Indian Council of Agricultural Research

Proforma for Certifying a Technology

Effect of RADIFARM-Bio-stimulant on crop growth, physiological and biochemical changes, and yield of Rice crop

Submitted by
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Certifying Products/Technologies/Process/Methodology/Model/Protocol/Policy etc.

Item	
1. Name of the product/technology (as defined above)	Effect of RADIFARM- bio-stimulants on crop growth, physiological and biochemical changes, and yield of Rice crop
2. Name and address of the Institute	ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad – 500030, Telangana
3. Institution(s) responsible for developing/evaluating/identifying including collaborators, if any	Valagro Bio Sciences, Ltd., The Platina Building, A-904, 9tj floor, Gachibowli, Serilingampalli, Hyderabad-500032.
4. Source of product/technology (Research Project/Student Research/Any other ad-hoc research study)	Research Project
5. Period of development/evaluation/validation	2021-2022
6. Developers (Lead and Associates)	Dr. R. Mahender Kumar
7. Summary of the product/technology (maximum of 200 words)	Biostimulants have much potential to improve crop production through enhanced yields, grain quality, and increased sustainability of agronomic production systems, particularly in relation to nutrient management. However, there is great variability in the efficacy of biostimulants and a limited understanding of the mechanisms responsible in field-tested scenarios where differences are observed. These unknown mechanisms may align with the recognized soil health indicators, providing opportunities for unrealized biostimulant potential beyond crop growth and development. This review aims to identify the predominant types of crop biostimulants, the known understandings of their modes of action, and examples of their current field efficacy with an outlook for their future. The focus on fertilizer recovery potential is currently the leading research strategy for biostimulant use in row crop systems, with growing attention to increasing grain yield, which is often a result of more efficient nutrient use. While many biostimulants are targeted for application to row crops for increased

	productivity, many products achieve these responses through impacts on soils and the biology of the root zone. A closer evaluation of biostimulant effects on soil quality and biological indicators may reveal previously unknown benefits to their application. With greater government and public awareness of agronomic practices and their influence on water quality and nutrient management, the use of biostimulants as a solution to more sustainable practices and improved soil quality provides a viable option even in the absence of measurable yield increases. Grain yield due to seaweed bio-stimulants application varied from 5.31 to 5.58 t/ha and significantly increased over recommended dose of fertilizer alone (5%). Percent increase of grain yield was 4.15 to 9.14 per cent over recommended dose of fertilizer (Arun et al 2020). The experiment was conducted to study the effect of bio-stimulant RADIFARM on the yield and yield attributes of transplanted rice in kharif 2021 and rabi 2021-22seasons in randomised block design with nine replications. The RADIFARM was applied as seed treatment, seedling treatment and field application four days after transplanting with three different concentrations of RADIFARM product. The yield attributes and yield was significantly superior in RADIFARM treated plots over control. The average percentage grain yield increase was 15.87 % in T4: Radifarm 1.5L/acre followed by 13.81 % in T3: Radifarm 1.0L/acre and 12.61 % in T2: Radifarm 0.5L/acre treatments over control treatment.
8. Is it a new technology? (Yes/No). If no, prove the details of the technology modified	Yes
9. IPR involved, if any (Patent/Copyright/Industrial Design Registration/Variety/Germplasm registration). Provide Filed/Granted number	NA

10. Validation procedure followed (within Institute, collaborators, multilocation/multi-site testing)	Within institute
11. Brief description of research output/technology	

a. **Objective**

- To evaluate and test effect bio-stimulant RADIFARM on crop growth, physiological and biochemical changes, and yield of Rice crop

b. **Methodology**

The experiment was conducted to study the effect of bio-stimulant RADIFARM on the yield and yield attributes of transplanted rice in kharif 2021 and rabi 2021-22seasons in randomised block design with nine replications. The RADIFARM was applied as seed treatment, seedling treatment and field application four days after transplanting with three different concentrations of RADIFARM product.

Table. Treatment details

S.No	Treatment	Application Timing &Dose			No of Applications
T_1	Untreated	_	_	_	-
T_2	RADIFARM	100 ml/100 kg of seeds + 500 ml of water. Timing: seed treatment	1 ml/ liter of water. Timing: Root dipping during transplant	0.5 l/acre. Timing: 4-5 days after transplanting	3
T_3	RADIFARM	200 ml/100 kg of seeds + 500 ml of water. Timing: seed treatment	2 ml/ liter of water. Timing: Root dipping during transplant	1 l/acre. Timing: 4-5 days after transplanting	3
T_4	RADIFARM	300 ml/100 kg of seeds + 500 ml of water. Timing: seed treatment	3 ml/ liter of water. Timing: Root dipping during transplant	1.5 l/acre. Timing: 4-5 days after transplanting	3

c. **Yield attributers & Yield**

Plant height was recorded at 30, 60, 90 days after transplanting and at harvest time and there was no significant difference among four treatments at all stages.
Number of tillers per square meter varied at critical stages of growth. Radifarm treatments influenced the number of tillers per square meter significantly at all stages of growth and found promising. Maximum no of tillers was recorded in T4: Radifarm 1.5L/acre (620) followed by T3: Radifarm 1.0L/acre (555) and T2: Radifarm 0.5L/acre (443) which contributed for higher yields in treated plots whereas lower no tillers per square meter was recorded in untreated control plot (368).

The chlorophyll content in plant leaves was recorded by SPAD meter at 30, 60 and 90 DAT and were significant at 90 DAT only. Maximum SPAD readings were recorded in Radifarm treated plots over control. The maximum SPAD value content indicates the higher chlorophyll and photo synthesis.

No of panicles per square meter were significantly higher in Radifarm treated plots and found promising over control plot. Maximum no of panicles per square meter was recorded in T4: Radifarm 1.5L/acre (599) followed by T3: Radifarm 1.0L/acre (548) and T2: Radifarm 0.5L/acre (439) which contributed for higher yields in treated plots whereas lower no panicles per square meter was recorded in untreated control plot (357).

Radifarm treatments contributed significantly for higher panicle weight and test weight and were found promising over control plot. No of grains per panicle was significantly higher in Radifarm treated plots. Maximum no of grains per panicle was recorded in T4: Radifarm 1.5L/acre (295) followed by T3: Radifarm 1.0L/acre (277) and T2: Radifarm 0.5L/acre (258) whereas lower no of grains per panicle was recorded in untreated control plot (236).

Treatment with Radifarm significantly contributed for higher grain yield over control plot. Maximum grain yield was recorded in T4: Radifarm 1.5L/acre (6.70 t/ha) followed by T3: Radifarm 1.0L/acre (6.58 t/ha) and was on par with T2: Radifarm 0.5L/acre (6.51 t/ha) whereas the Control treatment recorded 5.79 t/ha. The average percentage grain yield increase was 15.87 % in T4: Radifarm 1.5L/acre followed by 13.81 % in T3: Radifarm 1.0L/acre and 12.61 % in T2: Radifarm 0.5L/acre treatments over control treatment.
The mean average straw yield recorded was 7.29, 7.18 and 7.17 t/ha in T4: Radifarm 1.5L/acre, T3: Radifarm 1.0L/acre and T2: Radifarm 0.5L/acre treatments respectively. The treatments contributed significantly for straw yield. The trend is nearly similar in terms of harvest index values in Radifarm treated plots which contributed for higher yield.

d. **Saving of water, labour, time and energy**

Net energy output was more in RADIFARM treatments and Energy productivity was more in RADIFARM treated plots (0.81, 0.80 & 0.79 kg grain / MJ input energy in T4, T3 & T2) over control (0.73 kg grain/MJ energy) plots.

Phytotoxicity

Phytotoxicity data was collected before the spay and 5, 10,15 days after spraying. There was no phyto toxicity by abiotic stress symptoms were observed across the RADIFARM treatments.

e. **Cost effectiveness including B:C ratio**

Cost of cultivation was nearly same in all treated and control plots but the benefit cost ratio was superior in RADIFARM treated plots and higher B:C ratio was recorded in RADIFARM 1.5 L/acre followed by 1.0 L/acre and 0.5 L /acre (1.97, 1.92 & 1.89) over control (1.64).

f. **Passport data of the product/ technology**

The focus on fertilizer recovery potential is currently the leading research strategy for biostimulant use in row crop systems, with growing attention to increasing grain yield, which is often a result of more efficient nutrient use. While many biostimulants are targeted for application to row crops for increased productivity, many products achieve these responses through impacts on soils and the biology of the root zone. A closer evaluation of biostimulant effects on soil quality and biological indicators may reveal previously unknown benefits to their application. With greater government and public awareness of agronomic practices and their influence on water quality and nutrient management, the use of biostimulants as a solution to more sustainable practices and improved soil quality provides a viable option even in the absence of measurable yield increases. Grain yield due to seaweed bio-stimulants application varied from 5.31 to 5.58 t/ha and significantly increased over recommended dose of fertilizer alone (5%). Percent increase of grain yield was 4.15 to 9.14 per cent over recommended dose of fertilizer (Arun et al 2020). The experiment was conducted to study the effect of bio-stimulant RADIFARM on the yield and yield attributes of transplanted rice.

12. Details of relevant data generated during the development/validation	

Table. Phytotoxicity by abiotic stress in rice as influenced by application of RADIFARM (0-9 scale)

Treatment		Days after application				
		Before	5	10	15	20
RADIFARM	control	0	0	0	0	0
	5 L/ha	0	0	0	0	0
	10 L/ha	0	0	0	0	0
	20 L/ha	0	0	0	0	0

Table. Influence of RADIFARM treatments on plant height at critical stage of crop growth

Treatment		Plant height (cm)			
		30 DAT	60 DAT	90 DAT	Harvest
RADIFARM	Control (100% RDF)	45.59	64.99	94.74	92.41
	5L/ha	49.08	63.36	95.71	94.46
	10L/ha	43.94	64.29	94.72	93.01
	20L/ha	44.69	63.08	93.89	93.71
Exp. mean		45.82	63.93	94.77	93.4
CD(0.05)		3.89	5.09	4.48	6.38
CV		6.9	6.47	3.84	5.55
res1(t)		NS	NS	NS	NS

Table. Influence of RADIFARM treatments on No. of tillers at critical stage of crop growth

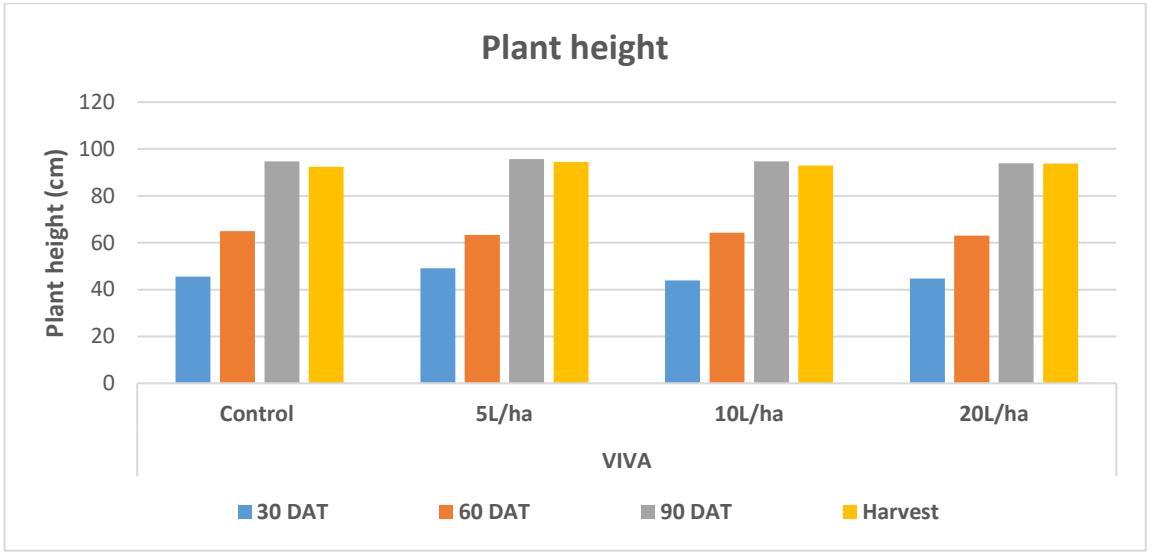
Treatment		No. of tillers/m^2			
		30 DAT	60 DAT	90 DAT	Harvest
RADIFARM	Control (100% RDF)	295	295	340	372
	5L/ha	359	476	368	434
	10L/ha	343	453	516	528
	20L/ha	380	452	532	597
Exp. mean		344	419	439	483
CD(0.05)		41.31	72.9	50.13	30.43
CV		9.75	14.14	9.29	5.12
res1(t)		**	**	**	**

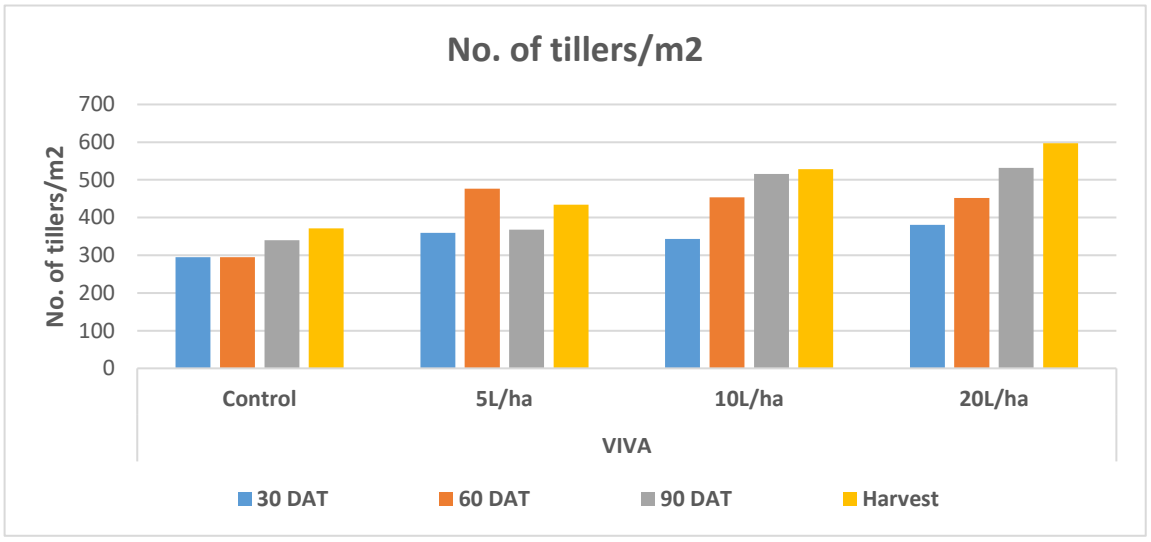
Table. Influence of RADIFARM treatments on SPAD at critical stage of crop growth

Treatment		SPAD		
		30 DAT	**60 DAT**	**90 DAT**
RADIFARM	Control (100% RDF)	32.93	37.17	40.66
	5L/ha	33.94	37.73	43.62
	10L/ha	34.76	37.97	41.87
	20L/ha	33.51	40.43	41.77
Exp. mean		33.78	38.32	41.98
CD(0.05)		3.35	3.08	2.96
CV		8.05	6.52	5.74
res1(t)		NS	NS	NS

Table. Influence of RADIFARM treatments on yield & yield attributes

Treatment		No. of panicles/m2	Panicle weight (g)	Test weight (g)	No of grains/panicle	Grain Yield (t/ha)	Straw Yield (t/ha)	Harvest Index (%)	% Grain Yield Increase over Control
RADIFARM	Control	361	3.97	2.81	235	5.78	6.54	46.91	
	5L/ha	427	4.43	3.04	256	6.37	7.14	47.09	**10.21**
	10L/ha	507	4.38	2.99	270	6.61	7.24	47.74	**14.43**
	20L/ha	580	4.60	3.00	288	6.58	7.10	48.10	**13.85**
Exp. mean		468	4.35	2.96	262	6.33	7.00	47.46	
CD(0.05)		27.07	0.15	0.15	17.83	0.44	0.33	1.41	
CV		4.7	2.87	4.08	5.53	5.6	3.78	2.42	
res1(t)		**	**	*	**	**	**	NS	





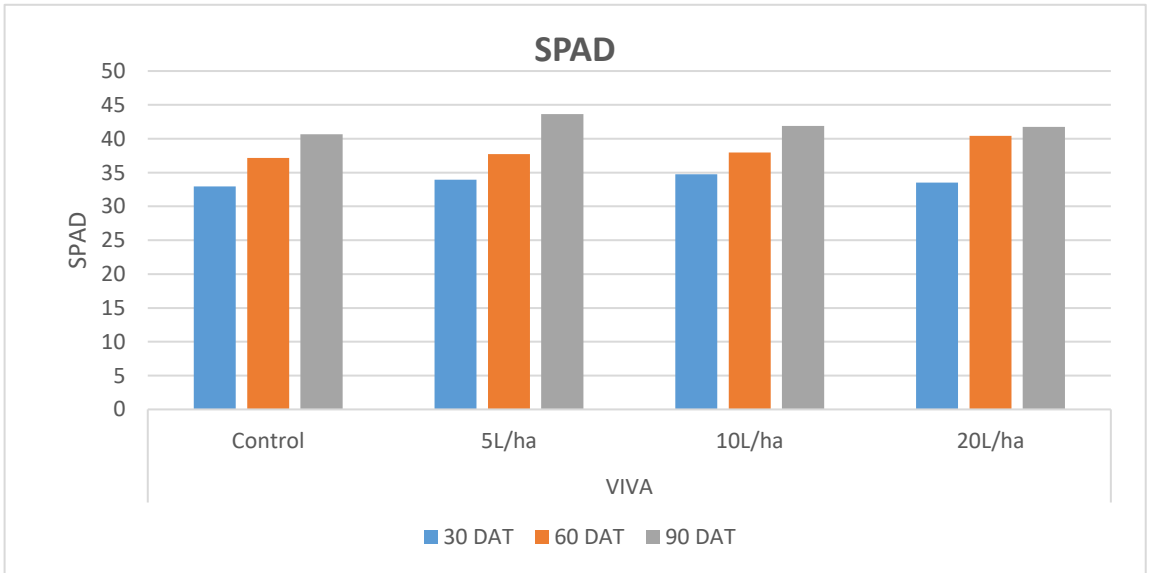


Fig. Growth parameters as influenced by RADIFARM treatments

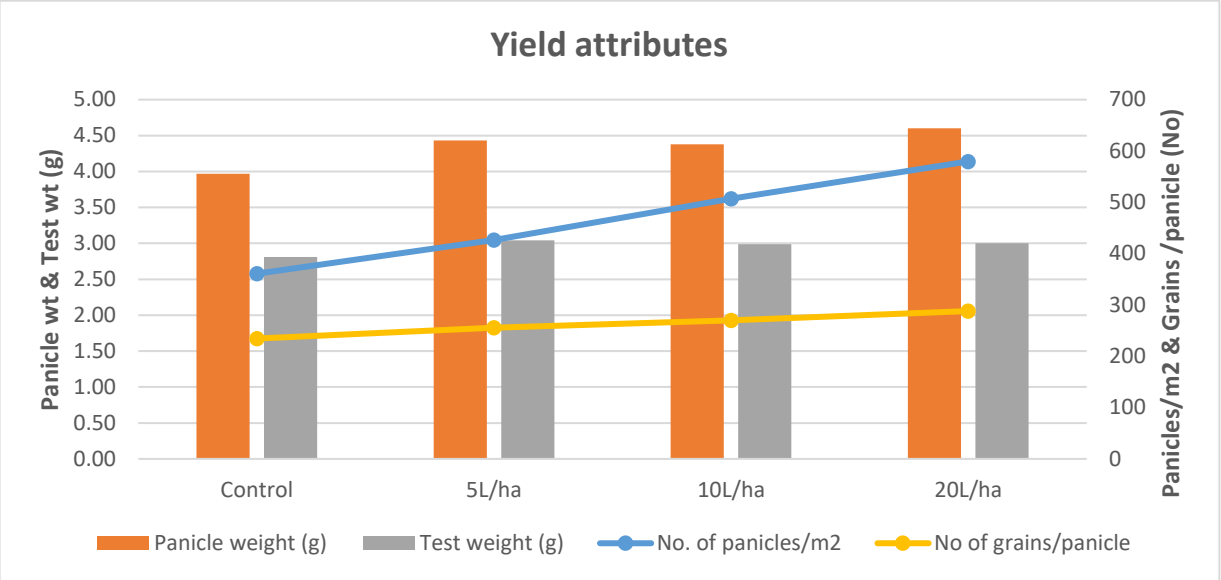


Fig. Yield attributes influenced by RADIFARM treatments

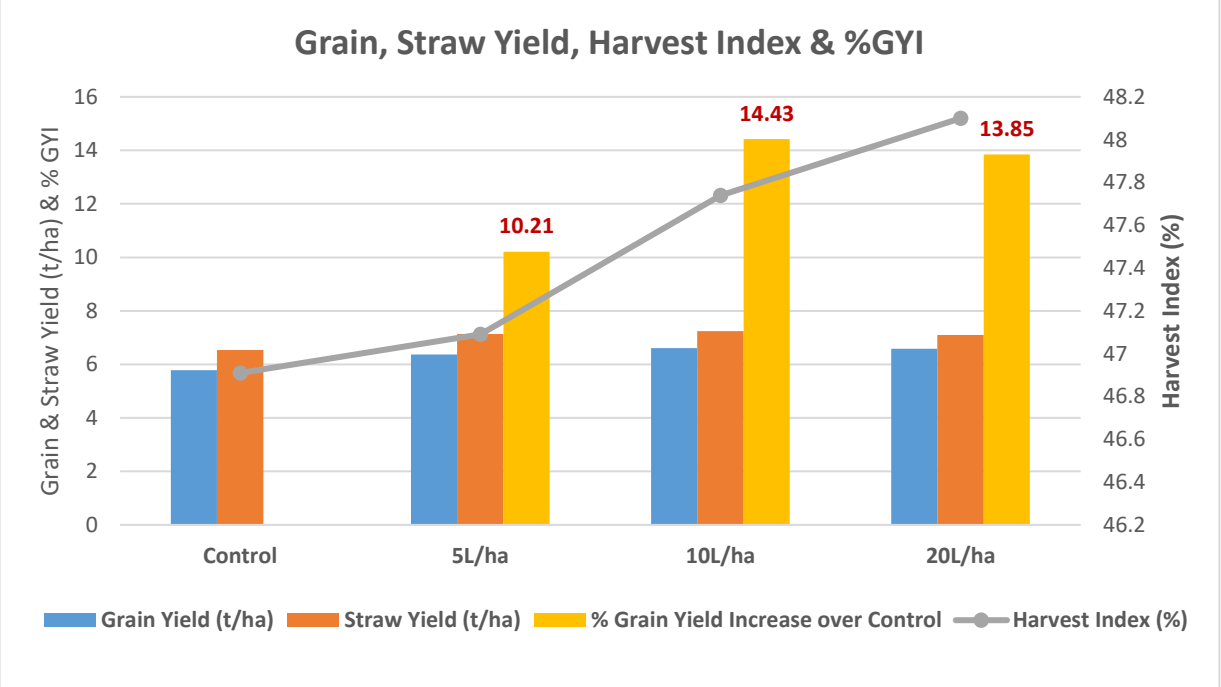


Fig. Grain, Straw yield & % grain yield increase over control as influenced by RADIFARM treatments

13. Proposed stakeholders	Transplanted rice farmers
14. Commercial potential, if any	Can be commercialized
15. Publications/photos/video clipping, if any	

Control

Radifarm 0.5L/acre

Radifarm 1L/acre

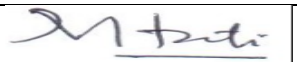
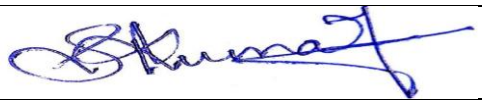
Radifarm 1L/acre

Plate.1. RADIFARM experimental plot at harvest stage

- Use of Radifarm product significantly enhanced the growth parameters and grain yield
- Among the treatments T4 (Radifarm 1.5L/acre) found superior with 15.87% followed by T3 (Radifarm 1.0L/acre) 13.81 % and T2: (Radifarm 0.5L/acre) 12.61 % grain yield increase over control and promising in terms of grain yield.

Declaration: I/we hereby undertake that the above information is correct. All scientists in the development of this research output have been included in the list of associates. The research output does not involve any third party IPR.

1. Name and signature of all the developers

Name	**Developer / co-developer / Collaborator**	**Signature**
Dr. R.Mahender Kumar	Developer	
Dr. B.Sreedevi	Co-developer	
Dr. Mangaldeep Tuti	Co-developer	
Dr. S. Vijaya Kumar	Co-developer	
Dr. K. Surekha	Co-developer	
Dr. M.B.B. Prasad Babu	Co-developer	
Dr. V. Manasa	Co-developer	
Dr. Prakasam	Co-developer	
Dr. Ch. Padmavathi	Co-developer	
Dr. Senguttuvelu	Co-developer	
Dr. D. Srinivas	Co-developer	

2. Recommendations of the Head of Division

3. Recommendations of ITMC/PME

4. Recommendations o DIRECTOR

5. Recommendations of SMD