

Original Research Article

<https://doi.org/10.20546/ijcmas.2020.902.285>

Influence of Integrated Nutrient Management on Paddy (*Oryza sativa* L.) under Hill Zone of Karnataka

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ABSTRACT

A field experiment was conducted at Zonal Agricultural and Horticultural Research Station, Mudigere, Chikkamagaluru district, Karnataka to investigate the integrated nutrient management in paddy under hilly zone of Karnataka during kharif season of 2018. The experiment was laid out in Randomized Complete Block Design consisting of ten treatments and three replication. The result revealed that application of 100% RDF + Glyricidia (50%) + Eupatorium (50%) + PGPR recorded significantly higher plant height (99.06 cm), number of leaves(71.26), number of tillers per hill (23.86), leaf area(1098 cm² hill⁻¹), leaf area index(5.49) and total dry matter (59.69 g hill⁻¹) over other treatments. Growth parameters such as AGR, RGR and CGR showed significant differences among all the treatments.at 60-90DAT and 90DAT- harvest. The yield and yield attributing parameters like number of productive tillers per hill(18.41), panicle length(22.29cm), panicle weight(4.13g hill⁻¹), total number of grains(128 panicle⁻¹), 1000 grain weight(25.36g), grain yield(5843kg ha⁻¹) and straw yield(7477 kg ha⁻¹) was recorded significantly higher with the application of 100 per cent recommended dose of fertilizers + Glyricidia (50 %) + eupatorium (50 %) + PGPR(T9), followed by 100 per cent recommended dose of fertilizers + FYM + PGPR(T5) and the lowest was recorded in 100 per cent recommended dose of fertilizers.

Keywords

Paddy, Integrated nutrient management, Eupatorium, Glyricidia, PGPR

Article Info

Accepted:
18 January 2020
Available Online:
10 February 2020

Introduction

Rice (*Oryza sativa* L.) is the leading cereal food crop of the world contributes as the principle food for about 62 per cent of the world's population. India is the world's second largest rice producer and consumer after China. Rice cultivation faces challenges across the world and India is no exception, with a reduction in area in most of the regions due to fluctuation in production and

productivity, stagnating yields and ever-increasing input cost besides labour scarcity. India needs to produce 135-145 m t of rice by 2020 to feed the additional 350 million people (Prakash *et al.*, 2008).

Due to continuous and imbalance use of chemical fertilizers adversely affects soil health and nutrient reserve, resulting in environmental pollution and concern for sustainable agriculture and ultimately the

yield. The basic concept of integrated nutrient management is to maintain soil fertility, sustainable agricultural productivity and improving farmer's profitability through judicious and efficient use of fertilizers, organic manures and biofertilizers.

Green manures, farm yard manure (FYM) and crop residues are important sources of organic matter. Adequate availability of FYM, is one of the best organic source, is seriously constrained by the use of dung as fuel in India. As an alternative, the green manure crops like dhaincha, sunhemp, cowpea, eupatorium and glyricidia *etc.* have the advantage of vigorous growth habit, N-fixing capacity and the ability to withstand a wide range of soil conditions. Green manuring is a practice of turning green biomass in the soil to improve the soil physico-chemical and biological properties suitable for plant growth and are excellent alternative to chemical fertilizers for sustainable agriculture.

Change in cropping sequence with respect to availability of resources the integrated approach of nutrient supply through inorganic and organic, has become very much promising in building soil health and quality of produce. Currently, growth of rice plants uses a lot of chemical fertilizer and chemical pesticide.

The increase of production of paddy must be achieved through improvement in agricultural productivity. Microbes are the beneficial key factors in maintaining soil quality by decreasing the dose of chemical fertilizers and increasing the crop production.

Materials and Methods

A field experiment was conducted during *kharif* season of 2018 at Zonal Agricultural and Horticultural Research Station, Mudigere, Chikkamagaluru district, Karnataka, to study

the integrated nutrient management in paddy. The experimental site is located at 13° 7' North latitude and 74° 37' East longitude with an altitude of 980 m above mean sea level. The soil of the experimental site was sandy loam in texture and pH was acidic (6.15), with normal salt load (EC 0.053 d Sm⁻¹). The organic carbon content was low (4.7 g kg⁻¹). The soil was medium in available nitrogen (325.00 kg ha⁻¹), high in available phosphorus (62.01 kg ha⁻¹) and medium in available potassium (102.27 kg ha⁻¹). KHP-13 a popular variety was transplanted in July with a spacing of 20 cm x 10 cm.

The experiment was laid out in Randomized Complete Block Design consisting of ten treatments and replicated thrice. The treatment combination includes T₁- 100 % RDF, T₂- 100 % RDF + FYM, T₃- 100 % RDF + Glyricidia equivalent to FYM, T₄- 100 % RDF + Eupatorium equivalent to FYM, T₅- 100 % RDF + FYM + PGPR, T₆- 100 % RDF + Glyricidia+ PGPR, T₇- 100 % RDF + Eupatorium+ PGPR, T₈- 100 % RDF + PGPR, T₉- 100 % RDF + Glyricidia (50%) + Eupatorium (50%) + PGPR and T₁₀- 100 % RDF + Glyricidia (50%) + Eupatorium (50%).

The organic manures were incorporated in soil 25 days before transplanting of paddy. Yield (biological and economical) was recorded from individual plots at harvest and expressed in kg ha⁻¹ Standard statistical methods were used for comparing the treatment means.

Results and Discussion

Morpho-Physiological Parameters

Influence of integrated nutrient management on morpho-physiological parameters such as plant height, number of leaves, number of tillers, leaf area, leaf area index and total dry matter at 90 DAT is presented in Table-1.

All the morpho-physiological parameters showed significant differences due to integrated nutrient management. Significantly maximum plant height (96.74cm), number of leaves (71.26), number of tillers (23.86), leaf area (1098cm² hill⁻¹), leaf area index (5.49) and total dry matter (59.69g) was observed in treatment T₉-100 per cent RDF+ glyricidia (50 %) + eupatorium (50 %) + PGPR followed by T₅-100 per cent RDF + FYM + PGPR 100 per cent RDF + glyricidia + PGPR (94.34 cm) and the lowest was recorded in T₁-100% RDF.

Combined application of inorganic and organic nutrients recorded higher morpho-physiological parameters might be due to direct and more availability and translocation of nutrients during developmental phase of crop growth, which accelerated the metabolic and physiological activity of the plant and put up more growth by assimilating more amounts of nutrients and facilitated more photosynthesis. Similar findings were also reported by Sunil Kumar *et al.*, (2017), Ogundare *et al.*, (2015) and Macedo (2008).

Significantly maximum leaf area, leaf area index and total dry matter production was recorded with treatment T₉-100 per cent RDF+ glyricidia (50 %) + eupatorium (50 %) + PGPR and it was followed by T₅-100 per cent RDF + FYM + PGPR 100 per cent RDF + glyricidia + PGPR.

This might be due to adequate supply of nitrogen through INM had produced larger leaves which in turn, resulted in more photosynthetic surface area. The significant response with leaf area might be due to addition of green manures that tend to increase the respiration rate, metabolism and growth of plants (Gangwar and Dubey, 2013), (Singh and Agarwal, 2001) and (Jamilah and Juniarti, 2017).

Leaf area fairly gives a good idea of the photosynthetic capacity of the plant. In the present study leaf area and leaf area index increases drastically up to grand growth period and decreases there after towards maturity.

Growth Parameters

Influence of integrated nutrient management on growth parameters is furnished in Table-.2

The data on AGR, RGR and CGR differed significantly between 60-90 days after transplanting. Significantly higher AGR, RGR and CGR was recorded in treatment T₅-100 % RDF + FYM + PGPR, T₈-100 % RDF + PGPR and T₆100 % RDF + glyricidia+ PGPR – respectively.

During 90DAT to harvest significantly higher AGR(0.45) and CGR(1.96) was observed in treatment T₅-100 % RDF + FYM + PGPR and T₄- 100 % RDF + eupatorium equivalent to FYM respectively.

Increase in growth parameters at different growth stage might be due to combined application of chemical fertilizers, organics and bio fertilizers.

In the present study, it was found that the AGR and CGR increased with increase in the crop duration up to 90 days after transplanting. Crop growth rate is widely used character for estimating production efficiency of crop stand and enables to make comparisons between the aspect of study (Watson, 1952).

Among different treatment data on relative growth rate (RGR) showed non-significant differences. Relative growth rate (RGR) was declined with an advancement of the crop growth could be due to decline in the rate of dry matter production.

Table.1 Morpho-physiological parameters of paddy (*Oryza sativa* L.) as influenced by integrated nutrient management

Treatments	90 Days after transplanting					
	Plant height(cm)	Number of leaves	No. of tillers	Leaf area (cm ² hill ⁻¹)	LAI	TDM (g hill ⁻¹)
T₁- 100 % RDF	78.52	55.12	15.41	461	2.31	36.90
T₂- 100 % RDF + FYM	84.83	58.63	17.35	618	3.09	43.08
T₃- 100 % RDF + glyricidia equivalent to FYM	85.58	66.47	19.14	906	4.53	47.30
T₄- 100 % RDF + eupatorium equivalent to FYM	89.71	67.14	20.78	913	4.57	50.73
T₅- 100 % RDF + FYM + PGPR	93.65	70.68	22.19	1034	5.17	57.02
T₆- 100 % RDF + glyricidia+ PGPR	90.17	69.81	21.36	975	4.87	56.28
T₇- 100 % RDF + eupatorium+ PGPR	85.15	63.53	19.26	840	4.20	46.32
T₈- 100 % RDF + PGPR	83.95	58.24	17.19	593	2.97	40.95
T₉- 100 % RDF + glyricidia (50%) + eupatorium (50%) + PGPR	96.74	71.26	23.86	1098	5.49	59.69
T₁₀- 100 % RDF + glyricidia (50%) + eupatorium (50%)	84.63	60.18	18.59	704	3.52	41.25
S. Em±	3.69	4.26	1.31	76	0.37	3.69
CD (P=0.05)	10.95	12.66	3.88	225	1.12	10.98

Note: RDF @ 75:75:90 kg N: P₂O₅: K₂O ha⁻¹, FYM @ 10 t ha⁻¹, Glyricidia @ 7.4 t ha⁻¹, Eupatorium @ 8.10 t ha⁻¹, DAT- Day after transplanting

Table.2 Growth parameters of paddy (*Oryza sativa* L.) as influenced by integrated nutrient management

Treatments	60 – 90 DAT			90 DAT- at harvest		
	AGR (g hill ⁻¹ day ⁻¹)	RGR (g g ⁻¹ day ⁻¹)	CGR (g dm ⁻² day ⁻¹)	AGR (g hill ⁻¹ day ⁻¹)	RGR (g g ⁻¹ day ⁻¹)	CGR (g dm ⁻² day ⁻¹)
T₁- 100 % RDF	0.75	0.031	3.30	0.37	0.0097	1.62
T₂- 100 % RDF + FYM	0.84	0.029	3.71	0.25	0.0049	1.08
T₃- 100 % RDF + glyricidia equivalent to FYM	0.87	0.027	3.84	0.27	0.0053	1.09
T₄- 100 % RDF + eupatorium equivalent to FYM	0.96	0.027	4.21	0.45	0.0075	1.96
T₅- 100 % RDF + FYM + PGPR	1.08	0.028	4.74	0.44	0.0069	1.92
T₆- 100 % RDF + glyricidia+ PGPR	1.09	0.028	4.80	0.36	0.0057	1.59
T₇- 100 % RDF + eupatorium+ PGPR	0.90	0.029	3.95	0.28	0.0045	1.10
T₈- 100 % RDF + PGPR	0.83	0.031	3.65	0.26	0.0061	1.14
T₉- 100 % RDF + glyricidia (50%) + eupatorium (50%) + PGPR	1.07	0.026	4.72	0.43	0.0067	1.89
T₁₀- 100 % RDF + glyricidia (50%) + eupatorium (50%)	0.75	0.026	3.28	0.38	0.0083	1.69
S. Em±	0.10	0.001	0.43	0.041	0.005	0.21
CD (P=0.05)	0.30	0.004	1.27	0.12	NS	0.62

Note: RDF @ 75:75:90 kg N: P₂O₅: K₂O ha⁻¹, FYM @ 10 t ha⁻¹, Glyricidia @ 7.4 t ha⁻¹, Eupatorium @ 8.10 t ha⁻¹, DAT- Day after transplant

Table.3 Yield and yield attributes of paddy (*Oryza sativa* L.) as influenced by integrated nutrient management

Treatments	No. of productive tillers hill ⁻¹	Panicle length (cm)	Panicle weight (g hill ⁻¹)	Total no. of grains panicle ⁻¹	1000 grain weight (g)	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Harvest index
T₁- 100 % RDF	12.20	16.49	2.56	103	23.50	4952	6293	0.441
T₂- 100 % RDF + FYM	13.32	17.98	3.03	102	24.76	5159	6451	0.443
T₃- 100 % RDF + glyricidia equivalent to FYM	14.95	19.16	3.39	103	25.29	5354	6870	0.440
T₄- 100 % RDF + eupatorium equivalent to FYM	16.02	20.37	3.58	108	24.99	5527	7094	0.439
T₅- 100 % RDF + FYM + PGPR	17.72	21.22	3.95	121	25.80	5652	7295	0.436
T₆- 100 % RDF + glyricidia+ PGPR	16.40	20.58	3.81	118	25.15	5565	7144	0.439
T₇- 100 % RDF + eupatorium+ PGPR	13.68	18.82	3.22	116	24.83	5289	6807	0.435
T₈- 100 % RDF + PGPR	13.18	17.65	2.98	98	23.68	5130	6389	0.445
T₉- 100 % RDF + glyricidia (50%) + eupatorium (50%) + PGPR	18.41	22.29	4.13	128	25.36	5843	7477	0.438
T₁₀- 100 % RDF + glyricidia (50%) + eupatorium (50%)	13.39	18.66	3.15	106	24.97	5197	6573	0.442
S. Em±	1.19	1.02	0.26	4.24	0.92	203	284	0.013
CD (P=0.05)	3.55	3.03	0.78	13.00	NS	603	838	NS

Note: RDF @ 75:75:90 kg N: P₂O₅: K₂O ha⁻¹, FYM @ 10 t ha⁻¹, Glyricidia @ 7.4 t ha⁻¹, Eupatorium @ 8.10 t ha⁻¹, DAT- Day after transplanting

Yield and yield attributes

Influence of integrated nutrient management on yield and yield attributes at harvest is presented in Table-3. Among various treatments maximum number of productive tillers per hill (18.41), panicle length (22.29cm), panicle weight (4.13g hill⁻¹), total number of grains (128 panicle⁻¹), 1000 grain weight (25.36g), grain yield (5843kg ha⁻¹) and straw yield (7477 kg ha⁻¹) was recorded by the application of 100 per cent recommended dose of fertilizers + Glyricidia (50 %) + eupatorium (50 %) + PGPR(T₉), followed by 100 per cent recommended dose of fertilizers + FYM + PGPR(T₅). Higher yield and yield attributing parameters may be due to better carbon assimilation and accumulation of carbohydrates in the plant. However, maximum Harvest index was observed in T₈- 100 % RDF + PGPR followed by T₂- 100 % RDF + FYM.

Number of productive tillers increased with supplemental addition of N and K through green manures, which could be attributed to the influence of N on leaf development, tiller production and increasing leaf photosynthetic activity (Ntanson and Koutroubas, 2002). In RDF treatment, insufficient nutrients for filling of grains led to diminished grain number per panicle; thus, in this state, lower competition is the cause of decreased hallow grain percentage in panicle. The results were in accordance with the findings of Esfehani *et al.*, (2005) and (Ramachandra Prasad *et al.*, 2016).

Grain yield and straw yield of paddy was significantly influenced by the combined application of 100 per cent recommended dose of fertilizers, green manures and biofertilizers. Increase in 1000 grain weight, grain yield and straw with treatment T₉- RDF + glyricidia (50 %) + eupatorium (50 %) + PGPR followed by T₅-100 per cent RDF + FYM + PGPR.

This might be due to better nitrogen and chlorophyll content of plant at panicle emergence and grain filling period consequent to an increasing availability of nitrogen to rice crop maintained complimentary source-sink relationship. Thus the increase in growth and yield owing to the application of N-fertilizers may be due to nitrogen is an important constituents of nucleotides, proteins, chlorophyll and many enzymes, involved in various metabolic processes which have direct impact on vegetative and reproductive phases of plants. With increment of nitrogen fertilizer, grain yield increased relatively, but further increase in nitrogen level produced higher straw yield. These findings are supported by Indira (2005), (Thomas and Thomas, 2009). Ashley *et al.*, (2006), (Amit Kaul *et al.*, 2015) and (Glick, 2012).

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How to cite this article:

Shreeshail, M. Hanumanthappa and Ganapathi, M. 2020. Influence of Integrated Nutrient Management on Paddy (*Oryza sativa* l.) under Hill Zone of Karnataka. *Int.J.Curr.Microbiol.App.Sci*. 9(02): 2508-2515. doi: <https://doi.org/10.20546/ijcmas.2020.902.285>