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Effect of organic manures, green leaf manures, liquid organic manures and micronutrients on yield and economics of cotton (*Gossypium* spp.)

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ABSTRACT

A field study was carried out at Main Agricultural Research Station (MARS), Dharwad during *kharif* 2010-11 and 2011-12 to study the effect of organic manures and micronutrients on cotton. The results of the two years pooled data revealed that, application of enriched compost (EC) (1/3) + vermicompost (VC) (1/3) + gliricidia leaf manure (GLM) (1/3) equivalent to recommended dose of fertilizer (5 tonnes/ha FYM) recorded significantly higher kapas yield (1 944 kg/ha) and mean boll weight (4.57 g) over EC (1/3) + VC (1/3) + GLM (1/3) equivalent to recommended dose of nitrogen. Foliar spray of panchagavya @ 5% recorded significantly higher kapas yield (2 038 kg/ha) and mean boll weight (4.76 g) over foliar spray of bio-digester @ 20% (1 874 kg/ha). Among the organic treatment combinations, combined application of EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDF with foliar spray of panchagavya @ 5% recorded significantly higher kapas yield (1 999 kg/ha) and mean boll weight (4.70 g) over other organic combinations. Application of EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDF recorded significantly higher gross returns, net returns and B:C ratio (₹ 110380, 77335/ha and 3.34, respectively) over other manurial treatments. The foliar spray of panchagavya @ 5% recorded significantly higher gross returns, net returns and B:C ratio (₹ 108542, 76048 ha and 3.34, respectively) over foliar spray of bio-digester @ 20%. Among the treatment combinations, combined application of EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDF with foliar spray of panchagavya @ 5% recorded significantly higher gross returns, net returns and B:C ratio (₹ 113574, 80199/ha and 3.40, respectively) over EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDN with foliar spray of bio-digester @ 20%. Higher yield, yield parameters and economics can be obtained in cotton with combined application of EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDF with foliar spray of panchagavya @ 5%.

Key words: Green leaf manures, Kapas yield, Liquid organic manures, Organic manures

Indian agriculture has been passing through a very turbulent phase. Exclusive and continuous use of chemical fertilizers for attaining maximum yield and rest less monocropping deplete the inherent fertility of the soil much faster than it can be replenished. Beyond this, it also results in nutritional problems in soils and imbalances in plants.

Exclusive use of chemical fertilizers and pesticides in agriculture not only shattered the hope of farmers, but also received severe criticism from environmentally conscious people who reveal that increase in agricultural production achieved at the cost of soil health (Cooke 1982).The global retail market of organic cotton has increased from 583 million to 4.3 billion in 2009 with an annual growth rate of 3.5% (Anon 2009). In India, cotton is grown over an area of about 11.14 m.ha with a total production of 33.43 m. bales (Anon 2012). India ranks fifth in area and third in production of cotton after USA and China. The productivity of cotton is 510 kg of lint/ha which is much lower than the world average of 621 kg/ha. Among the cotton growing states, Karnataka ranks fifth with an area of 3.90 lakh/ha and sixth in production with 9.0 lakh bales of lint with an average productivity of 392 kg of lint/ha. Conversion to organic farming can improve livelihoods of smallholders while protecting natural resources. Due to 10–20% lower total production costs and a 20 % organic price premium, average gross margins from organic cotton fields were 30–40 % higher than in the conventional system (Frank *et al*. 2007). To sustain the productivity of organic cotton, nutrition and plant protection play a very important role. In this context, to make the organic cotton production more sustained the field studies were carried out to study the nutrient management practices for organic cotton production.

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MATERIALS AND METHODS

The field experiment was conducted at MARS,

Dharwad during 2010-11 and 2011-12 to study the effect of organic manures and micronutrients on cotton. The soil of the experiment site was medium deep black, having medium in organic carbon (0.48%) (Organic carbon estimation was carried by wet oxidation method (Jackson 1973)) and available NPK (264.70:21.80:285.30 NPK kg/ha) (Available nitrogen estimation was carried by using Alkaline permanganate method (Subbiah and Asija 1956), available phosphours and potassium estimation was carried by Olsen's method (Jackson 1973) and NH_4 OAC extract method (Jackson 1973), respectively. The experiment was laid out in split plot design with three replications. The main plot comprises of three manurial treatments as M_1 : Recommended dose of fertilizer (RDF)(80:40:40 N:P_2O_5:K_2O kg/ha + Farmyard manure (FYM) @ 5 tonnes/ha), M_2: Enriched compost (EC) (1/3) + Vermicompost (VC) (1/3) + green leaf manure (GLM) (1/3) equivalent to recommended dose of nitrogen (RDN), M_3: EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDF and sub-plot consists of five liquid organic manures treatments are L_1 : Foliar application of panchagavya @ 5% at sympodial branching, square, flower and boll development stages, L_2: Foliar application of bio-digester @ 20%, L_3: Foliar application of cow urine @ 10%, L_4: Foliar application of vermiwash, L_5 : Foliar application borax @ 0.2% + $MgSO_4$ and one control treatment was T_1: Recommended dose of fertilizer (RDF) (80:40:40 N:P_2O_5:K_2O kg/ha+ FYM @ 5 tonnes/ha). As per the treatments, the organic manures equivalent to RDN and RDF through

Table 1 Number of bolls at 90, 120, 150 DAS and bad bolls/plant at 150 DAS of cotton as influenced by organic manures, GLM, liquid organicmanures and micronutrients

Treatment	2010			2011			Pooled		
	90 DAS	120 DAS	150 DAS	90 DAS	120 DAS	150 DAS	90 DAS	120 DAS	150 DAS
Organic manure (M)									
M_1	8.10a	21.1a	37.2a	8.13a	22.0a	38.8a	8.11a	21.5a	38.0a
M_2	5.84c	16.4c	31.2c	6.13c	14.1c	32.2c	5.99c	15.3c	31.7c
M_3	6.60b	18.0b	33.8b	7.31b	18.6b	36.1b	6.96b	18.3b	35.0b
SEm±	0.059	0.17	0.53	0.075	0.17	0.41	0.0392	0.09	0.46
Foliar spray of liquid manures + micronutrients (L)									
L_1	7.11a	19.1a	35.0a	7.40a	19.0a	36.8a	7.25a	19.0a	35.9a
L_2	6.48b	17.8b	32.7b	6.84c	16.6b	34.3b	6.66d	17.2c	33.5b
L_3	6.77ab	18.2ab	33.8ab	7.16b	18.3a	35.8a	6.97c	18.2b	34.8a
L_4	6.80ab	18.4ab	34.0ab	7.21ab	18.5a	36.0a	7.01bc	18.4ab	35.0a
L_5	7.07a	18.9a	34.8a	7.35ab	18.9a	35.8a	7.21ab	18.9a	35.3a
SEm±	0.118	0.32	0.52	0.069	0.25	0.44	0.076	0.21	0.43
Interactions (MXL)									
M_1 L_1	8.25a	21.8a	38.8a	8.28a	22.9a	40.9a	8.26a	22.4a	39.8a
M_1 L_2	7.74ab	20.3ab	35.0b-d	7.90ab	20.2b	37.1b-d	7.82bc	20.2b-d	36.0b-e
M_1 L_3	8.14a	20.7a	37.0ab	8.09ab	22.2a	39.1a-c	8.11ab	21.4a-c	38.0a-c
M_1 L_4	8.17a	20.9a	37.3ab	8.12ab	22.4a	39.4ab	8.15ab	21.6a-c	38.3ab
M_1 L_5	8.19a	21.7a	38.1a	8.26a	22.2a	39.6b-d	8.23ab	21.9ab	38.9ab
M_2 L_1	5.93c	16.8cd	31.8e-g	6.34ef	14.5d	32.1fg	6.13fg	15.7h	32.3fg
M_2 L_2	5.70c	15.8d	30.2g	5.77f	12.3e	31.2g	5.74g	14.0h	30.7g
M_2 L_3	5.82c	16.2d	31.0fg	6.11f	14.4d	32.0g	5.97g	15.3gh	31.5fg
M_2 L_4	5.87c	16.4cd	31.3fg	6.19f	14.4d	32.3fg	6.03fg	15.4gh	31.8fg
M_2 L_5	5.90c	16.6cd	31.7e-g	6.24f	15.1d	32.8fg	6.07fg	15.9fg	32.2fg
M_3 L_1	7.16b	18.6bc	34.5b-e	7.58bc	19.5bc	37.1c-e	7.37d	19.0de	35.9c-e
M_3 L_2	6.00c	17.5cd	33.0d-g	6.84de	17.4c	34.6ef	6.42f	17.4ef	33.8ef
M_3L_3	6.35c	17.7cd	33.4c-f	7.28cd	18.3bc	36.2de	6.82e	18.0e	34.8de
M_3 L_4	6.37c	17.8cd	33.5c-f	7.31cd	18.6bc	36.4de	6.84e	18.2e	34.9de
M_3 L_5	7.13b	18.5bc	34.5b-e	7.54bc	19.3bc	36.9b-e	7.33d	18.9de	35.7c-e
C_1	7.72ab	20.1ab	36.2a-c	7.61bc	20.0b	37.4b-d	7.67cd	20.0cd	36.8b-d
SEm±	0.256	0.64	0.93	0.184	0.66	0.76	0.130	0.56	0.77

EC- Enriched compost; C- Compost; VC – Vermicompost ; M_1 _ RDF – 80:40:40 NPK kg/ha + FYM @ 5 t/ha ; M_2 - EC (1/3)+ VC(1/3) + GLM (1/3) equi.to RDN; M_3- EC (1/3)+ VC(1/3) + GLM (1/3) equi.to RDF; L_1- Panchagavvy @ 5%; L_2- Bio-digester @ 20% ; L_3- Cow urine @ 10%; L_4- Vermiwash @ 20%; L_5- borax @ 0.2% + $MgSO_4$ @ 1% ; C_1- RDF – 80:40:40 NPK kg + FYM @ 5 t/ha.

farmyard manure, enriched compost (50%), green leaf manure were applied 15 days before sowing and 50% vermicompost was spot applied to the soil before dibbling of cotton seeds and top dressing with remaining 50% of vermicompost was done at 60 DAS. The chemical fertilizers as per the recommended package alone and along with farm yard manure were applied to the check treatments (Beej and Hamara 2012). The seeds were treated with cow urine, *Azospirillum*, Phosphate solubalizing bacteria, *Pseudomonas striata,* Trichoderma and cow dung slurry before sowing. The seed of Hybrid cotton DHH-11 was obtained from ARS Dharwad (ARS, Hebballi) and were hand dibbled with two cotton seeds per hill on 12 July 2010 in 1st year and 8 June 2011 in 2nd year.

RESULTS AND DISCUSSION

Among the various factors affecting the growth and yield of cotton, nutrient management plays a vital role. Presently, the chemical fertilizers are the major source of nutrients but escalating cost, coupled with increasing demand of chemical fertilizers and depleting soil health necessitates the safe and efficient use of organics in crop production. These practices gaining much popularity to enhance and maintain soil organic carbon status for obtaining sustainable crop yields. Among the organic manurial treatments, application of EC (1/3) + VC (1/3) +

Table 2 Yield and yield parameters of cotton as influenced by organic manures, GLM, liquid organic manures and micronutrients

Treatment	2010				2011				Pooled			
	Seed index	Mean boll weight (g)	Kapas weight/ plant (g)	Kapas yield (kg/ha)	Seed index	Mean boll weight (g)	Kapas weight/ plant (g)	Kapas yield (kg/ha)	Seed index	Mean boll weight (g)	Kapas weight/ plant(g)	Kapas yield (kg/ha)
Organic manure (M)												
M_1	10.5a	4.94a	125.5a	2097a	10.7a	5.06a	127.4a	2323a	10.6a	5.01a	126.5a	2210a
M_2	10.3b	4.30c	106.8b	1656c	10.4c	4.41b	108.3c	1858c	10.4c	4.23c	107.5c	1757c
M_3	10.4b	4.48b	110.5b	1798b	10.5b	4.66ab	120.5b	2090b	10.5b	4.57b	115.5b	1944b
SEm±	0.031	0.044	1.70	39.51	0.0082	0.13	1.72	36.23	0.016	0.083	1.49	22.29
Foliar spray of liquid manures + micronutrients (L)												
L_1	10.5a	4.69a	117.1a	1924a	10.6a	4.80a	121.5a	2152a	10.5a	4.76a	119.3a	2038a
L_2	10.3b	4.46b	110.1b	1753b	10.4c	4.56b	114.0b	1996b	10.4c	4.51b	112.1b	1874c
L_3	10.4a	4.53ab	113.6ab	1830ab	10.5bc	4.70ab	118.9a	2084ab	10.5b	4.62ab	116.2a	1957ab
L_4	10.5a	4.52ab	114.1ab	1845ab	10.5ab	4.72ab	119.3a	2098ab	10.5ab	4.62ab	116.7a	1972b
L_5	10.5a	4.66a	116.4a	1922a	10.6ab	4.76ab	120.0a	2141a	10.5a	4.71a	118.2a	2032a
SEm±	0.040	0.059	1.41	36.50	0.025	0.067	1.44	31.14	0.021	0.055	1.40	21.69
Interactions (MXL)												
M_1 L_1	10.6a	5.08a	127.6a	2200a	10.7ab	5.19a	129.4a	2410a	10.7a	5.17a	128.5a	2305a
M_1 L_2	10.4c-f	4.82ab	124.0a-c	2013a-c	10.6a-c	4.91a-c	126.2ab	2227bc	10.5b-d	4.87a-c	125.1ab	2120c
M_1 L_3	10.5a-d	4.91ab	124.5a-c	2058ab	10.6a-d	5.04ab	126.7ab	2277a-c	10.6ab	4.97ab	125.6ab	2167bc
M_1 L_4	10.6a-c	4.92ab	125.0a-c	2097a	10.6a-c	5.05ab	127.1ab	2317ab	10.6ab	4.98ab	126.0ab	2207a-c
M_1 L_5	10.6ab	5.00ab	126.4ab	2118a	10.7a	5.13a	127.9ab	2387ab	10.7a	5.06ab	127.1ab	2252ab
M_2 L_1	10.4c-f	4.34cd	109.2d-f	1701d-f	10.5d-h	4.48b-d	111.6d	1918e	10.4c-e	4.41d-f	110.4de	1810g
M_2 L_2	10.2f	4.20d	100.0f	1519f	10.3j	4.27d	100.2e	1789e	10.3g	4.23f	100.1f	1654h
M_2 L_3	10.3d-f	4.33cd	107.5ef	1630ef	10.4h-j	4.40cd	109.3d	1837e	10.3e-g	4.37ef	108.4ef	1734gh
M_2 L_4	10.3c-f	4.29cd	108.2d-f	1637ef	10.4g-j	4.42cd	109.8d	1830e	10.4d-g	4.35ef	109.0e	1733gh
M_2 L_5	10.4c-f	4.34cd	109.1d-f	1795de	10.5f-j	4.46b-d	110.4d	1914e	10.4c-f	4.40d-f	109.7de	1854fg
M_3 L_1	10.5a-e	4.66bc	114.7b-e	1870b-d	10.6a-f	4.73a-d	123.5a-c	2129cd	10.5bc	4.70b-e	119.1a-d	1999de
M_3 L_2	10.3ef	4.36cd	106.5ef	1725de	10.3ij	4.51b-d	115.7cd	1972de	10.3fg	4.44c-f	111.1de	1848fg
M_3L_3	10.4b-f	4.36cd	108.7d-f	1771de	10.5e-i	4.66a-d	120.6bc	2109cd	10.4c-e	4.51c-f	114.7c-e	1940c-f
M_3 L_4	10.4a-f	4.37cd	109.1d-f	1773de	10.5c-h	4.69a-d	120.9a-c	2117cd	10.5b-d	4.53c-f	115.0c-e	1945c-f
M_3 L_5	10.5a-f	4.63bc	113.7c-e	1853cd	10.6b-g	4.70a-d	121.9a-c	2123c	10.5bc	4.67b-f	117.8b-e	1988de
C_1	10.5a-d	4.81ab	120.2a-d	2041a-c	10.6a-e	4.83a-d	121.5a-c	2133cd	10.6ab	4.82a-d	120.8a-c	2087cd
SEm±	0.068	0.12	3.72	60.03	0.044	0.18	2.54	56.66	0.036	0.13	2.91	38.86

EC- Enriched compost; C- Compost; VC – Vermicompost ; M_1 _ RDF – 80:40:40 NPK kg/ha + FYM @ 5 t/ha ; M_2 - EC (1/3)+ VC(1/3) + GLM (1/3) equi.to RDN; M_3- EC (1/3)+ VC(1/3) + GLM (1/3) equi.to RDF; L_1- Panchagavvy @ 5%; L_2- Bio-digester @ 20% ; L_3- Cow urine @ 10%; L_4- Vermiwash @ 20%; L_5- Borax @ 0.2% + $MgSO_4$ @ 1% ; C_1- RDF – 80:40:40 NPK kg + FYM @ 5 t/ha.

GLM (1/3) equivalent to RDF recorded significantly higher kapas yield (1944 kg/ha) accounting for 10.64% increased kapas yield over EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDN (1757 kg/ha). The factors mainly responsible for variation in the seed cotton yield was mainly due to positive association between yield and yield contributing characters like number of bolls/plant, mean boll weight and kapas weight/plant. Significantly higher number of bolls/plant (35.0), mean boll weight (4.57 g) kapas weight/plant (115.5 g) and seed index (10.5) were recorded (Table 1) in EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDF was mainly attributed to better performance of plants due to the substantial release of N, P_2O_5 and K_2O and other nutrients from the processes of mineralization of organic materials and CO_2, which in turn increased the available pool of nutrients and soil moisture throughout growing period. These results are in agreement with those of Ram Prakash *et al*. (2001). The higher yield with integrated application of vermicompost, enriched compost and GLM might be due to the very nature of vermicompost which supply the micronutrients in the readily available form to the plants, react with native soil nutrients in a way that enhance their availability to crops (Nekar *et al*. 2009). The kapas yield of cotton differed significantly due to foliar spray of liquid organic manures and micronutrients. Foliar spray of panchagavya @ 5% and borax @ 0.2% + $MgSO_4$ @ 1% recorded significantly higher kapas yield (2038 and 2032 kg/ha, respectively) accounting for 8.75% higher over foliar spray of bio-digester @ 20% (1874 kg/ha) but was on par with vermiwash @ 20 % and cow urine @ 10 %. The factors responsible for variation in the seed cotton yield was mainly due to positive association between yield and yield contributing characters like number of bolls/plant (35.9), mean boll weight (4.76 g), kapas weight/plant (119.3 g) and seed index (10.5). Significantly higher yield components in this treatment was mainly attributed to cow dung in panchagavya act as a medium for the growth of beneficial microbes and cow urine provides nitrogen which is essential for crop growth (De Britto and Girija 2006). Greater response to panchagavya foliar spray was done to fact that it contains nutrients, microorganisms and plant growth promoters as reported by Hazariaka *et al*. (2006). They observed that it acts as manure (75%) and biopesticide (25%), helps in management of pests at flowering and fruiting stages of crop growth. Boron is required for normal flower development. Foliar application of boron accelerates translocation of nitrogen compounds, increases protein synthesis and stimulates fruiting and hastens the translocation of nitrogen and sugars, improve fruiting, and may make plants less attractive to insects.

Among the organic treatment combinations, combined application of EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDF (5 tonnes/ha) with foliar spray of panchagavya @ 5% recorded significantly higher kapas yield (1 999 kg/ha) over EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDN with foliar spray of bio-digester @ 20% (Table 2). The factors mainly responsible for variation in the seed cotton yield was mainly due to positive association between yield and yield contributing characters like number of bolls/plant (35.9), mean boll weight (4.70 g), kapas weight/plant (119.1 g) and seed index (10.5). Significantly higher number of bolls/plant, mean boll weight and kapas weight/plant was recorded in this treatment might be due to better performance of plants (Lokesh *et al*. 2012) with respect to growth parameters like plant height, number of monopodial branches, leaf area index, SPAD value and total dry matter production. The increased growth parameters might be due to better availability of nutrients from organic throughout growing period and panchagavya contains kinetin along with other enzymes and might have increased the chlorophyll content of the leaves. Thus it might have lead to higher leaf area production capture of more solar radiation resulting in higher photosynthesis and consequent improvement in all growth attributes. These results were also supported by the Sanjutha *et al*. (2008). Rajendran *et al*. (2006) reported that the application of vermicompost 5 tonnes/ha with foliar spray of panchagavya @ 3% at 30 DAS could be recommended to enhance the yield and quality of grain amaranthus. The treatments with combined application of organics with liquid organic manures might have resulted in better availability of nutrients, throughout the crop growth. This is mediated by biological process as noticed by increased microbial activity and soil enzymatic activity and also panchagavya contains nutrients, microorganisms and plant growth promoters. The foliar application of boron accelerates translocation of nitrogen compounds, increases protein synthesis and stimulates fruiting and hastens the translocation of nitrogen and sugars and improve fruiting. In soybean and groundnut combined application of organics mainly enriched compost + vermicompost + GLM with foliar spray of panchagavya, cow urine produced significantly higher yield and yield attributes (Babalad 1999 and Nekar *et al*. 2009). Shwetha *et al*. (2009) observed soybean yield significantly higher in treatments supplemented with organic manures in combination of beejamruhta + jeevamrutha + panchagavya over control and was on par with RDF + FYM.

To work out the economics of cotton, 20% premium price considered for organically grown cotton as compared to conventional cotton it is environment friendly, fair with labour, energy saving with quality produce. Among the nutrient management practices, application of EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDF recorded significantly higher gross returns (Table 3), net returns and B:C ratio (₹ 110380, 77335/ha and 3.34, respectively) over other manurial treatments. The higher net returns were mainly due to optimum yield levels and the premium price (20 %) given to the produce for organically grown cotton. The foliar spray of panchagavya @ 5% recorded significantly higher gross returns, net returns and B:C ratio (₹ 108542, 76048/ha and 3.34 kg/ha, respectively) over foliar spray of bio-digester @ 20%. This might be due to higher kapas yield with these treatments. Premsekhar *et al*. (1997)

Table 3 Economics of cotton as influenced by organic manures, GLM, liquid organic manures and micronutrients

Treatment	2010			2011			Pooled		
	Gross returns (₹/ha)	Net returns (₹/ha)	B : C	Gross returns (₹/ha)	Net returns (₹/ha)	B : C	Gross returns (₹/ha)	Net returns (₹/ha)	B : C
Organic manure (M)									
M_1	104853a	72648a	3.26ab	104555a	72200b	3.23b	104704b	72424b	3.24b
M_2	99385b	68317b	3.20b	100315b	69048b	3.21b	99850c	68683b	3.20b
M_3	107906a	74961a	3.27a	112854a	79709a	3.41a	110380a	77335a	3.34a
SEm±	1078	1078	0.0346	1891	1891	0.0583	1095	1095	0.035
Foliar spray of liquid manures + micronutrients (L)									
L_1	108088a	75686a	3.33a	108996	76410a	3.34a	108542a	76048a	3.34a
L_2	98440b	66488b	3.08b	101095	68959b	3.14b	99767c	67723c	3.11b
L_3	102314ab	70812ab	3.25ab	105179	73493ab	3.32a	103747b	72153ab	3.28a
L_4	103134ab	71182ab	3.23ab	105802	73666ab	3.29a	104468b	72424ab	3.26a
L_5	108262a	75709a	3.33a	108468	75733a	3.31a	108365a	75721ab	3.32a
SEm±	2016	2016	0.0633	1541	1541	0.0483	1195	1195	0.038
Interactions (MXL)									
M_1 L_1	110000ab	77465ab	3.38a	108450ab	75765ab	3.32a-c	109225a-d	76615ab	3.35ab
M_1 L_2	100673b-d	68588a-c	3.14ab	100209b-d	67974b-d	3.11c	100441e-h	68281cd	3.12cd
M_1 L_3	102883a-c	71248ab	3.25ab	102462b-d	70677b-d	3.22a-c	102673d-g	70963bc	3.24a-d
M_1 L_4	104833a-c	72748ab	3.27ab	104250b-d	72015a-d	3.23a-c	104542c-g	72382bc	3.25a-c
M_1 L_5	105875a-c	73190ab	3.24ab	107403a-c	74568a-c	3.27a-c	106639b-e	73879a-c	3.26a-c
M_2 L_1	102065a-c	70668a-c	3.25ab	103590b-d	71993a-d	3.28a-c	102828d-g	71331bc	3.26a-c
M_2 L_2	91145d	60198c	2.95b	96615d	65468cd	3.10c	93880h	62833d	3.02d
M_2 L_3	97802c-d	67305bc	3.21ab	99213cd	68516b-d	3.23a-c	98508gh	67911cd	3.22a-c
M_2 L_4	98200c-d	67253bc	3.17ab	98820cd	67673b-d	3.17bc	98510gh	67463cd	3.17b-d
M_2 L_5	107710a-c	76163ab	3.41a	103338b-d	71591b-d	3.26a-c	105524c-f	73877a-c	3.33a-c
M_3 L_1	112200a	78925a	3.37a	114948a	81473a	3.43ab	113574a	80199a	3.40a
M_3 L_2	103502a-c	70677a-c	3.15ab	106461a-c	73436a-d	3.22a-c	104981c-g	72056bc	3.19a-d
M_3L_3	106258a-c	73883ab	3.28ab	113861a	81286a	3.50a	110059a-c	77584ab	3.39ab
M_3 L_4	106370a-c	73545ab	3.24ab	114336a	81311a	3.46ab	110353a-c	77428ab	3.35ab
M_3 L_5	111200ab	77775ab	3.33a	114664a	81039a	3.41ab	112932ab	79407a	3.37ab
C_1	102053a-c	70868a-c	3.27ab	95993d	64658d	3.06c	99023f-h	67763cd	3.17b-d
SEm±	3291.0	3291.0	0.103	2846	2846	0.088	2084	2084	0.066

EC- Enriched compost; C- Compost; VC – Vermicompost ; M_1 – RDF – 80:40:40 NPK kg/ha + FYM @ 5 t/ha ; M_2 - EC (1/3)+ VC(1/3) + GLM (1/3) equi.to RDN; M_3- EC (1/3)+ VC(1/3) + GLM (1/3) equi.to RDF; L_1- Panchagavvy @ 5%; L_2- Bio-digester @ 20% ; L_3- Cow urine @ 10%; L_4- Vermiwash @ 20%; L_5- Borax @ 0.2% + $MgSO_4$ @ 1% ; C_1- RDF – 80:40:40 NPK kg + FYM @ 5 t/ha.

reported higher net returns and B: C ratio with combined use of FYM or green manure with 50% of inorganic fertilizer as compared to inorganic fertilizers alone (Satyanarayan Rao and Janawade 2009). Among the treatment combinations, combined application of EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDF with foliar spray of panchagavya @ 5% recorded significantly higher gross returns, net returns and B:C ratio (₹ 113574, 80199/ha and 3.40, respectively) over RDF + FYM but was on par with EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDF with foliar spray of vermiwash @ 20% and cow urine @ 10%. Solaiappan (2002) reported that application of inorganic fertilizer at 40:20 kg N and P_2O_5/ha every year with FYM @ 25 tonnes/ha once in two years recorded significantly higher net income (8439/ha) which was closely followed by application of 40:20 kg N and P_2O_5 with FYM @ 12.5 tonnes/ha. Higher yield, yield parameters and economics can be obtained in cotton with combined application of EC (1/3) + VC (1/3) + GLM (1/3) equivalent to RDF with foliar spray of panchagavya @ 5%.

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