Agronomy Tech -1

Indian Council of Agricultural Research

Proforma for Certifying a Technology

Evaluation of EcoAgra product for yield maximization

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)	Evaluation of EcoAgra product for yield maximization
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	ICAR-IIRR & Ecocrest Solutions & Services Pvt Ltd., Golden Iris, Golmuri, Jamshedpur, Jharkhand, INDIA - 831003.
4. Source of product/technology (Research Project/Student Research/Any other ad-hoc research study)	Research Project
5. Period of development/evaluation/validation	2020-2021
6. Developers (Lead and Associates)	Dr. R. Mahender Kumar
7. Summary of the product/technology (maximum of 200 words)	Rice (Oryza sativa L.) is grown in India over a gross area of 44 million hectares (ha). The total production in 2019 was about 107 million tons. However, India would need to produce at least 200 million tons of paddy to meet its ever-growing population requirements, and this figure would have to increase by almost 75% by 2050. Rice occupies a pivotal position concerning food security in India. The future of food security in this region will depend on its ability to improve rice productivity continuously on an ecologically sustainable basis. One of the main reasons for low rice productivity in India is the variation in fertilizer usage between the country's different agro-climatic zones and between states in each region. Low input use in general is a further factor accounting for the plateau or declining trend of grain yields. To evaluate the efficacy of growth promotor EcoAgra in DSR dibbling method in puddled condition, a trial was conducted with following objectives 1. To maximize the yield 2. To compare yield and economics of the best management practices. The experiment was conducted for two seasons. The experiment was laid out in randomized block design with three treatments (EcoSolv irrigation, EcoAgra and Control all with 100% RDF) allocated randomly and replicated nine times. The

	mean average grain yield recorded was 5.42, 5.51 and 5.47/ha in Kharif, Rabi and in Pooled respectively. The EcoAgra treatment was significantly differed with grain yield in Kharif and Rabi season and in pooled. EcoAgra treatment was found promising in both the seasons. The mean percent grain yield increase was 15% in EcoAgra treatment over control.
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	Nil
10. Validation procedure followed (within Institute, collaborators, multilocation/multi-site testing)	Within institute and multisite
11. Brief description of research output/technology	Higher straw yield was recorded with EcoSolv followed by EcoAgra treatments. The trend is similar in terms of straw yield and better harvest index values in EcoSolv treatment which contributed for higher yield. Maximum B:C Ratio Values were recorded in EcoSolv treatment (1.91,1.96and1.93) followed by EcoAgra (1.62,1.64and1.63) and significantly superior over Control treatment (1.44, 1.51and 1.47).

Objectives

- To enhance the productivity of the DSR rice through groth promotor EcoAgra
- To assess the impact of EcoAgra on crop establishment and productivity of the DSR system and its energetics and economics.

Methodology

The experiment was laid out in randomized block design with three treatments (EcoSolv irrigation, EcoAgra and Control all with 100% RDF) allocated randomly and replicated nine times.

Yield

The mean average grain yield recorded was 5.42, 5.51 and 5.47/ha in Kharif, Rabi and in Pooled respectively. The treatments significantly differed with grain yield in Kharif and Rabi season and in pooled. As the data is heterogeneous in two seasons the transformed values were considered for the correlation studies and it was significant among the treatments. Maximum grain yield was recorded with EcoSolv treatment (5.79, 5.88 and 5.84 t/ha in Kharif, Rabi and Pooled respectively) followed by EcoAgra (5.62, 5.67 and 5.65 t/ha in Kharif, Rabi and Pooled respectively) and significantly higher over control plot (4.85,4.99 and 4.92t/ha in Kharif, Rabi and Pooled respectively).

The average percentage grain yield increase is 19.27 % in EcoSolv and 15.77 % in EcoAgra treatments over control treatment.

The mean average straw yield recorded was 6.22, 6.25 and 6.24 t/ha in Kharif, Rabi and in Pooled respectively. The treatments significantly contributed for straw yield. Higher straw yield was recorded with EcoSolv followed by EcoAgra treatments. The trend is similar in terms of straw yield and better harvest index values in EcoSolv treatment which contributed for higher yield.

Water Productivity (kg grain/mm irrigation/ha)

Water input for individual treatments for Kharif was 1075, 1216 & 1224 mm for EcoSolv, EcoAgra and control respectively and Rabi 1020, 1170 & 1178 for EcoSolv, EcoAgra and control respectively.

The mean average water productivity- kg grain produced per mm irrigation per hectare was 4.67, 4.79 and 4.73 kg/mm/ha in Kharif, Rabi and Pooled. The treatments significantly contributed for water productivity. Higher water productivity was recorded with EcoSolv treatment (5.28, 5.47 and 5.37 kg/mm/ha in Kharif, Rabi and Pooled respectively) followed by EcoAgra (4.68, 4.73 and 4.70 kg/mm/ha in Kharif, Rabi and Pooled respectively) significantly over control plot (4.05, 4.16 and 4.11 kg/mm/ha in Kharif, Rabi and Pooled respectively).

The higher water productivity in EcoSolv treatment was due to energized water which reduced five irrigations over EcoAgra and control treatments.

Energetics

The energy input workouts were mentioned in annexure. The energy input was 17.1, 16.9 and16.8 Giga Joules per hectare in EcoSolv, EcoAgra and control treatments. The gross energy output recorded was 168, 161 and 143 Giga Joules per hectare in Pooled data. The EcoSolv and EcoAgra treatments were significantly higher for energy productivity- Kg grain produced per Million Joul Joule energy input per hectare. Maximum energy productivity was recorded

with EcoSolv treatment (0.73,0.73 and 0.73 kg/MJ in Kharif, Rabi and Pooled respectiviely) followed by EcoAgra treatment (0.71, 0.72 and 0.71 MJ/ha in Kharif, Rabi and Pooled respectively) whereas lowest water productivity values were recorded with control treatment i.e., 0.63, 0.64 and 0.64MJ/ha in Kharif, Rabi and Pooled respectively.

The higher grain and straw yields contributed for higher energy productivity in EcoSolv and EcoAgra treatments.

Cost of cultivation

Cost of cultivation was Rs. 37141, Rs. 40,141 and Rs. 37141 for EcoSolv, EcoAgra and Control treatments respectively for two seasons. The treatments significantly contributed for higher B:C (Benefit to Cost) ratio. Maximum B:C Ratio Values were recorded in EcoSolv treatment (1.91,1.96and1.93) followed by EcoAgra (1.62,1.64and1.63) and significantly superior over Control treatment (1.44, 1.51and 1.47).

In view of energy productivity, energy intensity, net returns and benefit cost ratio, the two treatments EcoSolv and EcoAgra are found promising and significant over Control treatment.

Front line demonstration in farmer's field rabi 2020-21

A field trial was conducted in Jannipalli village, Nizamabad district in Rabi 2020-21 season in transplanted condition with two irrigation situations (Saturation and limited irrigation) with EcoAgra treatment. EcoAgra was promising in both the situations and recorded 16.55 & 17.96 % higher grain yield over control plots.

EcoAgra treatment found promising in both crop establishment methods DSR dibbling (Station trial) and transplanting (FLD) in terms of yield, water productivity, energy and economics.

Yield attributes of Farmer field with EcoAgra application						
Treatments	**Plant height(cm)**	**No of tillers/m2**	**No of Panicles/m2**	**Panicle weight (g)**	**Grain Yield (t/ha)**	**% Grain Yield Increase over Control**
EcoAgra with Saturation Irrigation	100	581.7	520.0	3.28	6.90	16.55
EcoAgra Limited Irrigation	97	555.0	463.3	3.13	6.55	17.96
Control with Saturation Irrigation	93	476.7	420.0	2.95	5.92	
Control with Limited Irrigation	84	401.7	348.3	2.72	5.55	

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

Table: Growth parameters in direct seeded rice as affected by different treatments, *Kharif* 2020 and Rabi 2020-21

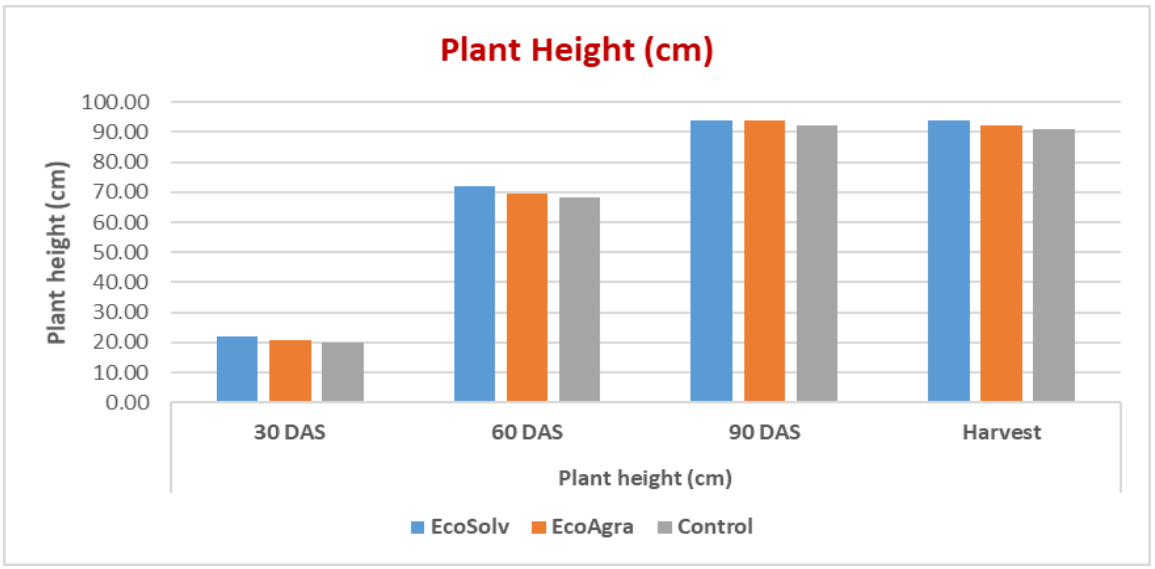
Treatments	Plant height(cm)				No of tillers/m2				SPAD		
	30DAS	60DAS	90DAS	Harvest	30DAS	60DAS	90DAS	Harvest	30DAS	60DAS	90DAS
Kharif 2020											
EcoSolv	23.13	71.62	92.94	93.24	62.4	112.4	344	330	35.0	36.3	37.6
EcoAgra	20.89	67.97	91.38	91.13	64.0	114.0	312	297	34.4	35.4	36.3
Control	19.21	67.00	90.59	89.45	59.2	109.2	244	263	33.2	34.1	34.8
CD	2.18	4.01	4.56	3.82	12.9	12.9	49.9	33.0	2.0	3.0	2.3
CV	10.34	5.83	4.98	4.19	20.9	11.5	16.6	11.1	5.8	8.5	6.3
	*	NS	NS	NS	NS	NS	*	**	NS	NS	*
Expt. Mean	**21.08**	**68.86**	**91.64**	**91.28**	**61.89**	**111.89**	**300.30**	**296.64**	**34.19**	**35.26**	**36.20**
Rabi 2020-21											
EcoSolv	21.21	72.18	94.72	94.51	62.0	112.0	352	359	36.0	37.8	38.1
EcoAgra	20.76	70.93	96.26	93.36	57.8	107.8	331	326	35.0	36.5	36.1
Control	20.35	69.76	93.79	92.73	48.1	98.1	237	250	33.1	34.7	35.1
CD	1.52	5.19	5.20	2.68	12.0	12.0	41.3	36.8	2.4	3.15	1.80
CV	7.32	7.32	5.48	2.87	21.5	11.3	13.4	11.8	6.9	8.68	4.96
	NS	NS	NS	NS	NS	NS	*	**	NS	NS	**
Expt. Mean	**20.77**	**70.96**	**94.92**	**93.53**	**55.96**	**105.96**	**307.04**	**311.41**	**34.68**	**36.31**	**36.41**
Pooled											
EcoSolv	22.17	71.90	93.83	93.88	62.2	112.2	348	345	35.5	37.0	37.8
EcoAgra	20.82	69.45	93.82	92.24	60.9	110.9	322	311	34.7	35.9	36.2
Control	19.78	68.38	92.19	91.09	53.7	103.7	241	256	33.1	34.4	34.9
CD	1.28	1.86	1.93	2.24	8.5	8.5	31.1	23.7	1.66	2.19	1.57
CV	8.98	6.64	5.25	3.57	21.2	11.5	15.1	11.5	4.84	6.13	4.33
	*	NS	NS	NS	NS	NS	**	**	**	**	**
Expt. Mean	**20.93**	**69.91**	**93.28**	**92.40**	**58.93**	**108.93**	**303.67**	**304.02**	**34.43**	**35.79**	**36.30**

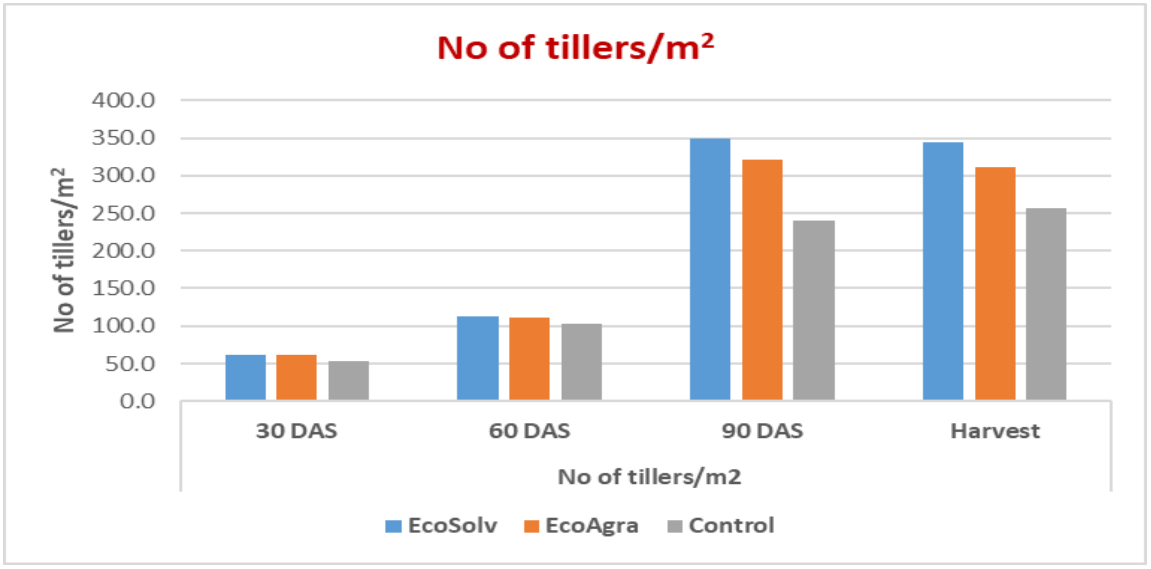
Table: Yield and yield attributes in direct seeded rice as affected by different treatments, *Kharif* 2020 and Rabi 2020-21

Kharif2020								
Treatments	**No of Panicles/m^2**	**Effective tillers (%)**	**Panicle Weight (g)**	**Test weight (g)**	**(Grain) Yield(t/ha)**	**Straw Yield(t/ha)**	**Harvest Index (%)**	**% GYI**
EcoSolv	286.4	86.9	3.76	20.87	5.79	6.64	46.53	19.27
EcoAgra	256.1	86.2	3.68	20.06	5.62	6.30	47.09	15.77
Control	223.6	85.3	3.55	19.79	4.85	5.73	45.84	
CD	29.9	3.4	0.63	0.90	0.79	0.79	0.60	
CV	11.7	3.9	17.25	4.47	14.60	12.77	1.30	
	**	NS	NS	**	**	**	*	
Expt. Mean	**255.3**	**86.1**	**3.66**	**20.24**	**5.42**	**6.22**	**46.49**	
Rabi2020-21								
EcoSolv	326.4	90.8	3.91	21.22	5.88	6.58	47.20	17.91
EcoAgra	294.8	90.5	3.79	20.64	5.67	6.42	46.94	13.73
Control	210.0	85.2	3.60	19.95	4.99	5.77	46.36	
CD	32.7	9.8	0.40	0.65	0.31	0.39	0.50	
CV	11.8	11.0	10.57	3.14	5.57	6.19	1.06	
	**	NS	NS	**	**	**	*	
Expt. Mean	**277.1**	**88.8**	**3.76**	**20.60**	**5.51**	**6.25**	**46.84**	
Pooled								
EcoSolv	306.4	88.9	3.83	21.04	5.84	6.61	46.9	18.58
EcoAgra	275.4	88.3	3.73	20.35	5.65	6.36	47.0	14.73
Control	216.8	85.2	3.57	19.87	4.92	5.75	46.1	
CD	21.3	4.98(0.67)	0.36	0.53	0.41(0.68)	0.42(0.67)	0.38	
CV	11.8	8.39(5.80)	14.22	3.85	10.98(8.06)	10.02(8.34)	1.19	
	**	**	NS	**	**	**	**	
Expt. Mean	**266.2**	**87.5**	**3.71**	**20.42**	**5.47**	**6.24**	**46.66**	

Table: Energy and Economics in direct seeded rice as affected by different treatments & water studies

Kharif2020									
Treatments	**Total water Input(Rainfall + Irrigation)(mm)**	**Water productivity**	**Total Energy Input (GJ/ha)**	**Gross energy output(GJ /ha)**	**Energy Productivity (kg/MJ)**	**Cost of Cultivation (Rs/ha)**	**Gross Returns (Rs/ha)**	**Net Returns (Rs/ha)**	**B:CRatio**
EcoSolv	1075.0	5.28	17.102	168.06	0.73	37141	108095	70954	1.91
EcoAgra	1216.0	4.68	16.85	161.31	0.71	40141	104982	64841	1.62
Control	1224.0	4.05	16.802	142.99	0.63	37141	90683	53542	1.44
CD		0.68			0.09				0.38
CV		14.45			13.72				23.06
		*			*				*
Expt. Mean	**1172**	**4.67**		**157.5**	**0.69**	**38141**	**101253**	**63112**	**1.66**
Rabi2020-21									
EcoSolv	1020.0	5.47	17.102	168.64	0.73	37141	109838	72697	1.96
EcoAgra	1170.0	4.73	16.85	163.56	0.72	40141	105936	65795	1.64
Control	1178.0	4.16	16.802	145.40	0.64	37141	93151	56010	1.51
CD		0.2703			0.04				0.15
CV		5.652716			5.64				8.92
		**			*				**
Expt. Mean	**1123**	**4.79**		**159.2**	**0.70**	**38141**	**102975**	**64834**	**1.70**
Pooled									
EcoSolv	1047.5	5.37	17.10	168	0.73	37141	108967	71826	1.93
EcoAgra	1193.0	4.70	16.85	162	0.71	40141	105459	65318	1.63
Control	1201.0	4.11	16.80	144	0.64	37141	91917	54776	1.47
CD		0.35(0.68)			0.50(0.68)				0.20(0.68)
CV		10.91(8.26)			10.45(8.10)				17.31(12.86)
		**			**				**
Expt. Mean	**1147.17**	**4.73**		**158.3**	**0.69**	**38141**	**102114**	**63973**	**1.68**





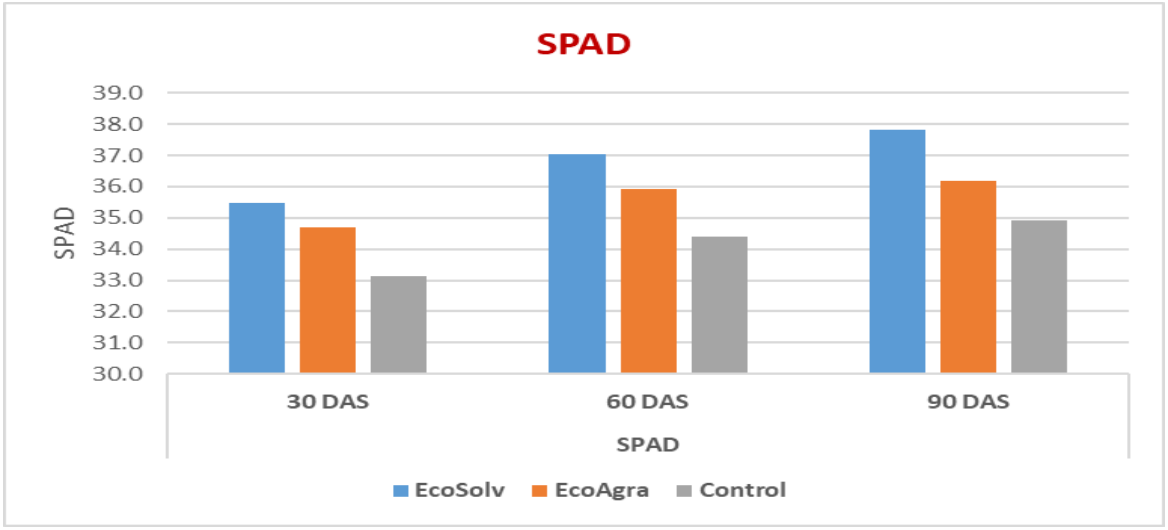


Fig.1.Pooled data of growth parameters as influenced by treatments

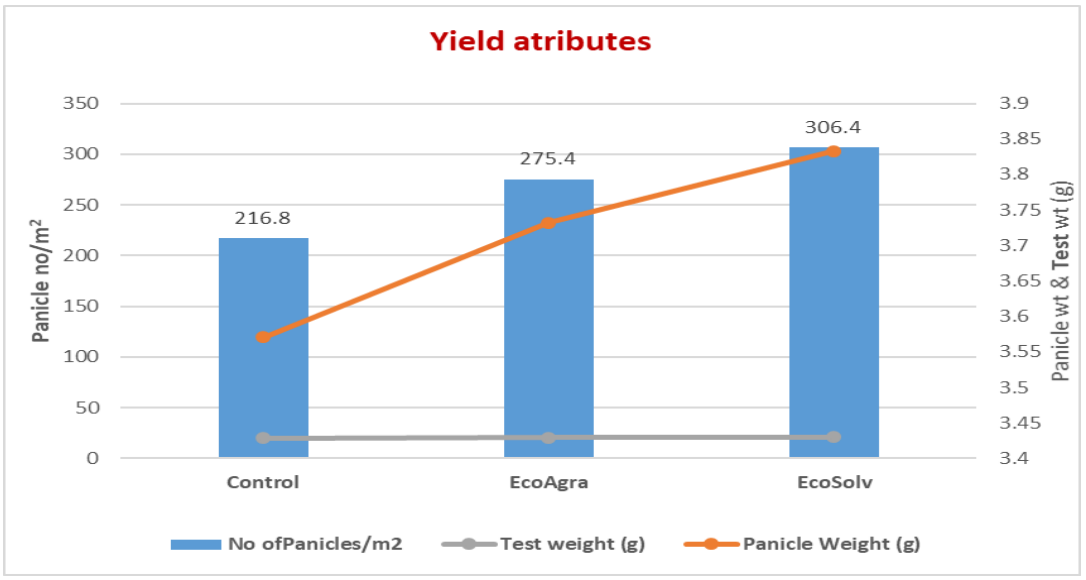


Fig.2.Yield attributes influenced by treatments

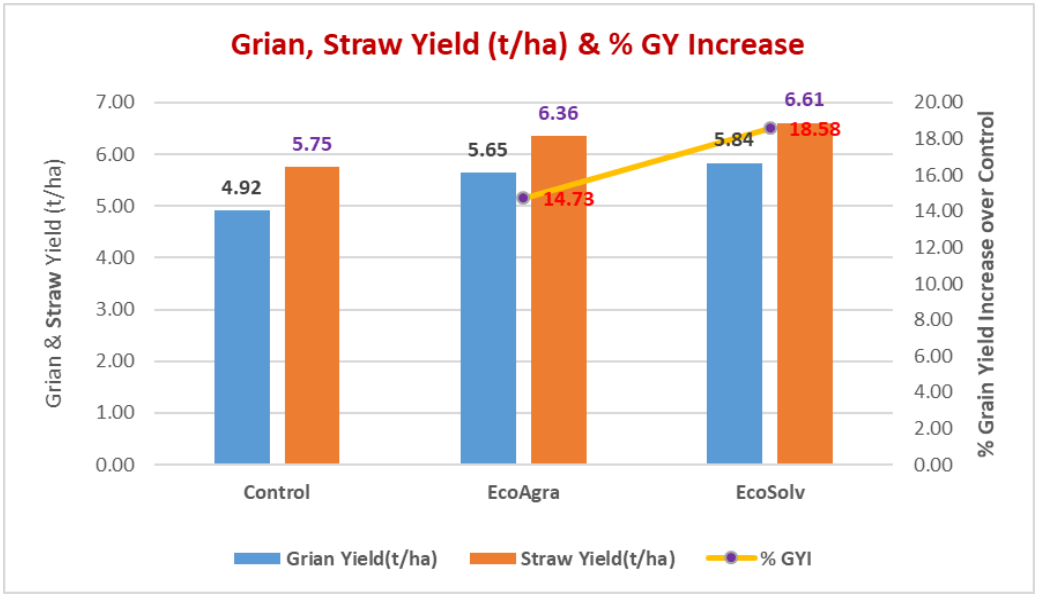


Fig.3. Pooled Grain, Straw yield & % grain yield increase over control as influenced by EcoSolv & EcoAgra treatments

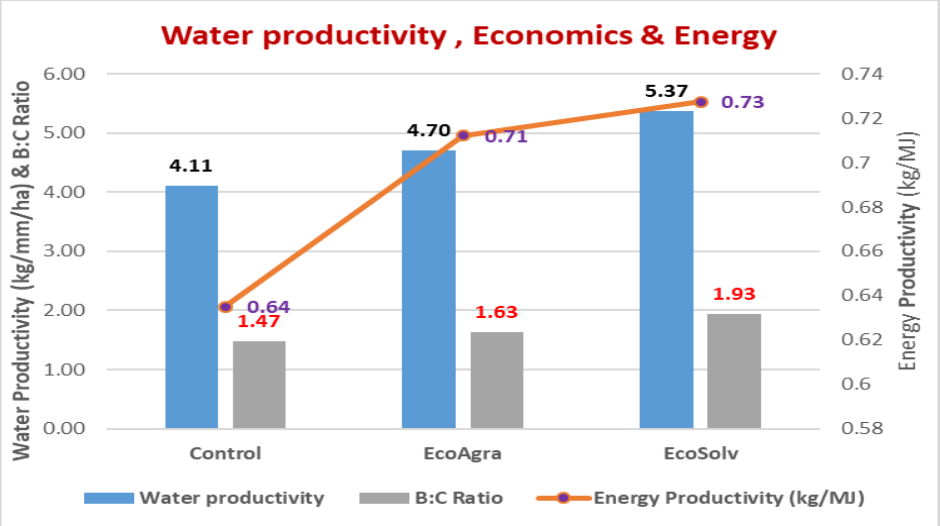


Fig.4.Water productivity, Energy & Economics of EcoSolv & EcoAgra

Passport data of the technology

Ecoagra is USDA Bio Preferred, it has gained acceptance and recognition in all areas of usage and across various countries.

Ingredients in the eA300 formula provide efficient transportation of nutrients from the soil into the plant through the root system.

- More Nutrient Availability
- Increased Root Mass – Larger Leaf Surface – Increased Yield
- Increased Photosynthesis – Healthy and Stronger Plants
- Increased Ability to Fight Pests and Disease

Dosage: 1 in dilution with water. 660ml/acre

Application: Foliar spray – two sprays - 1st after 25 – 30 days after sowing & 2nd after 50-60 days after sowing in DSR

1. Proposed stakeholders	DSR and Conventional formers
2. Commercial potential, if any	About to commercialize
3. Publications/photos/video clipping, if any	

Plate 1. Direct Seeded Rice through dibbling method in IIRR field

Filed after DSR dibbling

Germination in field

Plate.2.Crop at different stages, EcoAgra spraying & observations

Plate.3. Comparison of treatments at harvest

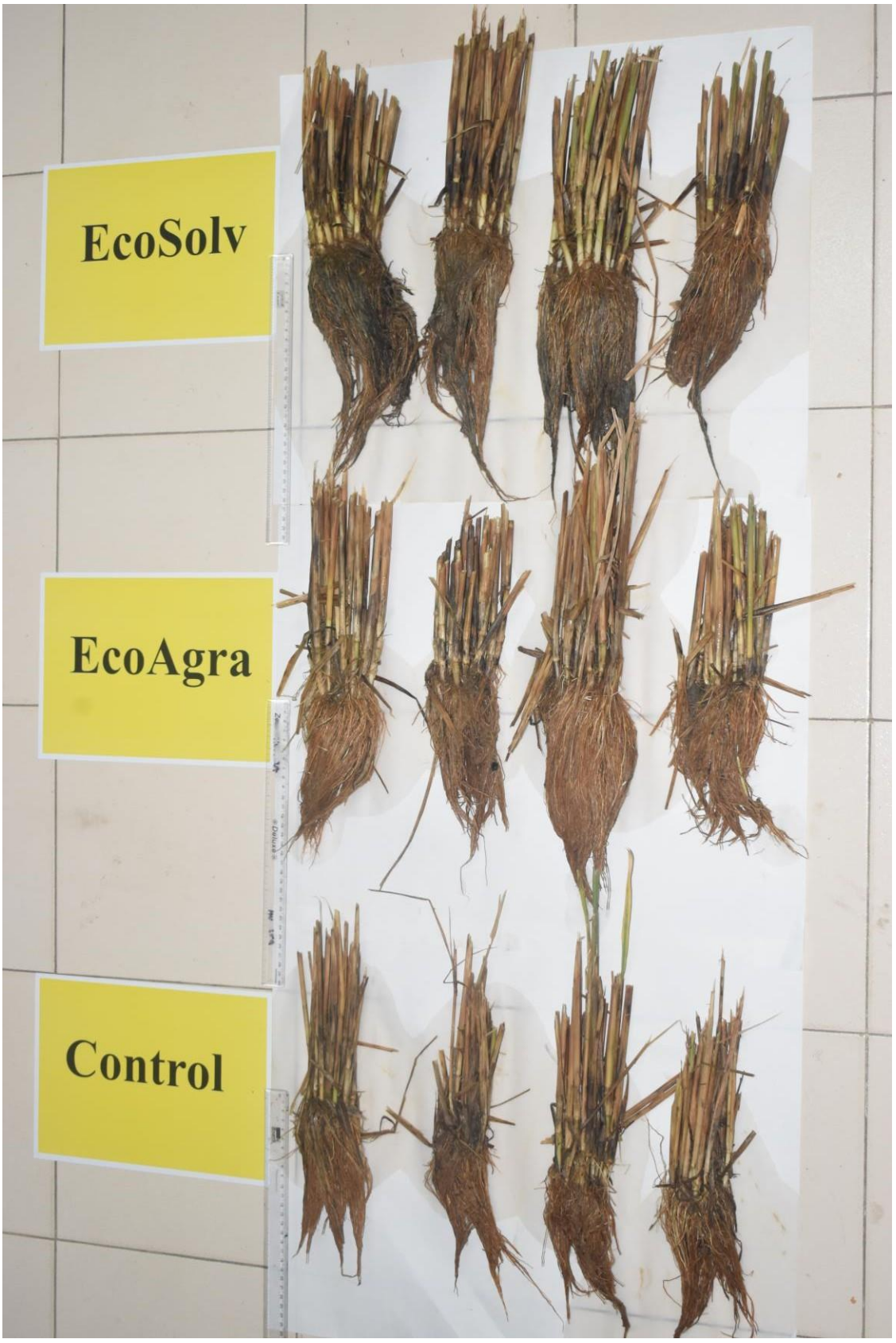


Plate.4. Comparative image of root mass of different treatments

Plate.5. Crop at maturity stage & Harvest

	
EcoAgra Treatment	**Control plot**
	
DSR Dibling in puddled condition	**Application of EcoAgra**
	

Plate.6. FLD conducted in Jannipalli village Nizamabad District in rabi 2020-21 season

Plate.7. EcoSolv team members visit to IIRR

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. Soumya Saha	Co-developer	
Dr. Ch. Padmavathi	Co-developer	

2. Recommendations of the Head of Division

3. Recommendations of ITMC/PME

4. Recommendations of Director

5. Recommendations of SMD

No Objection Certificate

ecosolv
ecoSolv Technologies LLC
www.ecosolv.com

Our Ref: EST/IIRR/001/23
Date: 18th July 2023

Dr. R. Mahendra Kumar
Principal Scientist & Head Agronomy
ICAR - Indian Institute of Rice Research
Rajendra Nagar, Hyderabad 500 030

Dear Sir

Sub: ICAR- CPPT's for granting AICRTP – ECOAGRA Joint Technology – No objection Certificate

We thank you for your letter reference, no: F. No. AGRO/2023 dated 13th July 2023 requesting No Objection Certificate for granting AICRIP- Ecoagra joint technology status.

We are pleased to confirm that we have "No Objection" for the above proposal.

Thanking once again and look forward to work with your organization.

Yours truly

M. Bala Satyanarayana

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