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Influences on Growth Parameters and Yield of Various Moisture Regimes and Weed Management Practices on Drum Seeded Rice (*Oryza sativa* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The field experiment was conducted on Agronomy research farm of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj Ayodhya UP, (India) during Kharif season 2021 and 2022. The experiment was laid out in split plot design with three replications taking three moisture regimes *viz.,* 6 cm at 1 DADPW, 6 cm at 4 DADPW and 6 cm at 7 DADPW (Days after

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disappearance of ponded water) in main plot, and four weed management practices *viz.,* control, Organic Mulch (Rice Straw@5t ha^{-1}), Herbicide (Bispyribac sodium (10%) @ 200 ml ha^{-1} post emergence) and Two hand weeding at 25 and 45 DAS in sub plot. Result revealed that significantly plant height, numbers of tillers, dry matter accumulation, leaf area index and test weight, grain yield, straw yield and harvest index was recorded in 6 cm at 4 cm DADPW during both the years of investigation. Among the weed management practices, higher value recorded with sequential two hand weeding at 25 and 45 day after sowing.

Keywords: Growth parameters; yield; weed; rice.

1. INTRODUCTION

Rice (*Oryza sativa* L.) belongs to Poaceae family and is relished as staple food by majority more than 60% world's population. Among the cereal crops, it serves as the principal source of nourishment for over half of the global population. Uttar Pradesh is the largest rice growing state only after West Bengal in the country.The increase in water scarcity and declining rate of per capita fresh water availability along with increasing demand of food has made the present researcher to look for alternate options which increase the water use efficiency (WUE) along with saving of water. Under such situation, interventions in the form of mechanized transplanting or direct seeding of rice is the need of hour. Direct seeding in non puddled condition eliminates the needs of raising, maintaining and subsequent transplanting of seedling. Thus, it saves labour and water beside early maturity of crop. It allows timely sowing of subsequent crop too. It needs only 34% of total labour and save 27.9%of total cost of transplanting [1]. Yield of weedy rice infested plots at the rate of 10, 100, and 1,000 weedy seeds per square meter were 4.05, 2.75, and 0.43t ha^{-1}, respectively, compared to the check yield of 4.53 t ha^{-1} [2]. Weeds compete with crop for light, nutrient, water and space in absence of standing water because both seeds of crop and weeds emerge almost at the same time. So, control of weed is important which can be accomplished by cultural, mechanical and chemical methods. Out of three chemical methods is more efficient in timely and quickly controlling of weeds. In chemical method, pre emergence application is vital for effective and efficient control of weeds where weeds competition with main crop from the date of germination and weeds emerging later stage are controlled by post emergence herbicides. But in spite of the usage of all such herbicidal combinations, lot of escapes or generation has been noticed. Therefore, considering the long window of emergence of diverse type of weeds in *Kharif* season the purpose can't be solved by one-time application of herbicide alone. Considering these problems, application of several herbicides in combination or in sequence can be utilized in controlling complex and diverse weed flora Weed species respond differently to changing water regimes. In rice culture, water and weeds are often considered to be closely inter linked. The dominance of grasses is favoured by saturated and below saturated condition, whereas broadleaves weeds and sedges grown rapidly when soil is submerged with water [3].

2. MATERIALS AND METHODS

The field experiment was conducted during kharif seasons of 2021 and 2022 at Agronomy Research farm, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, UP, (India),which is situated at latitude of 26˚47′ North and longitude 82˚12′ East and at an altitude of 113 meter above mean sea level. The climate of the site is semi-arid with hot summer and cold winter with average rainfall received during the cropping period was 796.9 mm. The experiment was laid out in split plot design with three replications taking three moisture regimes *viz.,*6 cm at 1 DADPW, 6 cm at 4 DADPW, 6 cm at 7 DADPW (Days after disappearance of ponded water) in main plot, and four weed management practices *viz.,* control, Organic Mulch (Rice Straw@5t ha^{-1}), Herbicide (Bispyribac sodium (10%) @ 200 ml ha^{-1} post emergence) and Two hand weeding at 25 and 45 DAS in sub plot. Soil was sampled before sowing and after harvest of the crop to know the fertility status of the experiment field. The growth analysis was done as per standard procedures. For taking the five tagged plant s from five hills was measured of the all observations. Plant height (cm) was measured from base of the plant to tip of the tallest leaf. The tiller number was counted 5 places randomly keeping a quadrate of 25 cm × 25 cm. Dry matter production, plants were cut close to ground level and kept in the field 2-3 days for sun drying. The

collected samples were oven dried at 60^0C for 48 hours and weighed. The mean weight of dry matter (g m^{-2}) per hill was then computed dividing the total weight by the number of hills and expressed as dry matter accumulation g m^{-2} in each plot at different stages. The maximum length and width of the three randomly selected leaves of each group was measured and the leaf area was calculated by using the formula as given by Yoshida et al*.* (1972) and multiplied with the total leaves from each group.

$$\text{LAI} = \frac{\text{Leaf area}}{\text{Ground area}}$$

3. RESULTS AND DISCUSSION

The different growth stage of wheat plant height significant influenced by moisture regimes and weed management practices during both years (Table 1). Data further reveals that maximum plant height during both year recorded under 6 cm at 4 DADPW (M_2).Which was significantly higher than rest of the treatment. Among weed management practices two hand weeding (W_3) recorded maximum plant height. Which was at par with application of Bispyribac sodium (10%) @ 200 ml ha^{-1} post emergence (W_2) which significantly higher than rest of the weed management practices during both years. Increase in plant height under different weed management practices as compare to control (W_0) to be due to lowest weed population and dry weight resulted lesser crop weed competition which provided better opportunity for better utilization of nutrient, moisture, space and solar radiation to the crop. This was ultimately resulted to improved growth of crop. These results are supported by the finding of Singh et al*.,* [4] Nath and Panday (2013).

The numbers of tiller significant influenced by moisture regimes and weed management practices during both years. (Table 2) Data further reveals that maximum numbers of tiller recorded under 6 cm at 4 DADPW (M_2), which was significantly higher than rest of the treatment.The results are supported by the findings of Kumari [5] revealed that significantly higher number of tiller with moisture regime (10% DASM) as compare to other treatments.Among weed management practices two hand weeding (W_3) recorded maximum numbers of tillers. Which was at par with application of Bispyribac sodium (10%) @ 200 ml ha^{-1} post emergence (W_2) which significantly higher than rest of the weed management practices during both years.

The dry matter accumulation significant influenced by moisture regimes and weed management practices during both years. (Table 3) Data further reveals that maximum dry matter accumulation under 6 cm at 4 DADPW, which was at par with 6 cm at 1 DADPW which was significantly higher than rest of the treatment.The results are supported by the findings of Chowdhury et al, [6] from Bihar working in sandy loam soil found that dry matter production significantly influenced by 2.5 cm irrigation 1 days after disappearance of ponded water (DADPW) over 6 DADPW but were at par with 3 DADPW. Among weed management practices two hand weeding recorded maximum dry matter accumulation. Which was at par with application of Bispyribac sodium (10%) @ 200 ml ha^{-1} post emergence which significantly higher than rest of the weed management practices during both years.

The Leaf area index significant influenced by moisture regimes and weed management practices during both years. Data further reveals that maximum Leaf area index under 6 cm at 4 DADPW, which was at par with 6 cm at 1 DADPW which was significantly higher than rest of the treatment. Study the productivity and water use efficiency of rice cultivars under different irrigation regimes and systems of cultivation Alternative wetting and drying recorded significantly highest LAI and CGR than saturation in all the growth stages.Among weed management practices two hand weeding recorded maximum Leaf area index.Which was at par with application of Bispyribac sodium (10%) @ 200 ml ha^{-1} post emergence which significantly higher than rest of the weed management practices during both years.Gill et al. [7] reported from loamy sand soils that high leaf area index was obtained under direct seeded rice as compared to transplanted rice.

The all yield attributes characters such as number of effective tillers per meter square, Panicle length (cm)**,** number of rachilla per panicle and number of grain per panicle are significant influenced by moisture regimes and weed management practices during both years. Data further reveals that maximum value of observations recorded under 6 cm at 4 DADPW (Days after disappearance of ponded water) which was at par with 6 cm at 1 DADPW which

Table 1. Plant height (cm) in drum seeded rice as affected by various treatments at different growth stages

Treatments	Plant height (cm)									
	30 DAS		60 DAS		90 DAS		120 DAS		At harvest	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Moisture Regimes										
M_1:	37.05	37.58	71.08	72.68	88.85	90.85	93.30	95.38	94.10	96.35
M_2:	38.30	38.88	78.48	82.13	98.11	102.68	103.04	109.28	104.05	108.88
M_3:	36.75	37.55	69.53	72.43	86.84	90.50	91.13	95.03	92.08	96.05
SEm±	0.83	0.81	1.44	1.78	2.04	2.04	1.89	2.35	2.06	2.06
CD at 5%	**NS**	**NS**	**5.65**	**7.00**	**8.01**	**8.01**	**7.42**	**9.25**	**8.09**	**8.12**
Weed Management Practices										
W_0:	36.83	37.37	63.67	65.53	79.55	81.87	83.50	85.93	84.33	86.80
W_1:	37.27	37.77	71.40	73.83	89.22	92.23	93.70	96.83	94.60	97.83
W_2:	37.60	38.17	77.53	80.33	96.95	100.47	101.80	107.43	102.80	106.57
W_3:	37.77	38.70	79.50	83.27	99.35	104.13	104.27	109.37	105.23	110.50
SEm±	0.75	0.77	1.38	1.68	1.83	1.90	1.81	2.25	2.13	2.23
CD at 5%	**2.24**	**2.29**	**4.10**	**5.00**	**5.45**	**5.65**	**5.38**	**6.70**	**6.33**	**6.63**

Table 2. Numbers of tillers in drum seeded rice as affected by various treatments at different growth stages

Treatments	Numbers of tillers (m^{-2})							
	30 DAS		60 DAS		90 DAS		At harvest	
	2021	2022	2021	2022	2021	2022	2021	2022
Moisture Regimes								
M_1	221.55	227.05	330.70	338.70	354.75	363.30	339.13	347.35
M_2	231.95	237.60	374.00	290.95	401.10	410.90	383.50	392.85
M_3	220.55	250.65	326.80	334.90	350.70	359.30	335.20	343.40
SEm±	4.26	5.77	7.90	6.62	7.17	9.35	6.96	8.49
CD at 5%	**NS**	**NS**	**31.02**	**26.02**	**28.16**	**36.72**	**27.33**	**33.35**
Weed Management Practices								
W_0	219.40	258.13	296.47	303.80	318.0	325.80	304.07	311.47
W_1	223.80	228.73	334.87	343.00	359.20	367.87	343.40	351.73
W_2	227.60	233.27	365.87	374.80	392.40	401.93	375.17	384.33
W_3	227.93	233.60	378.13	264.47	405.73	415.73	387.80	397.27
SEm±	4.48	4.68	7.01	7.16	7.07	7.56	6.65	8.04
CD at 5%	**13.32**	**13.91**	**20.83**	**21.29**	**21.02**	**22.46**	**19.76**	**23.89**

Table 3. Dry matter accumulation in drum seeded rice as affected by various treatments at different growth stages

Treatments	Dry matter accumulation (gm^{-2})							
	30 DAS		60 DAS		90 DAS		At harvest	
	2021	2022	2021	2022	2021	2022	2021	2022
Moisture Regimes								
M_1	240.80	244.38	447.95	450.21	860.98	853.46	1283.98	1245.15
M_2	246.80	250.49	499.59	503.60	925.34	950.85	1363.83	1387.13
M_3	238.61	242.16	420.09	447.10	805.59	837.10	1190.90	1227.18
SEm±	5.28	5.19	8.39	11.504	19.56	19.62	29.05	27.75
CD at 5%	**NS**	**NS**	**32.96**	**45.16**	**76.83**	**77.04**	**114.10**	**108.98**
Weed Management Practices								
W_0	237.05	240.58	406.63	400.50	705.63	705.83	1004.03	1007.13
W_1	241.87	245.47	442.23	454.00	844.77	881.33	1272.77	1265.13
W_2	244.10	247.73	475.23	498.78	934.07	955.78	1398.57	1425.23
W_3	245.27	248.92	499.40	514.60	971.40	978.93	1442.90	1448.43
SEm±	5.03	5.12	9.65	9.67	18.16	18.51	25.88	26.49
CD at 5%	**14.94**	**15.21**	**28.67**	**28.75**	**53.96**	**55.00**	**76.89**	**78.71**

Table 4. Leaf area index in drum seeded rice as affected by various treatments at different growth stages

Treatments	Leaf Area Index							
	30 DAS		60 DAS		90 DAS		120 DAS	
	2021	2022	2021	2022	2021	2022	2021	2022
Moisture Regimes								
M_1	2.26	2.24	4.49	4.36	4.99	4.84	3.60	3.49
M_2	2.31	2.28	4.77	4.85	5.30	5.39	3.82	3.88
M_3	2.24	2.22	4.17	4.30	4.63	4.77	3.33	3.44
SEm±	0.04	0.05	0.09	0.09	0.09	0.12	0.08	0.08
CD at 5%	**NS**	**NS**	**0.37**	**0.36**	**0.36**	**0.48**	**0.31**	**0.31**
Weed Management Practices								
W_0	2.21	2.18	3.51	3.52	3.90	3.91	2.81	2.82
W_1	2.27	2.25	4.45	4.43	4.94	4.92	3.56	3.54
W_2	2.29	2.27	4.89	4.99	5.43	5.54	3.92	3.99
W_3	2.31	2.28	5.05	5.07	5.61	5.63	4.04	4.06
SEm±	0.04	0.04	0.10	0.10	0.10	0.10	0.07	0.07
CD at 5%	**0.13**	**0.13**	**0.29**	**0.30**	**0.31**	**0.31**	**0.22**	**0.22**

Table 5. Yield attributes characters in drum seeded rice as affected by various treatments at different growth stages

Treatments	Number of effective tillers m^{-2}		Panicle length (cm)		Number of rachilla $panicle^{-1}$		Number of grains $panicle^{-1}$	
	2021	**2022**	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**
Moisture Regimes								
M_1	300.94	313.44	24.08	25.08	23.45	23.60	122.50	121.60
M_2	319.38	333.13	25.55	26.65	25.15	25.55	130.85	129.90
M_3	288.13	300.63	23.05	24.05	22.55	22.75	118.25	117.40
SEm±	7.22	6.12	0.50	0.54	0.57	0.44	2.79	2.68
CD at 5%	**28.36**	**24.03**	**1.98**	**2.13**	**2.24**	**1.74**	**10.97**	**10.52**
Weed Management Practices								
W_0	205.83	246.67	16.47	19.73	20.67	20.87	108.87	108.07
W_1	322.50	325.00	25.80	26.00	24.27	24.53	126.93	125.73
W_2	331.25	336.25	26.50	26.90	24.73	25.00	129.13	128.13
W_3	351.67	355.00	28.13	28.40	25.20	25.47	130.53	129.93
SEm±	6.93	6.09	0.55	0.55	0.50	0.50	2.59	2.57
CD at 5%	**20.60**	**18.09**	**1.64**	**1.66**	**1.48**	**1.49**	**7.69**	**7.65**

Table 6. Yields of drum seeded rice as affected by various treatments at different growth stages

Treatments	Grain yield (q/ha)		Straw yield (q/ha)		Harvest index (%)	
	2021	2022	2021	2022	2021	2022
Moisture Regimes						
M_1	51.16	50.51	76.79	74.01	40.13	40.36
M_2	54.90	55.99	81.48	82.73	40.25	40.42
M_3	48.10	49.70	70.99	73.02	40.10	40.24
SEm±	1.16	1.12	1.50	1.81	0.88	0.86
CD at 5%	**4.59**	**4.41**	**5.92**	**7.13**	**NS**	**NS**
Weed Management Practices						
W_0	38.64	38.87	61.76	61.85	38.49	38.59
W_1	51.63	51.48	75.64	75.04	40.56	40.69
W_2	57.24	58.46	82.62	84.07	40.65	41.03
W_3	58.63	59.46	85.66	85.38	40.93	41.06
SEm±	1.05	1.08	1.43	1.73	0.82	0.83
CD at 5%	**3.13**	**3.21**	**4.26**	**5.14**	**NS**	**NS**

was significantly higher than rest of the treatment. Among weed management practices two hand weeding recorded maximum value of observations, which was at par with application of Bispyribac sodium (10%) @ 200 ml ha^{-1} post emergence which significantly higher than rest of the weed management practices during both years Walia *et al.* [8]. The results are in agreement with the findings of Khattaket et al. (2006); Aslam *et al.* [9]; Yadav *et al.,* [10] and Singh and Singh (2010). Jabran et al*.,* [11] reported that applicati0n of post emergence bispyribac-sodium was the most effective herbicide in reducing the total weed density and dry weight over the weedy check, followed by penoxsulam and pendimethal1n, respectively. Kumar *et al*. [12] recorded higher number of effective tiller m^{-1}, length of panicle (cm), No. of grains $panicle^{-1}$, was recorded under 7 cm irrigation 1 DADPW which was significantly superior over the 7 cm irrigation 3 and 5 DADPW.

Here is all of the yield of crop such as biological yield, grain yield straw yield and harvest index significant influenced by moisture regimes and weed management practices during both years. Data further reveals that maximum grain yield recorded under 6 cm at 4 DADPW (Days after disappearance of ponded water) which was at par with 6 cm at 1 DADPW which was significantly higher than rest of the treatment. Among weed management practices two hand weeding recorded maximum yields, which was at par with application of Bispyribac sodium (10%) @ 200 ml ha^{-1} post emergence which significantly higher than rest of the weed management practices during both years. Kumar et al., [12] recorded higher grain yield (t ha^{-1}), straw yield (t ha^{-1}) was recorded under 7 cm irrigation 1 DADPW which was significantly superior over the 7 cm irrigation 3 and 5 DADPW. Chinnamani I *et al.* [13] reported that Higher grain yield (kg ha^{-1}) and straw yield (kg ha^{-1}) was recorded in the application of pretilachlor @ 0.75 kg a.i ha^{-1}on 8 DAS as PE bispyribac sodium @ 25 g a.i ha^{-1}on 20 DAS as post emergence apart from weed free check.

4. CONCLUSION

The most suitable moisture regimes was found with 6 cm at 4 DADPW (Days after disappearance of ponded water) and weed management practices Two hand weeding (at 25 and 45 DAS) was most suitable for drum seeded rice. No any interaction effect was recorded between moisture regimes and weed management practices for drum seeded rice.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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