



Integrated Nutrient Management Studies in Rice

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Field experiments were conducted at Agricultural Research Station, Thirupathisaram during *kharif* and *rabi* 2011-12 to study the effect of integrated nutrient management (INM) in rice under rice-rice-pulse cropping system. Biometrics such as plant height, number of tillers hill⁻¹, number of panicles m⁻², number of grains panicle⁻¹, panicle length, grain yield and straw yield were recorded in both rice crops. Integrated Nutrient management significantly influenced the growth and yield. The treatment *Sesbania aculeata* @ 6.25 t ha⁻¹ + 120:48:48 kg NPK ha⁻¹ for short duration rice (ASD 16) and *Sesbania aculeata* @ 6.25 t ha⁻¹ + 150:50:50 kg NPK ha⁻¹ for medium duration rice (TPS 3) recorded relatively higher growth, yield and economics than other treatments.

Key words: Rice, *Sesbania aculeata*, NPK, Integrated nutrient management

In India rice is cultivated in an area of 44.1 million hectares with a production of 103.4 million tons (USDA, 2012), which plays a key role in food security. The country has to produce about 130 million tons of rice by 2025 to meet the food requirement of the growing population (Hugar *et al.*, 2009). Every year, huge amount of chemical fertilizers are applied to achieve maximum production in rice to meet the food requirement of our country. Due to the indiscriminate and injudicious use of chemical fertilizers, pesticides and aberrant weather conditions, the production and productivity of rice in India is facing a sustainability problem. Use of chemical fertilizers without addition of organic manures has created problems such as environmental pollution, health hazards, interruption of natural ecology, destruction of biological communities that support crop production, the depletion of soil organic carbon and mineral nutrients (Sheeja Raj *et al.*, 2013).

Continuous application of fertilizers at high doses may have adverse effects on crop yield besides affecting soil physical, chemical and biological properties. It was therefore considered important to initiate long term manurial experiment with a commonly practiced cropping sequence of the region, *i.e.*, rice-rice- pulse cropping system. The use of organic manures in combination with chemical fertilizers proved its significant long term consistent beneficial effect on soil properties and productivity. Thus, keeping in view the above consideration present investigation was undertaken to study the effect of integrated nutrient management in rice under rice-rice-pulse cropping system.

Materials and Methods

The field experiments were conducted during *kharif* and *rabi* 2011-12 at Agricultural Research Station, Thirupathisaram, Kanyakumari District. The experiment was laid out four treatments. According to plot size of each treatment, observation was made by dividing the whole plot area into 4-6 sub plots based on the number of rows, with forming binds. Each subplot was treated as replication. Based on variance the standard error for each treatment was worked out and compared. The treatments details of the experiment are furnished below.

T ₁ - Control	No manures/fertilizers
T ₂ - Organic manuring	<i>Sesbania aculeata</i> @ 6.25 t ha ⁻¹
T ₃ - Inorganic Fertilization	NPK @ 120:48:48 kg ha ⁻¹ for short duration rice (<i>kharif</i>) NPK @ 150:50:50 kg ha ⁻¹ for medium duration rice (<i>rabi</i>)
T ₄ - Integrated Nutrient Management	<i>Sesbania aculeata</i> @ 6.25 t ha ⁻¹ + NPK @ 120:48:48 kg ha ⁻¹ for short duration rice (<i>kharif</i>) <i>Sesbania aculeata</i> @ 6.25 t ha ⁻¹ + NPK @ 150:50:50 kg ha ⁻¹ for medium duration rice (<i>rabi</i>)

The variety ASD 16 and TPS 3 were used for *kharif* (June-Sep) and *rabi* (Oct-Mar) seasons of 2011-12, respectively. *Sesbania aculeata* @ 6.25 t ha⁻¹ was applied as a source of organic manure at the time of final ploughing. The recommended dose of NPK @ 120:48:48 kg ha⁻¹ for short duration rice ASD 16 and NPK @ 150:50:50 kg ha⁻¹ for medium duration rice TPS 3 was applied as inorganic sources in *kharif* and *rabi* seasons, respectively. Observations on growth characters, yield characters,

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grain yield and straw yield were recorded and economics was worked out.

Results and Discussion

Effect on crop growth

Data on growth attributes of rice viz., plant height and number of tillers hill⁻¹ of short duration rice ASD 16 and medium duration rice TPS 3 were significantly influenced by the treatments. Plant height varied from 89 to 102 cm and 90 to 103 cm and the number of tillers varied from 18 to 29 and 18

to 30 (Table 1). The maximum plant height (102 and 103 cm) and number of tillers hill⁻¹ (29 and 30) were recorded under integrated nutrient management followed by inorganic fertilizer and organic manure. This might be owing to efficient utilization of nutrients, which helped in better and vigorous vegetative growth under integrated nutrient management than inorganic and organic treatments (Yadhuvanshi, 2002). The lowest plant height (89 and 90 cm) and number of tillers hill⁻¹ (18 and 18) was noticed under control. Similar results were also reported by Aswan *et al.* (2000).

Table 1. Effect of integrated nutrient management on growth and yield characters of rice ASD 16 and TPS 3 (2011- 2012)

Treatment	Plant height (cm)		No. of tillers hill ⁻¹		No. of panicles m ⁻²		No. of grains Panicle ⁻¹		Panicle length (cm)	
	<i>kharif</i>	<i>rabi</i>	<i>kharif</i>	<i>rabi</i>	<i>kharif</i>	<i>rabi</i>	<i>kharif</i>	<i>rabi</i>	<i>kharif</i>	<i>rabi</i>
T1-Control	89	90	18	18	172	177	158	165	16	14
T2-Organic manure	93	95	22	21	194	194	180	194	19	19
T3-Inorganic manure	96	98	26	25	229	227	236	235	23	24
T4-INM	102	103	29	30	248	255	264	268	25	27
S.Ed	1.3	1	0.9	1.2	7	7	9	12	0.8	1
CD (P= 0.05)	2.6	2	1.9	2.4	16	14	19	25	1.6	2.2

Effect on yield attributes

The effect of organic and inorganic nutrients on yield attributes viz., number of panicles m⁻², number of grains panicle⁻¹ and panicle length were significantly influenced by the treatments during both the seasons (Table 1). The highest number of panicles m⁻² (248 and 255), number of grains panicle⁻¹ (264 and 268) and panicle length (25 and 27cm) were recorded under INM than inorganic and organic nutrients treatments. This was due to favourable influence of combined effect of *Sesbania aculeata* and recommended dose of N, P and K resulting in enhancing the maximum yield attributes produced on account of better availability and uptake

of nutrients. This results are in accordance with the findings of the Tabassam *et al.* (2002). The minimum number of panicles m⁻² (172 and 177), number of grains per panicle (158 and 165) and panicle length (16 and 14 cm) were recorded in control during both *kharif* and *rabi* seasons.

Yield and economics

Grain and straw yield of rice were significantly influenced by the application of organic manures and inorganic fertilizers (Table 2). Higher grain yield (6550 and 6225 kg ha⁻¹) and straw yield (6710 and 6850 kg ha⁻¹) were recorded with the combined application of *Sesbania aculeata* @ 6.25 t ha⁻¹ +

Table 2. Effect of integrated nutrient management on yield and economics of rice ASD 16 and TPS 3

Treatment	Grain yield (kg ha ⁻¹)		Straw yield (kg ha ⁻¹)		Cost of cultivation (Rs.ha ⁻¹)		Gross return (Rs.ha ⁻¹)		Net return (Rs.ha ⁻¹)		BC ratio	
	<i>kharif</i>	<i>rabi</i>	<i>kharif</i>	<i>rabi</i>	<i>kharif</i>	<i>rabi</i>	<i>kharif</i>	<i>rabi</i>	<i>kharif</i>	<i>rabi</i>	<i>kharif</i>	<i>rabi</i>
T1-Control	5100	5200	5250	5300	29250	29366	40950	41700	11700	12334	1.40	1.42
T2-Organic manure	5650	5725	5700	5860	31643	31248	45250	45935	13607	14687	1.43	1.47
T3-Inorganic manure	6150	6250	6340	6390	32848	31734	49930	50140	17082	18406	1.52	1.58
T4-INM	6550	6625	6710	6850	32850	31308	52560	53225	19710	21917	1.60	1.70
S.Ed	180	154	169	194								
CD (P= 0.05)	362	310	340	390								

NPK @ 120:48:48 kg ha⁻¹ for short duration rice ASD 16 and *Sesbania aculeata* @ 6.25 t ha⁻¹ + NPK @ 150:50:50 kg ha⁻¹ for medium duration rice TPS 3 during *kharif* and *rabi* seasons, respectively. This was due to the production of more number of panicles m⁻², grains per panicle and panicles weight. The increased efficiency of NPK fertilizers with green manuring may be due to chemical and enzymatic process, various growth and yield components of rice were positively affected, which contributed towards increase in grain and straw yield of rice (Shahzada *et al.*, 2011). Inorganic and organic

manure alone applied plots did not result in better grain and straw yield when compared to INM practice. The lowest grain yield (5100 and 5200 kg ha⁻¹) and straw yield (5250 and 5300 kg ha⁻¹) were recorded under no manured/no fertilizer applied plots. The grain and straw yield in control was found to be low in both rice ASD 16 and TPS 3, which might be due to insufficient nutrient supply to the plants due to non addition of fertilizers and manures (Elayarajan *et al.*, 2013). Integrated nutrient management proved to be the most profitable treatment in terms of the highest gross income

(Rs.52560 and 53225/ha), net income (Rs.19710 and 21917/ha) and benefit cost ratio (1.60 and 1.70) during *kharif* and *rabi*, respectively. This might be owing to the production of the highest grain yield, the gross and net returns were found maximum under INM practice. Higher gross returns were due to higher grain yield, consequently better return for rupee invested on cost of cultivation. The lower returns were fetched from no manure/no fertilizer applied plots, which was the result of lowest grain yield under this treatment.

It is concluded that combined application of *Sesbania aculeata* @ 6.25 t ha⁻¹+ NPK @ 120:48:48 kg ha⁻¹ for short duration rice ASD 16 and *Sesbania aculeata* @ 6.25 t ha⁻¹+ NPK @ 150:50:50 kg ha⁻¹ for medium duration rice TPS 3 during *kharif* and *rabi* seasons, respectively can be recommended as the best integrated nutrient management practice for higher yield and economics.

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