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T Kanna
Assistant Professor, Department of Agricultural and Horticultural Sciences, Vignan University, Vadlamudi, Guntur, Andhra Pradesh, India

Dr. B Rajendra Kumar
Assistant Professor, Department of Agronomy, Acharya N.G. Ranga Agricultural University, Agricultural College, Naira, Srikakulam, Andhra Pradesh, India

Dr. A Upendra Rao
Professor, Department of Agronomy, Acharya N.G. Ranga Agricultural University, Agricultural College, Naira, Srikakulam, Andhra Pradesh, India

Dr. G Mohan Naidu
Professor & Head, Department of Statistics and Computer Applications, Acharya N.G. Ranga Agricultural University, Agricultural College, Naira, Srikakulam, Andhra Pradesh, India

Corresponding Author:
T Kanna
Assistant Professor, Department of Agricultural and Horticultural Sciences, Vignan University, Vadlamudi, Guntur, Andhra Pradesh, India

Evaluation of soil moisture, irrigation parameters and post nutrient status influenced in six fallow crops with limited number of irrigations

T Kanna, Dr. B Rajendra Kumar, Dr. A Upendra Rao and Dr. G Mohan Naidu

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Abstract
A field experiment entitled "Evaluation of Soil moisture, Irrigation parameters and Post Nutrient status influenced in six fallow crops with limited number of irrigations" was conducted at Agricultural College Farm, Naira. The experimental site was uniform in topography and the soil was sandy loam in texture. The soil pH was slightly alkaline, low in organic carbon, low in available nitrogen, medium in available phosphorus and medium in available potassium. The experimentation was conducted during *rabi*, 2021-22 and was laid out in a split plot design, replicated thrice with three irrigation levels *viz.*, two irrigations (I_1), three irrigations (I_2) and four irrigations (I_3) assigned to main plots and six fallow crops *viz.*, Maize (C_1), Sorghum (C_2), Fingermillet (C_3), Mustard (C_4), Sunhemp (C_5) and Blackgram (C_6) assigned to sub plots. Regarding number of irrigations the relative production efficiency, soil moisture availability at 60, 90 and 105 DAS, water requirement, water productivity, apparent water use productivity were recorded progressively higher with four irrigations (I_3) and were decreased gradually and significantly with reduction in number of irrigations to two (I_1). Pertaining to six fallow crops, water requirement was recorded highest in Maize (C_1) and lowest in Blackgram (C_6). The water productivity was significantly maximum with Maize (C_1) and minimum with Mustard (C_4). Apparent water use productivity was highest in Sunhemp (C_5) and lowest in Maize (C_1). System productivity and Relative production efficiency were recorded highest in Sorghum (C_2) and lowest in Mustard (C_4). With regard to the interaction effect with number of irrigations and six fallow crops was significant and statistically measurable. The system productivity and relative production efficiency were progressively high with four irrigations in Maize (C_1) and minimum with two irrigations in Mustard (C_4). The highest water productivity was recorded in Maize (C_1) with two irrigations (I_1) and lowest was recorded with four irrigations (I_2) in Mustard (C_4). The Apparent water use productivity was recorded highest with four irrigations (I_3) in Sunhemp (C_5) and lowest was recorded in Maize (C_1) with two irrigations (I_2).

Keywords: System productivity, relative production efficiency, apparent water use productivity, rice fallows, limited irrigation

Introduction
Global demand for grain crops is projected to rise significantly in the upcoming decades. To meet this demand and ensure food security at the national level, it is imperative to enhance the productivity of agricultural systems through sustainable intensification of conventional cropping practices (FAO, 2017) [8]. The rice fallow system, covering approximately 14 million hectares, is a prevalent monoculture system in South Asia, particularly in India, including Andhra Pradesh. It is currently attracting greater attention as a promising approach for sustainable intensification. Efficient utilization of these fallow lands has the potential to boost productivity and promote overall sustainability of the system. Given the soil conditions and climatic characteristics, it is evident that short-duration crops can be effectively integrated into these fallow areas (Riton Chowdhury *et al*., 2020) [27].

The resources available in rice fallow areas offer a clear opportunity to diversify crops in these regions, which would be a highly beneficial addition. By effectively addressing location-specific constraints, these unused lands can be transformed into productive assets.

This transformation would not only boost the overall production of the agricultural system but also enhance the economic well-being of farmers, improve soil health, and ensure nutritional security for the population. Rice cultivation typically occurs during the *kharif* season (June-October/November), followed by a fallow period during the *rabi* season (November-February).

The major constraint for majority of these rice fallows is the soil moisture either excess some times and deficit often. With the adaptation of improved technology, selecting suitable rice varieties during *kharif* along with a best suited crops and cultivars during *rabi*, soil moisture conservation process, along with a proper strategy to deal with the other biotic and abiotic stresses, then the rice fallow crops would be a new way out for the farmers. This would benefit the system productivity, improve the soil health, strengthen the financial condition of the farmers and also provide a new way to fulfill the food and nutritional security.

Despite encountering various obstacles, the rice-fallow system presents significant potential for integrating a second crop following rice cultivation, especially when accompanied by enhanced soil and crop management techniques and careful selection of crops and varieties. Among the potential crops, those with low input requirements are particularly favoured for intensifying rice-fallow production systems. Implementing holistic crop management approaches such as no-till farming, relay cropping, residue preservation, mulching, seed priming, establishing farm ponds for supplemental irrigation, micronutrient supplementation, and others can greatly enhance the survival and productivity of crops in rice fallow areas.

Incorporating low-input crops into rice fallow areas is reported to enhance both productivity and sustainability of the agricultural system (Kumar *et al*., 2018) [15]. Among different fallow crops, Maize reported the highest grain yield (5.88 t/ha) with 4 irrigations provided at four leaf stage + eight leaf stage + tasselling stage+ grain filling stage and which was statistically similar to 3 irrigations provided at Four leaf stage + tasselling stage+ grain filling stage (Kobir *et al.*, 2019) [16]. Higher equivalent yield in Maize (6320 kg ha^{-1}), Sorghum (6992 kg ha^{-1}) and Bajra (2768 kg ha^{-1}) were recorded under irrigation scheduled at vegetative, flowering and grain filling stages (Three irrigations) as reported by (Nazma *et al.*, 2019) [21]. Similarly, in Mustard (Alamin *et al.*, 2019) [1] observed tallest plants, maximum number of branches $plant^{-1}$, siliqua $plant^{-1}$, seeds $siliqua^{-1}$and the highest seed yield (1.05 t ha^{-1}) with three irrigations in Mustard.

Irrigated agriculture is generally acknowledged to be more productive than rainfed agriculture at any given location. Approximately 24% of the global cropped area is under irrigation, contributing to the cultivation of around 40% of global agricultural commodities, thus making it a crucial component of the global agricultural sector. The availability of irrigation facilities enhances crop performance during dry spells and in regions with insufficient or uneven distribution of precipitation. Studies indicate that expanding irrigation infrastructure must remain a primary focus to sustain future food production in the face of climate change impacts. Water security forms the foundation of food security, and scarcity of water resources could result in fluctuating grain production, potentially leading to genuine food crises.

Implementing efficient water management practices, particularly through limited irrigation during critical stages of crop growth, is essential for increasing food production to meet the needs of a growing population. As emphasized by Jose Graziano da Silva, Director-General of the Food and Agriculture Organization of the United Nations (Bertilsson, 2012) [34], "There is no food security without water security." Agriculture accounts for the majority of water usage, consuming around 70% of the world's total water supply. Therefore, enhancing agricultural water productivity is a crucial step toward ensuring both global water sustainability and food security.

Hence, the current study aimed to assess the productivity of rice fallows under zero-tillage conditions, striving for optimal yields. There has been a longstanding necessity among farmers to identify an alternative crop capable of thriving and generating significant profits while requiring minimal moisture and farm operations within a zero-tillage system, where rice serves as the primary crop.

Materials and Methods

A field experiment entitled “Evaluation of Soil moisture, Irrigation parameters and Post Nutrient status influenced in six fallow crops with limited number of irrigations” was conducted during rabi, 2021-22 at Agricultural College Farm, Naira to assess the performance of different crops with limited irrigation and to work out minimum number of irrigations required for different crops in rice fallow situation under zero-tillage. The experiment was laid out in field no.124 of Block-F of Agricultural College Farm, Naira. It is located in north coastal agro climatic zone of Andhra Pradesh situated at 18^0 38′ 31″ N latitude, and 83º 94′ 48″ E longitude with an altitude of 12 m above the mean sea level (MSL).

The weather data recorded during the crop growth period (12-12 2021 to 30-04-2022) at Agricultural College Farm, Naira are as the weekly mean minimum temperatures ranged from 13.7 °C to 27.2 °C with an average of 20.5 °C and the weekly mean maximum temperatures ranged from 28.1 °C to 38.2 °C, with an average of 32.8 °C. The weekly mean relative humidity ranged from 63 to 84.2 percent with an average of 70.7 percent. The weekly mean bright sunshine hours during the crop growing period ranged from 2.3 to 7.4 with an average of 4.6 while, the rate of evaporation (USWB Class A open pan evaporimeter) ranged from 1.7 to 7.0 mm day^{-1} with an average of 3.7 mm day^{-1}.

The experiment was conducted at Agricultural College Farm, Naira with three main treatments comprising of number of irrigations and six sub treatments comprising of six different crops. The experiment was conducted in Split plot Design with three replications. The experiment was laid out in a split plot design with 18 treatment combinations and three replications with Gross plot size of (6m x 5m) and Net plot size of (5.4 m x 4.4 m).

No ploughing and levelling operations were carried out during the cropping period as the experiment was conducted under zero till condition. Maize and Sorghum were dibbled at recommended spacing 60x20 cm and 45x15 cm. Finger millet, mustard, sunhemp and blackgram were broadcasted uniformly on 14th December 2021. Fertilizer was applied as per the recommended doses and method of application of respective crops.

To maintain optimum plant population, gap filling was done at 15 DAS and thinning was done at 20 DAS. Two hand weedings were carried out at 20 and 40 DAS to keep the plots free from weeds. The crops were grown on residual soil moisture up to first irrigation and there after irrigations were given as per the treatments individually with pipes in the respective plots till the plots were fully covered with water upto the bunds. Quantification of water is done by Volumetric method.

Water requirement is the amount of water required for each crop for total crop growth in its duration. Water requirement was worked out and expressed in mm ha^{-1}.
Water productivity is the ratio of grain yield to total water required in hectare centimeters.

$$\text{Water productivity} = \frac{\text{Grain yield (kg/ha)}}{\text{Required water (ha/mm)}}$$

The apparent water use productivity (AWUP) may calculated using the following formula.

$$\text{AWUP} = \frac{\text{Equivalent yield of a system/ ha}}{\text{Total quantity of water used/ ha in cm}}$$

Inference: Higher the AWUP, more efficient is the system. The approach is more useful under irrigation constraints conditions.
Relative production efficiency (RPE) refers to the capacity of the system for production in relation to existing system and expressed in percentage. The following method is proposed for calculating the RPE.

$$\text{RPE} = \frac{(\text{EYD}-\text{EYE})}{\text{EYE}} \text{ x } 100$$

Where
EYD denotes the equivalent yield under improved/diversified system while EYE denotes the existing system yield.

Inference: Positive values shows the superiority of the new system over the existing in percentage and considered desirable. Negative values shows inferiority over the existing system, thus not desirable. Any positive value of more than 20% is considered optimum.
The system productivity was calculated by accounting the *kharif* paddy yield acquired from hectare to the calculated Blackgram equivalent yield for different crops in *rabi* season. The initial composite soil sample was collected from the field before starting of experiment and final soil samples after harvesting of crop were drawn from each plot as per treatments separately and then shade dried, ground with a wooden hammer, passed through a 2 mm sieve and finally stored in labeled air tight polythene bags for laboratory analysis. Processed soil samples were used for analyzing various nutrients.

Results and Discussion

1. Soil moisture (%) during crop growth at 15 day's interval

Soil moisture estimated at every 15 day's interval during growth period of six different crops were presented in the table 1. Initially at 15 and 30 DAS no irrigations were provided to fallow crops although sowings were carried out in residual soil moisture after harvest of paddy crop in fallow situation under zero-till conditions. The soil moisture was non-significant and unaffected with number of irrigations in six fallow crops as well as their interaction effect at 15, 30, 45 and 75 DAS.
At 60 and 90 DAS the soil moisture with number of irrigations was recorded as significant. Among six fallow crops there was no significant difference at 60 and 90 DAS. The interaction effect between number of irrigations and six different crops at 60 and 90 DAS was reported as non-significant.
At 60 and 90 DAS the soil moisture was recorded significantly highest at four irrigations and lowest at two irrigations.
At 105 DAS there was significant difference in soil moisture with number of irrigations and six fallow crops. The interaction effect with number of irrigations and six fallow crops was recorded as non-significant and presented in the table 2.
At 105 DAS the soil moisture recorded significantly highest at four irrigations and lowest at two irrigations. Among six fallow crops the soil moisture recorded significantly highest with Maize crop and lowest with Mustard crop.

1.1. Water requirement (mm ha^{-1}) of six fallow crops with limited number of irrigations

The water requirement with limited number of irrigations in six fallow crops was presented in table 3. There was significant difference with number of irrigations and with six fallow crops. The interaction effect between number of irrigations and six fallow crops was reported as non-significant.
The water requirement was recorded significantly higher with four irrigations and decreased significantly and gradually with reduction in number of irrigations and recorded minimum values with two irrigations. Among six fallow crops, significantly highest water requirement was with Maize crop and lowest water requirement was recorded with Blackgram.

1.2. Water productivity (yield ha^{-1} mm^{-1}) of six fallow crops with limited number of irrigations

The water productivity with number of irrigations among six fallow crops was presented in table 4. Significant difference was observed with number of irrigations among six different crops. Regarding interaction effect between number of irrigations and six different crops there is significant difference and the data is statistically measurable.
The water productivity was recorded highest with four irrigations and decreased significantly and gradually with reduction in number of irrigations and recorded lowest with two irrigations. Among six different crops water productivity was recorded as highest with Maize and lowest with Mustard crop.
The Interaction effect was recorded as significant with number of irrigations and six fallow crops. Significantly highest water productivity was recorded in Maize crop with two irrigations and minimum was recorded in Mustard crop with four irrigations which was however, on par with two irrigations.
Maize, Sorghum, Ragi and Sunhemp utilized greater quantities of water to produce higher yields as compared with Mustard and Blackgram. The results were in agreement with those reported by Jiatun Xu *et al*. (2020) [12] and Parihar *et al.* (2016) [22].

1.3. Apparent Water Use Productivity (yield ha^{-1} cm^{-1}) of six fallow crops with limited number of irrigations

The data pertaining to Apparent water use productivity with number of irrigations in six different crops was presented in table 5. There is a significant difference with number of irrigations and with six different crops. Data regarding interaction effect between number of irrigations and different crops was recorded as significant. Apparent water use productivity recorded highest with four irrigations and decreased significantly and gradually with reduction in number of irrigations and recorded lowest with two irrigations. Among six different crops the Apparent water use productivity was maximum with Blackgram and minimum was recorded with Maize crop.
The interaction effect between number of irrigations and six different crops was recorded as significant and statistically measurable. The highest Apparent water use productivity was recorded with four irrigations in Blackgram crop and lowest was

recorded with three irrigations in Maize crop which was however, on par with two irrigations.

Higher the apparent water use productivity more efficient is the system. According to data the rice fallow Blackgram under zero-till is the efficient system and rice fallow Maize observed as less efficient system among crops. This approach is very useful under irrigation constraint conditions. The efficiency of the system depends on the higher yield attainment by utilizing less amount of irrigation water.

1.4. System productivity (kg BEY ha^{-1}) of six fallows crops with limited number of irrigations

Perusal of data on system productivity with limited number irrigations among six fallow crops was presented in the table 6. The system productivity was significant with number of irrigations in six fallow crops. The interaction effect between number of irrigations and six fallow crops was significant.

The system productivity was significant with number of irrigations in six fallow crops. The highest system productivity was recorded progressively with four irrigations and decreased gradually and significantly with reduction in number of irrigations and recorded lowest with two irrigations. The system productivity was recorded higher in Maize and lower system productivity was recorded in Mustard.

The interaction effect of was significant between number of irrigations and six fallow crops. Significantly higher system productivity was registered with four irrigations in Sorghum crop and the least with two irrigations in Mustard crop which was however, on parity with four irrigations.

1.5. Relative Production Efficiency (%) of six fallow crops with limited number of irrigations

The relative production efficiency with limited irrigation in six fallow crops was presented in the table 7. Significant difference was registered in relative production efficiency with limited number of irrigations in six fallow crops. The interaction effect was also significant and statistically measurable.

The relative production efficiency with number of irrigations was significant and recorded maximum with four irrigations and minimum was recorded with two irrigations. Among six fallows crops the Maize recorded significantly highest relative production efficiency and lowest was with Mustard.

The system productivity in terms of Blackgram equivalent yield and relative production efficiency of rice fallow system revealed that, sorghum followed by maize, sunhemp and Fingermillet performed well in the rice- rice fallow system whereas mustard Blackgram and sunhemp proved inferior due to the fact of difference in the duration and tolerance of crops to abiotic and biotic stresses prevalent under rice fallows. Crops like Maize, Sorghum, Fingermillet and Sunhemp were having more duration than Blackgram and sunhemp the residual soil moisture and residual nutrients may not be sufficient for the entire crop growth period though they were heavy feeders as they produce more yield.

Hence, minimum of four irrigations has to be provided along with recommended dosage of fertilizers to fallow crops during crop growth period. Diversification of rice-fallows with the inclusion of suitable and effective short duration crop is one of the options for horizontal expansion apart from improving productivity and profitability. Rice fallow lands can be utilized for enhancing resource use efficiency and also yield of different crops can be increased in this system ultimately results in sustainability. These findings are in corroborations with those reported by Khumlo and Singh (2021) [25], Priyanka Gautam *et al.* (2021) [25], Lal *et al.* (2020) [7] and Jat *et al.* (2019) [10].

1.6. Post-harvest soil OC and soil available N, P_2O_5 and K_2O

The analysis for post-harvest OC and soil available N, P_2O_5 and K_2O were presented in table 8. Data pertaining to final OC and soil available N, P_2O_5 and K_2O with number of irrigations in six different crops as well as their interaction effect was found to be non-significant.

Table 1: Soil moisture (%) during crop growth at every 15 cm depth with limited number of irrigations in six fallow crops

Treatments	15 DAS	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS
Main plots : No of Irrigations							
M_1: Two Irrigations	61.39	28.44	63.00	32.33	63.06	29.78	13.02
M_2: Three Irrigations	65.00	30.06	67.94	64.06	68.28	32.33	14.26
M_3: Four Irrigations	67.94	33.72	68.61	69.72	69.17	61.39	25.34
SEm±	0.87	1.04	0.97	0.74	1.15	0.62	0.32
CD (P=0.05)	NS	NS	NS	2.90	NS	2.42	1.27
CV (%)	5.7	14	6.1	5.6	7.3	6.3	7.8
Sub plots : Different crops							
C_1: Maize	65.44	30.00	67.67	57.89	68.44	41.89	19.10
C_2: Sorghum	63.89	29.11	65.11	54.67	65.33	39.78	18.11
C_3: Fingermillet	66.33	32.00	67.89	56.78	67.67	41.78	17.98
C_4: Mustard	65.89	30.00	67.44	55.11	67.22	40.33	16.79
C_5: Sunhemp	63.78	30.89	65.78	53.67	66.44	41.44	15.78
C_6: Blackgram	63.33	32.44	65.22	54.11	65.89	41.78	17.48
SEm±	1.71	1.03	1.72	1.56	1.70	1.43	0.40
CD (P=0.05)	NS	NS	NS	NS	NS	NS	1.15
CV (%)	7.9	10	7.7	8.4	7.6	10	6.8
Interaction							
SEm±	2.96	1.79	2.98	2.70	2.94	2.47	0.69
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS

Table 2: Interaction effect of soil moisture (%) at 105 DAS in six fallow crops with limited number of irrigations

Treatments	Soil moisture at 105 DAS			
	M_1: Two Irrigations	M_2: Three Irrigations	M_3: Four Irrigations	Mean
C_1: Maize	15.74	16.42	25.14	19.10
C_2: Sorghum	13.50	14.60	26.22	18.11
C_3: Fingermillet	12.85	15.10	26.00	17.98
C_4: Mustard	11.76	13.69	24.92	16.79
C_5: Sunhemp	11.69	11.71	23.93	15.78
C_6: Blackgram	12.56	14.06	25.83	17.48
Mean	13.02	14.26	25.34	17.54

	SEm±	CD (p = 0.05)	CV (%)
Six different crops (S)	0.40	1.15	6.8
Number of Irrigations (M)	0.32	1.27	7.8
S at M	1.41	2.00	--
M at S	1.48	2.10	--

Table 3: Interaction effect of Water requirement (mm ha^{-1}) of six fallow crops with limited number of irrigations

Treatments	Water requirement			
	M_1: Two Irrigations	M_2: Three Irrigations	M_3: Four Irrigations	Mean
C_1: Maize	150.6	223.1	303.4	225.7
C_2: Sorghum	144.2	212.3	290.7	215.8
C_3: Fingermillet	140.6	206.5	283.1	210.1
C_4: Mustard	133.9	198.2	270.4	200.8
C_5: Sunhemp	135.4	200.5	271.5	202.5
C_6: Blackgram	131.7	195.4	265.6	197.6
Mean	139.4	206.0	280.8	208.7

Table 4: Interaction effect of Water Productivity (yield ha^{-1} mm^{-1}) of six fallow crops with limited number of irrigations

Treatments	Water Productivity			
	M_1: Two Irrigations	M_2: Three Irrigations	M_3: Four Irrigations	Mean
C_1: Maize	49.68	33.70	24.84	36.07
C_2: Sorghum	41.28	27.99	20.64	29.97
C_3: Fingermillet	10.50	7.11	5.25	7.62
C_4: Mustard	3.40	2.30	1.70	2.47
C_5: Sunhemp	6.42	4.33	3.21	4.65
C_6: Blackgram	4.33	2.91	2.16	3.13
Mean	19.27	13.06	9.63	13.98

	SEm±	CD (p = 0.05)	CV (%)
Six different crops (S)	1.15	3.33	24
Number of Irrigations (M)	0.38	1.48	11
S at M	2.00	5.77	--
M at S	1.86	5.36	--

Table 5: Interaction effect of Apparent Water Use Productivity (yield ha^{-1} mm^{-1}) of six fallow crops with limited number of irrigations

Treatments	Apparent Water Use Productivity			
	M_1: Two Irrigations	M_2: Three Irrigations	M_3: Four Irrigations	Mean
C_1: Maize	448	666	895	670
C_2: Sorghum	649	962	1298	970
C_3: Fingermillet	762	1120	1524	1135
C_4: Mustard	1280	2003	2688	1990
C_5: Sunhemp	1538	2314	3077	2309
C_6: Blackgram	1458	2161	2915	2178
Mean	1026	1538	2066	1542

	SEm±	CD (p = 0.05)	CV (%)
Six different crops (S)	58.8	170	11
Number of Irrigations (M)	22.9	90	6.3
S at M	101.7	294	--
M at S	95.7	276	--

Table 6: Interaction effect of System productivity (kg BEY ha^{-1}) of six fallow crops with limited number of irrigations

Treatments	System productivity (kg BEY ha^{-1})			
	M_1: Two Irrigations	M_2: Three Irrigations	M_3: Four Irrigations	Mean
C_1: Maize	7556	8071	8925	8184
C_2: Sorghum	8489	8569	8700	8586
C_3: Fingermillet	6600	6757	6862	6740
C_4: Mustard	6235	6352	6305	6298
C_5: Sunhemp	6855	6930	7012	6932
C_6: Blackgram	6589	6523	6432	6514
Mean	7054	7200	7373	7209

	SEm±	CD (p = 0.05)	CV (%)
Six different crops (S)	23	66	0.9
Number of Irrigations (M)	28	108	1.6
S at M	40	115	--
M at S	46	139	--

Table 7: Interaction effect of Relative Production Efficiency (%) of six fallow crops with limited number of irrigations

Treatments	Relative Production Efficiency (%)			
	M_1: Two Irrigations	M_2: Three Irrigations	M_3: Four Irrigations	Mean
C_1: Maize	161.5	245.3	384.5	263.8
C_2: Sorghum	313.5	326.4	347.9	329.3
C_3: Fingermillet	5.83	31.46	48.59	28.62
C_4: Mustard	-27.31	-26.06	-28.14	-27.17
C_5: Sunhemp	47.37	59.67	72.96	60.00
C_6: Blackgram	4.07	0.11	-3.91	0.09
Mean	84.17	106.1	137.0	109.1

	SEm±	CD (p = 0.05)	CV (%)
Six different crops (S)	3.6	10.5	10
Number of Irrigations (M)	4.3	16.8	16
S at M	6.3	18.2	--
M at S	7.2	21.8	--

Table 8: Post-harvest soil OC (%), available N, P_2O_5 and K_2O (kg ha^{-1}) status as influenced with limited number of irrigations in six fallow crops

Treatments	OC	N	P_2O_5	K_2O
Main plots : No of Irrigations				
M_1: Two Irrigations	0.32	221.3	28.39	235.5
M_2: Three Irrigations	0.34	218.1	28.28	232.8
M_3: Four Irrigations	0.33	215.7	28.83	228.5
SEm±	0.09	4.21	0.54	6.13
CD (P=0.05)	NS	NS	NS	NS
CV (%)	10	8.1	8.0	11
Sub plots : Different crops				
C_1: Maize	0.31	212.5	28.67	230.1
C_2: Sorghum	0.32	212.7	28.11	232.6
C_3: Fingermillet	0.34	213.1	29.00	230.6
C_4: Mustard	0.33	213.8	28.22	235.2
C_5: Sunhemp	0.36	226.6	29.00	231.5
C_6: Blackgram	0.37	231.6	28.33	233.6
SEm±	0.01	3.81	0.58	4.18
CD (P=0.05)	NS	NS	NS	NS
CV (%)	8.4	5.2	6.1	5.4
Interaction				
SEm±	0.02	6.60	1.01	7.24
CD (P=0.05)	NS	NS	NS	NS

Summary and Conclusion

A field experiment entitled "Evaluation of Soil moisture, Irrigation parameters and Post Nutrient status influenced in six

fallow crops with limited number of irrigations" was conducted during *rabi*, 2021-22 at Agricultural College Farm, Naira. The experiment was laid out in a split plot design, replicated thrice with three irrigation levels *viz.*, two irrigations (I_1), three irrigations (I_2) and four irrigations (I_3) assigned to main plots and six different fallow crops *viz.*, Maize (C_1), Sorghum (C_2), Fingermillet (C_3), Mustard (C_4), Sunhemp (C_5) and Blackgram (C_6) assigned to sub plots.

The salient findings of the experiment are summarized below. Data with regard to soil moisture availability at 15, 30, 45 and 75 DAS were recorded as non-significant with number of irrigations and with six fallow crops as well as their interaction effect. Regarding number of irrigations, the relative production efficiency, soil moisture availability at 60, 90 and 105 DAS, water requirement, water productivity, apparent water use productivity were recorded progressively higher with four irrigations (I_3) and were decreased gradually and significantly with reduction in number of irrigations to two (I_1).

Pertaining to six fallow crops, System productivity, number of man working days and Relative production efficiency were recorded highest in Sorghum (C_2) and lowest in Mustard (C_4). Water requirement was recorded highest in Maize (C_1) and lowest in Blackgram (C_6). The water productivity was significantly maximum with Maize (C_1) and minimum with Mustard (C_4). Apparent water use productivity was highest in Sunhemp (C_5) and lowest in Maize (C_1). With regard to the interaction effect with number of irrigations and six fallow crops was significant and statistically measurable. The system productivity was high with four irrigations in Maize (C_1) and minimum with two irrigations in Mustard (C_4). On the other hand, the Relative production efficiency was high in Maize (C_1) with four irrigations (I_3). The highest water productivity was recorded in Maize (C_1) with two irrigations (I_1) and lowest was recorded with four irrigations (I_2) in Mustard (C_4). The Apparent water use productivity was recorded highest with four irrigations (I_3) in sunhemp (C_5) and lowest was recorded in Maize (C_1) with two irrigations (I_2).

Conclusions

- From the above results it can be concluded that considering the system productivity, profitability and water use efficiency, maize followed by sorghum and sunhemp were the best options when four irrigations were available, sorghum followed by maize and fingermillet were the good options when irrigations were limited to two to three under rice fallows during *rabi* in north coastal zone of Andhra Pradesh.
- Blackgram and mustard were proved inefficient in terms of productivity and profits in rice fallows compared to sorghum, maize, sunhemp and fingermillet.

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