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Performance of Direct Seeded Rice under Integrated Nutrient Management Practices in Old Alluvial Soils of West Bengal

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Authors' contributions

This work was carried out in collaboration among all authors. Author TKP designed the study and carried out the research trial. Author SM performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author JK managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during *Kharif* 2018-19 and 2019-20 at the farm of Regional Research station, Old Alluvial Zone, Uttar Banga Krishi Viswavidyalaya, Majhian, Dakshin Dinajpur, West Bengal to study the Performance of direct seeded rice (var. GB-1) under integrated nutrient practices. Highest number of effective tillers plant^{-1} (17.81), panicle length (29.56 cm) and number of filled grains panicle^{-1} (262.15) as well as seed yield (3051.89 kg ha^{-1}) have been observed where direct seed rice crop received 75% of the recommended dose of fertilizers, FYM @ 5ton ha^{-1} and brown manuring with dhaincha. Highest number of effective tillers plant^{-1} (18.86), panicle length (28.89 cm) and number of filled grains panicle^{-1} (260.54) and seed yield (3079.92 kg ha^{-1}) have also been observed with spraying of Vermiwash and N-P-K 19:19:19 at 35 DAS and 55 DAS respectively to the direct seeded rice crop. An increasing trend in residual fertility status has also been observed with this treatment compared to the initial fertility status of the soil. This treatment can be an acceptable option of integrated nutrient management practice for the direct seeded rice growers of the old alluvial zone.

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Keywords: Brown manuring; direct seeded rice; green manuring; INM; yield component.

1. INTRODUCTION

Rice (*Oryza sativa* L.), a staple food for more than half of the world's population, is grown in more than 95 countries across the globe [1,2]. India stands not in exception. In West Bengal, an eastern state of India, agriculture scenario is also mostly of rice intensive in nature. The Old alluvial zone in the northern part of the state of West Bengal in India is one of the prominent rice growing belts. Traditionally rice in this zone is grown by transplanting of certain aged seedlings in to the puddled field. Transplanted rice requires a continuous supply of water throughout its growth and development period [3]. Transplanting operation of rice is labour intensive and sometimes it cause delayed transplanting due to crisis in availability of labour which ultimately reflects in lower productivity and poor return [4]. Direct seeded rice culture is an alternative cost effective technology which requires less labour and water than conventional transplanted rice [5,4].Comparable rice yield in the dry direct-seeded rice system and low input demand justifies the higher output to input ratio [6]. In present day agriculture, there is increasing concern about the sustainability in productivity of soils as a resource base to meet the demand of the expanding human population. In intensive cultivation practices and escalating contribution towards food production scenario cannot be attained without external supply of adequate amount of nutrients. In spite of the significant contribution of mineral fertilizers to the increased production system, a steady decline in fertilizer use efficiency for production of agricultural crops has now become a matter of serious concern. The need for continued increase in agricultural production to meet the ever expanding human and livestock population coupled with the inability of chemical fertilizers to maintain long-term soil health and crop productivity in intensive cropping system have underlined the need for integrated sources of nutrient such as the combination of chemical fertilizers, organic manures, bio-fertilizers etc. [7]. Keeping this in view an experiment was undertaken to assess the effect of integrated nutrient management in direct seeded rice at the old alluvial zone of West Bengal, India.

2. MATERIALS AND METHODS

The field experiment was conducted at the farm of Regional Research Station (Old Alluvial Zone), Uttar Banga Krishi Viswavidyalaya, Majhian, Dakshin Dinajpur, West Bengal, India in 2018-19 and 2019-20 during *Kharif*. The farm is situated at 26°19'86" Nlatitude and 89°23'53" E longitude and at an altitude of 43 meter above mean sea level. This zone is characterized by annual rainfall of 1400-1600 mm and pre-humid condition. The experimental soil was slightly acidic in reaction (pH 5.58) and texturally sandy-loam in nature.

The experiment was laid out in factorial randomized block design with nine (9) treatment combinations in experimental plot sized 3 m x 4 m and replicated thrice.

Factor-I: Soil fertility management

1. 100% RDF (N-P_2O_5-K_2O 60:30:30)
2. 75% RDF+FYM @ 5t ha^{-1}+Green Manuring with Dhaincha (*Sesbania aculeata*)
3. 75% RDF+FYM @5t ha^{-1}+Brown Manuring with Dhaincha (*Sesbania aculeata*)

Table 1. Initial soil fertility status

Particular	Value	Status
Textural class		
Sand	58%	
Silt	27%	
Clay	15%	Sandy loam
pH	5.58	Acidic
Organic Carbon (%)	0.42	Medium
Available N (kg ha^{-1})	185.36	Medium
Available P_2O_5 (kg ha^{-1})	22.12	Low
Available K_2O(kg ha^{-1})	295.78	High

Factor II: Spraying schedule

1. No. Spray
2. Spraying vermiwash(10%) after 35 and 55 DAS
3. Spraying vermiwash(10%) after 35 DAS + NPK 19:19:19 at 55 DAS @ 5 g litre^{-1} of water

The rice variety Gotra Bidhan-1, was sown at 25 cm rows apart on June 28 and June 30 during 2018-19 and 2019-20 respectively. Fertilizers were applied in the plots as per treatments just after laying out of the experiment. Nitrogen was applied in three splits (1/4at 15 DAS, ½ at 30 DAS and rest 1/4at 45 DAS), while ¾ potassium was applied during final land preparation with ¼ as top dressing at 45 DAS. Entire phosphatic fertilizers were applied as basal. All other agronomic operations were performed as per recommendations of the crops. Pre germinated seeds of rice were used in wet bed in this study. Green manuring was done in situ during land preparation by incorporating *Dhaincha* plant in to the soil which was sown 45 days back and brown manuring was done by killing of *dhaincha* plant by spraying of herbicide 2, 4-D at 28 DAS. In Brown manuring, the seeds of dhaincha were sown after mixing with rice seeds. Economic analysis was carried out using the prevailing market price. Data were collected on yield attributing character of rice. The soil samples were analyzed using standard methods. The statistical analysis of data was done following the procedure for analyzing factorial RBD [8] and by using statistical software MSTAT-C version 2.1(Michigan State University, USA). Significant differences between the treatments were compared with the critical difference at ± 5% probability by LSD.

3. RESULTS AND DISCUSSION

Significantly higher values of plant height (125.81 cm), number of effective tillers plant^{-1} (17.81), panicle length (29.56 cm) and number of filled grains panicle^{-1} (262.15) have been recorded where direct seed rice crop received 75% of the recommended dose of fertilizers, FYM @ 5ton ha^{-1} and brown manuring with dhaincha compared to the recommended dose of inorganic fertilizer (Table 2). But this treatment was statistically at par with the values recorded with the treatment comprising of 75% of the recommended dose, FYM @ 5 ton ha^{-1} along with green manuring with Dhaincha. Significantly higher yield (3051.89 kg ha^{-1}) was also obtained from the treatment 75% of the recommended dose of fertilizers, FYM @ 5ton ha^{-1} and brown manuring with dhaincha which ultimately fetched highest return rupee-1 invested (1.97) compared to the rice crop received only recommended dose inorganic fertilizer (1.54).This is in conformity with [9]. During an experiment they reported highest cost-benefit ratio (1.19) with brown manuring in rice crop. Singh et al. [10] recorded that rice yield in direct seeding along with brown manuring significantly higher than direct seeding without brown manuring. Sarangi et al. [11] observed in an experiment that the brown manuring in direct seeded rice increased the plant height by 1.57%, effective tiller number by 9.09%, and grain yield by 7.91% compared to the farmers practice. Sarangi et al. [11] reported that use of nitrogenous fertilizer can be reduced up to 25 per cent in the farmers' field by brown manuring without affecting the economical attributes and saving the precious soil health with the better nutrient availability. In brown manuring, *dhaincha* surface mulch decomposes very fast to supply N and other recycled nutrients [12] and furthermore, direct seeded rice avoids the transplanting shock hence attains the physiological maturity earlier than transplanted rice and reduces the vulnerability to late-season drought along with the less weed density in application of 2,4D at 28 DAS and with the better nutrient absorption might be the possible reason for better response in the yield attributes of the direct seeded rice crop at the old alluvial zone of West Bengal compared to the sole application of inorganic fertilizers. This is in affirmation of the result found by Singh et al. [13] who also reported inter cropping of *dhaincha* along with direct seeded rice up to vegetative phase and application of herbicide for managing weeds optimised the yield direct seeded rice.

From the Table 2 it has also been revealed that spraying of vermiwash (10%) and NPK 19:19:19 @ 5 g litre^{-1} of water was the best in the spraying schedule of the direct seeded rice crop. Significantly higher values of plant height (128.26 cm), number of effective tillers plant^{-1} (18.86), panicle length (28.89cm) and number of filled grains panicle^{-1} (260.54) as well as yield (3079.92 kg ha^{-1}) have been recorded where direct seed rice crop received two sprays of vermiwash and NPK 19:19:19 @ 5 g litre^{-1} of water at 35 and 55 DAS respectively compared to the no spray and this spraying schedule was followed by the spraying schedule where crop received two sprays of vermiwash at 35 and 55 DAS. Highest return rupee^{-1} (1.96) obtained with

the spraying schedule comprising vermiwash and NPK 19:19:19 at 35 and 55 DAS respectively. Vermiwash contains nitrogenous excretory substances growth stimulating hormones and enzyme [14]. The increased yield and yield components observed with foliar spray of vermiwash and NPK 19:19:19. This might be due to the quick, proper absorption with assimilation and utilization of nutrients in balanced manner by the rice crop. The better yield in rice with this treatment ultimately reflected in to the better return rupee^{-1} of invested. Subasashri [15] reported that Vermiwash is very good liquid manure and affect significantly on the growth and productivity of rice crop during as foliar spray. No interaction effect has been found between soil fertility management practices and the foliar spraying schedule.

From the Table 3 it has been revealed that integrated nutrient management practice in direct seeded rice has an effect in the residual soil fertility which has been reflected in the increasing trend of the residual soil fertility status after two years of experimentation. Highest value of available N (192.85 kg ha^{-1}) in soil was recorded where the direct seeded rice the treatment comprised of 75% of the recommended dose of fertilizer along with brown manuring followed by the treatment comprised of 75% of the recommended dose of fertilizer along with green manuring (191.23 kg ha^{-1}). Increase in available nitrogen status after two years of experimentation was observed due to incorporation of *dhaincha* through brown manuring practice which could sustain soil fertility. Such an increase is attributed to the accumulation of root residues and shedding of leaves by dhaincha [16]. The same trend has also been found in the recorded value of the available P_2O_5 and K_2O. On the other side, highest value of available N, P_2O_5 and K_2O (193.12, 29.14 and 303.12 kg ha^{-1} respectively) were recorded where crop received two foliar sprays of vermiwash and NPK 19:19:19 at 35 and 55 days after sowing followed by spray schedule of vermiwash at 35 and 55 days after sowing. No remarkable changes in pH was recorded after two years of experimentation.

Table 2. Growth, yield attributes and production economics of direct seeded upland rice (Variety: GB-1) as influenced by integrated nutrient management practice at OAZ

Soil fertility management:	Plant height at maturity in cm	number of effective tillers plant^{-1}	panicle length in cm	number of filled grains panicle^{-1}	Yield (Kg ha^{-1})	return rupee^{-1} invested
100% RDF (N-P_2O_5-K_2O 60:30:30)	108.63	13.12	21.45	221.85	2416.45	1.54
75% RDF+FYM @ 5 ton ha^{-1}+Green Manuring with Dhaincha	123.12	16.56	26.52	248.66	2845.68	1.91
75% RDF+ FYM @ 5 ton ha^{-1} +Brown Manuring with Dhaincha	125.81	17.81	29.56	262.15	3051.89	1.97
S.Em (±)	3.12	0.96	1.36	6.82	125.14	-
C.D	12.13	3.10	4.51	19.14	376.62	-
Spraying schedule:						
No. Spray	105.13	11.65	19.96	215.17	2248.16	1.52
Spraying vermiwash after 35 and 55 DAS	124.18	16.98	28.68	256.95	2985.94	1.94
Spraying vermiwash(10%) at 35 DAS + NPK 19:19:19 at 55 DAS @ 5 g litre^{-1} of water	128.26	18.86	28.89	260.54	3079.92	1.96
S.Em (±)	3.12	0.96	1.36	6.82	125.14	-
C.D	12.13	3.10	4.51	19.14	376.62	-

Table 3. Residual soil fertility status after two years of experimentation

Soil fertility management:	P^H	Available N in kg ha^{-1}	Available P_2O_5 in kg ha^{-1}	Available K_2O in kg ha^{-1}
100% RDF (N-P_2O_5-K_2O 60:30:30)	5.59	188.14	22.98	295.98
75% RDF+ FYM @ 5 ton ha^{-1} +Green Manuring with Dhaincha	5.42	191.23	27.28	299.35
75% RDF+ FYM @ 5 ton ha^{-1} +Brown Manuring with Dhaincha	5.40	192.85	28.65	302.16
Spraying schedule:				
No. Spray	5.60	187.12	21.65	295.66
Spraying vermiwash35 and 55 DAS	5.40	191.98	28.12	298.71
Spraying vermiwash(10%) at 35 DAS + NPK 19:19:19 at 55 DAS @ 5 g $litre^{-1}$ of water	5.41	193.12	29.14	303.12
Initial value:	5.58	185.36	22.12	295.78

4. CONCLUSION

The integrated nutrient management practice with 75% of the recommended dose of fertilizers, FYM @ 5ton ha^{-1} and brown manuring with dhaincha comprised with spraying of vermiwash and NPK 19:19:19 @ 5 g $litre^{-1}$ of water can be the beneficial option to the direct seeded rice farmers of the old alluvial zone of West Bengal.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Coats B. Global rice production. In: Smith CW, Dilday RH (eds) Rice origin, history, technology and production. Wiley, Hoboken. 2003;247–470.
2. IRRI. Rice almanac: source book for the most important economic activity on earth. CABI, Wallingford; 2002.
3. Farooq M, Basra SMA, Ahmad N. Improving the performance of transplanted rice by seed priming. Plant Growth Reg. 2007;51(2):129-137.
4. Farooq M, Siddique KHM, Rehman H, Aziz T, Lee DJ, Wahid A. Rice direct seedling: Experiments, Challenges and opportunities. Soil. Till. Res. 2011;111:87-98.
5. Balasubramanian V, Hill JE. Direct seeding of rice in Asia: emerging issues and strategic research needs for the 21stcentury, 15-39. In: Pandey S, Mortimer M, Wade L, Tuong TP, Lopez K, Hardy B. (eds). Direct seedling: research strategies and opportunities. Manila (Philippines): International Rice Research Institute; 2002.
6. Liu H, Saddam Hussain S, Zheng M, Peng S, Huang J, Kehui Cui K, Nie L. Agron. Sustain. 2015;35:285–294. DOI: 10.1007/s13593-014-0239-0
7. Hegde DM, Dwivedi BS, Sudhakarababu SN. Biofertilizers for cereals production in India - A review. Indian Journal of Agricultural Sciences. 00001999;69(2):73-83.
8. Cochran WG, Cox GM. Experimental design. Asia Publishing House, Calcutta. 1977;95-132 and 142-181.
9. Kumar MS, Mukherjee PK. Integrated weed management in dry direct-seeded rainy season rice (*Oryza sativa* L.). Indian J. Agron. 2008;53:107-111.
10. Singh SK, Bharadwaj V, Thakur TC, Pachauri SP, Singh PP, Mishra A, K. Influence of crop establishment methods on methane emission from rice fields. Curr Sci. 2009;97:84–89.
11. Sarangi DR, Sahoo TR, Sethy S, Chourasia M, Prasad SM, Mohanta RK, Sadangi BN. Effect of replacing a part of nitrogenous fertilizer by brown manuring in direct seeded rice: A field study. ORYZA-An Int. J. on Rice. 2016;53(2):226-228.
12. Gopal R, Jat RK, Malik RK, Kumar V, Alam MM, Jat ML, Mazid MA, Saharawat YS, Mc Donald, Gupta R. Direct dry seeded rice production technology and weed management in rice based system. Tech. Bull. International Maize and Wheat Improvement Centre, New Delhi, India. 2010;28.
13. Singh P, Singh P, Singh R, Singh KN. Efficacy of new herbicides in transplanted

rice under temperate condition of Kashmir. Indian J. of Weed Science. 2007;39:167-71.

14. Tripathi G, Bharadwaj P. Comparative studies on biomass production, life cycles and composting effiency of *Eisenia foetida* (Savigny) and *Lampito mauritii* (Kingberg). Biores. Technol. 2004;92:275-278.

15. Subasashri M. Vermiwash collection and its pesticidal properties. The Hindu. 2003;17:1-2.

16. Thakur HC, Sharma NN. Effect of various cropping patterns including cereals, pulses and oilseeds on chemical properties of the soil. Indian Journal Agric. Science. 1988; 58(9):708-709.

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