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Knowledge, Adoption and Economics of Integrated Nutrient Management (INM) in Rice of Vizianagaram District, Andhra Pradesh

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ABSTRACT

On-farm demonstrations of INM in paddy were carried out by DAATT Centre (District agriculture advisory and transfer of technology centre) in Vizianagaram district, Andhra Pradesh for balanced crop nutrition the crop pests, reducing the cost of production to farmers and ensuring quality produce to the consumers. INM verification trials were conducted under farmer's conditions as well as large scale implementation of INM through farmers' participatory approach at five villages in Vizianagaram district of Andhra Pradesh. Adoption of INM practices resulted in increase in rice yield from 5.22 to 6.18 tones/ha in Vizianagaram district during kharif, 2012-13 and 2013-14. The cost of chemical fertilizers under INM practices in paddy is reduced by 44.5% as compared to non- INM farmers' practice. The cost-benefit ratio of rice was 1: 2.41 in INM farmers as compared to 1 : 1.62 in Non-INM farmers. Knowledge and adoption of INM in paddy was studied in ten villages consisting of 6 INM farmers and 6 non- INM farmers in each village. Majority of INM practicing farmers (46.7%) had high extension contact and majority of non-INM farmers (40%) had low extension contact. High proportion of INM farmers (35.5%) having medium farm holding and majority of non-INM (40%) were marginal farmers. Forty eight per cent of the INM farmers possessed high knowledge level and remaining farmers possessed medium (37%) and low (15%) level knowledge regarding paddy INM practices. Whereas forty seven percent of non-INM farmers possessed medium level of knowledge followed by high (33%) and low (20%) level of knowledge on rice INM. Forty eight percent of INM farmers had high adoption level and thirty seven percent of INM farmers had medium adoption level. Thirty eight per cent of non-INM farmers had low adoption level of INM practices followed by medium level adoption (33%). The success of INM technology through demonstrations was found to be more suitable in increasing the knowledge and adoption level of the paddy farmers. Majority of INM farmers have a high knowledge on split application of N and K fertilizers, followed by 85% INM farmers have knowledge on zinc application and 82% on FYM application. However, low knowledge of INM farmers was associated with adopting a gap of 2 days between phosphatic fertilizers and zinc fertilizers. Highest adoption levels (91.67) was found in INM farmers with split application of N & K fertilizers followed by recommended dose of N fertilizers (75%). Non INM farmers registered highest knowledge levels (66.7%) on split application of N and K fertilizers followed by use of recommended dose of N fertilizers (75%). Highest adoption levels of non-INM farmers was associated with split application of N and K fertilizers and lowest adoption rates of 6.67% was associated with adopting soil test based fertilizer recommendations.

Key words: *Adoption, Economics, INM in Rice, Knowledge, soil testing.*

Nutrient management is an important functional component in rice production. Farmers presently nourish the rice crop by application of chemical fertilizers. Most farmers are risk averse and seem to have indiscrimination and un-rational towards the use of chemical fertilizers. However the farmers fail to control nutrient imbalances due to faulty and indiscriminate use of chemical fertilizers. Further, more indiscriminate use of chemical fertilizers increased production costs, caused soil and water pollution besides causing severe incidence of micronutrient disorders and pest problems. Kimetu *et al*., (2004) opined that that as long as agriculture remains a soil based industry, major increases in productivity are unlikely to be attained without ensuring that crop plants get an adequate and balanced supply of nutrients. Fertilizer is one of the costliest inputs in agriculture and the use of right amount through INM is fundamental for farm profitability and environmental protection. Indiscriminate use of fertilizers by the farmers without valid information on soil fertility status and nutrient requirement by crop causes adverse effects on soil and crop regarding both nutrient toxicity and deficiency either by overuse or inadequate use (Ray *et al*., 2000). Balanced fertilization of rice crop should be based on soil testing and integrated use of all the nutrient resources (Rajan Bhatt, 2013). In this context, integrated nutrient management (INM) through soil test based fertilizer management has emerged out as the prominent technology to combat nutrient imbalance in soil. In spite of all its advantages, the INM technology has not spread over to all farmers. Attempt to develop and use INM in rice crop aiming at balanced nutrition, reducing production costs and improving quality of produce to the consumers. The strategy includes soil

Table.1 Item wise analysis of knowledge and adoption of INM and non-INM farmers.

S. No	INM practices	Knowledge				Adoption			
		INM farmers (60)		Non-INM farmers (60)		INM farmers (60)		Non-INM farmers (60)	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1	Was the soil tested and got soil test report (soil health card)	43	71.67	21	35.00	22	36.67	13	21.67
2	Collection of soil sample by prescribed methodology and sending to soil test laboratories along with required information.	33	55.00	14	23.33	19	31.67	7	11.67
3	Application FYM @ 10 metric tons per hectare to improve soil physical and biological properties.	49	81.67	25	41.67	31	51.67	19	31.67
4	Growing green manure crops with summer showers and incorporating in soil 10-12 days before transplantation of rice	36	60.00	21	35.00	33	55.00	18	30.00
5	Using recommended dose of nitrogen fertilizer @ 100 kg ha^{-1}	47	78.33	32	53.33	45	75.00	26	43.33
6	Using recommended dose of phosphorous (P_2O_5) fertilizer @ 60 kg ha^{-1}.	42	70.00	25	41.67	40	66.67	22	36.67
7	Using recommended dose of potash (K_2O) fertilizer @ 40 kg ha^{-1}	42	70.00	19	31.67	39	65.00	15	25.00
8	Split application of N and K fertilizers.	57	95.00	40	66.67	55	91.67	40	66.67
9	Basal application of P fertilizers	33	55.00	19	31.67	19	31.67	7	11.67
10	Following soil test based fertilizer recommendations viz., when the soil test value is high reducing the dose of corresponding nutrient fertilizer to 75%, when the soil test value is low increasing the dose of corresponding nutrient fertilizer to 125%.	28	46.67	10	16.67	12	20.00	4	6.67
11	Proper water management for minimizing nutrient loss and improving fertilizer use efficiency and	40	66.67	25	41.67	21	35.00	10	16.67
12	Application of Zn fertilizer @ 50 kg $ZnSO_4$ as basal dose once in 3 crops	51	85.00	26	43.33	39	65.00	18	30.00
13	Maintaining a gap of 48 hours between application of P and Zn fertilizers to soil.	24	40.00	6	10.00	15	25.00	6	10.00

Table 1. cont....

S. No	INM practices	Knowledge				Adoption			
		INM farmers (60)		Non-INM farmers (60)		INM farmers (60)		Non-INM farmers (60)	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
14	Coating of urea with neem product to increase its efficiency.	36	60.00	12	20.00	18	30.00	6	10.00
15	Application of biofertilisers, Azospirillum and PSB @ 500g each per hectare mixing in 250 kg well rotten compost and application at 7-10 days after transplanting.	31	51.67	14	23.33	18	30.00	5	8.33
16	Following best management practices viz., pest and diseases for increased nutrient use efficiency.	44	73.33	31	51.67	40	66.67	21	35.00

test based nutrient management and integration of all the available nutrient sources *viz*., organic, chemical and biological sources of plant nutrients. Awareness on the collection of soil samples, understating and interpretation of soil test data and use of various nutrient sources including crop residues and bio fertilizers has been created by high profile campaign and regular field visits. These efforts evoked interest among farmers in adopting IPM practices. The success achieved in promoting Integrated nutrient management and soil test based fertilizer management is mainly due to awareness created and INM skills transferred to the farmers.

MATERIAL AND METHODS

The district agricultural advisory and transfer of technology centre in Vizianagaram district, Andhra Pradesh has conducted on farm trails for demonstration of integrated nutrient management through soil test based nutrient management in rice cultivation. DAATT centre has conducted a total of ten demonstrations in 10 villages covering 8 predominant rice growing mandals of the district. From each village ten INM farmers and non-INM farmers were selected randomly for the study. Data was collected from the sample of 120 farmers from 10 villages by personal interviews method using structured pre tested interview schedule.

Expost facto design was used to study the knowledge and adoption of INM practices by rice growing farmers. Knowledge was operationalised as the amount of information and understanding posses by the farmers on rice INM practices. Knowledge was tested against 16 items related to rice INM practices. Adoption was operationalised for the purpose of investigation as practicing the recommended package of practices. Selected profile characteristics- age, farming experience, farm size, extension contact, the extent of knowledge and level of adoption were measures by the schedule of question are developed for the study. Frequency and percentages were worked out to know the extent of adoption of each INM practice in paddy cultivation.

Components of INM in Rice demonstration:

1) Was the soil tested and got soil test report (soil health card)
2) Collection of soil sample by prescribed methodology and sending to soil test laboratories along with required information.
3) Application FYM @ 10 metric tons per hectare to improve soil physical and biological properties.
4) Growing green manure crops with summer showers and incorporating in soil 10-12 days before transplantation of rice
5) Using recommended dose of nitrogen fertilizer @ 100 kg ha^{-1}

Table 2. Distribution of respondents based on their profile characteristics.

S. No	Profile Characteristics	INM farmers (60)		Non INM farmers (60)	
		F	%	F	%
1	Age:				
	Young: 25- 36	20	33.33	18	30.00
	Middle : 37-50	25	41.67	26	43.33
	Old: 51-65	15	25.00	16	26.67
2	Farming experience:				
	Low : 3- 10 years	22	36.67	16	26.67
	Medium : 11- 22 years	20	33.33	23	38.33
	High : 23- 34 years	18	30.00	21	35.00
3	Farm size:				
	Marginal : up to 2.5 acres	17	28.33	24	40.00
	Small : 2.6 – 5.0	14	23.33	22	36.67
	Medium : 5.1 – 10.0	21	35.00	10	16.67
	Large : >10.0	8	13.33	4	6.67
4	Extension contact:				
	Low : 0- 10	13	21.67	24	40.00
	Medium: 11- 22	19	31.67	23	38.33
	High : 23 -34	28	46.67	13	21.67
5	Knowledge:				
	Low : 0-9	9	15.00	20	33.33
	Medium : 10- 18	22	36.67	28	46.67
	High : 19- 27	29	48.33	12	20.00
6	Adoption :				
	Low : 0-9	9	15.00	23	38.33
	Medium: 10- 18	22	36.67	20	33.33
	High: 19 -27	29	48.33	17	28.33

Table 3. Economics of Rice cultivation using INM and non-INM practices.

S. No	Particulars	INM practices	Non-INM practices
1	Productivity (t/ha)	6.18	5.22
2	Cost of chemical fertilizers (Rs./ha)	5250.00	9625.00
3	Cost of other operations (Rs./ha)	20150.00	22200.00
4	Total cost of cultivation (Rs./ha)	25400.00	31825.00
5	Gross returns (Rs./ha) for grain and straw	61180.00	51680.00
6	Net returns (Rs./ha)	35780.00	19825.00
7	Cost benefit ratio	01:02.4	01:01.6

6) Using recommended dose of phosphorous (P_2O_5) fertilizer @ 60 kg ha^{-1}.
7) Using recommended dose of potash (K_2O) fertilizer @ 40 kg ha^{-1}
8) Split application of N and K fertilizers
9) Basal application of P fertilizers.
10) Following soil test based fertilizer recommendations *viz*., when the soil test value is high reducing the dose of corresponding nutrient fertilizer to 75%, when the soil test value is low increasing the dose of corresponding nutrient fertilizer to 125%.
11) Proper water management for minimizing nutrient loss and improving fertilizer use efficiency and
12) Application of Zn fertilizer @ 50 kg $ZnSO_4$ as basal dose once in 3 crops
13) Maintaining a gap of 48 hours between application of P and Zn fertilizers to soil.
14) Coating of urea with neem product to increase its efficiency.

15) Application of bio fertilizers, Azospirillum and PSB @ 500g each per hectare mixing in 250 kg well rotten compost and application at 7-10 days after transplanting.
16) Following best management practices viz., pest and diseases for increased nutrient use efficiency.

RESULTS AND DISCUSSION

The findings on knowledge and adoption of INM practices in rice by farmers of vizianagarm district are presented in Table 1 &2. The knowledge levels of INM practicing farmers are in the following order of majority viz., split application of N and K fertilizers (95%) > application of Zn fertilizers @ 50 kg /ha once in three seasons (85%) > application of FYM @10t/ha > using recommended dose of N fertilizers (81.67%) > best crop management for high fertilizer use efficiency (73.3%)> soil testing (71.7%)> use of recommended dose of P and K fertilizers (70%)> proper water management like mid season drainage to minimize nutrient losses (66.7%)> growing green manure crops and incorporation in soil (60%)> coating of urea with neem products (60%)> collection of soil samples by prescribed methodology (55%)> basal application of P fertilizers (55%)> application of bio fertilizers (51.67)> following soil test based fertilizer recommendations (46.7%)> maintaining a gap of 2 days between application of P fertilizers and zinc fertilizers (40%). Highest adoption levels (91.67) was found in INM farmers with split application of N & K fertilizers followed by recommended dose of N fertilizers (75%). The lower level of adoption by INM practicing farmers was found with soil test based fertilizer recommendations(20%), coating of urea with neem products for increasing its use efficiency (30%), application of bio fertilizers (30%) and soil samples collection method (31.7%), basal application of P fertilizers (31.7%) and proper water management to minimize the nutrient losses (35%).

Critical examination of data in table 1 reveals that reasonably high knowledge levels of some of the core technologies of INM viz., soil testing (71.67%), following soil test based fertilizer recommendations (46.7%), application of bio fertilizers (51.67%) and coating of urea with neem products for its increased efficiency (60%) are known to farmers but they are not adopted, hence recorded low adoption levels. Therefore extension centres of Agricultural University, extension officers of department of agriculture should focus bringing these technologies within reach of farmers. These findings were in line with the finds of Praveen babu (2014) on knowledge and adoption levels of paddy farmers of East Godavari district.

Non- INM farmers registered highest knowledge levels (66.7%) on split application of N and K fertilizers followed by use of recommended dose of N fertilizers (75%). Lower knowledge levels among non- INM farmers was found with maintaining a gap of 2 days between application of P fertilizers and zinc fertilizers (10%), soil test based fertilizer recommendations (16.7%), coating of urea fertilizers with neem products (20%), application of bio fertilizers (23.3) and proper method of collection of soil sample (23.3). Hence there is need for conducting awareness campaigns on these important aspects. The adoption levels of non-INM farmers were relatively high in case of split application of N&K fertilizers (66.7%), recommended dose of N fertilizers (43.3). Since these practices do not involve much skill and cost and easy to follow. These findings were in line with those of Prasad (2002) and Venkateswarrao *et.al*., (2012) However, non-INM farmers have very low adoption levels in case of soil test based fertilizer use (6.7%), application of bio-fertilizers (8.3%), coating of urea for higher efficiency (10%), maintaining a gap of 2 days between application of P and Zn fertilizers (10%), collection of soil samples from field (11.7%). Therefore it is priority to organize field demonstrations, skill teachings by extension units to improve adoption levels. One of critical finding was that farmers are not adopting bio fertilizers application to rice crop due to it unavailability in the local markets, hence there is high need to establish bio fertilizer manufacturing units at agricultural subdivision level to made availability of the important and low cost input at farmers access.

Majority of INM practicing farmers (46.7%) had high extension contact and majority of non-INM farmers (40%) had low extension contact. Majority of INM farmers (35.5%) having medium farm holding and majority of non-INM (40%) were marginal farmers. Forty eight per cent of the INM farmers possessed high knowledge level and remaining farmers possessed medium (37%) and low (15%) level knowledge regarding paddy INM practices, whereas forty seven percent of non-INM farmers possessed medium level of knowledge followed by high (33%) and low (20%) level of knowledge on rice INM. Forty eight percent of INM farmers had high adoption level and thirty seven percent of INM farmers had medium adoption level. Thirty eight per cent of non-INM farmers had low adoption level of INM practices followed by medium level adoption (33%). Knowledge levels of majority of INM practicing farmers was in high level (48.33%), while 46.7% of non-IPM farmers knowledge was medium level. This is in conformity with the findings of Prasad (2002). With reference to adoption level of INM practices,

48.3% of INM farmers have high level adoption and 38% of non-INM farmers recorded low level adoption. The success of INM technology through demonstrations was found to be more suitable in increasing the knowledge and adoption level of the paddy farmers.

Adoption of INM practices resulted in increase in rice mean yield from 5.22 to 6.18 tones/ha in Vizianagaram district during kharif, 2012-13 and 2013-14. The cost of chemical fertilizers under INM practices in paddy is reduced by 44.5% as compared to non- INM farmer's practice. The cost benefit ratio in INM trials was 1 : 2.41 while, in non-INM farmers practice was 1 : 1.62. Hence there is need to plan needful extension strategies to increase awareness and skills of INM practices which not only reduce cost of cultivation but also ensures high cost benefit ratio.

CONCLUSION

Majority of INM practicing farmers (46.7%) had high extension contact and majority of non-INM farmers (40%) had low extension contact. Majority of INM farmers (35.5%) having medium farm holding and majority of non-INM (40%) were marginal farmers. Forty eight per cent of the INM farmers possessed high knowledge level and remaining farmers possessed medium (37%) and low (15%) level knowledge regarding paddy INM practices, whereas forty seven percent of non-INM farmers possessed medium level of knowledge followed by high (33%) and low (20%) level of knowledge on rice INM. Forty eight percent of INM farmers had high adoption level and thirty seven percent of INM farmers had medium adoption level. Thirty eight per cent of non-INM farmers had low adoption level of INM practices followed by medium level adoption (33%). Knowledge levels of majority of INM practicing farmers were in high level (48.33%). Although farmers possesses reasonably high knowledge levels of some of the core technologies of INM viz., soil testing (71.67%), following soil test based fertilizer recommendations (46.7%), application of biofertilisers (51.67%) and coating of urea with neem products for its increased efficiency (60%), but the farmers are not in access to those critical inputs and services for adoption, hence recorded low adoption levels. Therefore extension centers of Agricultural University, extension officers of department of agriculture should focus bringing these critical inputs and services within reach of farmers.

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