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Long Term Effect of INM on Yield and Nutrient Uptake of Rice-Rice Cropping System in North Konkan

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ABSTRACT

Present investigation is a part of long term experiment which was started in 1986-87 at Model Agronomic Experimental Farm, Regional Agricultural Research Station, Karjat, Dist. Raigad, Maharashtra (18.920 N latitude, 73.330 E longitude and 52.0 m altitude) on yield and uptake of nutrients in rice-rice cropping system. For present investigation 31thcycle rice crop was grown as 62th crop during kharif and 63th crop during Rabi-hot weather. Long term application of Integrated Nutrient Management (INM) increase grain yield (25.07, 22.87 to 57.52, 57.87q ha-1) and straw yield (30.65, 28.14 to68.36, 67.94q ha-1) in Kharifrice and Rabi-hot weather Rice respectively.

Higher rice grain yields were observed in T6 (receiving50 per cent RDF+ 50 per cent RDN through FYM to Kharif rice and 100 per cent RDF through inorganic fertilizers during Rabi), while least was obtained in control during both kharif season and Rabi season. The uptake pattern of nutrients in both of the rice variety (Palghr -1 during Kharif and KJT-3 in Rabi season) followed the same trend. Adoption of INM practices saved 50 per cent of recommended dose of nitrogen with incorporation of FYM as organic source of nutrient in rice-rice cropping system in long run.

KEYWORDS: *INM, Rice –Rice cropping system, INM in cropping system,NPK content, NPK uptake in rice.*

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1. INRODUCTION

Rice (Oryza sativa L.) is one of the most ancient crops being cultivated in 117 countries, hence called as "Global Grain". It is the staple cereal food grain of majority of India's over one billion population, contributes to nearly 44% of total food grain production. In India, it is grown over an area of 44.1 m.ha with a total production of 105 m t and productivity of 2393 kg/ha. India has to produce 114 m t of rice by the year 2030 to meet the food grain requirement of burgeoning population. But with the present day high yielding cultivars, which have higher nutrient requirements, the use of inorganic fertilizers has increased considerably leading to decline in the use of organic materials (Hossain and Singh, 2000) The impact of increased fertilizer use on crop production has been large, but ever increasing cost of energy is an important constraint for increased use of inorganic fertilizer (Alim, 2012).It is widely recognized that neither use of organic manures alone nor chemical fertilizers can achieve the sustainability of the yield under the modern intensive farming. Contrary to detrimental effects of inorganic fertilizers, organic manures are available indigenously which improve soil health resulting in enhanced crop yield. However, the use of organic manures alone might not meet the plant requirement due to presenceof relatively low levels of nutrients. Therefore, in order to make the soil well supplied with all the plant nutrients in the readily available form and to maintain good soil health, it is necessary to use organic manures in conjunction with inorganic fertilizers to obtain optimum yields (Ramalakshmi*et al.*, 2012). Results have also shown that integrated nutrients management increases the yield and nutrient uptake (Mohanty*et al.*, 2013). The crop residue and green manuring are also known to serve as a good source of organic manures. The information on the effect of all these organics in conjunction with inorganic fertilizer is limiting. Rice-rice is the predominant cropping sequence under the North Konkan command area. Hence, an experiment was conducted to study the effect of organic and inorganic sources of nutrient on yield and nutrient uptake of rice over longer period in rice-rice cropping system.

MATERIALS AND METHODS

A long term field experiment was conducted from 1986 to 2017 at at MAE Farm, Regional Agricultural Research Station, Karjat, Dist. Raigad (18.92^0 N latitude, 73.33^0 E longitude and 52.0 m MSL) under North Konkan command area to study the effect of integrated nutrient management on yield and nutrient uptake of rice over longer period in rice-rice cropping system. The experiment was laid out in a randomized block design with twelve treatments with different organic sources of nutrients (Treatment details are given in Table-1)with four replications. After harvest, the straw was weighed and treated as crop residue. The initial soil fertility levels were (pH - 6.40, EC - 0.13 dSm^{-1}, organic carbon 0.68 %, available Nitrogen 288.0 kg/ha, available phosphorus 12.3 kg/ha, available potash 211.4 kg/ha). The organic sources of nitrogen used were FYM (Farm yard manure), paddy straw and *Glyricidia* with nitrogen content of 0.5 per cent, 0.61 per cent and 2.74 per cent on dry weight basis respectively. Nutrient equivalent basis of organic sources to meet the required quantity of N were incorporated in the soil 15 days before transplanting of *kharif* paddy. Entire dose of P, K and 50 per cent of inorganic N were applied at the time of transplanting in the form of Single Super Phosphate, Muriate of Potash and Urea respectively. The remaining dose of nitrogenous fertilizer was top dressed in equal splits at tillering stage and flower initiation stagein the form of Urea. Rice variety *Palghr* -1 was grown as 62th during reported period of 2017 during *Kharif* and*KJT*-3 as 63th during reported period of 2017-2018 during *Rabi* season. The plant samples (grain and straw samples separately) of both the seasons were collected after the harvest of crop and analyzed for uptake of nitrogen, phosphorus and potassium content by following standard methods and plant uptake of nutrients was calibrated using grain and straw yields data. The experimental data recorded on various parameters were analyzed statistically following the analysis of variance procedure as described by Gomez and Gomez (1984).

Nutrient uptake

Nutrient uptake/removal in grain and straw of the crops were calculated in kg ha^{-1} in relation to yield ha^{-1} by using the following formula (Jackson, 1967)

Nutrient uptake (kg/ha) = Nutrient content (%) × yield (q/ha)

RESULTS AND DISCUSSION

Crop yields

During both the seasons (*Kharif* and *Rabi*-hot weather) application of organic and inorganic source of nutrients significantly increased grain yields of rice compared to untreated control. Application of 50 per cent RDF along with 50 per cent RDN through FYM (T_6) to 62 th*Kharif* rice crop (*Palghr* -1) and 63th*Rabi*-hot weather crop (*KJT*-3)(table-3) produced maximum and significantly higher grain (57.52,57.87 q ha^{-1}) and (68.36,67.94 q ha^{-1}) straw yield as compared to rest of the treatments except the treatments T_{10} (application of 50 per cent RDF through fertilizers and 50 per cent RDN substitution through GGLM) and T_5 where 100 per cent RDF (NPK) was applied through fertilizers. During both season minimum grain yield (25.07,22.87qha^{-1}) and straw yield (30.65,28.14qha^{-1}) were recorded respectively under control. The increase in yield was associated with application of inorganic fertilizers in combination with organic manures maybe due to its greater availability and uptake of macro and micro-nutrients and active participation in carbon assimilation, photosynthesis, starch formation, translocation of protein andsugar, entry of water into plants root and development etc. Italso enhances the process of tissue differentiation *i.e.,* from somatic to reproductive phase leading to higher grain andstraw yield. The results arealso in conformity with findings of Kumar and Singh (2006), Hossaen*et al*., (2011), Mohanty*et al*., (2013) and Prasad (1994).

Effect on content of nutrients (N, P and K) in rice plant

Effect of Nitrogen content (%)

The nitrogen content in grain and straw of *Palghar*-1 varied from 1.13 to 1.28, 0.44 to 0.51 per cent during *Kharif*season and *Karjat*-3 ranged from1.18 to 1.33, 0.15 to 0.19 per cent during *Rabi* season respectively (Table-4). The highest nitrogen content in grain(1.28 and 1.33 %) and straw (0.51 and 0.19 %) was recorded with treatment T_6*i.e.* (RDF: 50 + FYM: 50 N during *Kharif* and 100per centRDF during *Rabi*) during both the season which was at par with T_5, T_7, T_8, T_9, T_{10} and T_{11}. The ranges of nitrogen content in grain and straw are in agreement with Desai (2001),Parchure (2011) in rice.In general, this decline in nitrogen content could be accounted to the dilution effect caused by higher dry matter accumulation of nitrogen from straw and mobilization and accumulation of nitrogen from straw to grain at harvest. In grain, N content was found to be higher than the straw which may be due to translocation of photosynthate to sink *i.e.* grain (Mishra and Lal 1994). Similar results are in agreement with Bamugade (2007).

Effect of Phosphorus content (%)

The phosphorus concentration in grain and straw content varied from 0.20 to 0.24 per cent and 0.10 to 0.14 per cent during *Kharif* season and 0.23 to 0.27 per cent and 0.15 to 0.19 per cent during *Rabi* season respectively (Table-4).

At harvest stage the highest phosphorus content (0.24 and 0.27 %) in grain and (0.14 and 0.19%) in straw was contributed by T_6whichwas significantly higher over rest of the treatments during both season and at par with all treatment except T_1 (control) and T_{12} (Farmers practice). The ranges of phosphorus content in grain are in agreement with those reported by Desai (2001), Gavanang (2000). In soils of Konkan, Jagtap (2007) observed positive effect of application of chemical fertilizer alone as well as in combination with organic manures also with respect to phosphorus content in rice. The reasons attributed to this are more supply of phosphorus from organic sources such as FYM, glyricidia green leaf manuringand rice straw with inorganic sources of phosphorus and due to enhanced availability of phosphorus as a result of reduction in P fixation capacity of soil. These observations corroborate with those reported by Jambhekar (1990).

Effect of potassium content (%)

The potassium concentration in grain and straw content varied from 0.33 to 0.38 per cent and 1.15 to 1.36 per cent during *Kharif* season and 0.36 to 0.42 per cent and 1.24 to 1.45 per cent during *Rabi* season respectively(Table 4).

The highest potassium content (0.38 and 0.42 %) in grain and (1.36and 1.45 %) in straw was contributed by T_6 which was significantly highest over rest of the treatments during both season of experiment and at par with treatment T_5, T_7, T_8, T_9, T_{10}, and T_{11}exceptT_9 during *Rabi* season. The ranges of potassium content in grain are in agreement with those reported by Parchure (2011). Singh *et al.* (2002) studied effect of green manuring and FYM on nutrient content of upland rice, they reported that green manure and FYM @ 5 t ha^{-1} are mineralized rapidly and maintain adequate potassium and supplied K from K bearing minerals by the organic acids and increased its content in plants. These findings are corroborative to the observations made by Kapure (2003) and Pillai (2004).

Effect on N, P and K uptake by rice

Effect of nitrogen uptake

Effect of inorganic fertilizers alone and combined application of organic manures and inorganic fertilizers on changes in nitrogen uptake at harvest stage during both season represented in table 5,table 6 and table7.

Amount of NPK uptake by crops as influenced by different organic and inorganic sources of nutrient represented in table 5,table 6 and table7.The maximum and significantly higher uptake of nitrogen in the grain, straw and their total value was obtained from the treatment T_6which was significantly higher over rest of the treatments during both season and at par with treatment T_5,$T_8$and T_{10}except T_8 in *Kharif* season. Singh *et al.*(2002)studied effect of green manuring and FYM on nitrogen uptake by upland rice and reported that the highest total nitrogen uptake was recorded due to application of green manuring and FYM .The increase in uptake of nutrients in the organic manure treated plots may be due to additional amount of nutrients supplied by these organic and providing conductive physical environment which helps in better root growth and absorption of nutrients from native as well as applied sources which favours highest nutrient uptake (Bhardwaj*et al.* 1994).

Effect of different treatment on phosphorus uptake

Effect of inorganic fertilizers alone and combined application of organic manures and inorganic fertilizers on changes in phosphorus uptake at harvest stage during both season represented in table 5,table 6 and table7.

P uptake by grain, straw and Total P uptake by the plant increased due to treatment T_6 which was significantly higher and on par with treatments T_5 and T_{10}during both season and T_8 during *Rabi* season over rest of the all treatments during both season. Surekha*et al.* (1999) found that anion nutrients like H_2PO_4 are co-transported with NH_4^+cation nutrients during nutrient absorption process. When NH_4^+ is absorbed by rice roots, counter release of protons (H^+) takes place to balance the charge. Effect of organic manures with chemical fertilizer was significantly higher in increasing phosphorus uptake (Jagtap 2007). Talukdar and Chakravarty (1988) and Gavanang (2000)also reported significant increase in total P uptake by rice with application of NPK fertilizers.

Effect on potassium uptake

Effect of inorganic fertilizers alone and combined application of organic manures and inorganic fertilizers on changes in potassium uptake at harvest stage during both season represented in table 5,table 6 and table7.

Total K uptake by the plant increased due to treatment T_6, which was significantly higher over rest of the treatments and at par with treatment T_5 and T_{10}during both season. In case of Grain and straw K uptake the treatment T_8 during *Rabi* season was at par with treatment T_6.Kalhapure*et al.* (2013) reported that in case of maize highest uptake of N, P_2O_5 and K_2O was observed in application of 25% RDF+ biofertilizers (*Azotobacter*+PSB)+ green manuring with sunhemp + compost. This might be due to the combined effect of rapid release of nutrients by decomposition of green manuring crop and compost and also due to the increased availability of N and P_2O_5 which added in the soil through organic and inorganic resources by *Azotobacter* and phosphate solubilizing bacteria.

Dwivedi *et al.* (2016) revealed that application of 5 t FYM ha^{-1}integrated with 50% NP + 100% K dose and biofertilizers recorded significantly higher values of nitrogen, phosphorus and potassium uptake. The increased uptake may be attributed to solubility action of organic acids produced during degradation of FYM resulting in more release of N, P, K and also to contribution by this manure.

CONCLUSION

Application of nutrient through combined sources of organic and inorganic fertilizer invariably improved the plant content and uptake of N, P and K. Inclusion of organic nutrients from varied sources viz., FYM, Glyricidia green manure and paddy straw etc can be seen as a supplemental alternative to enhance the fertility basket which will ensure higher productivity and profitability to farmers.

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Table1: Treatments Details

Tr. No	KharifRice	Tr. No.	Rabi Rice
T_1	No fertilizers, no organic manures	T_1	No fertilizers, no organic manures
T_2	50% recommended NPK dose through fertilizers	T_2	50% recommended NPK dose through fertilizers.
T_3	50% recommended NPK dose through fertilizers.	T_3	100% recommended NPK dose through fertilizers.
T_4	75% recommended NPK dose through fertilizers	T_4	75% recommended NPK dose through fertilizers
T_5	100% recommended NPK dose through fertilizers	T_5	100 % recommended NPK dose through fertilizers
T_6	50% recommended NPK dose through fertilizers + 50% N through FYM	T_6	100% recommended NPK dose through fertilizers
T_7	75 % recommended NPK dose through fertilizers + 25 % NPK through FYM	T_7	75% recommended NPK dose through fertilizers
T_8	50 % recommended NPK dose through fertilizers + 50 % N through rice straw	T_8	100% recommended NPK dose through fertilizers
T_9	75 % recommended NPK dose through fertilizers + 25 % N through rice	T_9	75% recommended NPK dose through fertilizers
T_{10}	50% recommended NPK dose +50% N through *Glyricidia* green leaf manure (GGLM)	T_{10}	100% recommended NPK dose through fertilizers
T_{11}	75 % recommended NPK dose through fertilizers + 25 % N through GGLM	T_{11}	75% recommended NPK dose through fertilizers
T_{12}	Farmer's practice (45:45:45 NPK kg ha^{-1})	T_{12}	Farmer's practice (90:45:45 NPK kg ha^{-1})

Table2. Nutrient composition of various organic manures and inorganic fertilizers in the study

Sr. No.	Name of fertilizer	Composition (%)		
		N	P_2O_5	K_2O
1.	Urea	46.0	-	-
2.	Single super phosphate	-	16.0	-
3.	Muriate of potash	-	-	60.0
4.	FYM	0.50	0.25	0.50
5.	*Glyricidia*green *leaf* manures	2.74	0.50	1.15
6	Rice straw	0.61	0.16	1.14

Table3: Long term effect of application of manures and fertilizers on grain yield and straw yield of medium black soil after thirty one years

Treatments	Grain yield (q ha^{-1})		Straw yield (q ha^{-1})	
	Kharif 2017	Rabi 2017-18	Kharif 2017	Rabi 2017-18
T_1= UTC:0 -0	25.07	22.87	30.65	28.14
T_2= RDF:50 - 50	43.25	40.59	51.49	48.01
T_3= RDF:50 - 100	51.80	53.66	60.77	62.29
T_4= RDF:75 - 75	51.89	50.39	60.78	56.32
T_5= RDF:100 - 100	56.79	56.98	67.60	65.19
T_6= RDF:50+FYM:50N –100	57.52	57.87	68.36	67.94
T_7= RDF:75+FYM:25N – 75	54.54	50.70	63.88	56.65
T_8= RDF:50+RS:50N – 100	52.36	55.31	61.46	63.40
T_9= RDF:75+RS:25N – 75	52.06	49.75	61.30	56.15
T_{10}= RDF:50+GGLM:50N -100	56.93	57.38	67.68	66.29
T_{11}= RDF:75+GGLM:25N- 75	53.61	49.76	63.69	56.59
T_{12}=FP 45+45+45 - 90+45+45	41.33	38.56	49.65	45.44
S.E. (m) ±	0.78	1.39	1.13	1.50
C.D. at 5 %	2.45	4.38	3.57	4.74

Table4: Effect of different treatments on changes in percent N, P and K content of *Kharif* rice and *Rabi* rice

Treatments	N content (%)				P content (%)				K content (%)			
	Kharif		Rabi		Kharif		Rabi		Kharif		Rabi	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T_1= UTC:0 -0	1.13	0.44	1.18	0.15	0.20	0.10	0.23	0.15	0.33	1.15	0.36	1.24
T_2= RDF:50 - 50	1.19	0.47	1.25	0.17	0.22	0.12	0.25	0.17	0.35	1.28	0.38	1.37
T_3= RDF:50 - 100	1.20	0.48	1.26	0.17	0.22	0.12	0.25	0.17	0.35	1.29	0.38	1.38
T_4= RDF:75 - 75	1.22	0.49	1.27	0.17	0.22	0.12	0.25	0.17	0.35	1.30	0.39	1.39
T_5= RDF:100 - 100	1.26	0.50	1.32	0.18	0.23	0.13	0.26	0.18	0.37	1.34	0.40	1.44
T_6= RDF:50+FYM:50N – 100	1.28	0.51	1.33	0.19	0.24	0.14	0.27	0.19	0.38	1.36	0.42	1.45
T_7= RDF:75+FYM:25N – 75	1.25	0.49	1.30	0.18	0.23	0.12	0.26	0.18	0.37	1.33	0.40	1.42
T_8= RDF:50+RS:50N – 100	1.26	0.50	1.31	0.18	0.23	0.13	0.26	0.18	0.37	1.34	0.41	1.43
T_9= RDF:75+RS:25N – 75	1.23	0.47	1.28	0.17	0.22	0.12	0.25	0.17	0.36	1.31	0.39	1.40
T_{10}= RDF:50+GGLM:50N – 100	1.26	0.51	1.32	0.18	0.23	0.13	0.26	0.18	0.38	1.35	0.41	1.44
T_{11}= RDF:75+GGLM:25N- 75	1.23	0.48	1.29	0.17	0.22	0.12	0.25	0.17	0.36	1.31	0.40	1.41
T_{12}= FP:45+45+45 - 90+45+45	1.17	0.46	1.23	0.16	0.21	0.11	0.24	0.16	0.34	1.22	0.38	1.30
S.E. ±	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01
C.D. at 5 %	0.04	0.02	0.05	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.04

Table5 : Effect of different treatments on N, P and K uptake by *Kharif*rice

Treatments	N Uptake (Kg ha-1)			P Uptake (Kg ha-1)			K Uptake (Kg ha-1)		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T_1= UTC:0 -0	28.26	13.62	41.88	5.10	3.11	8.22	8.19	35.28	43.47
T_2= RDF:50 - 50	51.45	23.95	75.41	9.30	5.99	15.30	15.06	65.67	80.73
T_3= RDF:50 - 100	62.40	29.13	91.53	11.21	7.06	18.27	18.14	78.41	96.55
T_4= RDF:75 - 75	63.20	29.56	92.76	11.37	7.34	18.71	18.20	78.92	97.12
T_5= RDF:100 - 100	71.77	34.08	105.85	13.09	8.46	21.55	21.06	90.64	111.71
T_6= RDF:50+FYM:50N - 100	73.88	35.18	109.06	13.56	9.25	22.81	21.82	92.63	114.45
T_7= RDF:75+FYM:25N – 75	67.95	31.07	99.02	12.44	7.93	20.37	20.02	84.69	104.70
T_8= RDF:50+RS:50N – 100	65.81	30.75	96.56	12.08	7.71	19.79	19.48	82.20	101.68
T_9= RDF:75+RS:25N – 75	63.92	28.99	92.91	11.56	7.50	19.06	18.66	80.39	99.05
T_{10}= RDF:50+GGLM:50N – 100	71.94	34.34	106.29	13.35	8.59	21.93	21.46	91.19	112.65
T_{11}= RDF:75+GGLM:25N- 75	66.06	30.53	96.59	12.01	7.83	19.84	19.38	83.65	103.03
T_{12}= FP:45+45+45 - 90+45+45	48.32	22.94	71.26	8.55	5.50	14.04	13.86	60.70	74.56
S.E. ±	0.96	0.71	1.41	0.34	0.34	0.62	0.41	1.61	1.75
C.D. at 5 %	3.03	2.23	4.45	1.06	1.08	1.95	1.29	5.06	5.51

Table6: Effect of different treatments on N, P and K uptake by *Rabi* rice

Treatments	N Uptake (Kg ha-1)			P Uptake (Kg ha-1)			K Uptake (Kg ha-1)		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T_1= UTC:0 -0	26.94	13.39	40.34	5.34	4.32	9.66	8.22	34.88	43.10
T_2= RDF:50 - 50	50.55	24.16	74.71	9.95	7.94	17.89	15.45	65.80	81.26
T_3= RDF:50 - 100	67.62	32.05	99.68	13.20	10.34	23.54	20.54	86.24	106.77
T_4= RDF:75 - 75	63.94	29.75	93.69	12.56	9.54	22.10	19.50	78.47	97.97
T_5= RDF:100 - 100	75.20	35.59	110.79	14.83	11.77	26.60	23.04	93.83	116.87
T_6= RDF:50+FYM:50N - 100	76.99	37.81	114.80	15.39	12.64	28.02	24.25	98.52	122.76
T_7= RDF:75+FYM:25N – 75	66.01	29.95	95.96	13.07	10.07	23.14	20.37	80.45	100.82
T_8= RDF:50+RS:50N – 100	72.42	34.41	106.83	14.44	11.48	25.92	22.50	90.72	113.22
T_9= RDF:75+RS:25N – 75	63.62	28.92	92.54	12.54	9.66	22.20	19.43	78.70	98.13
T_{10}= RDF:50+GGLM:50N – 100	75.62	36.44	112.06	15.16	12.22	27.38	23.71	95.37	119.08
T_{11}= RDF:75+GGLM:25N- 75	64.32	29.51	93.83	12.67	9.87	22.54	19.73	79.61	99.34
T_{12}= FP:45+45+45 - 90+45+45	47.25	22.42	69.67	9.14	7.13	16.27	14.52	59.02	73.54
S.E. ±	1.89	0.91	2.65	0.49	0.47	0.94	0.63	2.01	2.57
C.D. at 5 %	5.95	2.86	8.35	1.53	1.48	2.97	2.00	6.34	8.10

Table7: Effect of different treatments on total N, P and K uptake of rice-rice system

Treatments	N Uptake (Kg ha-1)			P Uptake (Kg ha-1)			K Uptake (Kg ha-1)		
	Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
T_1= UTC:0 -0	41.88	40.34	82.22	8.22	9.66	17.88	43.47	43.10	86.57
T_2= RDF:50 - 50	75.41	74.71	150.12	15.30	17.89	33.19	80.73	81.26	161.98
T_3= RDF:50 - 100	91.53	99.68	191.21	18.27	23.54	41.81	96.55	106.77	203.32
T_4= RDF:75 - 75	92.76	93.69	186.45	18.71	22.10	40.81	97.12	97.97	195.09
T_5= RDF:100 - 100	105.85	110.79	216.65	21.55	26.60	48.15	111.71	116.87	228.58
T_6= RDF:50+FYM:50N - 100	109.06	114.80	223.86	22.81	28.02	50.83	114.45	122.76	237.21
T_7= RDF:75+FYM:25N – 75	99.02	95.96	194.98	20.37	23.14	43.51	104.70	100.82	205.52
T_8= RDF:50+RS:50N – 100	96.56	106.83	203.40	19.79	25.92	45.71	101.68	113.22	214.90
T_9= RDF:75+RS:25N – 75	92.91	92.54	185.45	19.06	22.20	41.25	99.05	98.13	197.18
T_{10}= RDF:50+GGLM:50N – 100	106.29	112.06	218.34	21.93	27.38	49.31	112.65	119.08	231.73
T_{11}= RDF:75+GGLM:25N- 75	96.59	93.83	190.42	19.84	22.54	42.37	103.03	99.34	202.37
T_{12}= FP:45+45+45 - 90+45+45	71.26	69.67	140.93	14.04	16.27	30.31	74.56	73.54	148.10
S.E. ±	1.41	2.65	3.01	0.62	0.94	1.43	1.75	2.57	2.93
C.D. at 5 %	4.45	8.35	9.50	1.95	2.97	4.51	5.51	8.10	9.25