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INTEGRATION OF ON-FARM DRIP IRRIGATION SYSTEM IN RICE CULTIVATION (MORE CROP- PER DROP)

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ABSTRACT:

Food production has to increase from 247 to 494 m MT (AD 2050) to feed the ever increasing Population of India. Increase in cultivated area will not add much to this requirement. (Possible increase only 2 m ha from the present 143 m ha). Converting rain-fed crops to irrigation cover (Partial or Full) is the only way out (79 to 146 m ha). Gross Water Requirement increases to 1200 BCM from the present 700 BMC. Available water remain at 1137 BCM. Water deficit will force us to take ***extreme measures*** by 2030-2050. Before that happens conservation of water would help us survive better. Irrigation is the largest water user (+ 83%). Reducing water use in irrigation by increasing use efficiency will generate more water for irrigating more land area. Rice is the most important global food crop. Year-to-year fluctuations in its production have a direct bearing on food security and on price inflation in the world market. Given its continuing population growth, India should be producing 1.7 million tonnes of additional rice every year to ensure national food security (Dass and Chandra, 2013). Hence, there is a need to increase sustainably the yields and productivity of rice cultivation, doing this to the extent possible with reduced inputs and with less exploitation of natural resources to feed the increasing global population. This is a challenge for rice-growing countries around the world. Integration of Drip irrigation technology to the field of rice cultivation is the best way to achieve higher productivity with least water use. The results of studies on the justification of the combination of controllable factors of growth and development of rice, providing the usage of drip irrigation to obtain yields 5, 6 and 7 t/ha of grain are observed. During the

investigations were determined the reaction norms of periodically watered rice on the various options for the water regime of the soil and to ensure their regulations irrigation, fertilizer application rates. The proposed irrigation technology can reduce the cost of irrigation water in the cultivation of rice in the 2.0-5.6 times in comparison with the traditional, and bring the total water consumption of this culture to a biologically sound one.

INTRODUCTION:

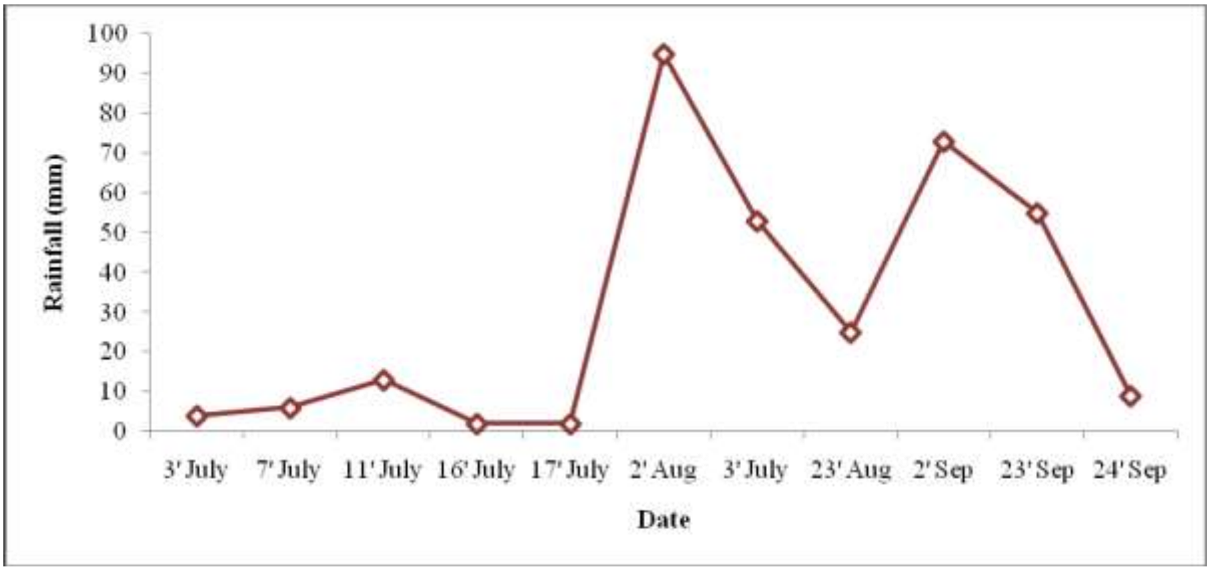
Expansion of rice cultivation is linked to availability of water. Rice cultivation expanded too many areas due to growing infrastructure such as dams, canals etc, and facilitating irrigation. Modern methods of rice cultivation require irrigation, which implies dependence on large quantities of surface and ground water. Due to water scarcity, rice cultivation is becoming unaffordable and unpredictable in many areas across the world. This will have serious implications on food security in many countries. Rice cultivation requires a large amount of water. With water becoming scarce, we need to find ways to reduce its consumption," The popular System of Rice Intensification (SRI) method uses around 120 to 150 lakh litres per hectare to produce 7 tonnes of rice. Using drip irrigation, with 50 to 60 lakh litres of water in one hectare, around 5 to 6.5 tonnes of rice was produced. This was more effective than the existing methods (Pandian 2013). Rice cultivation requires nearly 1000 mm to 2250 mm water throughout the crop cycle. Micro Irrigation System (MIS) is proved to be the best method for resolving the problem of water scarcity.

For producing rice at present with traditional irrigation techniques, large quantities of water are being used to flood paddy fields with standing water 2-5 cm deep at the different stages of crop growth. Studies have indicated that 3.0 to 5.0 m3 of water are often used to produce 1 kg of rice (Satyanarayana *et al.,* 2007), but this includes water applications which are clearly excessive. Water requirements for flooded rice production are now considered to average a little over 1.40 m3 per kg of rice. This is about three times more than for growing wheat and maize (Riaz, 2001). This will inexorably affect farming system of irrigated regions in future, especially irrigated for rice production. Further, traditional rice production system not only leads to wastage of water but also causes environmental problems and reduces nutrient use efficiency. Hence, an attempt to increase water productivity either by reducing water consumption or by increasing the yields will automatically facilitate higher growth in agricultural production. Micro irrigation through the trickle supply of water drops and or sprinkler systems holds promise in this respect. Micro Irrigation System (MIS) coming strongly as effective system for irrigating the paddy crop with more efficient in water use as well as more environment friendly in operation and management. With MIS system we can move towards ―**more crop per drop‖** (Soman, 2012).

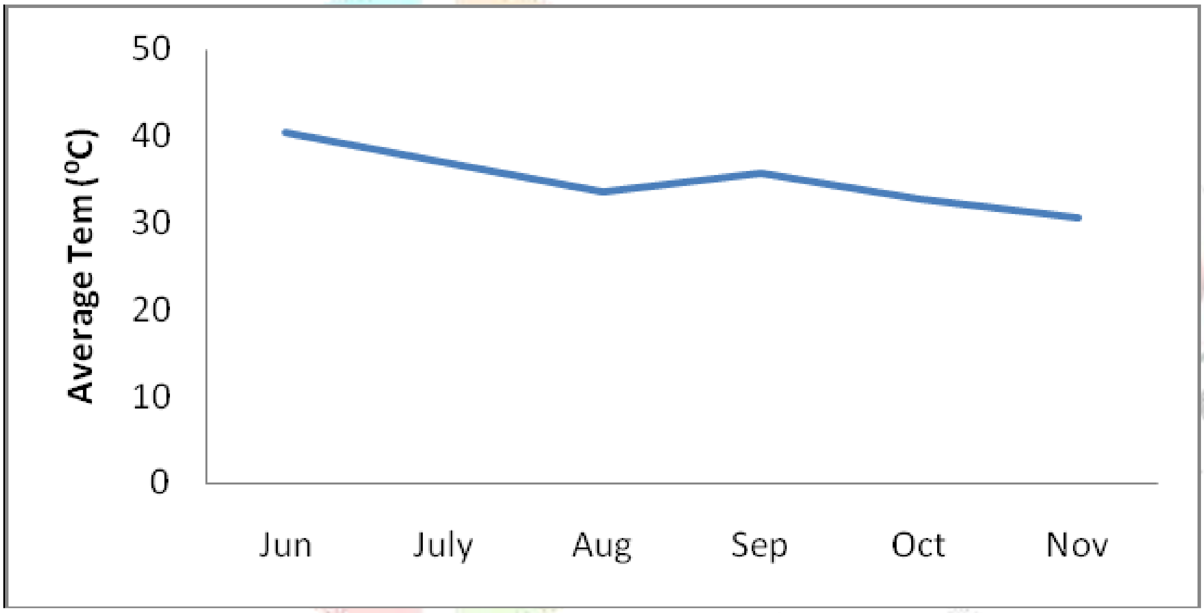
DISCUSSION ON MATERIALS AND METHODS:

The on farm trial was conducted in the farmer Kuman Meher field of Sinapali village of Nuapada district, Odisha state under the supervision of KVK, Nuapada. The experimental site is situated of Latitude 20̊ 09'N and Longitude 82̊ 64'E at an altitude of 995 m above mean sea level (MSL). Soil type of the experimental field is clay loam. Monsoon starts at the end of June and extends up to September. The annual rainfall of the region is 1286mm. The total rain received during cropping period was 463 mm and effective rainfall is 207 mm. The rainfall distribution is depicted in Figure presented below. The summer months from March to May are very hot and humid and temperature often rises above 40̊ c.

Annual rainfall as received during the experimental period in 2019



Average Temperature (°C) of Ten Years



STUDIES ON WATER USE PATTERN:

The total water use and water use efficiencies under flood, drip and sprinkler methods of irrigation are observed. The total water use inclusive of effective rainfall in flood irrigation of farmers practice was 587.4 mm whereas it was only 407.3 mm and 419 mm in drip and sprinkler irrigation methods, respectively. This resulted in 30.7 and 28.7 per cent of water saving under drip and sprinkler methods, respectively as compared to flood practice. The drip irrigation methods used less water due to restriction of water loss through evaporation from large amount of ground, conveyance losses resulted in maximum water use by crops. Similar result of water saving under drip irrigation was pointed out by Veeraputhiran (2000).

FERTIGATION SCHEDULE FOLLOWED FOR EXPERIMENTAL TRANSPLANTED RICE UNDER DRIP AND SPRINKLER IRRIGATION METHOD:

Schedule of Fertigation	Urea (Kg)	SSP (Kg)	MOP (Kg)	Zn (Kg)	Fertilizer Rate per Day
Basal (Soil Application)	0	150	0	10	3.5Kg Urea/day
10-20 DAT	35	0	0	_	2.08Kg Urea/day
21-40 DAT	52	0	0	_	650 grams/day
41-60 DAT	13	0	15	_	750 grams/ day
61-80 DAT	0	0	10	_	500 grams/day

TOTAL WATER USE AND WATER USEE EFFICIENCY (kg hamm-1) UNDER MICRO AND FLOOD IRRIGATION METHODS:

Treatments	Irrigation water applied (mm)	Effective Rainfall (MM)	Total Water Used (mm)	Percentage saving of water over flood irrigation	WUE (Kg ha/ mm)
Drip Irrigation	240	167	107.3	30.7	17.1
Sprinkler Irrigation	252	167	419.0	28.7	11.5
Flood Irrigation	420.4	167	587.4	_	10.6

ECONOMIC AND MONETARY BENEFITS OF RICE CULTIVATION WITH MICRO-IRRIGATION SYSTEMS OVER CONVENTIONAL SYSTEM:

Details	Transplanted Drip	Transplanted Sprinkler	Transplanted Flood
Total cost of drip/sprinkler system (Rs/ha)	125000	100000	_
Subsidy given to the farmer (one hectare) 85% of total cost (Rs/ha)	106250	85000	_
Farmers share (Rs.)	18750	15000	_
Cost of drip/sprinkler system for 7 year (2 crops/year) @ Rs.	1137.5	1072.5	_
Gross income/ha (Selling price @ Rs. 15.9/kg)	110505	76320	98977
Net income (Rs/ha-1)	84467	50572	74277
Incremental yield in drip/sprinklers/acre (in kg ha-1)	725	_	_
Net incremental income (Rs.)	11277	_	_

The paddy crop grown through drip irrigation was registered higher WUE (17.1 kg ha mm-1) while low level of WUE (10.6 kg hamm-1) was found in flood irrigation. The WUE of sprinkler method was 11.5 kg ha mm-1 in transplanted paddy crop. Adequate and timely availability of water, nutrients and their synergistic interaction had stimulated to record higher water use efficiency under drip fertigation (Veeraputhiran, 2000).

ECONOMIC BENEFITS:

In the present study, the monetary benefits of rice crop under micro irrigation i.e. drip and sprinkler methods were compared with flood irrigation method. The annual cost of drip irrigation system was calculated with the assumption that the life micro irrigation system infrastructure would be 07 years with 07-10 per cent annual depreciation. The cost components considered included land preparation, seeds, fertilizer, labour, harvesting and threshing. Uniform cost values were considered for all irrigation method. The drip fertigation system has been found more profitable than sprinkler and flood irrigation due to higher yield. The finding of the study indicated that the higher net return (Rs.33787 per acre) was obtained under drip irrigation method followed by flood irrigation method of irrigation (Rs. 29711 per acre). The lowest net return (Rs.20229 per acre) was in sprinkler irrigation method. It showed that drip irrigation produced 12% more net income than flood irrigation method, and 40% higher net income as compared to sprinkler irrigation system. Further, drip irrigation system proved 0.29 t higher incremental yield than any other method. Similarly, net increment income of drip irrigation system was Rs. 4511 over traditional flood irrigation method. Richakhanna (2013) reported that optimal water use can enhance returns with enhanced labour productivity and far higher net income than traditional methods for the cultivation of rice. These results were in agreement with the findings of Veeraputhiran *et al.,* (2002), Soman (2012) and Abdelraouf *et al.,* (2013).

BENEFITS OF DRIP IRRIGATION AND FERTIGATION IN RICE CULTIVATION:

- Enhanced yield upto50%
- Higher and cleaner straw production
- Higher water use efficiency
- Conserving irrigation water up to 66%
- Conserving energy use for pumping up to 52%
- Reduced seed rate
- Higher fertilizer use efficiency
- Absence of pollution from leached and washed Nitrate
- Maintains aerobic condition in the soil
- Prevents Methane emission and protects environment as there is no standing water
- Reduced humidity in micro climate
- Incidence of diseases and insects significantly low
- No need for land leveling (prerequisite for flow irrigation)
- No need for labour use for trimming bunds and plugging breaches to contain water
- Total Labour requirement less
- Intercropping and rotation cropping is possible. Pulse rotation crop will be beneficial
- Soil structure is maintained (absence of puddling operation that destroys soil structure)
- Lower mosquito population in the ecosystem as there is no standing water

PICTURES CORNER:

CONVENTIONAL PADDY (L), SRI (R)

DRIP IRRIGATED PADDY EMMITTER SPACED AT 20cm (L), 30cm (M), 40 cm (R)

CONCLUSION:

The present study concluded that irrigation through drip system along with fertilizer applications recorded higher grain yield and WUE in transplanted paddy crop. However, these results should further be tested with advanced experimentation and evaluation because the implications of this work could be rather far-reaching. The evidence assembled and analyzed here suggests that transplanted rice cultivation with drip irrigation is a hopeful adaptation for reducing the rice-crop's demand for water and nutrient, which are increasingly demanded and costly, while at the same time it raises grain yield. Further, long term and multi-location trials will be needed to arrive at percentages of water and nutrient saving that are realizable under different and specific situation.

The present study found consistent evidence that the adoption of drip irrigation combined with paddy transplanted and managed according to System of Rice Intensification practices offers substantial agronomic and economic advantages. Plant growth and yield-contributing parameters such as effective tillers, number of panicles m-2, and grain yield were found to be significantly higher in drip-irrigated treatments. Apart from higher yield, water productivity and water-energy productivity were both higher in the case of drip-irrigated paddy cultivation with young single seedlings transplanted at 30 x 30 cm spacing with drip emitters spaced at 20 cm.

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