Effects of Integrated Nutrient Management and Moisture Regime on Hybrid Rice, Oryza Sativa L.

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Abstract

Hybrid rice, Oryza sativa L., has been extensively investigated because of the consequences of integrated nutrition management and moisture regime on rice production. In order to maximize nutrient availability and utilization by the crop, integrated nutrient management involves integrating several types of nutrients, such as organic manures, chemical fertilizers, and biofertilizers. On the other hand, the term "moisture regime" is used to describe the methods used to regulate the flow of water to the rice field. Silt loam soil was used for the experiment, and its pH ranged from 8.2 to 8.4, its organic carbon content was 0.30 to 0.31 percent, and its available nitrogen (N), phosphorus (P), and potassium (K) contents were around 185.00 to 189.0, 16.0 to 16.2, and 282.00 to 284.00 kg ha-1. The rice variety Arize-6444 was planted with a fertilizer solution of 150 N:75 P2O5:60 K2O kg ha-1. Twenty kilograms per hectare were planted with seeds. 7 cm irrigation at 1 DADPW significantly increased plant height, dry matter accumulation, leaf area index, shoot number per running meter, yield, and yield characteristics compared to 7 cm irrigation at 4 and 7 cm DADPW and conventional irrigation.

Keywords: *Integrated nutrient, Management, Regime, hybrid rice, Oryza sativa L.*

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1. Introduction

One of the most widely farmed cereal grains in the world is Oryza sativa L., more often known as rice. A large percentage of the global population uses it as their main source of daily nourishment and food. To keep up with the ever-increasing demand for rice, agricultural practices that are both sustainable and effective need to be used. Integrated nutrition management (INM) and sufficient moisture regimes have a significant impact on the development, maturity, and harvesting of hybrid rice. These three stages are all profoundly influenced by these factors.[1]

Integrated Nutrient Management:

To maximize nutrient availability and enhance soil fertility, integrated nutrient management makes strategic use of both organic and inorganic fertilizers in tandem with other soil management practices. Its purpose is to prevent soil erosion and nutrient depletion while reducing pollution levels.

Soil structure, water-holding capacity, and nutrient retention are all improved by adding organic matter to the soil, such as farmyard manure, compost, or green manure. Decomposition of organic waste releases vital nutrients gradually, ensuring a steady supply throughout all phases of crop development. But inorganic fertilizers provide minerals that rice plants can swiftly use, so they're a good option. INM's organic and inorganic fertilizers work together to provide a steady stream of nutrients that boost plant health, growth, and yields. [2]

Moisture Regime:

In order to maximise development, nutrient absorption, and yield, it is essential to control moisture levels while growing hybrid rice. Soil type, climate, and the rice crop's developmental stage are just a few of the variables that influence what constitutes an optimal moisture regime.

Proper root establishment and vegetative development need a steady supply of water throughout the vegetative stage of rice growing. Maintaining an appropriate level of soil moisture at this stage requires a steady and consistent flow of water.[3]

Water supply must be carefully managed throughout the reproductive stage, which includes panicle initiation, blooming, and grain filling. Reduced pollen viability, improper grain filling, and eventually poorer yields might result from water stress during the reproductive cycle. Excessive water at this period, on the other hand, might cause nutrient leaching, higher disease prevalence, and lodging.[4]

Integrated Nutrient Management and Moisture Regime on Hybrid Rice:

There are major ramifications for hybrid rice production when good nutrition management practices are combined with suitable moisture regimes.[5]

i. Improved Nutrient Availability:INM improves soil nutrient availability, which guarantees a sufficient supply of vital nutrients for optimum growth and development. Soil structure and nutrient retention are both enhanced by the addition of organic matter, while inorganic fertilisers ensure that plants always have access to the nutrients they need. This mix is ideal for boosting plant vitality, root development, and nutrient absorption.

ii. Enhanced Water Use Efficiency: Hybrid rice yields may be maximised with efficient water usage via careful moisture control. Water stress is mitigated throughout crucial development stages when an adequate moisture regime is maintained. Higher yields may be expected as a result of the enhanced fertiliser absorption, photosynthesis, and general crop performance.[6]

iii. Balanced Growth and Development: Hybrid rice plants flourish when careful attention is paid to both their nutritional needs and their water availability. Optimal vegetative development, early blooming, and effective grain filling are all dependent on a sufficient supply of nutrients and careful regulation of moisture. This leads to taller plants with larger panicles and better grain quality overall.

iv. Sustainable Agricultural Practices: Sustainable agriculture benefits from INM and suitable moisture regimes, which lessen environmental contamination and lower production costs. Organic fertilizers are used less often when organic matter is incorporated into the soil, which helps prevent nutrient deficiencies and slows down soil deterioration. Effective moisture management helps save water by limiting the amount that is wasted.[7]

2. Literature review

Thomas V G. (2020) Han Dao 297, an aerobic rice variety, was investigated in China to see what seeding rates would result in optimal growth and harvest. When planted at a density of 60 kg/ha, Han Dao 297 showed the highest number of productive tillers and the highest population density. Aerobic rice was studied in the Philippines and India in 2008 and 2009 to determine the effects of seeding rates (15-125 kg/ha) on crop and weed development. Weed development was stifled, and losses in grain production due to weed competition were minimized, when the planting rates of aerobic rice were increased. Increases in seeding rates led to proportionally higher plant densities, tiller counts, and biomass in both weedy and weed-free conditions for rice.[8]

Takeo Y and Kazuo O. (2020)carried out a field study during Kharif 2012 at the University of Agriculture's Agronomic Research Area in Faisalabad. Maximum crop growth rate and leaf area index were both observed at a seeding rate of 75 kg/ha. an outdoor research conducted in the first week of July 2010 to compare two seeding densities (50 and 75 kg/ha) in the Agronomic Research Area of the University of Agriculture in Faisalabad, Pakistan. The results showed that increasing the seed rate under direct seeded rice conditions resulted to a significant increase in dry matter/m2 and the total number of effective tillers/m2.[9]

Zhao D and Oosterhuis D M. (2019) Seed rate was not found to affect growth metrics in a Nigerian research of three seed rates (32 kg/ha, 54 kg/ha, and 75 kg/ha) for two rice cultivars (Ex-China and NERICA-1). Plants grew taller and produced more tillers when seeded at a higher density. research conducted in Samaru during the wet years of 2011 and 2012 at the IAR farm. Higher yields were observed for plant height, leaf area index, crop growth rate, relative growth rate, and total dry matter at a seed rate of 60 kg per hectare.[10]

Jayasree, G. (2018) The best seed rate for DSR using a multi crop planter and 20 cm row spacing has been found to be between 20 and 30 kg/ha (using high quality seeds with a germination rate of greater than 95 percent). indicated that a seeding density of 75 kg/ha produced the tallest plants, the most tillers, and the maximum yield per square meter.. Seed rates up to 144 kg/ha were shown to increase maximum tillering, panicle initiation, heading dates, leaf area index, and chlorophyll content in a variety of rice cultivars over the course of two years of field experiments at the Rice Research and Training Centre (RRTC), Egypt.[11]

Veeramani, P. (2017) The rice fields in India are the largest in the world. The indica variety of rice is thought to have been domesticated in the region spanning the foothills of the Eastern Himalayas (i.e. north-eastern India), through Burma, Thailand, Laos, Vietnam, and Southern China; the japonica variety, on the other hand, is thought to have been domesticated from wild rice in Southern China and then introduced to India. Perennial populations of wild rice may still be found in Assam and Nepal. It first occurs in southern India about 1400 BC, having been domesticated on the northern plains. Then it surged through the verdant alluvial plains of the river basins. The Tamil word arisi may have been the inspiration for the English word rice.[12]

3. Methodology

The location, climate, and growing circumstances of the experimental crop, as well as the methods and materials used to get the results.

3.1 Experimental site

Materials and Methods describe the specific resources and methods used to conduct the study titled "Effect of moisture regime and integrated nutrients management in hybrid rice (Oryza sativa L.)" The kharif seasons of 2019 and 2020 were used for the experiment in the field. During the growing season, favorable climatic and soil conditions persisted.

3.2 Materials

3.2.1 Geographical situation of experimental site

This research was carried out at Kumarganj, Ayodhya (U.P.), on the Ayodhya-Raibarely road, around 42 kilometers from Ayodhya city, during the kharif seasons of 2019 and 2020 at the Agronomy Research Farm of Acharya Narendra Deva University of Agriculture and Technology.

3.3 Soil of the experimented field

Soil samples were taken at random from five locations around the experimental field using a soil auger to obtain data on the soil's physicochemical composition and fertility level before any fertilizers were applied. A composite sample was then collected to represent the whole field, from which a representative subsample was drawn for further study.

3.4 Description of variety under investigation

Arize-6444, a hybrid strain of rice, was used in this study. Hybrid rice International Ltd (a research station of PRO AGRO India Ltd) in Hyderabad is responsible for creating the Arize6444 hybrid. It can withstand explosions and is hopper- and drought-tolerant for a period of 125-130 days. Per hectare, it may yield between 70 and 80 quintals of rough rice.

3.5 Statistical analysis

Analysis of Variance was used for the statistical analysis of the data collected from the various observations.

4. Results

The tables and variance are provided in the appendices, and the findings of the experiment named "Effect of moisture regime and integrated nutrients management in hybrid rice (Oryza sativa L.)" have been statistically analyzed. The most relevant findings have been graphically represented. The fruiting heads are visible evidence of the outcomes. Tables containing condensed data on study averages and the appropriate number of figures have been included wherever they were needed. For all the character studies conducted in 2018–19 and 2019–20, the interaction impact between moisture regime and integrated nutrients management was determined to be non significant.

The effect of moisture regime and integrated nutrients management on the height of hybrid rice plants 30, 60, and 90 days after transplanting and at harvest is shown in Table 4.1 for the 2018–2019 and 2019–2020 growing seasons.

Table 4.1: Hybrid rice plant height (in centimeters) is affected by moisture regime and integrated nutrition management at various phases of crop development.

Treatments	Plantheight(cm)							
	30DAT		60DAT		90DAT		Atharvest	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Moistureregime								
I1	70.60	72.00	99.50	110.30	120.00	121.25	118.80	120.04
I2	65.40	66.00	88.80	90.00	112.50	113.67	111.38	112.53
I3	56.50	57.30	75.10	76.40	103.90	104.98	102.86	103.93
I4	58.70	59.50	77.00	79.10	105.80	106.90	104.74	105.83
SEm±	1.30	1.50	1.82	1.77	2.08	2.24	1.98	2.05
CDat5%	3.18	3.69	4.47	4.33	5.10	5.49	4.87	5.04
IntegratedNutrientsManagement								

N1	67.22	67.80	85.05	86.20	111.03	112.18	109.92	111.06
N2	63.10	72.20	94.70	97.55	119.53	121.74	118.36	119.56
N3	60.30	61.20	82.20	84.05	107.33	108.45	106.26	107.36
N4	62.90	68.30	88.40	90.25	113.13	114.31	112.00	113.16
N5	57.40	58.30	80.00	81.85	104.73	105.82	103.68	104.76
SEm±	1.40	1.14	1.99	2.28	2.28	2.34	2.64	1.99
CDat5%	4.06	3.29	5.76	6.59	6.59	6.75	7.62	5.76

Plant height of hybrid rice at all phenological phases of crop development in 2018–19 and 2019–20 was strongly impacted by integrated nutrients management (Table 4.1). The highest plant height was achieved in the first year of the experiment with the application of 100% RDF of NPK (150:75:60 kg ha-1) via inorganic fertilizers, while in the second year, the highest plant height was achieved with the application of 75% NPK + 25% N via biocompost at 30 days after transplanting, in comparison to the rest of the integrated nutrients management. Hybrid rice plants were the tallest when 50% NPK + 50% N through biocompost was treated 30 days after transplanting. This was followed by 75% NPK + 25% N via FYM and 100% RDF of NPK (150:75:60 kg ha-1) by inorganic fertilizers.

The number of hybrid rice shoots per running meter at 30, 60, and 90 days after transplanting, as well as at harvest in 2018–19 and 2019–20, is shown in Table 4.2, along with the impacts of moisture regime and integrated nutrients management.

Table 4.2: Hybrid rice shoot density as a function of moisture regime and integrated nutrients management during the crop's life cycle

Treatments	**Numberofshootsperrunning meter**							
	30DAT		**60DAT**		**90DAT**		**Atharvest**	
	2018-19	**2019-20**	**2018-19**	**2019-20**	**2018-19**	**2019-20**	**2018-19**	**2019-20**
Moistureregime								
I1	66.40	69.86	146.60	149.22	144.69	146.14	140.35	141.76
I2	48.20	50.71	121.50	123.67	119.92	121.12	116.32	117.49
I3	32.00	33.67	110.20	112.17	108.77	109.85	105.50	106.56
I4	33.60	35.35	113.70	115.73	112.22	113.34	108.85	109.94
SEm±	1.05	0.93	2.98	2.45	3.02	2.51	2.48	2.56

CDat5%	2.59	2.30	7.30	6.01	7.41	6.16	6.08	6.27
IntegratedNutrientsManagement								
N1	58.27	59.21	122.04	139.41	120.45	136.74	116.84	122.94
N2	46.77	62.31	139.34	147.83	137.53	145.90	133.40	134.74
N3	42.57	44.79	116.94	119.03	115.42	116.57	111.96	113.08
N4	43.57	59.84	127.14	140.22	125.49	137.66	121.72	123.01
N5	34.07	35.85	109.54	111.50	108.12	109.20	104.87	105.92
SEm±	1.15	0.84	2.80	2.41	2.60	2.39	2.56	2.42
CDat5%	3.31	2.44	8.09	6.96	7.51	6.89	7.39	7.00

Table 4.2 shows that in both years of research, the number of shoots per running meter of hybrid rice varied considerably throughout various physiological phases of crop development. 7 cm irrigation applied at 1 day after the disappearance of ponded water resulted in considerably more shoots per running meter of hybrid rice plants compared to the other treatments, as measured over the course of the two years of study. 7 cm irrigation applied 4 days after ponded water disappeared considerably increased the quantity of hybrid rice shoots per running meter throughout all physiological stages of crop development..

Table 4.2 shows that the quantity of hybrid rice shoots per running meter was substantially affected by integrated nutrients management throughout all phenological phases of crop development in 2018–19 and 2019–20. The first year of the experiment showed that 100% RDF of NPK (150:75:60 kg ha-1) applied through inorganic fertilizers resulted in the highest number of shoots per running meter of hybrid rice, while the second year showed that 75% NPK + 25% N through biocompost applied at 30 days after transplanting resulted in the highest number of shoots. Hybrid rice plants produced the most shoots per running meter when fertilized with 75% NPK + 25% N through biocompost in 2018-19, followed by 75% NPK + 25% N with FYM and 100% RDF of NPK (150:75:60 kg ha-1) using inorganic fertilizers.

Table 4.3 displays information on the 2018–19 and 2019–20 hybrid rice panicle length in relation to the moisture regime and integrated nutrients management.

The length of the panicle (in centimeters) in hybrid rice was considerably impacted by the various moisture regimes during the two years of study. The 7 cm of irrigation applied one day after the ponded water evaporated resulted in the longest panicles of hybrid rice (26.15 and 26.41 cm). This lasted far longer than the rest of the wet period. When 7 cm of irrigation were provided 4 days after the ponded water had drained, the panicle length rose from 23.69 to 24.89 centimeters in 2017-18 and 2018-19. The smallest feasible panicle length for hybrid rice was 22.95 and 23.18 cm in 2018-19 and 2019-20, respectively, when 7 cm of irrigation was provided 7 days after ponded water evaporated.

Table 4.3 displays information on grain yield per panicle in 2018–19 and 2019–20 as affected by varying moisture regimes and integrated nutrient management.

Variations in moisture regime were shown to have a substantial effect on hybrid rice yield throughout both years. When irrigation was provided 7 cm one day after the ponded water vanished, the number of grains per panicle for hybrid rice was significantly greater (215.0 and 218.58) than under the other moisture regimes in both 2018–19 and 2019–20. Compared to 7 cm irrigation given 7 days after disappearance of ponded water (189.0 and 191.82), the number of grains panicle-1 for hybrid rice was 205.0 and 208.06 in the years studied, respectively; this was on par with conventional irrigation (197.0 and 199.94). The lowest panicle-1 grain production of hybrid rice occurred when irrigation was applied 7 days after ponded water vanished in both years of study.

In Table 4.3, we can observe how the total weight of grains per panicle for hybrid rice was impacted by the moisture regime and integrated nutrients management in 2018–19 and 2019–20.

In both years of the research, the moisture regime had a significant effect on the grain weight per panicle (g) of hybrid rice. The 7 cm irrigation delivered 1 day after the ponded water had dried up resulted in considerably greater grain weights panicle-1 (5.05 and 5.15 g) in both research years when comparing hybrid rice yields across all moisture regimes. 7 cm irrigation given at 4 days after disappearance of ponded water resulted in significantly more production of hybrid rice in terms of weight of grains panicle-1 (4.78 and 4.87 g) when compared to conventional irrigation (4.37 and 4.48 g) in 2017-18 and 2018-19, respectively. In contrast, just 7 cm of water was required during the 2018–19 and 2019–20 growing seasons in order to provide a minimum yield of grains per panicle (4.14 and 4.22 g) of hybrid rice.

Table 4.3: The effects of varying moisture regimes and integrated nutrients management on the yield characteristics of hybrid rice.

Treatments	Lengthof panicle(cm)		No.ofgrains panicle-1		Weighto grains panicle-1 (g)		Test weight (g)	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Moistureregime								
I1	26.15	26.41	215.0	218.58	5.05	5.15	23.70	23.80
I2	24.65	24.89	205.0	208.06	4.78	4.87	23.30	23.40

I3	22.95	23.18	189.0	191.82	4.14	4.22	21.90	22.00
I4	23.69	23.92	197.0	199.94	4.37	4.48	22.30	22.40
SEm±	0.58	0.56	3.94	4.31	0.07	0.11	0.50	0.51
CDat5%	1.42	1.38	9.64	10.25	0.24	0.28	NS	NS
IntegratedNutrientsManagement								
N1	24.20	24.44	203.0	205.03	4.63	4.72	22.80	22.90
N2	26.80	27.06	217.0	220.24	5.00	5.11	23.00	23.10
N3	23.40	23.63	191.0	193.85	4.34	4.43	22.70	22.80
N4	24.40	24.88	206.0	207.07	4.70	4.80	22.90	23.00
N5	23.00	23.23	187.0	189.81	4.25	4.34	22.60	22.70
SEm±	0.44	0.55	3.51	4.71	0.10	0.10	0.49	0.50
CDat5%	1.27	1.59	10.14	12.58	0.29	0.30	NS	NS

Table 4.4 shows how the moisture regimes and integrated nutrient management used throughout the 2018–19 and 2019–20 growing seasons affected grain output and total water consumed (during the whole crop period).

Table 4.4:Efficiency in water use as influenced by soil moisture and interdisciplinary nutrient management

Treatment	Grainyield(qha^{-1})		Waterapplied(cm)	Effectiverainfall(cm)		Totalwaterapplied(cm)		WUE(kgha^{-1}cm)	
	2018-19	2019-20		2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Moistureregime									
I1	72.80	73.30	70	46.98	48.20	116.98	118.20	62.23	62.01

I2	68.40	69.83	42	46.98	48.20	88.98	90.20	76.87	77.42
I3	60.10	61.42	35	46.98	48.20	81.98	83.20	73.31	73.82
I4	65.10	66.46	84	46.98	48.20	130.98	132.20	49.70	50.27
SEm±	1.19	1.40							
CD (p=0.05)	2.93	3.44							
IntegratedNutrientsManagement									
N1	67.10	68.50	57.75	46.98	48.20	104.73	105.95	64.07	64.65
N2	72.50	73.99	57.75	46.98	48.20	104.73	105.95	69.23	69.83
N3	63.70	65.05	57.75	46.98	48.20	104.73	105.95	60.82	61.40
N4	68.80	69.24	57.75	46.98	48.20	104.73	105.95	65.69	65.35
N5	62.40	63.72	57.75	46.98	48.20	104.73	105.95	59.58	60.14
SEm±	1.30	1.50							
CD (p=0.0)	3.69	4.35							

Seven centimeters of irrigation applied four days after ponded water disappeared was found to have the highest water use efficiency (76.87 and 77.42 kg ha-1 cm) in 2018-19 and 2019-20, followed by seven centimeters of irrigation applied seven days after ponded water disappeared (73.31 and 73.82 kg ha-1 cm) and one centimeter of irrigation applied one day after ponded water disappeared (62.23 and 62.01 kg ha-1 cm). In both experimental years, conventional irrigation resulted in the lowest water usage efficiency of hybrid rice (49.70 and 50.27 kg ha-1).

5. Conclusion

The growth, yield, and yield characteristics of hybrid rice were all increased when it was fertilized with 75% NPK + 25% N using biocompost and watered with 7 cm water at 1 DADPW. The best results were achieved with an irrigation depth of 7 centimeters, a depth of 4 DADPW, and a ratio of 75% NPK + 25% N via biocompost. The optimal conditions for achieving the highest possible gross and net yields, as well as a B:C ratio, were found to be 7 cm of irrigation delivered at 1 DADPW with 75% NPK and 25% N derived from biocompost. It has been discovered that hybrid rice (Arize 6444) should be fertilized with 75% NPK + 25% N using biocompost and watered with 7 cm water at 1 DADPW. This combination of practices will result in the highest possible yield and financial return.

6. References

1. Singh M, Singh V P and Sammi Reddy K. (2015). Effect of integrated use of fertilizer nitrogen and FYM or GM on transformation of NKS and productivity of rice- wheat system on a vertisol. Journal of Indian Society of Soil Science 49(3): 430-435.
2. Singh V K and kumar P. (2016). Effect of integrated nutrient management on soil fertility, nutrient uptake and yield of rice-pea cropping system on an upland acid soil of Jharkhand. Journal of the Indian Society of Soil Science 59(2): 158-163.
3. Sangakkara U R and Sandanam S. (2015). Effect of plant density, nitrogen and gypsum on yield parameters of groundnut (Arachis hypogea L.) in regosols of Batticloa district. Tropical Agricultural Research 7: 112-123.
4. Smaling E M A and Braun A R. (2017). Soil fertility research in Sub-Saharan Africa: New dimensions, new challenges. Communications in Soil Science and Plant Analysis 27 (Nos. 3 and 4).
5. Subbiah B V and Asija G L. (2017). A rapid procedure for the determination of available nitrogen in soil. Current Science 25: 259-260.
6. Sudha B and Chandini S. (2016). Vermicompost - potential organic manure for rice. Internatonal. Agricultural 41(1-2): 18.
7. Thimme Gowda S. (2017). Studies on the soil fertility management and moisture utilization in rice based cropping systems under tank irrigation Ph.D. Thesis. University of Agricultural Sciences Bangalore.
8. Thomas V G. (2020). Land use and conservation from the perspectives of socioeconomics and environmental change. In Sustaining Land Use, edited by G. Hass. Saskatoon, SK: Extension Division, University of Saskatchewan.
9. Takeo Y and Kazuo O. (2020). The effects of green manure (Sesbania rostrata) on the growth and yield of rice. Journal of Faculty of Agriculture 54(2): 313-319.
10. Zhao D and Oosterhuis D M. (2019). Nitrogen application effect on leaf photosynthesis, nonstructural carbohydrate concentrations and yield of field- grown cotton. In D.M.

Oosterhuis ed., AAES special report. Proceedings of the 2000 Arkansas Cotton Research 198: 69-71.

11. Jayasree, G.(2018) Evaluation of rice (Oryza sativa L.) varieties and hybrids in relation to different nutrient management practices for yield, nutrient uptake and economics in SRI. Ann. Biol. Res, 4, 25–28
12. Veeramani, P. (2017) Enhancement of mat nursery management and planting pattern (using rolling markers) in System of Rice Intensification (SRI) technique. Res. J. Agric. Sci. 2011, 2, 371–375.