10 days after the 1st spraying, 3rd spraying days after the 2nd spraying and 4th spraying at heading stage) could effectively control the leaf blast and neck blast disease with higher yield in rice.

Two sprayings of Tilt 25 EC (Propiconazole) @ 1 ml 'or' OPUS 12.5SC (Epoxiconazole) 2 ml 'or' Folicure 250 EW (Tebuconazole) @ 1.5 ml 'or' Benlate 50 WP (Benomyl) @ 1.5 g or Contaf 5 EC (Hexaconazole) @ 1 ml 'or' SWING 250 EC (Epoxiconazole) @ 2 ml or RILIF - 004-75 WP (Hexcaconazole + Captan) 2 g 'or' KITAZIN 48 EC (I probenphos) @ 2.5 ml per liter of water (1st spraying at the appearance of the disease and 2nd spraying 10 days after the 1st spraying) could effectively control the sheath blight disease in rice.

Two sprayings of Tilt 25 EC (Propiconazole) @ 1 ml or Bavistin 50 WP @ 0.1 % or Chlorothalonil 40 Sc @ 2ml or Contaf 5 EC (Hexaconazole) @ 2 ml or Thiofluzamide 40 WP @ 1g per liter of water, at boot leaf stage and at complete emergence of the panicle was found most effective against sheath rot disease in rice.

Disease management trials over years revealed that the resistant varieties like Meher and Bhuban produced significantly higher grain yield than Jaya in both management and no management condition with lower sheath blight, sheath rot and blast disease intensity.

Four sprayings of RIL-FA 200 SC (Kresoxim methyl) @ 1.25 ml or Amistor 25 SC (Azoxystrobin) @ 1 ml at 10-12 days interval starting from first appearance of blast disease effectively controlled leaf and neck blast with 6-30 % higher yield.

Two sprayings of Amistor 25 SC (Azoxystrobin) @ 1 ml or Flusilazole @ 0.5 ml / l of water at appearance of sheath blight and 10 days after could effectively control sheath blight disease with 14-16 % higher yield.

The laboratory study of discoloured grains revealed the abundant presence of seven fungi viz, *Fusarium* sp, *Alternaria* sp, *Drechslera* sp, *Aspergillus* sp, *Curvularia* sp, *Diplodia* sp and *Pyricularia* sp in grain discolouration of rice.

Four sprayings of Achook @ 5 ml / l or Tricure @ 5 ml / l of water at 10 to 12 days interval could effectively control sheath blight and sheath rot with 20-30 % higher yield.

Filia (Tricyclazole and Propiconazole combination) @ 2 ml / l was found highly effective against leaf blast.

Kocide 2000 54 DF (35 % metallic copper) @ 1.5 g / l was found effective to check BLB.

Neem gold @ 20 ml / l was effective to control glume discolouration.

Field screening of genotypes for monitoring the virulence of *Xanthomonas oryzae* pv *oryzae* revealed that the genotypes were low to moderate in their infection pattern.

Both sheath blight and leaf blast was controlled by using 2/3rd of recommended dose of nitrogenous fertilizer along with 2-3 sprays of Hexaconazole @ 2 ml / l in a susceptible variety (Swarna) with higher grain yield.

Nitrogen management (80 kg N / ha) and use of resistant variety (Ajay) significantly reduced the BLB severity and increased grain yield.

A ready mix formulation of Flubendiamide 3.5 % + Hexaconazole 5 % WG (Origin) @ 2g / l was compatible and equally effective to control sheath blight, stem borer and leaf folder.

Trifloxystrobin 25 % + Tebuconazole 50 % (Nativo 75 WG) @ 0.4 g / l was found effective for both leaf blast & sheath blight.

Seed treatment + 3 spraying, both with *Trichoderma viride* @ 1% was most effective bio control treatment against sheath blight disease of rice.

Spraying of a mixture of Validamycin @ 2.5 ml/l and Rynaxypyr @ 0.3 ml/l thrice at 10-15 days interval starting from initiation of the infection was effective to control sheath blight, stem borer and leaf folder simultaneously without any phytotoxicity in rice crop.

Production Oriented Survey was carried out in the districts of Western Odisha viz, Sambalpur, Bargarh, Jharsuguda, Balangir etc during kharif seasons. The average seed rate varied from 50-90 kg / ha. Most of the farmers confirmed seed treatment with Bavistin @ 2 g / kg seed. Transplanting was generally carried out in the month of July. The predominant high yielding rice varieties cultivated were Swarna (MTU 7029), Puja, Pratikshya, Lalat, MTU 1001 and MTU 1010. Hybrids were cultivated by a very small number of farmers and the predominant hybrids were Dhani, 6444 gold and Ajay. The average rice yield varied from 3000-5800 kg / ha in *kharif* and 3200-6900 kg / ha in *rabi* season. The fertilizer dose used by the farmers varied from 60-200 kg N / ha, 40-125 kg P_2O_5 / ha, 30-75 kg K_2O / ha and 5-25 kg $ZnSo_4$ / ha. In addition to that, a large number of farmers were using growth promoting factors for better growth of plants. The major biotic constraints were blast, sheath blight, bacterial blight, sheath rot, stem borer and leaf hoppers. Farmers spray a number of pesticides and in most of the cases; they were mixing 2-3 pesticides altogether to reduce the labour cost and time. A large number of farmers used granular insecticide to prevent stem borer attack. The intensity of weed was low to medium and farmers made single time application of different weedicides in addition to hand weeding. Scarcity of water during *rabi* season especially in un irrigated area and shortage of labour were the major problems of the farmers.

Future Research Road map for next 10 years:-

A. Plant Breeding:-

Research Priorities	Remarks
i. Germplasm collection, evaluation and maintenance.	This is highly mandatory for taking up further rice breeding work.
ii. Evaluation of rice hybrids suitable for the zone.	Hybrid rice is gaining popularity. Hence evaluation of suitable hybrid variety is needed.
iii. Breeding of varieties for irrigated medium situation.	Much area of this zone comes under irrigated medium situation for which development of suitable varieties is required.
iv. Breeding of varieties for heat tolerance.	This is a new study. As the temperature is increasing, flowering is hampered in most existing varieties. Hence evaluation of germplasm and development of varieties for heat tolerance is the need of the hour.

B. Agronomy:-

Research Priorities	Remarks
i. Evaluation of suitable rice varieties under SRI	New SRI method is gaining popularity among the farmers for which they need suitable varieties.
ii. Evaluation of new molecules of herbicides.	Under upland situation weed is a major problem and about 35% loss occurs due to weed. So to overcome the problems of weed in the zone new herbicides are to be identified.
iii. Evaluation of some organic farming components in yield maximization of rice.	With increasing population growth it is required to increase the yield to meet the food demand. Simultaneously to maintain the soil health organic farming is need of the day.
iv. Development of some suitable package of practices for direct seeded upland rice for better yield and quality.	In direct seeded upland rice suitable agronomic practices are to be developed for yield sustainability.
v. Development of various modules of yield in relation to different weather parameters.	In changing climatic scenario for yield sustainability different agronomic packages are to be developed in relation to different weather parameters.
vi. Standardization of nutrient management modules in rice under changing climatic situation.	In changing climatic scenario for yield sustainability different nutrient management practices are to be developed.

C. Entomology:

Research Priorities	Remarks
i. Undertaking host-plant resistance trial against stem borer, gall midge, brown plant hopper and white-backed plant hopper either alone or in combination (multiple resistance)	This place is a hot spot for stem borer, gall midge, brown plant hopper and white-backed plant hopper. Hence continuous screening is necessary.
ii. Study of species composition through light trap and their correlation with biotic factors	This will enable to know species composition and help the scientists to chalk out an effective management tactic.
iii. Evaluation of new molecules against major insect pests of rice.	The conventional insecticides are losing their field efficacy for which new molecules need to be evaluated and recommended.
iv. Study of suitable insecticide-fungicide compatibility with special reference to phyto-toxicity and residue.	This is a new type of study which will enable the farmers to spray the crop with proper chemical to control insect and disease simultaneously.

D. Plant Pathology

Research Priorities	Remarks
i. Screening of germplasm for resistance to major rice diseases and production of disease resistant varieties.	The existing resistance against diseases could be broken down in course of time. Hence, continuous screening is necessary to recommend resistant or tolerant lines.
ii. To study the compatibility of different combinations of fungicides and insecticides with special reference to phytotoxicity.	This study will enable the farmers to spray the crop with proper chemical combinations to control disease and insect simultaneously.
iii. Integrated disease management for all the major diseases of the zone.	An IDM module is highly required for recommendation to the farmers to avoid unnecessary application of too many fungicides.
iv. Evaluation of new molecules against major diseases of rice.	The conventional fungicides are losing their field efficacy for which new molecules need to be evaluated and recommended.

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