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Nutrient Uptake and Economics of Field Bean as Influenced by Farmyard Manure and Bio-Digester Liquid Manure

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ABSTRACT

Field experiments were conducted from 2010 to 2012 at Zonal Agricultural Research Station, Mandya to study the nutrient uptake and economics of field bean as influenced by farmyard manure and bio-digester liquid manure. Soil was red sandy loam in texture, low in organic carbon (0.38%) and available nitrogen (215.5 kg ha^{-1}), medium in available P_2O_5 (26.2 kg ha^{-1}) and K_2O (162.3 kg ha^{-1}). The experiment was laid out using Randomized Complete Block Design with three replications and treatment consisted of three levels of FYM (5.0, 7.5 and 10 t ha^{-1}) and four levels of bio-digester liquid manure equivalent (BDLME) to 20, 25, 30 and 35 kg N ha^{-1} and compared with recommended practice (FYM 7.5 t + 25:50:25 kg N:P_2O_5:K_2O ha^{-1}) and control. Significantly higher total nitrogen, P_2O_5 and K_2O (92.3, 15.45 and 83.8 kg ha^{-1}, respectively) were taken up by the crop when applied with FYM 10 t + BDLME to 35 kg N ha^{-1} which was on par with FYM 10 t + BDLME to 30 kg N ha^{-1} (91.0, 15.22 and 82.6 N, P_2O_5 and K_2O kg ha^{-1}, respectively) and recommended practice (96.0, 15.96 and 86.1). Higher net returns and B:C ratio (Rs 12,625 ha^{-1} and 1.78 respectively) were obtained with FYM 10 t + BDLME to 35 kg N ha^{-1} followed by FYM 10 t + BDLME to 30 kg N ha^{-1} (Rs 12,397 ha^{-1} and 1.80, respectively).

Keywords Bio-digester liquid, Economics, Farm yard manure, Field bean, Uptake.

INTRODUCTION

Bio-digester is a low cost technology for the production of organic liquid manure using on farm organic crop wastes, animal wastes, green manures and weeds. It replaced the inorganic fertilizers and boosted the organic crop yields in some crops. The organic farming reduces pollutants and ensures soil sustainability by keeping a high level of organic matter in the soil. Field bean (*Dolichos lablab* L.) is one of the most ancient crops among cultivated plants and is a multifunctional crop that can be used for pulses, vegetables, and pasture. It is one of the most important sources of protein (20–28% in southern India) and is primarily restricted to the peninsular region of India. Karnataka state produces 18,000 tons of field bean from an area of 85,000 hectares, accounting for roughly 90% of the country's total area

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and production (Anon 2012). Now a day, the agricultural research is focused on developing technologies that are ecologically sound, biologically sustainable, and socio-economically viable. It's time to take a new look at organic farming methods that use local manurial and bio-pesticide sources to grow organic crops. With this background, an investigation was carried out to assess the impact of farmyard manure and bio-digester liquid manure on nutrient uptake and economics of field bean.

MATERIALS AND METHODS

Field experiments were conducted during *rabi* 2010 and 2011 at Zonal Agricultural Research Station, Mandya of the University of Agricultural Sciences, Bangalore. The experimental site is situated between 11°30' to 13°05' North latitude and 76°05' to 77°45' East longitude and an altitude of 695 meters above mean sea level. Soil of the experimental site was red sandy loam in texture, low in organic carbon (0.38 %) and available nitrogen (215.5 kg ha^{-1}), medium in available P_2O_5 (26.2 kg ha^{-1}) and K_2O (162.3 kg ha^{-1}). The treatments consisted of three levels of FYM (5.0, 7.5 and 10.0 t ha^{-1}) and four levels of bio-digester liquid manure equivalent (BDLME) to 20, 25, 30 and 35 kg N ha^{-1} and compared with recommended practice (FYM 7.5 t + 25:50:25 N:P_2O_5:K_2O kg ha^{-1}) and control. It was laid out in Randomized Complete Block Design with three replications. Hebbal Avare 4 variety was used for experimentation. Well decomposed farmyard manure was analyzed for its nutrient composition and applied as per the treatment specifications two weeks before sowing of the crop and mixed thoroughly with soil. Bio-digester liquid manure was analyzed for nitrogen a day before application and required quantity for different treatments was estimated based on N content and then applied by opening furrows near to the crop rows and later on covered with soil to avoid evaporation loss. Total quantity of nitrogen of different treatments was top dressed through BDLM in two splits at 20 and 40 days after sowing. The plant samples used for recording dry matter production at harvest were used for analyzing nutrients present in the plant. After recording the dry weight from each treatment the samples were powdered in a micro Willey mill. The samples were analyzed for concentration (%) of different macronutrients (N, P_2O_5 and K_2O) present in aerobic rice plant parts. Nitrogen content of grain and straw was estimated by modified micro-Kjeldhal's method as outlined by Jackson (1967) and expressed in percentage. Nitrogen uptake (kg ha^{-1}) by crop was calculated for each treatment separately using the following formula.

$$\text{Nitrogen uptake (kg ha}^{-1}\text{)} = \frac{\text{Nitrogen concentration (\%)}}{100} \times \text{Biomass (kg ha}^{-1}\text{)}$$

The sum of uptake of nutrients in grain and straw was considered as the total uptake by the crop. The phosphorus content of grain and straw was determined by Vanadomolybodo phosphoric acid yellow color method and absorbance of the solution was recorded at 430 nm using spectrophotometer (Jackson 1967) and then computed to total uptake by crop as same as that of N uptake. Potassium content in plant sample (grain and straw separately) was determined by Flame photometer method (Jackson 1967) and expressed in kg per ha as explained in nitrogen estimation. For the calculation of economics, the price of inputs that were prevailing at the time of their use was considered for working out the cost of cultivation. All the data were analyzed using ANOVA using standard procedures.

RESULTS AND DISCUSSION

Nutrient uptake

Uptake of nutrients is associated with the metabolic activities of plants and with the concentration and distribution of ions in the external medium. Significant differences existed in the nitrogen, phosphorus and potassium taken up by grain, haulm and the total per plant of field bean due to application of farmyard manure and bio-digester liquid manure (Tables 1–3). Significantly higher total nitrogen, P_2O_5 and K_2O (92.3, 15.45 and 83.8 kg ha^{-1}, respectively) were taken up by the crop when applied with FYM 10 t + BDLME to 35 kg N ha^{-1} which was on par with FYM 10 t + BDLME to 30 kg N ha^{-1} (91.0, 15.22 and 82.6 N, P_2O_5 and K_2O kg ha^{-1}, respectively) and recommended practice (FYM 7.5 t + 25:50:25 N:P_2O_5:K_2O kg ha^{-1}) (96.0, 15.96 and 86.1, respectively) (Table 1 to 3). In soil supplied with organics, there was an

Table 1. Nitrogen uptake (kg ha^{-1}) of field bean as influenced by FYM and bio-digester liquid manures.

Treatments	Seed uptake			Haulm uptake			Total uptake		
	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
T_1	31.0	33.3	32.2	30.3	31.6	30.9	61.3	64.9	63.1
T_2	31.6	34.7	33.1	31.2	32.6	31.9	62.7	67.4	65.1
T_3	34.8	40.2	37.5	35.6	37.5	36.5	70.4	77.7	74.0
T_4	35.4	41.2	38.3	36.2	38.1	37.2	71.6	79.3	75.5
T_5	32.7	36.9	34.8	32.7	34.7	33.7	65.3	71.6	68.5
T_6	33.8	36.1	34.9	33.5	35.5	34.5	67.3	71.6	69.4
T_7	36.1	42.6	39.3	36.9	39.0	37.9	73.0	81.6	77.3
T_8	36.1	44.6	40.3	37.4	39.1	38.3	73.4	83.7	78.6
T_9	34.4	38.6	36.5	34.8	36.6	35.7	69.3	75.2	72.2
T_{10}	34.7	39.3	37.0	34.8	36.8	35.8	69.5	76.0	72.8
T_{11}	41.7	51.2	46.5	43.6	45.4	44.5	85.3	96.6	91.0
T_{12}	42.5	51.9	47.2	44.5	45.8	45.1	86.9	97.7	92.3
T_{13}	46.1	53.2	49.7	45.9	46.8	46.3	92.0	100.0	96.0
T_{14}	16.2	14.8	15.5	19.4	15.2	17.3	35.6	30.0	32.8
SEm±	2.2	1.5	1.97	1.9	2.5	2.2	3.1	2.2	2.69
CD at 5%	6.3	4.4	5.58	5.6	7.3	6.3	9.0	6.5	7.64

T_1 : FYM 5 t + BDLME to 20 kg N ha^{-1}
T_2 : FYM 5 t + BDLME to 25 kg N ha^{-1}
T_3: FYM 5 t + BDLME to 30 kg N ha^{-1}
T_5: FYM 7.5 t + BDLME to 20 kg N ha^{-1}
FYM - Farmyard manure
T_6: FYM 7.5 t + BDLME to 25 kg N ha^{-1}
T_7: FYM 7.5 t + BDLME to 30 kg N ha^{-1}
T_8: FYM 7.5 t + BDLME to 35 kg N ha^{-1}
T_9: FYM 10 t + BDLME to 20 kg N ha^{-1}
T_{10}: FYM 10 t + BDLME to 25 kg N ha^{-1}
T_{11}: FYM 10 t + BDLME to 30 kg N ha^{-1}
T_{12} : FYM 10 t + BDLME to 35 kg N ha^{-1}
T_{13}: FYM 7.5 t + 25:50:25 kg N:P_2O_5:K_2O ha^{-1}
T_{14} : Control
BDLME - Bio-Digester Liquid Manure Equivalent

increased population of *Rhizobia* at Naganahally and Shimoga. Hence, more atmospheric nitrogen could have been fixed helping protein yield (Reddy *et al.* 2010).

These results are in conformity with the findings

Table 2. Phosphorus (P_2O_5) uptake (kg ha^{-1}) of field bean as influenced by FYM and bio-digester liquid manures.

Treatments	Seed uptake			Haulm uptake			Total uptake		
	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
T_1	2.57	2.76	2.66	7.74	8.07	7.91	10.31	10.83	10.57
T_2	2.61	2.88	2.74	7.98	8.34	8.16	10.59	11.22	10.90
T_3	2.88	3.33	3.11	9.09	9.58	9.34	11.98	12.91	12.44
T_4	2.93	3.41	3.17	9.26	9.74	9.50	12.19	13.16	12.67
T_5	2.71	3.05	2.88	8.35	8.87	8.61	11.06	11.92	11.49
T_6	2.80	2.99	2.89	8.56	9.09	8.82	11.36	12.07	11.71
T_7	2.99	3.53	3.26	9.43	9.96	9.70	12.42	13.49	12.96
T_8	2.99	3.69	3.34	9.56	10.00	9.78	12.55	13.69	13.12
T_9	2.85	3.20	3.02	8.91	9.36	9.13	11.76	12.56	12.16
T_{10}	2.87	3.25	3.06	8.91	9.41	9.16	11.78	12.66	12.22
T_{11}	3.46	4.24	3.85	11.15	11.60	11.37	14.60	15.84	15.22
T_{12}	3.52	4.29	3.91	11.37	11.71	11.54	14.88	16.01	15.45
T_{13}	3.82	4.41	4.11	11.73	11.96	11.85	15.55	16.37	15.96
T_{14}	1.34	1.22	1.28	4.95	3.89	4.42	6.30	5.12	5.71
SEm±	0.18	0.13	0.16	0.50	0.64	0.57	0.55	0.59	0.56
CD at 5%	0.52	0.37	0.46	1.44	1.86	1.61	1.60	1.72	1.59

T_1 : FYM 5 t + BDLME to 20 kg N ha^{-1}
T_2 : FYM 5 t + BDLME to 25 kg N ha^{-1}
T_3 : FYM 5 t + BDLME to 30 kg N ha^{-1}
T_4 : FYM 5 t + BDLME to 35 kg N ha^{-1}
T_5 : FYM 7.5 t +BDLME to 20 kg N ha^{-1}
FYM - Farmyard manure
T_6 : FYM 7.5 t + BDLME to 25 kg N ha^{-1}
T_7 : FYM 7.5 t + BDLME to 30 kg N ha^{-1}
T_8 : FYM 7.5 t + BDLME to 35 kg N ha^{-1}
T_9 : FYM 10 t + BDLME to 20 kg N ha^{-1}
T_{10} : FYM 10 t + BDLME to 25 kg N ha^{-1}
T_{11} : FYM 10 t + BDLME to 30 kg N ha^{-1}
T_{12} : FYM 10 t + BDLME to 35 kg N ha^{-1}
T_{13} : FYM 7.5 t + 25:50:25 kg N:P_2O_5:K_2O ha^{-1}
T_{14} : Control
BDLME - Bio-Digester Liquid Manure Equivalent

Table 3. Potassium (K_2O) uptake (kg ha^{-1}) of field bean as influenced by FYM and bio-digester liquid manures.

Treatments	Seed uptake			Haulm uptake			Total uptake		
	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
T_1	4.01	4.30	4.15	52.1	54.3	53.2	56.1	58.6	57.4
T_2	4.07	4.48	4.28	53.7	56.2	54.9	57.7	60.6	59.2
T_3	4.49	5.19	4.84	61.2	64.5	62.8	65.7	69.7	67.7
T_4	4.57	5.32	4.94	62.3	65.6	64.0	66.9	70.9	68.9
T_5	4.22	4.76	4.49	56.2	59.7	57.9	60.4	64.4	62.4
T_6	4.37	4.65	4.51	57.6	61.1	59.4	62.0	65.8	63.9
T_7	4.65	5.50	5.08	63.5	67.1	65.3	68.2	72.6	70.4
T_8	4.65	5.75	5.20	64.3	67.3	65.8	69.0	73.0	71.0
T_9	4.44	4.98	4.71	59.9	63.0	61.5	64.4	68.0	66.2
T_{10}	4.48	5.07	4.77	59.9	63.3	61.6	64.4	68.4	66.4
T_{11}	5.39	6.61	6.00	75.0	78.1	76.6	80.4	84.7	82.6
T_{12}	5.48	6.69	6.09	76.5	78.8	77.7	82.0	85.5	83.8
T_{13}	5.95	6.87	6.41	78.9	80.5	79.7	84.9	87.4	86.1
T_{14}	3.09	2.91	2.50	37.3	41.2	29.8	40.4	44.1	39.8
SEm±	0.28	0.20	0.25	3.3	4.3	3.8	3.4	4.2	3.8
CD at 5%	0.81	0.57	0.72	9.7	12.5	10.8	9.8	12.3	10.7

T_1 : FYM 5 t + BDLME to 20 kg N ha^{-1}
T_2 : FYM 5 t + BDLME to 25 kg N ha^{-1}
T_3 : FYM 5 t + BDLME to 30 kg N ha^{-1}
T_4 : FYM 5 t + BDLME to 35 kg N ha^{-1}
T_5 : FYM 7.5 t + BDLME to 20 kg N ha^{-1}
FYM - Farmyard manure
T_6 : FYM 7.5 t + BDLME to 25 kg N ha^{-1}
T_7 : FYM 7.5 t + BDLME to 30 kg N ha^{-1}
T_8 : FYM 7.5 t + BDLME to 35 kg N ha^{-1}
T_9 : FYM 10 t + BDLME to 20 kg N ha^{-1}
T_{10} : FYM 10 t + BDLME to 25 kg N ha^{-1}
T_{11}: FYM 10 t + BDLME to 30 kg N ha^{-1}
T_{12}: FYM 10 t + BDLME to 35 kg N ha^{-1}
T_{13}: FYM 7.5 t + 25:50:25 kg N:P_2O_5:K_2O ha^{-1}
T_{14} : Control
BDLME - Bio-Digester Liquid Manure Equivalent

of Yamagata and Otani (1996) from Tsukuba, Japan who found that nitrogen uptake by soybean supplied with organic nitrogen was higher than control. Higher P uptake might be due to application of phosphorus

Table 4. Pooled (2010 and 211) seed and haulm yields of field bean as influenced by FYM and bio-digester liquid manures.

Treatments	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
T_1	736	2302
T_2	759	2398
T_3	859	2845
T_4	877	2908
T_5	796	2569
T_6	800	2650
T_7	900	2983
T_8	923	3014
T_9	836	2768
T_{10}	846	2777
T_{11}	1045	3619
T_{12}	1088	3683
T_{13}	1137	3798
T_{14}	355	1082
SEm±	45	212
CD at 5%	128	600

T_1 : FYM 5 t + BDLME to 20 kg N ha^{-1}
T_2 : FYM 5 t + BDLME to 25 kg N ha^{-1}
T^3 : FYM 5 t + BDLME to 30 kg N ha^{-1}
T_4 : FYM 5 t + BDLME to 35 kg N ha^{-1}
T_5 : FYM 7.5 t + BDLME to 20 kg N ha^{-1}
FYM - Farmyard manure
T_6 : FYM 7.5 t + BDLME to 25 kg N ha^{-1}
T_7 : FYM 7.5 t + BDLME to 30 kg N ha^{-1}
T_8 : FYM 7.5 t + BDLME to 35 kg N ha^{-1}
T_9 : FYM 10 t + BDLME to 20 kg N ha^{-1}
T_{10}: FYM 10 t + BDLME to 25 kg N ha^{-1}
T_{11} : FYM 10 t + BDLME to 30 kg N ha^{-1}
T_{12} : FYM 10 t + BDLME to 35 kg N ha^{-1}
T_{13} : FYM 7.5 t + 25:50:25 kg N:P_2O_5:K_2O ha^{-1}
T_{14} : Control
BDLME - Bio-Digester Liquid Manure Equivalent

Table 5. Correlation coefficient matrix of various parameters of field bean.

	N uptake by seed	N uptake by haulm	P uptake by seed	P uptake by haulm	K uptake by seed	K uptake by haulm	Seed yield	Haulm yield
N uptake by seed	1.000							
N uptake by haulm	0.9984	1.0000						
P uptake by seed	0.9999	0.9985	1.0000					
P uptake by haulm	0.9984	0.9999	0.9985	1.0000				
K uptake by seed	0.9960	0.9957	0.9960	0.9957	1.0000			
K uptake by haulm	0.9983	0.9999	0.9983	0.9999	0.9957	1.0000		
Seed yield	0.9995	0.9977	0.9996	0.9978	0.9952	0.9976	1.0000	
Haulm yield	0.9975	0.9996	0.9976	0.9996	0.9972	0.9996	0.9967	1.0000

through BDLM and FYM increased its concentration in soil solution and ultimately might have been helped in the formation of more nodules, vigorous root development, better N_2 fixation and overall development of plants. Higher K uptake might be owing to increased supply of potassium nutrient sources to the crop as well as due to the indirect effect resulting from reduced loss of organically supplied nutrient. These results are in agreement with the findings of Reddy *et al.* (1992), Sharma and Mishra (1997) and Chaturvedi and Chandel (2005).

Yield

Seed and haulm yields of field bean were significantly influenced by the combinations of farmyard manure and bio-digester liquid manure (Table 4). Pooled data indicated that seed and haulm yields produced by the application of FYM 10 t + BDLME to 35 kg N ha^{-1} (1088 and 3683 kg ha^{-1}, respectively), FYM 10 t + BDLME to 30 kg N ha^{-1} (1045 and 3619 kg ha^{-1}, respectively) and recommended practice (FYM 7.5 t + 25:50:25 N:P_2O_5:K_2O kg ha^{-1}) (1137 and 3798 kg ha^{-1}, respectively) were on par with each other. Higher yields obtained with FYM 10 t + BDLME to 35 kg N ha^{-1} could be attributed to higher uptake of nutrients like N, P and K (92.3, 15.45 and 83.8 kg ha^{-1}, respectively) which have promoted the growth as well as yield of field bean. Further, the application of higher doses of FYM and BDLM also made improvement in seed and haul yield of crop. These findings are also evidenced and witnessed by better correlation coefficient values between yield (seed and haulm) and nutrient (N, P and K) uptake (Tables 5– 6). The correlation coefficient (r) matrix revealed that the 'r' values between nutrient uptake (N, P and K) and yields (seed and straw) were > 0.9952. This indicates a stronger relationship between N, P and K uptake and seed and haulm yields.

Further, the regression study also revealed that increase in N, P and K uptake by seed to the tune of 1 kg/ha shall enhance the seed yield of field bean by 22.8, 274.6 and 193.6 kg/ha, respectively (Table 6). Whereas, increase in N, P and K uptake by haulm to the tune of 1 kg/ha shall enhance the haulm yield of field bean by 94.3, 368.5 and 54.8 kg/ha, respectively. Thus, it reveals that the uptake and yields are directly

Table 6. Correlation and regression equations for various dependent and independent parameters of field bean. ** = Significant at 1% * = Significant at 5%. The variable x refers to the independent parameters listed in the column, variable y refers to the dependent parameters listed in the column.

Sl. No.	Independent variable (x)	Dependent variable (y)	Correlation coefficient (r)	Regression equation	R^2
1	N uptake by seeds (kg/ha)	Seed yield (kg/ha)	0.9995**	y = 4.11+22.76x	0.9908
2	P uptake by seeds (kg/ha)		0.9996**	y = 5.29+274.56x	0.9991
3	K uptake by seeds (kg/ha)		0.9952**	Y=-85.86+193.61x	0.9904
4	N uptake by haulm (kg/ha)	Haulm yield (kg/ha)	0.9996**	y = -590.83+94.28x	0.9992
5	P uptake by haulm (kg/ha)		0.9996**	y=-588.75+368.46x	0.9993
6	K uptake by haulm (kg/ha)		0.9997**	y=-589.78+54.76x	0.9993

Table 7. Economics of field bean cultivation as influenced by FYM and bio-digester liquid manure.

Treat-	Gross returns (Rs ha^{-1})			Cost of cultivation (Rs ha^{-1})			Net returns (Rs ha^{-1})			B:C ratio		
ments	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
T_1	18878	20224	19551	12650	12650	12650	6228	7574	6901	1.49	1.60	1.55
T_2	19214	21109	20162	13050	13050	13050	6164	8059	7112	1.47	1.62	1.54
T_3	21293	24493	22893	13450	13450	13450	7843	11043	9443	1.58	1.82	1.70
T_4	21658	25083	23371	13850	13850	13850	7808	11233	9521	1.56	1.81	1.69
T_5	19928	22442	21185	14300	14300	14300	5628	8142	6885	1.39	1.57	1.48
T_6	20625	22000	21313	14400	14400	14400	6225	7600	6913	1.43	1.53	1.48
T_7	22066	25933	24000	14200	14200	14200	7866	11733	9800	1.55	1.83	1.69
T_8	22090	27048	24569	14600	14600	14600	7490	12448	9969	1.51	1.85	1.68
T_9	21041	23511	22276	15000	15000	15000	6041	8511	7276	1.40	1.57	1.49
T_{10}	21183	23894	22538	15400	15400	15400	5783	8494	7138	1.38	1.55	1.46
T_{11}	25642	31153	28397	15800	15800	15800	9842	15353	12597	1.62	1.97	1.80
T_{12}	26100	31549	28825	16200	16200	16200	9900	15349	12625	1.61	1.95	1.78
T_{13}	28252	32372	30312	18134	18134	18134	10118	14238	12178	1.56	1.79	1.67
T_{14}	8974	9849	9412	6902	6902	6902	2072	2947	2510	1.30	1.43	1.36

T_1 : FYM 5 t + BDLME to 20 kg N ha^{-1}
T_2 : FYM 5 t + BDLME to 25 kg N ha^{-1}
T_3 : FYM 5 t + BDLME to 30 kg N ha^{-1}
T_4 : FYM 5 t + BDLME to 35 kg N ha^{-1}
T_5 : FYM 7.5 t + BDLME to 20 kg N ha^{-1}
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T_8 : FYM 7.5 t + BDLME to 35 kg N ha^{-1}
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T_{11} : FYM 10 t + BDLME to 30 kg N ha^{-1}
T_{12} : FYM 10 t + BDLME to 35 kg N ha^{-1}
T_{13} : FYM 7.5 t + 25:50:25 kg N:P_2O_5:K_2O ha^{-1}
T_{14} : Control
BDLME - Bio-Digester Liquid Manure Equivalent

and strongly correlated. These results are in conformity with the findings of Devakumar *et al.* (2011) who revealed higher seed yield of field bean (12.8 q ha^{-1}) with combed application of compost + poultry manure + pressmud (1:1:1 by weight equivalent to 7.5 t of FYM + 25 kg N ha^{-1}) which was on par with that of compost + poultry manure (1:1) (12.2 q ha^{-1}). On the similar line, Shete *et al.* (2011) obtained higher seed yield (964 kg ha^{-1}) and haulm yield (2229 kg ha^{-1}) of greengram with FYM at 5 t ha^{-1} over control.

Economics

Higher gross returns (Rs 30, 312 ha^{-1}) was obtained from the recommended practice (FYM 7.5 t + 25:50 : 25 N :P_2O_5:K_2O kg ha^{-1}) followed by FYM 10 t + BDLME to 35 kg N ha^{-1} (Rs 28,825 ha^{-1}) and FYM 10 t + BDLME to 30 kg N ha^{-1} (Rs 28,397 ha^{-1}) (Table 7). The higher gross returns were mainly due higher grain and haulm yields in the respective treatments. Similar findings were also observed by Mehla and Panwar (2000). Higher net returns and B:C ratio (Rs 12,625 ha^{-1} and 1.78, respectively) were obtained with FYM 10 t + BDLME to 35 kg N ha^{-1} followed by FYM 10 t + BDLME to 30 kg N ha^{-1} (Rs 12,397 ha^{-1} and 1.80). Further, application of recommended practice (FYM 7.5 t + 25:50:25 N:P_2O_5:K_2O kg ha^{-1}) resulted in 1.67 ratio as the cost of cultivation was high. The higher B:C ratio may be due to lower cost of cultivation and higher net returns. At Rodale Institute, Kutztown, USA, organic system had increased the income and returns and decreased the expenditure in soybean crop besides giving 28% higher production efficiency than inorganic system (Anon 2011). Further, higher income from organic cropping has been reported by Delate *et al.* (2003), Lotter *et al.* (2003) and Pimentel *et al.* (2005).

REFERENCES

Anonymous (2011) The Farming Systems Trial. The Rodale Institute, Kutztown, Pensyluvania, USA. http://www.rodaleinstitute.org.

Anonymous (2012) An overview of organic crop production. http://www.attra.ncat.org/attra-pub/organiccrop.html.

Chaturvedi Sumit, Chandel AS (2005). Influence of organic and inorganic fertilization on soil fertility and productivity of soybean (*Glycine max* L.). *Ind J Agron* 50 (4) : 311—313.

Delate K, Duffy M, Chase C, Holste A, Friedrich H, Wantat N (2003) An economic comparison of organic and conventional grain crops in a long-term agro-ecological research

(LTAR) sites in Iowa. *Am J Alternative Agric* 18 (2) : 59—69.

Devakumar N, Rao GGE, Reddy VC, Pradeep S (2011) Developing organic package of practices for yield maximization of irrigated field bean. Ann Prog Rep, Research Institute on Organic Farming, Univ Agric Sci Bangalore, pp 38—43.

Jackson ML (1967) Soil Chemical Analysis. Prentice Hall of India, Pvt Ltd, New Delhi, pp 498.

Lotter DW, Seidal R, Liebhardt W (2003) The performance of organic and conventional cropping systems in an extreme climate year. *Am J Alternative Agric* 18 (3) : 146—154.

Mehla DS, Panwar DVS (2000) Effect of organic and inorganic fertility levels on yield and yield components of scented rice. Extended Summary: Int. Conf. Managing Natural Resources, New Delhi, 14-18th Feb, 2 : 330—331.

Pimentel D, Hepperly P, Hanson J, Douds D, Seidal, R (2005) Environmental, energetic and economic comparison of organic and conventional farming systems. *BioSci* 55 (7) : 573—582.

Reddy KM, Reddy SC, Reddy TV (1992) Dry matter production, distribution and nutrient content of greengram varieties as varieties as influenced by fertility treatment. *Ind J Agron* 37 (2) : 268—272.

Reddy VC, Shivanandanam V, Jayarama Reddy M, Sannathimmappa M, Bhairappanavar ST, Girijesh GK, Narayan prasad, Mohan GS, Vasanthkumar HL, Govindaraju C, Jagadeesh BR, Basavaraj Naik TC, Hanumanthappa H (2010) Developing organic package of practices for production of paddy, ragi, maize, ground nut, red gram, field bean and soybean. Ann Prog Rep Research Institute on Organic Farm ing, Univ Agric Sci Bangalore, pp 126—127.

Sharma RA, Mishra DR (1997) Crop residues, farmyard manure and fertilizer use in relation to growth, yield and nutrient uptake in soybean. *Crop Res* 13 : 51—57.

Shete PG, Thanki JD, Baviskar VS, Bhoye KP (2011) Yield, nutrient uptake and economics of greengram as influenced by land configuration and FYM levels. *Green Fmg* 2 (4) : 425—427.

Chaturvedi Sumit, Chandel AS (2005). Influence of organic and inorganic fertilization on soil fertility and productivity of soybean (*Glycine max* L.). *Ind J Agron* 50 (4) : 311—313.

Yamagata M, Otani T (1996) Nitrogen uptake and response of crops to organic nitrogen. *Japanese J Soil Sci Pl Nutrition* 67 (4) : 345—353.