Int.J.Curr.Microbiol.App.Sci (2021) *10*(03): 1020-1025

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 10 Number 02 (2021)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2021.1003.129

Response of different Micro-Climatic Regimes on Productivity and Economics of Aerobic Rice (*Oryza sativa* L.) Varieties in Assam

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Keywords

Dry matter, Upland rice, Effective tillers, Growth, Seeding date

Article Info

Accepted:
10 February 2021
Available Online:
10 March 2021

A B S T R A C T

A field experiment was conducted in the Instructional Cum Research (ICR) Farm of Assam Agricultural University, Jorhat, Assam during autumn season of 2017. The experiment was laid out in a split-plot design with three replications. The treatments consisted of four micro-climatic regimes (M) in main plot *viz*., sowing of seed on 15th February (M_1), 1st March (M_2), 16th March (M_3) and 1st April (M_4) along with four different rice varieties (V) *viz*., CR-Dhan 205 (V_1), CR-Dhan 203 (V_2), CR-Dhan 204 (V_3) and Inglongkiri (V_4) in sub plot. The results of the experiment revealed that among the different micro-climatic regimes, the micro-climate associated with 1st April recorded positive effect on growth and yield parameters in terms of number of total tillers, dry matter accumulation, number of effective tillers and grain yield (3004 kg/ha), followed by the micro-climate associated with 16th March sown crop. Among the varieties evaluated, CR-Dhan 203 recorded the highest value in terms of number of total tillers, dry matter accumulation and number of effective tillers (187/m^2) followed by Inglongkiri, CR-Dhan 204 and CR-Dhan 205. The highest grain yield of 2860 kg/ha recorded in rice variety CR-Dhan 203 was significantly superior to that of other varieties except Inglongkiri. In terms of economics, the crop sown on 1st April recorded the highest net return (₹51755 /ha) and B:C ratio (2.30) which was found to be best.

Introduction

Rice (*Oryza sativa* L.) is the most important cereal crop of the country covering a cultivated area of 44.40 million hectare with a production of 109.32 million tones and average productivity of 2.27 t/ha (Agri. Statistics, 2016). In Assam, rice is cultivated in an area of about 2.48 million hectare. The total production and average productivity of rice in the state is 5.12 million tones and 2.08 t/ha, respectively (Statistical Handbook of Assam, 2016). The crop has enormous diversity in the region due to highly variable rice growing ecosystems. It is mostly grown under submerged condition resulting in low water use efficiency and emission of green house gases. With the global water crisis, it

has become imperative to develop technologies that produce rice using lower quantities of water (Bouman, 2001). Currently, sustainability of water resources is of major concern and declining water availability threatens the sustainability of traditional flood-irrigated rice ecosystems (Joshi *et al.,* 2015). Aerobic rice is a production system wherein specially developed aerobic rice varieties are grown in well-drained, non-puddled and non-saturated soils (Singh *et al.,* 2018). Supplementary irrigation, however, can be given in the same way as to any other upland cereal crop (Wang *et al.,* 2002). In India rice is direct seeded around 28 % of total cropped area (Anandan *et al.,* 2015). In Assam Ahu or autumn rice is grown mostly aerobically in upland areas during February/March to June/July and it covers around 1.9 lakh hectares, production is 2.5 lakh tones with average productivity of 1.32 t/ha (Agricultural statistics, 2016). This system of rice cultivation saves water by eliminating wetland preparation necessary to avoid seepage and percolation and by reducing evaporation. However, to make this technology viable, proper micro-climate through appropriate sowing time of suitable varieties needs to be identified for various agro ecological conditions. Considering the above facts, the present investigation was carried out to find out optimum micro-climate regimes for different promising varieties of rice for realizing higher yields under aerobic condition.

Materials and Methods

A Field experiment was conducted at the Instructional Cum Research (ICR) Farm of Assam Agricultural University, Jorhat, Assam during autumn season of 2017 on performance of different rice varieties grown at different dates of sowing under aerobic conditions. The experiment was comprised of sixteen treatment combinations, viz., four micro-climatic regimes (M) (M_1: 15th February, M_2: 1st March, M_3: 16th March and M_4: 1st April) assigned in main plots and four varieties (V) (V_1: CR-Dhan 205, V_2: CR-Dhan 203, V_3: CR-Dhan 204 and V_4: Inglongkiri) were in sub-plots. The experiment was laid out in split plot design tested with three replications having plot size of 4×3. The soil of the experimental field was sandy loam in texture, acidic in reaction (pH:5.2), medium in organic carbon content (0.62 %), medium in available nitrogen (311.5 kg/ha), low in phosphorus (15.85 %) and medium in available potassium (194.0 kg/ha). Farm Yard Manure (FYM) were applied to each plot twenty five days prior to sowing of the seed at the rate of 2 t/ha. The FYM were mixed thoroughly with soil after application. Medium duration rice variety seeds were placed in a well prepared leveled seedbed with a spacing of 20 cm × 10 cm, thinning and gap filling operations were done at 15 days after sowing and maintained optimum plant population.

The recommended fertilizer dose of 40 kg N, 20 kg P_2O_5 and 20 kg K_2O/ha was applied in the form of urea, single super phosphate and muriate of potash. Half of nitrogenous and potassic fertilizer were applied at 25 days after germination *i.e.* after first weeding as top dressing and remaining of half dose of nitrogenous and potassic fertilizers were applied at 50 days after germination *i.e.* after second weeding.

Full dose of phosphatic fertilizer was applied as basal. Pretilachlor, a pre emergence herbicide was applied as weed control measure at the rate of 0.75 kg/ha and was sprayed at 3 days after sowing and first weeding was done at 25 days after sowing with a light hoeing and thinning was done by maintaining a plant to plant spacing of 8-10 cm. Irrigation was applied immediately after sowing to hasten the germination and crop establishment. Subsequent irrigations were

given as and when needed so as to maintain the field at near saturation without stagnation. The observations on growth and yield parameter like number of total tillers, dry matter accumulation, number of effective tillers and grain yield were recorded and statistically analyzed at 5 % level of significance. The cost of cultivation, net returns and B: C ratios were worked out based on the prevailing local market price.

Results and Discussion

The results of the study indicated that the micro-climatic regime of sowing between mid of March to first week of April for rice variety CR-Dhan 203 was optimum for obtaining higher in yield attributing characters along with grain yield and net return under aerobic condition in Assam.

Effect of micro-climatic regimes and varieties on total tillers per square meter

The results revealed that micro-climatic regimes significantly influenced the number of total tillers per square meter. The highest number of total tillers at all the growth stages of the crop were recorded on April 1st sowing (211.4), which was being at par with 16th March and 1st March sowing, which might be due to the fact that during its vegetative growth period, adequate temperature and optimum rainfall had been received which might help in increasing the tiller number. This result is similar to that of Bharat (2015). Among the varieties, CR-Dhan 203 had the highest number of total tillers/m^2 followed by Inglongkiri at all the stages (Table 1). This might be due to genetical variation, physiological function and growth characters of the varieties and was full agreement with the findings of Tiwari (2015) and Bharat (2015).

Effect of micro-climatic regimes and varieties on dry matter accumulation gram per square meter

Dry matter accumulation was significantly affected by different micro-climatic regimes at 60 DAS, 90 DAS and at harvest. The highest dry matter accumulation was recorded at micro-climatic regime of 1st April sown crop which was at par with 16th March sowing. The higher dry matter accumulation was due to higher growth and uptake of nutrients resulted from higher dry matter partitioning forwarded by prevailing weather parameters (Table 1).

Similar, findings were also reported by Matloob *et al.,* (2015), Dari *et al.,* (2016) and Singh and Singh, (2016). So far the varieties are concerned, the highest dry matter accumulation was recorded in CR-Dhan 203 which was significantly higher than all other varieties and statistically at par with Inglongkiri and CR-Dhan 204. CR-Dhan 203 recorded the highest value which might be due to more vigorous growth and higher tillering nature of the rice variety. Sritharan *et al.,* (2014) also reported that total dry matter production varied significantly due to variety.

Effect of micro-climatic regimes and varieties on effective tillers per square meter

The higher number of effective tillers/m^2 was recorded on 1st April sown crop which was at par with 16th March and 1st March sown crop, which might be due to favorable climatic condition during the crop growth period that resulted in higher yield attributes than the earlier date of sowing. The number of effective tillers/m^2 showed a better response with delay in sowing because in early sowing the plants might have suffered from unfavorable temperature which ultimately resulted in shedding of pollen; therefore, reduced the number of effective tillers/m^2.

Table.1 Effect of micro-climatic regimes and varieties on total tiller, dry matter, effective tillers, grain yield and economics of aerobic rice

Treatment	Total tiller (No./m^2)				Dry matter (g /m^2)				Effective tiller (No./m^2)	Grain yield (Kg/ha)	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C
	30 DAS	60 DAS	90 DAS	Harvest	30 DAS	60 DAS	90 DAS	Harvest						
Micro-climatic regime (M)														
M_1=15thFebruary sown crop	71.5	200.3	186.5	180.9	61.9	266.4	516.8	631.8	157.4	2138	23635	40954	30139	1.27
M_2=1st March sown crop	77.0	211.3	197.9	193.5	66.5	276.6	612.9	727.1	171.1	2400	23235	46828	38723	1.66
M_3=16th March sown crop	82.9	224.8	209.1	203.6	69.3	309.5	663.0	769.4	180.0	2648	22435	51107	44457	1.97
M_4=1st April sown crop	88.0	230.3	215.7	211.4	72.5	320.0	708.9	832.8	188.3	3004	22435	57331	51755	2.30
SEm ±	2.8	5.9	5.6	5.8	2.5	11.2	25.6	30.2	5.8	111	-	-	-	-
CD (P=0.05)	9.7	20.6	19.5	19.9	NS	38.7	88.5	104.6	20.1	386	-	-	-	-
Variety (V)														
V_1= CR-Dhan 205	74.6	205.3	192.1	187.5	63.1	271.6	564.8	676.3	164.1	2236	22935	58818	35883	1.56
V_2=CR-Dhan 203	85.9	230.2	213.2	208.7	71.7	326.5	691.4	817.1	187.0	2860	22935	69800	46865	2.05
V_3=CR-Dhan 204	77.6	211.3	199.8	193.9	66.6	279.7	597.5	708.8	168.2	2439	22935	60596	37661	1.64
V_4= Inglongkiri	81.5	219.8	204.0	199.3	68.8	294.6	650.9	758.8	177.4	2654	22935	67602	44667	1.95
SEm ±	2.4	5.6	5.1	4.9	2.0	8.9	23.3	22.4	5.2	93	-	-	-	-
CD (P=0.05)	6.9	16.4	14.7	14.5	5.9	25.9	68.1	65.3	15.1	273	-	-	-	-

DAS: Days after sowing, NS= Non significant

Among the varieties the highest numbers of effective tillers/m^2 was recorded in CR-Dhan 203 which was at par with Inglongkiri. The difference in tiller production among cultivars may be attributed to varietal characters (Chandrashekhar *et al.,* 2001) (Table 1).

Effect of micro-climatic regimes and varieties on grain yield

In case of grain yield, out of different micro-climatic regimes, 1st April sown crop recorded the highest in grain yield which was 25.42 % more than average grain yield of other micro-climatic regimes which, however, was at par with 16th March sown crop and this might be due to favorable climatic condition such as optimum temperature (23 to 30°C), average weekly rainfall (76.8 mm) might have resulted in higher uptake of nutrients as well as post photosynthetic contribution in respect to other sowing dates.

The lowest grain yield was recorded on 15th February sown crop. Among the varieties, the highest grain yield was recorded in rice variety CR-Dhan 203 which, however, was statistically at par with Inglongkiri and significantly higher than CR-Dhan 204, CR-Dhan 205. The grain yield of CR-Dhan 203 was 17.07 % higher than the average yield of other varieties. This might be due to the higher value of yield attributing characters and genetic yield potential of the rice variety in aerobic condition.

Economics of aerobic rice as affected by different micro-climatic regimes and varieties

In case of economics, the highest net return (₹51755 /ha) and benefit-cost ratio (2.3) was obtained under rice crop sown on 1st April which was closely followed by crop sown on 16th March (₹44457 /ha, 1.97, respectively) whereas among the varieties, the highest net return (₹46865 /ha) and benefit-cost ratio (2.05) was recorded in rice variety CR-Dhan 203 (Table1.)

Acknowledgement

The author duly acknowledges the co-operations received from Assam Agricultural University, authority particularly Department of Agronomy and Directorate of Post Graduate Studies during the experimentation period

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How to cite this article:

Bidisha Borah and Kalyan Pathak. 2021. Response of different Micro-Climatic Regimes on Productivity and Economics of Aerobic Rice (*Oryza sativa* L.) Varieties in Assam. *Int.J.Curr.Microbiol.App.Sci.* 10(03): 1020-1025.
doi: https://doi.org/10.20546/ijcmas.2021.1003.129