Biological Forum – An International Journal **14(3): 1105-1109(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Growth and Yield of Paddy (*Oryza sativa* L.) in Coastal Acid Soil of Karnataka as Influenced by Integrated Nutrient Management Practices

Dileep R.[1*], Jayaprakash R.[1], Dhananjaya B.C.[1], Chethan Babu R.T.[2], Vinay Kumar M.[3] and Akshay Kumar Kurdekar[3]

[1]Department of Soil Science and Agricultural Chemistry,
University of Agricultural and Horticultural Sciences, Shivamogga (Karnataka), India.
[2] Department of Agronomy, ICAR-NDRI, Karnal (Haryana), India.
[3]Department of Agronomy, UAS, Raichur, (Karnataka), India.

(Corresponding author: Dileep R.)*
(Received 25 June 2022, Accepted 08 August, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: A field experiment was conducted during *Kharif* 2019 at ZAHRS, Brahmavar, Udupi to know the effect of integrated nutrient management practices on growth and yield of paddy. The experiment was laid out in RCBD design with 11 treatments and was replicated thrice. The treatment comprised of RDF and absolute control for comparison along with supplemental addition of 50 and 25 per cent of recommended dose of nitrogen (RDN) through poultry manure, vermicompost, FYM, gliricidia and eupatorium. Application of 50 per cent RDN through fertilizer and 50 per cent RDN through poultry manure recorded significantly higher plant height (104.27 cm), number of tillers per hill(23.73),total dry matter (77.18 g plant^{-1}), productive tillers (19.58), number of panicles per hill (21.59), panicle weight (4.16 g), panicle length (23.35 cm), number of grains per panicle (123), grain (5006 kg ha^{-1}) and straw (6534 kg ha^{-1}) yield of paddy as compared to RDF.

Keywords: Acid soil, nutrient management, paddy, poultry manure and vermicompost.

INTRODUCTION

Paddy (*Oryza sativa* L.) being the principal food crop to the billions of people around the World and India, occupies a pride place among the food crops cultivated in the World. Paddy plays a key role in food security and it is means of livelihood for millions of people making a slogan "Rice is life" most appropriate.In India, it is grown in an area of 43.78 million hectare with a production and productivity of 225.51 million tonnes 5150 kg ha^{-1}, respectively (Anon., 2019). In Karnataka, rice is cultivated in an area about 10.34 lakh hectare with a production of 28.74 lakh tonnes and productivity of 2924 kg ha^{-1} (Anon., 2017). Paddy is the prime crop in the coastal zone of Karnataka during *Kharif*.

Fertilizers play vital role in crop production and productivity but continuous indiscriminate use of chemical fertilizers, which badly influences on production potential and soil health. The negligence shown towards the conservation and use of organic sources of nutrients has not only caused the exhaustion of soil nutrient reserves but also resulted in an imbalance among the available nutrients leading to soil problems. Integrated nutrient management (INM) with FYM, vermicompost, poultry manure, green manures and biofertilizers along with chemical fertilizers are the alternative to restore the soil health and productivity. Integrated nutrient management is a flexible approach to reduce the use of chemical sources of nutrients along with maximization of their use efficiency and farmer's profit. INM is a strategy for judicious and balanced use of plant nutrients for sustainable crop production under varied agroclimatic conditions. Results from on farm and farmer's fields of India reveal the imperative need to use organic manures, biofertilizers and lime in acid soils in conjunction with chemical fertilizers for better soil health and higher crop production as against the use of chemical fertilizers alone (Sarkar *et al.*, 2020). In acidic soils, lower availability of nutrients (N, P, K, Ca, Mg and S), higher nutrient losses due to leaching, volatilization and runoff has further aggravated the problem of nutrient management in rainfed paddy.

Keeping in view the situation of the coastal zone of Karnataka, it is necessary to make use of the balanced supply of plant nutrients as a pre-requisite for successful agriculture. This can be achieved through integrated nutrient management for achieving sustainable yields and to maintain good soil physical environment to provide the required quantity of nutrients. Based on the availability of organic and green manures at the farmer's level, an experiment entitled

growth and yield of paddy (*Oryza sativa* L.) in coastal acid soil of Karnataka as influenced by integrated nutrient management practices was conducted at ZAHRS, Brahmavar, Udupi.

MATERIAL AND METHODS

A field experiment was conducted at Zonal Agricultural and Horticultural Research Station (ZAHRS), Brahmavar, Udupi district, Karnataka. The experimental site is situated between 13°25′N latitude and 74°45′E longitude with an altitude of 10 meters above mean sea level. It comes under the coastal zone (agro-climatic zone 10) of Karnataka. The soil of the experimental site belongs to the sandy loam texture.

Field experiment was laid out in Randomized Complete Block Design (RCBD) with 11 treatments and three replications. Treatments consisting of different combinations of organic and inorganic nutrient sources *viz.*, T_1- Absolute control, T_2–Recommended dose of fertilizer (60:30:45 kg $N:P_2O_5:K_2O$ ha^{-1}), T_3 - 50 per cent recommended dose of nitrogen(RDN) through fertilizer + 50 per cent RDN through FYM**,** T_4- 50 per cent RDN through fertilizer + 25 per cent RDN through FYM + 25 per cent RDN through poultry manure**,** T_5- 50 per cent RDN through fertilizer + 25 per cent RDN through FYM + 25 per cent RDN through vermicompost**,** T_6- 50 per cent RDN through fertilizer + 25 per cent RDN through FYM + 25 per cent RDN through gliricidia**,** T_7- 50 per cent RDN through fertilizer + 25 per cent RDN through FYM + 25 per cent RDN through eupatorium**,** T_8- 50 per cent RDN through fertilizer + 50 per cent RDN through poultry manure**,** T_9- 50 per cent RDN through fertilizer + 50 per cent RDN through vermicompost**,** T_{10}- 50 per cent RDN through fertilizer + 50 per cent RDN through gliricidia**,** T_{11}- 50 per cent RDN through fertilizer + 50 per cent RDN through eupatorium.

The land was prepared by disc ploughing once followed by passing cultivator twice and harrowing to bring the soil to a fine tilth. The land was puddled twice then demarked with bunds to prepare the required plot size and laid out as per the plan. Full dose of farmyard manure, vermicompost, poultry manure, gliricidia, eupatorium applied and incorporated into fields two weeks before planting of paddy. Rock phosphate was applied as basal dressing.19days old seedlings were planted @ 2-3 seedlings $hill^{-1}$ with a spacing of 20 cm × 10 cm. Nitrogen and muriate of potash were given in three split doses-first dose was given at the time of field preparation, second after one month of transplanting and third during the panicle initiation stage. Liquid plant growth promoting rhizomicrobial consortia is common for all treatment. Five hills were selected randomly from the net plot and labelled for recording the observations in each treatment. The growth and yield parameters were recorded at 30, 60 and 90 days after planting and at harvest. All the biometric observations are recorded were subjected to analysis.

RESULTS AND DISCUSSION

Growth parameters: Crop growth is dependent not only on the amount of nutrients present in the soil but also on their availability in accordance with the pattern of crop growth. The sunlight, nutrients and moisture influence growth parameters such as plant height, number of tillers and dry matter production.

Significantly higher plant height was observed at 30, 60, 90 DAT and harvest with a combined application of 50 per cent RDN through fertilizer + 50 per cent RDN through poultry manure (33.72, 78.16, 103.42 and 104.27 cm, respectively) are described in Table 1. However, remaining treatments were recorded higher plant height as compared to the absolute control treatment. Poultry manure contains higher amounts of nitrogen and phosphorus compared to other organic manures. Phosphorus is a constituent of nucleic acid, phytin and phospholipids. The beneficial influence of phosphorus in early stages of crop growth may be explained by early stimulation of root system through efficient translocation to the root of certain growth stimulation compounds formed on account of protoplasmic activity in phosphorus fed plants (Sago and Kobayashi 2007).

Significantly number of tillers per hill was observed at 60, 90 DAT and harvest with treatment with the use of 50 per cent RDN through fertilizer + 50 per cent RDN through vermicompost (20.07, 23.73 and 21.19, respectively). The combined effect of the recommended dose of fertilizer and vermicompost has resulted in increased absorption of nutrients resulting in the rapid conversion of synthesized photosynthetic products into protein to form more protoplasm, thereby increasing the number and size of the cell and thus contribute to better growth of plants. It also contains significant amounts of micronutrients and regulates the accessibility of metallic micronutrients to plants and enhances plant growth by providing nutrients in an accessible and crop-based form (Ananda *et al.,* 2006; Siddaram, 2009; Nagaraj *et al.,* 2018).

At 30DAT the combined application of 50 per cent RDN through fertilizer + 50 per cent RDN through vermicompost reported significantly higher total dry matter production (3.41 g $hill^{-1}$) are described in Table 1. Combined application of 50 per cent RDN through fertilizer + 50 per cent RDN through poultry manure treatment produced largely higher total dry matter during 60 DAT, 90 DAT and at harvest (26.50, 58.29 and 77.18 g $hill^{-1}$, respectively). The higher dry matter observed when applying poultry manure might be ascribed partly to its ability to release N synchronously with the demand for rice (Arunkumar *et al.*, 2017; Ofori *et al*., 2005).

Table 1: Growth parameters at different growth stages of paddy as influenced by integrated nutrient management practices.

Treatments	Plant height (cm)				Number of tillers hill^{-1}				Total dry matter production (g hill^{-1})			
	30 DAT	60 DAT	90 DAT	At harvest	30 DAT	60 DAT	90 DAT	At harvest	30 DAT	60 DAT	90 DAT	At harvest
T_1	29.38	47.76	70.64	71.02	7.75	9.80	11.31	9.95	1.69	9.84	22.19	35.07
T_2	33.29	68.75	87.30	89.81	12.07	15.17	17.88	16.70	2.47	18.19	43.09	58.24
T_3	29.78	67.29	83.55	85.85	11.15	16.10	17.06	16.53	2.44	18.82	40.01	56.27
T_4	31.30	67.57	88.21	91.20	12.09	17.54	18.15	17.50	2.79	20.47	44.63	62.80
T_5	30.48	67.40	89.84	92.00	11.02	14.78	17.55	16.44	2.60	21.65	49.70	68.49
T_6	29.03	67.18	85.88	87.43	10.28	14.76	16.05	14.89	2.35	15.25	35.43	52.90
T_7	29.10	66.59	85.07	86.91	10.57	14.82	16.63	15.05	2.39	15.91	38.21	54.29
T_8	33.72	78.16	103.42	104.74	12.48	19.29	22.42	20.27	2.88	26.50	58.29	77.18
T_9	32.00	76.44	103.09	104.27	12.43	20.07	23.73	21.19	3.41	24.71	55.65	73.53
T_{10}	29.43	66.82	85.38	86.19	10.73	15.04	17.10	15.76	2.36	17.89	46.27	66.03
T_{11}	27.09	75.68	98.04	102.30	12.29	18.87	21.62	19.94	2.82	22.48	53.47	72.06
S. Em.±	1.37	2.65	3.41	3.61	0.86	1.05	1.18	1.06	0.12	1.07	2.26	3.35
C.D. at 5 %	4.01	7.76	10.01	10.59	NS	3.07	3.45	3.10	0.36	3.16	6.65	9.85

Note: T_1- Absolute control, T_2 –Recommended dose of fertilizer (60:30:45 kg N:P_2O_5:K_2O ha^{-1}), T_3 - 50 per cent recommended dose of nitrogen(RDN) through fertilizer + 50 per cent RDN through FYM, T_4- 50 per cent RDN through fertilizer + 25 per cent RDN through FYM + 25 per cent RDN through poultry manure, T_5- 50 per cent RDN through fertilizer + 25 per cent RDN through FYM + 25 per cent RDN through vermicompost, T_6- 50 per cent RDN through fertilizer + 25 per cent RDN through FYM + 25 per cent RDN through gliricidia, T_7- 50 per cent RDN through fertilizer + 25 per cent RDN through FYM + 25 per cent RDN through eupatorium, T_8- 50 per cent RDN through fertilizer + 50 per cent RDN through poultry manure, T_9- 50 per cent RDN through fertilizer + 50 per cent RDN through vermicompost, T10- 50 per cent RDN through fertilizer + 50 per cent RDN through gliricidia, T_{11}- 50 per cent RDN through fertilizer + 50 per cent RDN through eupatorium.

Yield parameters: Yield was governed by number of factors which had direct or indirect impacts. The improvement in yield was achieved through improvement in yield parameters characters *viz.*, numbers of panicles per hill, number of productive tillers per hill, panicle length, panicle weight, total number of grains per panicle and test weight are described in Table 2.

In the present investigation, application of 50 per cent RDN through fertilizer + 50 per cent RDN through poultry manure treatment increased the yield attributing characters. Significantly higher numbers of panicles per hill (21.59), number of productive tillers per hill (19.58), panicle length (23.35 cm), panicle weight (4.16 g), total number of grains per panicle (123), were recorded in 50 per cent RDN through fertilizer + 50 per cent RDN through poultry manure treatment. Better nitrogen status of the plant at the panicle growth period consequent to increasing availability of nitrogen to rice crop maintained a complimentary source-sink relationship. Because increasing nitrogen fertilization improved growth, photosynthesis and other plant growth and yield components. The results are supported by the findings of Rajendran and Veeraputhiran (1999). Combined application of organic manure with recommended nutrient dosage showed significant improvement in various yield attributes resulting in better yield. Improvement in soil microbial activity leads to sympathetic physico-chemical properties that enhance the availability and absorption of nitrogen, resulting in a positive conversion of the source to sink accompanied by higher panicle length, panicle weight and test weight of rice (Mamta *et al.,* 2013). The increase in components of grain yield could be since more nutrient availability would have improved the absorption of nitrogen and other macro and micro-elements as well as increased the production and translocation of the dry matter content from source to sink. Arunkumar *et al.* (2019); Ebaid and EL-Refaee (2007) also reported similar results. Better nutrition at the grain filling period due to integrated fertilizer management led to higher filled grains per panicle. The test weight was not affected significantly by the various INM practices. Yet it ranged from 20.51 g in control to 25.23 g in 50 per cent RDN through fertilizer + 50 per cent RDN through poultry manure treatments applied.

Due to increase in yield attributing characters, which finally increased the grain yield (5006 kg ha^{-1}) and straw yield (6534 kg ha^{-1}). The higher per cent increase in grain yield (10.48 %) was noticed in T_8 when compared to T_2 (RDF) (Fig. 1). The increase in biomass yield reflects the better growth and development of the plants due to balanced and more availability of nutrients which was associated with increased root growth due to which the plants explore more soil nutrients and moisture throughout the growing period. The increased

yield was due to the uptake of nutrients in paddy and the application of poultry manure reduced the dosage of NPK (Manivannan and Sriramachandrasekharan 2016). This may indicate that organic manures reduces the loss of nutrients through leaching from the soil. The increase in growth and yield due to the application of fertilizer with organic manures (Jeyabal and Kuppuswamy 2001).

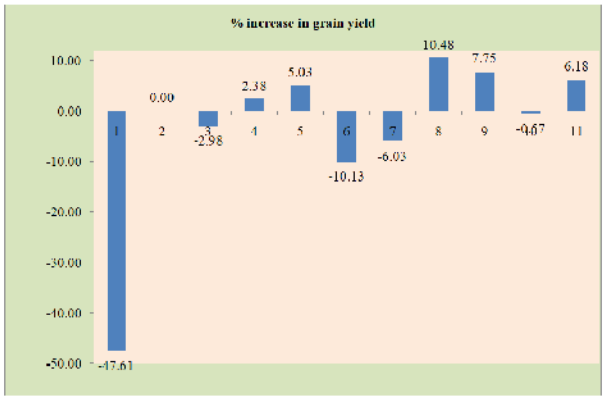

Fig. 1. Per cent increase in grain yield as influenced by INM practices.

Table 2: Yield parameters of paddy as influenced by integrated nutrient management practices

Treatments	No. of panicles hill^{-1}	No. of productive tillers hill^{-1}	Panicle length (cm)	Panicle weight (g)	Total number of grains	Test weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1	8.82	6.29	9.16	1.37	75	20.51	2374	2819
T_2	13.50	12.85	17.58	3.43	104	24.87	4531	5906
T_3	12.41	12.64	16.23	3.08	105	23.53	4396	5465
T_4	16.47	15.40	18.78	3.48	114	23.68	4639	6061
T_5	15.80	13.36	18.01	3.02	113	24.05	4759	5853
T_6	11.99	11.38	16.20	2.58	109	22.73	4072	4907
T_7	12.23	11.74	16.46	3.15	111	22.80	4258	5283
T_8	21.59	19.58	23.35	4.16	123	25.23	5006	6534
T_9	21.28	19.16	22.74	3.96	119	24.36	4882	6486
T_{10}	17.09	16.12	19.32	3.57	106	23.28	4505	5848
T_{11}	19.25	18.83	21.05	3.89	116	24.47	4811	6419
S. Em.±	0.91	0.76	0.94	0.13	4.0	0.91	72	116
C.D. at 5 %	2.66	2.22	2.75	0.38	12.0	NS	212	340

Note: T_1- Absolute control, T_2 –Recommended dose of fertilizer (60:30:45 kg N:P_2O_5:K_2O ha^{-1}), T_3 - 50 per cent recommended dose of nitrogen(RDN) through fertilizer + 50 per cent RDN through FYM, T_4- 50 per cent RDN through fertilizer + 25 per cent RDN through FYM + 25 per cent RDN through poultry manure, T_5- 50 per cent RDN through fertilizer + 25 per cent RDN through FYM + 25 per cent RDN through vermicompost, T_6- 50 per cent RDN through fertilizer + 25 per cent RDN through FYM + 25 per cent RDN through gliricidia, T_7- 50 per cent RDN through fertilizer + 25 per cent RDN through FYM + 25 per cent RDN through eupatorium, T_8- 50 per cent RDN through fertilizer + 50 per cent RDN through poultry manure, T_9- 50 per cent RDN through fertilizer + 50 per cent RDN through vermicompost, T_{10}- 50 per cent RDN through fertilizer + 50 per cent RDN through gliricidia, T_{11}- 50 per cent RDN through fertilizer + 50 per cent RDN through eupatorium.

CONCLUSION

For successful adoption of any technology or invention in agriculture, it should be economically feasible, technically utilizable and socially acceptable. More supply of nutrients through chemical fertilizers as a results reduction in total factor productivity or only supply of organic manures cannot meet the nutrient requirement and causes sudden yield loss. So, an integrated approach that recognizes soil as the storehouse of most of the plant nutrients essential for plant growth and that how nutrients are managed will have a major impact on plant growth, soil fertility, and agriculture sustainability.

FUTURE SCOPE

From the current field experiment there is huge scope for recommending the 50 per cent RDN through fertilizer + 50 per cent RDN through poultry manure with effective utilization of microbial consortia in the paddy crop cultivation in acid soils of coastal Karnataka to achieve the best integrated approaches to nutrient management and soil sustainability, better crop growth and productivity.

Conflict of interest. None.

REFERENCES

Ananda, M. G., Ananda, M. R., Reddy, V. C. & Ajayakumar, M. Y. (2006). Influence of different organic sources on yield and its components and benefit: cost ratio of paddy and groundnut in paddy-groundnut cropping system. *Crop Research, 31*: 329-333.

Anonymous (2017). *Agri. Situationin India, agristat. http//www.des.kar.nic.in*

Anonymous (2019). *Agri. Situationin India, agristat. http//www.des.kar.nic.in*

Arunkumar, B. R., Srinivasa, N. & Prakash, S. S. (2017). Effect of gypsum and boron application on growth and yield of Maize under different nutrient management practices. *Green Farming International Journal, 8*(3): 576-580.

Arunkumar, B. R., Thippeshappa, G. N., Chiddanandappa, H. M. & Gurumurthy, K. T. (2019). Impact of biochar, FYM and NPK fertilizers integration aerobic rice growth, yield and nutrient uptake under sandy loam soil. *Crop Research, 54*(5&6): 111-117.

Ebaid, R. A. & El-Refaee, I. S. (2007). Utilization of rice husk as an organic fertilizer to improve productivity and water use efficiency in rice fields. *African Crop Science Conference Proceedings, 8*: 1923-1928.

Jeyabal, A. & Kuppuswamy, G. (2001). Recycling of organic wastes for the production of vermicompost and its response in rice-legume cropping system and soil fertility. *European Journal of Agronomy, 15*: 153-170.

Mamta, M., Patel, M. V., Poonia, T. C., Meena, M. D. & Tania, D. (2013). Effects of organic manures and nitrogen fertilizer on growth and yield of paddy grown in system of rice intensification technique under Middle Gujarat conditions. *Annals of Agri Bio Research, 18*(2): 141-145.

Manivannan, R. & Sriramachandrasekharan, M. V. (2016). Integration of organics and mineral N on growth and yield of rice in *Typic Ustifluvents* soil. *International Journal of Current Microbiology and Applied Sciences, 5*(12): 428-436.

Nagaraj, R., Hanumanthappa, M. & Sudhir, K. V. (2018). Integrated nutrient management in paddy at coastal zone of Karnataka, India. *International Journal of Current Microbiology and Applied Sciences, 7*(6): 1745-1753.

Ofori, J., Kamidouzono, A., Masunaga, T. & Waakatsuki, T. (2005). Organic amendment and soil type effects on dry matter accumulation, grain yield and nitrogen use efficiency of rice. *Journal of Plant Nutrition, 28:* 1311-1322.

Rajendran, K. & Veeraputhiran, R. (1999). Effect of seed rate and nitrogen levels on hybrid rice (*Oryza sativa* L.). *Madras Agricultural Journal, 86*: 459-464.

Sago, R. & Kobayashi, H. (2007). Characteristics of soil fertility in organic rice cultivation. *Japanese Journal of Farm Work Research, 12(*5): 114-119.

Sarkar, A. K. Pattanayak, S. K. Singh, S. Mahapatra, P. Kumar, A. & Ghosh, G. K. (2020). Integrated nutrient management stratergies for acidic soils. *Indian J. Fertilizer, 16*(5): 476-491.

Siddaram (2009). Effect of various levels of nitrogen through organic sources on growth and yield of irrigated aerobic rice (*Oryza sativa* L.). M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Bangalore, Karnataka.

How to cite this article: Dileep R., Jayaprakash R., Dhananjaya B.C., Chethan Babu R.T., Vinay Kumar M., Akshay Kumar Kurdekar (2022). Growth and Yield of Paddy (*Oryza sativa* L.) in Coastal Acid Soil of Karnataka as Influenced by Integrated Nutrient Management Practices. *Biological Forum – An International Journal, 14*(3): 1105-1109.