International Journal of Environment and Climate Change

Volume 13, Issue 9, Page 270-276, 2023; Article no.IJECC.102755
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Effect of Moisture Regimes and Weed Management Practices on Growth Indices under Drum Seeded Rice (*Oryza sativa* L.)

Ram Prakash [a++*], Rajesh Kumar [a#], Ravi Verma [a++], Shivanand Maurya [a++] and A. K. Singh [a†]

[a] *Department of Agronomy, A.N.D. University of Agriculture and Technology, Kumarganj Ayodhya, U.P., India.*

Authors' contributions

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

Article Information

DOI: 10.9734/IJECC/2023/v13i92252

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/102755

Original Research Article

Received: 25/04/2023
Accepted: 29/06/2023
Published: 30/06/2023

ABSTRACT

Afield experiment was conducted during Kharif season 2021 and 2022 at Agronomy research farm, Acharya Narendra Deva University of Agriculture and Technology Kumarganj, Ayodhya Uttar Pradesh, (India). The experiment was laid out in split plot design with thrice replications taking three moisture regime *viz.,* 6 cm at 1 DADPW (Days after disappearance of ponded water); 6 cm at 4 DADPW (Days after disappearance of ponded water); 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

[++] *Research Scholar;*
[#] *Assistant Professor;*
[†] *Associate Professor;*
**Corresponding author: E-mail: ramprakashpal1996@gmail.com;*

Emergence) and two hand weeding at 25 and 45 DAS in sub plot. Results revealed that significantly higher crop growth rate, relative growth rate, absolute growth rate, net assimilation rate and grain yield was recorded in 6 cm at 4 DADPW (Days after disappearance of ponded water) during both the years of investigation. Among the weed management practices, higher value recorded with sequential two hand weeding at 25 and 45 days after sowing.

Keywords: Growth indices; herbicides; moisture regimes; weed.

1. INTRODUCTION

Rice (*Oryza sativa* L.) belongs to Poaceae family and is relished as staple food by majority (more than 60%) of world's population. Rice plays a pivotal role in Indian agriculture, as it is the principal food crop for more than 70 per cent of the world population. Among the cereal crops, it serves as the principal source of nourishment for over half of the global population [1-3]. Uttar Pradesh is the largest rice growing state only after West Bengal in the country. Yield losses largely depend on season, weed species, weed density, rice cultivar, growth rate and density of weeds and rice. Weedy rice at 35% infestation caused about a 60% yield loss and, under serious infestation, yield loss of 74% was recorded in direct seeded rice [4] (Watanabe *et al*., 1996). Drum seeder consists of four cylindrical seed drums made of plastic, ground wheels, floats and handle. The seed drum having volume 250 mm x 180 mm with 40 cm length. Nine numbers of seed metering hole (funnel shaped) of 8 mm diameter were provided along the circumference of the drum at both the ends with row to row spacing of 20 cm. In direct seeding method of rice cultivation, need for a nursery and task such as pulling, transporting and transplanting seedlings are avoided as the pre germinated seeds are directly sown [5,6]. Use of drum seeder in a well puddle and level wet field. Drum seeder is light in weight, easy to operate and more area can be covered by a single man. Under aerobic soil condition weed diversity is much higher as compared to saturated or flooded condition [7].

Weed infestation and competition are severe in puddle drum seeded rice as compared to transplanted rice because of the simultaneous growth of both crops and weeds reduction in yield to the tune of 34 percent in transplanted rice, 45 per cent in direct seeded low land rice and 67 percent in upland rice due to weeds were reported by Muthu krishnan et al. [8].

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 wasreceived796.9 mm during the cropping period (June-September). The experiment was layout in SPD 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 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 in subplot. 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.

2.1 Crop Growth Rate

The ratio of dry matter production per unit land area per unit time or crop growth rate was worked out by using the following formula proposed by Watson [9] and expressed as g m^{-2} day^{-1}.

$$\mathrm{CGR} = \frac{1}{\mathrm{A}} \times \frac{\mathrm{W_2} - \mathrm{W_1}}{\mathrm{T_2} - \mathrm{T_1}}$$

Where,

W_1 and W_2 are dry matter of crop (g) at time T_1 and T_2 respectively.
P is ground area covered by crop in meter square.

2.2 Relative Growth Rate

The rate of increase in dry weight per unit dry weight of crop expressed in g g^{-1} day^{-1} was calculated using the following formula suggested by Blackman in [10].

$$RGR = \frac{Log_e W_2 - Log_e W_1}{t_2 - t_1}$$

Where,

W_1 and W_2 are dry matter of crop (g) at time t_1 and t_2 respectively.

2.3 Absolute Growth Rate

Absolute growth rate is expressed in g per day was calculated as follow,

$$AGR = \frac{W_2 - W_1}{T_2 - T_1}$$

Where,

W_2 and W_1 are the total dry weight of the plant (g) at time t_2 and t_1, respectively.

2.4 Net Assimilation Rate

Net Assimilation Rate is expressed in g/cm^2/day was calculated by using the formula as suggested by Williams [11] and expressed as mass/unit leaf area per unit time(g/cm^2/day).

$$NAR = \frac{W_2 - W_1}{t_2 - t_1} \times \frac{Log_e LA_2 - Log_e LA_1}{LA_2 - LA_1}$$

Where,

W_1 and $W_2$is dry weight of plant at time $t_1$and t_2 respectively. LA_1 & LA_2 is the leaf area at times T_1 and T_2 respectively.

3. RESULTS AND DISCUSSION

3.1 Crop Growth Rate (g m^{-2} day^{-1})

Data given in Table 1, clearly indicated that moisture regimes and weed management practices had significant effect on crop growth rate (CGR) at all stages of crop growth during both the year of experimentation.

At 30-60, 60-90, 90-120, 120 DAS-at harvest, crop growth rate significantly influenced by moisture regimes and weed management practices during both years. Data further reveals that maximum crop growth rate 8.43 and 8.44, 14.19 and 14.9, 12.79 and 12.69, 3.65 and 3.70, during 2021 and 2022 respectively recorded under 6 cm at 4 DADPW (Days after disappearance of ponded water) which was at par with 6 cm at 1 DADPW at 60-90, 90-120 and 120- at harvest during 2021, while significantly higher than rest of the treatment. Crop growth rate did not vary significantly due to moisture regimes. Similar results were reported by Das et al. [12].

Table 1. Crop Growth Rate (gm^{-2} day^{-1}) in drum seeded rice as affected by various treatments at different growth stages

Treatments	Crop Growth Rate (gm^{-2} day^{-1})							
	30-60 DAS		60-90 DAS		90-120 DAS		120- at harvest	
	2021	2022	2021	2022	2021	2022	2021	2022
Moisture Regimes								
M_1: 6 cm at 1 DADPW	6.91	6.86	13.77	13.44	12.34	11.39	3.53	3.34
M_2: 6 cm at 4 DADPW	8.43	8.44	14.19	14.91	12.79	12.69	3.65	3.70
M_3: 6 cm at 7 DADPW	6.05	6.83	12.85	13.00	11.24	11.38	3.21	3.28
SEm±	0.13	0.18	0.30	0.29	0.24	0.28	0.07	0.07
CD at 5%	**0.53**	**0.73**	**1.21**	**1.16**	**0.94**	**1.11**	**0.28**	**0.28**
Weed Management Practices								
W_0: Control	5.65	5.33	9.97	10.18	8.70	8.78	2.49	2.58
W_1: Organic Mulch (Rice Straw @5 t ha^{-1}	6.68	6.95	13.42	14.24	12.48	11.15	3.57	3.29
W_2: Herbicide (Bispyribac sodium (10%) @200 ml ha^{-1} Post Emergence)	7.70	8.37	15.29	15.23	13.55	13.65	3.87	3.92
W_3: Two hand weeding (at 25 and 45 DAS)	8.47	8.86	15.73	15.48	13.75	13.69	3.93	4.00
SEm±	0.13	0.15	0.28	0.28	0.29	0.27	0.07	0.07
CD at 5%	**0.39**	**0.44**	**0.83**	**0.84**	**0.68**	**0.81**	**0.23**	**0.23**

Among weed management practices two hand weeding recorded maximum crop growth rate 8.47 and 8.86, 15.73 and 15.48, 13.75 and 13.69, 3.93 and 4.00, during 2021 and 2022 respectively which was at par with application of Bispyribac sodium (10%) @ 200 ml ha^{-1}as post emergence at all stages except 30-60 DAS, while significantly higher than rest of the weed management practices during both years.

3.2 Relative Growth Rate (g g^{-1} day^{-1})

Data clearly indicated that moisture regimes did not influenced significantly relative growth rate at all stages of crop growth except 30-60 DAS and weed management practices had significant effect on relative growth rate at all stages of crop growth during both the year of experimentation.

Data further reveals that maximum relative growth rate at 30-60 DAS of 23.43 and 23.11, 21.63 and 21.22, 11.86 and 11.35, 2.79 and 2.78 was recorded with 6 cm at 4DADPW (Days after disappearance of ponded water) during 2021 and 2022, respectively. Which was unaffected by moisture regimes at all stages except 30-60 DAS, where RGR affected significantly during both years of experimentation.

Among weed management practices two hand weeding recorded maximum relative growth rate of 23.63 and 24.15, 22.58 and 22.09, 12.22 and 11.93, 2.86 and 2.82, during 2021 and 2022, respectively which was at par with application of Bispyribac sodium (10%) @ 200 ml ha^{-1} as post emergence while significantly higher than rest of the weed management practices during both 2021 and 2022, respectively.

3.3 Absolute Growth Rate (g day^{-1})

Moisture regimes and weed management practices had significant effect on absolute growth rate at all stages of crop growth during both the year of experimentation.

Data further reveals that maximum absolute growth rate 1.34 and 1.44, 0.65 and 0.69, 0.16 and 0.22, 0.07 and 0.07, during 2021 and 2022 respectively recorded under 6 cm at 4 DADPW (Days after disappearance of ponded water) which was significantly higher than rest of the treatment. At all stage of crop growth during both years except at 90-120 DAS while such treatment at par with 6 cm at 1 DADPW during 2021 and 2022.

Table 2. Relative growth rate (g g^{-1} day^{-1}) in drum seeded rice as affected by various treatments at different growth stages

Treatments	Relative growth rate (g g^{-1} day^{-1}x 10^{-3})							
	30-60 DAS		60-90 DAS		90-120 DAS		120-at harvest	
	2021	2022	2021	2022	2021	2022	2021	2022
Moisture Regimes								
M_1: 6 cm at 1 DADPW	20.57	20.21	21.58	21.08	11.48	11.17	2.74	2.72
M_2: 6 cm at 4 DADPW	23.43	23.11	21.63	21.22	11.86	11.35	2.79	2.78
M_3: 6 cm at 7 DADPW	18.73	20.28	20.40	20.78	11.60	11.15	2.72	2.70
SEm±	0.38	0.52	0.46	0.44	0.22	0.27	0.06	0.05
CD at 5%	**1.49**	**2.07**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Weed Management Practices								
W_0: Control	17.84	16.91	18.45	18.91	10.52	10.59	2.53	2.55
W_1: Organic Mulch (Rice Straw @5 t ha^{-1}	20.07	20.49	21.59	22.09	12.22	10.72	2.78	2.64
W_2: Herbicide (Bispyribac sodium (10%) @200 ml ha^{-1} Post Emergence)	22.10	23.25	22.19	21.44	11.80	11.65	2.82	2.81
W_3: Two hand weeding (at 25 and 45 DAS)	23.63	24.15	22.58	21.68	12.05	11.93	2.86	2.82
SEm±	0.45	0.44	0.45	0.44	0.23	0.23	3.16	0.05
CD at 5%	**1.34**	**1.32**	**1.36**	**1.32**	**0.70**	**0.69**	**0.05**	**0.16**

Table 3. Absolute growth rate (g day^{-1}) in drum seeded rice as affected by various treatments at different growth stages

Treatments	Absolute growth rate (g day^{-1})							
	30-60 DAS		60-90 DAS		90-120 DAS		120–at harvest	
	2021	2022	2021	2022	2021	2022	2021	2022
Moisture Regimes								
M_1: 6 cm at 1 DADPW	1.13	1.17	0.59	0.61	0.15	0.15	0.05	0.06
M_2: 6 cm at 4 DADPW	1.34	1.44	0.65	0.69	0.16	0.22	0.07	0.07
M_3: 6 cm at 7 DADPW	1.09	1.16	0.58	0.60	0.14	0.15	0.06	0.03
SEm±	0.02	0.03	0.014	0.01	0.003	0.005	0.001	0.001
CD at 5%	**0.08**	**0.12**	**0.055**	**0.05**	**0.012**	**0.018**	**0.005**	**0.005**
Weed Management Practices								
W_0: Control	0.89	0.94	0.53	0.54	0.13	0.14	0.06	0.06
W_1: Organic Mulch (Rice Straw @5 t ha^{-1}	1.14	1.20	0.59	0.61	0.15	0.15	0.06	0.06
W_2: Herbicide (Bispyribac sodium (10%) @200 ml a.i. ha^{-1} Post Emergence)	1.33	1.42	0.65	0.67	0.16	0.17	0.06	0.07
W_3: Two hand weeding (at 25 and 45 DAS)	1.39	1.49	0.66	0.70	0.16	0.23	0.07	0.08
SEm±	0.02	0.02	0.013	0.01	0.003	0.003	0.001	0.002
CD at 5%	**0.07**	**0.07**	**0.038**	**0.03**	**0.009**	**0.010**	**0.004**	**0.006**

At 90 DAS to harvest, moisture regimes was recorded significantly higher AGR (0.59 g day^{-1}) which was closely followed by Semi dry rice (0.58 g day^{-1}). Among interactions, alternate wetting and drying with mechanical transplanting recorded higher AGR at 30 to 60 DAS (0.47 g day^{-1}). Similar results were reported by Theerthana et al. 2021.

Among weed management practices two hand weeding recorded maximum absolute growth rate (1.39 and 1.49, 0.66 and 0.70, 0.16 and 0.23, 0.07 and 0.08, during 2021 and 2022 respectively) which was at par with Bispyribac sodium (10%) @ 200 ml ha^{-1} post emergence at all stages except 120 DAS- at harvest, while significantly higher than rest of the weed management practices during both years.

3.4 Net Assimilation Rate (g m^{-2} day^{-1})

Data given in Table 4 clearly indicated that NAR unaffected by moisture regimes at all stages of crop growth except 30-60 DAS and weed management practices had significant effect on net assimilation rate at all stages of crop growth during both the year of experimentation.

Data further reveals that at 30-60 DAS, maximum net assimilation rate of 2.48 and 2.46 2.91 and 2.92, during 2021 and 2022, respectively recorded under 6 cm at 4 DADPW (Days after disappearance of ponded water) which was significantly higher than rest of the treatment.

Among weed management practices two hand weeding recorded maximum net assimilation rate (2.41 and 2.53), which was significantly higher than rest of the treatments, while at par with application of Bispyribac sodium (10%) @ 200 ml ha^{-1}as post emergence at all stages during both years. Two hand weeding recorded higher NAR which was at par with Bispyribac sodium, while significantly higher than rest of the weed management practices during both the years.

However, control (weedy) recorded significantly lower values of CGR, RGR, AGR and NAR over rest of the weed management practices at all the stage of crop growth. It might be because of the facts that rate of dry matter accumulation per unit time was directly linked with crop weed competition, happened during the course of crop growth. The results are in close conformity with Padmaja Rao [5]; Singh and Singh (2023).

Table 4. Net assimilation rate (g m^{-2} day^{-1}) in drum seeded rice as affected by various treatments at different growth stages

Treatments	Net assimilation rate (g m^{-2} day^{-1})					
	30-60 DAS		60-90 DAS		90-120 DAS	
	2021	2022	2021	2022	2021	2022
Moisture Regimes						
M_1: 6 cm at 1 DADPW	2.12	2.15	2.89	2.90	2.90	2.74
M_2: 6 cm at 4 DADPW	2.48	2.46	2.91	2.92	2.81	2.75
M_3: 6 cm at 7 DADPW	1.93	2.14	2.80	2.86	2.83	2.77
SEm±	0.04	0.05	0.06	0.06	0.05	0.050
CD at 5%	**0.17**	**0.21**	**NS**	**NS**	**NS**	**NS**
Weed Management Practices						
W_0: Control	2.00	1.90	2.69	2.74	2.62	2.63
W_1: Organic Mulch (Rice Straw @ 5 t ha^{-1}	2.06	2.16	2.86	2.90	2.88	2.66
W_2: Herbicide (Bispyribac sodium (10%) @ 200 ml ha^{-1} Post Emergence)	2.26	2.42	2.96	2.90	2.92	2.84
W_3: Two hand weeding (at 25 and 45 DAS)	2.41	2.53	2.97	3.05	2.96	2.87
SEm±	0.03	0.05	0.05	0.06	0.05	0.056
CD at 5%	**0.15**	**0.14**	**0.17**	**0.18**	**0.15**	**0.16**

4. CONCLUSIONS

It is concluded that, 6 cm at 4 DADPW (Days after disappearance of ponded water) moisture regimes and Bispyribac sodium (10%) @ 200 ml ha^{-1}as post emergence for weed management practices was found better for all growth indices (RGR,CGR, AGR & NAR) under drum seeded rice.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Meena RK, Singh YV, Shivay YS, Kumar D, Kumar R, Ram H, Ram M. Rice performance as influenced by crop establishment methods, green organic mulches and rates of nitrogen fertilization along with liquid Azotobacter chroococcum. Journal of Plant Nutrition. 2023;46(3):401-422.
2. Singh RP, Singh CM, Singh AK. Effect of crop establishment methods, split application of nitrogen and weed management on growth analysis parameters of rice (*Oryza sativa* L) Oryza. 2004;41(3&4): 120-124.
3. William BJ. Barnyardgrass (*Echinochloa crus galli*) control in dry seeded rice with V-10029. South Weed Science Society. 1999;52:50.
4. Karim RS, Man AB, Sahid IB. Weed problems and their management in rice fields of Malaysia: an overview. Weed Biology and Management. 2004;4(4): 177-186.
5. Padmaja Rao S. Studies on nitrogen management in relation to quality grain and yield in low land irrigated rice. Madras Agric. J. 1988;75(7-8):276-280.
6. Pasha ML, Reddy MD, Reddy MG, Devi MU. Influence of irrigation schedule, weed management and nitrogen levels on grain yield, Nutrient uptake and water productivity of aerobic rice. Indian J. Agric. Research. 2013;47(1):26-34.
7. Anwar MP, Juraimi AS, Man A, Puteh A, Selamat A, Begum M. Weed suppressive ability of rice (*Oryza sativa*L.) germplasm under aerobic soil conditions. Australian Journal of Crop Science. 2010;4(9): 706-717.
8. Muthukrishnan P, Subbalakshmi L, Sathiya K. Weed distribution and management in rice In Proceedings of the National conference on “Challenges in weed management in Agro-ecosystems Present status and future strategies”, Tamil Nadu Agricultural University, Coimbatore (T.N.), India. 2010;15-20.
9. Watson DJ. Comparative physiological studies on the growth of field crops: I. Variation in net assimilation rate and leaf area between species and varieties and

with in and between years. Annals of Botany. 1947;11:41–76.
10. Blackman, V.H. 1919. The compound interest law and plant growth. Annals of Botany 33:353-360.
11. Williams SRF. Methods of growth analysis.In: Plantphoto synthetic cproduction manual methods (Sestak, Z., J. Cataskyand P. J. Jouris(eds). Drow, Jenk N. U. Publishers. The Hague. 1946;348-391.
12. Das L, Kumar R, Kumar V, Kumar V, Kuma, N. Effect of moisture regimes and levels of iron on growth and yield of rice under aerobic condition. The Bioscan. 2016;11(4): 2475-2479.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/102755