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INTEGRATED NUTRIENT MANAGEMENT FOR OPTIMIZING POTASSIUM REQUIREMENT IN HYBRID RICE

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Abstract

An experiment was conducted for two years at College Farm, College of Agriculture, Rajendranagar, Hyderabad (Andhra Pradesh), India, during *kharif* 2009 and 2010 to study the effect of organic sources and fertilizer levels on yield and economic returns of hybrid rice. The experiment was laid out in split plot design with three replications. The treatments included organic sources (No organic manuring - control, subabul incorporation @ 5 t ha^{-1}, rice straw incorporation @ 2.5 t ha^{-1}) as main plot treatments and fertilizer levels comprising of N:K_2O kg ha^{-1} (150:75, 175:50, 175:25, 200:50, 200:25, 225:0) as sub plot treatments. The results revealed that among the organic sources, subabul incorporation @ 5 t ha^{-1} recorded the highest grain and straw yield while 200:50 N:K_2O kg ha^{-1} was the best fertilizer level in recording the maximum grain yield and straw yield during both the years of study. The interaction effect between organic sources and fertilizer levels was found significant on both grain yield and straw yield. Subabulincorporation @ 5 t ha^{-1}coupled with 200:50 N:K_2O kg ha^{-1} recorded the highest grain and straw yield and remained on par with subabul incorporation @ 5 t ha^{-1}coupled with 200:25 N:K_2O kg ha^{-1}. Economic analysis revealed that subabul incorporation @ 5 t ha^{-1} + 200:50 N:K_2O kg ha^{-1} recorded the highest gross returns while the highest net returns and benefit-cost ratio was obtained with subabul incorporation @ 5 t ha^{-1} + 200:25 N:K_2O kg ha^{-1} in both the years of study.

Key words : Economics, fertilizer levels, hybrid rice, subabul, yield.

Introduction

Rice (*Oryza sativa* L.) is one of the widely cultivated and consumer oriented crop in India grown in an area of 44.8 million ha with a production of 99.37 million tons and productivity of 2.2 t ha^{-1} (Anonymous, 2010). India has to produce around 140 million tons of rice by 2020 to meet the food grain requirement of burgeoning population (Kavitha *et al*., 2008). To meet the ever increasing demand, there is no scope for area expansion, therefore other ways and means to enhance the rice productivity have to be evolved. Exploitation of presently available high yielding varieties for increasing the production and productivity has attained a plateau. Further enhancement of yield potential of these high yielding varieties may not be possible under high input management conditions. Of late, hybrids are offering a good scope to improve the productivity and hence adoption of rice hybrids is gaining momentum in India. In several evaluation studies hybrids were reported to possess 15-20 per cent higher yield potential over the best high yielding varieties and the hybrids like KRH-2, DRRH-1, DRRH-2 and PHB-71 under good management conditions have got a yield potential of 7.0-9.0 t ha^{-1}. However, the yield potential of hybrid rice has not been fully realized due to higher percentage of sterility probably due to their higher nutrient demand mainly N, P and K to maximize their yield advantage. To realize the yield potential of these rice hybrids, yield maximization package has to be developed. The nutrient requirement of the crop is met either by the use of chemical fertilizers or through integrated nutrient management (INM) approach. Most of the INM practices were evolved by using organic manures based on N equivalent basis without due consideration to the supply of other two major nutrients and micronutrients. With regards to K, only chemical sources are being utilized and studies regarding optimization of K through organic sources are meager. Keeping this in view, the present study was conducted.

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Materials and Methods

An experiment was conducted for two years at College Farm, College of Agriculture, Rajendranagar,

Table 1 : Yield of transplanted hybrid rice as influenced by organicsources and fertilizer levels.

Treatment	Grain yield (kg ha^{-1})		Straw yield (kg ha^{-1})	
Organic sources	**2009**	**2010**	**2009**	**2010**
M_1- No organic manuring (control)	5623	5753	7731	7917
M_2- Subabul incorporation @ 5 t ha^{-1}	6012	6155	8352	8557
M_3- Rice straw incorporation @ 2.5 t ha^{-1}	5772	5908	7967	8162
S.Em+	44	51	53	61
CD (P=0.05)	123	142	146	169
Fertilizer levels (N:K_2O kg ha^{-1})				
F_1 - 150:75	5597	5730	7691	7880
F_2 - 175:50	5776	5907	7966	8154
F_3 - 175:25	5639	5760	7759	7932
F_4 - 200:50	6041	6190	8398	8611
F_5 - 200:25	5937	6083	8222	8431
F_6 - 225:0	5823	5963	8064	8265
S.Em+	42	39	41	39
CD (P=0.05)	85	81	85	80

Hyderabad (Andhra Pradesh), India; during *kharif* 2009 and 2010. The farm is geographically situated at an altitude of 542.6 m above the mean sea level on 17º 19' N latitude and 78º 23' E longitudes. The soil of the experimental site was sandy clay loam in texture, low in available nitrogen (242 kg ha^{-1}), medium in available phosphorus (39.4 kg ha^{-1}) and high in available potassium (368 kg ha^{-1}). The experiment was laid out in split plot design with three replications. The treatments consisted of organic sources (No organic manuring – ontrol, subabul incorporation @ 5 t ha^{-1}, rice straw incorporation @ 2.5 t ha^{-1}) as main plots and fertilizer levels comprising of N:K_2O kg ha^{-1} (150:75, 175:50, 175:25, 200:50, 200:25, 225:0) as sub-plots. A common dose of 75 kg P_2O_5 ha^{-1} was applied to all the plots. Measured quantities of subabul (*Leaucaena leucocephala*) twigs and rice straw were incorporated into the respective treatmental plot twelve days before transplanting. The % of N:P:K in subabul twigs was 3.90:0.39:2.2 and 3.84:0.40:2.3 in 2009 and 2010, respectively while in rice straw N:P:K was 0.54:0.16:1.6 and 0.51: 0.14:1.5 in 2009 and 2010, respectively. The entire dose of P_2O_5 and half dose of K_2O were applied basally while N was applied in three equal splits *i.e.* at transplanting, maximum tillering and at panicle initiation stage. The remaining K_2O was applied at flowering

Table 2: Effect of interaction between organic sources and fertilizer levels on grain yield (kg ha^{-1})of hybrid rice

Organic sources	Fertilizer levels (N:K_2O kg ha^{-1})					
	F_1 150:75	**F_2 175:50**	**F_3 175:25**	**F_4 200:50**	**F_5 200:25**	**F_6 225:0**
	2009					
M_1 - No organic manuring (control)	5520	5708	5365	5848	5680	5615
M_2 - Subabul incorporation @ 5 t ha^{-1}	5684	5907	5893	6289	6227	6074
M_3 - Rice straw incorporation @ 2.5 t ha^{-1}	5588	5712	5659	5987	5905	5781
	S.Em±		**CD (P=0.05)**			
F at same level of M	72		163			
M at same or different level of F	79		180			
2010						
M_1 - No organic manuring (control)	5650	5840	5480	5980	5820	5750
M_2 - Subabul incorporation @ 5 t ha^{-1}	5820	6040	6020	6450	6380	6220
M_3 - Rice straw incorporation @ 2.5 t ha^{-1}	5720	5840	5780	6140	6050	5920
	S.Em±		**CD (P=0.05)**			
F at same level of M	68		159			
M at same or different level of F	80		188			

Table 3 : Effect of interaction between organic sources and fertilizer levels on straw yield (kg ha^{-1}) of hybrid rice.

Organic sources	Fertilizer levels (N:K_2O kg ha^{-1})					
	F_1 150:75	F_2 175:50	F_3 175:25	F_4 200:50	F_5 200:25	F_6 225:0
	2009					
M_1 - No organic manuring (control)	7571	7845	7333	8104	7791	7739
M_2 - Subabul incorporation @ 5 t ha^{-1}	7843	8203	8181	8769	8671	8446
M_3 - Rice straw incorporation @ 2.5 t ha^{-1}	7660	7850	7761	8322	8203	8006
	S.Em±		CD (P=0.05)			
F at same level of M	72		167			
M at same or different level of F	84		196			
2010						
M_1 - No organic manuring (control)	7756	8034	7497	8294	7989	7932
M_2 –Subabul incorporation @ 5 t ha^{-1}	8038	8395	8364	8997	8891	8657
M_3 - Rice straw incorporation @ 2.5 t ha^{-1}	7847	8034	7934	8542	8411	8205
	S.Em±		CD (P=0.05)			
F at same level of M	68		162			
M at same or different level of F	87		208			

stage of the crop. Twenty five and twenty one days old seedlings of KRH-2 @ one seedling/hill were transplanted during 2009 and 2010, respectively. Spacing of 20 × 15cm was adopted for transplanting. Standard cultural practices were carried out from transplanting to maturity. Grain yield was recorded at moisture of 14% and straw yield after complete drying. The data were subjected to statistical analysis by applying analysis of variance for split plot design and significance was tested by F-test (Snedecor and Cochran, 1967) at 5% level of probability. Gross returns, net returns were worked out for different treatment combinations. Benefit-cost ratio was calculated by dividing the net returns by cost of cultivation.

Results and Discussion

Yield

The grain yield of hybrid rice was significantly influenced by organic sources and fertilizer levels. Among the organic sources, subabul incorporation @ 5 t ha^{-1} registered the highest grain yield (table 1). The increase in grain yield by the application of green leaf manure might be due to the continuous supply of phased release of mineral nutrients from green manure into the soil solution matching the required absorption rate of rice plant. Moola *et al*. (2011) and Rana Inayat *et al*. (2012) also reported significantly higher grain yield in rice with the incorporation of green manures when compared to control. As regards to the influence of different fertilizer levels on grain yield of hybrid rice, it was found that the fertilizer level F_4 (200:50 N:K_2O kg ha^{-1}) recorded maximum grain yield and was found significantly superior over the other fertilizer levels. Kumar (2009) also reported similar results. The interaction effect between organic sources and fertilizer levels was found significant on grain yield (table 2). Fertilizer levels F_2 and F_3 (nitrogen constant at 175 kg ha^{-1} and potassium at 50 and 25 kg ha^{-1}, respectively) gave on par grain yields under manurial treatments M_2 and M_3. Similarly, fertilizer levels F_4 and F_5 (nitrogen constant at 200 kg ha^{-1} and potassium at 50 and 25 kg ha^{-1}, respectively) gave on par yields indicating that incorporation of organic sources coupled with higher levels of nitrogen could help in reducing the level of potassium application. The highest grain yield was recorded by subabul incorporation @ 5 t ha^{-1} + 200:50 N:K_2O kg ha^{-1} and was comparable to subabul incorporation @ 5 t ha^{-1} + 200:25 N:K_2O kg ha^{-1}. M_3F_4 and M_3F_5 also remained on par indicating that the use of either subabul or rice straw could help in saving 25 kg K_2O kg ha^{-1}. The straw yield also followed the similar trend as that of grain yield in both the years of study (tables 1 and 3).

Economics

Economic evaluation revealed that the highest gross returns was registered by subabul incorporation @ 5 t ha^{-1} + 200:50 N:K_2O kg ha^{-1} in both the years of study

Table 4 : Gross returns, net returns and benefit-cost ratio as influenced by organic sources and fertilizer levels in hybrid rice.

Treatment	Gross returns (ha^{-1})	Net returns (ha^{-1})	Benefit-cost ratio (B:C)	Gross returns (ha^{-1})	Net returns (ha^{-1})	Benefit-cost ratio (B:C)
	2009			2010		
M_1F_1	58497	34517	1.44	62705	38625	1.60
M_1F_2	60502	37105	1.59	64827	41330	1.76
M_1F_3	56834	34290	1.52	60798	38154	1.68
M_1F_4	62039	38372	1.62	66435	42668	1.80
M_1F_5	60193	37379	1.64	64591	41667	1.82
M_1F_6	59534	37298	1.68	63846	41510	1.86
M_2F_1	60272	34492	1.34	64630	38750	1.50
M_2F_2	62679	37482	1.49	67116	41819	1.65
M_2F_3	62528	38184	1.57	66891	42447	1.74
M_2F_4	66761	41294	1.62	71698	46131	1.80
M_2F_5	66093	41504	1.69	70913	46199	1.87
M_2F_6	64460	40424	1.68	69126	44990	1.86
M_3F_1	59214	33234	1.28	63478	37398	1.43
M_3F_2	60544	35147	1.38	64827	39330	1.54
M_3F_3	59969	35425	1.44	64147	39503	1.60
M_3F_4	63534	37867	1.48	68234	42467	1.65
M_3F_5	62660	37846	1.53	67229	42315	1.70
M_3F_6	61324	37088	1.53	65764	41428	1.70

Paddy grain price : ₹ 9. 50 per kg. (2009) ₹ 10.00 per kg. (2010)
Paddy straw : ₹ 0.80 per kg. (2009 & 2010).

Main treatments:

M_1 : No organic manuring (control)
M_2 : Subabul incorporation @ 5 t ha^{-1}
M_3 : Rice straw incorporation @ 2.5 t ha^{-1}

Sub-treatments	N (kg ha^{-1})	K_2O (kg ha^{-1})
F_1	150	75
F_2	175	50
F_3	175	25
F_4	200	50
F_5	200	25
F_6	225	0

while the highest net returns and benefit-cost ratio was obtained with subabul incorporation @ 5 t ha^{-1} + 200:50 N:K_2O kg ha^{-1} (table 4).

Conclusion

On the basis of the results, it is inferred that incorporation of subabul @ 5 t ha^{-1} along with 200:25 N: K_2O kg ha^{-1} could help in reducing the application of 25 kg K_2O ha^{-1} in transplanted hybrid rice KRH-2 and obtaining maximum net returns and benefit-cost ratio.

References

Ali, Rana Inayat, Muhammad Nadeem Iqbal, Saleem Usman and Akhtar Muhammad (2012). Efficacy of various organic manures and chemical fertilizers to improve paddy yield and economic returns of rice under rice-wheat cropping sequence. *Intl. J. of Agric. and Appl. Sci.*, **4(2)** : 135-140.

Anonymous (2010). Centre for monitoring Indian Economy (CMIE). Apple Heritage, Mumbai. URL: http://www.CMIE.com/.

Kavitha, M. P., R. Balasubramanian, R. Babu and V. Paul and K. Pandi (2008). Nutrient uptake, yield and economics of hybrid rice as influenced by nitrogen and potassium management. *Crop. Res.*, **35(3)** : 176-179.

Kumar Santhosh, G. (2009). Performance of rice hybrids under varying fertility levels. *M.Sc.(Ag) Thesis*. Acharya N. G. Ranga Agricultural University, Hyderabad.

Ram, Moola, M. R. Davari and S. N. Sharma (2011). Effect of organic manures and biofertilizers on basmati rice (*Oryza sativa* L.) under organic farming of rice-wheat cropping system. *Intl. J. of Agric. and Crop Sci.*, **3(3)** : 76-84.

Snedecor, G. W and W. G. Cochran (1967). *Statistical Methods*. Oxford and IBH Publishing Company, Calcutta.