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RESEARCH ARTICLE

Varietal performance of rice under different source of nutrition in high altitude and tribal areas of Andhra Pradesh

■ **A. Upendra Rao, K. Tejeswara Rao, D. Sekhar, V. Visa Lakshmi and N. Hari Satyanarayana**

SUMMARY

A field experiment was conducted for two consecutive *Kharif* seasons of 2012-13 and 2013-14 in a Split Plot Design with three replications, at Agricultural Research Station, Seethampeta, Andhra Prtadesh, India to generate scientific data on organic farming, integrated nutrient and pest management practices, chemical farming with four prominent varieties of rice *viz.,* MTU 1001, RGL 2538, BPT 5204 and MTU 7029 in high altitude and tribal areas of Andhra Pradesh. Results showed that, grain yield of rice was reduced in organic farming by 37 per cent and 30.23 per cent compared to chemical farming and INM practices. Growth, yield attributes of rice also reduced noticeably in organic farming. Whereas, organic farming recorded higher root biomass per hill at flowering, higher post nutrient status of available nitrogen, phosphorus and potassium and lesser incidence of diseases and pests over INM and chemical farming. Chemical farming recorded higher growth, yield attributes, yield and returns. Among the cultivars, MTU 1001 showed better performance and recorded the higher grain yield and straw yields and least affected by diseases and pests compared to other varieties.

Key Words : Rice, Organic farming, INM, Chemical farming, Varieties

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MEMBERS OF THE RESEARCH FORUM

Author to be contacted :
K. Tejeswara Rao, Agricultural Research Station (ANGRAU), **Seethampeta (A.P.) India**
Email : tejaseniorscientist@gmail.com

Address of the Co-authors:
A. Upendra Rao, V. Visa Lakshmi and N. Hari Satyanarayana, Agricultural Research Station (ANGRAU), **Seethampeta (A.P.) India**

D. Sekhar, Department of Agronomy, Regional Agricultural Research Station, Chintapalle, Visakhapatnam (A.P.)
(Email: sekhardesagiri@gmail.com

Hill and agency areas also not an exception for yield stagnation and reduced factor productivity in rice even with increased levels of chemical fertilizers due to cropping up of second generation problems related to green revolution. Sole dependency on chemical inputs proving un sustainable crop production and returns. Indiscriminate usage of exclusive mineral fertilizers leads to soil, water and air pollution and finally causing problems to health of human beings and animals. On the other hand organic farming making it's way

Table A : Nutrient composition of different organic manures used in the study

Organic manure	% N	% P	% K
FYM	0.81	0.42	0.49
Green leaf manure	2.24	0.49	1.78
Vermi compost	1.81	1.96	0.69

throughout the world including India due to the farmers movement, growing awareness among the consumers and promotion from the policy makers. "Organic method was self-sufficient and self-dependent as compared to modern chemical farming with principle of nutrient capturing and relying more on organic inputs is need of the hour" (Singh *et al.,* 2011). "Organic rice posse's better nutritional quality and fetches higher market price" (Saha *et al.,* 2007). However, organic farming too have some operational difficulties and appears expensive especially during initial years. yield levels also less during its inception in organic agriculture, lack of appropriate demand in local market, non-availability of premium price in the nearby markets, meagre support from the Governments, non-availability of suitable varieties which responds well to organic farming, lack of very effective non pesticidal plant protection are some of the lacunas in adopting organic farming especially staple food crop like rice. Integrated nutrient and pest management is the amalgamation of both organic and chemical farming is one of the good approach advocated across the globe including India. "Organic farmers need varieties that adopt well and yield better at low fertility levels with resistance to pest and diseases" (Reddy *et al.,*2004). Therefore, a field study was conducted to generate scientific data on organic farming, INM practices and chemical farming with prominent varieties of rice in high altitude and tribal areas of Andhra Pradesh.

MATERIAL AND METHODS

A field experiment was conducted for two consecutive *Kharif* seasons of 2012-13 and 2013-14, at Agricultural Research Station, Seethampeta, Andhra Prtadesh, India. The soil was sandy clay loam with 6.8 pH, 0.64 per cent, organic carbon, 292 kg ha^{-1} available nitrogen, 29.3 kg ha^{-1} available P_2O_5 and 327 kg ha^{-1} K_2O. The treatments consisted of three main plots organic farming, integrated nutrient and pest management and chemical farming; four sub-plots (predominant rice varieties of the zone *viz.,* MTU 1001, RGL 2538, BPT 5204 and MTU 7029. The field study was conducted in a Split Plot Design with three replications. 28 days old seedlings were transplanted at 20 cm x 15 cm spacing maintaining 2-3 seedlings per hill. Weeds were controlled by hand weeding twice at 20 and 40 days after transplanting. Organic manures were applied duly calculating their nutrient content and incorporated three weeks before planting as per the treatmental requirement NPK@80-60-50 kg per hectare was applied following standard protocol as per treatments. Organic farming received 80 kg N/ha through FYM, green leaf manuring (Glyricidia) and vermicompost. In INM treatment 20 kg N/ha through FYM and remaining 60 kg N/ha through chemical fertilizers. Organic farming plot received plant protection and cultural management practices throughout the period of crop growth with *Neem* oil and pseudomonas was utilized for pest and disease management. Data on growth, yield structure, yield, pest and diseases were collected following standard procedures from 10 hills earmarked at random. Root biomass was taken at flowering duly following standard procedure. Grain and straw yield recorded from the net plot was thoroughly sun dried to 14 per cent moisture content, weighed and expressed in kg ha^{-1}. Soil nutrient available status and organic carbon was estimated following the standard methodology. Gross returns, cost of cultivation and rupee per rupee invested were worked out treatment wise considering prevailing market price for different inputs and out puts. Data were analyzed using ANOVA and the significance was tested by Fisher's least significance difference ($p= 0.05$) by pooling two years data.

RESULTS AND DISCUSSION

Results of two years pooled experimental data revealed that, nutrient supply systems and varieties had exerted a noticeable influence on the tiller production, root biomass, dry matter accumulation, yield attributes and yield, however, the interaction was not significant between varieties and nutrient supply systems. Among the three nutrient supply systems organic farming recorded 32 per cent lesser number of tillers, 38 per cent lesser no. of panicles per square meter, 39 per cent lesser dry matter production at harvest. Grain yield was reduced in organic farming by 37 per cent and 30.23 per cent compared to chemical farming and INM practices. Whereas there were no measurable differences between integrated nutrient and pest management and chemical farming regards to number of tillers, panicles, filled grains per panicle and thousand grain weight and grain yield. Quick release of N as per the crop needs resulted in favourable growth and yield structure in chemical farming and integrated nutrient and pest management compared to organic farming. These results are in line

Table 1: Effect of nutrient supply and pest management packages and varieties on growth yield attributes and yields of rice

Treatments	Tillers m^{-2}	Root bio-mass g $hill^{-1}$	Panicles m^{-2}	Filled grains $panicle^{-1}$	Test weight (g)	DMPH (kg ha^{-1})	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Nutrient supply and pest management packages								
Organic farming	362	11.91	272	94	22.86	8989	3885	4885
INM and IPM practices	491	11.12	400	137	23.54	12692	5568	6753
Chemical farming	532	10.57	410	142	23.75	13215	5864	7157
S.E.±	17.9	0.41	12.72	5.53	0.82	435	168	194
C.D. (P=0.05)	49.5	1.13	35	15	NS	1203	466	537
Varieties								
MTU 1001	437	13.06	345	121	26.08	12095	5506	6531
RGL 2538	460	11.89	358	123	24.34	11709	5149	6492
BPT 5204	429	12.13	338	116	18.74	10732	4519	5853
MTU 7029	443	13.35	341	124	24.09	11493	5256	6269
S.E. ±	19.76	1.12	14.04	5.80	1.38	468	203	291
C.D.(P=0.05)	41.5	2.3	29	12	2.88	981	427	610
Interaction effect								
S.E.±	28.53	1.86	26.37	9.11	1.39	722	307	385
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

DMPH-Dry matter production at harvest NS= Non-significant

Table 2: Effect of nutrient supply and pest management packages and varieties on post harvest available nutrient status in soil and economics of rice

Treatments	Post harvest available nutrient status in soil (kg ha^{-1})				Gross returns (Rs. ha^{-1})	C C* (Rs. ha^{-1})	RRI (Rs. ha^{-1})
	% OC	N	P_2O_5	K_2O			
Nutrient supply and pest management packages							
Organic farming	0.68	323	32.03	351	53573	54375	-802
INM and IPM practices	0.64	313	30.61	338	76489	49600	26889
Chemical farming	0.62	310	29.55	333	80353	46550	33802
S.E.±	0.03	2.01	1.39	2.11	1715	1036	875
C.D. (P=0.05)	NS	5.52	3.85	5.88	4627	2814	2360
Varieties							
MTU 1001	0.65	310	29.69	330	75217	46975	28242
RGL 2538	0.63	312	30.16	341	70733	48460	22273
BPT 5204	0.66	317	31.39	346	66456	50200	16255
MTU 7029	0.67	322	31.75	346	72180	48963	23217
S.E.±	0.04	2.59	1.79	3.26	1605	1011	908
C.D. (P=0.05)	NS	5.29	3.71	6.72	3519	2217	1988
Interaction effect							
S.E.±	0.06	4.81	3.05	4.11	2987	1890	1217
C.D.(P=0.05)	NS	NS	NS	NS	NS	NS	NS

*CC- Cost of cultivation ; *RRI Rupee per rupee invested NS= Non-significant to (Yadav *et al.,* 2002) who reported “25.4 per cent yield reduction was recorded with organic farming treatments over 100 per cent RDF in *Kharif* rice after four years of experimentation”. Among the cultivars, MTU 1001 showed better performance and recorded the higher grain yield and straw yields as MTU 1001 has least affected by diseases and pests due to higher tolerance to diseases and pests compared to other varieties might be the reason for this higher yield. Performance of MTU 7029 and RGL 2538 were also impressive and at par to each other, however, these two varieties found superior to BPT 5204 which was susceptibility to pest and diseases among all the varieties tested.

Root biomass per hill at flowering was higher in Organic farming followed by INM compared to chemical farming. The higher root biomass with organic farming practices might be due to prevailing of improved physical properties. Similar findings on root growth with sources of nutrition in rice was also reported by Rao *et al.,* (2013a). Among the varieties the root biomass per hill at flowering was higher in MTU 1001 followed by MTU 7029 and it was lowest with BPT 5204. Dry matter accumulation at harvest was conspicuously higher with chemical farming followed by INM practices compared to organic farming. Among the cultivars, MTU 1001 followed by RGL 2538 produced maximum dry matter at harvest. Better root development, growth and yield structure might have resulted this higher biomass production.

Economic analysis of the study revealed that, gross returns and rupee per rupee invested were significantly higher with chemical farming followed by INM practices over organic farming. Lesser yield and higher cost of cultivation associated with organic farming is the reason for this. These findings are corroborating the findings of Rao *et al.* (2013a) on influence of nutrient management systems on economics of rice. Higher cost of production besides reduced yields lead to decreased returns from different exclusive organic farming treatments. Similar findings were also reported by Basavarajappa *et al.* (2007). Among the varieties gross returns and net returns were significantly higher with MTU 1001 followed by MTU 7029 over other varieties due to higher grain yield and lesser cost of cultivation in these cultivars. Among the varieties lesser returns were registered with BPT 5204 because of higher cost of production. Differential varietal performance with respect to nutrient management packages was reported previously by Rao *et al.* (2013b) in rice.

Post nutrient status of the study showed that, status of organic carbon, available nitrogen, phosphorus and potassium was higher with organic farming followed by INM practices over chemical farming. Slow and steady

Table 3: Effect of nutrient supply and pest management packages and varieties on pest and disease incidence in rice

Treatments	% Sheath blight incidence	% Blast incidence	Dead hearts m^{-2}	White ears m^{-2}	BPH $hill^{-1}$	% Leaf folder
Nutrient supply and pest management packages						
Organic farming	8.7	15.1	23.5	32	14	9.7
INM and IPM practices	12.6	18.8	21.9	44	27	22.8
Chemical farming	13.9	21.9	19.3	53	32	31.4
S.E.±	1.56	1.04	0.98	4.10	3.66	1.04
C.D.(P=0.05)	4.33	2.89	2.72	11.34	1.83	2.89
Varieties						
MTU 1001	9.1	10.7	18.2	39	09	10.2
RGL 2538	10.5	11.4	16.1	37	17	13.5
BPT 5204	16.5	25.1	31.2	52	39	19.1
MTU 7029	26.0	23.8	30.1	49	34	23.7
S.E.±	2.01	2.85	3.11	5.41	4.07	2.85
C.D.(P=0.05)	4.1	5.9	6.4	11.15	8.91	5.9
Interaction effect						
S.E.±	3.29	3.66	4.30	7.85	6.59	3.14
C.D.(P=0.05)	NS	NS	NS	NS	NS	NS

- *BPH –Brown plant hopper NS= Non-significant release of nutrients and lesser uptake of nutrients by the plants in Organic farming plots might be reason behind this is in agreement to the report of Rao *et al.* (2013a) on Post nutrient status with different nutrient management packages. Among the varieties tested MTU 7029 raised plots showed the maximum Post nutrient status of available nitrogen, phosphorus and potassium over other varieties. Lesser nutrient uptake by the culture MTU 7029 might have resulted the higher Post nutrient status compared to the other cultivars. Rao *et al.* (2013c) also found the variations in Post nutrient status with different cultivars.

Influence of different nutrient supply packages, and cultivars on disease incidence and pest infestation was conspicuous but, the interaction effect between nutrient supply systems and varieties was not traceable (Table 3). The per cent sheath blight, blast incidence, number of white ears m^{-2} and BPH /hill and per cent leaf folder incidence was conspicuously higher with chemical farming followed by INM practices and least with organic farming. Quick and excess amount of nutrient availability in chemical farming followed by INM practices might have increased the pest and disease incidence over organic farming, which releases the nutrients slowly and steadily. "Soils with a high functional diversity of microorganisms, which occur very often under organic agriculture practice, develop disease and insect suppressive properties and can help to induce resistance in plants" (File Bbach *et al.,*2007). This supports the findings of Kajimura *et al.* (1995) who noted "low densities of BPH and WBPH in organically cultivated fields and those with low N content. Among the varieties infestation of stem borer, BPH, leaf folder, per cent incidence of sheath blight and blast were noticeably lower in MTU 1001 followed by RGL 2538. The pest and disease incidence was conspicuously higher in BPT 5204 and MTU 7029. Differences in pest and disease resistance among different varieties might be the reason for this variation in incidence of pest and diseases among these varieties. Similar findings were reported by Ratnasudhakar *et al.* (2004).

Conclusion:

Grain yield of rice was reduced in organic farming by 37 per cent and 30.23 per cent compared to chemical farming and INM practices. Growth, yield attributes of rice also reduced noticeably in organic farming. Whereas organic farming recorded higher root biomass per hill at flowering, higher post nutrient status of available nitrogen, phosphorus and potassium and lesser incidence of diseases and pests over INM and chemical farming. Chemical farming recorded higher growth, yield attributes, yield and returns. Among the cultivars, MTU 1001 showed better performance and recorded the higher grain yield and straw yields and least affected by diseases and pests compared to other varieties.

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