Mysore J. Agric. Sci., 51 (2) : 385-391, 2017

Growth, Yield and Quality of Groundnut as Influenced by Organic Nutrient Management in Groundnut (*Arachis hypogaea* L.) – Finger Millet (*Eleusine coracana* L.) Cropping System

M. R. Ananda and Sharanappa
Department of Agronomy, College of Agriculture, UAS, GKVK, Bengaluru-560 065
E-mail: anandmruas@gmail.com

Abstract

A field experiment was conducted during *kharif* 2015 and *kharif* 2016 in Chintamani taluk, Chickballapur district coming under eastern dry zone Karnataka to study the effect of bio-digested liquid manures on growth, productivity and quality of groundnut (*Arachis hypogaea* L.). Application of enriched biodigested liquid organic manure (EBDLM) at 25 kg N equivalent ha^{-1} + 3 sprays of panchagavya (PG) at 3 per cent produced significantly higher pod yield, kernel yield, number of pods $plant^{-1}$, 100 kernal weight and shelling per cent (2232 kg ha^{-1},1608 kg ha^{-1}, 36g $plant^{-1}$, 43.1 g,72.1 per cent, respectively), LAI, total dry matter production $plant^{-1}$, SPAD and nodules $plant^{-1}$ (1.5, 9.4 g $plant^{-1}$, 28.1 and 138.0, respectively). Further, higher protein and oil yield of groundnut (430.6 kgha^{-1} and 799.6 kg ha^{-1}) was recorded with EBDLM at 25 kg N equivalent ha^{-1} with 3 sprays of PG at 3 per cent as compared to other treatments.

Keywords: Groundnut, EBDLM, jeevamrutha, cow urine, panchagavya, vermiwash

Groundnut is major oilseed crop of India grown over an area of about 4.19 m. ha. with 5.62 mt. production and productivity of 1341 kg ha^{-1}. In Karnataka, it is grown in an area of about 8.5 lakh ha and contributes 7.4 lakh t. production with a productivity of 921 kg ha^{-1} (Anon., 2013). Being a leguminous crop it has an inherent capacity to fix atmospheric nitrogen and also can explore the soil nutrients. Organic sources which are good for improvement of soil properties, besides supplying nutrients for longer period of time without leaving ill effects on soil. Further, there is a possibility of substituting fertilizers by organic nutrient sources. The physicochemical and biological properties of the soil determine the production potential. Keeping this in view, large quantity of organic manure is recommended for groundnut. But the use of organic manures has been continuously declining in Indian agriculture due to several reasons. Decrease in cattle population in recent years and utilization of agricultural wastes into valuable by-products have made the availability of organic manure in agriculture questionable both in time and quantity. Non-availability of sufficient quantity of farmyard manure drawn the attention of researchers and cultivators to utilize the on-farm wastes, green biomass of *Glyricidia maculata, Pongamia pinnata etc.* and ubiquitous weeds *viz.,* parthenium, euphotorium, lantana, calatropis *etc*. for biodigested liquid manure production which can substitute the farmyard manure and compost. Most of the research on groundnut was mainly concentrated on the use of FYM, compost, green manure, oil cakes *etc*. There is need to generate efficient organic manurial sources using on-farm available organic substrates in addition to integrated use of vermicompost, panchagavya, jeevamruta, beejambruta, vermiwash, mycorrhizae culture, neem cake / neem seed extractants in organic farming. Further, there are evidences of enriched biodigested liquid manure use in enhancing the yields of finger millet, groundnut, pigeonpea and soybean (Reddy *et al.,* 2011 and Somasundaram, 2003). Further, Liquid cattle manures could supplement the nitrogen requirements of crops. There is a need to enhance nitrogen, phosphorus and potassium content of biodigested liquid manure by enriching with neem, pongamia, jatropa cake *etc*. and these enriched sources need to be evaluated for their effect on productivity of groundnut. Further, there is also need to evaluate the beneficial effects of cow urine, panchagavya,vermiwash in conjunction with enriched biodigested liquid manure. Hence, the investigation was carried out to study the efficacy of bio-digested

liquid manures on the yield potential and quality of groundnut.

Material and Methods

The field experiment was carried out during *kharif* 2015 and *kharif* 2016 in farmers' field of Chokkahalli village of Chintamanitaluk, Chikkaballapura district, Karnataka to study the effect of biodigested liquid manures on growth, productivity and quality of groundnut (*Arachis hypogaea* L.). The soil is red sandy loam in texture with a bulk density of 1.43 g cc^{-1} and water holding capacity 39.31 per cent. The soil p^H was neutral (7.59) and the electrical conductivity was normal (0.12 dSm^{-1}). The organic carbon content was low (0.29%). The soil was medium in available nitrogen (298.5 kg ha^{-1}), phosphorus (27.3 kg ha^{-1}), potassium (195.8 kg ha^{-1}) and available sulphur (21.56 kg ha^{-1}). During both the years of experimentation, more rainfall was received during the first year (917.6 mm) of cropping season with drought during second year (417.7 mm) except for beginning two months of crop period, as compared to normal rainfall (587.8 mm). Crop was raised under rainfed condition with protective irrigation at 5 cm depth during the dry spell of the cropping period. There were ten treatments comprising of three types of organic liquid manures *viz.,* jeevamrutha, enriched biodigested liquid manures (EBDLM) and cow urine (CU) along with foliar spray of 3 per cent panchagavya (PG) and 3 per cent vermiwash (VW) and recommended fertilizers for groundnut as detailed T_1: Jeevamrutha @ 25 kg N equivalent ha^{-1}, T_2: Jeevamrutha @ 25 kg N equivalent ha^{-1} + VW spray @ 3 per cent, T_3: Jeevamrutha @ 25 kg N equivalent ha^{-1} + PG spray @ 3 per cent, T_4: EBDLM @ 25 kg N equivalent ha^{-1}, T_5: EBDLM @ 25 kg N equivalent ha^{-1} + VW spray @ 3 per cent, T_6:EBDLM @ 25 kg N equivalent ha^{-1} + PG spray @ 3 per cent, T_7: CU@ 25 kg N equivalent ha^{-1}, T_8: CU@ 25 kg N equivalent ha^{-1} + VW spray @ 3 per cent, T_9: CU@ 25 kg N equivalent ha^{-1} + PG spray @ 3 per cent, T_{10}: Rec. FYM 10 t + 25:50:25 kg $N:P_2O_5:K_2O$ ha^{-1}. The treatments were laid out in randomized complete block design with three replications. The gross plot was 3.6 m x 3.2 m. The bio-digested liquid manure was prepared in a 200 litre cement tank by adding 15 kg cow dung, 20 litre cow urine, 30 kg of on-farm green biomass and 100 litre water by frequent stirring. The liquid manure was incubated for 45 days, then it was enriched with 10 per cent Pongamia cake. While, jeevamrutha was prepared by mixing 10 kg local cow dung with 10 litres cow urine, 2 kg local jaggery, 2 kg bengalgram flour and handful of garden soil was added and the volume was made upto 200 litres. The plastic drum was kept in shade covering with wet gunny bag and the mixture was stirred clockwise thrice a day and incubated for 9 days and the resultant jeevamrutha was used. Jeevamruth contained 1.48, 0.28 and 0.32 per cent N, P and K, respectively. While, enriched biodigested liquid manure has 1.29, 0.39, 0.57 per cent N, P and K, respectively. The required quantity of liquid manures on nitrogen equivalent was applied to the soil. Liquid manures were applied in two equal splits at 15 and 45 days after sowing groundnut.

Panchagavya was prepared by using five products of desi cow *viz.*, cow urine, dung, milk, curd and ghee. Vermiwash was prepared by dipping adult earth worms in luke warm water. Three per cent panchagavya and vermiwash solutions were prepared by mixing 30 ml each panchagavya and vermiwash in 1000 ml of water separately. Three sprays of 3 per cent panchagavya and vermiwash was applied at 25, 50 and 75 days after sowing to groundnut as per treatments. Treatment 1 to 9 were supplied with recommended FYM and vermicompost at 50 each based on N equivalent and treatment T_{10} received FYM+vermicompost at 10 t ha^{-1} two weeks before sowing and recommended dose of fertilizer 25:50:25 $N:P_2O_5:K_2O$ kg ha^{-1} for groundnut was incorporated into the soil at the time of sowing. The nutrients were applied in the form of urea, single super phosphate and muriate of potash.

The groundnut cultivar KCG 6 was sown during *kharif* of 2015 and 2016. The spacing adopted was 30 x 10 cm for groundnut. Thrips and aphids were controlled by spraying 4 per cent neem seed kernel extract twice during crop growth period of groundnut.The yield of groundnut was recorded at harvest. Further, protein and oil yield of groundnut were computed.

Results and Discussion

In general, the productivity of groundnut was more in the second year (2016) than during first year (2015) but response to different treatments was similar in both the years of experimentation hence, pooled data is discussed here. Application of enriched biodigested liquid organic manure at 25 kg N equivalent ha^{-1} + 3 sprays of panchagavya (PG) at 3 per cent produced significantly higher pod yield, kernel yield, number of pods $plant^{-1}$, 100 kernal weight and shelling per cent (2231.5 kg ha^{-1},1608.2 kg ha^{-1}, 35.9 g $plant^{-1}$, 43.12 g, 72.0 per cent, respectively), LAI, total dry matter production $plant^{-1}$, SPAD and nodules $plant^{-1}$ (2.73, 9.43 g $plant^{-1}$, 28.1 and 138.0, respectively) followed by EBDLM at 25 kg N equivalent ha^{-1} + 3 sprays of VW at 3 per cent (2157.0 kg ha^{-1}, 1552.5 kg ha^{-1}, 34.7 g $plant^{-1}$, 42.3 g and 71.8 per cent, 2.66, 9.22 g $plant^{-1}$, 24.0 and 131.1, respectively) and jeevamrutha at 25 kg N equivalent ha^{-1} + 3 sprays of PG at 3 per cent (2134.5 kg ha^{-1}, 1545.0 kg ha^{-1}, 33.8 g $plant^{-1}$, 40.6 g and 71.5 per cent, 2.61, 8.93 g $plant^{-1}$, 20.42 and 128.32, respectively) than all other treatments. Significantly lower pod yield, kernel yield, number of pods $plant^{-1}$, 100 kernal weight and shelling per cent (1807.0 kg ha^{-1}, 1182.6 kg ha^{-1}, 21.9 g $plant^{-1}$, 31.8 g and 65.4 per cent, respectively) was observed with recommended practice (Table II & III).

The increase in yield could be attributed to increased growth parameters. Yield being a complex character, is influenced by many morphological characteristics and biochemical processes that occur during the crop growth and development. These complicated events are in turn, based on environment under which the crop is grown. The agronomic practices can modify the crop environment to certain extent and thereby help the crop to exploit the available resources efficiently to achieve higher production. Thus maximum yields are obtained when optimum conditions are provided to crop. The balanced management of nutrients obviously results into greater variation in growth pattern leading to different levels of yield. This is ascribed with higher growth and yield components which might be due to supply of all nutrients through enriched biodigested liquid manure.

Such a conductive effect of organic manure could be attributed to the supply of nutrients through mineralization and improvement of physico-chemical properties of soil (Naveen Kumar, 2009). Higher yield parameters can be attributed to the ability of enriched biodigested liquid manure to satisfy the nutrient demand of crop more efficiently than inorganic manures.The increase in yield of groundnut in EBDLM and jeevamrutha along with three sprays of panchagavya and vermiwash at 3 per cent applied treatments may be also due to enrichment of biodigested liquid manure with *pongamia* cake and jeevamrutha with pulse flour which contributed secondary and micronutrients along with major nutrients besides improving the soil condition, which enhanced the root proliferation and source to sink relationship. Similar resuts were obtained by Sudheendra Saunshi *et al.* (2014). Foliar application of panchagavya and vermiwash readily supplied nutrients and growth hormones *viz.,* IAA and GA present in panchagavya which might have stimulated the production of growth regulators in cell system. Similar results of higher gross and net returns were obtained with the application of panchagavya by Yadav and Lourduraj (2006) in rice and Somasundaram (2003) in greengram. The significant effect of panchagavya was mainly attributed to its nutrient content, higher biological activity and presence of plant growth promoting substances, which was confirmed by Hazarika *et al.* (2006). The results also corroborate those of Pradeep Gopakkali and Sharanappa (2014) in chilli, Latha and Sharanappa (2014) in groundnut-onion sequence, Mahalingam and Sheela (2003) in garden pea, Ravi Kumar (2009) in groundnut.

Quality parameters *viz.,* protein and oil yield of groundnut were significantly higher (430.5 and 799.6 kg ha^{-1}, respectively) with the application of EBDLM at 25 kg N equivalent ha^{-1} + 3 sprays of PG at 3 per cent as compared to other treatments (Table III). This is in conformity with the findings of Kamdi *et al.* (2014) and Naveen Kumar (2009).

It can be concluded from the study that the application of enriched liquid organic manure or jeevamrtha 15 and 45 days after sowing for groundnut

TABLE I

Growth parameters ingroundnut as influenced by different liquid organic manures

Treatments	*LAI @ 60 DAS*			*SPAD @ 60 DAS*			*TDMA (G PLANT^{-1} @ HARVEST*			*No. of nodules plant^{-1} @ 60 DAS*		
	2015	2016	*Pooled*	2015	2016	*Pooled*	2015	2016	*Pooled*	2015	2016	*Pooled*
T_1	2.31	2.24	2.28	18.80	18.90	18.85	8.10	8.60	8.35	114.0	112.5	113.3
T_2	2.39	2.66	2.53	19.77	19.90	19.83	8.40	9.10	8.75	121.3	119.4	120.4
T_3	2.57	2.66	2.61	20.00	20.83	20.42	8.67	9.20	8.93	125.0	131.6	128.3
T_4	2.42	2.53	2.48	22.30	22.10	22.20	8.67	9.23	8.95	115.3	127.2	121.2
T_5	2.59	2.72	2.66	23.90	24.10	24.00	8.97	9.47	9.22	127.4	134.8	131.1
T_6	2.66	2.79	2.73	27.63	28.70	28.17	9.17	9.70	9.43	136.1	139.8	138.0
T_7	2.00	2.12	2.06	16.73	16.60	16.67	7.10	7.53	7.32	104.6	110.6	107.6
T_8	2.12	2.28	2.20	18.43	18.83	18.63	7.33	7.63	7.48	109.5	114.3	111.9
T_9	2.22	2.31	2.27	20.23	20.00	20.12	7.40	7.57	7.48	118.3	113.2	115.7
T_{10}	2.12	2.15	2.13	19.27	19.63	19.45	7.30	7.20	7.25	97.8	101.8	99.8
S. Em±	0.07	0.08	0.06	0.78	1.60	0.87	0.35	0.33	0.18	5.17	3.88	3.54
C. D. at 5 %	0.22	0.23	0.16	2.33	4.75	2.59	1.03	0.99	0.52	15.36	11.53	10.53

T1: Jeevamrutha @ 25 kg N equivalent ha-^{1}

T2: Jeevamrutha @25 kg N equivalent ha-^{1}+ Vermi wash(VW) spray @ 3 %

T3: Jeevamrutha @ 25 kg N equivalent ha-^{1}+ Panchagavya (PG) spray @ 3 %

T4: Enriched Bio-digester Liquid Manure (EBDLM) @ 25 kg N equivalent ha-^{1}

T5: EBDLM @ 25 kg N equivalent ha-^{1}+ VW spray @ 3 %

T6: EBDLM @ 25 kg N equivalent ha-^{1}+ PG spray @ 3 %

T7: Cow Urine (CU) @ 25 kg N equivalent ha-^{1}

T8: CU@ 25 kg N equivalent ha-^{1}+ VW spray @ 3 %

T9: CU@ 25 kg N equivalent ha-^{1}+ PG spray @ 3 %

T10: Rec. POP. 25:50:25 kg NPK ha-^{1}

DAS: Days after sowing

NS: Non significant

TABLE II

Yield and quality parameters in groundnut as influenced by different liquid organic manures

Treatments	*Number of pods plant^{-1}*			*100 Kernal weight (g)*			*Shelling %*			*Pod yield (kg/ha^{-1})*		
	2015	2016	*Pooled*	2015	2016	*Pooled*	2015	2016	*Pooled*	2015	2016	*Pooled*
T_1	30.4	29.8	30.1	37.50	37.30	37.40	70.8	69.3	70.1	2010.0	2025.0	2017.5
T_2	31.2	33.2	32.2	38.43	38.77	38.60	71.7	69.5	70.6	2087.3	2084.0	2085.6
T_3	32.3	35.4	33.8	40.50	40.77	40.63	71.1	71.5	71.3	2163.0	2106.0	2134.5
T_4	35.8	32.8	34.3	39.60	40.90	40.25	70.4	71.1	70.7	2092.0	2051.3	2071.6
T_5	36.1	33.4	34.7	42.20	42.57	42.38	71.7	71.9	71.8	2198.0	2116.0	2157.0
T_6	37.1	34.8	35.9	42.83	43.40	43.12	72.2	72.0	72.1	2243.0	2220.0	2231.5
T_7	29.3	28.4	28.8	33.40	33.80	33.60	65.6	66.5	66.0	1890.0	1863.0	1876.5
T_8	31.4	30.4	30.9	35.80	36.87	36.33	67.6	67.5	67.5	1906.0	1986.0	1946.0
T_9	32.5	32.8	32.6	36.43	37.57	37.00	68.6	68.8	68.7	2025.0	2089.0	2057.0
T_{10}	21.3	22.5	21.9	31.37	32.33	31.85	65.3	65.5	65.4	1816.0	1798.0	1807.0
S. Em±	1.76	1.65	1.21	1.28	1.35	0.91	2.06	2.05	1.51	104.23	105.24	64.86
C. D. at 5 %	5.23	4.90	3.60	3.80	4.01	2.71	6.12	6.09	4.50	309.70	312.69	192.70

T1: Jeevamrutha @ 25 kg N equivalent ha-^{1}

T2: Jeevamrutha @25 kg N equivalent ha-^{1}+ Vermi wash(VW) spray @ 3 %

T3: Jeevamrutha @ 25 kg N equivalent ha-^{1}+ Panchagavya (PG) spray @ 3 %

T4: Enriched Bio-digester Liquid Manure (EBDLM) @ 25 kg N equivalent ha-^{1}

T5: EBDLM @ 25 kg N equivalent ha-^{1}+ VW spray @ 3 %

DAS: Days after sowing

T6: EBDLM @ 25 kg N equivalent ha-^{1}+ PG spray @ 3 %

T7: Cow Urine (CU) @ 25 kg N equivalent ha-^{1}

T8: CU@ 25 kg N equivalent ha-^{1}+ VW spray @ 3 %

T9: CU@ 25 kg N equivalent ha-^{1}+ PG spray @ 3 %

T10: Rec. POP. 25:50:25 kg NPK ha-^{1}

NS: Non significant

TABLE III

Kernal yield, Oil yield and Protein yield in groundnut as influenced by different liquid organic manures

Treatments	Kernal yield (kg ha^{-1})			Oil yield (kg ha^{-1})			Protein yield (kg ha^{-1})		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
T_1	1422.4	1402.4	1412.4	666.43	635.33	650.88	331.10	328.78	329.94
T_2	1486.0	1424.0	1455.0	704.17	666.50	685.34	355.26	329.99	342.62
T_3	1553.0	1537.0	1545.0	753.83	750.54	752.18	380.38	384.86	382.62
T_4	1473.4	1495.4	1484.4	717.61	709.64	713.63	368.82	369.44	369.13
T_5	1580.2	1524.8	1552.5	774.62	729.44	752.03	408.69	392.45	400.57
T_6	1615.6	1600.8	1608.2	797.14	802.15	799.64	446.95	414.15	430.55
T_7	1242.3	1244.2	1243.2	558.13	543.31	550.72	280.05	264.76	272.41
T_8	1282.5	1337.9	1310.2	587.21	613.90	600.55	290.14	298.83	294.48
T_9	1391.6	1441.4	1416.5	647.95	663.26	655.60	326.58	344.03	335.31
T_{10}	1184.0	1181.2	1182.6	537.18	544.88	541.03	245.55	253.25	249.40
S. Em±	79.68	94.56	55.95	53.47	50.63	31.87	27.28	26.88	18.14
C. D. at 5 %	236.76	280.94	166.23	158.87	150.44	94.70	81.05	79.85	53.91

T1 : Jeevamrutha @ 25 kg N equivalent ha-^{1}

T2 : Jeevamrutha @25 kg N equivalent ha-^{1}+ Vermi wash(VW) spray @ 3 %

T3 : Jeevamrutha @ 25 kg N equivalent ha-^{1}+ Panchagavya (PG) spray @ 3 %

T4 : Enriched Bio-digester Liquid Manure (EBDLM) @ 25 kg N equivalent ha-^{1}

T5 : EBDLM @ 25 kg N equivalent ha-^{1}+ VW spray @ 3 %

DAS: Days after sowing

T6: EBDLM @ 25 kg N equivalent ha-^{1}+ PG spray @ 3 %

T7: Cow Urine (CU) @ 25 kg N equivalent ha-^{1}

T8: CU@ 25 kg N equivalent ha-^{1}+ VW spray @ 3 %

T9: CU@ 25 kg N equivalent ha-^{1}+ PG spray @ 3 %

T10: Rec. POP. 25:50:25 kg NPK ha-^{1}

NS: Non significant

equivalent to 100 per cent recommended dose of nitrogen with foliar spray of panchagavya or vermiwash at 3 per cent on 25, 50 and 75 DAS is the best option for higher productivity of groundnut, besides improving protein and oil yield.

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(*Received :* May, 2017 *Accepted :* June, 2017**)**